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Contents

Foreword

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

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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.

1 Scope

The present document specifies the management aspects of edge computing including concepts, use cases, requirements and procedural flows that covers lifecycle management, provisioning, performance assurance and fault supervision for edge computing.

2 References

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

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

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

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

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

[2]   3GPP TS 23.558: "Architecture for enabling Edge Applications".

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

[4]   3GPP TS 28.622: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".

[5]   3GPP TS 28.532: "Management and orchestration; Generic management services".

[6]   ETSI GS NFV-IFA 013 V3.4.1 "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; Os-Ma-nfvo reference point -Interface and Information Model Specification".

[7]   ETSI GS NFV-IFA 011 (V3.3.1): "Network Functions Virtualisation (NFV) Release 3; Management and Orchestration; VNF Descriptor and Packaging Specification".

[8]   3GPP TS 28.550: "Management and orchestration; Performance assurance".

[9]   3GPP TS 28.531: "Management and orchestration; Provisioning".

[10]   3GPP TS 28.552: "Management and orchestration; 5G performance measurements".

[11]   3GPP TS 23.501: "System architecture for the 5G System (5GS); Stage 2".

[12]   3GPP TS 28.658: "Telecommunications management; Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Network Resource Model (NRM) Integration Reference Point (IRP): Information Service (IS)".

[13]   3GPP TS 38.300: "NR; Overall description; Stage-2".

[14]   GSMA OPG: "Operator Platform Telco Edge Requirements; Version 2.0".

[15]   ETSI GS MEC 010-2 (v 2.2.1) (2022-02): " Multi-access Edge Computing (MEC); MEC Management; Part 2: Application lifecycle, rules and requirements management".

[16]   3GPP TS 23.548: "5G System Enhancements for Edge Computing".

[17]   ETSI GS NFV-SOL 005 V4.4.1: "Network Functions Virtualisation (NFV) Release 4; Protocols and Data Models; RESTful protocols specification for the Os-Ma-nfvo Reference Point".

[18]		3GPP TS 32.160: " Management service template".

# 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].

Edge Computing: A concept, as described in 3GPP TS 23.501 [4], that enables operator and 3rd party services to be hosted close to the UE's access point of attachment, to achieve an efficient service delivery through the reduced end-to-end latency and load on the transport network.

Edge Computing Service Provider: A mobile network operator offering Edge Computing service.

Edge Data Network: A local Data Network that supports the architecture for enabling edge applications.

ECSP Management System: is a part of 3GPP management system that utilizes 3GPP defined management services to enable consumers (e.g., ASP. ECSP) to orchestrate and manage the EDN.

PLMN Management System: is a part of 3GPP Management System that utilizes 3GPP defined management services to enable consumers (e.g., PLMN operator) to orchestrate and manage the mobile networks.

Availability Zone: Refer to GSMA Operator Platform Telco Edge Requirements [14].

Leading Operator: The Leading Operator is the operator which consumes EDN shared by the PO.

Participating Operator: The Participating Operator is the operator who provides its EDN to be shared with Leading Operator.

## 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].

ASP	Application Service Provider
DN	Data Network
DNAI	Data Network Access Identifier
DNN	Data Network Name
EAS	Edge Application Server
ECS	Edge Configuration Server
ECSP	Edge Computing Service Provider
EDN	Edge Data Network
FQDN	Fully Qualified Domain Name
GSM	Global System for Mobile Communications
GSMA	GSM AssociationLOLeading Operator
PO	Participating Operator
MEO	MEC Orchestrator
MEAO	MEC Application Orchestrator

4 Concepts and overview

4.1 Concept of edge computing management

The edge computing services are provided by edge computing service providers (ECSP), application service providers (ASP), and PLMN operators (see annex B in TS 23.558 [2]), where ASP is responsible for the creation of edge application servers (EAS) and application clients (AC), ECSP is responsible for the deployment of edge data networks (EDN) that contain EAS and EES, and PLMN operator is responsible for the deployment of 5G network functions, such as 5GC and 5G NR.

Figure 4.1-1 describes the edge computing management framework that contains PLMN management system and ECSP management system. ECSP management system, as the producer, provides management services enabling ASP and ECSP consumers to orchestrate and manage EDN NFs (e.g., EAS, EES, and ECS). PLMN management system, as the producer, provides management services enabling ECSP management system to interconnect EDN NFs with 5GC NFs (e.g., PCF, UPF, NEF). Both ECSP management system and PLMN management system communicate with ETSI NFV MANO to perform lifecycle management functions.
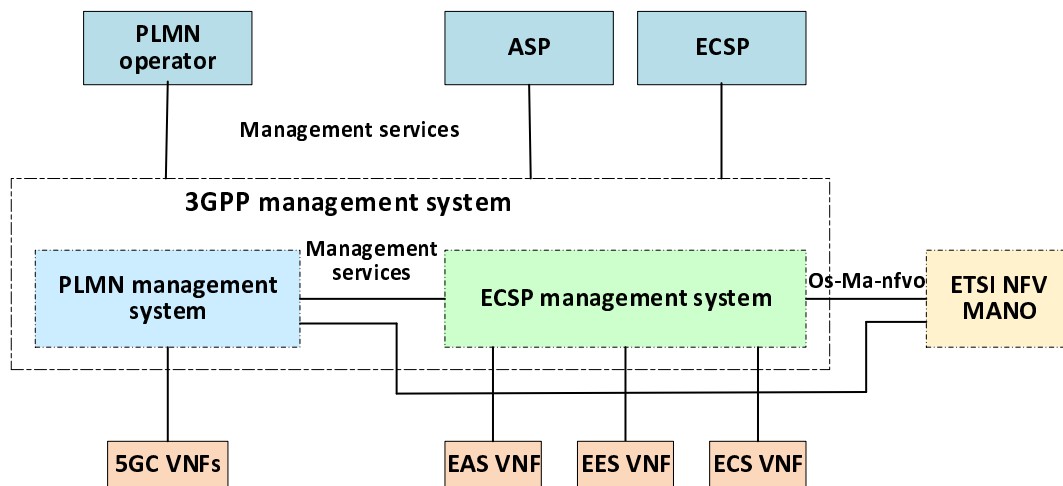
Figure 4.1-1: Edge computing management framework

5 Edge Computing Management (ECM) Capabilities

5.1 Lifecycle Management

5.1.1 Description

The lifecycle management of the edge components is to be enabled by the 3GPP Management System. The lifecycle management includes instantiation, termination, modification and query of the edge components.

## 5.1.2	EAS Deployment

The goal of this use case is to enable ASP to deploy the EAS in the EDN, by requesting the provisioning MnS producer with the deployment requirements (e.g. the topological or geographical service areas, software image information, QoS, affinity/anti-affinity with other EAS, etc.) to deploy the EAS. The provisioning MnS producer returns a response indicating the operation is in progress to prevent the consumer from waiting, as the deployment in the edge cloud may take a while. Since, there can be multiple Edge Data Network (EDN) present/serving a particular edge location. This makes it critical for ASP to have their EAS deployed at appropriate EDN(s) to provide high performance services for the UE. Therefore, provisioning MnS producer analyses the deployment requirements to determine where (i.e. on which EDN) and how many EAS instance(s) should be instantiated, and requests the ETSI NFV NFVO or ETSI MEC MEO or ETSI MEC MEAO to instantiate the EAS instance(s). The provisioning MnS producer sends a notification to ASP indicating the result of instantiation (e.g. success, failure) when a response is received from NFVO or MEO or MEAO indicating the result of instantiation operation.

## 5.1.3	EAS Termination

The goal of this use case is to enable ASP to terminate the EAS in the EDN, by requesting the provisioning MnS producer to terminate the EAS VNF instance. The provisioning MnS producer requests the ETSI NFV NFVO or ETSI MEC MEO or MEAO to terminate the EAS instances. The provisioning MnS producer sends a notification to ASP indicating the termination is in progress when a response is received from NFVO or MEO or MEAO indicating the start of termination operation. The provisioning MnS producer sends another notification to ASP indicating the result of termination (e.g. success, failure) when a response is received from NFVO indicating the result of termination operation.

## 5.1.4	Query EAS Information

The goal of this use case is to enable ASP to query the EAS information in the EDN, by requesting the provisioning MnS producer to query the EAS instance. Upon receiving the query request, the provisioning MnS producer sends the EAS instance information to ASP.

## 5.1.5	EAS Modification

The goal of this use case is to enable ASP to modify the EAS in the EDN, by requesting the provisioning MnS producer to modify the EAS instance. If the modification requires the change (e.g. scale) for the virtualized resource of the EAS VNF instance, the provisioning MnS producer requests the ETSI NFV NFVO or ETSI MEC MEO or ETSI MEC MEAO for the appropriate operation of the EAS instances. The provisioning MnS producer sends a notification to ASP indicating the attribute(s) change of the EAS instance.

## 5.1.6	EES Deployment

The provisioning MnS producer is requested to instantiate the EES, as 3GPP network functions, aiming to server the particular location. The instantiated EES may serve one or multiple EAS.

A consumer request for EES(s) instantiation providing EES deployment requirements. The provisioning MnS producer determines the EDN where the EES(s) will be instantiated, instantiate the EES VNF and establish the connection with 5GC network functions. The provisioning MnS producer will accept the request and notify the consumer about the instantiation in-progress. Thereafter, the notification will be sent to indicate the successful EES instantiation.

## 5.1.7	EES Termination

The goal is to enable the termination of one or more EES(s) on the EDN. A consumer consumes the provisioning MnS to terminate the EES with the EES identifier. The provisioning MnS producer terminates the EES VNF based on the EES identifier, and disconnects the EES from the 5GC network functions. The provisioning MnS producer will accept the request and notify the consumer about the termination in-progress. Thereafter, the notification will be sent to indicate that the EES has been terminated successfully.

5.1.8   Query EES Information

The goal of this use case is to enable a consumer to query the EES information in the EDN, by requesting the provisioning MnS producer to query the EES instance. Upon receiving the query request, the provisioning MnS producer sends the EES instance information to the consumer.

5.1.9   EES Modification

The goal of this use case is to enable a consumer to modify the EES in the EDN, by requesting the provisioning MnS producer to modify the EES instance. If the modification requires the change (e.g. scale) for the virtualized resource of the EES VNF instance, the provisioning MnS producer requests the NFVO in ETSI NFV MANO for the appropriate operation of the EES VNF instances. The provisioning MnS producer sends a notification to the consumer indicating the attribute(s) change of the EES instance.

5.1.10   ECS Deployment

The goal is to enable the instantiation of one or more ECS. To support deployed EDN, operator will deploy ECS serving one or multiple EES. A consumer request for ECS(s) instantiation providing ECS deployment requirements. The provisioning MnS producer instantiate the ECS VNF and establish the required connection with 5GC network functions. The notifications will be sent to indicate that the ECS has been instantiated successfully.

5.1.11   ECS Termination

The goal is to enable the termination of one or more ECS. A consumer consumes the provisioning service to terminate the ECS with the ECS identifier. The provisioning MnS producer terminates the ECS VNF based on the ECS identifier, and disconnects the ECS from the 5GC network functions. The notification will be sent to indicate that the ECS has been terminated successfully.

5.1.12   Query ECS Information

The goal of this use case is to enable a consumer to query the ECS instance information, by requesting the provisioning MnS producer to query the ECS instance. Upon receiving the query request, the provisioning MnS producer sends the ECS instance information to the consumer.

5.1.13   ECS Modification

The goal of this use case is to enable a consumer to modify the ECS instance, by requesting the provisioning MnS producer to modify the ECS instance. If the modification requires the change (e.g. scale) for the virtualized resource of the ECS VNF instance, the provisioning MnS producer requests the NFVO in ETSI NFV MANO for the appropriate operation of the ECS VNF instances. The provisioning MnS producer sends a notification to the consumer indicating the attribute(s) change of the ECS instance.

5.1.13a   Instantiation triggered by EAS discovery failure

EES may need to trigger dynamic EAS instantiation when EES fails to discover and select the EAS that matches the UE location and the requesting application characteristics EAS (see table 8.5.3.2-2 in TS 23.558 [2]) due to no available EAS during the EAS discovery (see clause 8.5 in TS 23.558 [2]).

A consumer would consume performance assurance MnS to request the ECSP management system to collect EAS discovery failure measurement that will be used to determine whether an EAS needs to be initiated, based on performance information, such as UE locations, application characteristics, and number of UEs that have failed in the EAS discovery.

5.1.14 Requirements

Requirement label	Description	Related use case(s)
REQ-EAS-INST-FUN-1	Generic provisioning MnS producer should have a capability allowing an authorized consumer to request the deployment of EAS based on the given deployment requirements.	EAS Deployment
REQ-EAS-INST-FUN-2	Generic Provisioning MnS Producer should have the capability to deploy EAS at a suitable EDN which can support the EAS requirements e.g. serving location, required latency, affinity/anti-affinity with other EAS, service continuity.	EAS Deployment
REQ-EAS-INST-FUN-3	Generic provisioning MnS producer should have a capability to inform the authorized consumer about the progress of instantiation as the response to the deployment request.	EAS Deployment
REQ-EAS-INST-FUN-4	Generic provisioning MnS producer should have a capability to notify the authorized consumer the result (e.g. success, failure) of instantiation operation.	EAS Deployment
REQ-EAS-TERM-FUN-1	Generic provisioning MnS producer should have a capability allowing an authorized consumer to request the termination of the EAS VNF instance.	EAS Termination
REQ-EAS-TERM-FUN-2	Generic provisioning MnS producer should have a capability to inform the authorized consumer about the progress of termination as the response to the termination request.	EAS Termination
REQ-EAS-TERM-FUN-3	Generic provisioning MnS producer should have a capability to notify the authorized consumer the result (e.g. success, failure) of termination operation.	EAS Termination
REQ-EAS-QUERY-FUN-1	Generic provisioning MnS producer should have a capability allowing an authorized consumer to obtain the EAS instance information.	Query EAS information
REQ-EAS-MOD-FUN-1	Generic provisioning MnS producer should have a capability allowing an authorized consumer to request the modification of the EAS instance.	EAS Modification
REQ-EES-INST-FUN-1	Generic provisioning MnS producer should have the capability to instantiate the EES, as per request from authorized consumers.	EES Deployment
REQ-EES-INST-FUN-2	Generic provisioning MnS producer should have the capability to send the notification indicating the status of EES instantiation	EES Deployment
REQ-EES-INST-FUN-3	Generic provisioning MnS producer should have the capability to relate instantiated EES with one or multiple served EAS(s).	EES Deployment
REQ-EES-TERM-FUN-1	Generic provisioning MnS producer should have the capability to terminate the EES with the EES identifier, as per request from authorized consumers	EES Termination
REQ-EES-TERM-FUN-2	Generic provisioning MnS producer should have the capability to send the notification indicating the status of EES termination	EES Termination
REQ-EES-QUERY-FUN-1	Generic provisioning MnS producer should have a capability allowing an authorized consumer to obtain the EES instance information.	Query EES information
REQ-EES-MOD-FUN-1	Generic provisioning MnS producer should have a capability allowing an authorized consumer to request the modification of the EES instance.	EES Modification
REQ-EES-INST-FUN-4	Generic provisioning MnS producer should have a capability to inform the authorized consumer about the progress of EES instantiation as the response to the deployment request.	EES Deployment
REQ-EES-TERM-FUN-3	Generic provisioning MnS producer should have a capability to inform the authorized consumer about the progress of EES termination as the response to the termination request.	EES Termination

Requirement label	Description	Related use case(s)
REQ-ECS-INST-FUN-1	Generic provisioning MnS producer should have the capability to instantiate the ECS, as per request from authorized consumers.	ECS Deployment
REQ-ECS-INST-FUN-2	Generic provisioning MnS producer should have the capability to send the notification indicating the status of ECS Instantiation.	ECS Deployment
REQ-ECS-INST-FUN-3	Generic provisioning MnS producer should have the capability to relate instantiated ECS with one or multiple served EES(s).	ECS Deployment
REQ-ECS-TERM-FUN-1	Generic provisioning MnS producer should have the capability to terminate the ECS with the ECS identifier, as per request from authorized consumers.	ECS Termination
REQ-ECS-TERM-FUN-2	Generic provisioning MnS producer should have the capability to send the notification indicating the status of ECS termination.	ECS Termination
REQ-ECS-TERM-FUN-3	Generic provisioning MnS producer should have a capability to inform the authorized consumer about the progress of ECS instantiation as the response to the deployment request.	ECS Termination
REQ-ECS-TERM-FUN-4	Generic provisioning MnS producer should have a capability to inform the authorized consumer about the progress of ECS termination as the response to the termination request.	ECS Termination
REQ-ECS-QUERY-FUN-1	Generic provisioning MnS producer should have a capability allowing an authorized consumer to obtain the ECS instance information.	Query ECS information
REQ-ECS-MOD-FUN-1	Generic provisioning MnS producer should have a capability allowing an authorized consumer to request the modification of the ECS instance.	ECS Modification
REQ-EAS-DF-FUN-1	Performance assurance MnS producer should have a capability allowing an authorized consumer to request the collection of EAS discovery failure measurements that contain UE location and the requesting application characteristics information.	Instantiation triggered by EAS discovery failure
REQ-EAS-DF-FUN-2	3GPP Management system should have a capability allowing an EES to trigger or request for an EAS deployment.	Instantiation triggered by EAS discovery failure
REQ-EAS-REL-FUN-1	Generic provisioning MnS producer shall have a capability allowing EAS to declare its mobility policies indicating whether EAS can be moved within EDN or from one EDN to another with or without prior notification.	EAS Relocation
REQ-EAS-REL-FUN-4	Generic provisioning MnS producer shall have a capability allowing ASP to reject the EAS relocation on receiving the relocation notification.	EAS Relocation
REQ-EAS-REL-FUN-5	Generic provisioning MnS producer should have a capability allowing scheduling of an EAS relocation.	EAS Relocation

5.1.15   EAS Relocation

The ESCP Management System may decide that a different EDN can better host the EAS. The EAS relocation trigger from ESCP Management System are related with lifecycle management of its edge compute resources. The ASP provides its policy indication regarding change of the edge compute resource hosting the Edge Application. There ESCP Management System considers these policy while relocating EAS within the ED or from one EDN to another.

The ASP indicates the following policies:

-   Its Edge Application cannot be moved from one edge compute resource to another;

-   Its Edge Application can be moved from one edge compute resource to another, without any notification;

-   Its Edge Application can be moved from one edge compute resource to another with prior notification.

When the policy is that a change of edge compute resource can be done with prior notification, the ESCP Management System decides that a change of edge compute resource is needed and selects the new edge compute resource. In this case, the ASP chooses the exact timing of the move. If the ASP indicates that the EAS is not able to handle relocation, the ESCP Management System shall not initiate relocation procedure.

5.2 Performance assurance

5.2.1 Description

The clause contains use cases associated with performance assurance.

5.2.2 EAS performance assurance

The goal of this use case is to provide a mechanism for EAS to publish KPIs or measurements, as per requirements shown in Table 5.2.2-1 (see clause 5.2.10.2 in TS 23.558 [2]).

Table 5.2.2-1: Edge Application Server Service KPIs

Information element	Status	Description
Maximum Request rate	O	Maximum request rate from the Application Client supported by the server.
Maximum Response time	O	The maximum response time advertised for the Application Client's service requests.
Availability	O	Advertised percentage of time the server is available for the Application Client's use.
Available Compute	O	The maximum compute resource available for the Application Client.
Available Graphical Compute	O	The maximum graphical compute resource available for the Application Client.
Available Memory	O	The maximum memory resource available for the Application Client.
Available Storage	O	The maximum storage resource available for the Application Client.
Connection Bandwidth	O	The connection bandwidth in Kbit/s advertised for the Application Client's use.
NOTE: The maximum response time includes the round-trip time of the request and response packet, the processing time at the server and the time required by the server to consume 3GPP Core Network capabilities, if any.		

A consumer, such as ASP, would consume performance assurance MnS to request the ECSP management system to collect EAS KPIs and measurements. The performance assurance MnS producer at ECSP management system will report the measurements to the consumer.

5.2.3 5GC NF measurements to evaluate EAS performance

The goal is to enable ECSP management system to collect the measurements of 5GC NFs (e.g. UPF, PCF, …) that are needed to evaluate the EAS performance. For example, the ECSP management system can correlate the 5GC NF and EAS measurements to determine the root cause of poor EAS performance. ECSP management system, as the consumer would consume performance assurance MnS to request the PLMN management system to collect 5GC NF measurements that are related to EAS performance. The performance assurance MnS producer at PLMN management system will report the measurements to the consumer.

Since an PLMN operator may not want to expose certain measurements (e.g. measurements for 5GC NF(s) not relevant to EAS) to 3rd party operators, like ECSP, the PLMN management system should be able to select specific measurements to be reported to the consumer.

5.2.4 ECS performance assurance

The goal of this use case is to provide a mechanism for ECS performance assurance. ECS performance can be based on various functionalities defined for ECS in (see clause 6.3.4 of [2]). The measurement/KPI should be defined for each functionality, that can be collected as and when required.

A consumer, such as ECSP Management system, would consume performance assurance MnS to request the PLMN management system to collect ECS KPIs and measurements. The performance assurance MnS producer at PLMN management system will report the measurements to the consumer.

5.2.5 EES performance assurance

The goal of this use case is to provide a mechanism for EES performance assurance. EES performance can be based on various functionalities defined for EES in (see clause 6.3.4 of [2]). The measurement/KPI should be defined for each functionality, that can be collected as and when required.

A consumer, such as ECSP Management system, would consume performance assurance MnS to request the PLMN management system to collect EES KPIs and measurements. The performance assurance MnS producer at PLMN management system will report the measurements to the consumer.

5.2.6 Requirements

Requirement label	Description	Related use case(s)
REQ-EAS-PA-FUN-1	Performance assurance MnS producer should have a capability allowing an authorized consumer to request the collection of EAS KPIs and measurements.	EAS performance assurance
REQ-EAS-PA-FUN-2	Performance assurance MnS producer should have a capability to report EAS KPIs and measurements to authorized consumer(s).	EAS performance assurance
REQ-5GCNF-PA-FUN-1	Performance assurance MnS producer should have a capability allowing an authorized consumer to request the collection of 5GC NF(s) (e.g. UPF, PCF, …) measurements that may affect the EAS performance.	5GC NF measurements to evaluate EAS performance
REQ-EAS-5GCNF -FUN-2	Performance assurance MnS producer should have a capability allowing the selection of specific 5GC NF(s) (e.g. UPF, PCF, …) measurements to be reported to authorized consumer(s).	5GC NF measurements to evaluate EAS performance
REQ-ECS-PA-FUN-2	Performance assurance MnS producer should have a capability to report ECS KPIs and measurements to authorized consumer(s).	ECS performance assurance
REQ-EES-PA-FUN-2	Performance assurance MnS producer should have a capability to report EES KPIs and measurements to authorized consumer(s).	EES performance assurance

5.3 Fault supervision

5.3.1 Description

The clause contains use cases associated with fault supervision.

5.3.2 EDN NF performance impacted by 5GC NF alarms

The goal is to enable ECSP management system to receive 5GC NFs (e.g. UPF, PCF, NEF, SCEF, …) alarms that may impact the EDN NFs (e.g. EAS, EES) performance from PLMN management system. ECSP management system can correlate the 5GC NF alarms to determine the root causes for poor EDN NF performance. ECSP management system subscribes to receive 5GC NF alarms from PLMN management system. PLMN management system sends the NF alarm notification to ECSP management system when it detects 5GC NF alarms.

5.3.3 5GC NF issues resulted from EDN NF alarms

The goal is to enable PLMN management system to receive EDN NFs (e.g. EAS, EES, ECS) alarms that may generate issues in 5GC NFs (e.g. UPF, PCF, NEF, SCEF, …) that are supporting EDN from ECSP management system. PLMN management system can correlate the EDN NF alarms to determine the root causes for 5GC NF issues. PLMN management system subscribes to receive EDN NF alarms from ECSP management system. ECSP management system sends the NF alarm notification to PLMN management system when it detects EDN NF alarms.

5.3.4　Requirements

Requirement label	Description	Related use case(s)
REQ-EDNNF-FS-FUN-1	Fault supervision MnS producer should have a capability allowing an authorized consumer to subscribe to receive alarms of 5GC NFs that are supporting edge computing applications.	EDN NF performance impacted by 5GC NF alarms
REQ-EDNNF-FS-FUN-2	Fault supervision MnS producer should have a capability to send the 5GC NF alarm notification to authorized consumer(s).	EDN NF performance impacted by 5GC NF alarms
REQ-5GCNF-FS-FUN-1	Fault supervision MnS producer should have a capability allowing an authorized consumer to subscribe to receive alarms of EDN NFs that may generate issues in 5GC NFs.	5GC NF issues resulted from EDN NF alarms
REQ-5GCNF-FS-FUN-2	Fault supervision MnS producer should have a capability to send the EDN NF alarm notification to authorized consumer(s).	5GC NF issues resulted from EDN NF alarms

5.4　5GC NF Provisioning

5.4.1　Description

The clause contains use cases associated with provisioning.

5.4.2　EDN NF 5GC connection provisioning

The goal is to enable ECSP management system to request PLMN management system to query the connection information of EDN NFs (i.e., EAS, EES, ECS) to 5GC NFs, as specified in clauses 6.3.2, 6.3.4, 6.4.6 in TS 23.558 [2], where EES, ECS, and EAS are interacting with 3GPP Core Network for accessing the capabilities of network functions either directly (e.g. via PCF) or indirectly (e.g. via SCEF/NEF/SCEF+NEF).

Figure 5.4.2-1 shows an example of edge computing networks. EDN #1 is trusted by PLMN operators; therefore, EAS #1 and EES #1 are acting as the trusted AF, and are authorized to interfaces to PCF directly in via the N5 reference point (see clause 4.2.3 in TS 23.501 [11]), or via Edge-7 and Edge-2 interfaces (see clause 6.2 in TS 23.558). EDN #2 is not trusted by PLMN operators; therefore, EAS #2 and EES #2 are acting as the untrusted AF, and are not authorized to interfaces to PCF directly (See clause 5.6.7.1 TS 23.501 [11]), and need to interface to NEF / SCEF via the N33 reference point (see Figure 4.2.3-5 in TS 23.501), or via Edge-7 and Edge-2 interfaces. ECS should be able to connect to NEF / SCEF via the edge-8 interface (see clause 6.3.4 in TS 23.558 [2]).
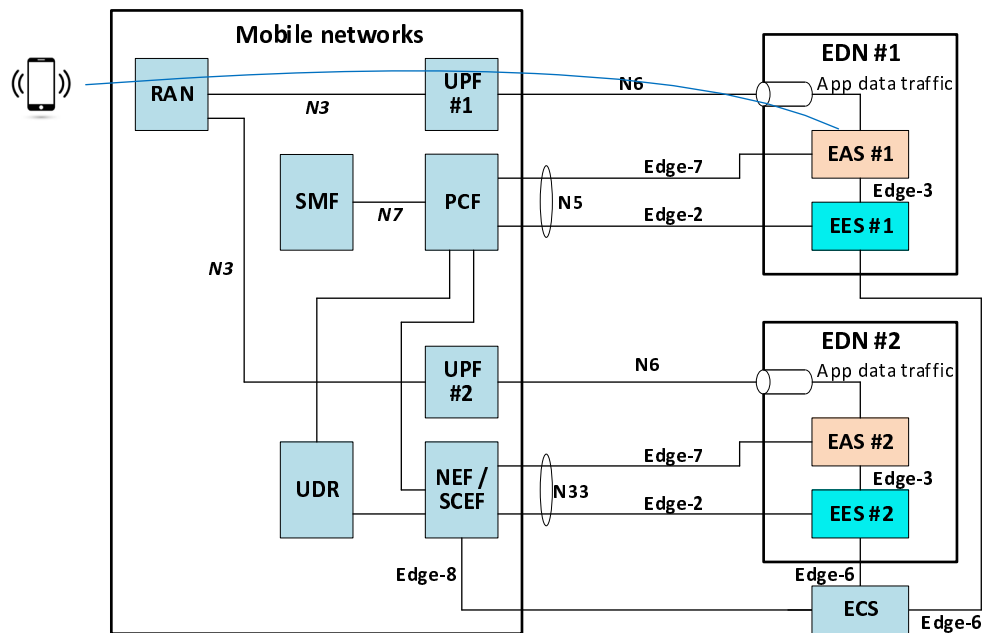
Figure 5.4.2-1: Edge computing networks

ECSP management system requests PLMN management system to identify the PCF, NEF, or SCEF to which the EDN NFs need to interface. The request should include the EDN identifier and the service area requirements (i.e., EDN service area, EES service area, and EAS service area (see clause 7.3.3 in TS 23.558 [2])). PLMN management system finds and returns the connection information (i.e., the IP addresses and DN of PCF, NEF, SCEF) to ECSP management system, based on the requirements. ECSP management system then connects EAS, ECS, and EES to 5GC NFs via the connection information given by PLMN management system, according to Figure 5.4.2-1.

5.4.3 Configuration needed for EAS registration

The goal is to enable a consumer to configure EASID and EES address for the EAS that are required as the pre-conditions of EAS registration procedure (see clause 8.4.3.2.1 in TS 23.558 [2]). A consumer (e.g. ASP, ECSP) requests ECSP management system to configure the EASID and EES address attributes in EASFunction IOC. ECSP management system configures the EASID and EES address attributes in EASFunction MOI, and returns the attribute change notification to the consumer.

5.4.4 EAS to connect with UPF

The goal is to enable ECSP management system to connect a newly deployed EAS to a UPF. Figure 5.4.4-1 shows that EASs are deployed in the local part of the Data Network (DN) that are connected to UPF to carry the user traffic via the N6 interface (see clause 6.3.3 in TS 23.501 [11]). ECSP management system requests PLMN management system to connect a newly deployed EAS to a UPF with EAS IP address, EAS service area requirements (see clause 7.3.3.6 in TS 23.558 [2])), and list of DNAI and N6 traffic routing requirements ((see Table 8.2.4.1 in TS 23.558 [2])). PLMN management system finds a UPF among the UPF(s) being deployed that meets the service area requirements (e.g. UPF #2 is found to connect to EAS #2). In the case that no UPF can be found (e.g. EAS #3), PLMN management system will deploy a new UPF (e.g. UPF #3) and then configure the SMF to add the UPF to the list of available UPF(s) (see clause 6.3.3.2 in TS 23.501 [11]). PLMN management system connects the UPF to the EAS, and return the UPF information (e.g. IP addresses and DN of the UPF) to the ECSP management system.
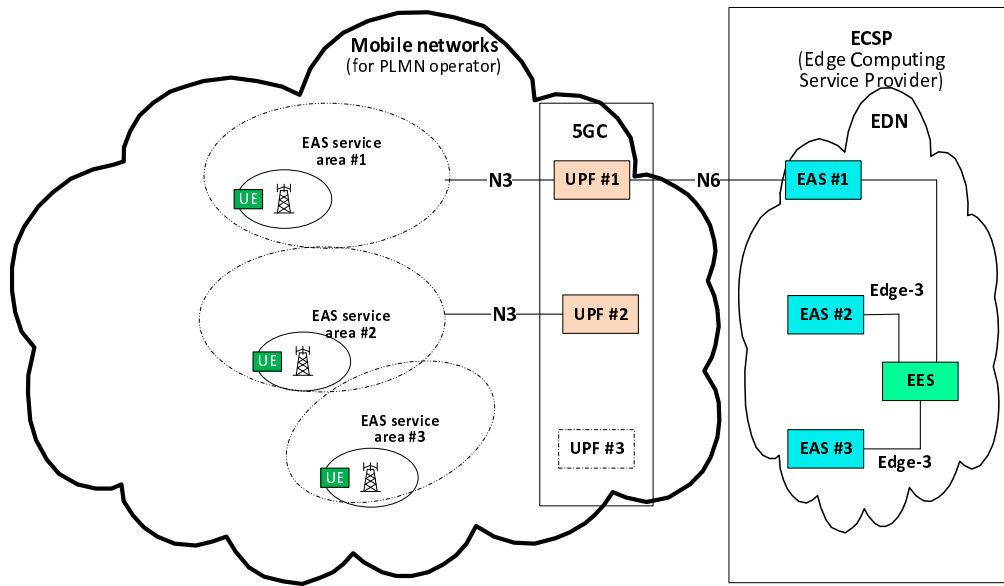
Figure 5.4.4-1: EASs to connect with UPFs

5.4.5 Requirements

Requirement label	Description	Related use case(s)
REQ-PROV-FUN-1	Generic provisioning MnS producer should have the capability allowing authorized consumer to query the connection information of 5GC functions, such as the IP addresses and DN of PCF, NEF, SCEF, by providing EDN identifier and service area requirements.	EDN NF to access 5GC NF
REQ-PROV-FUN-2	Generic provisioning MnS producer should have the capability to return to the authorized consumer with the connection information of 5GC functions, such as the IP addresses and DN of PCF, NEF, SCEF, based on the requirements.	EDN NF to access 5GC NF
REQ-PROV-FUN-3	Generic provisioning MnS producer should have the capability to establish the connection relationship between EAS, EES, and ECS and 5GC NFs via PCF, NEF, or SCEF.	EDN NF to access 5GC NF
REQ-PROV-FUN-4	Generic provisioning MnS producer should have the capability allowing authorized consumer to configure the EASID and EES address attributes for EAS.	Configuration needed for EAS registration
REQ-PROV-FUN-5	Generic provisioning MnS producer should have the capability to send a notification to the consumer, indicating that the attributes have been changed.	Configuration needed for EAS registration
REQ-PROV-FUN-6	Generic provisioning MnS producer should have the capability allowing authorized consumer to provide information for connecting the EAS to UPF by providing EAS IP address, EAS service area requirements and list of DNAI and N6 traffic routing requirements.	EAS to connect with UPF
REQ-PROV-FUN-7	Generic provisioning MnS producer should have the capability to return to the authorized consumer with the UPF connection information of 5GC functions, such as the IP addresses and DN of UPF, based on the requirements.	EAS to connect with UPF
REQ-PROV-FUN-8	Generic provisioning MnS producer should have the capability to connect the EAS to UPF.	EAS to connect with UPF

5.5 Void

5.6 Edge Federation Management

5.6.1 Description

This clause contains use cases associated with federation management.

5.6.2 Federation Management

The federation management functionality within the operator enables it to interact with other operator instances, often in different geographies, thereby providing access for the ASP to a larger footprint of EDN, a more extensive set of subscribers and multiple Operator capabilities. An operator initiates the establishment of federation relationship with another operator sharing available location(s) at which the edge services are provided, resource available at each location, federation expiry etc. The operator which initiates federation relationship is called Leading Operator (LO). The operator which receives federation relationship request is called Partner Operator (PO).

The federation relationship enables the following functionalities.

- Federated EAS resource reservation management: This is intended for an LO to reserve resources for an ASP, with the PO, when the ASP initiate the reservation using NBI.

- Federated EAS deployment and termination: This will be used by an LO to instantiate an EAS deployment on EDN of LO as requested by ASP over NBI.

- EDN sharing: This is intended for operator to share EDN among each other.

5.6.3 Requirements

Table 5.6.3-1

Requirement label	Description	Related use case(s)
REQ-FED-FUN-1	Generic Provisioning MnS shall have a capability to establishing federation relationship with the MnS consumer (e.g. partner operator platforms).	Federation Management
REQ-FED-FUN-2	Generic Provisioning MnS shall enable federation relationship to include appropriate information including (not limited to) location(s) at which the edge services are provided, resource available at each location, federation expiry.	Federation Management
REQ-FED-FUN-3	Generic Provisioning MnS shall have a capability to remove existing federation relationship with the MnS consumer(e.g. partner operator platforms).	Federation Management
REQ-FECS-MGMT-FUN-1	Generic Provisioning MnS shall enable federation relationship to include information on PO ECS including (not limited to) ECS Profile, served EES and served EAS.	Federated ECS management
REQ-FEAS-INST-FUN-1	The generic provisioning MnS producer shall have a capability to deploy the EAS on the EDN owned by PO.	Federated EAS deployment and termination
REQ-FEAS-TERM-FUN-2	The generic provisioning MnS producer shall have a capability to terminate the EAS on the EDN owned by PO.	Federated EAS deployment and termination

5.6.4 Federated ECS management

In federation, the EAS requested by UE may only be available with the federated operator. The EAS discovery will fail at leading operator resulting in the initiation of discovering target EES and ECS belonging to partner operator. See clause 8.18.2.3.2 [2]. This will require configuring leading operator ECS with federated ECS information belonging to partner operator. The information may include ECS address (clause 8.2.12[2]), related EES and EAS etc.

The partner operator provides information related with its ECS as part of federation establishment. Based on the provided information required configurations can be done in leading operator ECS.

5.6.5 Federated EAS deployment and termination

Federation enables operator to control the launch and termination of applications on a PO. This will be used by a LO to instantiate an application on EDN of PO as requested by ASP over NBI. A LO makes the application instantiation result available on the NBI interface. PO also provide the application instance status to LO which LO may expose to ASP on NBI.

5.7 Query available EDN Edge resources

5.7.1 Description

This clause contains use cases associated with querying EDN available Edge resources.

5.7.2 Querying available resources from EDN

The goal of this use case is to enable ASP to query the available resources in an EDN. An EDN contains the infrastructure resources (e.g., compute, networking, storage) which can be used for EAS deployments. Some of the resources in an EDN may be already allocated, while others may be available to be used by ASP. The available resources in an EDN can be queried by ASP to know what resources are available in what locations. ASP can then take a decision on where its EAS to be deployed.

5.7.3 Requirements

Table 5.7.3-1

Requirement label	Description	Related use case(s)
REQ-QUERY-EDN-RESOURCE-1	The provisioning MnS producer for edge computing management shall have a capability allowing ASP to obtain the available resources (e.g., compute, networking, storage) in an EDN.	Querying available resources from EDN

5.8 EAS resource reservation Management

5.8.1 Description

This clause contains use cases associated with EAS resource reservation management.

5.8.2 EAS resource reservation creation and termination

The goal of this use case is to enable a MnS consumer (ASP or L-OP) to express the resource (e.g., compute, networking, storage) requirements that the MnS consumer wants to be guaranteed, by requesting resource reservation request to ECSP management system. ASP or L-OPmay want to reserve resources ahead of the EAS deployment and unrelated to any specific application, only related to the ASP or L-OP themselves. After resource reservation, an ASP or L-OP is allowed to consume the reserved resources when onboarding a new application, creating the association between the reserved resources and the application (resources allocation). ASP or L-OP is also allowed to delete the reservation when it is not required.

5.8.3 Requirements

Table 5.8.3-1

Requirement label	Description	Related use case(s)
REQ-EAS-RES-RESERV-1	The provisioning MnS producer for edge computing management shall have a capability allowing a MnS consumer (ASP or L-OP) to create resource reservation related to virtualisation resources (e.g., compute, networking, storage).	EAS resource reservation creation and termination
REQ-EAS-RES-RESERV-2	The provisioning MnS producer for edge computing management shall have a capability allowing a MnS consumer (ASP or L-OP) to terminate the reserved resources.	EAS resource reservation creation and termination

6 Edge NRM

6.1 Information Model definitions for Edge NRM

6.1.1 Imported information entities and local labels

Label reference	Local label
TS 28.622 [4], IOC, `Top`	`Top`
TS 28.622 [4], IOC, `SubNetwork`	`SubNetwork`
TS 28.622 [4], IOC, `ManagedFunction`	`ManagedFunction`
TS 28.541 [3], IOC, PCFFunction	PCFFunction
TS 28.541 [3], IOC, NEFFunction	NEFFunction
TS 28.541 [3], IOC, UPFunction	UPFFunction
TS 28.541 [3], IOC, EP_N5	EP_N5
TS 28.541 [3], IOC, EP_N33	EP_N33
TS 28.541 [3], IOC, EP_N6	EP_N6
TS 28.541 [3], `dataType, tAI`	`tAI`
TS 28.658 [12], dataType, `PLMNId`	`PLMNId`
TS 28.541 [3], dataType, `mCC`	`mCC`

6.2 Class diagram

6.2.1 Relationships
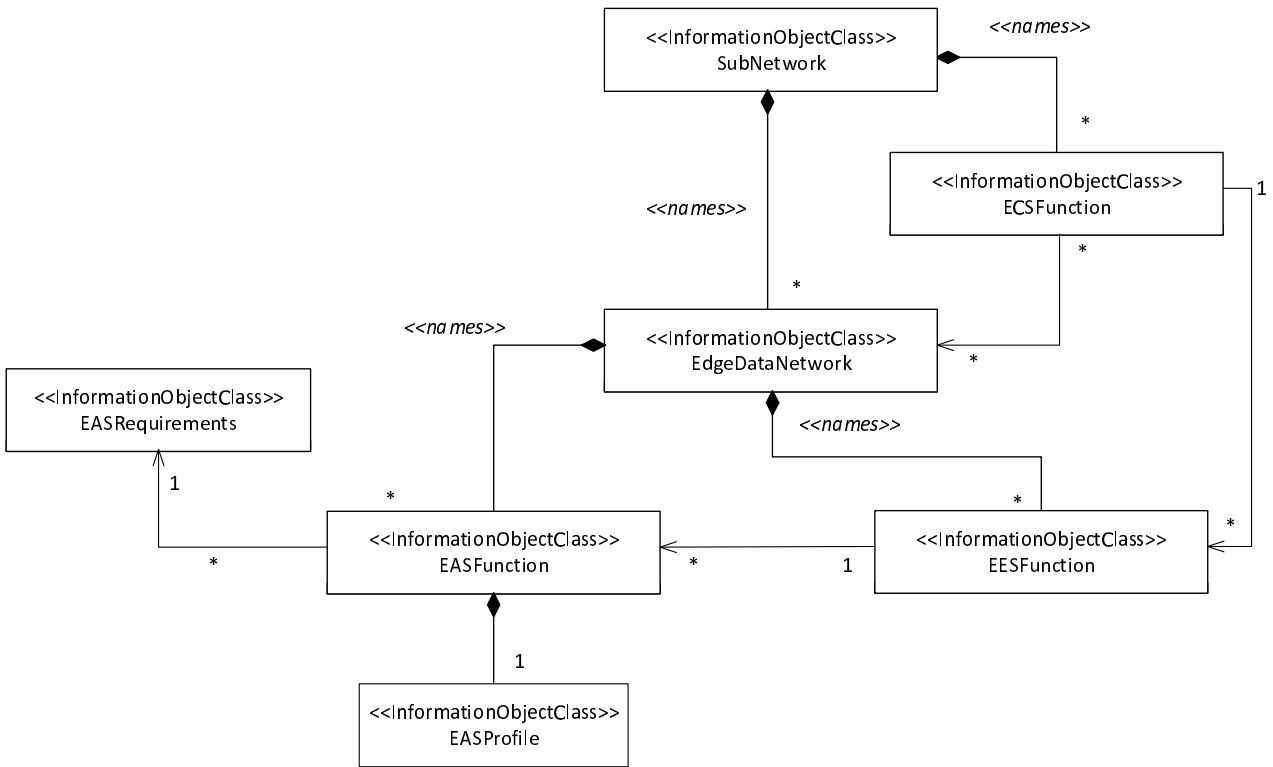
Figure 6.2.1-1: Edge NRM relationship diagram
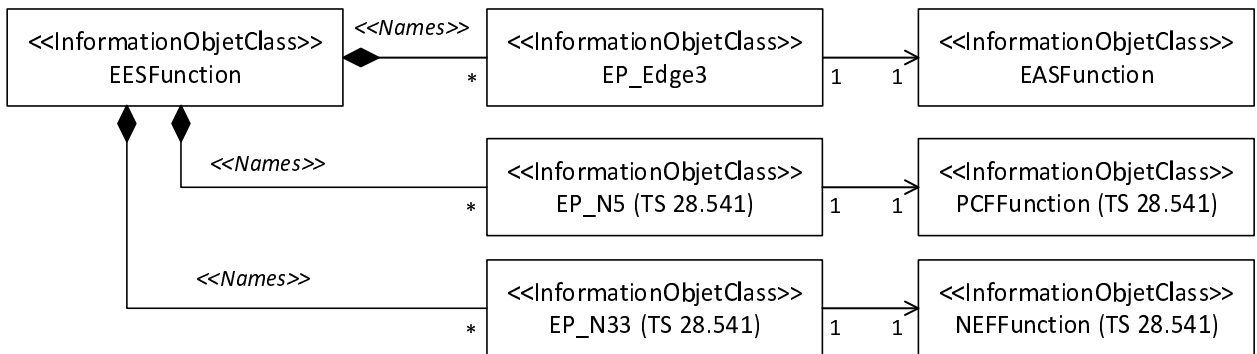
Figure 6.2.1-3: Transport view of EES NRM
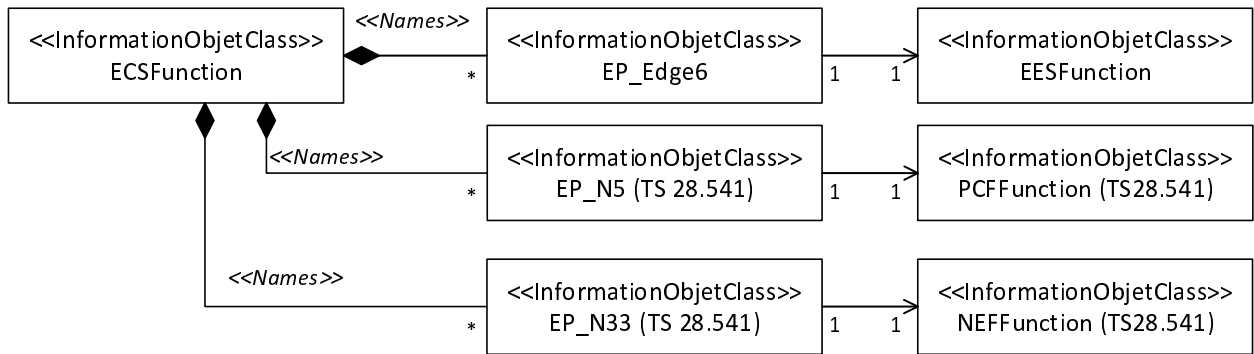
Figure 6.2.1-4: Transport view of ECS NRM
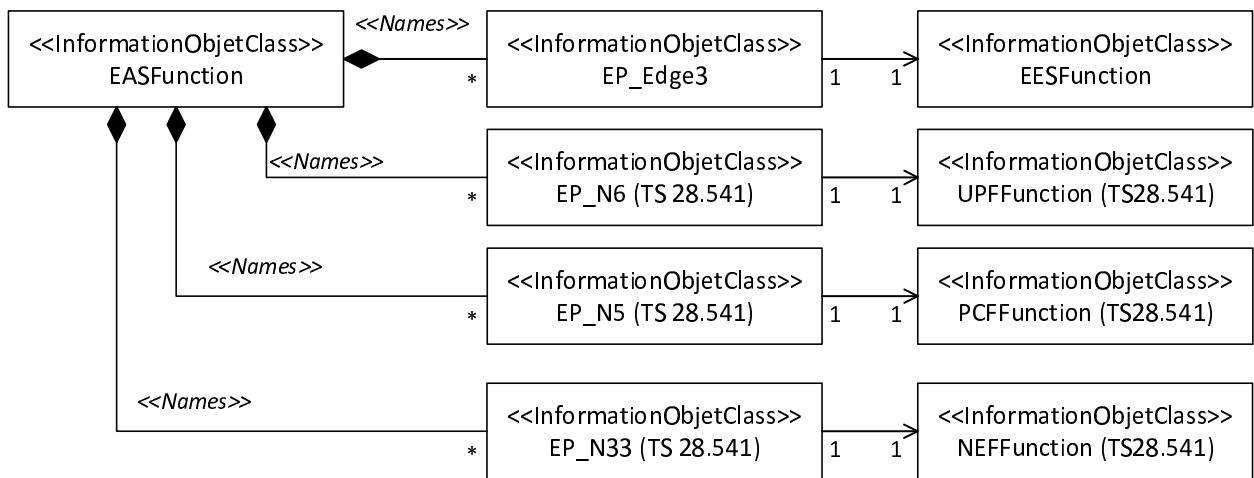
Figure 6.2.1-5: Transport view of EAS NRM
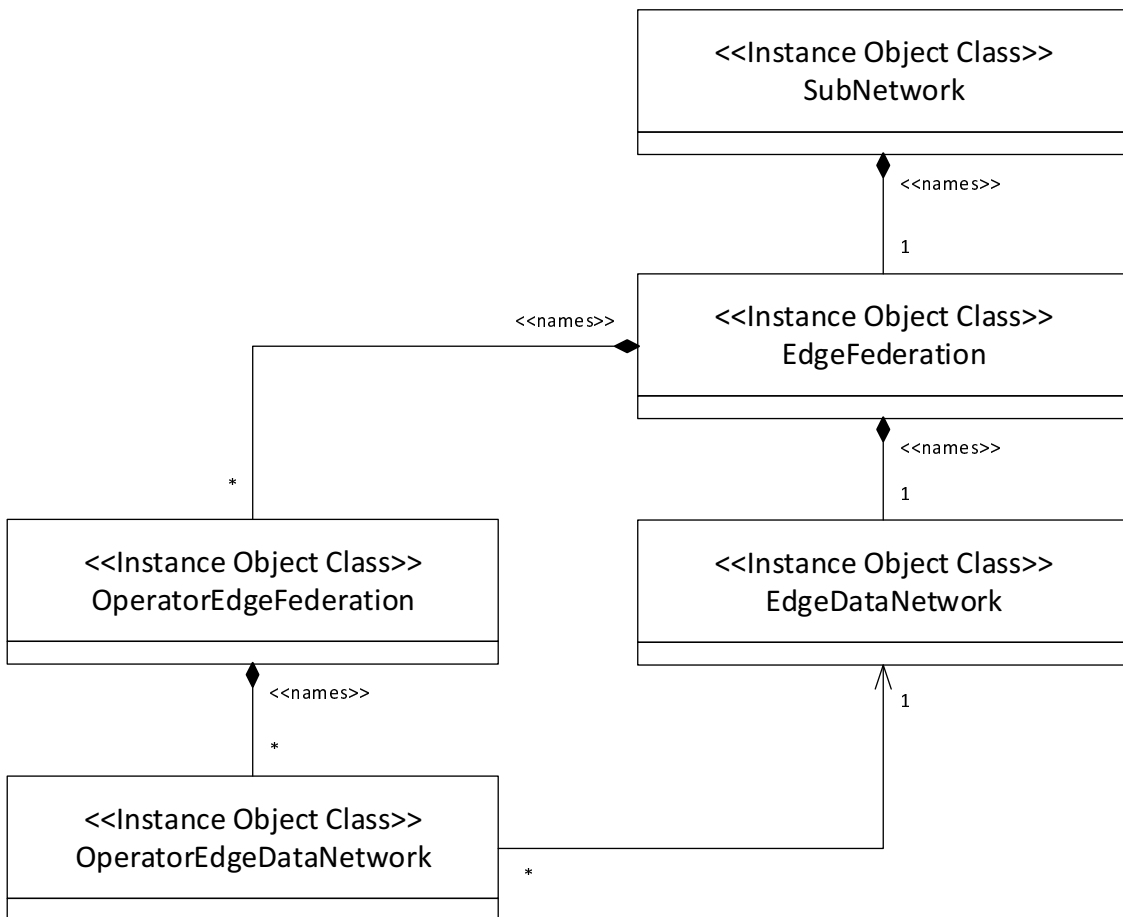
Figure 6.2.1-6: Edge Federation NRM6.2.2 Inheritance
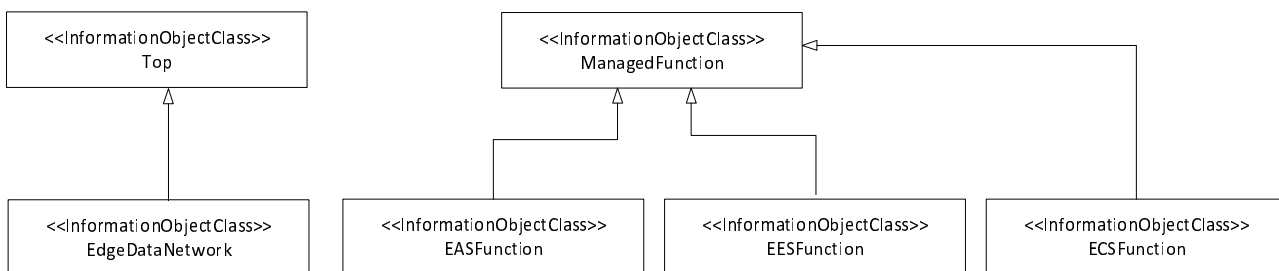
Figure 6.2.2-1: Edge Inheritance Relationship
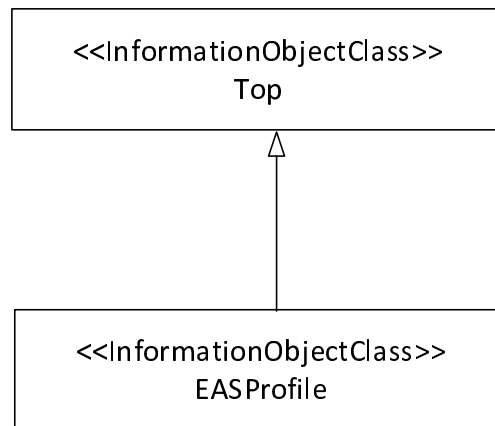
Figure 6.2.2-2: EASProfile Inheritance

6.3   Class definition

6.3.1   EASFunction

6.3.1.1   Definition

This IOC represent the properties of a EAS in a 3GPP network. For more information about EAS, see 3GPP TS 23.558 [2] and 3GPP TS 23.548 [16].

6.3.1.2   Attributes

The EASFunction IOC includes attributes inherited from ManagedFunction IOC (defined in TS 28.622 [4]) and the following attributes:

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
eASIdentifier	M	T	T	F	T
eASAddress	O	T	T	F	T
eESAddress	O	T	T	F	T
registrationInfo	O	T	T	F	T
relocationTriggerInfo	M	T	T	F	T
relocationRejectByASP	M	T	T	F	T
Attribute related to role					
eASRequirementsRef	M	T	T	F	T

6.3.1.3   Attribute constraints

None.

6.3.1.4   Notifications

The common notifications defined in clause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.2   EASRequirements

6.3.2.1   Definition

This represent the requirements needed to deploy EAS(s) and the information of EAS(s) deployment process.

6.3.2.2 Attributes

The EASRequirements IOC includes attributes inherited from Top IOC (defined in TS 28.622[4]) and the following attributes:

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
requiredEASservingLocation	M	T	T	F	T
softwareImageInfo	M	T	T	F	T
affinityAntiAffinity	M	T	T	F	T
serviceContinuity	M	T	T	F	T
virtualResource	M	T	T	F	T
eASSchedule	O	T	T	F	T
eASFeature	O	T	T	F	T
relocationPolicy	M	T	T	F	T
federationID	CM	T	T	F	T
reservationJobRef	O	T	T	F	T
eASDeploymentMonitor	O	T	T	F	T

6.3.2.3 Attribute constraints

Name	Definition
federationID	Condition: Only when the request is being send by the LO.

6.3.2.4 Notifications

The common notifications defined in clause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.3 ServingLocation <<dataType>>

6.3.3.1 Definition

This datatype represents the location which is to be served by the node.

6.3.3.2 Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
geographicalLocation	CM	T	T	F	T
topologicalLocation	CM	T	T	F	T

6.3.3.3 Attribute constraints

Name	Definition
geographicalLocation Support Qualifier	Condition: If the serving location is defined as Geographical Service Area [2].
topologicalLocation Support Qualifier	Condition: If the serving location is defined as Topological Service Area [2].

NOTE: Only one of the attributes is needed.

6.3.3.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.4 GeoLoc <<dataType>>

6.3.4.1 Definition

This datatype represent the geographical location.

6.3.4.2 Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
geographicalCoordinates	CM	T	T	F	T
civicLocations	CM	T	T	F	T

6.3.4.3 Attribute constraints

Name	Definition
geographicalCoordinates Support Qualifier	Condition: If the serving location is defined as geographical coordinates [2].
civicLocationsSupport Qualifier	Condition: If the serving location is defined as civic locations [2].

NOTE: Only one of the attributes is needed.

6.3.4.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.5 ECSFunction

6.3.5.1 Definition

This IOC represents the ECS functionality for supporting Edge Computing. For more information about the ECS, see 3GPP TS 23.558 [2].

6.3.5.2 Attributes

The ECSFunction IOC includes attributes inherited from ManagedFunction IOC (defined in TS 28.622 [4]) and the following attributes:

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
ecsAddress	M	T	T	F	T
providerIdentifier	O	T	T	F	T
softwareImageInfo	M	T	T	F	T
trackingAreaIdList	O	T	T	F	T
mCC	O	T	T	F	T
geographicalLocation	O	T	T	F	T
sharedECSInfo	O	T	T	F	T
Attribute related to role					
edgeDataNetworkRef	M	T	T	F	T
eESFunctionRef	M	T	T	F	T

6.3.5.3 Attribute constraints

None.

6.3.5.4　Notifications

The common notifications defined in clause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.6　EDNConnectionInfo <<datatype>>

6.3.6.1　Definition

This datatype represent the EDN connection information.

6.3.6.2　Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
dNN	M	T	T	F	T
eDNServiceArea	M	T	T	F	T

6.3.6.3　Attribute constraints

None.

6.3.6.4　Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.7　TopologicalServiceArea <<dataType>>

6.3.7.1　Definition

This datatype represents the topological service area.

6.3.7.2　Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
cellIDList	CM	T	T	F	T
trackingAreaIdList	CM	T	T	F	T
servingPLMN	CM	T	T	F	T

6.3.7.3　Attribute constraints

Name	Definition
cellIDList Support Qualifier	Condition: If the serving location is defined as cell IDs [2].
trackingAreaIdList Support Qualifier	Condition: If the serving location is defined as tracking area IDs [2].
servingPLMN Support Qualifier	Condition: If the serving location is defined as PLMN ID [2].

NOTE:　Only one of the attributes is needed.

6.3.7.4　Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.8 GeographicalCoordinates <<dataType>>

6.3.8.1 Definition

This datatype represents the geographical coordinates.

6.3.8.2 Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
latitude	M	T	T	F	T
longitude	M	T	T	F	T

6.3.8.3 Attribute constraints

None.

6.3.8.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.9 SoftwareImageInfo <<dataType>>

6.3.9.1 Definition

This datatype represents the software image information.

6.3.9.2 Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
minimumDisk	M	T	T	F	T
minimumRAM	M	T	T	F	T
diskFormat	M	T	T	F	T
operatingSystem	M	T	T	F	T
Attribute related to role					
swImageRef	M	T	T	F	T

6.3.9.3 Attribute constraints

None.

6.3.9.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.10 EdgeDataNetwork

6.3.10.1 Definition

This IOC represents the edge data network for supporting Edge Computing. This IOC could represent EDN as described in 3GPP TS 23.558 [2] or local part of Data Network as described in 3GPP TS 23.548 [16].

6.3.10.2 Attributes

The EdgeDataNetwork IOC includes attributes inherited from Top IOC (defined in TS 28.622[4]) and the following attributes:

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
ednIdentifier	M	T	T	F	T
eDNConnectionInfo	M	T	T	F	T
availableEdgeVirtualResources	M	T	F	F	T

6.3.10.3 Attribute constraints

None.

6.3.10.4 Notifications

The common notifications defined in subclause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.11 AffinityAntiAffinity <<datatype>>

6.3.11.1 Definition

This datatype represent the affinity and anti-affinity requirements of the EAS with other EAS on the same EDN.

6.3.11.2 Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
affinityEAS	M	T	T	F	T
antiAffinityEAS	M	T	T	F	T

6.3.11.3 Attribute constraints

None.

6.3.11.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.12 VirtualResource <<datatype>>

6.3.12.1 Definition

This datatype represent the virtual resource requirements of an EAS.

6.3.12.2 Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
virtualMemory	M	T	T	F	T
virtualDisk	M	T	T	F	T
virtualCPU	M	T	T	F	T
vnfdId	O	T	T	F	T

6.3.12.3 Attribute constraints

None.

6.3.12.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.13 EESFunction

6.3.13.1 Definition

This IOC represent the properties of a EES in a 3GPP network. For more information about EES, see 3GPP TS 23.558.

6.3.13.2 Attributes

The EESFunction IOC includes attributes inherited from ManagedFunction IOC (defined in TS 28.622 [4]) and the following attributes:

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
eESIdentifier	M	T	T	F	T
eESServingLocation	M	T	T	F	T
eESAddress	M	T	T	F	T
softwareImageInfo	M	T	T	F	T
serviceContinuitySupport	M	T	T	F	T
registrationInfo	M	T	T	F	T
Attribute related to role					
eASFunctionRef	M	T	T	F	T

6.3.13.3 Attribute constraints

None.

6.3.13.4 Notifications

The common notifications defined in clause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.14 RegistrationInfo <<dataType>>

6.3.14.1 Definition

This datatype represents the EAS registration infomration.

6.3.14.2 Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
registrationExpiry	M	T	F	F	T
registrationID	M	T	F	F	T
secCredential	M	T	T	F	T

6.3.14.3 Attribute constraints

None

6.3.14.4 Notifications

The subclause 5.5, in 3GPP TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.15 EASProfile

6.3.15.1 Definition

This IOC represent an EASProfile, see TS 23.558[2]. This IOC will be instantiated with the instantiation of every EASFunction IOC.

6.3.15.2 Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
eASIdentifier	M	T	F	F	T
eEASEndpoint	M	T	F	F	T
aCID	O	T	F	F	T
eASProvider	O	T	F	F	T
eASdescription	O	T	F	F	T
eASSchedule	O	T	F	F	T
eASGeographicalServiceArea	O	T	F	F	T
eASTopologicalServiceArea	O	T	F	F	T
eAServiceKPIs	O	T	F	F	T
eASServicePermissionLevel	O	T	F	F	T
eASFeature	O	T	F	F	T
eASServiceContinuitySupport	O	T	F	F	T
eASDNAI	O	T	F	F	T
eASAvailabilityReportingPeriod	O	T	F	F	T
eASStatus	O	T	F	F	T

6.3.15.3 Attribute constraints

None.

6.3.15.4 Notifications

The common notifications defined in subclause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.16 Duration <<dataType>>

6.3.16.1 Definition

This data type defines a time duration.

6.3.16.2 Attributes

Attribute name	S	isReadable	isWritable	isInvariant	isNotifyable
startTime	M	T	T	T	T
endTime	M	T	T	T	T

6.3.16.3 Attribute constraints

None.

6.3.16.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.17 EASResourceReservationJob

6.3.17.1 Definition

This IOC represents a resource reservation job for describing resource reservation requirements to determine whether the resource requirements for EAS deployment can be reserved. After the MnS Consumer derives the resource related requirements for EAS deployemnt, and before request the MnS producer to deploy an EAS, MnS consumer may express a resource reservation job requirement for the specified resource requirements to MnS producer.

To express a resource reservation job requirement for specific resources (e.g., compute, networking and storage), MnS consumer needs to request MnS producer to create an EASResourceReservationJob instance on the MnS producer side with the resource requirements specified, and to execute the resource reservation process.

For deletion of resource reservation job, the MnS consumer needs to request the MnS producer to delete the EASResourceReservationJob instance on the MnS producer side.

Attribute "reservationLocation" is used to represent MnS consumer's requirements for location where the resource needs to be reserved.

Attribute "resourceRequirement" is used to represent MnS consumer's requirements for resource needs to be reserved ((e.g., compute, networking, storage, acceleration).

Attribute "requestedReservationExpiration" is used to represent MnS consumer's requirements for validity period of the resource reservation.

To obtain the resource reservation status, MnS consumer need to request MnS producer to query the value of the attribute "resourceReservationStatus".

6.3.17.2 Attributes

The EASResourceReservationJob IOC includes attributes inherited from Top IOC (defined in TS 28.622[4]) and the following attributes:

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
reservationLocation	M	T	T	F	T
resourceReservationRequirement	M	T	T	F	T
requestedReservationExpiration	O	T	T	F	T
resourceReservationStatus	M	T	F	F	T

6.3.17.3   Attribute constraints

None.

6.3.17.4   Notifications

The common notifications defined in clause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.18   ResourceReservationRequirement <<datatype>>

6.3.18.1   Definition

This datatype represent the resource requirements for reservation.

6.3.18.2   Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
computeRequirement	O	T	T	F	T
storageRequirement	O	T	T	F	T
networtkingRequirement	O	T	T	F	T

6.3.18.3   Attribute constraints

None.

6.3.18.4   Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.19   ResourceReservationStatus <<datatype>>

6.3.19.1   Definition

This datatype represent the resource requirements for reservation.

6.3.19.2   Attributes

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
resourceId	M	T	F	F	T
reservationStatus	M	T	F	F	T

6.3.19.3   Attribute constraints

None.

6.3.19.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.20 RelocationTriggerInfo <<dataType>>

6.3.20.1 Definition

This defines the relocation trigger for the EAS. It is a complex type which include the following attributes.

6.3.20.2 Attributes

Attribute name	S	isReadable	isWritable	isInvariant	isNotifyable
triggerType	M	T	T	F	T
futuristicTriggerTime	CM	T	T	F	T

6.3.20.3 Attribute constraints

Name	Definition
futuristicTriggerTime Support Qualifier	Condition: Will only be present when the value of triggerType is FUTURE.

6.3.20.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.21 EdgeFederation

6.3.21.1 Definition

This IOC represent the the set of federation relationship maintained by the PO and/or LO. This IOC when instantiated represents a set of available federations.

6.3.21.2 Attributes

The EdgeFederation IOC includes attributes inherited from ManagedFunction IOC (defined in TS 28.622 [4]) and the following attributes:

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
participatingOPiD	CM	T	T	F	T
originatingOPiD	CM	T	T	F	T
federatedECSInfo	M	T	T	F	T

6.3.21.3 Attribute constraints

Name	Definition
participatingOPiD Support Qualifier	Condition: Will only be present when the IOC is being used by LO.
originatingOPiD Support Qualifier	Condition: Will only be present when the IOC is being used by PO.

6.3.21.4 Notifications

The common notifications defined in clause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.22 OperatorEdgeFederation

6.3.22.1 Definition

This IOC contains attributes to support the edge federation. An instance of OperatorEdgeFederation IOC should be created and configured for each federation to be maintained provided by PO and LO. When configured the attributes override those in parent EdgeFederation instance. This IOC when instantiated represents a particular available federation.

6.3.22.2 Attributes

The OperatorEdgeFederation IOC includes attributes inherited from ManagedFunction IOC (defined in TS 28.622 [4]) and the following attributes:

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
federationID	M	T	T	F	T
FederationExpiry	M	T	T	F	T
originatedOPiD	M	T	T	F	T
avaibleEDNList	M	T	T	F	T
Attribute related to role					
acceptedEDNList	M	T	T	F	T

6.3.22.3 Attribute constraints

None.

6.3.22.4 Notifications

The common notifications defined in clause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.23 OperatorEdgeDataNetwork

6.3.23.1 Definition

The OperatorEdgeDataNetwork IOC is, optionally defined to contain attributes to support an edge data network available. An instance of OperatorEdgeDataNetwork IOC should be created and configured for each EDN shared with another operator. When configured the attributes override those in the associated EdgeDataNetwork instance. This IOC when instantiated represents a particular EDN shared with the L-OP

6.3.23.2 Attributes

The OperatorEdgeDataNetwork IOC includes attributes inherited from ManagedFunction IOC (defined in TS 28.622 [4]) and the following attributes:

Attribute name	Support Qualifier	isReadable	isWritable	isInvariant	isNotifyable
availableEASResource	M	T	T	F	T
Attribute related to role					
edgeDataNetworkRef	M	T	T	F	T

6.3.23.3 Attribute constraints

None.

6.3.23.4 Notifications

The common notifications defined in clause 5.5 of TS 28.541 [3] are valid for this IOC, without exceptions or additions.

6.3.24 AvailableEDN <<dataType>>

6.3.24.1 Definition

This data type defines information related with available EDN with PO.

6.3.24.2 Attributes

Attribute name	S	isReadable	isWritable	isInvariant	isNotifyable
availableEDN	M	T	T	F	T
resourceQuota	M	T	T	F	T

6.3.24.3 Attribute constraints

None.

6.3.24.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.3.25 FederatedECSInfo <<dataType>>

6.3.25.1 Definition

This datatype contains the information related with shared ECS.

6.3.25.2 Attributes

Attribute name	S	isReadable	isWritable	isInvariant	isNotifyable
federateECSIdentifier	M	T	T	F	T
federatedECSProfile	M	T	T	F	T
servedEASList	O	T	T	F	T
servedEESList	O	T	T	F	T

6.3.25.3 Attribute constraints

None.

6.3.25.4 Notifications

The clause 5.5, in TS 28.541[3], of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

6.4 Attribute definition

6.4.1 Attribute Properties

Attribute Name	Documentation and Allowed Values	Properties
eASIdentifier	It refers to EASID that identifies a particular application (e.g. SA6Video, SA6Game, … etc.) (see clause 7.2.4 in TS 23.558 [2]).	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eASAddress	One or more URLs and/or IP Address(es) of EAS(s) (See TS 23.558 [2]). allowedValues: N/A	type: String multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
eASREquirementsRef	This is the DN of EASRequirements. allowedValues: Not applicable	type: DN multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eESFunctionRef	This is the DN of EESFunction. allowedValues: DN of the EESFunction MOI.	type: DN multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
registrationInfo	This refers to the registration information (e.g. registrationExpiry, registrationID and secCredential) (see clause see clause 8.4.3 and 8.4.4 in TS 23.558[2]). It is defined as a datatype (see clause 6.3.14). allowedValues: N/A	type: RregistrationInfo multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
registrationExpiry	This specifies the expiration time of the EAS and EES Registration (see clause 8.4.3 and 8.4.4 in TS 23.558[2]).	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
registrationID	This identifies particular EAS and EES registration. (see clause 8.4.3 and 8.4.4 in TS 23.558[2]).	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
secCredential	This specifies the security credentials of the EAS and EES Registration (see clause 8.4.3 and 8.4.4 in TS 23.558[2]).	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
edgeDataNetworkRef	This holds a list of DN of EdgeDataNetwork.	type: DN multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
requiredEASservingLocation	It defines the location where the EAS service should be available (see clause 7.3.3.6 in TS 23.558 [2]).	type: ServingLocation multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False

Attribute Name	Documentation and Allowed Values	Properties
geographicalLocation	This refers to the Geographical Service Area, (see clause 7.3.3.3 in TS 23.558 [2] that is defined as a datatype (see clause 6.3.4). allowedValues: N/A	type: GeoLoc multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
latitude	This defines the single latitude coordinate.	type: Float multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
longitude	This defines the single longitude coordinate.	type: Float multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
civicLocation	This defines the civic locations, such as: a well-known buildings, parks, arenas, civic addresses, or ZIP code etc (see clause 7.3.3.3 in TS 23.558 [2]).	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
topologicalLocation	This refers to the Topological Service Area, (see clause 7.3.3.2 in TS 23.558 [2]) that is defined as a datatype (see clause 6.3.7). allowedValues: N/A	type: TopologicalServiceArea multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
geographicalCoordinates	This refers to the Topological Service Area, (see clause 7.3.3.2 in TS 23.558 [2]) that is defined as a datatype (see clause 6.3.8). allowedValues: N/A	type: GeographicalCoordinates multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
softwareImageInfo	This refers to the software image information (e.g. software image location, minimum RAM, disk requirements) (see clause 7.1.6.5 in ETSI NFV IFA-011 [7]). It is defined as a datatype (see clause 6.3.9). allowedValues: N/A	type: SoftwareImageInfo multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
swImageRef	It indicates the reference to the actual software image that is represented by URL (see clause 7.1.6.5 in ETSI NFV IFA-011 [7]).	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
minimumDisk	It indicates the minimum disk size requirement for the EAS software (see clause 7.1.6.5 in ETSI NFV IFA-011 [7]). The unit is Megabyte.	type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
minimumRAM	It indicates the minimum RAM size requirement for the EAS software (see clause 7.1.6.5 in ETSI NFV IFA-011 [7]). The unit is Megabyte.	type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False

Attribute Name	Documentation and Allowed Values	Properties
diskFormat	It indicates the disk format requirement for the EAS software (see clause 7.1.6.5 in ETSI NFV IFA-011 [7]).	type: String multiplicity: 1 isOrdered: N/A isUnique: True defaultValue: None isNullable: False
operatingSystem	It indicates the operating system requirement for the EAS software (see clause 7.1.6.5 in ETSI NFV IFA-011 [7]).	type: String multiplicity: 1 isOrdered: N/A isUnique: True defaultValue: None isNullable: False
cellIDList	It represents the list of NR cells. The cell ID, together with the gNB Identifier (using gNBId of the parent GNBCUCPFunction or GNBDUFunction or ExternalCUCPFunction), identifies a NR cell within a PLMN. This is the NR Cell Identity (NCI). See subclause 8.2 of TS 38.300 [13]. AllowedValues: Not applicable	type: Integer multiplicity: * isOrdered: False isUnique: Yes defaultValue: None isNullable: False
trackingAreaIdList	It represents the list of tracking areas within a PLMN.	type: TAI multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
servingPLMN	It specifies the PLMN to be served.	type: PLMNId multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: True
ecsAddress	One or more URLs and/or IP Address(es) of ECS(s) (See TS 23.558 [2]). allowedValues: N/A	type: String multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
providerIdentifier	The identifier of the ECSP that provides the ECS (See TS 23.558 [2]). allowedValues: N/A	type: string multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eDNConnectionInfo	It defines the set of information needed to connect to an EDN.	type: EDNConnectionInfo multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
eDNServiceArea	This parameter defines the service location for the EDN (see clause 7.3.3.4 in TS 23.558 [2]).	type: ServingLocation multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
ednIdentifier	The identifier of the edge data network (See TS 23.558 [2]). allowedValues: N/A	type: string multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False

Attribute Name	Documentation and Allowed Values	Properties
affinityAntiAffinity	This parameter defines the affinity and anti-requirements of the EAS with other EAS on the same EDN.	type: AffinityAntiAffinity multiplicity: 1 isOrdered: N/A isUnique: defaultValue: None isNullable: False
affinityEAS	This parameter defines the EAS identifier with which the affinity is required.	type: String multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
antiAffinityEAS	This parameter defines the EAS identifier with which the anti-affinity is required.	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
serviceContinuity	This parameter defines if the service continuity is required by the EAS. If the value is TRUE, the EAS will be deployed with an EES supporting service continuity.	type: Boolean multiplicity: 1..* isOrdered: False isUnique: True defaultValue: False isNullable: False
virtualResource	This parameter defines the virtual resource requirements of an EAS.	type: VirtualResource multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
virtualMemory	It indicates the minimum virtual memory size requirements for EAS in megabytes. (see clause 7.1.9.3.2.2 in ETSI NFV IFA-011 [7]).	type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
virtualDisk	It indicates the minimum virtual disk storage requirement for the EAS (see clause 7.1.9.4.3.2 in ETSI NFV IFA-011 [7]).	type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
virtualCPU	It indicates the virtual CPU requirement for the EAS (see clause 7.1.9.2.3.2 in ETSI NFV IFA-011 [7]).	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eESAddress	One or more URLs and/or IP Address(es) of EES(s) (See TS 23.558 [2]). allowedValues: N/A	type: String multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
eESIdentifier	It identifies the EES, see 3GPP TS 23.558.	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eASFunctionRef	This is the DN of EASFunction. allowedValues: DN of the EASFunction MOI.	type: DN multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False

Attribute Name	Documentation and Allowed Values	Properties
serviceContinuitySupport	This parameter defines whether the EES supports service continuity, see 3GPP TS 23.558	type: Boolen multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eESservingLocation	It defines the serving location for an EES.	type: ServingLocation multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
eESAddress	One or more URLs and/or IP Address(es) of EES(s) (See TS 23.558 [2]). allowedValues: N/A	type: String multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
eESFunctionRef	This is the DN of `EESFunction`. allowedValues: DN of the `EESFunction MOI`.	type: DN multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
aCID	Identifies the AC(s) that can be served by the EAS (See TS 23.558 [2]). allowedValues: N/A	type: String multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
eASProvider	The identifier of the ASP that provides the EAS (See TS 23.558 [2]). allowedValues: N/A	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eASdescription	Human-readable description of the EAS (See TS 23.558 [2]). allowedValues: N/A	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eASSchedule	The availability schedule of the EAS (e.g. time windows) (See TS 23.558 [2]). allowedValues: N/A	type: Duration multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
startTime	It defines the start time of the duration for which the EAS is available. allowedValues: N/A	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
endTime	It defines the send time of the duration for which the EAS is available. allowedValues: N/A	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False

Attribute Name	Documentation and Allowed Values	Properties
eASGeographicalServiceArea	The geographical service area that the EAS serves. ACs in UEs that are located outside that area shall not be served (See TS 23.558 [2]). allowedValues: N/A	type: GeoLoc multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
eASTopologicalServiceArea	The EAS serves UEs that are connected to the Core Network from one of the cells included in this service area. ACs in UEs that are located outside this area shall not be served. (See TS 23.558 [2]). allowedValues: N/A	type: TopologicalServiceArea multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
eASServicePermissionLevel	Level of service permissions e.g. trial, gold-class supported by the EAS (See TS 23.558 [2]). Allowed Values: TRIAL, SILVER, GOLD	type: StringENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eASFeature	Service features e.g. single vs. multi-player gaming service supported by the EAS (See TS 23.558 [2]). Allowed Value: N/A	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eASServiceContinuitySupport	Indicates if the EAS supports service continuity or not. This IE also indicates which ACR scenarios are supported by the EAS (See TS 23.558 [2]). Default value: FALSE allowedValues: FALSE, TRUE	type: Boolean multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: False isNullable: False
eASDNAI	DNAI(s) associated with the EAS. This IE is used as Potential Locations of Applications. It is a subset of the DNAI(s) associated with the EDN where the EAS resides. allowedValues: N/A	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eASAvailabilityReportingPeriod	The availability reporting period (i.e. heartbeat period) that indicates to the EES how often it needs to check the EAS's availability after a successful registration (See TS 23.558 [2]). allowedValues: N/A	type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
eASStatus	The status of the EAS (e.g. enabled, disabled, etc.) (See TS 23.558 [2]). Allowed values: ENABLED, DISABLED	type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
reservationLocation	This parameter defines the location where the resource needs to be reserved	type: ServingLocation multiplicity: 1 isOrdered: N/A isUnique: True defaultValue: None isNullable: False

Attribute Name	Documentation and Allowed Values	Properties
resourceReservationRequirement	This parameter defines the resource requirements that needs to be reserved.	type: ResourceReservationRequirement multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
computeRequirement	This parameter defines the compute requirement for reservation (see VirtualComputeDesc in clause 7.1.9.2.2 in ETSI NFV IFA-011 [7]).	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
storageRequirement	This parameter defines the storaget requirement for reservation (see VirtualStorageDesc in clause 7.1.9.2.2 in ETSI NFV IFA-011 [7]).	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
networtkingRequirement	This parameter defines the networking requirement for reservation. It is described as the connection bandwidth in Kbit/s reserved for EAS to use.	type: Integer multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
requestedReservationExpiration	This parameter defines the MnS consumer's requiremets for the validity period of the resource reservation. allowedValues: N/A	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
resourceReservationStatus	This parameter defines the status for the reserved resources.	type: ResourceReservationStatus multiplicity: 1..* isOrdered: False isUnique: True defaultValue: None isNullable: False
resourceId	It identifies a reserved resource.	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
reservationStatus	This parameter defines the status for a reserved resource. This attribute is configured by MnS producer and can be read by MnS consumer. Allowed Value: RESERVED: which means the specified resources is reserved and available to be used by the ASP. USED: which means the reserved resource is used by ASP.	type: Enum multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
relocationTriggerInfo	This attributes dictates the relocation trigger for the EAS. It is a complex type which include the following attributes. allowedValues: N/A	type: RelocationTriggerInfo multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: LOCKED isNullable: False

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Attribute Name	Documentation and Allowed Values	Properties
relocationType	This attribute defines if the EAS is to be relocated immediately or at a future point of time. AllowedValue: "IMMEDIATE", "FUTURE", "NO-RELOCATION"	type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: Not isNullable: False
futuristicTriggerTime	This attribute defines a time stamp in future at which the EAS relocation will be initiated. allowedValues: N/A	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
relocationRejectByASP	A Boolean attribute which can be updated by the ASP to indicate its disagreement with the relocation. The value TRUE indicate that the ASP do not agree with the relocation. Allowed Values: NA	type: Boolean multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: FALSE isNullable: False
relocationPolicy	This attribute described the EAS relocation policies from the ASP. YES: This dictates that an EAS can be relocated as and when required NO: This dictates an EAS cannot be relocated at all YESwNOTIFY: This indicates that an EAS can be relocated with a prior notification allowedValues: "YES", "NO", "YESwNOTIFY" Editors Note: The notification mechanism in FFS.	type: ENUM multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
availableEdgeVirtualResources	This parameter defines the available edge virtual resources managed by an EDN (see NfviCapacityInfo in clause 10.5.2.3 of ETS NFV SOL-005 [17]).	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
vnfdId	It indicates the identifier of the VNFD which contains the virtual resource requirements of an EAS. (see clause 7.1 in ETSI NFV IFA-011 [7]).	type: String multiplicity: 1 isOrdered: N/A isUnique: True defaultValue: None isNullable: False
participatingOPiD	This identifies the PO. allowedValues: N/A	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
originatingOPiD	This identifies the OP. allowedValues: N/A	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
federationID	This identifies the particular federation created. allowedValues: N/A	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
FederationExpiry	This defines the time post which the federation relationship shall expire. allowedValues: N/A	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False

Attribute Name	Documentation and Allowed Values	Properties
initiationTime	Date and time of the federation initiated by the originating operator. allowedValues: N/A	type: DateTime multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
offeredEDN	It provides the list of EDN that are offered by the PO. allowedValues: N/A	type: DN multiplicity: 1…* isOrdered: False isUnique: True defaultVaisNullable: False
acceptedEDNList	It provides the list of EDN that are accepted by the LO. allowedValues: N/A	type: DN multiplicity: 1…* isOrdered: False isUnique: True defaultValue: None isNullable: False
resourceQuota	This defines the virtual resource quota assigned to the LO by the PO as per the federation relationship. This may be the subset of available virtual resource (indicate with attribute `availableVirtualResource`) in the EDN. The LO will only be authorized to reserve and use this amount of resources. allowedValues: N/A	type: VirtualResource multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
availableEASResource	This defines the available EAS in the shared EDN. This will be the DN of EASProfile. allowedValues: N/A	type: DN multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
avaibleEDNList	This defines information related with available EDN with PO. allowedValues: N/A	type: AvailableEDNList multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
federationID	This defines the federation ID provided by the PO to LO at the time of federation establishment. allowedValues: N/A	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
reservationID	This defines the reservation identification of the block of reserved resources for L-OP in P-OP's edge network. allowedValues: N/A	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
federateECSIdentifier	This defines the ECS that is to be shared as part of edge federation. This will be a DN of the ECS deployed in the participating operator domain for edge services.	type: DN multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
federatedPOPIdentifier	The identifier of the participating operator	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False

Attribute Name	Documentation and Allowed Values	Properties
federatedECSProfile	The information related with ECS Profile. See clause 8.2.12 of [2].	type: String multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False
servedEASList	This defines the list of EAS(s) available with the partner ECS. This specifies the will a DN of EASFunction instance.	type: DN multiplicity: * isOrdered: False isUnique: True defaultValue: None isNullable: False
servedEESList	This defines the list of EES(s) available with the partner ECS. This specifies the will a DN of EESFunction instance.	type: DN multiplicity: * isOrdered: False isUnique: True defaultValue: None isNullable: False
sharedECSInfo	This defines the ECS(s) belonging to P-OP that can be used in case of roaming and federation	type: FederatedECSInfo multiplicity: * isOrdered: False isUnique: True defaultValue: None isNullable: False
federatedECSInfo	This defines the information related with shared ECS	type: FederatedECSInfo multiplicity: * isOrdered: False isUnique: True defaultValue: None isNullable: False
availableEDN	This defines the available EDN.	type: DN multiplicity: 1 isOrdered: False isUnique: True defaultValue: None isNullable: False
eASDeploymentMonitor	Provides monitoring for the process of deployment of EAS(s). The data type of this attribute is the "ProcessMonitor" as defined in TS 28.622[4]. allowedValues: N/A	type: ProcessMonitor multiplicity: 1 isOrdered: N/A isUnique: N/A defaultValue: None isNullable: False

7 Procedural Flows

7.1 Lifecycle management

7.1.1 Description

The clause contains procedures associated with lifecycle management.

7.1.2 EAS lifecycle management

7.1.2.1 EAS deployment

7.1.2.1.1 EAS deployment by interworking with ETSI NFV MANO

Figure 7.1.2.1.1-1 depicts a procedure that describes how an ASP can consume provisioning MnS to instantiate the EAS by interworking with ETSI NFV MANO. It is assumed that both ASP and ECSP consumers have subscribed to the producer of provisioning MnS to receive notifications.
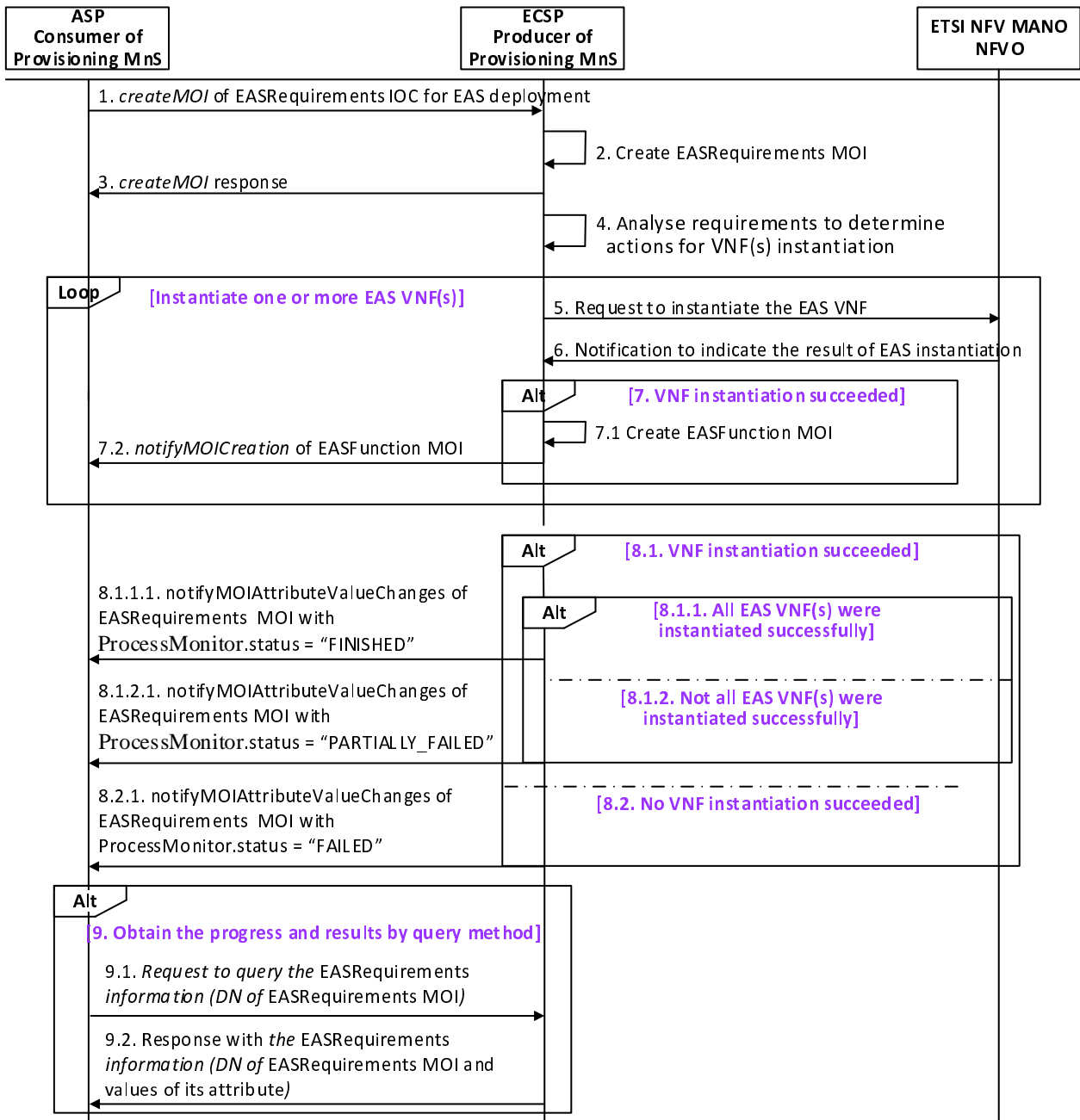
Figure 7.1.2.1.1-1: EAS deployment

1. ASP consumes the provisioning MnS with *createMOI* operation (see clause 11.1.1.1. in TS 28.532 [5]) for EASRequirements IOC to request ECSP provisioning MnS producer to start the EAS VNF instantiation, where the EASRequirements IOC as defined in clause 6.3.2.2 contains the deployment requirements and the information of EAS deployment process, including (but not limited to) the following attributes:

- the service areas (i.e., geographical, or topological) where the UEs can access the edge computing service (see clause 7.3.3 in TS 28.558 [2]).

- Software image information and virtual resource information (e.g. software image location, minimum RAM, disk requirements) (see clause 7.1.6.5 and 7.1.9 in ETSI NFV IFA-011 [7]).

- service continuity requirements (e.g. whether service continuity is required).

- Affinity/Anti-affinity: The affinity and ant-affinity requirements for the EAS with other existing EAS on the target EDN.

- resource reservation information (i.e. reservationJobRef): reserved resource information if it has before ASP initiating EAS deployment procedure.

- eASDeploymentMonitor

2. ECSP provisioning MnS producer creates the MOI for EASRequirements IOC.

3. ECSP provisioning MnS producer sends a response to the ASP indicating the EASRequirements MOI has been successfully created.

4. ECSP provisioning MnS producer analyses the deployment requirements to determine which EDN and how many EAS instance(s) should be instantiated to satisfy the deployment requirements, and downloads the EAS VNF software image from the software image location. The EDN can be selected either by considering the individual requirement or by grouping the multiple requirements as single selection criteria.

5. ECSP provisioning MnS producer invokes the *InstantiateNsRequest* or UpdateNsRequest operation (see clause 7.3.3 and 7.3.5 in ETSI GS NFV-IFA 013 [6]) to request NFVO via the Os-Ma-nfvo interface to instantiate a NS instance including the EAS VNF instance.

6. NFVO sends a notification to ECSP provisioning MnS producer indicating the result of instantiation procedure (see clause 7.3.3.4 and 7.3.5.4 of ETSI GS NFV-IFA 013 [6]).

7. If the VNF instantiation has been successful, then:

    7.1. ECSP provisioning MnS producer creates the MOI for EASFunction IOC.

    7.2. ECSP provisioning MnS producer sends notifyMOICreation to notify ASP about the creation of EASFunction MOI.

    8.1. If VNF instantiation were succeeded, then:

        8.1.1. If all VNF instance(s) have been successfully instantiated, then:

            8.1.1.1. ECSP provisioning MnS producer sends notifyMOIAttributeValueChanges with processMonitor.status = "FINISHED" and eASRequirementsRef = DN of EASRequirements MOI to notify ASP the EAS deployment was successful.

        8.1.2. If not all EAS VNF(s) were instantiated successfully, then:

            8.1.2.1. ECSP provisioning MnS producer sends notifyMOIAttributeValueChanges with processMonitor.status = "PARTIALLY_FAILED" and eASRequirementsRef = DN of EASRequirements MOI to notify ASP the EAS deployment was partially failed.

  8.2. If no VNF instantiation succeeded, then:

        8.2.1. ECSP provisioning MnS producer sends notifyMOIAttributeValueChanges with processMonitor.status = "FAILED" and eASRequirementsRef = DN of EASRequirements MOI to notify ASP about the un-successful instantiation of the EAS.

9. The ASP may check the status and completion of the EAS deployment procedure any time by monitoring the values of EASRequirements MOI attributes eASDeploymentMonitor by querying the values.

9.1. The ASP sends query request to ECSP provisioning MnS producer to query the attribute value of EASRequirements MOI to obtain the progress and result.

9.2. ECSP provisioning MnS producer sends the reponse to ASP with EASRequirements information.

7.1.2.1.2 EAS deployment by interworking with ETSI MEC

As an alternative procedure, when ASP requesting ECSP provisioning MnS producer to deploy an EAS, the ECSP provisioning MnS producer could interacts with ETSI MEC MEO/MEAO (see application instantiation operation in clause 6.3.1.3 in ETSI GS MEC 010-2 [15]) for EAS instantiation.

7.1.2.2 EAS termination

7.1.2.2.1 EAS termination by interworking with ETSI NFV MANO

Figure 7.1.2.2.1-1 depicts a procedure that describes how an ASP can consume provisioning MnS to terminate the EAS VNF by interworking with ETSI NFV MANO. It is assumed that both ASP and ECSP consumers have subscribed to the producer of provisioning MnS to receive notifications.
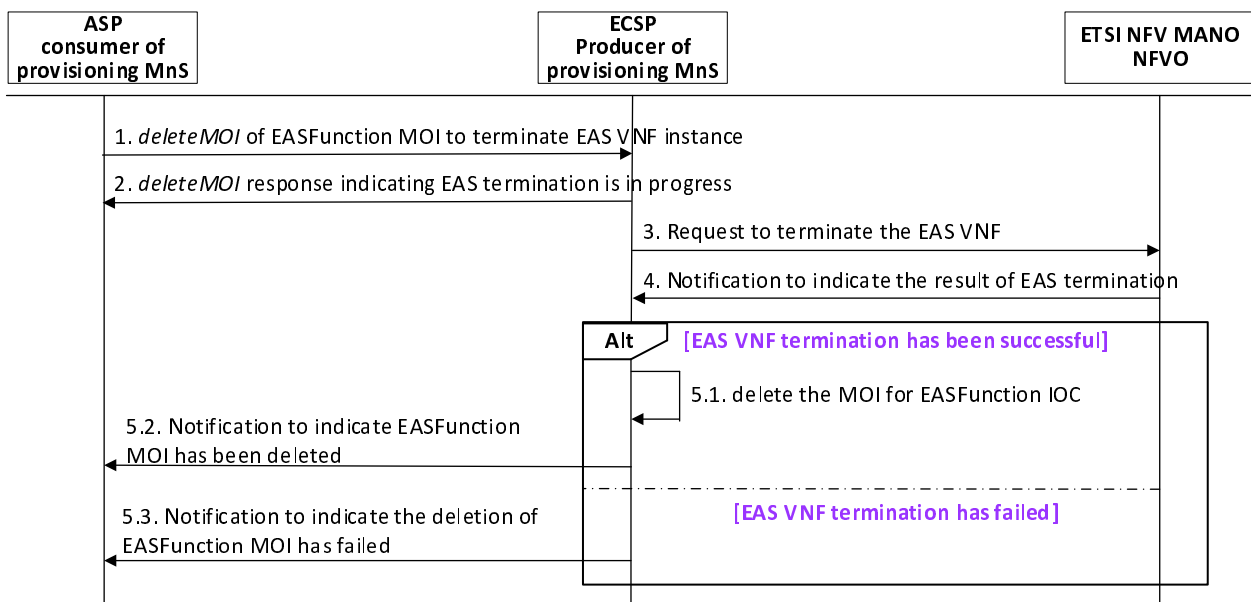

Figure 7.1.2.2.1-1: EAS termination

1. ASP consumes the provisioning MnS with *deleteMOI* (see clause 11.1.1.4. in TS 28.532 [5]) operation for EASFunction MOI to request ECSP provisioning MnS producer to start the EAS VNF termination.

2. ECSP provisioning MnS producer sends a response to the ASP indicating that the termination operation is in progress.

3. ECSP provisioning MnS producer invokes the *TerminateNsRequest* or UpdateNsRequest operation (see clauses 7.3.7 and 7.3.5 in ETSI GS NFV-IFA 013 [6]) to request NFVO via the Os-Ma-nfvo interface to terminate EAS VNF instance.

4. NFVO sends the NS Lifecycle Change notification to ECSP provisioning MnS producer indicating the result of termination procedure (see clause 7.3.12 of ETSI GS NFV-IFA 013 [6]).

5. If the VNF termination has been successful then:

5.1. ECSP provisioning MnS producer deletes the MOI for EASFunction IOC ,if all the related EASFunction MOIs have been deleted, the EASRequirement IOC shall also be deleted.

5.2. ECSP provisioning MnS producer notifies ASP about the successful termination of the EAS.

Otherwise :

     5.3. ECSP provisioning MnS producer notifies ASP about the un-successful termination of the EAS.

7.1.2.2.2 EAS termination by interworking with ETSI MEC

As an alternative procedure, when ASP requesting ECSP provisioning MnS producer to terminate an EAS instance, the ECSP provisioning MnS producer could interacts with ETSI MEC MEO/MEAO (see application termination operation in clause 6.3.1.7 in ETSI GS MEC 010-2 [15]) for EAS termination.

7.1.2.3 EAS modification

7.1.2.3.1 EAS modification by interworking with ETSI NFV MANO

Figure 7.1.2.3.1-1 depicts a procedure that describes how an ASP can consume provisioning MnS to modify the EAS by interworking with ETSI NFV MANO if required. It is assumed that both ASP and ECSP consumers have subscribed to the producer of provisioning MnS to receive notifications.
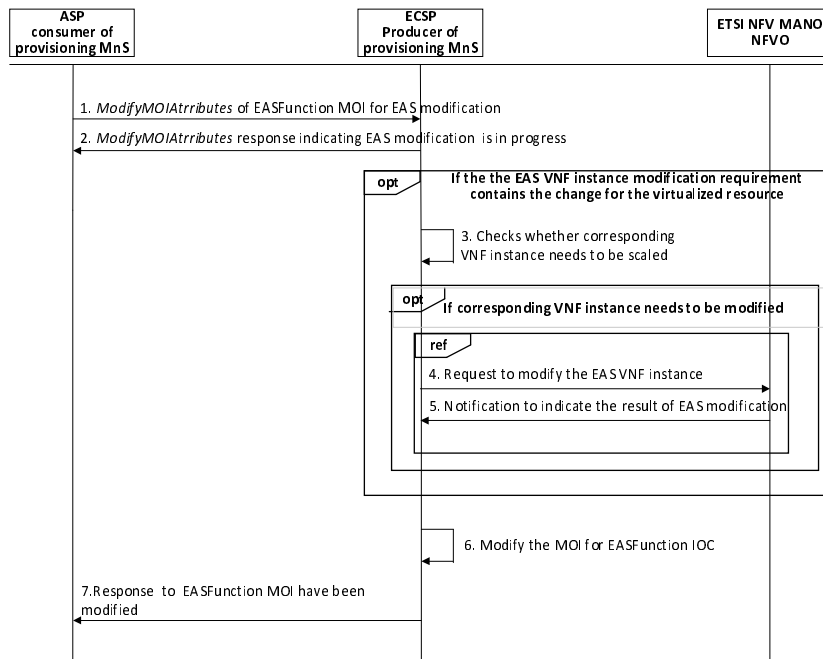

Figure 7.1.2.3.1-1: EAS modification procedure

1. ASP consumes the provisioning MnS with modifyMOIAttributes operation (see clause 11.1.1.3. in TS 28.532 [5]) for EASFunction MOI to request ECSP management system provisioning MnS producer to modify the EAS VNF instance.

2. ECSP management system provisioning MnS producer sends a response to the consumer indicating that the modification operation is in progress.

3. If EAS instance to be modification contains virtualized part, checks whether corresponding VNF instance needs to be modified to satisfy the modification related requirements.

4. If corresponding VNF instance needs to be modified, ECSP provisioning MnS producer invokes theUpdateNsRequest operation (see clause 7.3.5 in ETSI GS NFV-IFA 013 [6]) to request NFVO via the Os-Ma-nfvo interface to modify the virtualized resource of the EAS VNF instance.

5. NFVO sends the NS Lifecycle Change notification to ECSP provisioning MnS producer indicating the result of modification procedure (see clause 7.3.12 of ETSI GS NFV-IFA 013 [6]).

6. ECSP provisioning MnS producer modifies the MOI for EASFunction IOC.

7. ECSP management system provisioning MnS producer response the consumer about the modification of the EAS.

7.1.2.3.2 EAS modification by interworking with ETSI MEC

As an alternative procedure, when ASP requesting ECSP provisioning MnS producer to modify an EAS, the ECSP provisioning MnS producer could interacts with ETSI MEC MEO/MEAO (see clause 6.3.1.4 in ETSI GS MEC 010-2 [15]) for EAS modification.

7.1.2.4 EAS query

7.1.2.4.1 EAS query by interworking with ETSI NFV MANO

Figure 7.1.2.4.1-1 depicts a procedure that describes how an ASP can consume provisioning MnS query the EAS by interworking with ETSI NFV MANO if required. It is assumed that both ASP and ECSP consumers have subscribed to the producer of provisioning MnS to receive notifications.
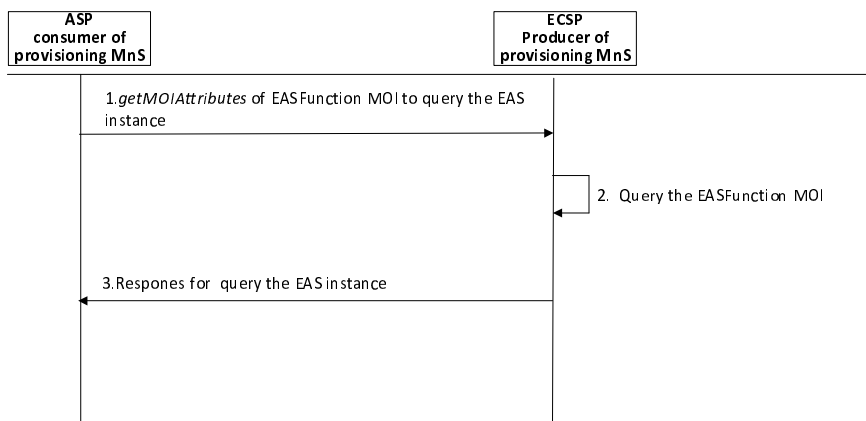

Figure 7.1.2.4.1-1: EAS query procedure

1. ECSP provisioning MnS Producer receives a query request (this will use getMOIAttributes operation defined in 3GPP TS 28.532[5]) with objectInstance of the existing EASFunction MOI, scope, and list of attributes of EASFunction IOC. The list of attributes identifies the attributes to be returned by this operation.

2. Based on the request, ECSP provisioning MnS producer queries the concrete EASFunction MOI

3. MnS Producer sends a response to the MnS consumer with objectClass, objectInstance, status (e.g. succeed or failed), and list of [Attribute, Value] related to EAS instance as defined in clause 6.4 (e.g. eASAddress).

7.1.2.4.2 EAS query by interworking with ETSI MEC

As an alternative procedure, when ASP requesting ECSP provisioning MnS producer to query an EAS, the ECSP provisioning MnS producer could interacts with ETSI MEC MEO/MEAO (see clause 6.3.1.5 in ETSI GS MEC 010-2 [15]) for EAS query.

7.1.2.5 EAS instantiation triggered by measurement data

Figure 7.1.2.5-1 depicts a procedure to support the use case described in clause 5.1.13a EAS discovery failure that utilized measurement data to trigger EAS instantiation.
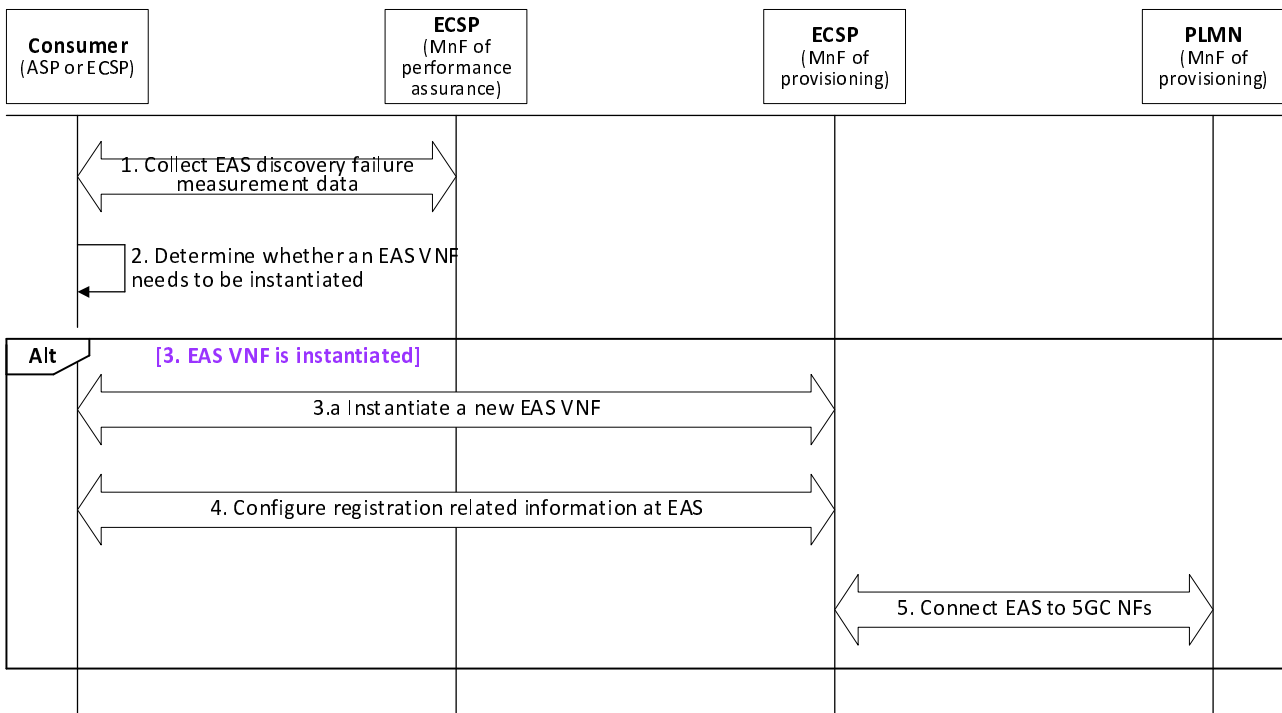
Figure 7.1.2.5-1: EAS instantiation triggered by measurement data

1. The consumer utilizes the procedure described in clause 7.2.2 to request MnF for performance assurance for EES to request MnF for performance assurance for EES to collect EAS discovery failure measurements from the EES (see clause 5.15.1.3 in TS 28.552 [10], containing subcounters based on EAS Discovery Filter (see table 8.5.3.2-2 in TS 23.558 [2]), e.g. UE location and EAS type.

2. The consumer determines whether an EAS VNF needs to be instantiated, based on the information in the measurement data, including number of EAS discovery failures under certain conditions (see clause 5.15.1.3 in TS 28.552 [10], e.g. UE locations (i.e., cell ID), EAS service area and EAS types, and the number of UEs in a cell.

3. If a new EAS VNF should be instantiated, then

   3.a The consumer utilizes the procedure described in clause 7.1.2.1 to instantiate the new VNF instance based on the information in the measurement data.

4. The consumer utilizes the procedure described in clause 7.4.2 to configure the EAS with the information needed for EAS to register to EES.

5. ECSP MnF of provisioning, acting as the consumer, utilizes the procedures described in clause 7.4.3 and 7.4.4 to request PLMN MnF of provisioning, acting as the producer, to connect the EAS to 5GC NFs.

7.1.2.6 EAS Relocation

Figure 7.1.2.5-1 depicts a procedure for EAS Relocation.
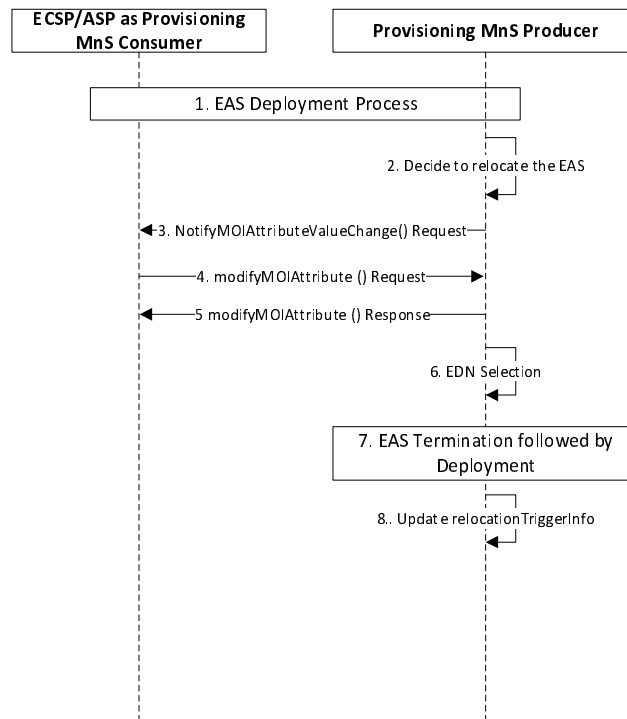
Figure 7.1.2.6-1: EAS Relocation

1. EAS is deployed as per the procedures defined in clause 7.1.2.1. The reallocation policies are created as part of the deployment procedures.

2. The producer decides to relocate the EAS.

3. Producer sends the notification to the authorized subscriber (e.g ASP, EES) indicating the updating of the attribute `triggerType`.

4. If the ASP decides not to allow for relocation based on its internal policies. The ASP will send modifyMOIAttributeChange to update the value of the attribute `relocationRejectByASP` to TRUE.

5. The producer sends the response.

6. The producer selects the appropriate EDN to relocate the EAS.

7. The producer will then follow EAS termination (from source EDN) and EAS deployment (on Target EDN) as defined in clauses 7.1.2.1 and 7.1.2.2 respectively.

8. The values of the attribute `triggerType` are set to defaults as defined in clause 6.3.20.

7.1.2.7   EAS resource reservation

Figure 7.1.2.7-1 depicts a procedure for EAS resource reservation.
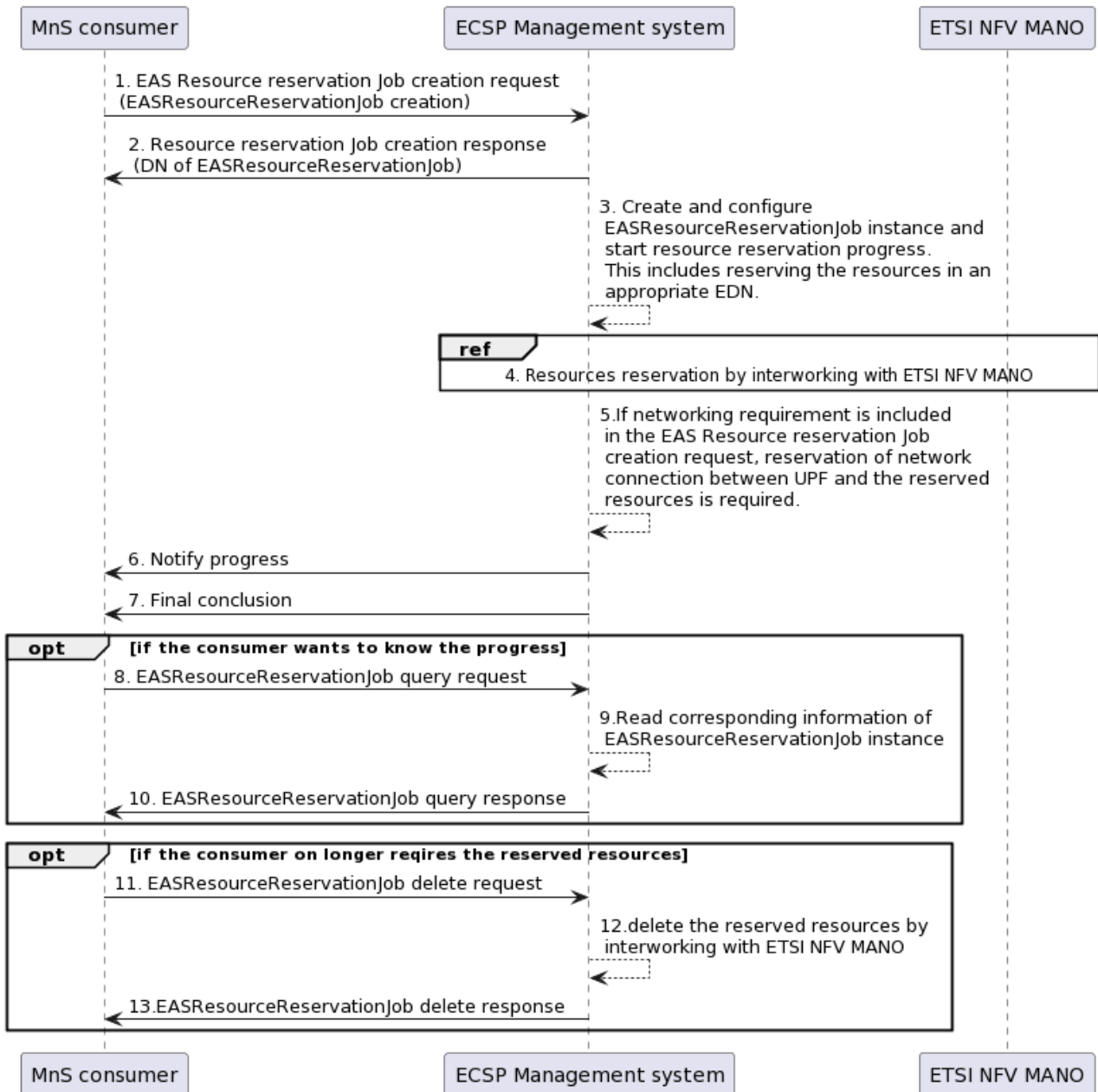
Figure 7.1.2.7-1: EAS resource reservation

1. ECSP management system receives a EAS resource reservation job creation request (createMOI operation for EASResourceReservationJob), the EASResourceReservationJob contains the following attributes:

   - Location at which the resources are to be reserved;

   - Resource for reservation, including virtual compute, virtual storage and virtual network resources;

   - expiration time;

   - resource reservation status.

2. ECSP management system sends the EASResourceReservationJob creation response to the MnS consumer (ASP or L-OP) for the received Job DN.

3. ECSP management system creates the EASResourceReservationJob instance and configures the attribute from the request and ECSP management system starts the executing the resource reservation process. This includes reserving the resources in an appropriate EDN.

4. ECSP management system requests resource reservation by interworking with ETSI NFV MANO (based on the information contained in the EASResourceReservationJob creation request e.g. reservationLocation, resourceReservationRequirement to initiate Instantiate NS operation in an appropriate EDN. See clause 7.3.3 in ETSI GS NFV-IFA 013 [6]).

5. If networking requirement is included in the EAS Resource reservation Job creation request, reservation of network connection between UPF and the reserved resources is required (following the procedure as described in clause 7.4.4).

6. Response with the progress of EASResourceReservationJob instance creation.

7. ECSP management system sends the final notification with the status of EASResourceReservationJob instance.

8-10. Once after step 2, the MnS consumercan send query request to ECSP management system any time, to know and receive the status of EASResourceReservationJob instance.

11-13. the MnS consumer (ASP or L-OP) can request to delete the EASResourceReservationJob any time and the ECSP management system deletes the EASResourceReservationJob and sends response to ASP (interworking with ETSI NFV MANO is required).

7.1.3 ECS lifecycle management

7.1.3.1 ECS deployment

Figure 7.1.3.1-1 shows that the PLMN operator or ECSP as the consumer requests the ECS instantiation via the provisioning MnS.
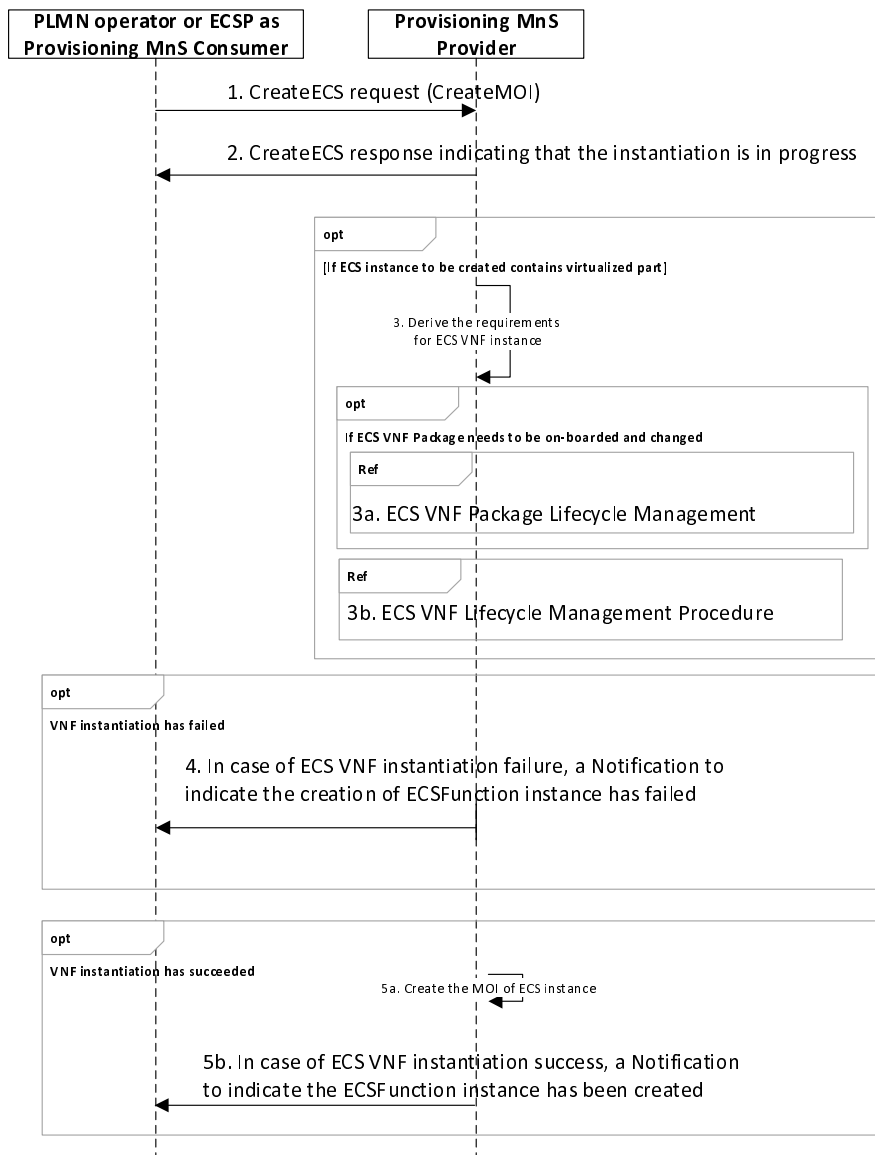
Figure 7.1.3.1-1: ECS deployment procedure

1. Provisioning MnS Producer receives a request (this will use createMOI operation defined in 3GPP TS 28.532 [5]) with ECS related requirements. The following are the list of requirements, which can be provided with the request as part of attributeListIn parameter of createMOI operation.

   a. ecsAddress: the URLs and/or IP Address(es) of ECS.

   b. providerIdentifier: Identifying the ECSP that provides the ECS.

2. Provisioning MnS Producer returns a response indicating that the instantiation operation is in progress.

3. The NF instance creation procedure as described in clause 7.10 of [5] is reused to instantiate the ECS VNF instance with the requirements captured in the ECSFunction IOC.

4. In case of ECS VNF instantiation failure, a Notification to indicate the creation of ECSFunction instance has failed.

5. In case of ECS VNF instantiation success, the producer creates the MOI (Managed Object Instance) for ECSFunction IOC. The MOI shall contain attributes as defined in ECSFunction IOC. The Provisioning MnS Producer sends a Notification to indicate the ECSFunction instance has been created.

7.1.3.2 ECS termination

Figure 7.1.3.2-1 shows that the PLMN operator or ECSP as the consumer requests the ECS termination via the provisioning MnS.


Figure 7.1.3.2-1: ECS termination procedure

1. PLMN operator or ECSP consumes the provisioning MnS with deleteMOI operation (see clause 11.1.1.4. in TS 28.532 [5]) for ECSFunction MOI to request ECSP management system provisioning MnS producer to terminate the ECS VNF instance.

2. ECSP management system provisioning MnS producer sends a response to the consumer indicating that the termination operation is in progress.

3. ECSP management system provisioning MnS producer invokes the TerminateNsRequest or UpdateNsRequest operation (see clause 7.3.7 and 7.3.5 in ETSI GS NFV-IFA 013 [6]) to request NFVO via the Os-Ma-nfvo interface to terminate ECS VNF instance.

4. NFVO sends the NS Lifecycle Change notification to ECSP provisioning MnS producer indicating the result of termination procedure (see clause 7.3.12 of ETSI GS NFV-IFA 013 [6]).

5. If the VNF termination has been successful then:

   5.1. ECSP management system provisioning MnS producer deletes the MOI for ECSFunction IOC.

   5.2. ECSP management system provisioning MnS producer notifies the consumer about the successful termination of the ECS.

   Otherwise :

   5.3. ECSP management system provisioning MnS producer notifies the consumer about the un-successful termination of the ECS.

7.1.3.3 ECS modification

Figure 7.1.3.3-1 shows that the PLMN operator or ECSP as the consumer requests the ECS modification via the provisioning MnS.
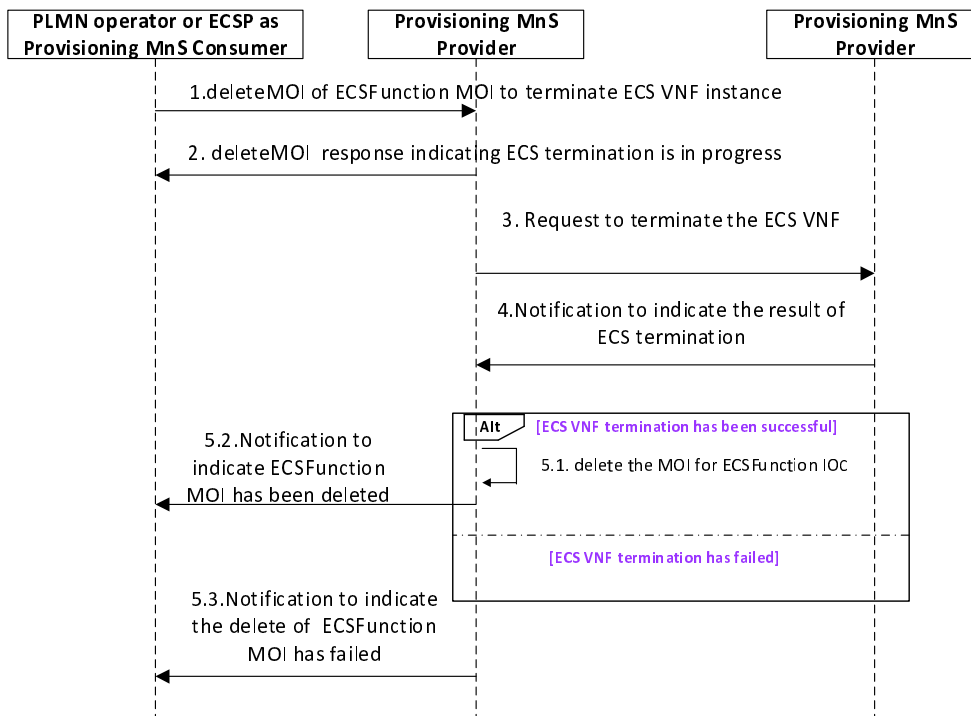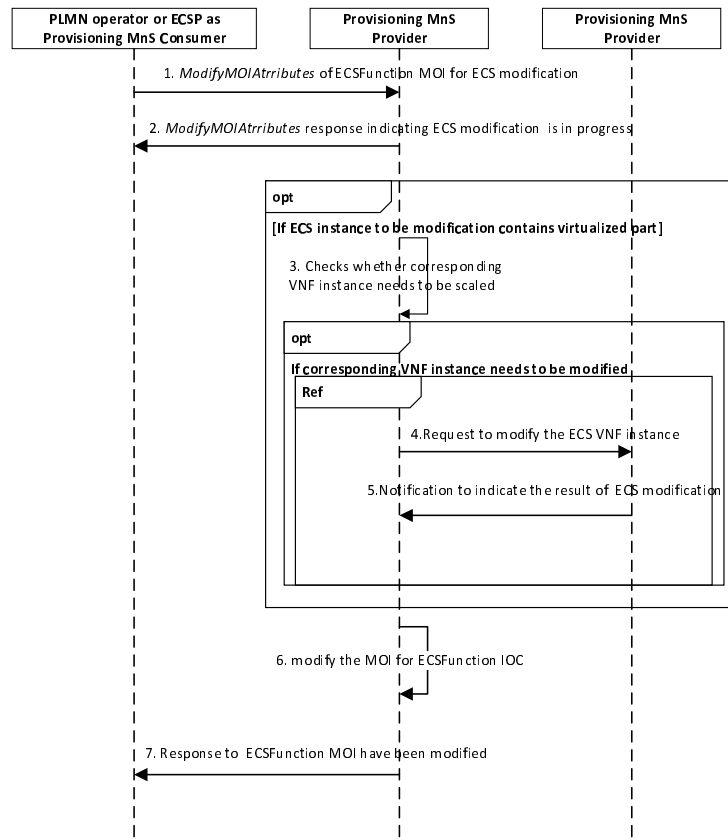
Figure 7.1.3.3-1: ECS modification procedure

1. PLMN operator or ECSP consumes the provisioning MnS with modifyMOIAttributes operation (see clause 11.1.1.3. in TS 28.532 [5]) for ECSFunction MOI to request ECSP management system provisioning MnS producer to modify the ECS VNF instance.

2. ECSP management system provisioning MnS producer sends a response to the consumer indicating that the modification operation is in progress.

3. If ECS instance to be modification contains virtualized part, checks whether corresponding VNF instance needs to be modified to satisfy the modification related requirements.

4. If corresponding VNF instance needs to be modified, ECSP management system provisioning MnS producer invokes the updateNsRequest operation (see clause 7.3.5 in ETSI GS NFV-IFA 013 [6]) to request NFVO via the Os-Ma-nfvo interface to modify the virtualized resource of ECS VNF instance.

5. NFVO sends the NS Lifecycle Change notification to ECSP provisioning MnS producer indicating the result of modification procedure (see clause 7.3.12 of ETSI GS NFV-IFA 013 [6]).

6. ECSP management system provisioning MnS producer modifies the MOI for ECSFunction IOC.

7. ECSP management system provisioning MnS producer response to consumer about the modification of the ECS instance.

7.1.3.4 ECS query

Figure 7.1.3.4-1 shows that the PLMN operator or ECSP as the consumer requests the ECS query via the provisioning MnS.
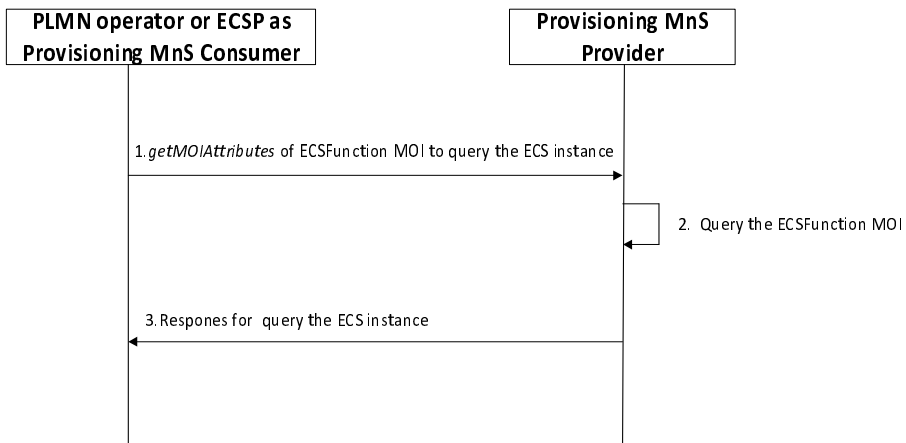
Figure 7.1.3.4-1: ECS query procedure

1. ECSP provisioning MnS Producer receives a query request (this will use getMOIAttributes operation defined in 3GPP TS 28.532[5]) with objectInstance of the existing ECSFunction MOI, scope, and list of attributes of ECSFunction IOC. The list of attributes identifies the attributes to be returned by this operation.

2. Based on the request, ECSP provisioning MnS producer queries the concrete ECSFunction MOI

3. MnS Producer sends a response to the MnS consumer with objectClass, objectInstance, status (e.g. succeed or failed), and list of [Attribute, Value] related to ECS instance which is defined in clause 6.4(e.g. providerIdentifier).

7.1.4 EES lifecycle management

7.1.4.1 EES deployment

Figure 7.1.4.1-1 shows that the PLMN operator or ECSP as the consumer requests the EES instantiation via the provisioning MnS.
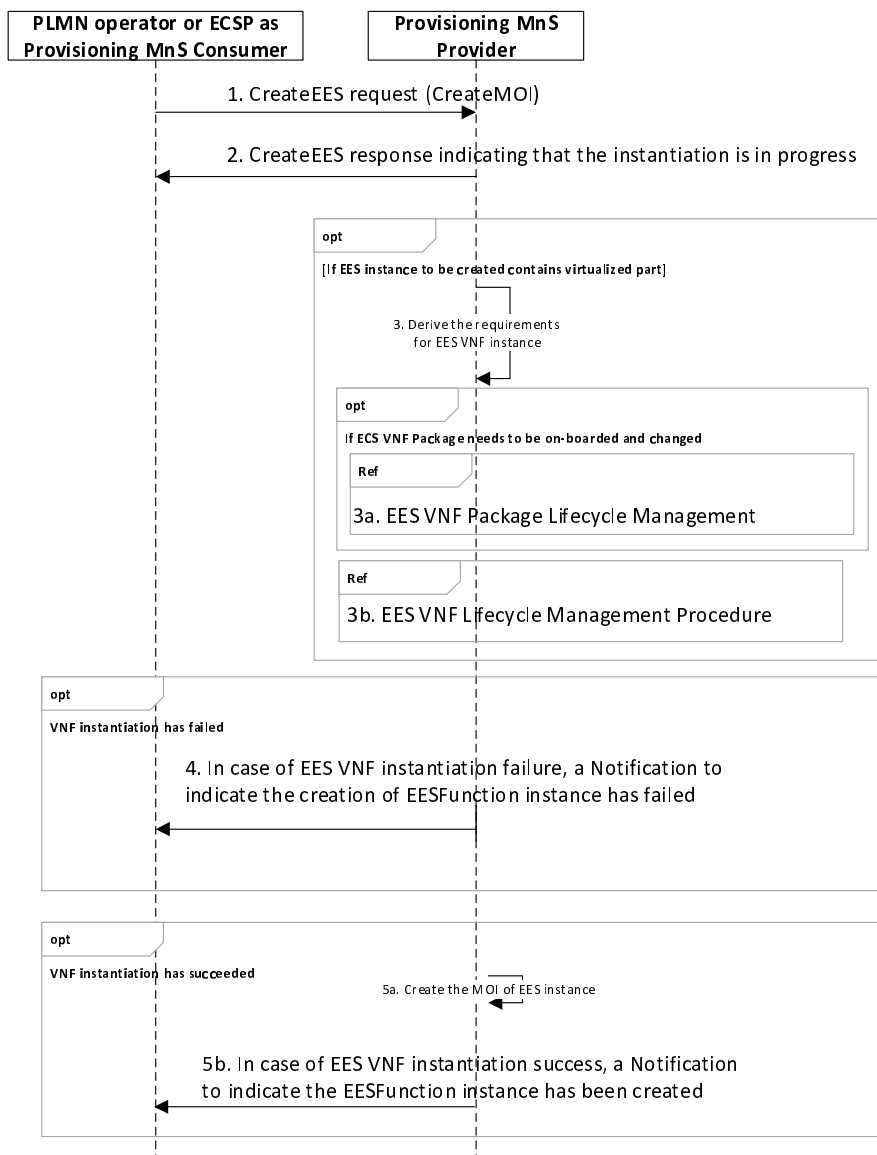
Figure 7.1.4.1-1: EES deployment procedure

1. Provisioning MnS Producer receives a request (this will use createMOI operation defined in 3GPP TS 28.532 [5]) with EES related requirements. The following are the list of requirements, which can be provided with the request as part of attributeListIn parameter of createMOI operation.

    a. EDN identifier: Identifying the EDN to contain the EES in.

    b. EAS identifier: Identifying the list of EAS registered with the EES. This is optional depending on the availability of the EAS.

2. Provisioning MnS Producer returns a response indicating that the instantiation operation is in progress

3. The NF instance creation procedure as described in clause 7.10 of [5] is reused to instantiate the EES VNF instance with the requirements provided in the instantiation request.

4. In case of EES VNF instantiation failure, a Notification to indicate the creation of EESFunction instance has failed.

5. In case of EES VNF instantiation success, the producer creates the MOI (Managed Object Instance) for EESFunction IOC. The MOI shall contain attributes as defined in EESFunction IOC. The Provisioning MnS Producer sends a Notification to indicate the EESFunction instance has been created.

7.1.4.2   EES termination

Figure 7.1.4.2-1 shows that the PLMN operator or ECSP as the consumer requests the EES termination via the provisioning MnS.
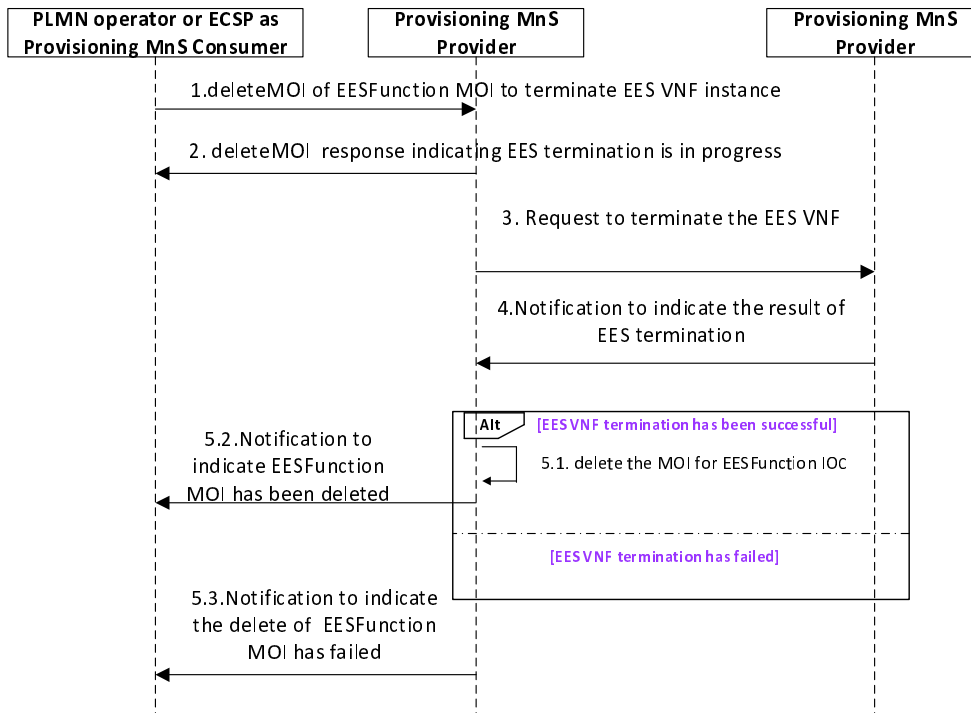
Figure 7.1.4.2-1: EES termination procedure

1. PLMN operator or ECSP consumes the provisioning MnS with deleteMOI operation (see clause 11.1.1.4. in TS 28.532 [5]) for EESFunction MOI to request ECSP management system provisioning MnS producer to terminate the EES VNF instance.

2. ECSP management system provisioning MnS producer sends a response to the consumer indicating that the termination operation is in progress.

3. ECSP management system provisioning MnS producer invokes the TerminateNsRequest or UpdateNsRequest operation (see clauses 7.3.7 and 7.3.5 in ETSI GS NFV-IFA 013 [6]) to request NFVO via the Os-Ma-nfvo interface to terminate EES VNF instance.

4. NFVO sends the NS Lifecycle Change notification to ECSP provisioning MnS producer indicating the result of termination procedure (see clause 7.3.12 of ETSI GS NFV-IFA 013 [6]).

5. If the VNF termination has been successful then:

    5.1. ECSP management system provisioning MnS producer deletes the MOI for EESFunction IOC.

    5.2. ECSP management system provisioning MnS producer notifies the consumer about the successful termination of the EES.

    Otherwise :

5.3. ECSP management system provisioning MnS producer notifies the consumer about the un-successful termination of the EES.

7.1.4.3 EES modification

Figure 7.1.4.3-1 shows that the PLMN operator or ECSP as the consumer requests the EES modification via the provisioning MnS.
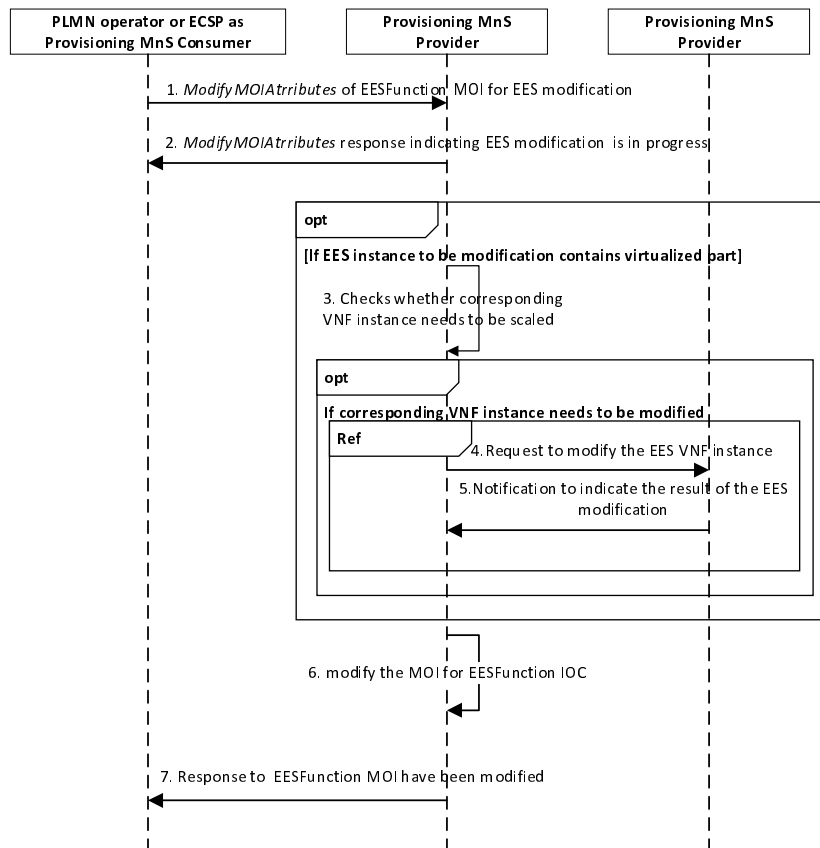

Figure 7.1.4.3-1: EES modification procedure

1. PLMN operator or ECSP consumes the provisioning MnS with modifyMOIAttributes operation (see clause 11.1.1.3. in TS 28.532 [5]) for EESFunction MOI to request ECSP management system provisioning MnS producer to modify the EES VNF instance.

2. ECSP management system provisioning MnS producer sends a response to the consumer indicating that the modification operation is in progress.

3. If EES instance to be modification contains virtualized part, checks whether corresponding VNF instance needs to be modified to satisfy the modification related requirements.

4. If corresponding VNF instance needs to be modified, ECSP management system provisioning MnS producer invokes the updateNsRequest operation (see clause 7.3.5 in ETSI GS NFV-IFA 013 [6]) to request NFVO via the Os-Ma-nfvo interface to modify the virtualized resource of EES VNF instance.

5. NFVO sends the NS Lifecycle Change notification to ECSP provisioning MnS producer indicating the result of modification procedure (see clause 7.3.12 of ETSI GS NFV-IFA 013 [6]).

6. ECSP management system provisioning MnS producer modifies the MOI for EESFunction IOC.

7. ECSP management system provisioning MnS producer response to consumer about the modification of the EES instance.

7.1.4.4 EES query

Figure 7.1.4.4-1 shows that the PLMN operator or ECSP as the consumer requests the EES query via the provisioning MnS.
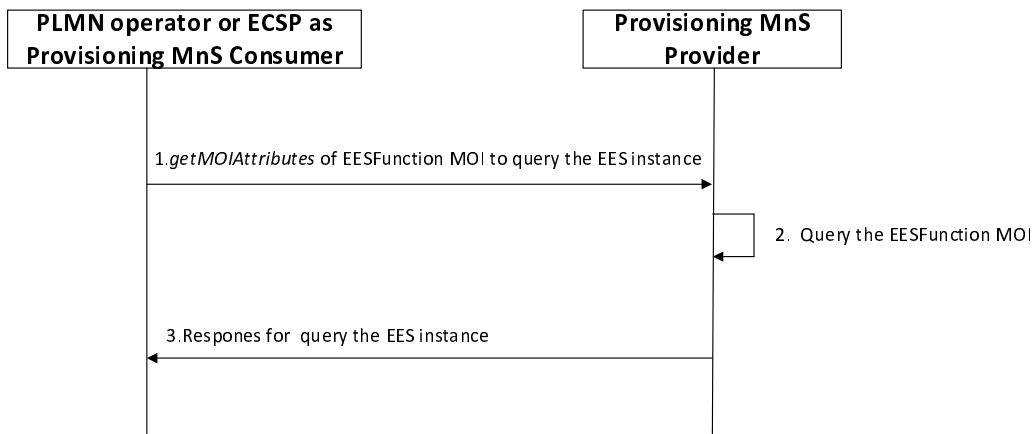
**Figure 7.1.4.4-1: EES query procedure**

1. ECSP provisioning MnS Producer receives a query request (this will use getMOIAttributes operation defined in 3GPP TS 28.532[5]) with objectInstance of the existing EESFunction MOI, scope, and list of attributes of EESFunction IOC. The list of attributes identifies the attributes to be returned by this operation.

2. Based on the request, ECSP provisioning MnS producer queries the concrete EESFunction MOI

3. MnS Producer sends a response to the MnS consumer with objectClass, objectInstance, status (e.g. succeed or failed), and list of [Attribute, Value] related to EES instance which is defined in clause 6.4(e.g. eESservingLocation).

7.2 Performance assurance

7.2.1 Description

The clause contains procedures associated with performance assurance.

7.2.2 EAS performance assurance

7.2.2.1 Measurement collection via performance job control

Figure 7.2.2.1-1 depicts a procedure that describes how an ASP can consume performance assurance MnS to collect the EAS measurements via performance job control.

Figure 7.2.2.1-1: Measurement collection via performance job control

1. ASP, as the consumer of performance assurance MnS, consumes the measurement job control MnS with `createMeasurementJob` operation (see TS 28.550 [8]) to request ECSP management system, as the producer of performance assurance MnS, to collect EAS measurements. The `createMeasurementJob` operation also includes a reportingMethod attribute to indicating the report method (i.e., performance data file or by performance data streaming).

2. ECSP management system returns the output parameter with jobId to indicate the PM job been created.

3. If this PM job is based on performance file reporting service, then

    3.1. ASP invokes the `subscribe` operation (see clause 12.6.1.1.1 in TS 28.532 [5]) to subscribe to receive notifications from the ECSP management system.

    3.2. ECSP management system sends a `notifyFileReady` notification (see clause 11.6.1.1 in TS 28.532 [5]) to ASP to indicate the performance data file is ready.

    3.3. ASP fetches the EAS measurement data from the MnS producer.

    Otherwise (performance data streaming service)

    3.4. ECSP management system invokes the `establishStreamingConnection` operation (see clause 11.5.1.1 in TS 28.532 [5]) to establish a streaming connection with ASP for sending the streaming data.

    3.5 ECSP management system collects the EAS measurement data and invokes the `reportStreamData` operation (see clause 11.5.1.3 in TS 28.532 [5]) to send the streaming data to ASP.

7.2.2.2 Measurement collection via configurable measurement control

Figure 7.2.2.2-1 depicts a procedure that describes how an ASP can consume performance assurance MnS to collect the EAS measurements via configurable measurement control.
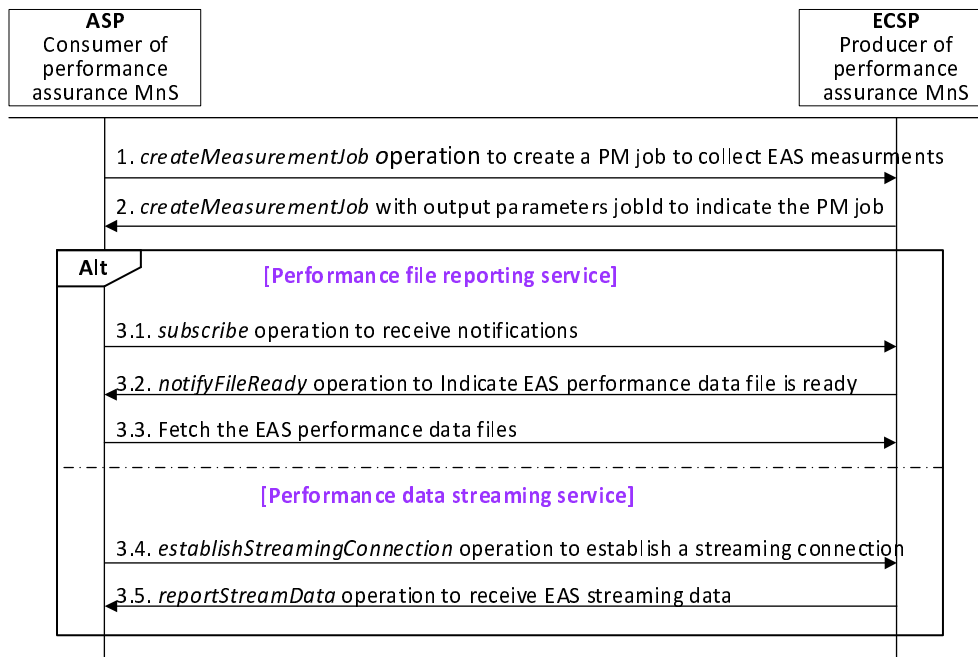
Figure 7.2.2.2-1: Measurements collection via configurable measurement control

1. ASP, as the consumer of provisioning MnS, consumes the provisioning MnS with `createMOI` operation for `PerfMetricJob` IOC to request ECSP management system, as the producer of provisioning MnS, to collect EAS measurements. The `PerfMetricJob` MOI includes a ReportingCtrl attribute (See clause 4.3.33 in TS 28.622 [4]) to indicating the report method (i.e., performance data file or by performance data streaming).

2. ECSP management system returns the output parameter with jobId to indicate the PM job been created.

3. If this PM job is based on performance file reporting service, then:

   3.1. ASP invokes the `subscribe` operation (see clause 12.6.1.1.1 in TS 28.532 [5]) to subscribe to receive notifications from the ECSP management system.

   3.2. ECSP management system sends a `notifyFileReady` notification to ASP to indicate the performance data file is ready.

   3.3. ASP fetches the EAS measurement data from the MnS producer.

   Otherwise (performance data streaming service)

   3.4. ECSP management system invokes the `establishStreamingConnection` operation to establish a streaming connection with ASP for sending the streaming data.

   3.5. ECSP management system collects the EAS measurement data and invokes the `reportStreamData` operation to send the streaming data to ASP.

7.2.3 5GC NF measurements to evaluate EAS performance

7.2.3.1 Measurement collection via performance job control

Figure 7.2.3.1-1 depicts a procedure that describes how an ECSP management system can consume performance assurance MnS to collect the 5GC NF measurements from PLMN management system via performance job control.

Figure 7.2.3.1-1: Measurements collection via performance job control

1. ECSP management system, as the consumer of performance assurance MnS, consumes the measurement job control MnS with `createMeasurementJob` operation (see TS 28.550 [8]) to request PLMN management system, as the producer of performance assurance MnS, to collect 5GC NF measurements that may impact EAS performance. The `createMeasurementJob` operation also includes a reportingMethod attribute to indicating the report method (i.e., performance data file or by performance data streaming).

2. PLMN management system returns the output parameter with jobId to indicate the PM job been created.

3. If this PM job is based on performance file reporting service, then

    3.1. ECSP management system invokes the `subscribe` operation (see clause 12.6.1.1.1 in TS 28.532 [5]) to subscribe to receive notifications from the PLMN management system.

    3.2. PLMN management system sends a `notifyFileReady` notification to ECSP management system to indicate the performance data file is ready.

    3.3. ECSP management system fetches the 5GC NF measurement data from the MnS producer.

  Otherwise (performance data streaming service)

    3.4. ECSP management system invokes the `establishStreamingConnection` operation to establish a streaming connection with ECSP management system for sending the streaming data.

    3.5 PLMN management system collects the measurement data and invokes the `reportStreamData` operation to send the 5GC NF streaming data to ECSP management system.

7.2.3.2 Measurement collection via configurable measurement control

Figure 7.2.3.2-1 depicts a procedure that describes how an ECSP management system can consume performance assurance MnS to collect the 5GC NF measurements from PLMN management system via configurable measurement control.
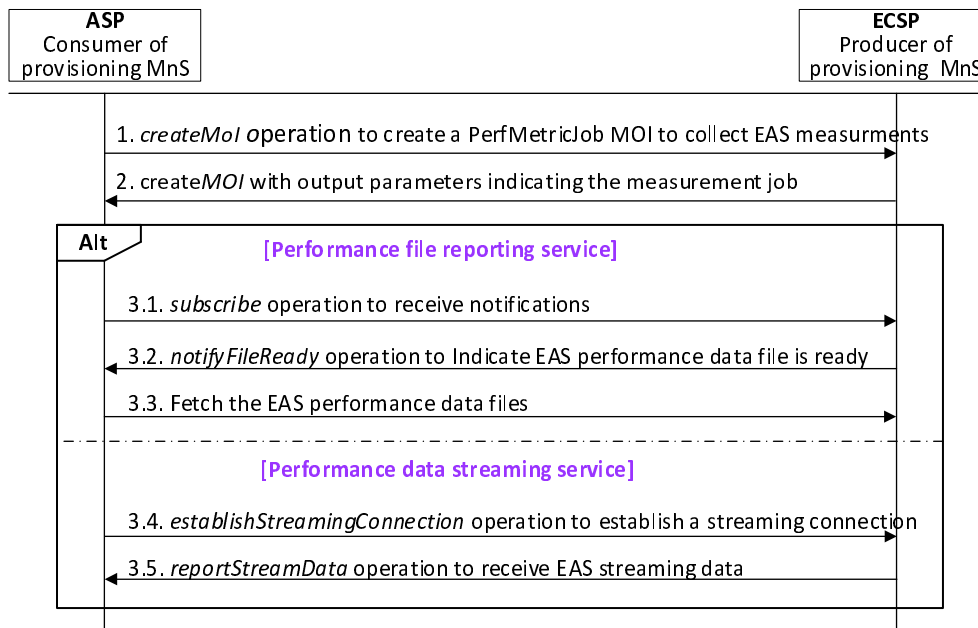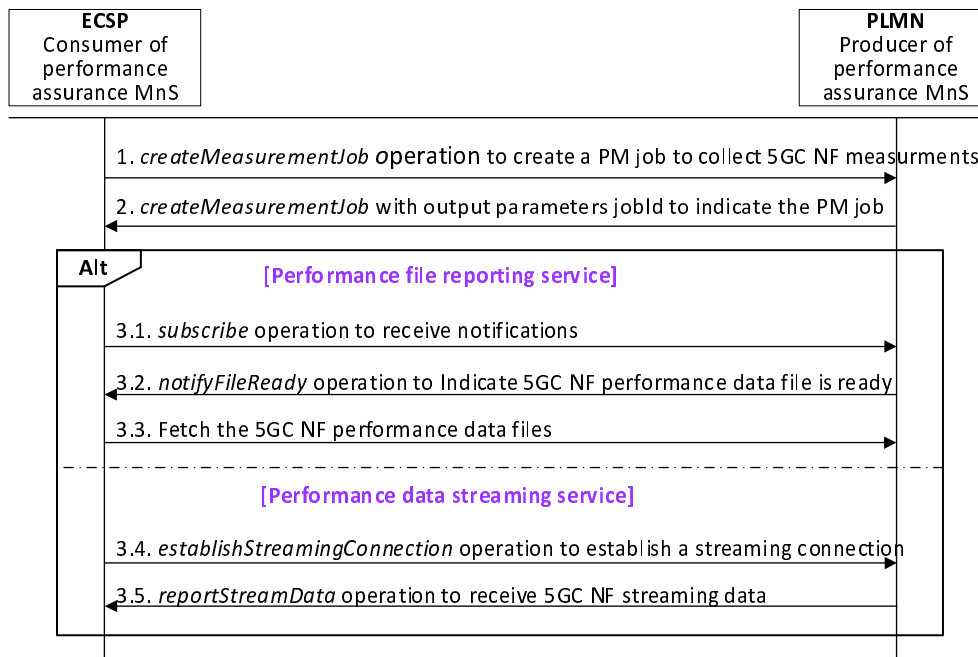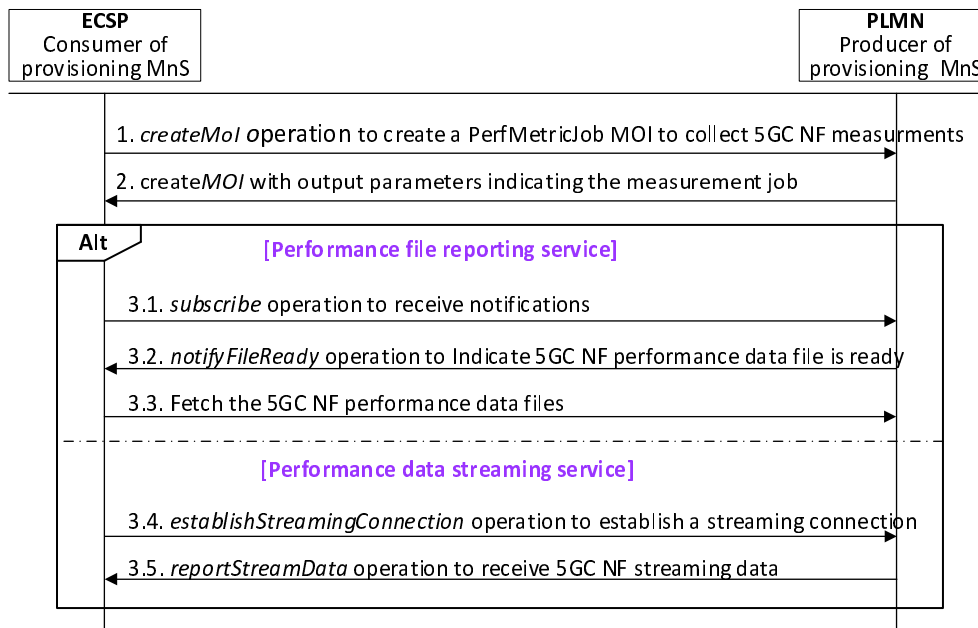
Figure 7.2.3.2-1: Measurement collection via configurable measurement control

1. ECSP management system, as the consumer of provisioning MnS, consumes the provisioning MnS with `createMOI` operation for `PerfMetricJob` IOC to request PLMN management system, as the producer of provisioning MnS, to collect 5GC NF measurements that may impact EAS performance. The `PerfMetricJob` MOI includes a ReportingCtrl attribute (See clause 4.3.33 in TS 28.622 [4]) to indicating the report method (i.e., performance data file or by performance data streaming).

2. PLMN management system returns the output parameter with jobId to indicate the PM job been created.

3. If this PM job is based on performance file reporting service, then

   3.1. ECSP management system invokes the `subscribe` operation (see clause 12.6.1.1.1 in TS 28.532 [5]) to subscribe to receive notifications from the PLMN management system.

   3.2. PLMN management system sends a `notifyFileReady` notification to ECSP management system to indicate the performance data file is ready.

   3.3. ECSP management system fetches the 5GC NF measurement data from the MnS producer.

   Otherwise (performance data streaming service)

   3.4. ECSP management system invokes the `establishStreamingConnection` operation to establish a streaming connection with ECSP management system for sending the streaming data.

   3.5. PLMN management system collects the measurement data and invokes the `reportStreamData` operation to send the 5GC NF streaming data to ECSP management system.

7.2.4 ECS performance assurance

7.2.4.1 Measurement collection via performance job control

The mechanism used for collecting EAS measurements, as defined in clause 7.2.2.1, via performance job control are used for collecting ECS measurements too. ECSP consumer can request ECSP management system for collecting ECS measurements using measurement job control MnS with createMeasurementJob operation (see TS 28.550 [8]). The measurements are delivered to the consumer either using File data reporting service or Streaming data reporting service as defined in [5].

7.2.4.2 Measurement collection via configurable measurement control

The mechanism used for collecting EAS measurements, as defined in clause 7.2.2.2, via configurable measurement control are used for collecting ECS measurements too. ECSP consumer can request ECSP management system for collecting ECS measurements using `createMOI` operation for `PerfMetricJob` IOC [4]. The measurements are delivered to the consumer either using File data reporting service or Streaming data reporting service as defined in [5].

7.2.5 EES performance assurance

7.2.5.1 Measurement collection via performance job control

The mechanism used for collecting EAS measurements, as defined in clause 7.2.2.1, via performance job control are used for collecting EES measurements too. Any management consumer can request for collecting EES measurements using measurement job control MnS with createMeasurementJob operation (see TS 28.550 [8]). The measurements are delivered to the consumer either using File data reporting service or Streaming data reporting service as defined in [5].

7.2.5.2 Measurement collection via configurable measurement control

The mechanism used for collecting EAS measurements, as defined in clause 7.2.2.2, via configurable measurement control are used for collecting EES measurements too. Any management consumer can request for collecting EES measurements using `createMOI` operation for `PerfMetricJob` IOC [4]. The measurements are delivered to the consumer either using File data reporting service or Streaming data reporting service as defined in [5].

7.3 Fault supervision

7.3.1 Description

The clause contains procedures associated with Fault supervision.

7.3.2 EDN NF performance impacted by 5GC NF alarm

Figure 7.3.2-1 depicts a procedure to describe how an ECSP management system can consume fault supervision MnS to receive 5GC NF alarms.
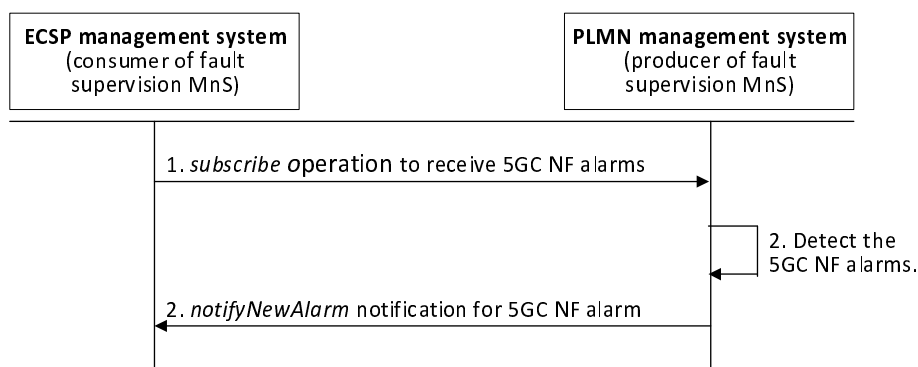
Figure 7.3.2-1: EDN NF performance impacted by 5GC NF alarm

1. ECSP, as the consumer of fault supervision MnS, consumes the generic fault supervision MnS with `subscribe` operation (see TS 28.532 [5]) to subscribe to receive 5GC NFs (i.e., UPF, PCF, NEF, SCEF) alarms.

2. PLMN management system detects the 5GC NF alarms.

3. PLMN management system detects sends `notifyNewAlarm` notification to indicate the 5GC NF alarms being detected.

7.3.3 5GC NF issues resulted from EDN NF alarms

Figure 7.3.3-1 depicts a procedure to describe how a PLMN management system can consume fault supervision MnS to receive EDN NF alarms.
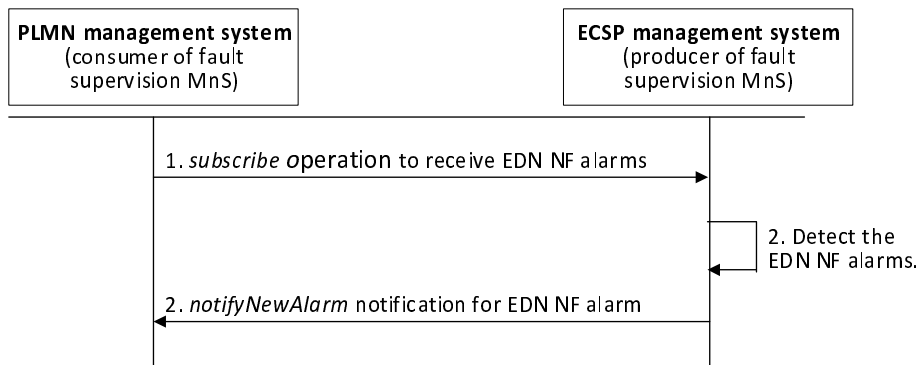
Figure 7.3.3-1: 5GC NF issues resulted from EDN NF alarms

1. ECSP, as the consumer of fault supervision MnS, consumes the generic fault supervision MnS with `subscribe` operation (see TS 28.532 [5]) to subscribe to receive EDN NFs (i.e., EAS, EES, ECS) alarms.

2. PLMN management system detects the EDN NF alarms.

3. PLMN management system detects sends `notifyNewAlarm` notification to indicate the EDN NF alarms being detected.

7.4 Provisioning

7.4.1 Description

The clause contains procedures associated with provisioning.

7.4.2 Configuration needed for EAS registration

Figure 7.4.2-1 depicts a procedure to describe how a consumer can consume provisioning MnS to request ECSP management system to configure the EASID and EES address that are required for EAS registration procedure (see clause 8.4.3.2.1 in TS 23.558 [2]). It is assumed that the EASFunction MOI has been created.
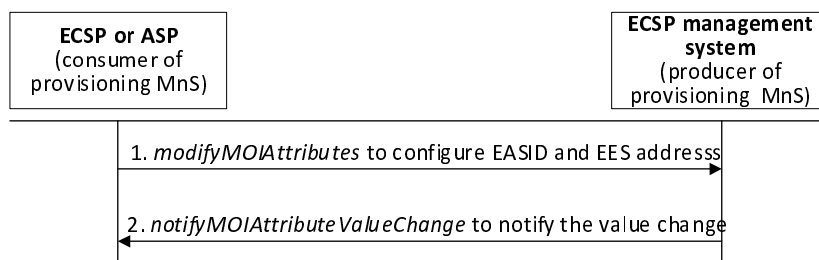
Figure 7.4.2-1: Configuration needed for EAS registration

1. A consumer (i.e., ASP or ECSP) consumes the provisioning MnS with `modifyMOIAttributes` operation (see TS 28.532 [5]) to configure the EASID (clause 7.2.4 in TS 23.558 [2]) and EES address (e.g. URI).

2. ECSP management system returns `notifyMOIAttributes` to notify the consumer that attributes have been changed.

7.4.3 EDN NF 5GC connection provisioning

Figure 7.4.3-1 depicts a procedure to describe how ECSP management system can consume provisioning MnS to request PLMN management system to query the connection information of EDN NFs (i.e., EAS, EES, ECS) to 5GC NFs, as specified in clauses 6.3.2, 6.3.4, 6.4.6 in TS 23.558 [2]. To support the connection of EDN NFs to 5GC NFs, EcmConnectionInfo IOC should contain the following attributes:

- EDN identifier: used to determine whether the EDN is trusted by PLMN operators.

- EAS, EES, and ECS IP address: indicate the EAS, EES, and ECS IP address.

- Service area requirements: including EDN service area, EES service area, and EAS service area (see clause 7.3.3 in TS 23.558 [2]) representing the service areas for ECS, EES, and EAS, respectively.

- ECM connection type: indicate the control plane connection.

- 5GC NF Connection information list: each entry in the list should contain the following attributes:

    - Accessing NF type: the NF (i.e., PCF, NEF, or SCEF) where the EDN NFs should interface to access the 5GC NFs.

    - IP address: the IP address of the accessing NF.

    - 5GC NF DN: the DN of the accessing NF that needs to be configured in EASFunction IOC, EESFunction IOC, and ECSFunction IOC to indicate where the EDN NFs are connected.

Figure 7.4.3-1: EDN NF to access 5GC NF

1. ECSP management system consumes the provisioning MnS with *createMOI* operation (see clause 11.1.1.1. in TS 28.532 [5]) for EcmConnectionInfo IOC to request PLMN management system to provide the connection information. EcmConnectionInfo IOC includes EDN identifier, and service area requirements (i.e., EDN service area, EES service area, and EAS service area).

2. PLMN management system determines whether the EAS and EES are trusted by PLMN operators, based on the EDN identifier `ednIdentifier`.

 If the EDN NFs are trusted by PLMN operators, then performs the following steps.

3. PLMN management system found the PCF(s) based on EES service area `eESServiceArea`, and EAS service area `requiredEASservingLocation`, and NEF(s) based on EDN service area `eDNServiceArea`, and then creates the EcmConnectionInfo MOI with connection information for PCF and NEF, including the IP address and DN.

4. PLMN management system returns the connection information in the `attributeListOut` of the output parameter in *createMOI* operation to ECSP management system.

5. Connects EDN NFs to 5GC NFs via PCF and NEF.

   5.1 ECSP management system executes the following actions to connect EAS / EES to PCF and ECS to NEF:

   - create EP_N5 MOI with EAS IP address in `localAddress`, and PCF IP address in `remoteAddress` to connect EAS to PCF.

   - create EP_N5 MOI with EES IP address in `localAddress`, and PCF IP address in `remoteAddress` to connect EES to PCF.

   - create EP_N33 MOI with ECS IP address in `localAddress`, and NEF IP address in `remoteAddress` to connect ECS to NEF.

   5.2 PLMN management system executes the following actions to add the EAS and EES connections to PCF and the ECS connection to NEF:

   - create EP_N5 MOI with PCF IP address in localAddress, and EAS IP address easAddress in remoteAddress.

   - create EP_N5 MOI with PCF IP address in localAddress, and EES IP address eecsAddress in remoteAddress.

   - create EP_N33 MOI with NEF IP address in localAddress, and ECS IP address ecsAddress in remoteAddress.

   NOTE: There is no sequence dependency between steps 5.1 and 5.2.

   5.3 ECSP management system performs the following configuration operations:

   - configure the `farEndEntity` in EP_N5 MOI with the PCF DN.

   - configure the `farEndEntity` in EP_N5 MOI with the PCF DN.

   - configure the `farEndEntity` in EP_N33 MOI with the NEF DN.

 If the EDN NFs are untrusted by PLMN operators, then performs the following steps:

6. PLMN management system found the NEF(s) based on EES service area, EAS service area, EDN service area, and then creates the EcmConnectionInfo MOI with connection information for NEF, including the IP address and DN.

7. PLMN management system returns the connection information in the attributeListOut of the output parameter in *createMOI* operation to ECSP management system.

8. Connects EDN NFs to 5GC NFs via NEF.

   8.1 ECSP management system executes the following actions to connect EAS, EES, and ECS to NEF:

- create EP_N33 MOI with EAS IP address in `localAddress`, and NEF IP address in `remoteAddress` to connect EAS to PCF.

- create EP_N33 MOI with EES IP address in `localAddress`, and NEF IP address in `remoteAddress` to connect EES to PCF.

- create EP_N33 MOI with ECS IP address in `localAddress`, and NEF IP address in `remoteAddress` to connect ECS to NEF.

8.2 PLMN management system executes the following actions to add the EAS, EES, and ECS connections to NEF:

- create EP_N33 MOI with NEF IP address in `localAddress`, and EAS IP address `easAddress` in `remoteAddress`.

- create EP_N33 MOI with NEF IP address in `localAddress`, and EES IP address `eesAddress` in `remoteAddress`.

- create EP_N33 MOI with NEF IP address in `localAddress`, and ECS IP address `ecsAddress` in `remoteAddress`.

8.3 ECSP management system performs the following configuration operations:

- configure the `farEndEntity` in EP_N33 MOI with the NEF DN.

- configure the `farEndEntity` in EP_N33 MOI with the NEF DN.

- configure the `farEndEntity` in EP_N33 with the NEF DN.

7.4.4   EAS to connect to UPF

Figure 7.4.4-1 depicts a procedure to describe how ECSP management system can consume provisioning MnS to request PLMN management system to connect EAS to UPF for transporting the user traffic via the N6 interface (see clause (see clause 4.2.3 in TS 23.501 [11]). To support the connection of EAS NF or the reserved resource for EAS to UPF NF, EcmConnectionInfo IOC should include the following attributes:

- EAS IP address: indicate the EAS IP address or the IP address of the reserved resource for EAS.

- EAS and EDN service area requirements: EAS service area (see clause 7.3.3 in TS 23.558 [2]).

- ECM connection type: indicate the user plane connection

-

- UPF Connection information: contains the following attributes:

  - UPF IP address: the IP address of the accessing UPF.
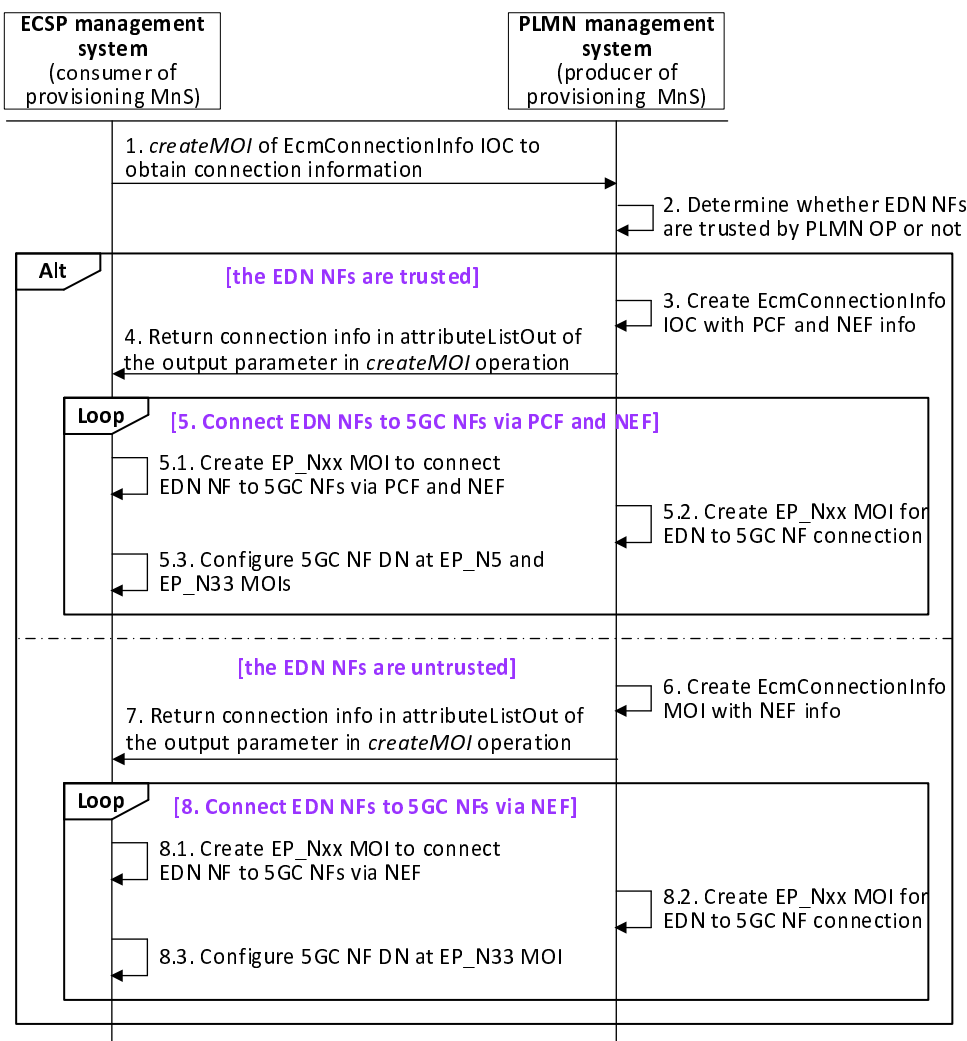
  - UPF DN: the UPF DN.
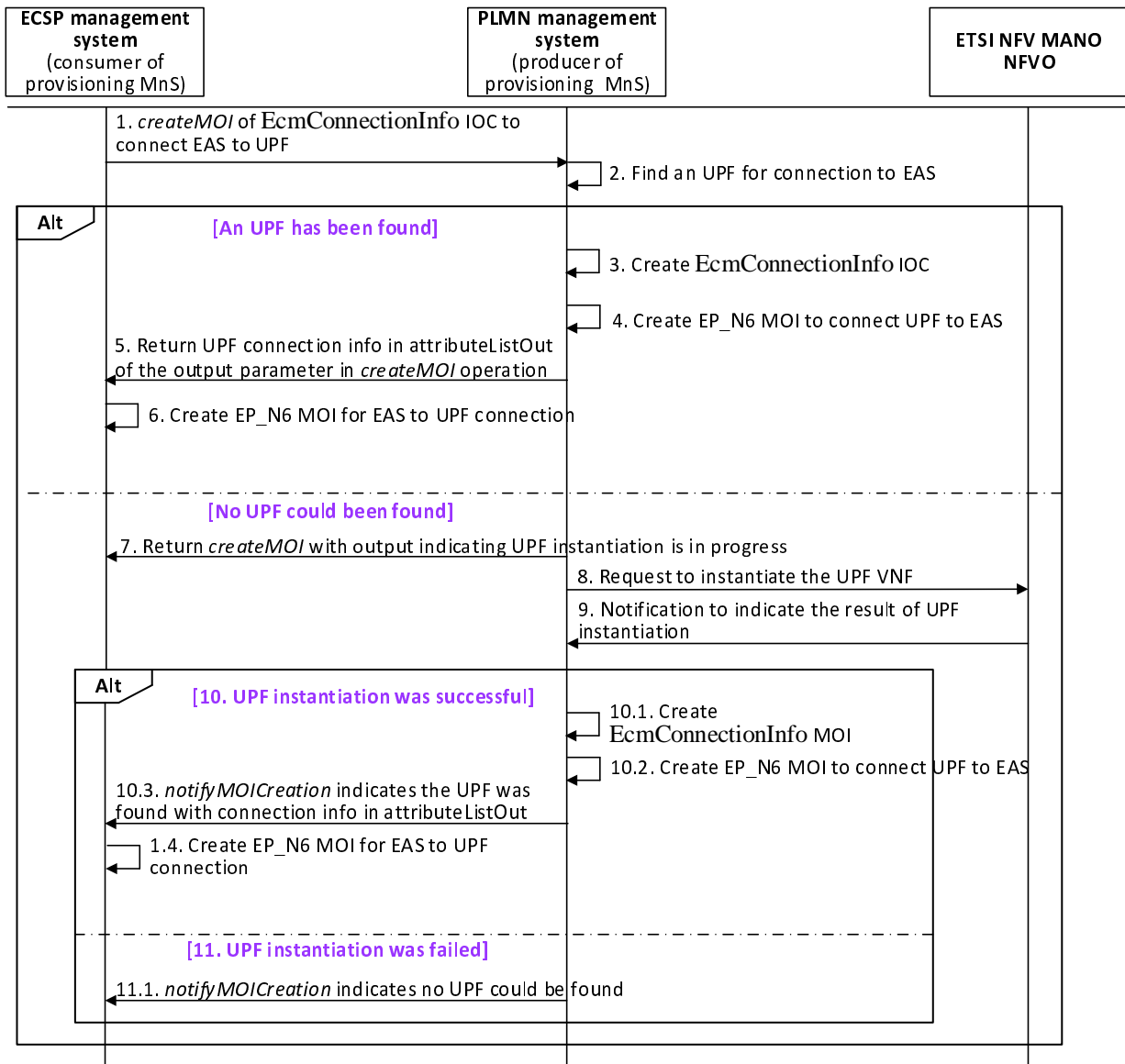
Figure 7.4.4-1: EAS to connect to UPF

1. ECSP management system consumes the provisioning MnS with *createMOI* operation (see clause 11.1.1.1. in TS 28.532 [5]) for EcmConnectionInfo IOC to request PLMN management system to connect the EAS or the reserved resource for EAS to an UPF. EcmConnectionInfo includes EAS IP address, or the IP address of the reserved resource for EAS, EAS service area , EDN service area and ecmConnectionType with value USERPLANE.

2. PLMN management system finds a UPF based on the EAS and EDN service areas.

 If an UPF can be found, then performs the following steps:

3. PLMN management system creates the EcmConnectionInfo MOI with uPFConnectionInfo, including UPF IP address and UPF DN.

4. PLMN management system create EP_N6 MOI with UPF IP address in `localAddress`, and EAS IP address or the IP address of the reserved resource for EAS in `remoteAddress` to connect UPF to EAS or the reserved resource for EAS.

5. PLMN management system returns the UPF connection information in the `attributeListOut` of the output parameter in *createMOI* operation to ECSP management system.

6. ECSP management system create EP_N6 MOI with EAS IP address in `localAddress` or the reserved resource for EAS, and UPF IP address in `remoteAddress`.

If an UPF cannot be found, then performs the following steps:

7. PLMN management system returns the output parameters for *createMOI* operation to indicate the UPF instantiation is in progress.

8. PLMN management system invokes the *InstantiateNsRequest* operation (see clause 7.3.3 in ETSI GS NFV-IFA 013 [6]) to request NFVO via the Os-Ma-nfvo interface to instantiate a NS instance including the UPF VNF instance.

9. NFVO sends a notification to PLMN management system indicating the result of instantiation procedure (see clause 7.3.3.4 of ETSI GS NFV-IFA 013 [6]).

10. If the UPF has been instantiated, then performs the following steps:

   10.1. PLMN management system creates the EcmConnectionInfo MOI with UPF connection information, including UPF IP address and UPF DN.

   10.2. PLMN management system create EP_N6 MOI with UPF IP address in `localAddress`, and EAS IP or the reserved resource for EAS address in `remoteAddress` to connect UPF to EAS.

   10.3 PLMN management system sends *notifyMOICreation* with UPF connection information in attributeList.

   10.4. ECSP management system create EP_N6 MOI with EAS IP address or the reserved resource for EAS in `localAddress`, and UPF IP address in `remoteAddress`.

11. If the UPF has not been instantiated, then performs the following step:

   11.1 PLMN management system sends *notifyMOICreation* to ECSP management system to indicate no UPF can be found.

7.5   Federation management

7.5.1   Description

The clause contains procedures associated with federation management.

7.5.2   Edge Federation Establishment

Figure 7.5.2.1-1 depicts a procedure that describes how a federation relationship is established between LO and and PO.
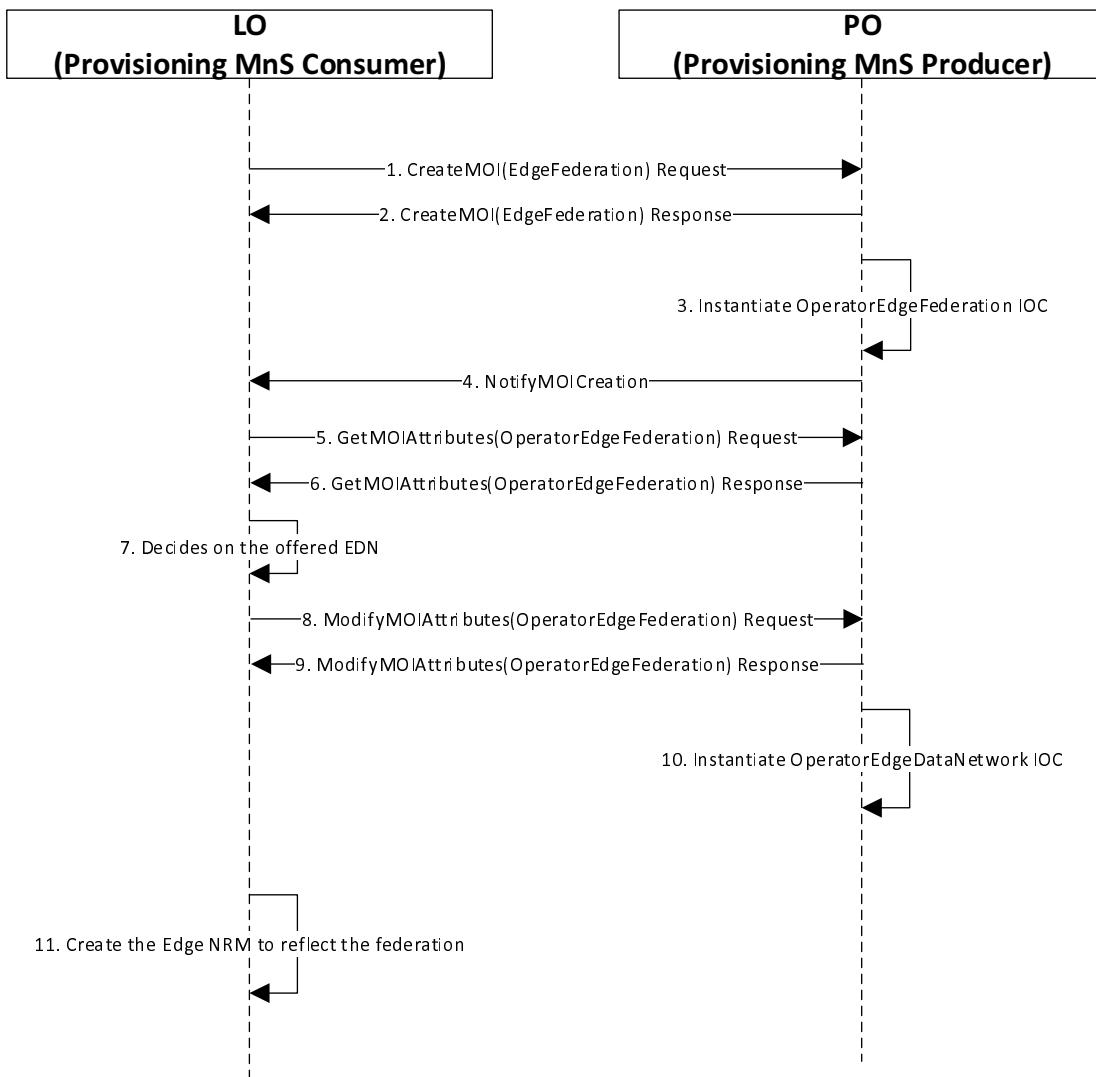
Figure 7.5.2.1-1: Federation Establishment

1. In order to establish the edge federation with the PO (Producer), LO (Consumer) send createMOI request to instantiate EdgeFederation IOC.

Editor's Note: Whether consumer may send a ModifyMOI operation is FFS.

2. Producer sends the response.

3. Producer instantiates the OperatorEdgeFederation IOC providing details on the offered EDN.

4. Producer sends a notification for the creation of the OperatorEdgeFederation IOC using notifyMOICreation as defined in 3GPP TS 28.532.

5. Consumer reads the OperatorEdgeFederation MOI using GetMOIAttributes operation to know the offered EDN and other related information.

6. Producer sends the response0

7. Based on the offered EDN list consumer decides on to which EDN it wants to accept.

8. Consumer updates the value of acceptedEDN attribute, indicating the accepted EDN, using ModifyMOIAttributes operation.

9. Producer sends the response. At this point the federation establishment is completed.

10. Based on the accepted EDN information, producer instantiates OperatorEdgeDataNetwork IOC to represent the accepted EDN which is shared with the LO.

11. The LO, behaving as Provisioning MnS Producer, instantiates the FederationIOC, OperatorFederation IOC and OperatorEdgeDataNetwork IOC.

7.5.3   Federated EAS Deployment

Figure 7.5.2.1-1 depicts a procedure that describes how a EAS is deployed on the partner operator.
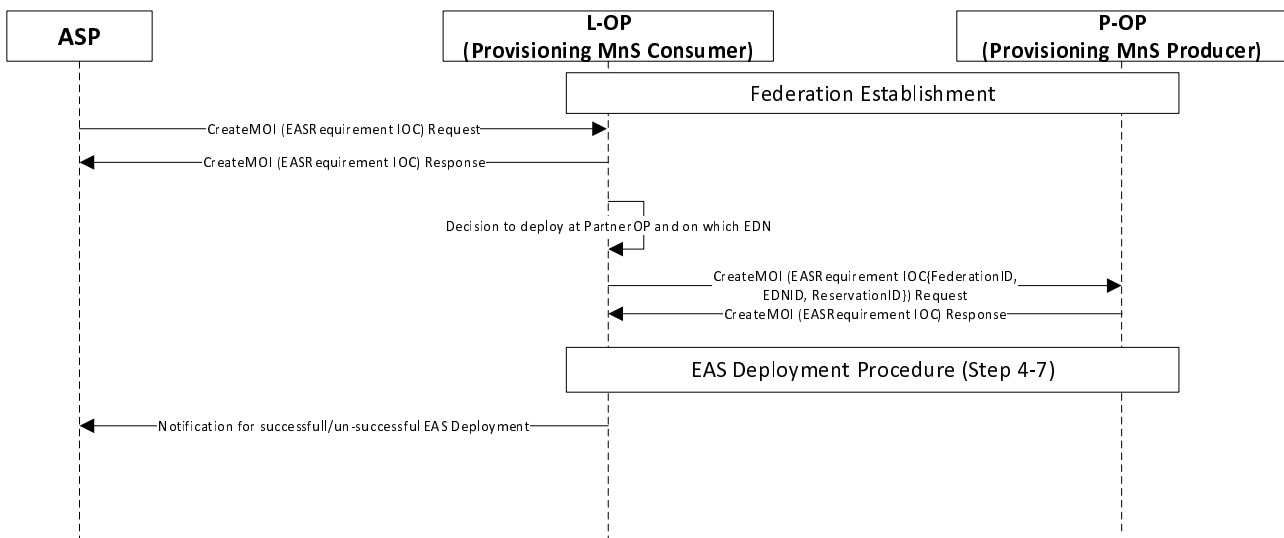
Figure 7.5.2.1-1: Federated EAS Deployment

1) Federation establishment procedures are done between LO and PO

2) ASP sends createMOI operation for EASRequirements IOC to LO as defined in clause 7.1.2.1.1.

3) The LO sends a response

4) After receiving the EAS deployment request form the ASP, the LO will check if it can deploy the EAS at one of its own EDN. If not, LO will select a PO and the EDN based on the received federation and EDN and reservation information.

5) The LO will send an existing createMOI operation for EASRequirements IOC.

6) The PO will send a response

7) EAS deployment procedure as defined in 3GPP TS 28.538 will be followed.

8) The notifications for a successful or un-successful EAS deployment will be send to ASP.

7.5.4 Federated ECS Management

Figure 7.5.2.1-1 depicts a procedure that describes how a EAS is deployed on the partner operator.
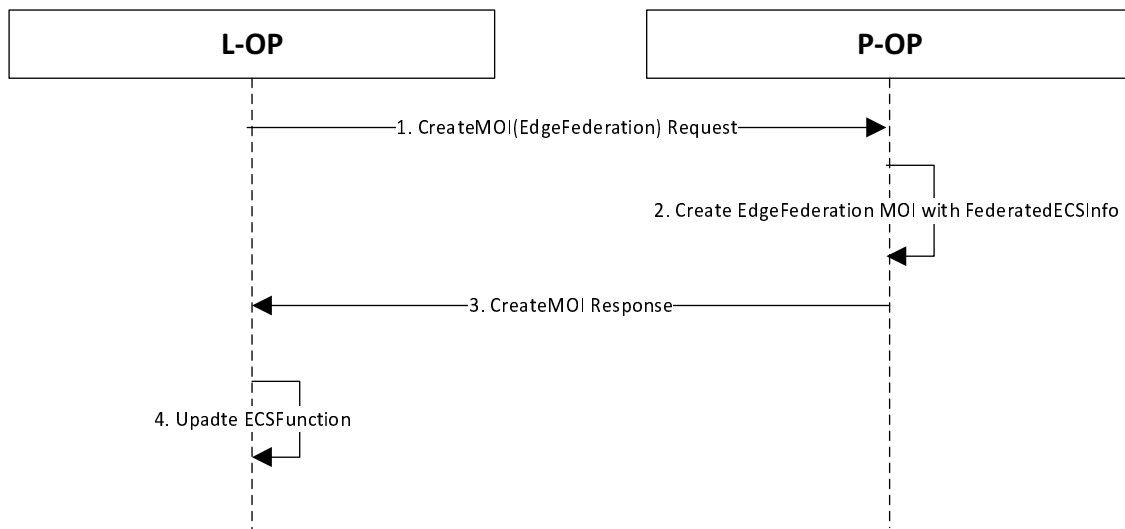
Figure 7.5.2.1-1: Federated ECS Management

1. L-OP sends a createMOI request to P-OP in order to establish the federation relationship.

2. P-OP creates the EdgeFederation MOI.

3. L-OP receives the response

4. L-OP updates its own ECS to contain the information related with the shared ECS provided with FederatedECSInfo attribute. On receiving Retrieve EES Request (see clause 8.8.3.3 of [2]), the appropriate partner ECS is determined based on the information configured in step 4 above.

8 Management Service for Edge Computing

8.1 Provisioning

8.1.1 Lifecycle management

The management services for Edge Computing lifecycle management are listed in table 8.1.1-1.

Table 8.1.1-1: Management services for Edge Computing lifecycle management

MnS Component Type A (operations and notifications)	MnS Component Type B (information model)	Note
Operations and Notifications defined in clause 11.1.1 of TS 28.532 [5]: - createMOI operation - deleteMOI operation - getMOIAttributes operation - modifyMOIAttributes operation - notifyMOICreation Notification - notifyMOIDeletion Notification	Edge Computing information model defined in clause 6.3.	This management service enables its consumer to request lifecycle management of EAS, EES and ECS.

8.2 Performance assurance

8.2.1 EAS performance assurance

8.2.1.1 MnS component type A

Table 8.2.1.1-1: EAS performance assurance type A

MnS Component Type A	Note
Operations and notifications defined in clause 11.1.1, 11.5 and 11.6 of TS 28.532 [5].	It is supported by using Provisioning MnS to manage PerfMetricJob IOC, as defined in TS 28.622 [4].
Operations defined in clause 11.5 and 11.6 in TS 28.532 [5] and clause 6.1 of TS 28.550 [8].	It is supported by using Measurement job control services for EAS, as defined in TS 28.550 [8].

8.2.1.2 MnS Component Type C definition

Performance measurements related EAS are captured in Table 8.2.1.2.-1:

Table 8.2.1.2-1. EAS related performance measurements

Performance measurements	Description	Related targets
Mean virtual CPU usage	Includes the mean usage of the underlying virtualized CPUs for a virtualized 3GPP NF (see clause 5.7.1.1.1 in TS 28.552 [10]).	
Mean virtual memory usage	Includes the mean usage of the underlying virtualized memories for a virtualized 3GPP NF (see clause 5.7.1.2.1 in TS 28.552 [10]).	
Mean virtual disk usage	Includes the mean usage of the underlying virtualized disks for a virtualized 3GPP NF (see clause 5.7.1.3.1 in TS 28.552 [10]).	
Data volume of incoming bytes to EAS	Includes the number of incoming bytes received by the EAS (see clause 5.7.2.1 in TS 28.552 [10]).	
Data volume of outgoing bytes to EAS	Includes the number of outgoing bytes received by the EAS (see clause 5.7.2.2 in TS 28.552 [10]).	

Performance measurements	Description	Related targets
Data volume of incoming packets to EAS	Includes the number of incoming packets received by the EAS (see clause 5.7.2.3 in TS 28.552 [10]).	
Data volume of outgoing packets to EAS	Includes the number of outgoing packets received by the EAS (see clause 5.7.2.4 in TS 28.552 [10]).	

8.2.2   ECS performance assurance

8.2.2.1   MnS component type A

Table 8.2.2.1-1: ECS performance assurance type A

MnS Component Type A	Note
Operations and notifications defined in clause 11.1.1, 11.5 and 11.6 of TS 28.532 [5].	It is supported by using Provisioning MnS to manage PerfMetricJob IOC, as defined in TS 28.622 [4].
Operations defined in clause 11.5 and 11.6 in TS 28.532 [3] and clause 6.1 of TS 28.550 [8].	It is supported by using Measurement job control services for ECS, as defined in TS 28.550 [8].

8.2.2.2   MnS Component Type C definition

Performance measurements related ECS are captured in Table 8.2.1.2.-1:

Table 8.2.2.2-1. ECS related performance measurements

Performance measurements	Description	Related targets
Mean virtual CPU usage	Includes the mean usage of the underlying virtualized CPUs for a virtualized 3GPP NF (see clause 5.7.1.1.1 in TS 28.552 [10]).	
Mean virtual memory usage	Includes the mean usage of the underlying virtualized memories for a virtualized 3GPP NF (see clause 5.7.1.2.1 in TS 28.552 [10]).	
Mean virtual disk usage	Includes the mean usage of the underlying virtualized disks for a virtualized 3GPP NF (see clause 5.7.1.3.1 in TS 28.552 [10]).	
EES Registration	Includes the total, mean and successful number of EES Registration request processed by ECS (see clause 5.14.1 in TS 28.552 [10]).	
Service Provisioning	Includes the total, mean and successful number of service provisioning request processed by ECS (see clause 5.17.1 in TS 28.552 [10]).	

8.2.3 EES performance assurance

8.2.3.1 MnS component type A

Table 8.2.3.1-1: EES performance assurance type A

MnS Component Type A	Note
Operations and notifications defined in clause 11.1.1, 11.5 and 11.6 of TS 28.532 [5].	It is supported by using Provisioning MnS to manage PerfMetricJob IOC, as defined in TS 28.622 [4].
Operations defined in clause 11.5 and 11.6 in TS 28.532 [3] and clause 6.1 of TS 28.550 [8].	It is supported by using Measurement job control services for EES, as defined in TS 28.550 [8].

8.2.3.2 MnS Component Type C definition

Performance measurements related EES are captured in Table 8.2.3.2.-1:

Table 8.2.3.2-1. EES related performance measurements

Performance measurements	Description	Related targets
Mean virtual CPU usage	Includes the mean usage of the underlying virtualized CPUs for a virtualized 3GPP NF (see clause 5.7.1.1.1 in TS 28.552 [10]).	
Mean virtual memory usage	Includes the mean usage of the underlying virtualized memories for a virtualized 3GPP NF (see clause 5.7.1.2.1 in TS 28.552 [10]).	
Mean virtual disk usage	Includes the mean usage of the underlying virtualized disks for a virtualized 3GPP NF (see clause 5.7.1.3.1 in TS 28.552 [10]).	
EAS Registration	Includes the total, mean and successful number of EAS Registration request processed by ECS (see clause 5.15.3 in TS 28.552 [10]).	
EAS Discovery	Includes the total, mean and successful number of EAS discovery request processed by ECS (see clause 5.15.1 in TS 28.552 [10]).	
EEC Registration	Includes the total, mean and successful number of EEC Registration request processed by ECS (see clause 5.15.2 in TS 28.552 [10]).	

Annex A (normative):
OpenAPI definition of edge NRM

A.1 General

This annex contains the OpenAPI definition of the Edge NRM in YAML format.

The Information Service (IS) of the Edge NRM is defined in clause 6.

Mapping rules to produce the OpenAPI definition based on the IS are defined in TS 32.160 [10].

A.2 Solution Set (SS) definitions

A.2.1 OpenAPI document `"TS28538_EdgeNrm.yaml"`

```
<CODE BEGINS>
openapi: 3.0.1
info:
  title: 3GPP Edge NRM
  version: 18.6.0
  description: >-
    OAS 3.0.1 specification of the Edge NRM
    © 2024, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
externalDocs:
  description: 3GPP TS 28.538; Edge NRM
  url: http://www.3gpp.org/ftp/Specs/archive/28_series/28.538/
paths: {}
components:
  schemas:

#-------- Definition of types-----------------------------------------------
    ServingLocation:
      type: object
      properties:
        geographicalLocation:
          $ref: '#/components/schemas/GeoLoc'
        topologicalLocation:
          $ref: '#/components/schemas/TopologicalServiceArea'
    TopologicalServiceArea:
      type: object
      properties:
        cellIdList:
          type: array
          items:
            type: integer
        trackingAreaIdList:
          $ref: 'TS28541_NrNrm.yaml#/components/schemas/TaiList'
        servingPLMN:
          $ref: 'TS28623_ComDefs.yaml#/components/schemas/PlmnId'
    GeoLoc:
      type: object
      properties:
        geographicalCoordinates:
          $ref: '#/components/schemas/GeographicalCoordinates'
        civicLocation:
          type: string
    GeographicalCoordinates:
      type: object
      properties:
        latitude:
          type: integer
        longitude:
          type: integer
    EDNConnectionInfo:
      type: object
      properties:
        dNN:
          type: string
```

```
        eDNServiceArea:
          $ref: '#/components/schemas/ServingLocation'
  AffinityAntiAffinity:
    type: object
    properties:
      affinityEAS:
        type: array
        items:
          type: string
      antiAffinityEAS:
        type: array
        items:
          type: string
  VirtualResource:
    type: object
    properties:
      virtualMemory:
        type: integer
      virtualDisk:
        type: integer
      virtualCPU:
        type: string
      vnfdId:
        type: string
  SoftwareImageInfo:
    type: object
    properties:
      minimumDisk:
        type: integer
      minimumRAM:
        type: integer
      discFormat:
        type: string
      operatingSystem:
        type: string
      swImageRef:
        type: string
  Duration:
    type: object
    properties:
      startTime:
        $ref: 'TS28623_ComDefs.yaml#/components/schemas/DateTime'
      endTime:
        $ref: 'TS28623_ComDefs.yaml#/components/schemas/DateTime'
  EASServicePermission:
    type: string
    description: any of enumerated value
    enum:
      - TRIAL
      - SILVER
      - GOLD
  EASFeature:
    type: string
  EASStatus:
    type: string
    description: any of enumerated value
    enum:
      - ENABLED
      - DISABLED
  ResourceReservationRequirement:
    type: object
    properties:
      computeRequirement:
        type: string
      storageRequirement:
        type: string
      networkingRequirement:
        type: integer

  ResourceReservationStatus:
    type: object
    properties:
      resourceId:
        type: string
      reservationStatus:
        type: string
        description: any of enumrated value
        enum:
```

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```
                - RESERVED
                - USEd
    RelocationTriggerInfo:
      type: object
      properties:
        triggerType:
          type: string
          description: any of enumrated value
          enum:
            - IMMEDIATE
            - FUTURE
        futuristicTriggerTime:
          $ref: 'TS28623_ComDefs.yaml#/components/schemas/DateTime'
    AvailableEDNList:
      type: object
      properties:
        resourceQuota:
          $ref: '#/components/schemas/VirtualResource'

#-------- Definition of types for name-containments ------
    SubNetwork-ncO-EdgeNrm:
      type: object
      properties:
        ECSFunction:
          $ref: '#/components/schemas/ECSFunction-Multiple'
        EdgeDataNetwork:
          $ref: '#/components/schemas/EdgeDataNetwork-Multiple'

#-------- Definition of concrete IOCs -------------------------------------------
    MnS:
      oneOf:
        - type: object
          properties:
            SubNetwork:
              type: array
              items:
                $ref: '#/components/schemas/SubNetwork-ncO-EdgeNrm'

    EdgeDataNetwork-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            ednIdentifier:
              type: string
            eDNConnectionInfo:
              $ref: '#/components/schemas/EDNConnectionInfo'
        - type: object
          properties:
            EASFunction:
              $ref: '#/components/schemas/EASFunction-Multiple'
            EESFunction:
              $ref: '#/components/schemas/EESFunction-Multiple'
            availableEdgeVirtualResources:
              type: string

    EASFunction-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            attributes:
              allOf:
                - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/ManagedFunction-Attr'
                - type: object
                  properties:
                    eASIdentifier:
                      type: string
                    eESAddress:
                      type: array
                      items:
                        type: string
                    eASRequirementsRef:
                      $ref: 'TS28623_ComDefs.yaml#/components/schemas/Dn'
                    eASAddress:
                      type: array
                      items:
                        type: string
```

```
                    relocationTriggerInfo:
                      $ref: '#/components/schemas/RelocationTriggerInfo'
                    relocationRejectByASP:
                        type: boolean
          - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/ManagedFunction-ncO'
    EASProfile-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            aCID:
              type: string
            eASProvider:
              type: string
            eASdescription:
              type: string
            eASSchedule:
              $ref: '#/components/schemas/Duration'
            eASGeographicalServiceArea:
              $ref: '#/components/schemas/GeoLoc'
            eASTopologicalServiceArea:
              $ref: '#/components/schemas/TopologicalServiceArea'
            eASServicePermissionLevel:
              $ref: '#/components/schemas/EASServicePermission'
            eASFeature:
              $ref: '#/components/schemas/EASFeature'
            eASServiceContinuitySupport:
              type: boolean
            eASDNAI:
              type: string
            eASAvailabilityReportingPeriod:
              type: integer
            eASStatus:
              $ref: '#/components/schemas/EASStatus'
    EESFunction-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            attributes:
              allOf:
                - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/ManagedFunction-Attr'
                - type: object
                  properties:
                    eESIdentifier:
                      type: string
                    eESServingLocation:
                      type: array
                      items:
                        $ref: '#/components/schemas/ServingLocation'
                    eESAddress:
                      type: array
                      items:
                        type: string
                    softwareImageInfo:
                      $ref: '#/components/schemas/SoftwareImageInfo'
                    serviceContinuitySupport:
                      type: boolean
                    eASFunctionRef:
                      $ref: 'TS28623_ComDefs.yaml#/components/schemas/DnList'
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/ManagedFunction-ncO'

    ECSFunction-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            attributes:
              allOf:
                - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/ManagedFunction-Attr'
                - type: object
                  properties:
                    eCSAddress:
                      type: string
                    providerIdentifier:
                      type: string
                    edgeDataNetworkRef:
                      $ref: 'TS28623_ComDefs.yaml#/components/schemas/DnList'
```

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```yaml
                      eESFuncitonRef:
                        $ref: 'TS28623_ComDefs.yaml#/components/schemas/DnList'
                      softwareImageInfo:
                        $ref: '#/components/schemas/SoftwareImageInfo'
          - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/ManagedFunction-ncO'

    EASRequirements-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            requiredEASservingLocation:
              $ref: '#/components/schemas/ServingLocation'
            affinityAntiAffinity:
              $ref: '#/components/schemas/AffinityAntiAffinity'
            serviceContinuity:
              type: boolean
            virtualResource:
              $ref: '#/components/schemas/VirtualResource'
            softwareImageInfo:
              $ref: '#/components/schemas/SoftwareImageInfo'
            eASSchedule:
              $ref: '#/components/schemas/Duration'
            eASFeature:
              $ref: '#/components/schemas/EASFeature'
            relocationPolicy:
              type: string
              description: any of enumrated value
              enum:
                - YES
                - NO
                - YESwNOTIFY
            federationID:
              type: string
            eASDeploymentMonitor:
              $ref: 'TS28623_GenericNrm.yaml#/components/schemas/ProcessMonitor'
            reservationJobRef:
              $ref: 'TS28623_ComDefs.yaml#/components/schemas/Dn'
    EASResourceReservationJob-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            reservationLocation:
              $ref: '#/components/schemas/ServingLocation'
            resourceReservationRequirement:
              type: array
              items:
                $ref: '#/components/schemas/ResourceReservationRequirement'
            requestedReservationExpiration:
              $ref: 'TS28623_ComDefs.yaml#/components/schemas/DateTime'
            resourceReservationStatus:
              type: array
              items:
                $ref: '#/components/schemas/ResourceReservationStatus'
    EdgeFederation-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            participatingOPiD:
              type: string
            originatingOPiD:
              type: string
    OperatorEdgeFederation-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            federationID:
              type: string
            FederationExpiry:
              $ref: 'TS28623_ComDefs.yaml#/components/schemas/DateTime'
            originatedOPiD:
              type: string
            avaibleEDNList:
              $ref: '#/components/schemas/AvailableEDNList'
            acceptedEDN:
```

```
                $ref: 'TS28623_ComDefs.yaml#/components/schemas/DnList'
    OperatorEdgeDataNetwork-Single:
      allOf:
        - $ref: 'TS28623_GenericNrm.yaml#/components/schemas/Top'
        - type: object
          properties:
            availableEASResource:
                $ref: 'TS28623_ComDefs.yaml#/components/schemas/DnList'
            edgeDataNetworkRef:
                $ref: 'TS28623_ComDefs.yaml#/components/schemas/DnList'


#-------- Definition of JSON arrays for name-contained IOCs ---------------------

    EASFunction-Multiple:
      type: array
      items:
        $ref: '#/components/schemas/EASFunction-Single'
    ECSFunction-Multiple:
      type: array
      items:
        $ref: '#/components/schemas/ECSFunction-Single'
    EESFunction-Multiple:
      type: array
      items:
        $ref: '#/components/schemas/EESFunction-Single'
    EdgeDataNetwork-Multiple:
      type: array
      items:
        $ref: '#/components/schemas/EdgeDataNetwork-Single'
    EASProfile-Multiple:
      type: array
      items:
        $ref: '#/components/schemas/EASProfile-Single'
    EdgeFederation-Multiple:
      type: array
      items:
        $ref: '#/components/schemas/EASProfile-Single'
    OperatorEdgeFederation-Multiple:
      type: array
      items:
        $ref: '#/components/schemas/OperatorEdgeFederation-Single'
    OperatorEdgeDataNetwork-Multiple:
      type: array
      items:
        $ref: '#/components/schemas/OperatorEdgeDataNetwork-Single'


#------------------------------- Definition -----------------------------------

    resources-edgeNrm:
      oneOf:
        - $ref: '#/components/schemas/MnS'
        - $ref: '#/components/schemas/EASFunction-Single'
        - $ref: '#/components/schemas/ECSFunction-Single'
        - $ref: '#/components/schemas/EESFunction-Single'
        - $ref: '#/components/schemas/EdgeDataNetwork-Single'
        - $ref: '#/components/schemas/EASRequirements-Single'
        - $ref: '#/components/schemas/EASProfile-Single'
        - $ref: '#/components/schemas/EdgeFederation-Single'
        - $ref: '#/components/schemas/OperatorEdgeFederation-Single'
        - $ref: '#/components/schemas/OperatorEdgeDataNetwork-Single'
        - $ref: '#/components/schemas/EASResourceReservationJob-Single'
<CODE ENDS>
```

Annex B (normative):
Availability Zone

B.1 General

An Availability Zone [14] is the lowest level of abstraction exposed to a developer who wants to deploy an application on the edge network. It is defined in terms of a geographical area. A Cloudlet [14] is a point of presence for the edge cloud. It is the point where edge applications are deployed. The ECSP do not expose physical location of the cloudlets to the application service providers. The application service provider is not allowed to request deployment of its application on a specific edge cloud. There can be multiple Cloudlet in an Availability Zone. The application service provider can query for the QoS (latency, jitter etc.) available in a particular Availability Zone. The OP requires application service provider to specify target Availability Zone, when requesting for an Application deployment. The virtual resources can be reserved in a particular Availability Zone on request from the application service provider.

B.2 Example of Availability Zone implementation

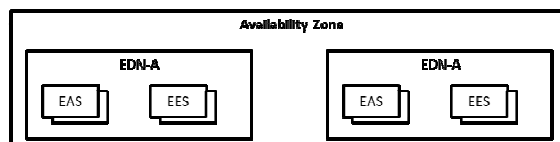The following figure shows the relation between AZ and EDN.

Figure B.2-1 Example of Availability Zone

Annex C (Informative):
GSMA OP introduction and concept mapping

The Operator Platform (OP) is defined by GSMA OPG [2], it facilitates access to the Edge Cloud capability of an Operator or federation of operators and their partners.

The architecture scope under definition is shown below,
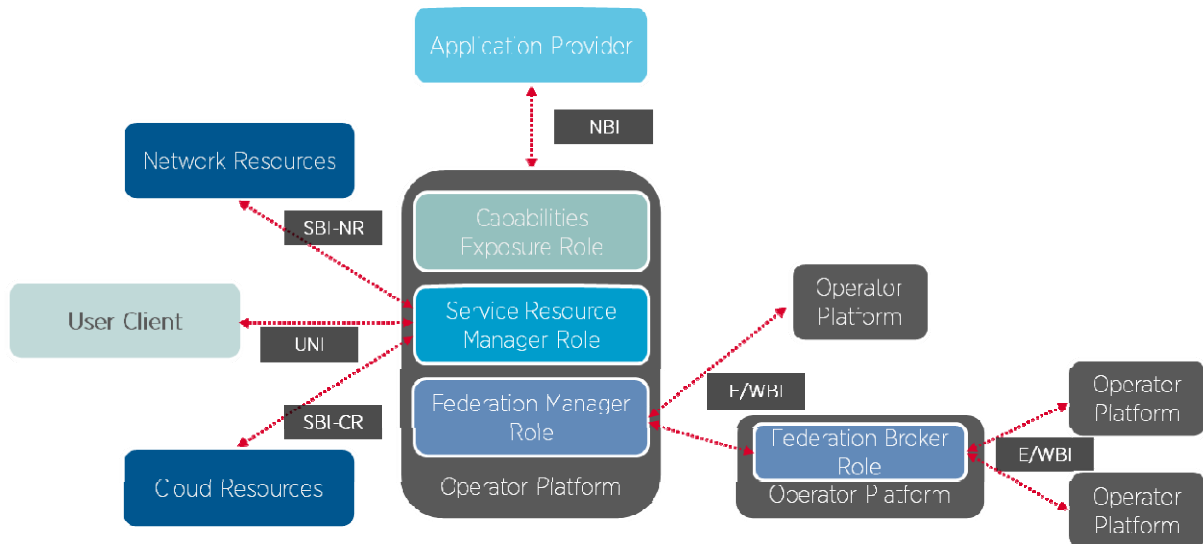
Figure C-1: OP Roles and Interfaces Reference Architecture

The NBI is the interface between the application provider and the Capabilities Exposure Role in the Operator Platform, it allows an OP to advertise the above cloud capabilities that it can provide to application providers. In addition, the NBI allows an application provider to reserve a set of resources or request an Edge Cloud service with the resources and features that they require and for the OP to accept or reject the request.

The following table provides the mapping of concepts (not exhaustive) defined in TS 28.538[6] with the concepts defined in GSMA OPG [14].

Table C-1: Mapping of concepts of TS 28.538 [6] with GSMA [14]

GSMA[14]	ECM(TS 28.538)	Comment/Observations
Application Instance Edge Application	EAS VNF Instance EAS	Application Instance and EAS VNF Instance are both referring to the application instances running in the edge. Edge Application and EAS are both referring to the application running in the edge.
Application Provider	Application Service Provider	Application Provider and Application Service Provider both referring to the application providers producing and requesting for the deployment of the applications.
Availability Zone	Edge Data Network	An Availability Zone is the lowest level of abstraction exposed to a developer who wants to deploy an Application on the edge network. It is mapped with one or multiple Edge Data Network.
Capabilities Exposure Role in OP	ECSP Management System	Both Capabilities Exposure Role in Operator Platform and the ECSP Management System are the entities which exposes interface and management service towards ASP.
Northbound Interface	Management services for Edge Computing lifecycle management	NBI maps to management service, enabling LCM for EAS, exposed towards ASP.

Annex D (informative):
Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2022-03	SA#95					Upgrade to change control version	17.0.0
2022-06	SA#96	SP-220564	0001	-	F	Fixing OpenAPI Discoverability issue in EdgeNrm.yaml stage 3	17.1.0
2022-06	SA#96	SP-220506	0002	-	C	Add the concept for edge computing management	17.1.0
2022-06	SA#96	SP-220506	0003	-	F	Add the missing procedure not implemented from approved pCR	17.1.0
2022-06	SA#96	SP-220506	0004	-	F	Add the terminologies for PLMN and ECSP management systems	17.1.0
2022-06	SA#96	SP-220564	0006	1	F	OpenAPI file name and dependence change for edgeNrm.yaml	17.1.0
2022-06	SA#96	SP-220506	0010	-	F	Notifications	17.1.0
2022-06	SA#96	SP-220506	0011	-	F	Notifications	17.1.0
2022-06	SA#96	SP-220506	0012	-	F	Update description of ECM LCM	17.1.0
2022-06	SA#96	SP-220506	0013	-	F	Update ECM NRM stage 2	17.1.0
2022-06	SA#96	SP-220506	0014	-	F	Update ECM NRM stage 3	17.1.0
2022-06	SA#96	SP-220506	0015	-	F	Correct EAS lifecycle management procedure	17.1.0
2022-09	SA#97e	SP-220846	0016	-	B	Rel-18 draftCR to CR conversion for eECM	18.0.0
2022-09	SA#97e	SP-220846	0018	1	B	ECSFunction IOC update	18.0.0
2022-09	SA#97e	SP-220846	0019	1	B	Add a use case for EAS discovery failure measurement	18.0.0
2022-09	SA#97e	SP-220846	0020	1	B	Add a procedure of EAS instantiation triggered by measurement data	18.0.0
2022-09	SA#97e					Alignment with code in FORGE	18.0.1
2022-12	SA#98e	SP-221172	0021	1	F	Add editorial changes	18.1.0
2023-03	SA#99	SP-230196	0029	-	A	Update stage 3 PlmnId reference	18.2.0
2023-03	SA#99	SP-230205	0030	1	B	Rel-18 CR 28.538 eECM	18.2.0
2023-06	SA#100	SP-230656	0033	-	F	Correct the wrong and missing clauses of reference	18.3.0
2023-06	SA#100	SP-230660	0036	1	A	Correct EAS to connect to UPF procedure	18.3.0
2023-06	SA#100	SP-230660	0037	-	A	Correction of ECM NRM	18.3.0
2023-06	SA#100	SP-230651	0038	-	F	Several editorial Corrections	18.3.0
2023-09	SA#101	SP-230949	0040	-	A	Correction of EAS to connect with UPF UC	18.4.0
2023-09	SA#101	SP-230950	0041	1	B	Rel-18 CR 28.538 EAS Relocation Requirements	18.4.0
2023-09	SA#101	SP-230950	0042	1	B	CR 28.538 Federated EAS Lifecycle Management Requirements	18.4.0
2023-09	SA#101	SP-230950	0044	1	B	Rel-18 CR 28.538 Federation Management Requirements	18.4.0
2023-12	SA#102	SP-231466	0047	1	F	Correct the errors in the requirement label in section 5.1.14	18.5.0
2023-12	SA#102	SP-231464	0050	1	A	Correction on performance assurance	18.5.0
2023-12	SA#102	SP-231464	0053	-	A	Correction of 5GC NF measurements to evaluate EAS performance	18.5.0
2023-12	SA#102	SP-231466	0055	-	B	DraftCR to CR	18.5.0
2024-03	SA#103	SP-240186	0056		F	TS28.538 Rel18 correction to Schema definition Issues for SubNetwork of OpenAPI SS	18.6.0
2024-03	SA#103	SP-240161	0058	1	F	Rel-18 CR TS 28.538 Correct the IOC name and properties of "isOrdered" and "isUnique" in 6.4.1	18.6.0
2024-03	SA#103	SP-240161	0060	1	F	Rel-18 CR TS 28.538 Correct the error in the relocationPolicy field of the YAML file.	18.6.0
2024-03	SA#103	SP-240161	0061	1	B	Rel-18 CR 28.538 ECS Federation	18.6.0
2024-03	SA#103	SP-240161	0062	1	B	Rel-18 CR 28.538 GSMA Mapping Update	18.6.0
2024-03	SA#103	SP-240161	0063	1	C	Rel-18 CR 28.538 Minor Updates	18.6.0
2024-03	SA#103	SP-240161	0064	1	C	Rel-18 CR 28.538 EAS Deployment Modifications	18.6.0
2024-03	SA#103	SP-240161	0065	1	D	Rel-18 CR 28.538 Rapp Clean-up	18.6.0
2024-03	SA#103	SP-240161	0066	1	F	Rel-18 CR 28.538 Update EAS resource reservation procedure	18.6.0
2024-03	SA#103	SP-240161	0067	1	F	Rel-18 CR 28.538 Update availableVirtualResource	18.6.0
2024-03	SA#103	SP-240161	0068	1	F	Rel-18 CR 28.538 Update EAS deployment procedure using eASDeploymentMonitor	18.6.0

History

Document history		
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