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# Foreword

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

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

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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] Void.

[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".

[19] 3GPP TS 28.623: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".

[20] 3GPP TS 29.558: "Enabling Edge Applications; Application Programming Interface (API) specification".

[21] 3GPP TS 28.111: "Management and orchestration; Fault management (FM)".

# 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

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

GSMA GSM Association

LO Leading 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 |
| **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 ECSP Management System may decide that a different EDN can better host the EAS. The EAS relocation trigger from ECSP 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 ECSP Management System considers this 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 ECSP 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 ECSP 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 that is 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 Participating 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. Participating 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. Participating 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 Participating operator. See clause 8.18.2.3.2 [2]. This will require configuring leading operator ECS with federated ECS information belonging to Participating operator. The information may include ECS address (clause 8.2.12[2]), related EES and EAS etc.

The Participating 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 LO) 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 LO may want to reserve resources ahead of the EAS deployment and unrelated to any specific application, only related to the ASP or LO themselves. After resource reservation, an ASP or LO 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 LO 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 LO) 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 LO) 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 |
| TS 28.622 [4], choice, Host | Host |

## 6.2 Class diagram

### 6.2.1 Relationships

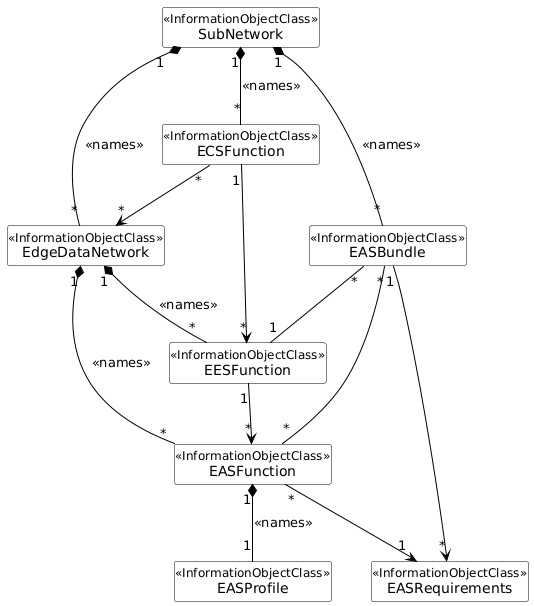


Figure 6.2.1-1: Edge NRM relationship diagram

Figure 6.2.1-2: Void

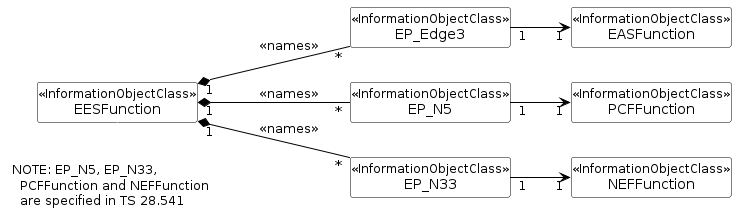


Figure 6.2.1-3: Transport view of EES NRM

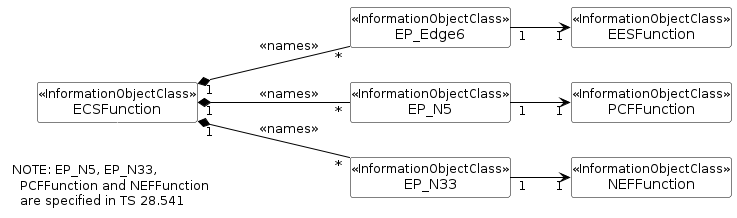


Figure 6.2.1-4: Transport view of ECS NRM

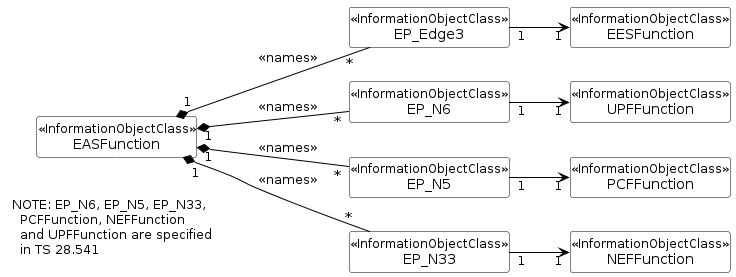


Figure 6.2.1-5: Transport view of EAS NRM

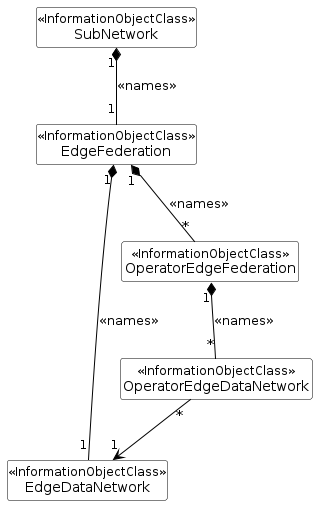


Figure 6.2.1-6: Edge Federation NRM

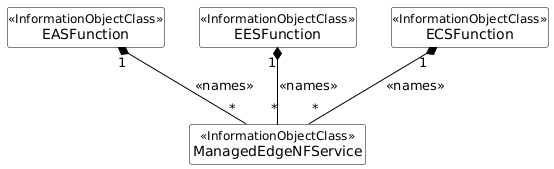


Figure 6.2.1-7: NRM fragment for ManagedFunction (representing Edge NF) and ManagedEdgeNFService

NOTE 1: The ManagedEdgeNFService shall only be name-contained in one Edge NF.

### 6.2.2 Inheritance

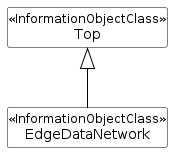


Figure 6.2.2-1: Edge Inheritance Relationship

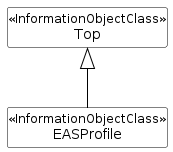


Figure 6.2.2-2: EASProfile Inheritance

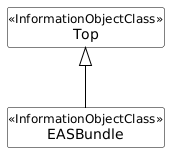


Figure 6.2.2-3 EASBundle Inheritance



Figure 6.2.2-4 Inheritance hierarchy for ManagedEdgeNFService

## 6.3 Class definitions

### 6.3.1 EASFunction

#### 6.3.1.1 Definition

This IOC represents 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 |
| eASBundleInfo | CM | T | T | F | T |
| **Attribute related to role** |  |  |  |  |  |
| eASRequirementsRef | M | T | T | F | T |
| eASBundleInfo | CM | T | T | F | T |

#### 6.3.1.3 Attribute constraints

|  |  |
| --- | --- |
| Name | Definition |
| eASBundleInfo | Condition: Only when the EAS Bundle functionality is supported. |
| eASBundleRef | Condition: Only when the EAS Bundle functionality is supported. |

#### 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 IOC represents 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 | Condition: If the serving location is defined as Geographical Service Area [2]. |
| topologicalLocation | 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 | Condition: If the serving location is defined as geographical coordinates [2]. |
| civicLocations | 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 | Condition: If the serving location is defined as cell IDs [2]. |
| trackingAreaIdList | Condition: If the serving location is defined as tracking area IDs [2]. |
| servingPLMN | 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 represents 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 |
| eASBundleRef | CM | T | T | F | T |

#### 6.3.13.3 Attribute constraints

|  |  |
| --- | --- |
| Name | Definition |
| eASBundleRef | Condition: Only when the EAS Bundle functionality is supported. |

#### 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 represents 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 Void

#### 6.3.16.1 Void

#### 6.3.16.2 Void

#### 6.3.16.3 Void

#### 6.3.16.4 Void

### 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 deployement 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 | 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 represents the set of federation relationships 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 |
| leadingOPiD | CM | T | T | F | T |
| federatedECSInfo | M | T | T | F | T |

#### 6.3.21.3 Attribute constraints

|  |  |
| --- | --- |
| Name | Definition |
| participatingOPiD | Condition: Will only be present when the IOC is being used by LO. |
| LeadingOPiD | 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 |
| leadingOPiD | 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 LO.

#### 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.

### 6.3.26 EASBundle

#### 6.3.26.1 Definition

This IOC represent an EAS Bundle [2].

ASP decides to use EAS bundle functionality due to internal policies. ASP would first like to know the available EAS bundles. ASP sends getMOIAttributes request to ECMS (ECSP Management System) in order to read the available EASBundle MOI. Based on the available EAS bundle, ASP may either decide to use an existing bundle or create a new one.

The ASP may decide to use an existing bundle. It send modifyMOIAttributes for EASBundle IOC in order to update the existing bundle. This update may include updating any of the attribute of EASBundle IOC.

#### 6.3.26.2 Attributes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Attribute name** | **S** | **isReadable** | **isWritable** | **isInvariant** | **isNotifyable** |
| bundleIdentifier | M | T | F | F | T |
| bundledEASIdentifier | O | T | T | F | T |
| bundleType | M | T | T | F | T |
| mainEASIdentifier | O | T | T | F | T |
| coordinatedEASDiscovery | O | T | T | F | T |
| coordinatedACR | O | T | T | F | T |
| eDNAffinity | O | T | T | F | T |
| **Attribute related to role** |  |  |  |  |  |
| eASFunctionRef | O | T | F | F | T |
| eESFunctionRef | O | T | F | F | T |
| eASRequirementsRef | O | T | T | F | T |

#### 6.3.26.3 Attribute constraints

None.

#### 6.3.26.4 Notifications

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

### 6.3.27 EASBundleInfo <<dataType>>

#### 6.3.27.1 Definition

This datatype represent the consumer opinion on whether the EAS can be part of a bundle. ASP decides to use EAS bundle functionality due to internal policies. Post EAS deployment, ASP decideds whether the EAS should be part of any or some of the bundle. ASP may decide that a particular EAS shall never be part of any of the bundle or it can be part of some of the available bundle only. According it send modifyMOIAttribute request for EASFunction MOI to update the value of the attribute present in this <<datatype>>.

#### 6.3.27.2 Attributes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Attribute name** | **S** | **isReadable** | **isWritable** | **isInvariant** | **isNotifyable** |
| isBundlingAllowed | O | T | T | F | T |
| **Attribute related to role** |  |  |  |  |  |
| allowedBundleRef | O | T | T | F | T |
|  |  |  |  |  |  |

#### 6.3.27.3 Attribute constraints

None.

#### 6.3.27.4 Notifications

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

### 6.3.28 ManagedEdgeNFService

#### 6.3.28.1 Definition

A ManagedEdgeNFService represents a Service offered by EAS, EES or ECS as defined in TS 29.558 [20]. This IOC is inherited from TOP IOC.

6.3.28.2 Attributes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Attribute name | S | isReadable | isWritable | isInvariant | isNotifyable |
| administrativeState | M | T | T | F | T |
| operationalState | M | T | F | F | T |
| userLabel | O | T | T | F | T |
| sAP | M | T | T | F | T |
| operations | M | T | T | F | T |

#### 6.3.28.3 Attribute constraints

None

#### 6.3.28.4 Notifications

The subclause 5.5 of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

### 6.3.29 Operation <<dataType>>

#### 6.3.29.1 Definition

This data type represents a service operation (See TS 29.558 [20]).

#### 6.3.29.2 Attributes

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

#### 6.3.29.3 Attribute constraints

None

#### 6.3.29.4 Notifications

The subclause 5.5 of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

### 6.3.30 SAP <<dataType>>

#### 6.3.30.1 Definition

This data type represents the access point of a managed Edge NF service which is comprised of a host and a port.

#### 6.3.30.2 Attributes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Attribute Name** | **S** | **isReadable** | **isWritable** | **isInvariant** | **isNotifyable** |
| host | M | T | T | F | T |
| port | M | T | T | F | T |

#### 6.3.30.3 Attribute constraints

None

#### 6.3.30.4 Notifications

The subclause 5.5 of the <<IOC>> using this <<dataType>> as one of its attributes, shall be applicable.

## 6.4 Attribute definitions

### 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 EAS Endpoint defined in clause 8.2.4 in 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 (see clause see clause 8.4.3 and 8.4.4 in TS 23.558 [2]).  allowedValues: N/A | type: RegistrationInfo  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 |
| 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 |
| 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 ECS address defined in clause 8.2.12 in 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 |
| 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 EES Endpoint defined in clause 8.2.6 in 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 EESID defined in clause 8.2.6 in 3GPP TS 23.558 [2]. | 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 |
| 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 |
| 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 EAS Provider ID defined in clause 8.6.5.3.2 in 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 EAS description defined in clause 8.2.4 in 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 EAS Schedule defined in clause 8.2.4 in TS 23.558 [2]).  The detailed definition for TimeWindow can be found in TS 28.622 [4].  allowedValues: N/A | type: TimeWindow  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| eASGeographicalServiceArea | The geographical service area that the EAS serves. ACs in UEs that are located outside that area shall not be served (See EAS Geographical Service Area defined in clause 8.2.4 in 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 EAS Topological Service Area defined in clause 8.2.4 in 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 EAS service permission level defined in clasue 8.2.4 in TS 23.558 [2]).  Allowed Values: TRIAL, SILVER, GOLD | type: ENUM  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 EAS Feature(s) defined in clause 8.2.4 in 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 EAS Service continuity support defined in clause 8.2.4 in TS 23.558 [2]). | 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 EAS Availability Reporting Period defined in clause 8.2.4 in 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, overload warning, etc.) (See EAS Status defined in clause 8.2.4 in TS 23.558 [2]).  Allowed values: ENABLED, DISABLED, OVERLOAD\_WARNING | 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 |
| 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 7.1.9.4.2 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 requirememts 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 attribute 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: None  isNullable: False |
| 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: None 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” | 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 ETSI 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 7.1.2.2 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 |
| leadingOPiD | This identifies the LO.  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 |
| initiationTime | Date and time of the federation initiated by the Leading operator.  allowedValues: N/A | type: DateTime  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: 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 |
| availableEDNList | This defines information related with offered EDN available with PO.  allowedValues: N/A | type: AvailableEDN  multiplicity: 1...\*  isOrdered: False  isUnique: True  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 |
| reservationJobRef | This identifies the reserved block of resources. This will be the DN of EASResourceReservationJob.  allowedValues: N/A | type: DN  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 |
| 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 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 DN of EESFunction instance. | type: DN  multiplicity: \*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| sharedECSInfo | This defines the ECS(s) belonging to PO 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 |
| bundleIdentifier | Identifier of the bundle. See clause 8.2.2 [2] | type: String  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| bundledEASIdentifier | List of EAS identifier associated with the EAS bundle. See clause 8.2.2 [2]. | type: String  multiplicity: \*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| bundleType | Type of the EAS bundle. See clause 8.2.2 [2].  Allowed Values: DIRECT, PROXY | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| mainEASIdentifier | Indicate which EAS in a bundle takes the main EAS service role. See clause 8.2.2 [2]. | type: String  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| coordinatedEASDiscovery | Indicates if coordinated EAS discovery is required i.e., if EAS discovery request for one of the bundled EAS is processed, then EAS discovery response should include information of all the EASs belonging to the bundle. See clause 8.2.10 [2]. | type: Boolean  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: FALSE  isNullable: False |
| coordinatedACR | Indicates if coordinated ACR is required i.e., if EAS ACR is initiated for one of the bundled EAS, then ACR should be initiated for all the EASs belonging to the bundle.  The IE may further indicate what actions must be taken if ACR for one or more bundled EAS fails e.g. ACR for all other EAS that are part of the bundle must be cancelled or not. See clause 8.2.10 [2]. | type: Boolean  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| eDNAffinity | Indicates the affinity requirement of the EAS bundle. The IE can be set to "strong" indicating that the EASs must be in the same EDN, "preferred" indicating that it is nice to have EASs in the same EDN but not essential or "weak" indicating that it’s not essential for EASs to be in the same EDN. See clause 8.2.10 [2].  Allowed Values: “STRONG”, “WEAK”, “PREFERRED” | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| EASBundle.eASFunctionRef | This indicates the constituent EAS of the EAS bundle. | type: DN  multiplicity: \*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| EASBundle.EESFunctionRef | This indicate the related EES with the EAS bundle | type: DN  multiplicity: \*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| EASBundle. eASRequirementsRef | This indicates the requirements for each constituent EAS in the bundle. | type: DN  multiplicity: \*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| EASFunction. eASBundleRef | This indicates the EAS bundles in which the EAS is included. See clause 8.2.2 [2]. | type: DN  multiplicity: \*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| EESFunction. eASBundleRef | This indicates the related EAS bundles with the EES. See clause 8.2.2 [2]. | type: DN  multiplicity: \*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| eASBundleInfo | This defines the bundle relation information for the EAS | type: EASBundleInfo  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue:None  isNullable: False |
| isBundlingAllowed | This defines whether the EAS should be put in a bundle. The FALSE value indicates that this EAS shall not be part of any bundle. | type: Boolean  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue:TRUE  isNullable: False |
| allowedBundleRef | This defines the EAS bundles where this EAS can be placed. | type: DN  multiplicity: \*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| administrativeState | It indicates the administrative state of the managed edge NF service. It describes the permission to use or prohibition against using the managed edge NF service, imposed through the OAM services.  allowedValues: “LOCKED”, “UNLOCKED”, SHUTTINGDOWN”  The meaning of these values is as defined in 3GPP TS 28.625 [17] and ITU-T X.731 [18]. | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: LOCKED  isNullable: False |
| operationalState | It indicates the operational state of the managed edge NF service. It describes whether or not the resource is physically installed and working.  allowedValues: "ENABLED", "DISABLED".  The meaning of these values is as defined in 3GPP TS 28.625 [17] and ITU-T X.731 [18]. | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| userLabel | A user-friendly (and user assignable) name of this services offered by the edge entities as defined in 3GPP TS 29.558 [20].  allowedValues: N/A | type: String  multiplicity: 0..1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| sAP | This parameter specifies the service access point of the managed Edge NF service instance.  allowedValues: N/A | type: SAP  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| operations | This parameter defines set of operations supported by the managed Edge NF service instance.  allowedValues: See TS 29.558 [20] for supported operations | type: Operation  multiplicity: 1..\*  isOrdered: False  isUnique: True  defaultValue: None  isNullable: False |
| Operation.name | This parameter defines the name of the operation of the managed edge NF service instance.  allowedValues: N/A | type: String  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: True |
| operationSemantics | This paramerter identifies the semantics type of the operation. See TS 29.558 [20]  allowedValues: “REQUEST\_RESPONSE”, “SUBSCRIBE\_NOTIFY”. | type: ENUM  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| host | This parameter specifies the host address of the managed edge NF service instance. It can be FQDN (See TS 23.003 [13]) or an IPv4 address (See RFC 791 [37]) or an IPv6 address (See RFC 2373 [38]).  allowedValues: N/A | type: Host  multiplicity: 1  isOrdered: N/A  isUnique: N/A  defaultValue: None  isNullable: False |
| port | This parameter specifies the transport port of the managed edge NF service instance.  allowedValues: 1 - 65535 | type: Integer  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 (ASP or ECSP as performance MnS consumer) utilizes the procedure described in clause 7.2.2 to request performance assurance MnS producer 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 provisioning MnS producer, acting as the consumer, utilizes the procedures described in clause 7.4.3 and 7.4.4 to request PLMN provisioning MnS producer, 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.

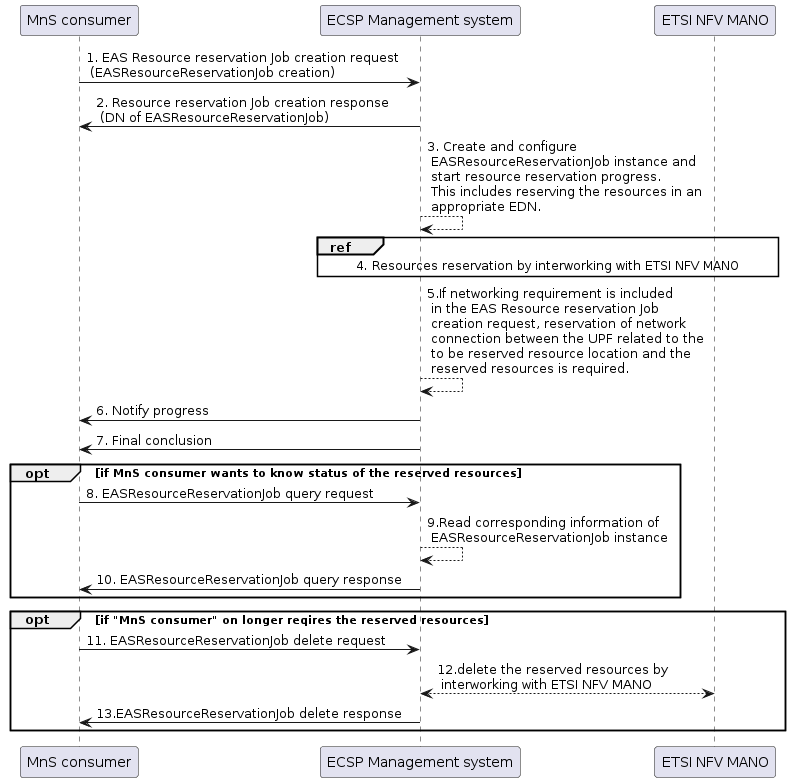


Figure 7.1.2.7-1: EAS resource reservation

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.

2. ECSP management system sends the EASResourceReservationJob creation response to the MnS consumer (ASP or LO) 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 the UPF related to the to be reserved resource location 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. The MnS consumer can send query request to ECSP management system after EASResourceReservationJob instance creation, to know and receive the status of the reserved resources.

11-13. the MnS consumer (ASP or LO) can request to delete the EASResourceReservationJob any time and the ECSP management system deletes the EASResourceReservationJob and sends response to the MnS consumer (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 management MnS to receive 5GC NF alarms.

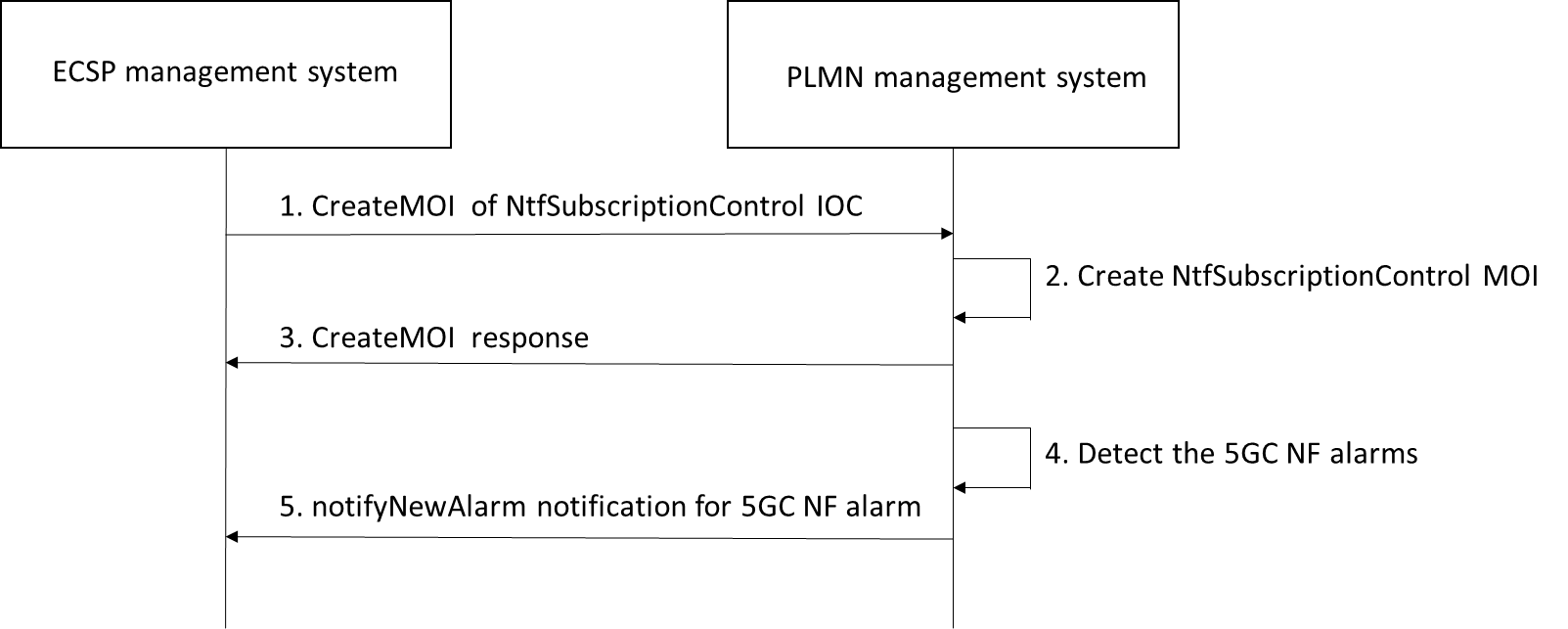


Figure 7.3.2-1: EDN NF performance impacted by 5GC NF alarm

1. ECSP sends a createMOI request (see createMOI operation defined in TS 28.532 [5]) with NtfSubscriptionControl IOC (see TS 28.622 [4]) including notificationTypes related to the fault management as defined in TS 28.111 [21] to subscribe 5GC NFs (i.e., UPF, PCF, NEF, SCEF) related alarms.

2. PLMN management system creates the MOI for NtfSubscriptionControl IOC.

3. PLMN management system sends a response to the ECSP management system indicating the NtfSubscriptionControl MOI has been successfully created.

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

5. PLMN management system 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 management MnS to receive EDN NF alarms.

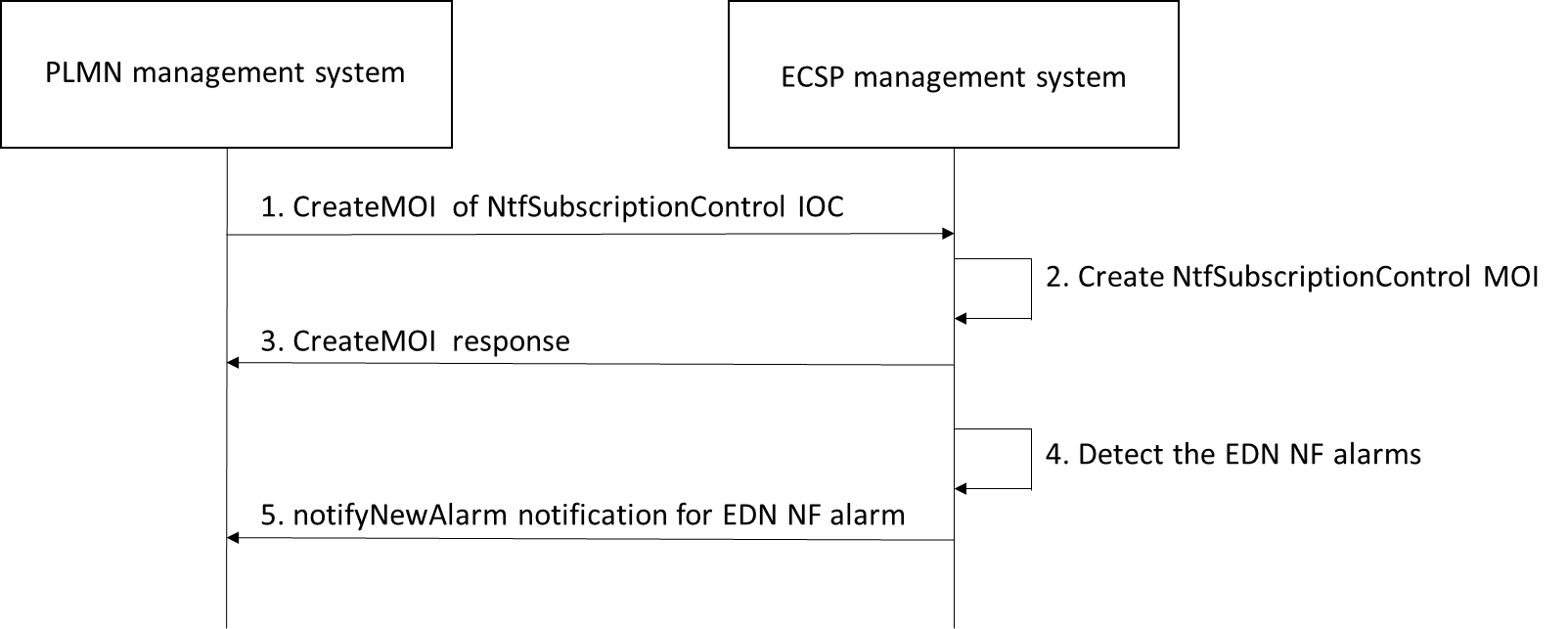


Figure 7.3.3-1: 5GC NF issues resulted from EDN NF alarms

1. PLMN management system sends a createMOI request (see createMOI operation defined in TS 28.532 [5]) with NtfSubscriptionControl IOC (see TS 28.622 [4]) including notificationTypes related to the fault management related notification as defined in TS 28.111 [11] to subscribe EDN NFs (i.e., EAS, EES, ECS) related alarms.

2. ECSP management system creates the MOI for NtfSubscriptionControl IOC.

3. ECSP management system sends a response to the PLMN management system indicating the NtfSubscriptionControl MOI has been successfully created.

4. ESCP management system detects the EDN NF alarms.

5. ESCP management system 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 (see clause 5.3.119 in TS 28.541 [3]) 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 (name contained by EASFunction) with the PCF DN.

- configure the farEndEntity in EP\_N5 MOI (name contained by EESFunction) 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 (name contained by EASFuntion) with the NEF DN.

- configure the farEndEntity in EP\_N33 MOI (name contained by EESFuntion) with the NEF DN.

- configure the farEndEntity in EP\_N33 (name contained by ECSFunction) 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 (see clause 5.3.119 in TS 28.541[3]) 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, and configure the farEndEntity of EP\_N6 with the UPFFunction DN.

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, and configure the farEndEntity of EP\_N6 with the UPFFunction DN.

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.

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 Participating 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 Participating operator.



Figure 7.5.2.1-1: Federated ECS Management

1. LO sends a createMOI request to PO in order to establish the federation relationship.

2. PO creates the EdgeFederation MOI.

3. LO receives the response

4. LO 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]). |  |
| 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]). |  |

# 9 Stage 3 definitions

## 9.1 OpenAPI document for Edge NRM

The OpenAPI/YAML definitions for Edge NRM are specified in 3GPP Forge, refer to clause 4.3 of TS 28.623 [19] for the Forge location. An example of Forge location is: "https://forge.3gpp.org/rep/sa5/MnS/-/tree/Tag\_Rel18\_SA104/".

Directory: OpenAPI

File: TS28538\_EdgeNrm.yaml

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 [18].

## A.2 Solution Set (SS) definitions

### A.2.1 OpenAPI document "TS28538\_EdgeNrm.yaml"

Note that clause 9.1 includes the location of TS28538\_EdgeNrm.yaml.

Annex B (normative):  
Availability Zone

# B.1 General

An Availability Zone defined in GSMA OPG [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 defined in GSMA OPG [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 [14], 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 this specification with the concepts defined in GSMA OPG [14].

Table C-1: Mapping of concepts of this specification with GSMA OPG [14]

|  |  |  |
| --- | --- | --- |
| GSMA OPG [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):  
PlantUML source code for procedure flows

## D.1 General

The present annex contains the PlantUML source code for the procedure flows defined in clause 7 of the present document.

## D.2 PlantUML code for Figure 7.1.2.7-1: EAS resource reservation

@startuml

"MnS consumer" -> "ECSP Management system": 1. EAS Resource reservation Job creation request \n (EASResourceReservationJob creation)

"ECSP Management system" -> "MnS consumer": 2. Resource reservation Job creation response \n (DN of EASResourceReservationJob)

"ECSP Management system" --> "ECSP Management system": 3. Create and configure\n EASResourceReservationJob instance and\n start resource reservation progress. \n This includes reserving the resources in an \n appropriate EDN.

Ref over "ECSP Management system", "ETSI NFV MANO": 4. Resources reservation by interworking with ETSI NFV MANO

"ECSP Management system" --> "ECSP Management system": 5.If networking requirement is included \n in the EAS Resource reservation Job \n creation request, reservation of network \n connection between the UPF related to the \n to be reserved resource location and the \n reserved resources is required.

"ECSP Management system" -> "MnS consumer": 6. Notify progress

"ECSP Management system" -> "MnS consumer": 7. Final conclusion

opt if MnS consumer wants to know status of the reserved resources

"MnS consumer" -> "ECSP Management system": 8. EASResourceReservationJob query request

"ECSP Management system" --> "ECSP Management system": 9.Read corresponding information of \n EASResourceReservationJob instance

"ECSP Management system" -> "MnS consumer": 10. EASResourceReservationJob query response

end

opt if "MnS consumer" on longer reqires the reserved resources

"MnS consumer" -> "ECSP Management system": 11. EASResourceReservationJob delete request

"ECSP Management system" <--> "ETSI NFV MANO": 12.delete the reserved resources by \n interworking with ETSI NFV MANO

"ECSP Management system" -> "MnS consumer": 13.EASResourceReservationJob delete response

end

@enduml

Annex E (informative):  
PlantUML source code

## E.1 ECM NRM UML diagrams

### E.1.1 Figure 6.2.1-1: Edge NRM relationship diagram

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

class SubNetwork <<InformationObjectClass>>

class ECSFunction <<InformationObjectClass>>

class EdgeDataNetwork <<InformationObjectClass>>

class EASRequirements <<InformationObjectClass>>

class EASFunction <<InformationObjectClass>>

class EESFunction <<InformationObjectClass>>

class EASProfile <<InformationObjectClass>>

class EASBundle <<InformationObjectClass>>

SubNetwork “1” \*-- "\*" EdgeDataNetwork: <<names>>

SubNetwork “1” \*-- "\*" ECSFunction: <<names>>

EdgeDataNetwork “1” \*-- "\*" EESFunction: <<names>>

EdgeDataNetwork “1” \*-- "\*" EASFunction: <<names>>

EASFunction “1” \*-- "1" EASProfile: <<names>>

ECSFunction "\*" --> "\*" EdgeDataNetwork

ECSFunction "1" --> "\*" EESFunction

EESFunction "1" --> "\*" EASFunction

EASFunction "\*" --> "1" EASRequirements

SubNetwork “1” \*-- "\*" EASBundle: <<names>>

EASBundle "\*" -- "\*" EASFunction

EASBundle "\*" -- "1" EESFunction

EASBundle "1" --> "\*" EASRequirements

@enduml

### E.1.2 Figure 6.2.1-3: Transport view of EES NRM

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

left to right direction

class EESFunction <<InformationObjectClass>>

class EP\_Edge3 <<InformationObjectClass>>

class EP\_N5 <<InformationObjectClass>>

class EP\_N33 <<InformationObjectClass>>

class EASFunction <<InformationObjectClass>>

class PCFFunction <<InformationObjectClass>>

class NEFFunction <<InformationObjectClass>>

EESFunction “1” \*-- "\*" EP\_Edge3: <<names>>

EESFunction “1” \*-- "\*" EP\_N5: <<names>>

EESFunction “1” \*-- "\*" EP\_N33: <<names>>

EP\_Edge3 "1" --> "1" EASFunction

EP\_N5 "1" --> "1" PCFFunction

EP\_N33 "1" --> "1" NEFFunction

note bottom of EESFunction

  NOTE: EP\_N5, EP\_N33,

    PCFFunction and NEFFunction

    are specified in TS 28.541

  end note

@enduml

### E.1.3 Figure 6.2.1-4: Transport view of ECS NRM

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

left to right direction

class ECSFunction <<InformationObjectClass>>

class EP\_Edge6 <<InformationObjectClass>>

class EP\_N5 <<InformationObjectClass>>

class EP\_N33 <<InformationObjectClass>>

class EESFunction <<InformationObjectClass>>

class PCFFunction <<InformationObjectClass>>

class NEFFunction <<InformationObjectClass>>

ECSFunction “1” \*-- "\*" EP\_Edge6: <<names>>

ECSFunction “1” \*-- "\*" EP\_N5: <<names>>

ECSFunction “1” \*-- "\*" EP\_N33: <<names>>

EP\_Edge6 "1" --> "1" EESFunction

EP\_N5 "1" --> "1" PCFFunction

EP\_N33 "1" --> "1" NEFFunction

note bottom of ECSFunction

  NOTE: EP\_N5, EP\_N33,

    PCFFunction and NEFFunction

    are specified in TS 28.541

  end note

@enduml

### E.1.4 Figure 6.2.1-5: Transport view of EAS NRM

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

left to right direction

class EASFunction <<InformationObjectClass>>

class EP\_Edge3 <<InformationObjectClass>>

class EP\_N6 <<InformationObjectClass>>

class EP\_N5 <<InformationObjectClass>>

class EP\_N33 <<InformationObjectClass>>

class EESFunction <<InformationObjectClass>>

class UPFFunction <<InformationObjectClass>>

class PCFFunction <<InformationObjectClass>>

class NEFFunction <<InformationObjectClass>>

EASFunction “1” \*-- "\*" EP\_Edge3: <<names>>

EASFunction “1” \*-- "\*" EP\_N6: <<names>>

EASFunction “1” \*-- "\*" EP\_N5: <<names>>

EASFunction “1” \*-- "\*" EP\_N33: <<names>>

EP\_Edge3 "1" --> "1" EESFunction

EP\_N6 "1" --> "1" UPFFunction

EP\_N5 "1" --> "1" PCFFunction

EP\_N33 "1" --> "1" NEFFunction

note bottom of EASFunction

  NOTE: EP\_N6, EP\_N5, EP\_N33,

    PCFFunction, NEFFunction

    and UPFFunction are specified

    in TS 28.541

  end note

@enduml

### E.1.5 Figure 6.2.1-6: Edge Federation NRM

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

class SubNetwork  <<InformationObjectClass>>

class EdgeFederation <<InformationObjectClass>>

class EdgeDataNetwork <<InformationObjectClass>>

class OperatorEdgeFederation <<InformationObjectClass>>

class OperatorEdgeDataNetwork <<InformationObjectClass>>

SubNetwork “1” \*-- "1" EdgeFederation: <<names>>

EdgeFederation “1” \*-- "1" EdgeDataNetwork: <<names>>

EdgeFederation “1” \*-- "\*" OperatorEdgeFederation: <<names>>

OperatorEdgeFederation “1” \*-- "\*" OperatorEdgeDataNetwork: <<names>>

OperatorEdgeDataNetwork "\*" --> "1" EdgeDataNetwork

@enduml

### E.1.6 Figure 6.2.2-1: Edge Inheritance Relationship

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

class Top  <<InformationObjectClass>>

class EdgeDataNetwork <<InformationObjectClass>>

Top <|-- EdgeDataNetwork

@enduml

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

class ManagedFunction  <<InformationObjectClass>>

class EASFunction <<InformationObjectClass>>

class EESFunction <<InformationObjectClass>>

class ECSFunction <<InformationObjectClass>>

ManagedFunction <|-- EASFunction

ManagedFunction <|-- EESFunction

ManagedFunction <|-- ECSFunction

@enduml

### E.1.7 Figure 6.2.2-2: EASProfile Inheritance

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

class Top  <<InformationObjectClass>>

class EASProfile <<InformationObjectClass>>

Top <|-- EASProfile

@enduml

### E.1.8 Figure 6.2.2-3: EASBundle Inheritance

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

class Top  <<InformationObjectClass>>

class EASBundle <<InformationObjectClass>>

Top <|-- EASBundle

@enduml

### E.1.9 Figure 6.2.1-7: ManagedEdgeNFService NRM

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

class EASFunction <<InformationObjectClass>>

class EESFunction <<InformationObjectClass>>

class ECSFunction <<InformationObjectClass>>

class ManagedEdgeNFService <<InformationObjectClass>>

EASFunction “1” \*-- "\*" ManagedEdgeNFService: <<names>>

EESFunction “1” \*-- "\*" ManagedEdgeNFService: <<names>>

ECSFunction “1” \*-- "\*" ManagedEdgeNFService: <<names>>

@enduml

### E.1.10 Figure 6.2.2-4: ManagedEdgeNFService Inheritance

@startuml

skinparam backgroundColor white

skinparam classBackgroundColor white

skinparam classBorderColor black

skinparam Shadowing false

skinparam noteBackgroundColor white

skinparam noteBorderColor white

skinparam arrowColor black

skinparam ClassStereotypeFontStyle normal

hide circle

hide members

class Top <<InformationObjectClass>>

class ManagedEdgeNFService <<InformationObjectClass>>

Top <|-- ManagedEdgeNFService

@enduml

Annex F (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 |
| 2024-06 | SA#104 | SP-240832 | 0070 | 1 | F | Rel-18 CR 28.538 Corrections on EAS resource reservation | 18.7.0 |
| 2024-06 | SA#104 | SP-240832 | 0071 | - | F | Rel-18 CR 28.538 Corrections on reservationID | 18.7.0 |
| 2024-06 | SA#104 | SP-240832 | 0072 | - | F | Rel-18 CR 28.538 Replace Originating with Leading | 18.7.0 |
| 2024-06 | SA#104 | SP-240832 | 0073 | - | F | Rel-18 CR 28.538 Update Offered EDN | 18.7.0 |
| 2024-06 | SA#104 | SP-240832 | 0074 | 1 | F | Rel-18 CR 28.538 Adding Missing Stage 3 for FederatedECSInfo | 18.7.0 |
| 2024-06 | SA#104 | SP-240809 | 0077 | - | F | TS28.538 Rel18 remove MnS root in stage 3 and Moving normative stage 3 to Forge | 18.7.0 |
| 2024-06 | SA#104 | SP-240825 | 0079 | 1 | F | Rel-19 CR 28.538 UML diagram and other minor corrections | 19.0.0 |
| 2024-09 | SA#105 | SP-241187 | 0081 | 1 | A | Rel-19 CR TS 28.538 Correct RegistrationInfo and add stage 3 | 19.1.0 |
| 2024-09 | SA#105 | SP-241184 | 0084 | 1 | B | Rel-19 CR 28.538 EAS Bundle Stage 2 and Stage 3 | 19.1.0 |
| 2024-09 | SA#105 | SP-241187 | 0088 | - | A | Rel-18 CR 28.538 Fixing Dynamic EAS Instantiation | 19.1.0 |
| 2024-12 | SA#106 | SP-241638 | 0089 | 1 | C | Rel-19 CR TS 28.538 Implement readonly attributes for openAPI SS | 19.2.0 |
| 2024-12 | SA#106 | SP-241633 | 0092 | 1 | A | Rel-19 CR TS 28.538 Correct the description of attributes | 19.2.0 |
| 2024-12 | SA#106 | SP-241653 | 0094 | 1 | A | Rel-19 CR 28.538 CR implemention issue for reservationJobRef | 19.2.0 |
| 2024-12 | SA#106 | SP-241647 | 0095 | 1 | B | Rel-19 CR 28.538 adding managed services to Edge entities | 19.2.0 |
| 2024-12 | SA#106 | SP-241653 | 0096 | - | C | Rel 19 CR TS 28.538 Remove Support Qualifier from attribute constraints | 19.2.0 |
| 2024-12 | SA#106 | SP-241638 | 0097 | - | C | Rel-19 CR TS 28.538 Implement default value for openAPI SS | 19.2.0 |
| 2024-12 | SA#106 | SP-241638 | 0098 | - | C | Rel-19 CR TS 28.538 Implement readOnly for timewindow | 19.2.0 |
| 2024-12 | SA#106 | SP-241653 | 0100 |  | A | Rel-19 CR TS 28.538 correct type and multiplicity of availableEDNList | 19.2.0 |
| 2024-12 | SA#106 | SP-241653 | 0102 | 1 | A | Rel-19 CR 28.538 update Fault management | 19.2.0 |
| 2024-12 | SA#106 | SP-241638 | 0103 | - | D | Rel 19 CR TS 28.538 Remove editors notes | 19.2.0 |
| 2025-03 | SA#107 | SP-250174 | 0105 |  | A | Rel-19 CR 28.538 correction on PO and LO | 19.3.0 |
| 2025-03 | SA#107 | SP-250162 | 0106 | 1 | B | Rel-19 CR 28.538 Update on ManagedEdgeNFService | 19.3.0 |
| 2025-03 | SA#107 | SP-250149 | 0107 | 1 | F | Rel 19 TS 28.538 Correct attributes | 19.3.0 |
| 2025-06 | SA#108 | SP-250520 | 0108 | 1 | C | Rel19 CR TS28.538 change the dataType concerning HostAddr | 19.4.0 |
| 2025-06 | SA#108 | SP-250520 | 0109 | 1 | F | Rel-19 CR TS 28.538 Update the procedure 5GC NF Provisioning | 19.4.0 |