Draft new Recommendation ITU-T Y.2326 (ex Y.NGNe-cp_na)

Network attachment control framework in Next Generation Network evolution control plane

Summary

This Recommendation aims to provide a network attachment control framework for an NGN evolution control plane (NGNe-cp) [ITU-T Y.2325] architecture that supports decoupling of the signalling handling functionality and the user plane control functionality in the control plane. In the NGNe-cp architecture, network attachment is considered a built-in service supported by using network attachment signalling service function (NASSF) and network attachment signalling service support function (NASSsupportF), which are detailed in this Recommendation. This is followed by a description of information flows for the network attachment process using the proposed network attachment control framework.

Keywords

Next Generation Network; Software-Defined Networking; Network attachment control; NGN evolution control plane

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Network attachment control framework in Next Generation Network evolution control plane

1 Scope

This Recommendation provides a network attachment control framework in an NGN evolution control plane (NGNe-cp) architecture.

The recommendation includes:

- Functional entities, reference points and their descriptions for network attachment signalling service function and network attachment signalling service support function; and
- Information flows for network attachment procedures.

2 References

The following ITU-T Recommendations and other references contain provisions, which through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.2014] Recommendation ITU-T Y.2014 (2010), *Network attachment control functions in next generation networks*

[ITU-T Y.2325] Recommendation ITU-T Y.2325 (2023), *Architectural evolution for Next Generation Network control plane by applying Software-Defined Networking technology*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 network attachment point [ITU-T b-E.760]: The physical location in the network used for terminating the routing of calls to/from the end-user system (terminal identifier). In the case where the segment spanned between the physical termination of the end-user system and the network access point has additional functions to the sheer electrical connection, access network functionality is required for user information and signalling transfer.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 network attachment: Network attachment is the process by which a device connects to network to access services. The process includes authentication, authorization, dynamic configuration, and location management.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AR-FE	Access Relay Functional Entity
AM-FE	Access Management Functional Entity (AM-FE)
EUE	End User Equipment
FE	Functional Entity
HGWC-FE	Home Gateway Configuration Functional Entity (HGWC-FE)
IP	Internet Protocol
NAC-FE (M)	Network Access Configuration Functional Entity (Main)
NAC-FE (S)	Network Access Configuration Functional Entity (Support)
NASSF	Network Attachment Signalling Service Function
NASSsupportF	Network Attachment Signalling Service Support Function
NGNe-cp	NGN (Next Generation Network) evolution Control Plane
MSSF	Mobility Signalling Service Function
MSSsupportF	Mobility Signalling Support Service Function
RACF	Resource and Admission Control Functions
SSF	Signalling Service Function
SSsupportF	Signalling Service Support Function
TAA-FE (M)	Transport Authentication and authorization Functional Entity (Main)
TAA-FE (S)	Transport Authentication and authorization Functional Entity (Support)
TLM-FE (M)	Transport Location Management Functional Entity (Maim)
TLM-FE (S)	Transport Location Management Functional Entity (Support)
TUP-FE	Transport User Profile Functional Entity

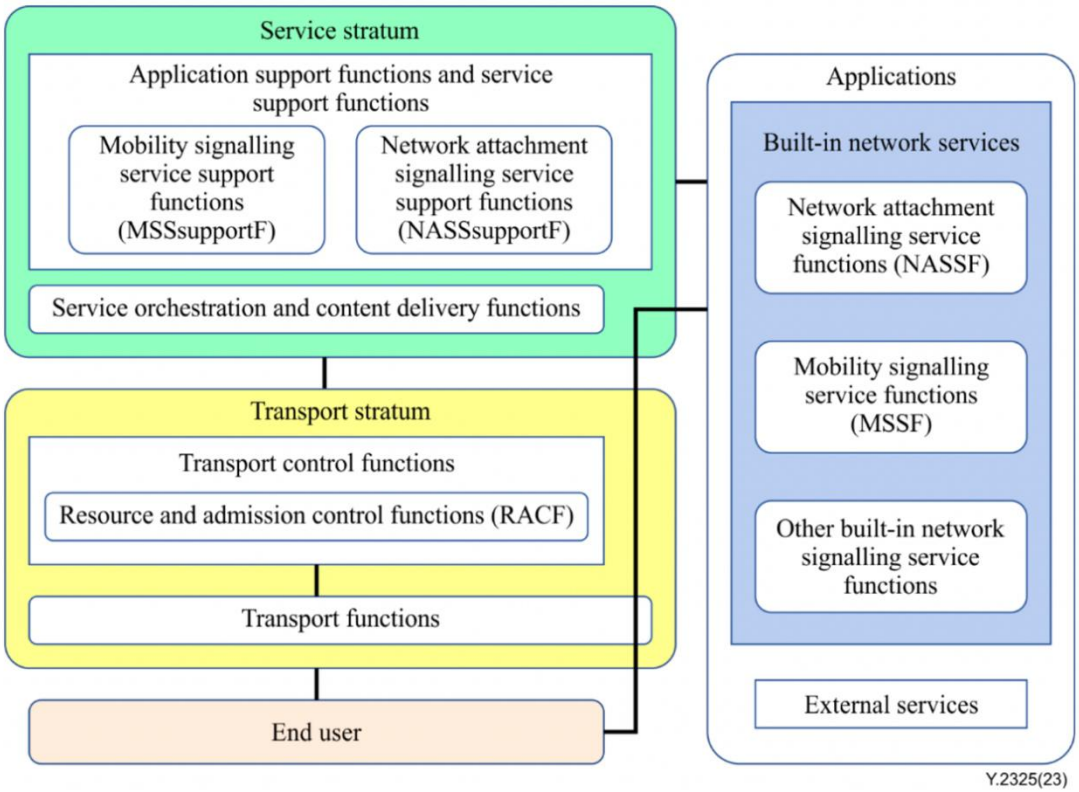
5 Conventions

In this Recommendation, requirements are classified as follows:

The keywords "**optionally**" or "**may**" indicate an optional requirement that is permissible, without implying any sense of being recommended. These terms are not intended to imply that the vendor's implementation must provide the option; rather, they mean the vendor may optionally provide the feature and still claim conformance with the specification.

6 Overview

ITU-T Y.2325 outlines the functional architecture of the NGN evolution control plane (NGNe-cp) as shown in Figure-1.



[Source: Recommendation ITU-T Y.2325, Figure 8-9]

Figure 1- Placement and splitting of high-level functions for network attachment and mobility services in NGN evolution.

In the NGNe-cp architecture, mobility and network attachment are considered built-in services and are handled in the same manner as external services/applications are handled in the network. For these built-in services, there are corresponding high-level functions named signalling service functions and signalling service support functions. The signalling service function (SSF) is placed in the applications , and the signalling service support function (SSsupportF) is placed in the service stratum to provide support for built-in service(s). These functions are responsible for end-user signalling and collecting/providing service-related information for built-in services. To support network attachment service in the NGNe-cp architecture, there are two high-level functions: network attachment signalling service function (NASSF) and network attachment signalling service support function (NASSsupportF). NASSF is considered an application (service), and NASSsupportF is placed in the service stratum as shown in Figure 1.

This Recommendation provides details of Functional Entities (FEs) associated with these two high-level functions (NASSF and NASSsupportF) to support the network attachment service. Furthermore, detailed procedures for network attachment point are also covered, considering functional entities for registration, initialisation, identification and authentication.

7 Network attachment control framework in NGNe-cp architecture

Network attachment service is a built-in service in the network that provides initial access and registration for the EUE to access the NGNe-cp services. To support network attachment as a service in NGNe-cp architecture, NASSF and NASSsupportF are composed of various FEs. These FEs are placed in the application and service stratum as per their inclusion in either NASSF or NASSsupportF. All FEs required in NASSF and NASSsupport functions to support network attachment in the NGNe-cp architecture are shown in Figure 2. Please note that some of these functional entities and their associated functionalities are the same as described in [ITU-T Y.2014]. However, their placement is changed to align with the architecture of NGNe-cp.

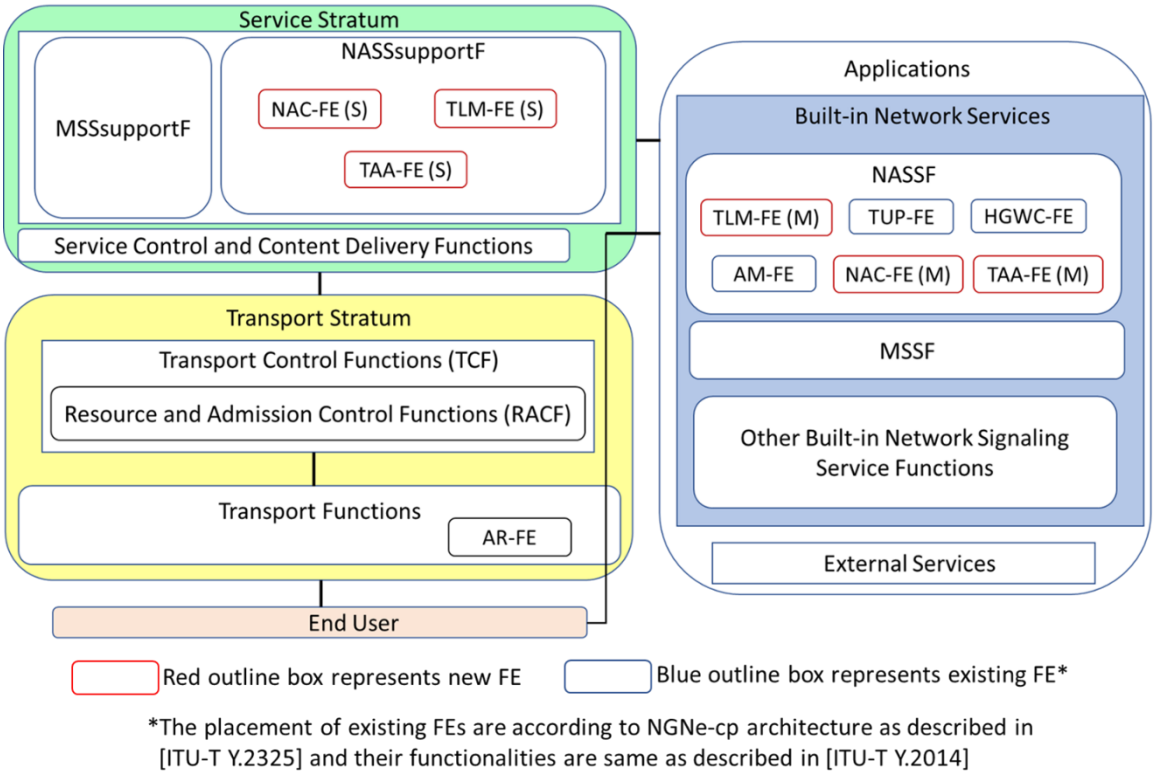


Figure 2- Functional entities for NASSF and NASSsupport in NGN evolution control plane

Other than FEs in NASSF and NASSsupportF, there is an Access Relay Functional Entity (AR-FE) as part of transport functions to support network attachment service. The functionalities and placement of AR-FE are the same for NGNe-cp architecture as described in [ITU-T Y.2014]. In addition, network attachment service-related FEs also need to interact with Mobility Signalling Service Function (MSSF) for mobility-related initial registration; they also need to interact with Resource and Admission Control Functions (RACFs) for resource configuration (for signalling sessions between EUE and NASSF). The next sections provide detailed functionalities of FEs associated with high-level network attachment functions (NASSF and NASSsupportF).

7.1 NASSF Functional entities

NASSF, placed in the applications, is the main point of contact with EUE to exchange network attachment service-related information. Its main functionalities are registration support, IP address allocation, authorization and authentication, the association between the IP address and EUE location information, distribution of network configuration parameters, initialization and update of the home gateway, and session initiation with EUE through NASSsupportF [ITU-T Y.2325]. Responsibilities of NASSF are further divided into the following functional entities: Network Access Configuration Functional Entity (Main) (NAC-FE (M)), Access Management Functional Entity (AM-FE), Transport Location Management Functional Entity (Main) (TLM-FE (M)), Transport Authentication and Authorization Functional Entity (Main) (TAA-FE (M)), Transport User Profile Functional Entity (TUP-FE), and Home Gateway Configuration Functional Entity (HGWC-FE), which are part of NASSF in the applications.

NOTE - Using (M) with some of the FEs indicates that all of their functionalities (as described in [ITU-T Y.2014]) are not the responsibilities of the main (M) FEs in the NGNe-cp architecture. Some of the functionalities of these FEs are now taken care of by Support (S) FEs, which are placed in the service stratum in the NGNe-cp architecture.

7.1.1 Network Access Configuration Functional Entity (Main) (NAC-FE (M))

The functionalities of NAC-FE (M) in NGNe-cp architecture are detailed based on clause 6.4.1 of [ITU-T Y.2014], which are listed as follows:

- It is responsible for allocating IP addresses for the EUE. It allocates persistent IP addresses and temporary addresses (in case of mobility). It also allocates an IP address for TAA-FE (M) during authentication procedures.
- It can distribute network configuration parameters to the EUE as detailed in clause 9.1 of [ITU-T Y.2325]. To serve this purpose, it interacts with NAC-FE (M) in the service stratum to collect access network-related information.

7.1.2 Access Management Functional Entity (AM-FE)

The functionalities of AM-FE in the NGNe-cp architecture are the same as detailed in clause 7.2.2 of [ITU-T Y.2014]. This FE provides a connection between EUE and NASSF FEs for registration and initial attachment of EUE. Other than the functionalities as per the given clause, it initiates a session establishment request through NAC-FE (S) for signalling exchange with EUE for network attachment service.

7.1.3 Transport Location Management Functional Entity (Main) (TLM-FE (M))

The functionalities of TLM-FE in the NGNe-cp architecture are detailed based on clause 7.2.3 of [ITU-T Y.2014]. It holds an association between IP addresses and related location information. In the case of a mobility scenario from the home network to the visited network, the old TLM-FE (M) needs to transfer this association to the new TLM-FE (M). It may store transport subscription profile information containing access network level information. It collects access network-related information from TLM-FE (S) to maintain transport subscription profile information for EUE. It informs location-related updates to TLM-FE (S) in case of a change in association due to the movement of EUE. It also responds to location-related queries from other FEs.

7.1.4 Transport Authentication and Authorization Functional Entity (Main) (TAA-FE (M))

The functionalities of TAA-FE in the NGNe-cp architecture are the same as detailed in clause 7.2.4 of [ITU-T Y.2014]. To serve these functionalities, it sends requests to TAA-FE (S) to collect specific information related to the access network.

7.1.5 Transport User Profile Functional Entity (TUP-FE)

The functionalities of TUP-FE in the NGNe-cp architecture are the same as detailed in clause 7.2.5 of [ITU-T Y.2014].

7.1.6 Home Gateway Configuration Functional Entity (HGWC-FE)

The functionalities of HGWC-FE in the NGNe-cp architecture are the same as detailed in clause 7.2.6 of [ITU-T Y.2014].

7.2 NASSsupportF Functional entities

NASSsupportF is placed in the service stratum to support NASSF. Its functionalities include support for session establishment between EUE and NASSF, information distribution, and provisioning for access network information [ITU-T Y.2325]. To serve these functionalities, Network Access Configuration Functional Entity (Support) (NAC-FE (S)), Transport Location Management Functional Entity (S) (TLM-FE (S)), and Transport Authentication and Authorization Functional Entity (S) (TAA-FE (S)) are part of NASSsupportF.

7.2.1 Network Access Configuration Functional Entity (Support) (NAC-FE (S))

NAC-FE (S) is a service support FE for NAC-FE (M) in the service stratum. Functionalities of MLM-FE (P) in NGNe-cp architecture are detailed based on clause 6.4.1 of [ITU-T Y.2014]. NAC-FE (S) collects access network-related information requested by NAC-FE (M) from RACFs and shares it with NAC-FE (M). This information is to identify the access network to which EUE is attached. In

addition, upon receiving a request for signalling session establishment from AM-FE, it requests RACFs for resource configuration for session establishment with EUE for network attachment-related signalling.

7.2.2 Transport Location Management Functional Entity (S) (TLM-FE (S))

TLM-FE (S) is a service support FE for TLM-FE (M) in the service stratum. Upon receiving a request from TLM-FE (M), it collects access-related specific information from RACFs, which is required by TLM-FE (M) for maintaining location updates. It also coordinates with the Mobility Signalling Service Support Function (MSSsupportF) regarding location updates in the service stratum.

7.2.3 Transport Authentication and authorization Functional Entity (S) (TAA-FE (S))

TAA-FE (S) is a service support FE for TAA-FE (M) in the service stratum. Upon receiving a request from TAA-FE (M), it collects access-related specific information from RACFs, which is required by TAA-FE (M) to maintain the transport subscription profile. It also coordinates with MSSsupportF FEs regarding EUE authentication and authorization attributes in the service stratum.

7.3 Reference points

Figure 3 shows the reference points for the network attachment service functions in the NGNe CP architecture. Modified reference points are represented with quotation marks in the figure. There are three new reference points named as Nn1, Nn2 and Nn3. The following sub-sections provide a description of the reference points based on Figure 3.

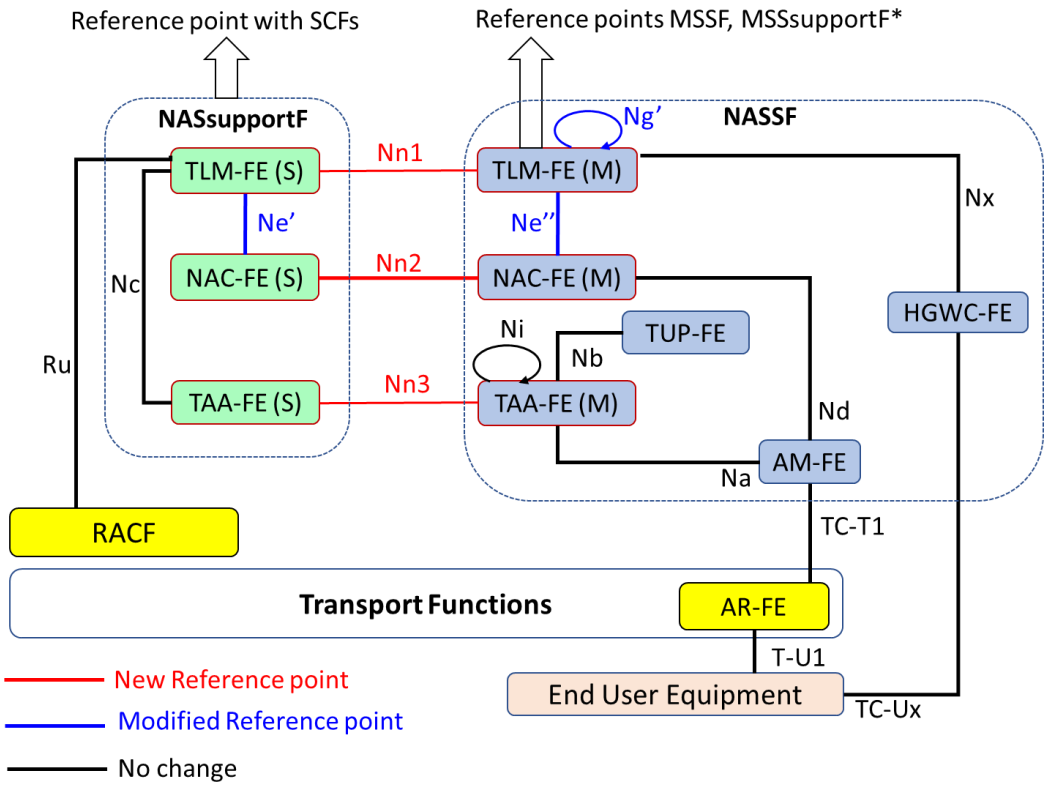


Figure 3: Reference points for network attachment service functions in NGNe-CP architecture

NOTE - Reference points with Mobility service functions are out of the scope of this Recommendation.

7.3.1 Internal NASSF reference points

7.3.1.1 Reference point Nd

The reference point Nd is between AM-FE and NAC-FE (M), which is used for the same purpose as described in clause 8.1.1 of [ITU-T Y.2014]

7.3.1.2 Reference point Na

The reference point Na is between AM-FE and TAA-FE (M), which is used for same purpose as described in clause 8.1.3 of [ITU-T Y.2014]

7.3.1.3 Reference point Ne''

The reference point Ne'' represents a modified form of the reference point Ne, and it is a reference point between TLM-FE (M) and NAC-FE (M) in NGNe-cp architecture, which is used for the purposes as described in clauses 8.1.2.1 - 8.1.2.5 of [ITU-T Y.2014].

7.3.1.4 Reference point Nx

The reference point Nx is between HGWC-FE and TLM-FE (M), which is used for same purpose as described in clauses 8.1.7 of [ITU-T Y.2014].

7.3.1.5 Reference point Nb

The reference point Nb is between TUP-FE and TAA-FE (M), which is used for the same purpose as described in clauses 8.1.9 of [ITU-T Y.2014].

7.3.1.6 Reference point Ng'

The reference point Ng' represents a modified form of the Ng, and it is a loop-back reference point at TLM-FE (M). It supports all information exchange described in clause 8.1.8 of [ITU-T Y.2014] except subclause 8.1.8.5 of [ITU-T Y.2014].

7.3.1.7 Reference point Ni

The purpose and description of using reference point Ni is the same for TAA-FE (M) entity in the NGNe-cp architecture as described in clause 8.1.6 of [ITU-T Y.2014] for the TAA-FE entity of NGN architecture.

7.3.2 Internal NASsupportF reference points

7.3.2.1 Reference point Ne'

The reference point Ne' represents a modified form of the Ne, and it is a reference point between TLM-FE (S) and NAC-FE (S), which is used for mobility service parameters indication as described in clause 8.1.2.6 of [ITU-T Y.2014]

7.3.1.2 Reference point Nc

The reference point Nc is between TAA-FE (S) and TLM-FE (S), which is used for the same purpose as described in clause 8.1.4 of [ITU-T Y.2014].

7.3.3 Reference points between NASSF and NASsupportF

7.3.3.1 Reference point Nn1

The reference point Nn1 is between TLM-FE (S) and TLM-FE (M), which is used for exchanging the information as described in clause 8.1.8.5 of [ITU-T Y.2014].

7.3.3.2 Reference point Nn2

The reference point Nn2 is between NAC-FE (S) and NAC-FE (M), which is used to support signalling session establishment as detailed in clauses 9.2 and 11.2 of [ITU-T Y.2325].

7.3.3.3 Reference point Nn3

The reference point Nn3 is between TAA-FE (S) and TAA-FE (M), which is used for exchanging the information as described in clause 8.1.6.1 of [ITU-T Y.2014].

7.3.4 Reference point between NASsupportF and RACF

The reference point Ru is between TLM-FE (S) in NASsupportF and RACF's FE, which is used for the same purpose as described in clause 8.2.1 of [ITU-T Y.2014].

7.3.5 Reference point between NASsupportF and Service control functions

The reference point S-TC1 is between TLM-FE (S) in NASsupportF and SCF, which is used for the same purpose as described in clause 8.3.1 of [ITU-T Y.2014].

7.3.6 Reference point between NASSF and EUE

7.3.6.1 Reference points for communication between AM-FE and EUE

There is no direct reference point between AM-FE and EUE. However, communication between AM-FE and EUE is possible via reference points TC-T1 (between AM-FE and AR-FE) and T-U1 (between AR-FE and EUE) as described in clause 8.4.1 of [ITU-T Y.2014].

7.3.6.2 Reference point between HWFC-FE and EUE

The reference point TC-Ux is between HWFC-FE and EUE as described in clause 8.4.2 of [ITU-T Y.2014].

8 Information flows

8.1 Information flow for network attachment process

This clause provides an information flow for the network attachment process, including the distribution of transport subscription profiles to other FEs in the NGNe-cp architecture. This information flow is detailed based on the flow provided in Appendix II of [ITU-T Y.2014]. As the NGNe-cp architecture does not impact the basic functionalities of FEs, only the placement of FEs is changed based on the concept of signalling service functions for built-in services. Hence, the aim is to show how FEs in NSSF and NSSupportF will coordinate in the NGNe-cp architecture to serve network attachment as a service. Network attachment flow consists of three main stages based on the functionalities and configuration required to complete the network attachment process for an EUE.

8.2 Information flow for authentication and authorization

In stage 1, EUE is authenticated and authorized to access the NGNe. Information flow for this stage is presented in Figure 4.

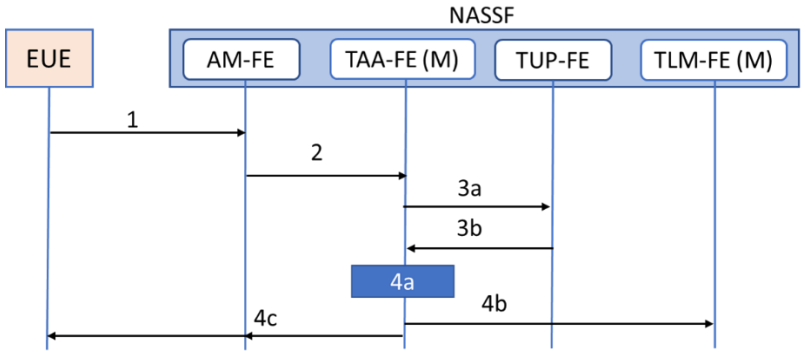


Figure 4: Information flow for authentication and authorization

The description of the steps is as follows:

1. As AM-FE provides a connection between EUE and NASSF FEs for registration and initial attachment of EUE, EUE sends a request for network attachment to AM-FE. EUE also provides identifiers, mobility service indicator, and credentials along with the request for authentication purposes.

2. AM-FE forwards this request to TAA-FE (M) for authentication and authorization to access the network. It translates the request into a format that is acceptable for TAA-FE. It may include link-layer parameters and host configuration parameters with this request, as detailed in clause 7.2.2 [ITU-T Y.2014].

3. Upon receiving the request from EUE (via AM-FE), TAA-FE (M) collects the transport subscription profile with steps 3a and 3b (as detailed in clause 7.2.5 [ITU-T Y.2014])) and mobility service parameters (as detailed in clause 7.2.1 [ITU-T Y.2018]) from TUP-FE.

4. TAA-FE (M) performs authentication for services, including mobility service (4a). Upon successful authentication, it forwards the transport subscription profile to TLM-FE (M) along with the logical connection identifier (4b), Transport Subscriber Identifier, and mobility service parameters (clause 8.1.4.1 of [ITU-T Y.2014]). It also sends a response to the EUE via AM-FE (4c).

8.3 Information flow for IP configuration

In stage 2, the information flow provided in this clause (shown in Figure 5) is for the dynamic provisioning of IP addresses and their related information to the EUE and to the other relevant FEs in the network. Further mapping of IP address information with the EUE profile is also performed.

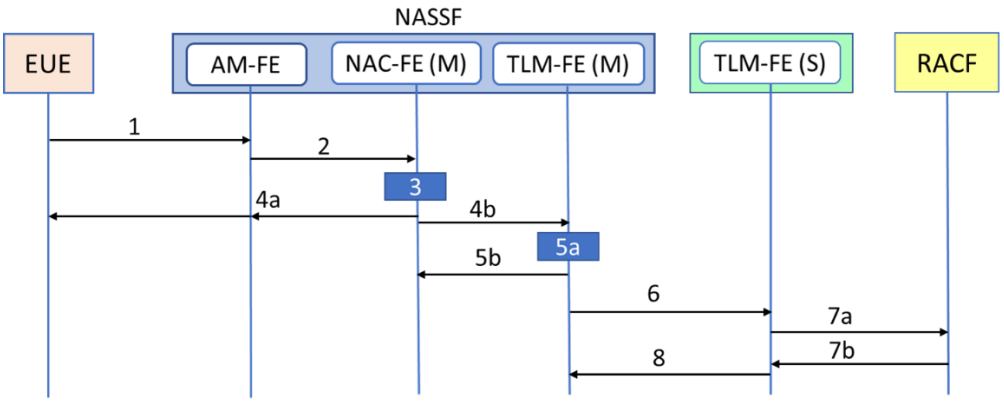


Figure 5: Information flow for IP configuration

The description of the steps is as follows:

1. Upon receiving successful authentication, EUE sends a request for IP address allocation and IP configuration to AM-FE.

2. AM-FE translates the request so that NAC-FE (M) understands it. It forwards this request to NAC-FE (M) for IP address allocation and other network configurations for EUE.

3. NAC-FE (M) allocates IP address and configures IP-related parameters. It maps IP configuration and logical connection identifier.

4. NAC-FE (M) sends a response to the EUE (4a) and shares this information with TLM-FE (M) (4b).

NOTE - NAC-FE (M) also updates NAC-FE (S), so this information is available at NAC-FE (S) in case other FEs require it in the service stratum for other procedures. This update is not shown in the figure.

5. TLM-FE (M) correlates transport subscription profile and IP configuration (5a) and acknowledges (5b) NAC-FE (M) [same as detailed in clause 8.1.2.1 and 8.1.2.2 of ITU-T Y.2014].

6. TLM-FE (M) shares this information with TLM-FE (S) so resources can be configured accordingly at RACFs.

7. TLM-FE (S) coordinates with RACF for resource configuration. In Figure 5, 7a represents a request from TLM-FE (S) to RACF, and 7b represents a response from RACF to TLM-FE (S).

8. Upon receiving a response from RACF, it responds to TLM-FE (M) to confirm resource configuration.

NOTE - There may be two more stages in the network attachment process as per Appendix II [ITU-T Y.2014]: EUE configuration at HGWC-FE to configure home gateway parameters, which remain the same for the NGNe-cp architecture between EUE and HGWC-FE; location management using TLM-FE (M) and (S) so location updates are available for other FEs.

8.4 Information flow for location management

In stage 3, TLM-FE (S) in the service stratum can support in providing location information from TLM-FE(M) to service control function (SCFs) upon receiving a request. TLM-FE (S) serves as the primary point of contact for any other FEs in the network that needs to retrieve location information.

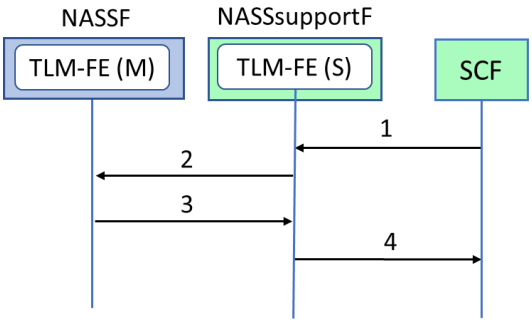


Figure 6: Information flow for Location management

Upon receiving such a request (step 1 in Fig 6), TLM-FE (S) forwards it to TLM-FE (M) to obtain the required location-related information (step 2 in Fig 6). The Transport Subscriber Identifier or the IP address allocated to EUE is used to retrieve the corresponding information by other FEs. TLM-FE (M) send the requested information (step 3 in Fig 6), which is forwarded to SCF via TLM-FE (S) (step 4 in Fig 6).

NOTE 1 - The term “Location information” context is based on Clause 8.3.1.2 of ITU-T Y.2014.

NOTE 2 - User consent and security aspects related to location-management information are outside the scope of this Recommendation. However, compliance with applicable security and consent requirements shall still be ensured as per NOTE 2 in Clause 8.3.1.2 Table 2 of ITU-T Y.2014 **“***Location information disclosure depends on the requesting application and the subscriber's privacy restrictions. Privacy restrictions are defined in the privacy indicator stored in the TLM-FE***”.**

Bibliography

[ITU-T E.760] Recommendation ITU-T E.760 (03/2000), *Terminal mobility traffic modelling*