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3rd Generation Partnership Project;

Technical Specification Group Services and System Aspects;

Application layer support for Factories of the Future (FF);

(Release 18)

** 

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# Foreword

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

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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.

# Introduction

In order to ensure efficient use and deployment of Factories of the Future (FF) applications on 3GPP networks an architecture for FF application layer consisting of FF application enabler is specified in this document.

The FF application enabler capabilities takes into consideration the existing stage 1 and stage 2 work within 3GPP related to FF in 3GPP TS 22.261 [2], 3GPP TS 22.104 [3] and 3GPP TS 23.501 [4].

# 1 Scope

The present document specifies the functional architecture, procedures and information flows for FF application enabler layer. This specification includes the capabilities of the application layer support for FF services that are necessary to ensure efficient use and deployment of FF services over 3GPP systems. The FAE capabilities applies to 5GS.

# 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 22.261: "Service requirements for the 5G system; Stage 1".

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

[4] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[5] 3GPP TS 23.434: "Service Enabler Architecture Layer for Verticals (SEAL); Functional architecture and information flows;"

[6] 3GPP TS 23.222: "Functional architecture and information flows to support Common API Framework for 3GPP Northbound APIs".

[7] 3GPP TS 23.558: "Architecture for enabling Edge Applications".

[8] 3GPP TS 23.502: "Procedures for the 5G System (5GS); Stage 2".

[9] 3GPP TS 23.554: "Application architecture for MSGin5G Service; Stage 2".

[10] 3GPP TS 23.435: "Procedures for Network Slice Capability Exposure for Application Layer Enablement Service".

[11] 3GPP TS 23.433: "SEAL Data Delivery enabler for vertical applications".

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions 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

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

## 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].

5GS 5G System

AF Application Function

API Application Programming Interface

FAE FF Application Enabler

FF Factories of the Future

# 4 Architectural requirements

## 4.1 General

### 4.1.1 Description

This subclause specifies the general requirements for FF application layer functional architecture.

### 4.1.2 Requirements

[AR-4.1.2-a] The FAE architecture shall support one or more FF applications.

[AR-4.1.2-b] The FAE capabilities shall be offered via APIs to the FF applications.

[AR-4.1.2-c] The FAE capabilities shall enable the FAE client to discover available FF services.

[AR-4.1.2-d] The FAE client shall be able to communicate to multiple FAE servers.

## 4.2 <Requirement type x>

Editor's Note: Provide a suitable title for the requirements.

### 4.2.1 Description

Editor's Note: This subclause will describe the requirement for application layer support aspect.

### 4.2.2 Requirements

Editor's Note: This subclause will describe the architectural requirements.

# 5 Application layer architecture

Illustrate the application layer architecture, its elements and its reference points in clauses under this clause.

## 5.1 General

## 5.2 Architecture

This clause describes the architecture for enabling FF applications in the following representations:

- A service-based representation of the functional model for FF services with SEAL functions specified in 3GPP TS 23.434 [5] and CAPIF core function specified in 3GPP TS 23.222 [6]; and

- A service-based representation of the functional model for FF services invoked by FF UE; and

- A reference point representation for FF application layer functional model.

FF application layer functions shown in the service-based representation of the FF architecture shall only use service-based interfaces for their interactions.

Figure 5.2-1 illustrates the service based representation of architecture for FF applications with SEAL and CAPIF.



Figure 5.2-1: FF application layer architecture - service-based representation

The service-based interface for FAE server is representation as Sfae.

Figure 5.2-2 illustrates the service based representation of architecture for FF applications invoked by FF UE.



Figure 5.2-3 illustrates the reference point representation of the architecture for FF application layer.



Figure 5.2-3: FF application layer architecture - reference point representation

The FF application server consists of the FAE server, the SEAL servers and the FF application specific server. The FAE server provides the FF application layer support functions to the FF application specific server over FAE-S reference point. The SEAL server(s) provide the SEAL services to the FF application specific server over SEAL‑S reference point.

The FF UE consist of the FAE client, the SEAL clients and the FF application specific client. The FAE client provides the FF application layer support functions to the FF application specific client over FAE-C reference point. The SEAL client(s) provide the SEAL services to the FF application specific client over SEAL‑C reference point.

Editor's note: The FF UE1 can have different roles, such as gateway/controller UE, basic UE. These roles need to define.

NOTE 1: In some deployments, the client and server entities of SEAL can be part of FAE client and FAE server respectively.

The FAE client/ FF application specific client acts as a VAL client for its interaction with the SEAL clients as specified in 3GPP TS 23.434 [5]. The FAE server/ FF application specific server acts as a VAL server for its interaction with the SEAL servers as specified in 3GPP TS 23.434 [5].

The FAE client communicates with the FAE server over FAE-1 reference point. The FF application specific client communicates with FF application specific server over FFA-1 reference point.

NOTE 2: The FFA-1 reference point is out of scope of the present document.

In the FAE layer, the FAE client of FF UE2 communicates with FAE client of FF UE1 over FAE-2 reference point. In the FF application specific layer, the FF application specific client of FF UE2 communicates with FF application specific client of FF UE1 over FFA-2 reference point.

NOTE 3: The FFA-2 reference point is out of scope of the present document. The following SEAL services for FF applications are supported:

- Location management as specified in 3GPP TS 23.434 [5];

- Group management as specified in 3GPP TS 23.434 [5];

- Configuration management as specified in 3GPP TS 23.434 [5];

- Identity management as specified in 3GPP TS 23.434 [5];

- Key management as specified in 3GPP TS 23.434 [5];

- Network resource management as specified in 3GPP TS 23.434 [5] and;

- Network slice capability management as specified in 3GPP TS 23.434 [5].

The FAE client interacts with SEAL clients over the SEAL-C reference point specified for each SEAL service. The FAE server interacts with SEAL servers over the SEAL-S reference point specified for each SEAL service. The interaction between the SEAL clients is supported by SEAL-PC5 reference point specified for each SEAL service. The interaction between a SEAL client and the corresponding SEAL server is supported by SEAL-UU reference point specified for each SEAL service.

NOTE 4: The SEAL-C, SEAL-S, SEAL-PC5, SEAL-UU reference points for each SEAL service is specified in 3GPP TS 23.434 [5].

To support distributed FAE server deployments, the FAE server interacts with another FAE server over FAE-E reference point.

FF UE1 can also act as a UE-to-network relay,

- to enable FAE client on FF UE2 to access FAE server over FAE-1 reference point; and

- to enable FF application specific client on FF UE2 to access FF application specific server over FFA-1 reference point; and

- to enable SEAL client on FF UE2 to access SEAL servers over SEAL-UU reference point.

## 5.3 Functional entities

### 5.3.1 General

Each subclause is a description of a functional entity corresponding to FF application layer and does not imply a physical entity.

### 5.3.2 FF application specific client

The FF application specific client provides the client side functionalities corresponding to the FF applications (e.g. motion control, control-to-control communication, mobile robots, process automation – process monitoring, mobile control panels, remote access and maintenance). The FF application specific client utilizes the FAE client for the FF application layer support functions.

NOTE: The details of the FF application specific client is out of scope of the present document.

### 5.3.3 FF application specific server

The FF application specific server provides the server side functionalities corresponding to the FF applications (e.g. motion control, control-to-control communication, mobile robots, process automation – process monitoring, mobile control panels, remote access and maintenance). The FF application specific server utilizes the FAE server for the FF application layer support functions. If CAPIF is supported, the FF application specific server acts as CAPIF's API invoker as specified in 3GPP TS 23.222 [6].

NOTE: The details of the FF application specific server is out of scope of the present document.

### 5.3.4 FAE client

The FAE client provides the UE side FF application layer support functions and supports interactions with the FF application specific client(s).

### 5.3.5 FAE server

The FAE server provides the server side FF application layer support functions and supports interactions with FF applications specific server(s).

The FAE server also support interactions with other FAE server(s).

### 5.3.6 SEAL client

The following SEAL clients for FF applications are supported:

- Location management client as specified in 3GPP TS 23.434 [5];

- Group management client as specified in 3GPP TS 23.434 [5];

- Configuration management client as specified in 3GPP TS 23.434 [5];

- Identity management client as specified in 3GPP TS 23.434 [5];

- Key management client as specified in 3GPP TS 23.434 [5];

- Network resource management client as specified in 3GPP TS 23.434 [5];

- Network slice capability enablement client as specified in 3GPP TS 23.434 [5];

- Notification management client as specified in 3GPP TS 23.434 [5].

### 5.3.7 SEAL server

The following SEAL servers for FF applications are supported:

- Location management server as specified in 3GPP TS 23.434 [5];

- Group management server as specified in 3GPP TS 23.434 [5];

- Configuration management server as specified in 3GPP TS 23.434 [5];

- Identity management server as specified in 3GPP TS 23.434 [5];

- Key management server as specified in 3GPP TS 23.434 [5];

- Network resource management server as specified in 3GPP TS 23.434 [5];

- Network slice capability enablement server as specified in 3GPP TS 23.434 [5];

- Notification management client as specified in 3GPP TS 23.434 [5].

## 5.4 Service-based interfaces

## 5.5 Reference Points

### 5.5.1 General

The reference points for the FF application layer are described in the following subclauses.

### 5.5.2 FAE-1

The interactions related to FF application layer support functions between FAE client and FAE server are supported by FAE-1 reference point.

### 5.5.3 FFA-1

The interactions related to FF application layer support functions between FF application specific client and FF application specific server are supported by FFA-1 reference point. The details of FFA-1 reference point is out of scope of the present document.

### 5.5.4 FAE-2

The interactions related to FF application layer support functions between the FAE clients are supported by FAE-2 reference point.

### 5.5.5 FFA-2

The interactions related to FF applications between FF application specific clients are supported by FFA-2 reference point. The details of FFA-2 reference point is out of scope of the present document.

### 5.5.6 FAE-S

The interactions related to FF application layer support functions between FF application specific server and FAE server are supported by FAE-S reference point. If CAPIF is supported, this reference point is an instance of CAPIF-2/2e reference point as specified in 3GPP TS 23.222 [6].

### 5.5.7 FAE-C

The interactions related to FF application layer support functions between FF application specific client and FAE client are supported by FAE-C.

### 5.5.8 SEAL-C

The following SEAL-C reference points for FF applications are supported:

- LM-C reference point for location management as specified in 3GPP TS 23.434 [5];

- GM-C reference point for group management as specified in 3GPP TS 23.434 [5];

- CM-C reference point for configuration management as specified in 3GPP TS 23.434 [5];

- IM-C reference point for identity management as specified in 3GPP TS 23.434 [5];

- KM-C reference point for key management as specified in 3GPP TS 23.434 [5];

- NRM-C reference point for network resource management as specified in 3GPP TS 23.434 [5]; and

- NSCE-C reference point for network slice capability enablement as specified in 3GPP TS 23.434 [5];

- NM-C reference point for notification management as specified in 3GPP TS 23.434 [5].

### 5.5.9 SEAL-S

The following SEAL-S reference points for FF applications are supported:

- LM-S reference point for location management as specified in 3GPP TS 23.434 [5];

- GM-S reference point for group management as specified in 3GPP TS 23.434 [5];

- CM-S reference point for configuration management as specified in 3GPP TS 23.434 [5];

- IM-S reference point for identity management as specified in 3GPP TS 23.434 [5];

- KM-S reference point for key management as specified in 3GPP TS 23.434 [5];

- NRM-S reference point for network resource management as specified in 3GPP TS 23.434 [5]; and

- NSCE-S reference point for network slice capability enablement as specified in 3GPP TS 23.434 [5];

- NM-S reference point for notification management as specified in 3GPP TS 23.434 [5].

### 5.5.10 SEAL-PC5

The following SEAL-PC5 reference points for FF applications are supported:

- LM-PC5 reference point for location management as specified in 3GPP TS 23.434 [5];

- GM-PC5 reference point for group management as specified in 3GPP TS 23.434 [5];

- CM-PC5 reference point for configuration management as specified in 3GPP TS 23.434 [5];

- IM-PC5 reference point for identity management as specified in 3GPP TS 23.434 [5];

- KM-PC5 reference point for key management as specified in 3GPP TS 23.434 [5]; and

- NRM-PC5 reference point for network resource management as specified in 3GPP TS 23.434 [5].

### 5.5.11 SEAL-UU

The following SEAL-UU reference points for FF applications are supported:

- LM-UU reference point for location management as specified in 3GPP TS 23.434 [5];

- GM-UU reference point for group management as specified in 3GPP TS 23.434 [5];

- CM-UU reference point for configuration management as specified in 3GPP TS 23.434 [5];

- IM-UU reference point for identity management as specified in 3GPP TS 23.434 [5];

- KM-UU reference point for key management as specified in 3GPP TS 23.434 [5];

- NRM-UU reference point for network resource management as specified in 3GPP TS 23.434 [5]; and

- NSCE-UU reference point for network slice capability enablement as specified in 3GPP TS 23.434 [5];

- NM-UU reference point for notification management as specified in 3GPP TS 23.434 [5].

### 5.5.12 FAE-E

The interactions related to FF application supports functions between the FAE servers in a distributed deployment are supported by FAE-E reference point. If CAPIF is supported, this reference point is an instance of CAPIF-2/2e reference point as specified in 3GPP TS 23.222 [6].

## 5.6 Capability exposure for enabling FF applications

# 6 Identities

## 6.1 General

This clause describes the identities associated with the entities in the FF application layer and used in this specification.

## 6.2 Identities

### 6.2.1 FF user identity (FF user ID)

The FF user ID can be an instance of the VAL user ID as specified in 3GPP TS 23.434 [5]. The FF user ID is a globally unique identifier within the FF service that represents the FF user. The FF user ID shall be a URI. The FF user ID is used for authentication and authorization purposes for providing the FF service towards the FF user via the FF UE. The FF user ID also indicates the FF service provider with whom the FF user has a FF service agreement. The FF user may have FF service agreement with several FF service providers and thus will have obtained unique FF user ID per FF service provider.

Based on the service agreement, each FF user ID is mapped to a FF UE ID.

### 6.2.2 FF UE identity (FF UE ID)

The FF UE ID can be an instance of the VAL UE ID as specified in 3GPP TS 23.434 [5]. The FF UE ID is a unique identifier within the FF service that represents the FF UE. Generally, the FF UE ID is a 3GPP UE ID which is identity of the 3GPP UE combined with a FF hardware device (e.g. motion control unit, mobile robot, AGV) and deployed in factory environment. The 3GPP UE ID can be a GPSI in the form of an External Identifier which maps to UE related specific services (e.g. TSN DS-TT, 5G LAN-type service, SNPN, PNI-NPN) specified in 3GPP TS 23.501 [4] and 3GPP TS 23.502 [8].

### 6.2.3 FF group identity (FF group ID)

The FF group ID is a globally unique identifier within the FF service that represents a set of FF users and the corresponding FF UE. The set of FF users may belong to the same or different FF service provider. It indicates the FF application server where the group is defined. The FF group ID can be an instance of the VAL group ID as specified in 3GPP TS 23.434 [5].

### 6.2.4 FF Application Specific Server Identifier (FASS ID)

The FF application specific server identifier is used to uniquely identify the FF application specific server. The FASS ID is in the form of URI.

### 6.2.5 FAE Server Identifier (FAE Server ID)

The FAE server identifier is used to uniquely identify the FAE server. The FAE Server ID is in the form of URI.

# 7 Procedures and information flows

## 7.0 Usage of SEAL services

### 7.0.1 Group management service

#### 7.0.1.1 General

#### 7.0.1.2 Information flows

#### 7.0.1.3 Procedures

#### 7.0.1.4 APIs

### 7.0.2 Configuration management service

#### 7.0.2.1 General

#### 7.0.2.2 Information flows

#### 7.0.2.3 Procedures

#### 7.0.2.4 APIs

### 7.0.3 Location management service

#### 7.0.3.1 General

#### 7.0.3.2 Information flows

#### 7.0.3.3 Procedures

#### 7.0.3.4 APIs

### 7.0.4 Identity management service

#### 7.0.4.1 General

The FAE capabilities (FAE client and FAE server) utilizes identity management service procedures (e.g. authentication and authorization of UEs) of SEAL to support FF services.

#### 7.0.4.2 Information flows

The information flows of identity management service are specified in subclause 12.3.2 of 3GPP TS 23.434 [5] and are applicable for the FF applications.

#### 7.0.4.3 Procedures

The following procedures of identity management service as specified in 3GPP TS 23.434 [5] are applicable for the FF applications:

- General user authentication and authorization for VAL services specified in subclause 12.3.3.

### 7.0.5 Key management service

#### 7.0.5.1 General

The FAE capabilities (FAE client and FAE server) utilizes key management service procedures of SEAL to support FF services.

Editor's note: The security mechanisms of the FAE layer are for SA3 to define.

#### 7.0.5.2 Information flows

The information flows of key management service are specified in subclause 13.3 of 3GPP TS 23.434 [5] and are applicable for the FF applications.

#### 7.0.5.3 Procedures

The procedures of key management service are specified in subclause 13.3 of 3GPP TS 23.434 [5] and are applicable for the FF applications.

### 7.0.6 Network resource management service

#### 7.0.6.1 General

#### 7.0.6.2 Information flows

#### 7.0.6.3 Procedures

#### 7.0.6.4 APIs

# 8 APIs

Editor's Note: This clause will describe the APIs.

Annex A (Informative):  
Deployment models

# A.1 General

This clause describes deployments of the functional model specified in clause 5. The network interfaces utilized from underlying 3GPP network as specified in clause 5 is represented as 3GPP interfaces in the deployment models.

# A.2 Deployment of FAE+SEAL server

## A.2.0 General

The FAE+SEAL server deployments can be centralized and distributed.

NOTE 1: The described deployment scenarios show FAE and SEAL server collocation as just an example of possible deployment with respect to FAE servers and SEAL servers. Other deployments are also possible.

NOTE 2: The representation of SEAL functionalities in the FF deployment is specified in 3GPP TS 23.434 [5].

## A.2.1 Centralized deployments

A centralized deployment is where FAE+SEAL server offer the FAE+SEAL capabilities to one or more FF application specific servers. The FAE+SEAL server and the FF application specific server can be co-located in a single physical entity. The FAE+SEAL server can be deployed either in the PLMN operator domain or deployed in the FF operator domain. The FAE+SEAL server connect with the 5GS in one or more PLMN operator domain. When FAE+SEAL server and FF application specific server are co-located in a single physical entity, the FAE-S+SEAL-S reference points between the FAE+SEAL server and the FF application specific server are not used.

Figure A.2.1-1 illustrates a deployment of the FAE+SEAL server and the FF application specific server in a single physical entity and deployed in FF operator domain. The FAE+SEAL server can be deployed in a separate physical entity from the FF application specific server in the FF operator domain. In such deployments, the FAE-S+SEAL-S reference points are used for the communication between the FAE+SEAL server and the FF application specific server.



Figure A.2.1-1: FAE+SEAL server co-located with FF application specific server in a single physical entity

Figure A.2.1-2 illustrates a deployment of the FAE+SEAL server in the PLMN operator domain and the FF application specific server in the FF operator domain. The FAE-S+SEAL-S reference points are used for the communication between FF application specific server and the FAE+SEAL server. The FAE+SEAL server can support multiple FF application specific servers.



Figure A.2.1-2: FAE+SEAL server deployed in the PLMN operator domain

Figure A.2.1‑3 illustrates a deployment of the FAE+SEAL server which connect to the 5GS in multiple PLMN operator domain. The FAE+SEAL server can be co-located with the FF application specific server in a single physical entity or deployed in different physical entities.



Figure A.2.1-3: Deployment of FAE+SEAL server with connections to 5GS in multiple PLMN operator domains

Figure A.2.1‑4 illustrates a deployment of the FAE+SEAL server which provide FAE+SEAL capabilities to multiple FF application specific servers over FAE-S+SEAL-S reference points and connect to the 5GS in multiple PLMN operator domain.



Figure A.2.1-4: Deployment of FAE+SEAL server with connections to multiple FF application specific servers

## A.2.2 Distributed deployment

The distributed deployment is where multiple FAE+SEAL servers are deployed either in the FF operator domain or in the PLMN operator domain. The distributed deployment of the FAE+SEAL servers provide geographical coverage or support multiple PLMN operator domains in a geographical location. The FAE+SEAL servers interconnect via FAE-E+SEAL-E and the FAE-S+SEAL-S reference points are used for interaction between FF application specific server and the FAE+SEAL server.

Figure A.2.2-1 illustrates the deployment of FAE+SEAL servers in multiple PLMN operator domain and provide FAE+SEAL capabilities to the FF application specific server deployed in the FF operator domain. The FF application specific server connects via FAE-S+SEAL-S to the FAE+SEAL servers.



Figure A.2.2-1: Distributed deployment of FAE+SEAL servers in multiple PLMN operator domain without interconnection between FAE+SEAL servers

Figure A.2.2-2 illustrates the deployment of multiple FAE+SEAL servers deployed in multiple PLMN operator domains. The FF application specific server connects via FAE-S+SEAL-S to the FAE+SEAL server. The interconnection between FAE+SEAL servers are via FAE-E+SEAL-E and support the FF applications for the FF UEs connected to the FAE+SEAL servers in multiple PLMN operator domains.



Figure A.2.2-2: Distributed deployment of FAE+SEAL servers in multiple PLMN operator domain with interconnection between FAE+SEAL servers

Figure A.2.2-3 illustrates the deployment of multiple FAE+SEAL servers in PLMN operator domain based on geographical coverage. The FF application specific server connects via FAE-S+SEAL-S to the FAE+SEAL server 1. The FAE+SEAL servers interconnect via FAE-E+SEAL-E and support the FF communications to the FF UEs connected to the FAE+SEAL servers.



Figure A.2.2-3: Distributed deployment of FAE+SEAL servers in PLMN operator domain

Figure A.2.2-4 illustrates the deployment of multiple FAE+SEAL servers in the FF operator domain where FAE+SEAL server 1 and FAE+SEAL server 2 connect with 5GS of PLMN operator domain 1 and PLMN operator domain 2 respectively. The FF application specific server connects via FAE-S+SEAL-S to the FAE+SEAL server 1. The FAE+SEAL servers interconnect via FAE-E+SEAL-E and support the FF applications for the FF UEs connected via both the PLMN operator domains.



Figure A.2.2-4: Distributed deployment of FAE+SEAL servers in FF operator domain

# A.3 Deployment of FFAPP with Edge Enabler Layer

## A.3.1 General

The architecture for edge enabler layer is specified in 3GPP TS 23.558 [7]. This clause describes the deployment of FF application layer services at Edge Data Network by utilizing the Edge Enabler Layer services.

## A.3.2 Description

Figure A.3.2-1 illustrates the edge deployment example for the FFAPP. For simplicity, the reference points between enabler server and 5GS are omitted, and the reference points for inter-enabler server communication in the same enabler layer are also omitted. At UE side, FF Application Specific client(s) and FAE client interact with the Edge Enabler Client (EEC) via EDGE-5 reference point. In an Edge Data Network (EDN), FF Application Specific Server and FF Application Enabler server assume the role of EAS (Edge Application Server) and interacts with the Edge Enabler Server (EES) via EDGE-3 reference point, for instance, to register its profile into the EES. Upon service provisioning, the EEC interacts with the EES via EDGE-1 reference point, for instance, to discover FF Application Specific Server(s) and FF Application Enabler Server and further the EEC provides the discovered FF Application Specific Server(s) and FF Application Enabler Server to the FF Application Specific client and FF Application Enabler client respectively.



Figure A.3.2-1: Deployment of FFAPP with Edge Enabler Layer

In an EDN, there could be several EES(s) provided by the same or different ECSP. The FF application specific server(s) and FAE server shall be able to discover and register into an appropriate EES. If CAPIF is used, this can be done by utilizing the AEF serving area and/or the AEF location as described in 3GPP TS 23.222 [6]; otherwise, local configuration of the EES endpoint may be used.

Note that the services provided by EES over EDGE-3 are not re-exposed by the FAE server or SEAL servers to the FF application specific server but are directly consumed by the SEAL servers, FAE server and FF application specific server(s).

Annex B (Informative):  
Involved entities and relationships

# B.1 General

Figure B.1-1 shows the business relationships that exist and that are needed to support a single FF user.



Figure B.1-1: Business relationships for FF services

The FF user belongs to a FF service provider based on a FF service agreement between the FF user and the FF service provider. The FF service provider can have FF service agreements with several FF users. The FF user can have FF service agreements with several FF service providers. The FF service provider can have FF service provider agreements with several partner FF service providers.

The FF service provider and the home PLMN operator can be part of the same organization, in which case the business relationship between the two is internal to a single organization.

The home PLMN operator can have PLMN operator service arrangements with multiple FF service providers and the FF service provider can have PLMN operator service arrangements with multiple home PLMN operators. As part of the PLMN operator service arrangement between the FF service provider and the home PLMN operator, PLMN subscription arrangements can be provided which allows the FF UEs to register with home PLMN operator network.

The home PLMN operator can have PLMN roaming agreements with multiple visited PLMN operators and the visited PLMN operator can have PLMN roaming agreements with multiple home PLMN operators.

Annex C (Informative):   
Guideline for service enablers usage

# C.0 General

The FF application layer utilizes the SEAL services to support FFAPP services (e.g. establishing communication with FF application service requirements, geographic location and positioning information, 5GLAN group management, QoS monitoring, device monitoring, TSN and TSC communications, Private slice monitoring etc.) specified in 3GPP TS 23.434 [5] and 3GPP TS 23.435 [10].

The usage of the information flows is clarified as below:

- The VAL server ID works as FASS ID;

- The VAL UE ID works as FF UE ID.

# C.1 Support for TSC services

## C.1.1 General

The FF application layer utilizes the SEAL services to support for TSC services which include TSC stream resource management and TSN Bridge resource management.

## C.1.2 TSC stream resource management

### C.1.2.1 TSC stream availability discovery

In the TSC stream availability discovery procedure, the FF application layer entity discover the availability of resources for TSC communication for the given stream specification (i.e., between the target FF UEs) prior to creating the stream.

The following steps of TSC stream resource management service apply for the FF application layer entity:

- Send the TSC stream availability discovery request specified in clause 14.3.2.23 of 3GPP TS 23.434 [5];

- Receive the TSC stream availability discovery response specified in clause 14.3.2.24 of 3GPP TS 23.434 [5];

The usage of the above information flows is clarified as below:

- The Requester Identity works as FAE Server ID/ FASS ID;

- Stream specification works as MAC addresses of the source and destination DS-TT ports of FF UEs;

### C.1.2.2 TSC stream creation

In the TSC stream creation procedure, the FF application layer entity create the stream to establish TSC connectivity with the required QoS between the FF UEs connected to the 5GS after the stream discovery procedure.

The following steps of TSC stream resource management service apply for the FF application layer entity:

- Send the TSC stream creation request specified in clause 14.3.2.25 of 3GPP TS 23.434 [5];

- Receive the TSC stream creation response specified in clause 14.3.2.26 of 3GPP TS 23.434 [5];

The usage of the above information flows is clarified as below:

- The Requester Identity works as FAE Server ID/ FASS ID;

- The VAL Stream ID works as identity of FF stream;

- Stream specification works as MAC addresses of the source and destination DS-TT ports of FF UEs;

### C.1.2.3 TSC stream deletion

In the TSC stream deletion procedure, the FF application layer entity delete a TSC stream.

The following steps of TSC stream resource management service apply for the FF application layer entity:

- Send the TSC stream deletion request specified in clause 14.3.2.27 of 3GPP TS 23.434 [5];

- Receive the TSC stream deletion response specified in clause 14.3.2.28 of 3GPP TS 23.434 [5];

The usage of the above information flows is clarified as below:

- The VAL Stream ID works as identity of FF stream;

## C.1.3 TSN Bridge resource management

### C.1.3.1 TSN Bridge information reporting

In the TSN Bridge information reporting procedure, the FF application layer entity acting as TSN CNC to get TSN Bridge information report.

The following steps of TSN Bridge resource management service apply for the FF application layer entity:

- Get the TSN Bridge information report specified in clause 14.3.2.29 of 3GPP TS 23.434 [5];

- Return the TSN Bridge information reporting specified in clause 14.3.2.30 of 3GPP TS 23.434 [5];

### C.1.3.2 TSN Bridge configuration

In the TSN Bridge configuration procedure, the FF application layer entity acting as TSN CNC to get TSN Bridge configuration.

The following steps of TSN Bridge resource management service apply for the FF application layer entity:

- Send the TSN bridge configuration request specified in clause 14.3.2.31 of 3GPP TS 23.434 [5];

- Receive the TSN bridge configuration response specified in clause 14.3.2.32 of 3GPP TS 23.434 [5];

# C.2 Support for MSGin5G services

## C.2.1 General

NOTE: Whether usage Support for MSGin5G services or not is FFS.

The FF application layer support message communication support for non-TSN messaging communications through usage of MSGin5G services specified in 3GPP TS 23.554 [9].

The following MSGin5G functional entities are supported:

- The FAE server acts as MSGin5G server specified in 3GPP TS 23.554 [9];

- The FAE client acts as MSGin5G client specified in 3GPP TS 23.554 [9];

- The FF application specific server acts as Application server specified in 3GPP TS 23.554 [9];

- The FF application specific client acts as Application client specified in 3GPP TS 23.554 [9];

The following MSGin5G reference points are supported:

- The FAE-1 acts as MSGin5G-1 specified in 3GPP TS 23.554 [9];

- The FAE-S acts as MSGin5G-3 specified in 3GPP TS 23.554 [9];

- The FAE-C acts as MSGin5G-5 specified in 3GPP TS 23.554 [9];

- The FAE-2 acts as MSGin5G-6 specified in 3GPP TS 23.554 [9];

## C.2.2 Registration

### C.2.2.1 MSGin5G UE Registration

The following steps of MSGin5G service applied:

- MSGin5G UE registration request specified in clause 8.2.1 of 3GPP TS 23.554 [9];

- MSGin5G UE registration response specified in clause 8.2.1 of 3GPP TS 23.554 [9];

The usage of the above information flows is clarified as below:

- The MSGin5G UE ID works as FF UE ID;

### C.2.2.2 MSGin5G UE De-Registration

The following steps of MSGin5G service applied:

- MSGin5G UE de-registration request specified in clause 8.2.2 of 3GPP TS 23.554 [9];

- MSGin5G UE de-registration response specified in clause 8.2.2 of 3GPP TS 23.554 [9];

### C.2.2.3 Application Server Registration

The following steps of MSGin5G service applied:

- Application Server registration request specified in clause 8.2.5 of 3GPP TS 23.554 [9];

- Application Server registration response specified in clause 8.2.5 of 3GPP TS 23.554 [9];

### C.2.2.4 Application Server De-registration

The following steps of MSGin5G service applied:

- Application Server de-registration request specified in clause 8.2.6 of 3GPP TS 23.554 [9];

- Application Server de-registration response specified in clause 8.2.6 of 3GPP TS 23.554 [9];

## C.2.3 Message delivery procedures into and from MSGin5G Server

### C.2.3.1 MSGin5G inbound messages into the MSGin5G Server

The following procedures of MSGin5G service applied:

- MSGin5G message request from UE specified in clause 8.3.2 of 3GPP TS 23.554 [9];

- MSGin5G message request from Application Server specified in clause 8.3.2 of 3GPP TS 23.554 [9];

### C.2.3.2 MSGin5G outbound messages from the MSGin5G Server

The following procedures of MSGin5G service applied:

- MSGin5G message towards UE specified in clause 8.3.3 of 3GPP TS 23.554 [9];

- Message towards an Application Server specified in clause 8.3.3 of 3GPP TS 23.554 [9];

### C.2.3.3 MSGin5G message delivery status report into the MSGin5G Server

The following procedures of MSGin5G service applied:

- Message delivery status report from MSGin5G UE specified in clause 8.3.4 of 3GPP TS 23.554 [9];

- Message delivery status report from Application Server specified in clause 8.3.4 of 3GPP TS 23.554 [9];

### C.2.3.4 MSGin5G message delivery status report from the MSGin5G Server

The following procedures of MSGin5G service applied:

- Message delivery status report towards an MSGin5G UE specified in clause 8.3.5 of 3GPP TS 23.554 [9];

- Message delivery status report towards an Application Server specified in clause 8.3.5 of 3GPP TS 23.554 [9];

### C.2.3.5 MSGin5G Store and Forward

The following procedure of MSGin5G service applied:

- Store and forward specified in clause 8.3.6 of 3GPP TS 23.554 [9];

## C.2.4 Message Aggregation

### C.2.4.1 Message Aggregation at MSGin5G Client

The following procedures of MSGin5G service applied:

- MSGin5G UE aggregates messages towards target MSGin5G UE specified in clause 8.4.2 of 3GPP TS 23.554 [9];

- MSGin5G UE aggregates messages towards target Application Server specified in clause 8.4.2 of 3GPP TS 23.554 [9];

### C.2.3.2 Message Aggregation at MSGin5G Server

The following procedure of MSGin5G service applied:

- MSGin5G Server aggregates messages towards target MSGin5G UE specified in clause 8.4.3 of 3GPP TS 23.554 [9];

## C.2.5 MSGin5G Message Segmentation and Reassembly

### C.2.5.1 Application-to-Point Segmentation and Reassembly

The following procedure of MSGin5G service applied:

- Application-to-Point MSGin5G Message Segmentation and Reassembly specified in clause 8.5.2 of 3GPP TS 23.554 [9];

### C.2.5.2 Point-to-Application Message Segmentation and Reassembly

The following procedure of MSGin5G service applied:

- Point-to-Application MSGin5G Message Segmentation and Reassembly specified in clause 8.5.3 of 3GPP TS 23.554 [9];

### C.2.5.3 Point-to-Point Message Segmentation and Reassembly

The following procedure of MSGin5G service applied:

- Point-to-Point MSGin5G Message Segmentation and Reassembly specified in clause 8.5.4 of 3GPP TS 23.554 [9];

### C.2.5.4 MSGin5G Message Segment Recovery

The following procedure of MSGin5G service applied:

- MSGin5G Message Segment Recovery specified in clause 8.5.6 of 3GPP TS 23.554 [9];

## C.2.6 E2E Message delivery procedures

### C.2.6.1 Point-to-Point Message delivery procedure

The following procedure of MSGin5G service applied:

- Message delivery between MSGin5G UEs specified in clause 8.7.1 of 3GPP TS 23.554 [9];

### C.2.6.2 Application-to-Point Message delivery procedure

The following procedure of MSGin5G service applied:

- Message delivery from Application Server to MSGin5G UE specified in clause 8.7.2 of 3GPP TS 23.554 [9];

### C.2.6.3 Point-to-Application Message delivery procedure

The following procedure of MSGin5G service applied:

- Message delivery from MSGin5G UE to Application Server specified in clause 8.7.3 of 3GPP TS 23.554 [9];

### C.2.6.4 MSGin5G Group messaging

The following procedures of MSGin5G service applied:

- Message delivery from UE to group specified in clause 8.7.4.2 of 3GPP TS 23.554 [9];

- Message delivery procedure from Application Server to group specified in clause 8.7.4.3 of 3GPP TS 23.554 [9];

## C.2.7 Message Topic

### C.2.7.1 Messaging Topic Subscription

The following procedure of MSGin5G service applied:

- MSGin5G Service endpoint subscribes to Messaging topic(s) specified in clause 8.8.1 of 3GPP TS 23.554 [9];

### C.2.7.2 Message delivery based on Messaging Topic

The following procedure of MSGin5G service applied:

- Message delivery to subscribing service endpoint based on Messaging Topic specified in clause 8.8.2 of 3GPP TS 23.554 [9];

### C.2.7.3 Messaging Topic Unsubscription

The following procedure of MSGin5G service applied:

- MSGin5G Service endpoint unsubscribes to Messaging topic(s) specified in clause 8.8.3 of 3GPP TS 23.554 [9];

## C.2.8 Constrained devices

### C.2.8.1 Constrained device registration to use gateway UE

The following procedure of MSGin5G service applied:

- Registration of application client on UE-2 with MSGin5G Client-1 to use gateway UE functionality specified in clause 8.11.2 of 3GPP TS 23.554 [9];

### C.2.8.2 Constrained device Deregistration from using gateway UE

The following procedure of MSGin5G service applied:

- Deregistration of Application Client on UE-2 with MSGin5G Client-1 on MSGin5G UE-1 to discontinue use of gateway UE functionality specified in clause 8.11.3 of 3GPP TS 23.554 [9];

### C.2.8.3 Constrained device sending message using Gateway UE

The following procedure of MSGin5G service applied:

- Application Client-2 on UE-2 sends message using gateway UE functionality on MSGin5G UE-1 specified in clause 8.11.4 of 3GPP TS 23.554 [9];

### C.2.8.4 Constrained device receiving message via Gateway UE

The following procedure of MSGin5G service applied:

- UE-2 receives message using gateway UE functionality on MSGin5G UE-1 specified in clause 8.11.5 of 3GPP TS 23.554 [9];

# C.3 Support for FF message delivery by SEALDD

Editor's note: the content shall be cross-checked, and if needed aligned with the final version of SEALDD later.

## C.3.1 General

The FF application layer utilizes the SEAL services to support for FF message delivery by SEALDD specified in 3GPP TS 23.433 [11].

## C.3.2 SEALDD regular connection establishment

The SEALDD regular connection establishment procedures are specified in subclause 9.2 of 3GPP TS 23.433 [11].

The following information flows applied:

- SEALDD enabled regular transmission request specified in subclause 9.2.3.1 of 3GPP TS 23.433 [11];

- SEALDD enabled regular transmission response specified in subclause 9.2.3.2 of 3GPP TS 23.433 [11];

- SEALDD enabled regular transmission connection establishment request specified in subclause 9.2.3.3 of 3GPP TS 23.433 [11];

- SEALDD enabled regular transmission connection establishment response specified in subclause 9.2.3.4 of 3GPP TS 23.433 [11];

## C.3.3 SEALDD enabled E2E redundant transmission

The SEALDD enabled E2E redundant transmission procedure is specified in subclause 9.3 of 3GPP TS 23.433 [11].

The following information flows applied:

- SEALDD URLLC transmission request specified in subclause 9.3.3.1 of 3GPP TS 23.433 [11];

- SEALDD URLLC transmission response specified in subclause 9.3.3.2 of 3GPP TS 23.433 [11];

- SEALDD URLLC transmission connection establishment request specified in subclause 9.3.3.3 of 3GPP TS 23.433 [11];

- SEALDD URLLC transmission connection establishment response specified in subclause 9.3.3.4 of 3GPP TS 23.433 [11];

- SEALDD URLLC transmission connection update request specified in subclause 9.3.3.5 of 3GPP TS 23.433 [11];

- SEALDD URLLC transmission connection update response specified in subclause 9.3.3.6 of 3GPP TS 23.433 [11];

Annex D (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2021-10 | SA6#45-BIS-e |  |  |  |  | TS skeleton | 0.0.0 |
| 2021-10 | SA6#45-BIS-e |  |  |  |  | Implementation of the following pCRs approved by SA6:  S6-212389, S6-212234, S6-212468 | 0.1.0 |
| 2021-11 | SA6#46-e |  |  |  |  | Implementation of the following pCRs approved by SA6:  S6-212822, S6-212741, S6-212532 | 0.2.0 |
| 2022-02 | SA6#47-e |  |  |  |  | Implementation of the following pCRs approved by SA6:  S6-220403, S6-220323, S6-220442, S6-220061 | 0.3.0 |
| 2022-04 | SA6#48-e |  |  |  |  | Implementation of the following pCRs approved by SA6:  S6-220936, S6-220886 | 0.4.0 |
| 2022-05 | SA6#49-e |  |  |  |  | Implementation of the following pCRs approved by SA6:  S6-221283,S6-221018, S6-221284 | 0.5.0 |
| 2022-07 | SA6#49-Bis-e |  |  |  |  | Implementation of the following pCRs approved by SA6:  S6-221906 | 0.6.0 |
| 2022-10 | SA6#51-e |  |  |  |  | Implementation of the following pCRs approved by SA6:  S6-223031, S6-222896 | 0.7.0 |
| 2022-11 | SA6#52 |  |  |  |  | Implementation of the following pCRs approved by SA6:  S6-223559 | 0.8.0 |
| 2023-01 | SA6#52-Bis-e |  |  |  |  | Implementation of the following pCRs approved by SA6:  S6-230455, S6-230456 | 0.9.0 |