International Telecommunication Union
Standardization Sector

Recommendation

ITU-T Y.2325 (12/2023)

SERIES Y: Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities

Next Generation Networks – Enhancements to NGN

Architectural evolution for the next generation network control plane by applying software-defined networking technology

ITU-T Y-SERIES RECOMMENDATIONS

Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T Y.2325

Architectural evolution for the next generation network control plane by applying software-defined networking technology

Summary

Recommendation ITU-T Y.2325 aims to standardize an evolved NGN control plane architecture that is scalable, simplified and flexible, by decoupling the end-user signalling handling functionality and the user plane control functionality and also treating the signalling as a user service (data) leading to uniform handling of services. This Recommendation includes the description of information flow for services such as network attachment, session establishment and registration for the recommended architecture.

History *

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T Y.2325	2023-12-14	13	11.1002/1000/15732

Keywords

Next generation network, NGN, software-defined networking, SDN.

---

* To access the Recommendation, type the URL https://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents/software copyrights, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the appropriate ITU-T databases available via the ITU-T website at http://www.itu.int/ITU-T/ipr/.

Table of Contents

Recommendation ITU-T Y.2325

Architectural evolution for the next generation network control plane by applying software-defined networking technology

1 Scope

This Recommendation specifies an evolved NGN control plane architecture that is scalable, simplified and flexible by decoupling the end-user signalling handling functionality and the user plane control functionality and also treating the signalling as a user service (data) leading to uniform handling of services.

This Recommendation includes:

– Requirements of the evolved NGN control plane architecture;

– Architecture to separate the end user-specific signalling exchange functionality from the user plane control (transport control) functionality for NGN architecture based on the SDN paradigm and network service model and also treating the signalling as a user service;

– Information flow for services such as network attachment, session establishment and registration.

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 Q.1743] Recommendation ITU-T Q.1743 (2016), *IMT-Advanced references to Release 11 of LTE-Advanced evolved packet core network.*

[ITU-T Y.1910] Recommendation ITU-T Y.1910 (2008), *IPTV functional architecture.*

[ITU-T Y.2011] Recommendation ITU-T Y.2011 (2004), *General principles and general reference model for Next Generation Networks.*

[ITU-T Y.2012] Recommendation ITU-T Y.2012 (2010), *Functional requirements and architecture of next generation networks*.

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

[ITU-T Y.2018] Recommendation ITU-T Y.2018 (2009), *Mobility management and control framework and architecture within the NGN transport stratum.*

[ITU-T Y.3300] Recommendation ITU-T Y.3300 (2014), *Framework of software-defined networking.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 authentication [ITU-T Y.2014]: A property by which the correct identifier of an entity or party is established with a required assurance. The party being authenticated could be a user, subscriber, home environment or serving network.

3.1.2 control plane [ITU-T Y.2011]: The set of functions that controls the operation of entities in the stratum or layer under consideration, plus the functions required to support this control.

3.1.3 customer premises equipment (CPE) [ITU-T Y.2014]: One or more devices allowing a user to access services delivered by NGN.

NOTE – This includes devices under user control commonly referred to as home gateway (HGW) or terminals (TE), etc., but not network-controlled entities, such as access gateways.

3.1.4 data plane [ITU-T Y.2011]: The set of functions used to transfer data in the stratum or layer under consideration.

3.1.5 end user [b-ITU-T M.3050.1]: The end user is the actual user of the products or services offered by the enterprise. The end user consumes the product or service.

3.1.6 functional architecture [ITU-T Y.2012]: A set of functional entities and the reference points between them used to describe the structure of an NGN. These functional entities are separated by reference points, and thus, they define the distribution of functions.

NOTE – The functional entities can be used to describe a set of reference configurations. These reference configurations identify which reference points are visible at the boundaries of equipment implementations and between administrative domains.

3.1.7 functional entity [ITU-T Y.2012]: An entity that comprises an indivisible set of specific functions. Functional entities are logical concepts, while groupings of functional entities are used to describe practical, physical implementations.

3.1.8 home gateway (HGW) [ITU-T Y.2014]: Gateway between the customer premises network (CPN) and the access network.

NOTE – A home gateway may be in its simplest form a bridged or routed modem, and in a more advanced form be an integrated access device.

3.1.9 mobility [b-ITU-T Q.1706]: The ability for the user or other mobile entities to communicate and access services irrespective of changes of the location or technical environment.

3.1.10 mobility management [b-ITU-T Q.1706]: The set of functions used to provide mobility. These functions include authentication, authorization, location updating, paging, download of user information and more.

3.1.11 NGN service stratum [ITU-T Y.2011]: That part of the NGN which provides the user functions that transfer service-related data and the functions that control and manage service resources and network services to enable user services and applications.

3.1.12 NGN transport stratum [ITU-T Y.2011]: That part of the NGN which provides the user functions that transfer data and the functions that control and manage transport resources to carry such data between terminating entities.

3.1.13 reference point [ITU-T Y.2012]: A conceptual point at the conjunction of two non-overlapping functional entities that can be used to identify the type of information passing between these functional entities.

NOTE – A reference point may correspond to one or more physical interfaces between pieces of equipment.

3.1.14 resource [b-ITU-T M.3050.1]: Resources represent physical and non-physical components used to construct services. They are drawn from the application, computing and network domains and include, for example, network elements, software, IT systems and technology components.

3.1.15 software defined networking [ITU-T Y.3300]: A set of techniques that enables to directly program, orchestrate, control and manage network resources, which facilitates the design, delivery and operation of network services in a dynamic and scalable manner.

3.1.16 user equipment (UE) [ITU-T Q.1743]: A device allowing a user access to network services. For the purpose of 3GPP specifications, the interface between the UE and the network is the radio interface. A[n item of] user equipment can be subdivided into a number of domains, the domains being separated by reference points. Currently defined domains are the USIM and ME Domains. The ME Domain can further be subdivided into several components showing the connectivity between multiple functional groups. These groups can be implemented in one or more hardware devices. An example of such a connectivity is the TE-MT interface. Further, an occurrence of a user equipment is a MS for GSM.

3.1.17 user plane [ITU-T Y.2011]: A synonym for data plane.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 built-in service: User services inherent to next generation networks such as support for data communication, user authentication or user mobility. The built-in services form the basis for more advanced services such as video streaming or gaming.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AR-FE	Access Relay Functional Entity
ASF	Application Support Function
CDF	Content Distribution Function
CPE	Customer Premises Equipment
EUE	End User Equipment
HGW	Home Gateway
IP	Internet Protocol
IPTV	Internet Protocol Television
MMCF	Mobility Management and Control Function
MSSF	Mobility Signalling Service Function
MSSsupportF	Mobility Signalling Service support Function
NACF	Network Attachment Control Function
NASSF	Network Attachment Signalling Service Function
NASSsupportF	Network Attachment Signalling Service support Function
NGN	Next Generation Networks
QoS	Quality of Service
RACF	Resource Admission and Control Function
SDN	Software Defined Networking

SSF	Service Support Function
SigSF	Signalling Service Function
SSsupportF	Signalling Service support Function
UE	User Equipment

5 Conventions

In this Recommendation, requirements are classified as follows:

- The keywords "**is required to**" or "**are required to**" indicate one or more requirements that must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed;
- The keywords "**is recommended**" indicate a requirement that is recommended but not absolutely required. Thus, such requirements need not be present to claim conformance; and
- The keywords "**optionally**" or "**may**" indicate an optional requirement which 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; it means the vendor may optionally provide the feature and still claim conformance with the specification.

6 Overview

The existing NGN architecture, per [ITU-T Y.2012], supports a separation between the control plane and the user plane. NGN control plane functions (or control functions) are responsible for controlling network resources, i.e., the establishment, modification or deletion of sessions over the underlying network resources (hereinafter referred to as "resource allocation (control)"). In addition to resource allocation, the control functions are also responsible for the exchange of signalling messages with the end user (hereinafter referred to as "signalling handling"). These two categories of functionalities, "signalling handling" and "resource allocation (control)", are logically separate functionalities that are tightly coupled within the control plane of existing NGN architecture.

Further, the control functions in NGN (as in [ITU-T Y.2012]) can be mapped with the functionality of the software defined networking (SDN) control layer as well as to the application (or service) layer (as in [ITU-T Y.3300]).

This Recommendation offers an evolved NGN control plane architecture with improved alignment to SDN principles as elucidated in [ITU-T Y.3300] based on the existing NGN architecture per [ITU-T Y.2012], wherein signalling handling functionality is treated as a service (application) by decoupling the "signalling handling functionality" from the "resource allocation (control) functionality". By treating end user-associated signalling as a service (application), the Recommendation aims to arrive at a service-driven SDN-based architecture for the next generation networks, where all services (applications) are handled in a uniform manner, whether these are built-in services such as user mobility or external services such as media streaming or Internet protocol (IP) multimedia subsystem services. As a result, the evolved NGN control plane architecture in this Recommendation is more scalable, simplified and flexible with simplified information flows and improved alignment with SDN principles.

7 Requirements

The evolved NGN control plane architecture is required to:

a) be aligned with software defined networking (SDN) technology by decoupling "resource allocation" and "signalling exchange with end users" functionalities and separating them via a standardized interface;

b) have provision for potentially different signalling message exchange for different use cases to support use case specific signalling overhead;

c) facilitate dynamic deployment of signalling service functions; and

d) provide uniform treatment to built-in and external services to bring simplicity to the procedures and architecture.

8 Evolved NGN control plane

8.1 Conceptual framework for the evolved NGN control plane

In the existing NGN architecture, per [ITU-T Y.2011] and [ITU-T Y.2012], "signalling handling functionality" and the "resource allocation (control) functionality" are both tightly coupled within the NGN control plane (as shown in Figure 8-1). Decoupling of the "signalling handling functionality" from the "resource allocation (control) functionality" is required to separate end user signalling handling from the control plane (as shown in Figure 8-2) and further, to handle end user signalling via a signalling service function (as shown in Figure 8-3). End user signalling messages may be treated as another form of data flowing through the network.

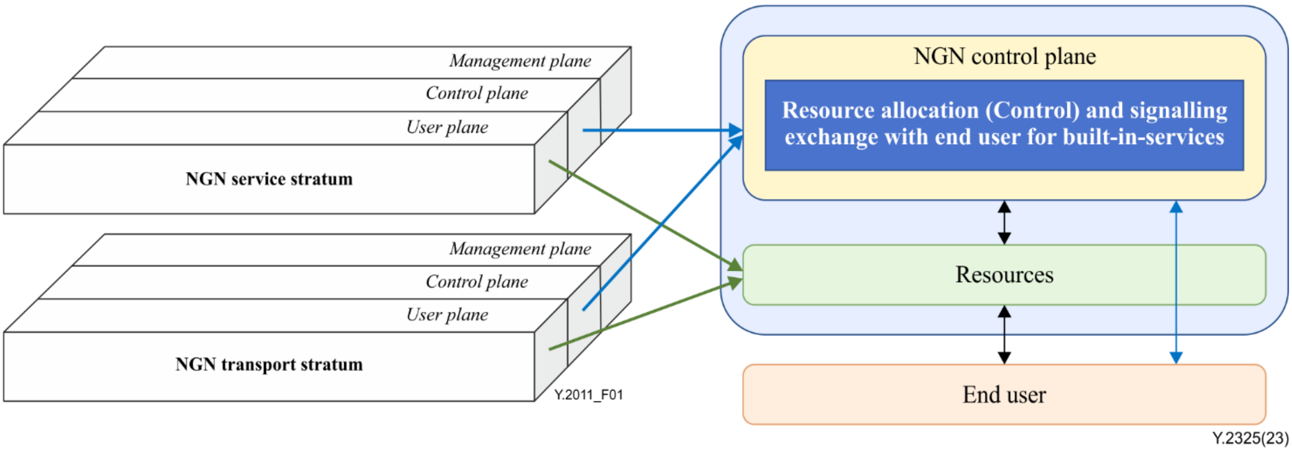

Figure 8-1 – Overview of the existing NGN architecture and high-level functionality distribution

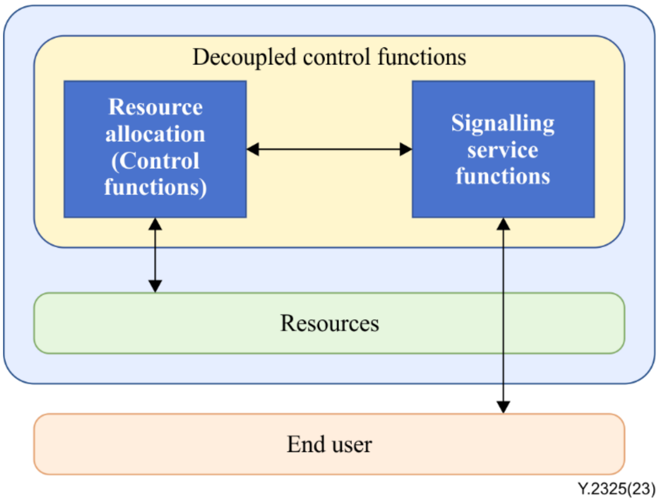

Figure 8-2 – Decoupling of resource control functions and signalling handling functions in control plane

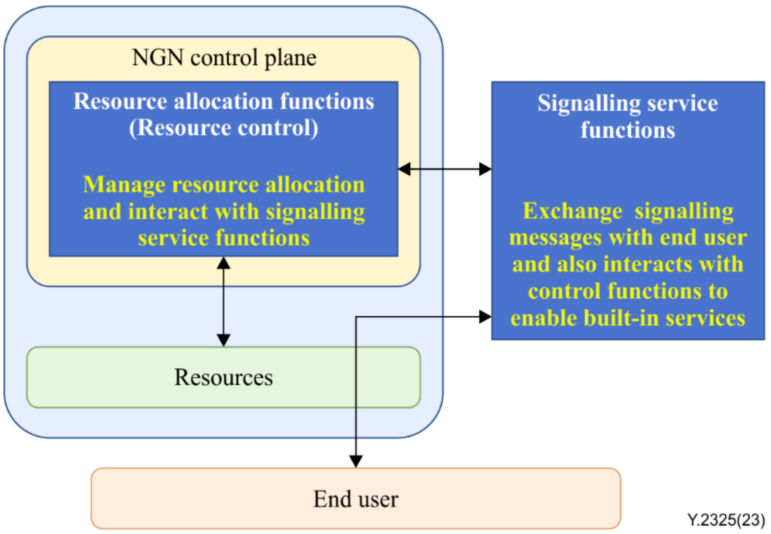

Figure 8-3 – Decoupled signalling service functions from the NGN control plane

The separation of signalling handling functionality from the control plane in the transport stratum is detailed below.

A subset of transport control functionality involves controlling and managing transport functions, i.e., management (establishment/modification/deletion) of data sessions via user plane (transport functions). This subset is hereinafter recommended to be denoted as "resource allocation (control) functions". The other set of functionalities is responsible for exchanging signalling messages with end users and providing built-in services to them either directly via signalling exchange or indirectly by enabling the services with the help of the resource allocation (control) functions; this functionality is recommended to be denoted "signalling service functionality" and transposed to separate "signalling service functions".

NOTE 1 – The signalling service function handles signalling exchange with end user equipment (EUE) to provide support for built-in service(s).

For example, in order to provide a mobility service, when a user is moving, the signalling service functions may interact with the mobile user to obtain its location update and provide the same to the resource allocation (control) functions for further processing, i.e., to set up new and release old data paths through the transport functions.

NOTE 2 – The term "EUE refers to UE [ITU-T Q.1743] as well as customer premises equipment (CPE) [ITU-T Y.2014]. EUE is not impacted by the recommended changes in the NGN control plane architecture.

While it is recommended to keep the resource allocation (control) functions within the transport stratum control plane (SDN control layer), the signalling exchange functionality is recommended to be decoupled from the resource allocation (control) functions and moved out of the control plane.

This Recommendation includes new signalling service functions to handle the exchange of signalling messages with end users. The evolved NGN transport control plane is required to contain only the resource allocation (control) functionality. These signalling service functions are also required to enable other services such as data transfer or user mobility by collecting relevant information (requirements) from end users through signalling exchange and providing the information for the configuration of transport functions via the transport control functions in order to support the appropriate service-aware behaviour.

Once decoupled, these signalling service functions are required to be treated like external application-based services. Similar to the application service-based architecture for service delivery, the signalling related to a built-in service may be exchanged with an end user over a data path (i.e., a signalling path) by signalling service functions. The transport control functions are required to interact with signalling service functions (and not with an end user directly) via service stratum and manage the required data path for service, e.g., network attachment or mobility.

8.2 Recommended high-level architecture for evolved NGN control plane

Figure 8-4 provides an overview of the existing NGN architecture. In this architecture, mobility management and NACFs are part of transport control functions. These control functions collect information from end users to execute mobility management and network attachment procedures. This control information exchange or signalling is tightly coupled with resource control protocols/interfaces in the existing architecture.

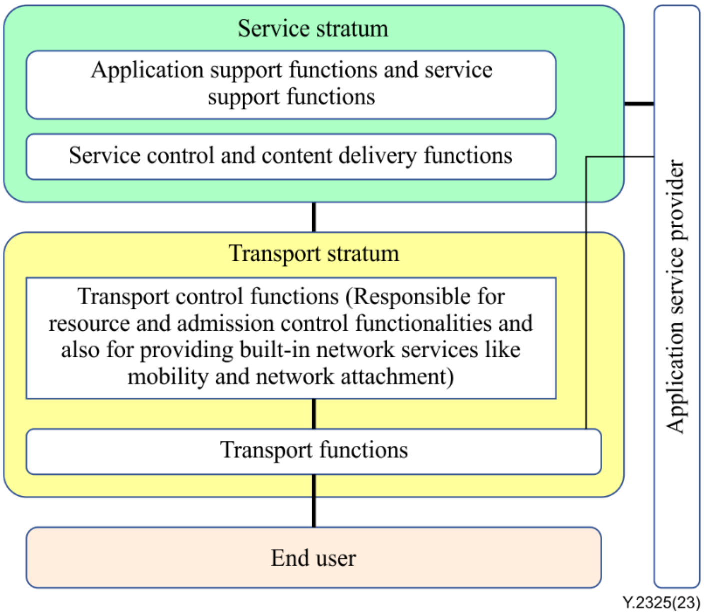

Figure 8-4 – NGN architecture overview

(Conceptual representation based on Figure 7-1 of [ITU-T Y.2012])

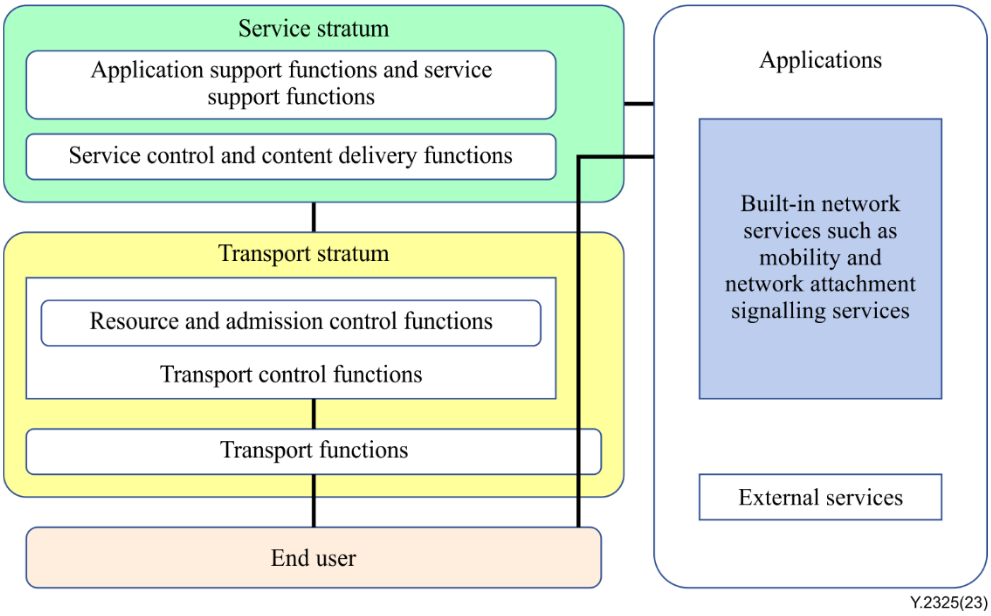

Figure 8-5 – Architecture overview for evolved NGN control plane

As shown in Figure 8-5, the recommended architecture of the evolved NGN control plane provides improved segregation of functionality in the network control plane (transport control functions). Signalling functions for built-in services such as mobility and network attachment can be thought of as a signalling service function and can be moved out as applications in this evolved architecture. The tasks of these service functions include collecting requirements from end users for service delivery, sending requirements to resource allocation (transport control) functions via service stratum for configuration of transport functions and confirming back to the end user that the requirements have been met, whereas (transport) control functions include resource and admission control functionality and only act as the SDN controller to set up the data path through the transport functions.

8.3 General service-based architecture based on SDN technology

The concept of service-based architecture applied in this Recommendation is the same as how an (external) application provides a service to an end user in the NGN architecture. An application interacts with the network via standardized interfaces, with the control plane (transport stratum control functions via service stratum's application support functions (ASFs) and service support functions (SSFs) as well as the data plane (transport functions via service stratum's content delivery function (CDF)) as shown in Figure 8-6. For example, in the case of internet protocol television (IPTV) service, the IPTV application function sends IPTV content to the transport functions via the CDF of the service stratum to be forwarded to the end users (as shown in Figure 9-1 of [ITU-T Y.1910]). In addition, it also interacts with the transport control functions via the ASF and SSF for the establishment of the service session through the network to be used for service delivery. An important point to note here is that the application may also need to interact with the end users before setting up the service sessions. This signalling message exchange between the end user and application provides the requirements to the application for the service session to be established later (via network) to deliver the service to end users. Here, the initial signalling exchange between the end user and application also takes place over a session established earlier. This session may have been specifically established for signalling exchange but is similar to the service session used for delivery of service (data). Application itself cannot set up this session for signalling exchange through transport functions but requests the control functions (in transport stratum) via service stratum to set up the session through the transport functions.

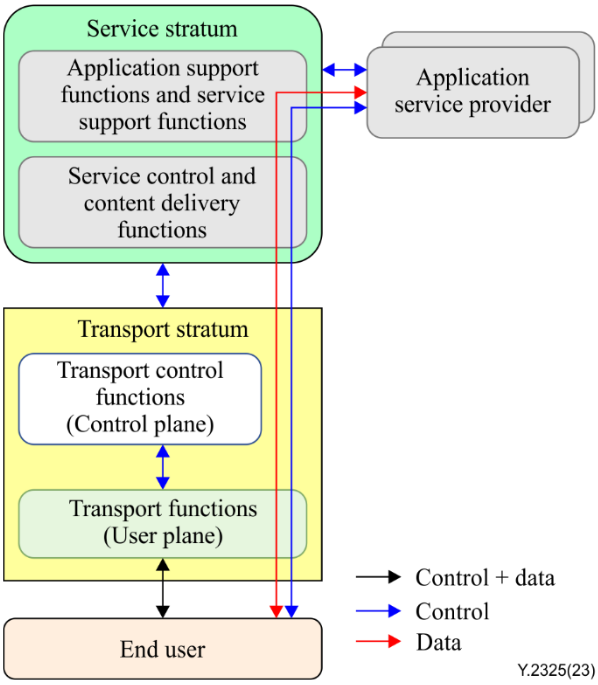

Figure 8-6 – Interfaces between an external application and NGN

As the applications are decoupled from the network and accesses it via service stratum to support the service delivery, the delivery of built-in services such as mobility can also be handled in the same way. Based on this concept, this Recommendation includes an evolved architecture for NGN control plane for the delivery of built-in services. The architecture applies SDN technology to NGN and considers built-in services as applications. Figure 8-7 shows the mapping of the evolved NGN control plane architecture with the SDN framework (as given in Figure 11-1 of [ITU-T Y.3300]). The modified transport control functions can be viewed as the SDN controller and a subset of ASFs and SSFs and the service control functions can be viewed as service orchestrators. The service orchestrators are responsible for the orchestration of services (including both external and built-in services) in the network.

The facilitation of a service (external as well as built-in) to an end user typically involves two steps:

a) the collection of service specific requirements; and

b) the establishment of a path for service delivery.

However, as noted above, even collecting service specific requirements from a user may necessitate the establishment of a path (session) through the network.

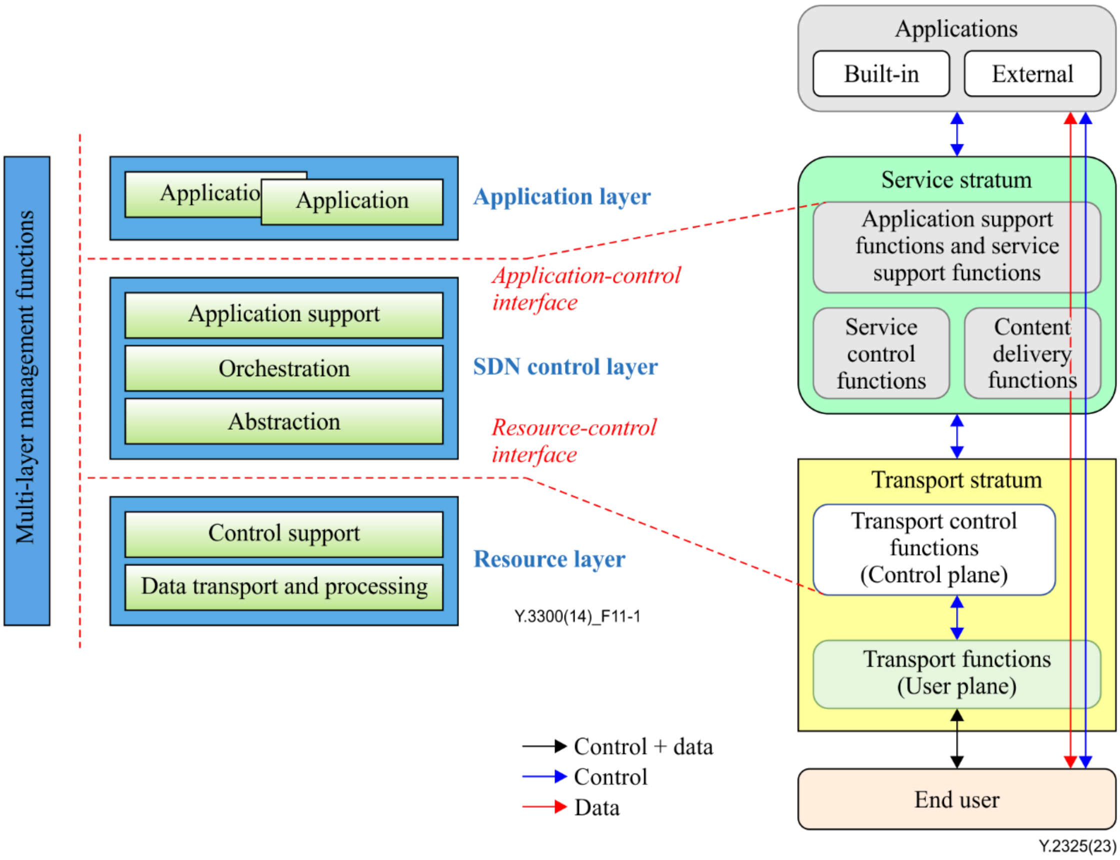

Figure 8-7 – Handling of built-in services in evolved NGN architecture based on SDN technology

8.4 Placement and splitting of high-level functions in evolved NGN

In the existing NGN architecture, the transport control functions consist of three high-level functions, resource and admission control functions (RACFs), NACFs, and mobility management and control Functions (MMCFs) as shown in Figure 8-8. In evolved NGN, mobility and network attachment are considered as built-in services and are handled in the same manner as external services/applications are handled in the network. To support these built-in services, high-level functions NACF and MMCF are moved out from the transport control functions and split into two categories of high-level functions named signalling service functions and signalling service support functions (as shown in

Figure 8-9). The signalling service function is a function in the application layer. The signalling service support function is a function in the service stratum, which provides support for built-in service(s). These functions are responsible for end user signalling and to collect/provide service-related information for built-in services. Functionalities of service orchestration functions (in the service stratum) include control and management of network resources, and coordination of requests for network resources. These functionalities are aligned with the orchestration functionalities of the SDN control layer (described in clause 11.2 of [ITU-T Y.3300]).

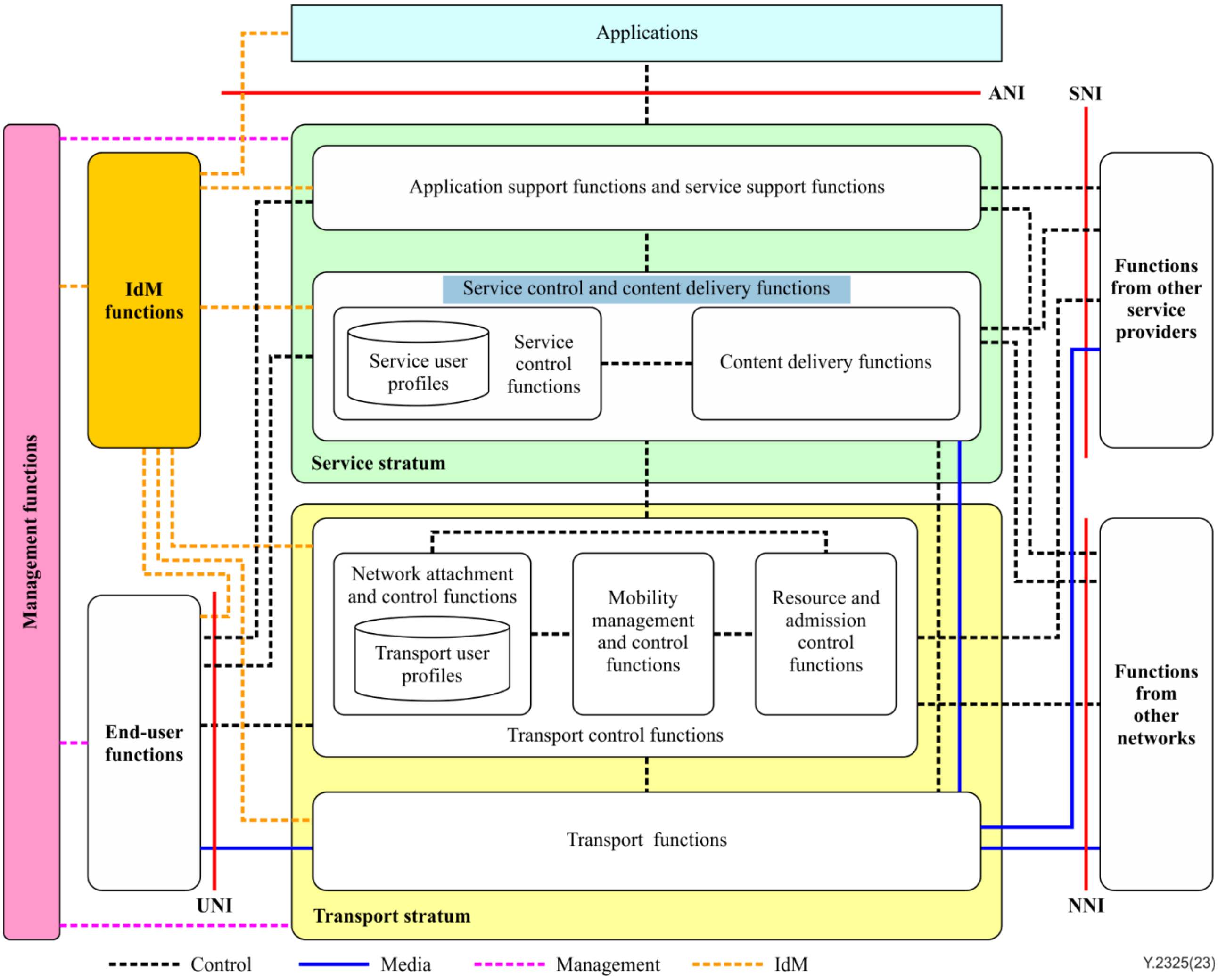

Figure 8-8 – Existing NGN architecture and high-level functions
[Source: ITU-T Y.2012]

To support the network attachment service (a built-in service) as part of the evolved NGN architecture, the existing NACF functionalities as specified in [ITU-T Y.2014] are distributed among two new and separate functions, network attachment signalling service function (NASSF) and network attachment signalling service support function (NASSsupportF). NASSF is considered as an application (service) and NASSsupportF is placed in the service stratum as shown in Figure 8-9. Similarly, to support the mobility service as part of the evolved NGN architecture, the existing MMCF functionalities as specified in [ITU-T Y.2018] are also distributed among two new and separate functions, the mobility signalling service function (MSSF) and mobility signalling service support function (MSSsupportF). MSSF is considered an application (service) and the MSSsupportF is placed in the service stratum as shown in Figure 8-9.

NOTE – For this Recommendation, network attachment and mobility services are taken as examples for built-in services. The above concept of distribution/placement of control functions can be applied for other built-in services also in evolved NGN.

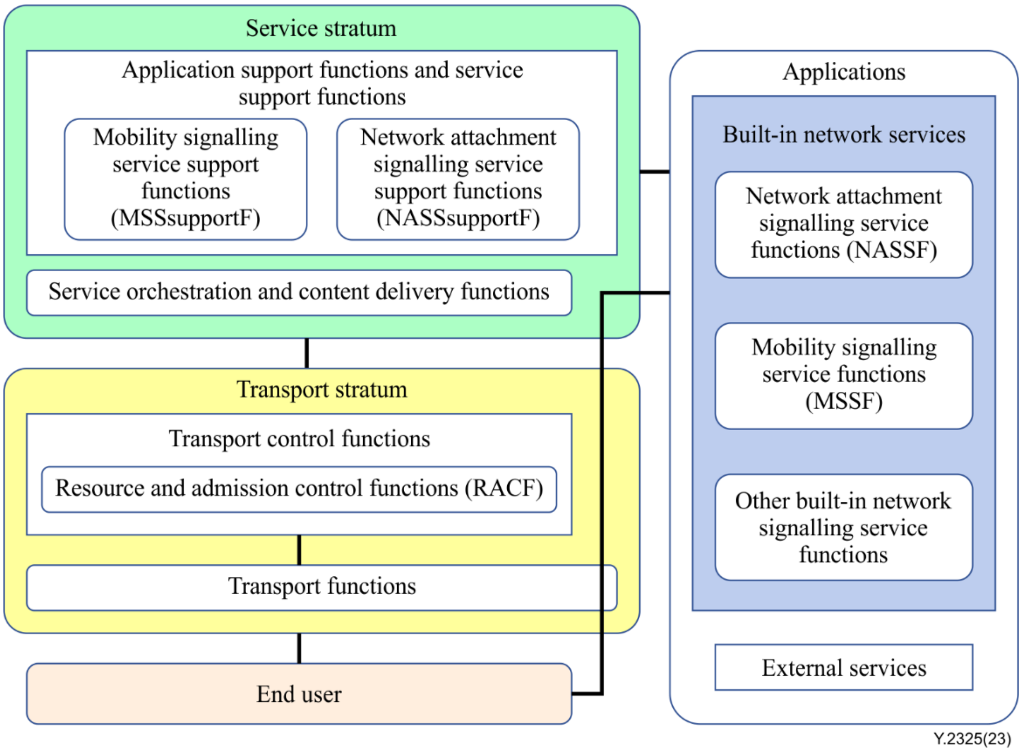

Figure 8-9 – Placement and splitting of high-level functions for network attachment and mobility services in evolved NGN

9 High-level functions for network attachment service in evolved NGN

In the existing NGN, the high-level function NACF provides registration at the access level (including EUE context creation and policy association) and initialization of EUE for accessing the NGN services. The NACF provides network level identification and authentication, manages the IP address space of the access network and authenticates access sessions. The NACF also announces the contact point(s) of the NGN service stratum components to the EUE (described in clause 6.2 of [ITU-T Y.2014]). The same functionalities are now supported in the evolved NGN via two individual high-level functions, NASSF and NASSsupportF. The functionalities supported by NASSF and NASSsupportF are described in clauses 9.1 and 9.2.

9.1 Network attachment signalling service function

NASSF is considered an internal network application (service) and interacts with EUE through a session established between the NASSF and EUE. This session is established with the help of NASSsupportF prior to providing network attachment service. Other than EUE, NASSF also interacts with ASFs and SSFs (e.g., NASSsupportF) in the service stratum. The functionalities of NASSF are as follows:

a) Registration Support

The NASSF provides registration at the access level and initialization of EUE for accessing NGN services (per clause 7.1.2.2 of [ITU-T Y.2012]).

b) IP address allocation

The NASSF is responsible for the IP address allocation to the EUE. It may be able to allocate two kinds of IP addresses, a persistent IP address and a temporary IP address, to the EUE, in order to support mobility (per clause 7.2.1 of [ITU-T Y.2014]). It supports IP address allocation for both the host-based and network-based mobility cases.

c) Authorization and authentication

The NASSF performs user authentication, as well as authorization checking, based on transport subscription profiles, for network access (per clause 9.3.2.2 of [ITU-T Y.2012]). It also contains subscription authentication data (transport subscriber identifier, list of supported authentication methods, etc.) and information related to the required network access configuration: this data is called "transport subscription profile" for end users (per clause 9.3.2.3 of [ITU-T Y.2012]).

d) Association between the IP address and EUE location information

The NASSF registers the association between the IP address allocated to the EUE and the related network location information, e.g., access transport equipment characteristics, logical connection identifier, identification of the edge policy enforcement device, etc. (based on clause 9.3.2.4 of [ITU-T Y.2012]). It also responds to location queries from other functions (described in clause 7.2.3 of [ITU-T Y.2014]).

e) Distribution of network configuration parameters

The NASSF can optionally distribute network configuration parameters, such as address of domain name system (DNS) server(s), address of signalling proxies for specific service stratum components to EUE (per clause 9.3.2.1 of [ITU-T Y.2012]). However, it may have to collect some access network related configuration parameters via NASSsupportF.

f) Initialization and update of the home gateway

The NASSF is used during initialization and update of the home gateway (HGW). It provides the HGW with additional configuration information (e.g., configuration of a firewall internally in the HGW, quality of service (QoS) marking of IP packets, etc.). These data differ from the network configuration data (based on clause 9.3.2.6 of [ITU-T Y.2012]).

g) Session initiation with EUE through NASSsupportF

A session needs to be established between EUE and NASSF for signalling related to the network attachment service. The NASSF initiates a session establishment request via NASSsupportF for the same.

9.2 Network attachment signalling service support function (NASSsupportF)

NASSsupportF interacts with the RACFs (transport control functions) for resource allocation and admission control, and to provide relevant information for the network attachment service. The NASSsupportF also interacts with the signalling service functions in the application layer to provide support for network attachment service. Functionalities of the NASSsupportF are as follows:

a) Support for session establishment between EUE and NASSF:

The NASSsupportF requests the RACFs to configure resources in transport functions for a signalling session between the EUE and NASSF.

b) The NASSsupportF collects and provides the EUE access network information to NASSF. This information uniquely identifies the access network to which the EUE is attached. (described in clause 7.2.1 of [ITU-T Y.2014])

c) The NASSsupportF can optionally perform the collection of accounting data for each user authenticated by the NASSF.

10 High-level functions for mobility service in evolved NGN

In an existing NGN, the MMCF is divided into two major functionalities: EUE location management and handover control. The handover control functions (HCFs) are used to provide session continuity for ongoing sessions of the moving EUE. The same functionalities are now supported in the evolved NGN via two individual high-level functions, MSSF and MSSsupportF. The functionalities supported by the MSSF and MSSsupportF are described in clauses 10.1 and 10.2.

10.1 Mobility signalling service function

The MSSF interacts with the EUE through a session established between the MSSF and EUE. This session is established through the MSSsupportF prior to providing a mobility service. MSSF also interacts with ASFs and SSFs (e.g., MSSsupportF) in the service stratum. The functionalities of the MSSF are as follows:

a) Location management

The MSSF initiates location registration on behalf of the EUE in the case of network-based mobility. It also processes location registration messages sent from or on behalf of the EUE. The MSSF manages the binding between the persistent IP address assigned to the EUE and its temporary address, in the case of host-based mobility, or the address of the lower tunnel-end point, in the case of network-based mobility (described in clause 9.3.2.9 of [ITU-T Y.2012]). Optionally, it holds two location bindings for the mobile EUE by marking the binding for the serving network as active state and marking the binding for the target network as standby state. MSSF is also responsible for the indication of a new mobility location binding and distribution of binding information to the MSSsupportF (clause 9.3.2 of [ITU-T Y.2012]).

b) Handover Signalling

The MSSF receives a list of candidate access links for handover from the EUE and sends them to the MSSsupportF for QoS verification. In a case where the EUE makes the handover decision, the MSSF provides the acceptable subset of links to the EUE. Before providing this to the EUE, the MSSF confirms this list from the RACFs through the MSSsupportF. In the case of network-triggered handover, it receives and forwards a handover request from the EUE to the MSSsupportF to trigger handover (described in clause 6.4.2.1 of [ITU-T Y.2018]).

c) Mobility service authentication and authorization

The MSSF handles user authentication, as well as authorization, for the mobility service in coordination with NASSF. EUE indicates mobility service request in its network attachment request. EUE may also indicate support for host-based and/or network-based mobility in this request.

d) Session initiation with EUE through the MSSsupportF

A session needs to be established between EUE and MSSF for signalling related to mobility service. MSSF initiates a session establishment request via the MSSsupportF for the same session establishment.

10.2 Mobility signalling service support function (MSSsupportF)

MSSsupportF interacts with the RACFs (transport control functions) for resource configuration and to distribute relevant information for mobility service. The MSSsupportF also interacts with other signalling service functions in the application layer. The functionalities of MSSsupportF are as follows:

a) Handover decision

The handover decision is made by the MSSsupportF in case of network-based mobility upon receiving handover request from EUE. Besides, the handover decision is taken by EUE in a case of host-based mobility.

b) Resource configuration request to the RACFs

The MSSsupportF is responsible for requesting the RACFs for resource configuration based on handover decision that includes the following functionalities:

i) Based on received list of candidate access links for handover from MSSF, the MSSsupportF invokes the RACF to verify session QoS availability for each candidate access link for handover and inform the MSSF for communicating to the EUE;

ii) It requests RACFs to re-provision the resource and QoS for the sessions of the moved EUE by submitting binding information to the RACFs; and

iii) It also requests the RACFs to release resource and QoS for the data path, which is verified not to be used any longer (based on clause 6.4.2.1 of [ITU-T Y.2018]).

In addition to the above, the MSSsupportF requests RACFs to configure resources in transport functions for a signalling session between EUE and MSSF.

c) Handover information distribution

the MSSsupportF distributes a handover policy (to EUE via the MSSF in case of host-based mobility), which is a set of operator-defined rules and preferences that affect the handover decisions. It also distributes other information available in its network information repository (see clause 9.3.2.11 of [ITU-T Y.2012]

d) Provisioning for network information repository

The MSSsupportF contains a network information repository that provides static information on neighbouring networks to assist the access network discovery and selection decision. It also provides operator policies such as charging mode and rates (cost for the usage of the network), roaming agreements and mobility mechanism selection policies (based on clause 6.4.3.1 of [ITU-T Y.2018]).

11 General procedures for network attachment

Clauses 11.1 and 11.2 cover general procedures for network attachment that comprise registration and session establishment. Registration is the responsibility of the NASSF in the recommended architecture, which is completed with the help of the NASSsupportF. The session establishment procedure is required to establish a data path through NGN to provide a service to EUE. It is also required to establish a signalling path with the EUE for built-in services.

11.1 Registration procedure

The registration procedure is required to authenticate and authorize the EUE for availing network services. It also includes EUE context creation, functional entities selection and policy association for that particular EUE in the network. Information flow for EUE registration (Figure 11-1) is as follows:

a) EUE sends a 'registration request' message to the access relay functional entity (AR-FE) (description available in clause 7.2.7 of [ITU-T Y.2014]) in the access network indicating service requests, its identity, credentials and attributes required for authentication and authorization.

NOTE – The EUE sends the initial registration request using the preconfigured common (or default) path (channel) to communicate with the AR-FE for the first time. The consequent signalling exchange between the EUE and AR-FE are handled through a dedicated path set up for the purpose.

b) AR-FE forwards this request to the NASSF. The NASSF performs authentication, authorization and confirms the EUE identity and allowed services. After successful authentication and authorization, it initiates EUE registration and forwards the 'registration request' along with user profile and list of authorized services to NASSsupportF, which selects functional entities (in the service stratum and transport stratum) and associates them with the EUE. Furthermore, it creates EUE context and performs policy association. After completion of these associations, the NASSsupportF sends a registration response to the NASSF. The NASSF sends a 'registration accept' to the EUE.

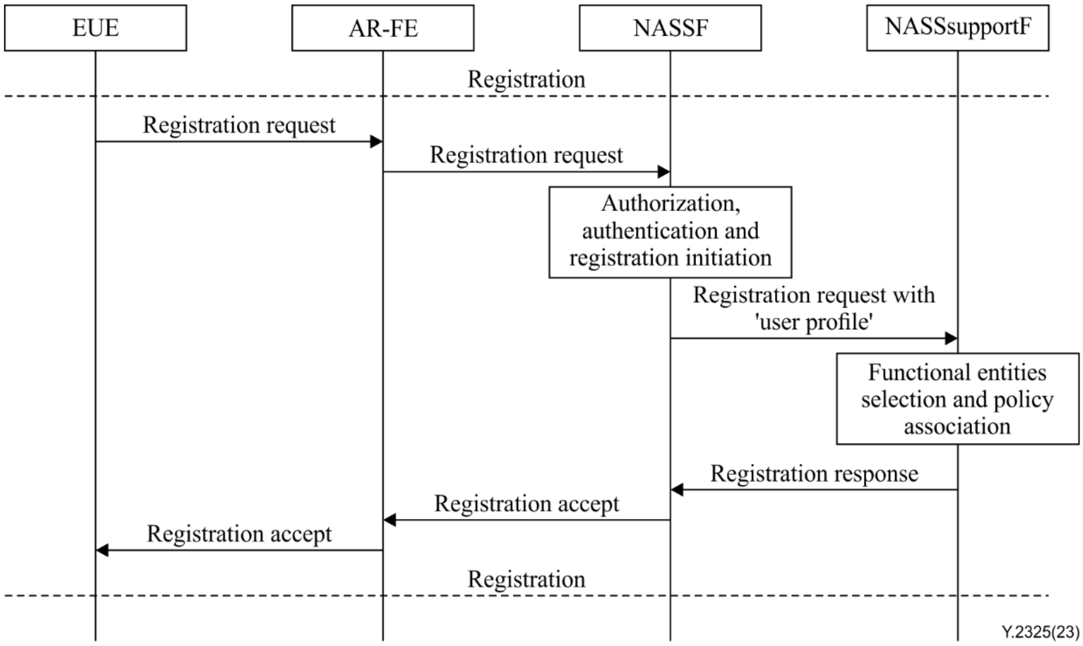

Figure 11-1 – Information flow for EUE registration

11.2 Session establishment procedure

The session establishment procedure is the same for data sessions and also for all built-in service functions, i.e., for the establishment of a signalling session between EUE and different signalling service functions (for example NASSF or MSSF). Hence, the generic terms, signalling service function (SigSF) and signalling service support function (SSsupportF) are used in this clause.

NOTE 1 – It is assumed that the EUE sending session establishment request has a default path available for signalling exchange and, it (EUE) is already registered with NGN, and authorized with the built-in service it is requesting session establishment for, i.e., with the signalling service function of that service.

The information flow for session establishment (Figure 11-2) is as follows:

a) The EUE sends the 'session establishment request' message to the AR-FE in the access network indicating its identity and with a request for data path.

NOTE 2 – The EUE sends the initial session establishment request using the preconfigured default path to communicate with the AR-FE for the first time. The consequent signalling exchange between the EUE and AR-FE is handled through a dedicated path set up for the purpose.

NOTE 3 – It is also possible that the network itself initiates the session establishment for signalling as a result of registration instead of EUE initiating.

b) AR-FE forwards this request to the SigSF. The SigSF performs authentication and authorization for the requested service and sends session establishment request to the SSsupportF. Further, the SSsupportF sends the request to the RACFs for resource configuration for data path establishment. After receiving session establishment response from the RACFs, SSsupportF sends a response to the SigSF. Further, the SigSF sends a 'session establishment complete' message to the EUE via the AR-FE.

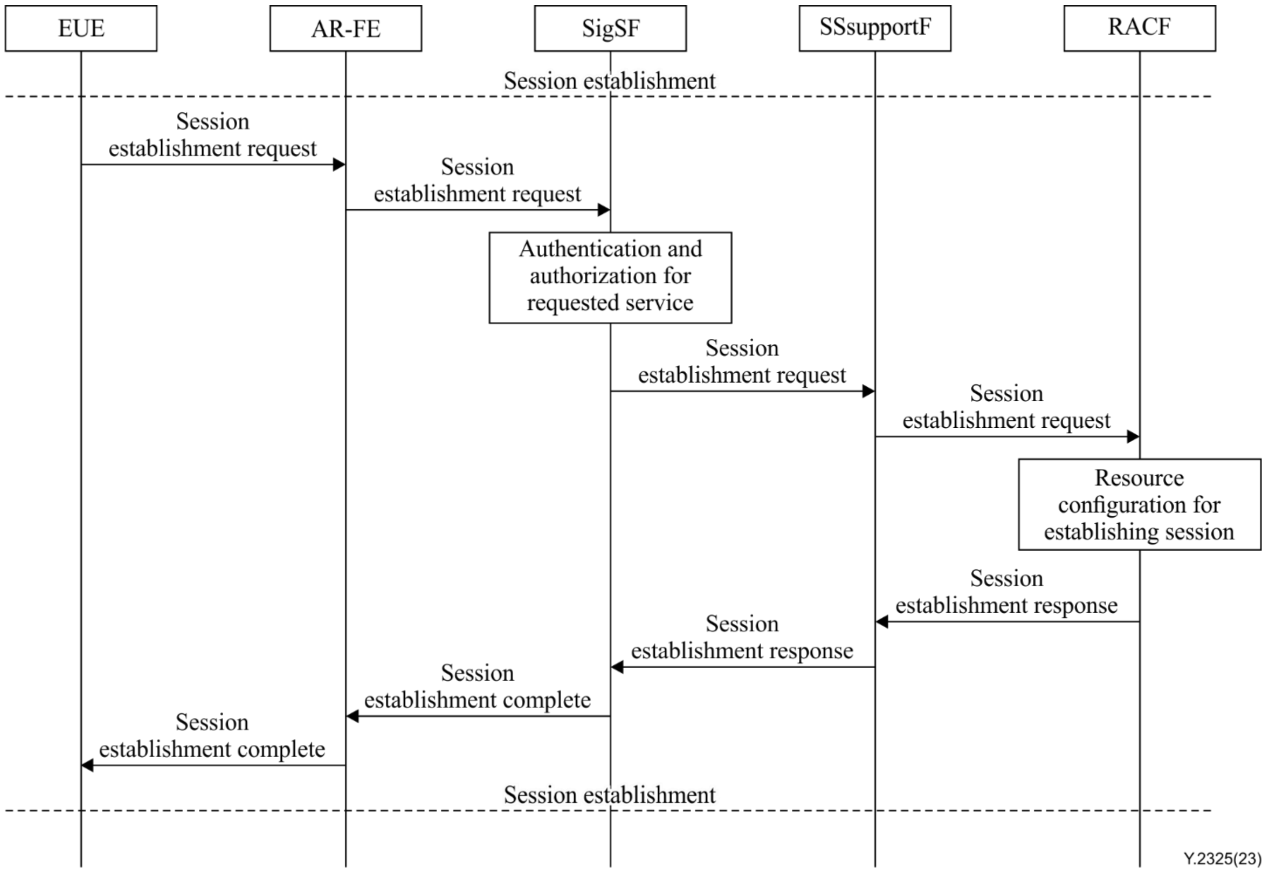

Figure 11-2 – Information flow for session establishment

Appendix I

(This appendix does not form an integral part of this Recommendation.)

A.I Network attachment procedure with mobility service (in case of host-based mobility)

The following information flow is for the network attachment procedure, which includes registration, session establishment and location update in case of host-based mobility. Reference for signalling flows and their description is taken from clause 7.2.1 of [ITU-T Y.2018] and mapped per recommended functions in this Recommendation.

Figure I.1 shows the information flow for the network attachment procedure with mobility service, which is divided into three phases: authentication and authorization (registration), IP configuration (session establishment) and mobility location management.

Phase 1: Authentication and authorization (registration)

The EUE sends an attachment request to the NASSF in which it also indicates that it requires mobility services along with the indication of support for host-based mobility. The NASSF performs authentication and authorization of the EUE, along with updating the relevant EUE profile information. EUE receives the response related to mobility services when the EUE authentication is successful and it is authorized to use the network resources. NASSF also transfers a EUE profile update to NASSsupportF along with mobility service-related information.

NOTE – This phase may be optional as EUE can be pre-authenticated and pre-authorized to receive mobility service.

Phase 2: IP configuration (session establishment)

The EUE sends an IP configuration request to the NASSF for the dynamic provisioning of IP address and IP configuration information in case of host-based mobility. The NASSF allocates the IP address and establishes the mapping between the allocated IP address and the logical connection identifier. This mapping information is correlated with transport subscription profile. The NASSF sends a resource configuration request along with additional correlated information to the NASSsupportF, and NASSsupportF forwards the configuration request with correlated information to the RACF.

The RACF configures resources and updates the EUE related profile information and sends the configuration response back to the NASSsupportF.

The NASSsupportF also informs the MSSF of the host-based mobility information, along with the user identity and network selection key transfer function.

The NASSsupportF then sends a configuration response to the NASSF for communication with the EUE.

The NASSF sends the required configuration information (e.g., persistent IP address, host-based mobility is to be used indication) to the EUE.

Phase 3: Mobility location management

The EUE initiates the mobility location binding update/registration to the MSSF.

MSSF updates its mobility bindings information and responds back to the EUE with the mobility location binding acknowledgement.

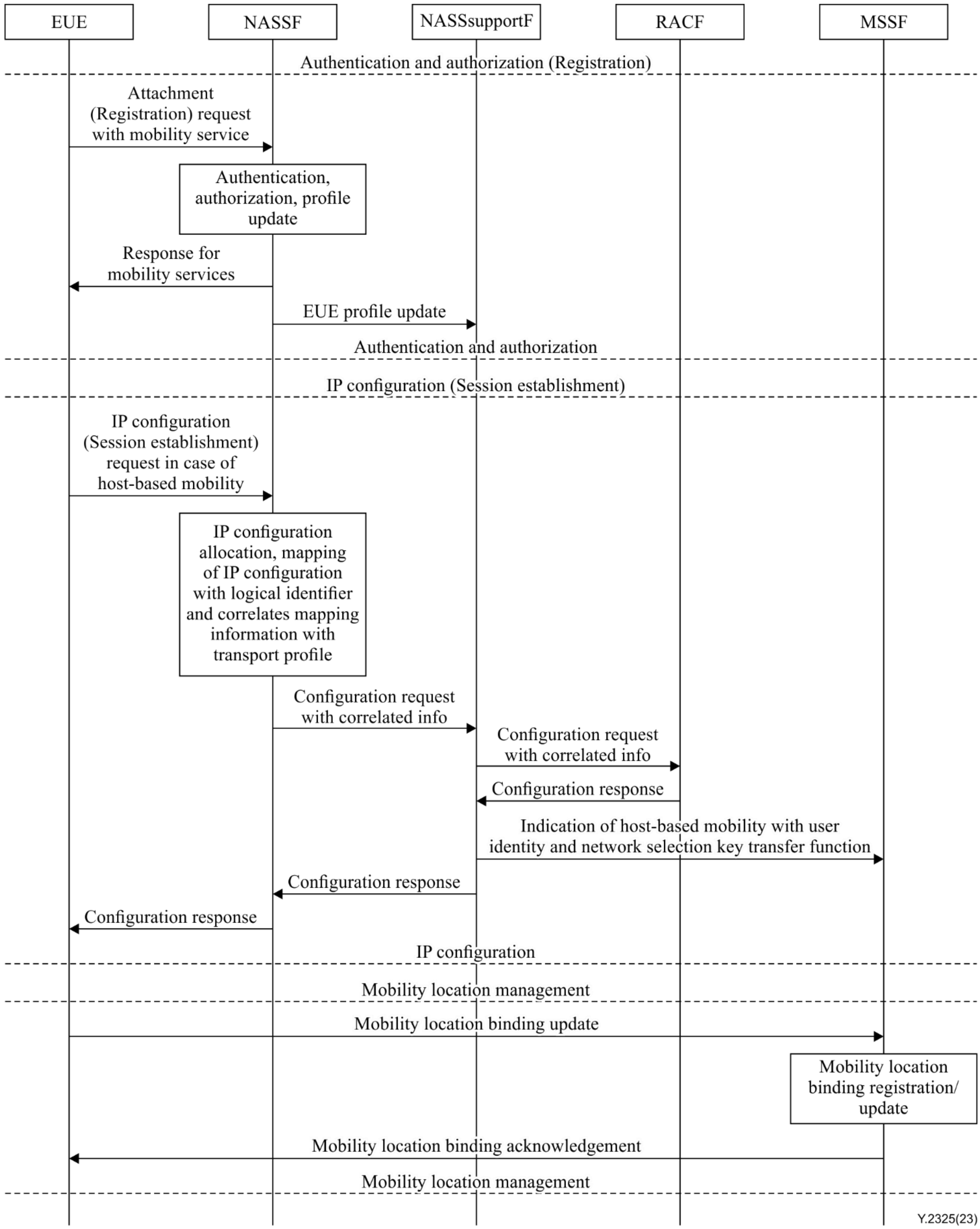

Figure I.1 – Information flows for attachment, case of host-based mobility

Bibliography

[b-ITU-T M.3050.1] Recommendation ITU-T M.3050.1 (2007), *Enhanced Telecom Operations Map (eTOM) – The business process framework.*

[b-ITU-T Q.1706] Recommendation ITU-T Q.1706/Y.2801 (2006), *Mobility management requirements for NGN.*

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	Tariff and accounting principles and international telecommunication/ICT economic and policy issues
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling, and associated measurements and tests
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	**Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities**
Series Z	Languages and general software aspects for telecommunication systems

Published in Switzerland
Geneva, 2024