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Study on management aspects of edge computing

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Contents

Foreword [5](#__RefHeading___Toc20475588)

1 Scope [7](#__RefHeading___Toc20475589)

2 References [7](#__RefHeading___Toc20475590)

3 Definitions of terms, symbols and abbreviations [8](#__RefHeading___Toc20475591)

3.1 Terms [8](#__RefHeading___Toc20475592)

3.2 Symbols [8](#__RefHeading___Toc20475593)

3.3 Abbreviations [8](#__RefHeading___Toc20475594)

4 Concept and background [8](#__RefHeading___Toc20475595)

4.1 Background [8](#__RefHeading___Toc20475596)

4.2 Edge computing deployment scenarios [9](#__RefHeading___Toc20475597)

5 Use cases [10](#__RefHeading___Toc20475598)

5.1 Deploy UPF to support edge computing [10](#__RefHeading___Toc20475599)

5.1.1 Introduction [10](#__RefHeading___Toc20475600)

5.1.2 Pre-conditions [10](#__RefHeading___Toc20475601)

5.1.3 Description [10](#__RefHeading___Toc20475602)

5.1.4 Post-conditions [10](#__RefHeading___Toc20475603)

5.2 Remove UPF not needed for edge computing [11](#__RefHeading___Toc20475604)

5.2.1 Introduction [11](#__RefHeading___Toc20475605)

5.2.2 Pre-conditions [11](#__RefHeading___Toc20475606)

5.2.3 Description [11](#__RefHeading___Toc20475607)

5.2.4 Post-conditions [11](#__RefHeading___Toc20475608)

5.3 Edge computing deployment [11](#__RefHeading___Toc20475609)

5.3.1 Introduction [11](#__RefHeading___Toc20475610)

5.3.2 Pre-conditions [11](#__RefHeading___Toc20475611)

5.3.3 Description [11](#__RefHeading___Toc20475612)

5.3.4 Post-conditions [11](#__RefHeading___Toc20475613)

5.4 Available UPF to support edge computing [12](#__RefHeading___Toc20475614)

5.4.1 Introduction [12](#__RefHeading___Toc20475615)

5.4.2 Pre-conditions [12](#__RefHeading___Toc20475616)

5.4.3 Description [12](#__RefHeading___Toc20475617)

5.4.4 Post-conditions [12](#__RefHeading___Toc20475618)

5.5 Performance measurements related to end-to-end QoS [12](#__RefHeading___Toc20475619)

5.5.1 Introduction [12](#__RefHeading___Toc20475620)

5.5.2 Pre-conditions [12](#__RefHeading___Toc20475621)

5.5.3 Description [12](#__RefHeading___Toc20475622)

5.5.4 Post-conditions [13](#__RefHeading___Toc20475623)

5.6 NEF accessibility for EC [13](#__RefHeading___Toc20475624)

5.6.1 Introduction [13](#__RefHeading___Toc20475625)

5.6.2 Pre-conditions [13](#__RefHeading___Toc20475626)

5.6.3 Description [13](#__RefHeading___Toc20475627)

5.6.4 Post-conditions [13](#__RefHeading___Toc20475628)

6 Potential requirements [13](#__RefHeading___Toc20475629)

7 Potential solutions [14](#__RefHeading___Toc20475630)

7.1 UPF instantiation or termination to support edge computing [14](#__RefHeading___Toc20475631)

7.1.1 General [14](#__RefHeading___Toc20475632)

7.1.2 UPF instantiation [14](#__RefHeading___Toc20475633)

7.1.3 UPF termination [14](#__RefHeading___Toc20475634)

7.2 SMF configuration to support UE traffic routing [15](#__RefHeading___Toc20475635)

7.2.1 General [15](#__RefHeading___Toc20475636)

7.2.2 SMF configuration for a new UPF [15](#__RefHeading___Toc20475637)

7.2.3 SMF configuration for removal from the UPF available list [15](#__RefHeading___Toc20475638)

7.3 NRF configuration to support UE traffic routing [15](#__RefHeading___Toc20475639)

7.3.1 General [15](#__RefHeading___Toc20475640)

7.3.2 NRF configuration to obtain UPF information [15](#__RefHeading___Toc20475641)

7.3.3 NRF receives UPF information from UPF instance [15](#__RefHeading___Toc20475642)

7.4 UPF and edge computing VNFs deployment [16](#__RefHeading___Toc20475643)

7.4.1 General [16](#__RefHeading___Toc20475644)

7.4.2 Deployment of UPF and edge computing VNFs in a NS [16](#__RefHeading___Toc20475645)

7.4.3 Deployment of UPF and edge computing VNFs in two separate NS [16](#__RefHeading___Toc20475646)

7.4.4 Retrieval of the UPF information [17](#__RefHeading___Toc20475647)

7.5 End-to-end performance assurance [18](#__RefHeading___Toc20475648)

7.5.1 General [18](#__RefHeading___Toc20475649)

7.5.2 Monitoring of the performance related to end-to-end QoS [18](#__RefHeading___Toc20475650)

7.6 AF access to NEF [18](#__RefHeading___Toc20475651)

7.6.1 General [18](#__RefHeading___Toc20475652)

7.6.2 Provision of NEF IP address [18](#__RefHeading___Toc20475653)

8 Conclusion [19](#__RefHeading___Toc20475654)

Annex A: Change history [20](#__RefHeading___Toc20475655)

# Foreword

This Technical Report 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:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

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

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

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

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

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

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

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

**can** indicates that something is possible

**cannot** indicates that something is impossible

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

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

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

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

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

In addition:

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

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

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

# 1 Scope

The present document studies how the 3GPP management system can support the management of edge computing management that includes the following aspects:

- The use cases and requirements for 3GPP management system to support the deployment and management of edge computing.

- The solutions for 3GPP management system to support the deployment and management of 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 23.501: "System Architecture for the 5G System; Stage 2".

[3] ETSI GS MEC 003 V1.1.1: "Mobile Edge Computing (MEC); Framework and Reference Architecture".

[4] ETSI GS MEC 010-1 V1.1.1: "Mobile Edge Computing (MEC); Mobile Edge Management; Part 1: System, host and platform management".

[5] ETSI GS MEC 010-2 V1.1.1: "Multi-access Edge Computing (MEC); MEC Management; Part 2: Application lifecycle, rules and requirements management".

[6] 3GPP TR 23.725: "Study on enhancement of Ultra-Reliable Low-Latency Communication (URLLC) support in the 5G Core network (5GC)".

[7] ETSI GS NFV-MAN 001 V1.1.1: "Network Function Virtualisation (NFV); Management and Orchestration".

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

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

[10] 3GPP TS 28.541 "Management and orchestration; 5G Network Resource Model (NRM); Stage 2 and stage 3".

[11] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[12] ETSI GR MEC 017 V1.0.0: "Mobile Edge Computing (MEC); Deployment of Mobile Edge Computing in an NFV environment".

[13] ETSI GS NFV-IFA 014 "Network Functions Virtualisation (NFV) Release 2; Management and Orchestration; Network Service Templates Specification".

[14] 3GPP TS 28.550: "Management and orchestration; Performance assurance".

[15] 3GPP TS 28.532: "Management and orchestration; Generic management services".

[16] 3GPP TS 28.622: "Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

## 3.2 Symbols

Void.

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

# 4 Concept and background

## 4.1 Background

The 5G networks are intended to support various new services such as IoT, Cloud-based services, industrial control, autonomous driving, mission critical communications, etc, based on the network slicing technology. Some services, e.g. autonomous driving, may have ultra-low latency and high data capacity requirements due to safety and performance concerns. 5GC system architecture as defined in TS 23.501 [2] supports edge computing to enable such services by applications that are hosted closer to the UE's access point of attachment in order to reduce the end-to-end latency and the load on the transport network.

Figure 4.1-1 shows how 3GPP network elements work with non-3GPP network elements, such as AF (Application Function) and local data network to provide the services mentioned above [5], [6]. The AF may send requests to SMF (Session Management Function) via PCF (Policy Function) or NEF (Network Exposure Function) to influence UPF (User Plane Function) (re)selection and traffic routing.

The end-to-end latency of the traffic traveling from UE to local data network includes the latency both inside and outside the 3GPP networks. The latency within the 3GPP networks is relevant to 5G QoS, as described in clause 5.7.3.1 in [2], which is the QoS a data flow receives edge-to-edge between the UE and the UPF. The latency outside the 3GPP networks is related to the geographical locations of UPF and local data network. Therefore, it is necessary to deploy the local data network and UPF in a manner that meets the end-to-end latency requirement of the services.



Figure 4.1-1: 5G edge computing network

The deployment of edge computing in 3GPP networks requires cooperation with other SDOs, as AF and AS are not 3GPP defined nodes. ETSI GS MEC 003 [3], ETSI GS MEC 010-1 [4], and ETSI GS MEC 010-2 [5] provides some information about non-3GPP edge computing management system.

## 4.2 Edge computing deployment scenarios

Figure 4.2-1 shows an example of edge computing deployment where gNB, 5GC and data centers, DC #1 - #4, DC #11 - #12 have been deployed. When an operator decides to deploy an edge computing application for UEs connected to gNB #1, it selects DC #2 to deploy UPF #2, and DC #11 to deploy local data network #1, based on the QoS requirements between UEs and local data network #1 that meets the end-to-end QoS requirements imposed by the application. It connects UPF#2 to local data network #1 via virtual link, as shown in Figure 4.2-1.



Figure 4.2-1: Edge computing network deployment example

The deployment of network functions in 3GPP networks and non-3GPP networks to support edge computing requires communication between 3GPP management system and non-3GPP management systems, such as ETSI NFV MANO [7], ETSI MEC [3].

Figure 4.2-2 shows a peer-to-peer edge computing management deployment scenario where the deployment of edge computing in 3GPP networks needs communication among 3GPP management system, non-3GPP management system, including edge computing management system, and ETSI NFV MANO.



Figure 4.2-2: Peer-to-peer edge computing management deployment scenario

3GPP management system can initiate the edge computing deployment by requesting the edge computing management system to deploy the local data network, and NFVO to connect the UPF and local data network with the QoS for N6 requirements for the connection (e.g. virtual link) between UPF and local data network.

Edge computing management system can initiate the edge computing deployment by requesting the 3GPP management system to deploy the UPF, and NFVO to connect the UPF and local data network with the QoS requirements for the connection between UPF and local data network.

# 5 Use cases

## 5.1 Deploy UPF to support edge computing

### 5.1.1 Introduction

An operator decides to deploy UPFs to support edge computing applications for UEs in a specific area. The UPFs should be deployed in locations where the data transported between UE and UPF should meet the 5G QoS requirements (see clause 5.7.3.1 [2]).

### 5.1.2 Pre-conditions

3GPP management system is aware of the 5G QoS requirements needed to support edge computing applications.

It is to deploy the UPF software only.

### 5.1.3 Description

3GPP management system requests NFVO to instantiate the UPF with conditions (e.g. location constraints).

NFVO responds that the UPF has been instantiated successfully.

3GPP management system configures SMF or NRF to add the newly instantiated UPF and may configure other NFs needed to support edge computing.

### 5.1.4 Post-conditions

The UPF is available to support the edge computing application.

## 5.2 Remove UPF not needed for edge computing

### 5.2.1 Introduction

An operator decides to remove UPF that is no longer needed to support edge computing applications.

### 5.2.2 Pre-conditions

UPF supporting edge computing application has been instantiated.

### 5.2.3 Description

3GPP management system requests NFVO to terminate the UPF.

NFVO responds that the UPF has been terminated successfully.

3GPP management system configures SMF to remove the UPF that has been terminated.

### 5.2.4 Post-conditions

The UPF is not available to support the edge computing application.

## 5.3 Edge computing deployment

### 5.3.1 Introduction

An operator decides to deploy the edge computing related resources in the local data network to support edge computing. The edge computing related resources should be deployed in locations where the data transported between UPF and edge computing related resources in the local data network should meet the QoS requirements for N6 interface.

### 5.3.2 Pre-conditions

3GPP management system has the QoS requirements for N6 interface.

The UPF supporting the edge computing application, has been instantiated.

### 5.3.3 Description

3GPP management system provides to the edge computing management system the QoS requirements for N6 interface, and UPF location information that can be used to deploy the edge computing related resources in the local data network.

Edge computing management system selects the data center to deploy the edge computing related resources in the local data network, based on the QoS requirements and UPF location.

Edge computing management system responds to 3GPP management system indicating that the edge computing related resources in the local data network has been deployed.

3GPP management system requests NFVO to connect the UPF to the edge computing related resources in the local data network with the QoS requirements for N6 interface.

### 5.3.4 Post-conditions

UEs are able to communicate with the edge computing application running in the local data network.

## 5.4 Available UPF to support edge computing

### 5.4.1 Introduction

An operator has deployed the resources needed to support edge computing in the local data network. The Edge computing management system needs to know the information of the UPFs deployed in locations where the data transported between UPF and the edge computing application in the local data network can meet the QoS requirements for the N6 interface.

### 5.4.2 Pre-conditions

Edge computing management system is aware of the QoS requirements on the N6 interface.

### 5.4.3 Description

Edge computing management system sends a request with the location of local data network and the QoS requirements for the N6 interface to ask 3GPP management system to provide the information of UPFs to which the edge computing related resources in the local data network can be connected.

3GPP management system find the available UPFs that can meet the QoS requirements for the N6 interface in the given location.

3GPP management system deploys new UPF(s) according to the steps described in use case 5.1.1, if the existing UPFs cannot meet the requirements.

3GPP management system provides the information of UPF(s) to the edge computing management system.

### 5.4.4 Post-conditions

The information of UPF(s) have been sent to the edge computing management system.

## 5.5 Performance measurements related to end-to-end QoS

### 5.5.1 Introduction

3GPP networks support edge computing to enable UEs to communicate with applications hosted in the local data network that are closer to the UE's access point of attachment in order to achieve an efficient service delivery through the reduced end-to-end latency and load on the transport network (see clause 5.13 in TS 28.501 [2]). Therefore, it is necessary to monitor the performance measurements (e.g. latency, data volume) for connections from UE to UPF and the N6 interface to insure the end-to-end QoS requirements are met.

### 5.5.2 Pre-conditions

3GPP network functions supporting the edge computing have been deployed.

Edge computing related in local data network have been deployed.

Edge computing applications have been deployed.

### 5.5.3 Description

3GPP management system collects the performance measurements (e.g. latency, data volume) for connections from UE to UPF and the N6 interface.

3GPP management system reports the performance measurements related to end-to-end QoS to the authorized consumer (e.g. edge computing management system).

### 5.5.4 Post-conditions

The performance measurements have been reported to the authorized consumer (e.g. edge computing management system).

## 5.6 NEF accessibility for EC

### 5.6.1 Introduction

In EC, an AF may send requests to 5GC to influence SMF routing decisions for traffic of PDU Session. The AF may issue requests on behalf of applications not owned by the PLMN serving the UE.

The AF sends the requests via the NEF (see in clause 5.6.7 and 6.3.7.2 of TS 23.501 [2]) in case:

- the AF is not authorized to access the 5GC directly; or

- the requests target existing or future PDU Sessions of multiple UE(s) or of any UE.

In this case, the AF may discover the NEF by using a locally configured NEF identifier/address. Therefore, edge computing management system needs to have the NEF information, so it can provide the IP address of NEF to AF via configuration.

### 5.6.2 Pre-conditions

5GC network functions are in operation to support edge computing.

### 5.6.3 Description

3GPP management system receives a request from an authorized consumer (e.g. edge computing management system) to provide the connection information (e.g. IP address) of the NEF to which the AF can communicate to influence traffic routing (see procedures described in clause 4.3.6 in TS 23.502 in [2]).

3GPP management system provides the connection information (e.g. IP address) of the NEF to the authorized consumer.

### 5.6.4 Post-conditions

The connection information (e.g. IP address) of the NEF have been sent to the edge computing management system.

# 6 Potential requirements

**REQ-ECM\_CON-1** NFVO should have a capability allowing 3GPP management system to instantiate the VNF(s) with conditions (e.g. location constraints).

**REQ-ECM\_CON-2** The 3GPP management system should have a capability to configure the SMF or NRF (e.g. to add or remove the UPF).

**REQ-ECM\_CON-3** NFVO should have a capability allowing 3GPP management system to terminate the VNF(s).

**REQ-ECM\_CON-4** The 3GPP management system should be able to provide the QoS requirements for the N6 interface, and the UPF location to edge computing management system.

**REQ-ECM\_CON-5** NFVO should have a capability allowing 3GPP management system to request connection between VNFs in the same or different NS instances.

**REQ-ECM\_CON-6** The 3GPP management system should have a capability allowing edge computing management system to request the UPF information in a given location and QoS requirements for the N6 interface.

**REQ-ECM\_CON-7** The 3GPP management system should have a capability to collect the performance measurements (e.g. latency, data volume) for connections from UE to 3GPP UPF.

**REQ-ECM\_CON-8** The 3GPP management system should have a capability allowing an authorized consumer (e.g. edge computing management system) to request the connection information (e.g. IP address) of NEF.

**REQ-ECM\_CON-9** The 3GPP management system should have a capability to provide the connection information (e.g. IP address) of NEF to the authorized consumer (e.g. edge computing management system).

# 7 Potential solutions

## 7.1 UPF instantiation or termination to support edge computing

### 7.1.1 General

UPF instantiation or termination is needed to support the deployment of edge computing (see use cases in clauses 5.1 and 5.2).

### 7.1.2 UPF instantiation

3GPP management system requests NFVO to instantiate the NS identified by nsInstanceId, with the parameter additionalParamForVnf providing the information for the UPF, and parameter locationConstraints indicating the constraints on where the UPF will be located (see clause 7.3.3.2 in GS NFV-IFA 013 [8]).

NFVO sends the NS LCM Operation Occurrence Notification to the 3GPP management system indicating the start of NS instantiation procedure (see clause 7.3.3.4 in GS NFV-IFA 013 [8]).

NFVO instantiates the NS and the UPF.

NFVO sends the NS LCM Operation Occurrence Notification to the 3GPP management system with the result of NS instantiation, including *vnfInstanceId* to indicate the UPF instance that has been instantiated (see clause 7.3.3.4 in GS NFV-IFA 013 [8]).

NFVO sends the NS LCM Operation Occurrence Notification to the 3GPP management system with the result of NS instantiation, including *vnfInstanceId* to indicate the UPF instance that has been instantiated (see clause 7.3.3.4 in GS NFV-IFA 013 [8]).

3GPP management system consumes Provisioning for NF service with *createMOIAttributes* operation (see clause 6.3 in TS 28.531 [10]) to create the UPFFunction IOC for the UPF instance.

NOTE: UPFFunction in NRM (see clause 5.3.3 in TS 28.541 [10]) may contain the NRF identity to contact for registration and UPF Provisioning Information (see clause 4.17.6.2 in TS 23.502 [11]).

### 7.1.3 UPF termination

3GPP management system requests NFVO to update the NS with updateType=RemoveVnf to terminate the UPF instance (see clause 7.3.5.2 in GS NFV-IFA 013 [8]).

NFVO sends the NS LCM Operation Occurrence Notification to the 3GPP management system indicating the start of NS update procedure (see clause 7.3.3.4 in GS NFV-IFA 013 [8]).

NFVO removes the UPF instance from the NS.

NFVO sends the NS LCM Operation Occurrence Notification to the 3GPP management system with the result of NS update, including *vnfInstanceId* to indicate the UPF instance that has been terminated (see clause 7.3.3.4 in GS NFV‑IFA 013 [8]).

## 7.2 SMF configuration to support UE traffic routing

### 7.2.1 General

SMF needs to be configured with the information about the available UPFs, when an UPF is instantiated or terminated (see clause 6.3.3.2 in TS 23.501 [2]). The information enables SMF to select UPF to route the user traffic to the local data network as described in clause 6.3.3 TS 23.501 [2].

### 7.2.2 SMF configuration for a new UPF

It is assumed that UPF has been instantiated and UPFFunction IOC has been created.

3GPP management system consumes the management service for NF provisioning with *modifyMOIAttributes* operation (see clause 6.3 in TS 28.531 [9]) to configure the SMF – SMFFunction with the UPF provisioning information in order to add the UPF to the available UPF list (see clause 6.3.3.2 in TS 23.501 [2]).

### 7.2.3 SMF configuration for removal from the UPF available list

3GPP management system consumes the management service for NF provisioning with *modifyMOIAttributes* operation (see clause 6.3 in TS 28.531 [9]) to configure SMF with the UPF identifier of the UPF to be removed from the available UPF list.

## 7.3 NRF configuration to support UE traffic routing

### 7.3.1 General

NRF may obtain the UPF information via the following two options:

- 3GPP management system configures NRF with the information about new UPF (see step 6 in clause 4.17.6.2 in TS 23.502 [11]).

- The UPF instance issues an Nnrf\_NFManagement\_NFRegister Request operation (see steps 4, 5 in clause 4.17.6.2 in TS 23.502 [11]).

NRF then send the UPF information to SMF via Nnrf\_NFManagement\_NFStatusNotify.

This subclause provides potential solutions from OAM aspects to support the two options mentioned above.

### 7.3.2 NRF configuration to obtain UPF information

It is assumed that a new UPF has been instantiated, and an UPFFunction IOC has been created.

3GPP management system consumes the management service for NF provisioning with *modifyMOIAttributes* operation (see clause 6.3 in TS 28.531 [9]) to configure the NRF – NRFFunction with the available UPF (see clause 4.17.6.2 in TS 23.502 [11]).

### 7.3.3 NRF receives UPF information from UPF instance

It is assumed that a new UPF has been instantiated, and an UPFFunction IOC has been created.

3GPP management system consumes the management service for NF provisioning with *createMOIAttributes* operation (see clause 6.3 in TS 28.531 [9]) to create an EP\_SBI\_X IOCcontained by UPFFunction IOC that can be used by UPF to communicate with NRF.

## 7.4 UPF and edge computing VNFs deployment

### 7.4.1 General

The following subclauses describe the solutions for the deployment of UPF and edge computing VNF instances (see use cases in clauses 5.3 and 5.4). The orchestration and lifecycle management of edge computing VNFs are realized in the NFVO and VNFM functional blocks as defined by ETSI NFV MANO (see clause 5.2 in ETSI GR MEC 017 [12]).

### 7.4.2 Deployment of UPF and edge computing VNFs in a NS

It is assumed that the UPF supporting the edge computing application has been instantiated in a NS identified by *nsInstanceId*, and no virtual link is available to connect the UPF VNF instance to the VNF instance supporting edge computing applications in the local data network.

3GPP management system sends the following parameters to the edge computing management system to support the instantiation of the edge computing VNF:

- QoS requirements, such as latency, bandwidth for N6 interface.

- UPF information related to the location of the UPF VNF that has been instantiated.

- *nsInstanceId* of the NS where the UPF VNF is contained.

- NSD that was used to instantiate the NS.

Edge computing management system performs the following operations:

- Update the NSD to add the VNFD for the VNF to be instantiated.

- Instantiate the VNF in the NS identified by *nsInstanceId*, based on the QoS requirements for the N6 interface and UPF information.

Edge computing management system returns the *vnfInstanceId* and the updated NSD to 3GPP management system when the VNF has been successfully instantiated.

3GPP management system adds a new VnfProfile or updates the existing VnfProfile (see clause 6.3.3 in GS NFV-IFA 014 [13]) with the NS virtual link information to or in the NSD.

3GPP management system initiates the on-board NSD operation (see clause 7.2.2 in GS NFV-IFA 013 [8]) at NFVO to upload the NSD with the new or updated VnfProfile.

3GPP management system initiates the update NS operation (see clause 7.3.5 in GS NFV-IFA 013 [8]) at NFVO with updateType=AssocNewNsdVersion to associate the NS with the on-boarded NSD.

3GPP management system initiates the update NS operation (see clause 7.3.5 in GS NFV-IFA 013 [8]) at NFVO with updateType=AssocVnfWithVnfProfile, *nsInstanceId* and *vnfInstanceId* of the UPF VNF to connect the UPF VNF instance to the virtual link contained in the VnfProfile.

3GPP management system initiates the update NS operation (see clause 7.3.5 in GS NFV-IFA 013 [8]) at NFVO with updateType=AssocVnfWithVnfProfile, *nsInstanceId* and *vnfInstanceId* of the edge computing VNF to connect the edge computing VNF instance to the virtual link contained in the VnfProfile.

### 7.4.3 Deployment of UPF and edge computing VNFs in two separate NS

It is assumed that the UPF supporting the edge computing application has been instantiated in a NS identified by *nsInstanceId #1*, based on NSD #1, and has been connected to a SAP #1.

3GPP management system sends the following parameters to the edge computing management system to instantiate the edge computing VNF:

- QoS requirements, such as latency, bandwidth for N6 interface

- UPF information related to the location of the UPF VNF that has been instantiated

Edge computing management system used NSD #2 to instantiate a NS identified by *nsInstanceId #2* containing the edge computing VNF instance identified by *vnfInstanceId #2*, based on the QoS requirements for the N6 interface and UPF information, and connects the VNF instance to SAP #2.

Edge computing management system returns the NSD #2, *vnfInstanceId* #2 and *nsInstanceId* #2 to 3GPP management system when the NS with the edge computing VNF has been successfully instantiated.

3GPP management system connects the NSs identified by *nsInstanceId #1* and *nsInstanceId #2 by* performing the following operations:

- Update the NSD #3 to add the NsProfile (see clause 6.3.11 in GS NFV-IFA 014 [13]) that contain NSD #1 and NSD #2 that are associated with the nested NS instances, and a NS virtual Link of the composite NS that is to connect SAP #1 and SAP #2.

- Initiate the Create NS identifier operation (see clause 7.3.2 in GS NFV-IFA 013 [8]) at NFVO with NSD #3 to create the identifier of composite NS identified by *nsInstanceId #3*.

- Initiate the Instantiate NS operation (see clause 7.3.3 in GS NFV-IFA 013 [8]) at NFVO with *nsInstanceId #3* to instantiate the NS instance that:

- Contains two nested NS instances, identified by *nsInstanceId #1* and *nsInstanceId #2*, respectively; and

- Connects the nested NS instances via SAP #1 and SAP #2.

Figure 7.4-1 shows the result of the operation where an UPF VNF is connected to the EC VNF via the NS virtual link in a composite NS.



Figure 7.4-1: Connecting UPF and EC VNFs residing in two NS via NS VL

### 7.4.4 Retrieval of the UPF information

It is assumed that the UPF identified by *vnfInstanceId* #1 has been instantiated in a NS identified by *nsInstanceId* #1, based on NSD #1, and has been connected to SAP #1. It is assumed that the edge computing VNF identified by *vnfInstanceId* #2 has been instantiated in a NS identified by *nsInstanceId* #2, based on NSD #2, and has been connected to SAP #2.

Edge computing management system requests 3GPP management system to provide the information of UPFs to which the VNF supporting the edge computing can be instantiated by providing the location of local data network and the QoS requirements for the N6 interface.

3GPP management system find the available UPFs that can meet the QoS requirements for the N6 interface in the given location.

3GPP management system provides the *vnfInstanceId* #1 of the UPF VNF, NSD #1, and *nsInstanceId* #1 of the NS where UPF VNF has been instantiated to the edge computing management system.

Edge computing management system connects the NSs identified by *nsInstanceId #1* and *nsInstanceId #2 by* performing the following operations:

- Update the NSD #3 to add the NsProfile (see clause 6.3.11 in GS NFV-IFA 014 [13]) that contain NSD #1 and NSD #2 that are associated with the nested NS instances, and a NS virtual Link of the composite NS NSD #1 and NSD #2 that are associated with the nested NS instances.

- Instantiate a composite NS, based on NSD #3, which:

- Contains two nested NS instances, identified by *nsInstanceId #1* and *nsInstanceId #2*; and

- Connects the nested NS instances via SAP #1 and SAP #2.

## 7.5 End-to-end performance assurance

### 7.5.1 General

This subclause provides a solution for the use case of performance measurements related to end-to-end QoS (see use cases in clause 5.5).

### 7.5.2 Monitoring of the performance related to end-to-end QoS

There are existing management services for performance measurement control and reporting, including:

- Measurement job control services for NSIs (see clause 7.1 in TS 28.550 [14]) for the collection of performance measurements.

- Management services for provisioning of networks and network slicing (see clause 6 in TS 28.531 [17) that are used to create MeasurementControl and MeasurementReader IOC (see clauses 4.3.12, 4.3.13 in TS 28.622 [16]) for the collection of performance measurements.

- Performance data file reporting service (see clause 7.2 in in TS 28.550 [14]).

- Performance data streaming service (see clause 7.3 in in TS 28.550 [14]).

The measurements related to end-to-end QoS are needed.

## 7.6 AF access to NEF

### 7.6.1 General

This solution supports the use case of NEF accessibility for EC (see use cases in clause 5.6 where the edge computing management system is able to obtain the NEF information, so it can configure the IP address of NEF at the AF.

### 7.6.2 Provision of NEF IP address

It is assumed that NEF has been instantiated.

3GPP management system consumes the management service for NF provisioning with *getMOIAttributes* operation (see clause 6.3 in TS 28.531 [9]) to get the IP address of NEF via which the AF can send the request to SMF for controlling the traffic routing of PDU Session (see clause 6.3.3.2 in TS 23.501 [2]), if not already known.

Upon request, 3GPP management system provides the IP address of NEF to an authorized consumer (e.g. edge computing management system).

NOTE: The IOC representing the NEF that contains the NEF IP address should be defined.

# 8 Conclusion

The study has identified use cases, requirements and solutions for 3GPP management system to support the deployment and management of edge computing.

It is concluded that:

- LCM:

1. Reuse ETSI NFV MANO to instantiate or terminate UPF needed to support edge computing.

2. Reuse ETSI NFV MANO to connect UPF and edge computing VNF, but, may need enhancement to for the connection to meet the N6 QoS requirements.

- Provisioning:

1. Require enhancements in 5G NRM to enable the configuration of SMF / NRF (see clause 7.2) to support edge computing.

2. Require enhancements in 5G NRM to enable the provisioning of NEF.

- Performance assurance:

1. Need end-to-end QoS performance measurements.

Normative work is needed to address the LCM, provisioning, and performance assurance works aforementioned.

Annex A:  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2019-09 | SA#85 | SP-190774 |  |  |  | Presented for approval | 2.0.0 |
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