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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

Next Generation Networks – Frameworks and functional architecture models

Open service environment functional architecture for next generation networks

Recommendation ITU-T Y.2020

International Telecommunication Union

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Recommendation ITU-T Y.2020

Open service environment functional architecture for next generation networks

Summary

Recommendation ITU-T Y.2020 describes the functional architecture of the open service environment (OSE) for next generation networks. The OSE functional architecture is based on the capabilities described in Recommendation ITU-T Y.2234 to enable enhanced flexible service creation and provisioning.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T Y.2020	2011-05-20	13

Keywords

Functional architecture, functional entities, next generation networks, NGN, open service environment, OSE, reference points.

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Introduction

According to the NGN requirements and capabilities in [ITU-T Y.2201], open service environment (OSE) capabilities stem from the general characteristics of the NGN in supporting and establishing an environment for enhanced, flexible and open service creation and provisioning within the service stratum.

[ITU-T Y.2201] describes the high-level requirements of NGN while [ITU-T Y.2234] describes service requirements, functional requirements and service architecture of open service environment (OSE) capabilities.

This Recommendation provides the OSE functional architecture including a description of the functional entities and the related reference points.

Recommendation ITU-T Y.2020

Open service environment functional architecture for next generation networks

1 Scope

This Recommendation describes the functional architecture for the open service environment (OSE) for next generation networks (NGN).

This Recommendation is based on the service requirements, functional requirements and service architecture of OSE capabilities as described in [ITU-T Y.2234]. In order to support OSE capabilities, this Recommendation provides extensions to the functional entities and reference points defined and described in [ITU-T Y.2012].

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

[ITU-T Y.2201] Recommendation ITU-T Y.2201 (2009), *Requirements and capabilities for ITU-T NGN*.

[ITU-T Y.2234] Recommendation ITU-T Y.2234 (2008), *Open service environment capabilities for NGN*.

[ITU-T Y.2240] Recommendation ITU-T Y.2240 (2011), *Requirements and capabilities for next generation network service integration and delivery environment*.

[ITU-T Y.2701] Recommendation ITU-T Y.2701 (2007), *Security requirements for NGN release 1*.

[ITU-T Y.2702] Recommendation ITU-T Y.2702 (2008), *Authentication and authorization requirements for NGN release 1*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 application [b-ITU-T Y.101]: A structured set of capabilities, which provide value-added functionality supported by one or more services.

3.1.2 application provider [ITU-T Y.2012]: A general reference to a provider that offers applications to the customers making use of the services capabilities provided by the NGN.

3.1.3 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.

3.1.4 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.

3.1.5 network operator [ITU-T Y.2012]: An operator that manages a telecommunication network. A network operator may be a service provider and vice versa. A network operator may or may not provide particular telecommunication services.

3.1.6 NGN service stratum [b-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 (see also clause 7.1 of [ITU-T Y.2011]).

3.1.7 NGN transport stratum [b-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 (see also clause 7.1 of [ITU-T Y.2011]).

3.1.8 open service environment capabilities [ITU-T Y.2234]: Capabilities provided by open service environment to enable enhanced and flexible service creation and provisioning based on the use of standards interfaces.

3.1.9 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.

3.1.10 service [b-ITU-T Y.2091]: A set of functions and facilities offered to a user by a provider.

3.1.11 service chain [ITU-T Y.2234]: A set of coordinated services that occur in a specific sequence.

3.1.12 service composition [ITU-T Y.2234]: Service composition is the capability of creating new services from other existing services.

3.1.13 service coordination [ITU-T Y.2234]: The ability to manage the relationships and interactions among services to provide a "service chain" as well as among services and applications.

3.1.14 service development support [ITU-T Y.2234]: Service development support provides an environment for service creation, development and maintenance.

3.1.15 service discovery [ITU-T Y.2234]: Service discovery performs a search against all registered services and provides the related service information.

3.1.16 service management [ITU-T Y.2234]: Service management provides the overall service managing functions such as service monitoring, service tracking and unexpected failure control.

3.1.17 service provider [ITU-T Y.2012]: A general reference to an operator that provides telecommunication services to customers and other users either on a tariff or contract basis. A service provider may or may not operate a network. A service provider may or may not be a customer of another service provider.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ANI	Application Network Interface
API	Application Programming Interface
APL-GW-FE	Application Gateway Functional Entity
APL-SCM-FE	Application Service Coordination Manager Functional Entity
ASF	Application Support Functions
ASF&SSF	Application Support Functions and Service Support Functions
AS-FE	Application Support Functional Entity
FE	Functional Entity
IdM	Identity Management
IN	Intelligent Network
IWSCE-FE	InterWorking with Service Creation Environments Functional Entity
NGN	Next Generation Network
NGN-SIDE	NGN Service Integration and Delivery Environment
NNI	Network-Network Interface
OSE	Open Service Environment
QoS	Quality of Service
SCM-FE	Service CoMposition Functional Entity
SCR-FE	Service CooRdination Functional Entity
SD-FE	Service Discovery Functional Entity
SDS-FE	Service Development Support Functional Entity
SM-FE	Service Management Functional Entity
SNI	Service Network Interface
SPE-FE	Service Policy Enforcement Functional Entity
SR-FE	Service Registration Functional Entity
SSF	Service Support Functions
SS-FE	Service Switching Functional Entity
UNI	User Network Interface
XACML	eXtensible Access Control Markup Language

5 Conventions

In this Recommendation,

– The keyphrase "is required to" indicates a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

– The keyphrase "is recommended" indicates a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

– The keyphrase "can optionally" indicates an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

– The term "NGN operator" is used to refer to a network operator (as defined in clause 3.1.5) that manages one or more NGN (s). An NGN operator can also be a service provider (as defined in clause 3.1.17). Note also that the term "NGN provider" when used in this Recommendation is equivalent to the term "NGN operator".

6 OSE capabilities in NGN

Open service environment (OSE) provides capabilities to enable flexible and agile service creation, execution and management based on the use of standard interfaces. The use of standard interfaces will ensure NGN OSE based service reusability and portability across networks, as well as accessibility by application providers or developers (See [ITU-T Y.2234]).

OSE capabilities have the following characteristics:

– flexible development of applications and capabilities by NGN providers, application providers, and other service providers;

– exposure of capabilities via standard application network interfaces (ANI) as defined in [ITU-T Y.2012];

– portability and re-usability of capabilities across networks (and from other network to NGN or from NGN to other network);

– leveraging new capabilities enabled by technologies from non-NGN environments.

Figure 6-1 shows the role of open service environment capabilities in NGN.

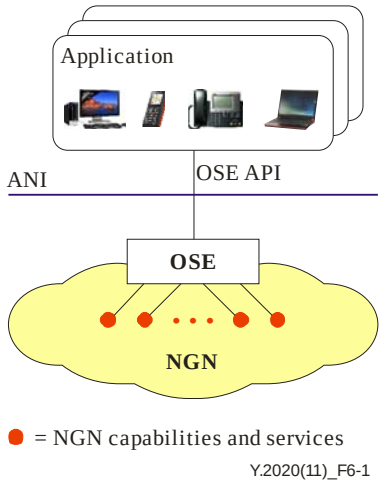


Figure 6-1 – Open service environment capabilities in NGN

The OSE allows applications to make use of NGN capabilities or services offered through the application network interface (ANI). Application providers or developers will be able to create and provide new applications via standard interfaces at the ANI as shown OSE API regardless of the type of underlying network and/or equipment.

7 OSE architecture

The functional requirements for OSE are defined in [ITU-T Y.2234]. The OSE functional architecture, provided in this Recommendation is developed to support these requirements.

7.1 OSE positioning within the NGN

Figure 7-1 shows the extended NGN architecture overview [ITU-T Y.2012] in order to illustrate the positioning of the OSE functional group.

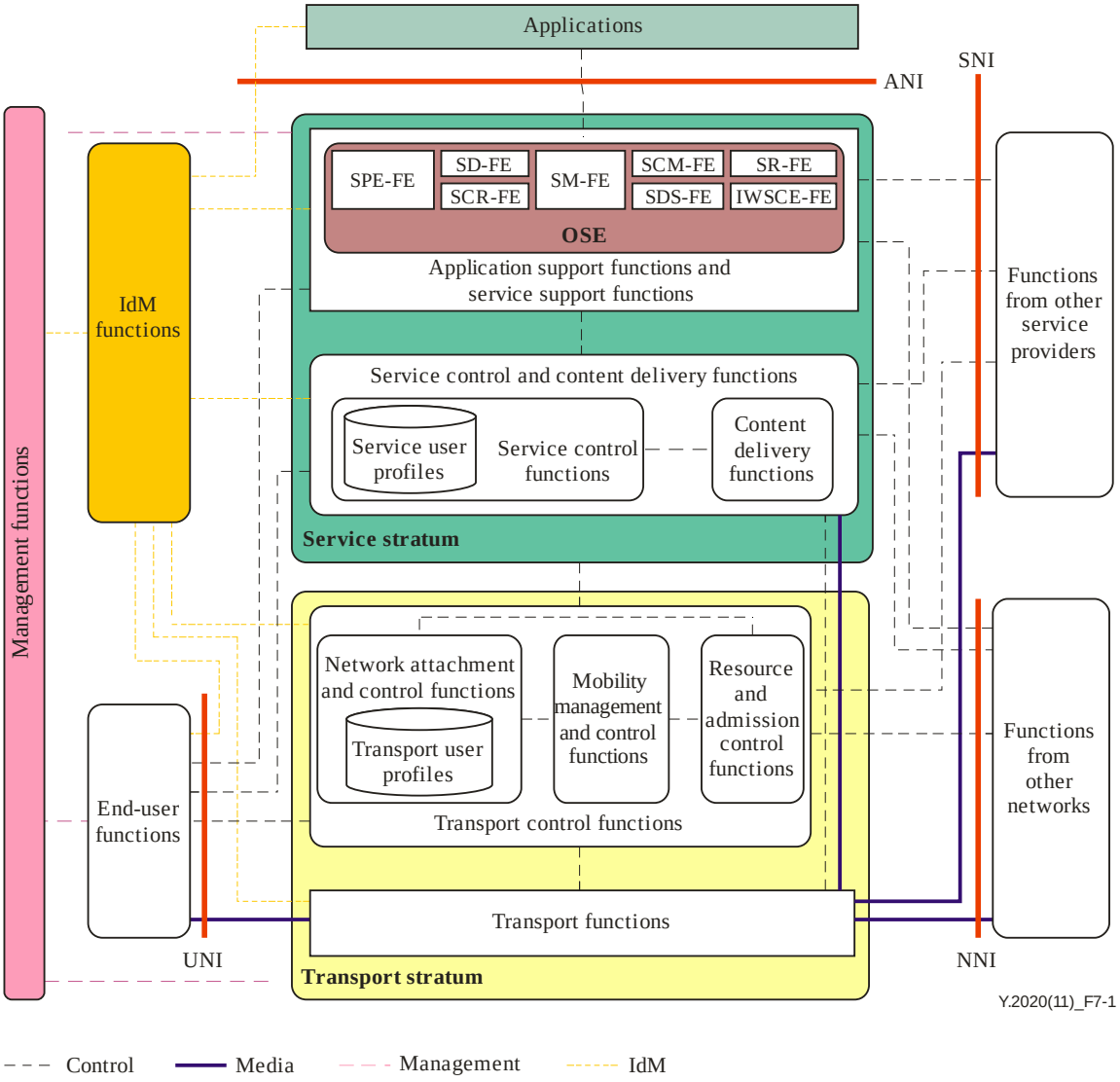


Figure 7-1 – OSE positioning in the NGN architecture

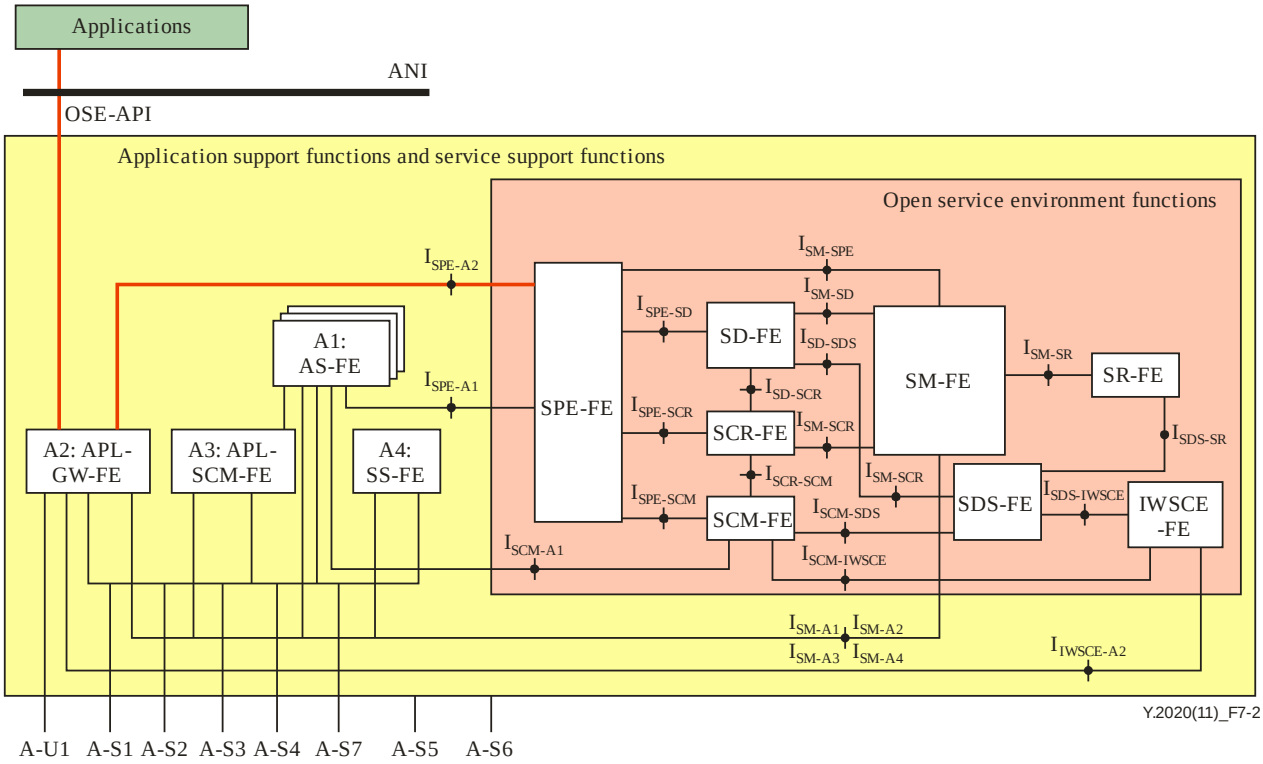
The NGN functional architecture supports the user network interface (UNI), network-network interface (NNI), application network interface (ANI) and service network interface (SNI) reference points identified in [ITU-T Y.2012]. Boxes in Figure 7-1 identify high-level functional groups and the reference points between the functional groups represent high-level interactions indicated in [ITU-T Y.2012]. The OSE resides in the NGN service stratum within the application support functions and service support functions (ASF&SSF).

The application support functions and service support functions (ASF&SSF) is connected to identity management (IdM) functions, end-user functions, applications and functions from other service providers through UNI, NNI, ANI and SNI reference points. The OSE has the following relationships:

– Regarding the relationship between OSE and applications, the OSE provides reference points at the ANI for applications to use the services of OSE.
– The OSE has a relationship with IdM functions to assure user, application, application provider identification, authentication and authorization for services of OSE.
– The OSE interacts with the end-user functions (at the UNI reference point) to allow the end users to securely manage and configure data for their services and applications.
– The OSE has a relationship with the service control and content delivery functions to interact with the capabilities and services supported by the service control and delivery functions. OSE can also interact with the transport stratum functions through cooperation with the service control and delivery functions.
– The OSE has a relationship at the NNI with "functions of other networks" (at the NNI reference point).
– The OSE has a relationship at the SNI with "functions from other service providers" (at the SNI reference point).

7.2 OSE functional architecture

Figure 7-2 shows the open service environment (OSE) functional architecture.



SPE-FE	Service policy enforcement functional entity
SD-FE	Service discovery functional entity
SCR-FE	Service coordination functional entity
SCM-FE	Service composition functional entity
SM-FE	Service management functional entity
SR-FE	Service registration functional entity
SDS-FE	Service development support functional entity
IWSCE-FE	Interworking with service creation environments functional entity

Figure 7-2 – OSE functional architecture

OSE functional architecture as shown in Figure 7-2 provides two basic operations, service creation and service execution.

– **Service creation in OSE**: in order to create a new service based on the services available in OSE, the following functional entities are used: service composition FE (SCM-FE), interworking with service creation environments FE (IWSCE-FE), service discovery FE (SD-FE), service development support FE (SDS-FE), service management FE (SM-FE) and service registration FE (SR-FE).

The creation of a new OSE service consists of programming its logic using the service composition FE (SCM-FE) and retrieving, as necessary, already existing OSE services using the service discovery FE (SD-FE). If services or capabilities belonging to a legacy network are needed to create new services, the SCM-FE interacts with the interworking with service creation environments FE (IWSCE-FE) for accessing such services or capabilities. When created, the new service has to be included as a new OSE service for life cycle management, using the service development support FE (SDS-FE). In addition, the service registration FE (SR-FE) is used to register the newly created service as a new OSE service in order to be made available to application developers. The newly created service is registered in the service management FE (SM-FE). The SM-FE manages the information about the new service such as service version, QoS information and availability.

– **Service execution in OSE**: When an application wants to use a service available in the OSE, it has to interact at the ANI with the application gateway functional entity (APL-GW-FE) as defined in [ITU-T Y.2012]. The APL-GW-FE then interacts with the service policy enforcement functional entity (SPE-FE) for authentication and authorization purposes. After being authorized, the SPE-FE interacts with the service discovery FE (SD-FE), which starts a discovery process in order to query the service requested by the application to the SM-FE through reference point I_{SD-SM}.

  - If the service exists in the SM-FE, the SD-FE returns the result to the SPE-FE. If the query to the SM-FE results in several services, the SD-FE needs to choose among the returned services. In this case, the SD-FE sends a coordinating request including the services returned by the SM-FE to the service coordination FE (SCR-FE) through reference point I_{SD-SCR}. The SCR-FE executes a coordination process and returns the result to the SD-FE which service is more adequate.
  - If the service does not exist in the SM-FE, the SPE-FE interacts with the service composition FE (SCM-FE) through the reference point $I_{SCR-SCM}$ to create a new service immediately. The SCM-FE interacts with the SDS-FE and IWSCE-FE to compose new services. The service composition FE (SCM-FE) interacts with each basic service in AS-FE according to the logic of the composite service. When the service of an application support functional entity (AS-FE) is called by the service composition FE (SCM-FE), the called service directly may interact with existing capabilities or services provided by the service control and content delivery functions.
  - During service execution, the SM-FE is responsible for managing services such as service status monitoring (e.g., version, availability, QoS), service failure detection and recovery, service substitution, etc.

NOTE – The impact of the definition of the NGN functional entities upon the support of the NGN-SIDE capabilities given in [ITU-T Y.2240] is outside the scope of this version of this Recommendation.

7.2.1 Service coordination functional entity (SCR-FE)

The service coordination FE (SCR-FE) offers the ability to manage and coordinate the relationships among services to provide a service chain as well as among services and applications described in [ITU-T Y.2234]. Additionally the SCR-FE manages interactions between applications and other OSE functional entities (i.e., SD-FE, SM-FE, SCM-FE or SPE-FE). The SCR-FE supports the selection of appropriate services and their coordination.

Figure 7-3 shows the service coordination FE (SCR-FE) and the related reference points.

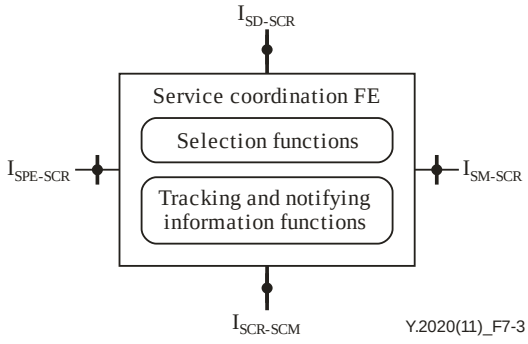


Figure 7-3 – Service coordination functional entity

The SD-FE, SPE-FE and SCM-FE interact with the SCR-FE to select a service which they use through the reference point I_{SD-SCR}, $I_{SPE-SCR}$ and the $I_{SCR-SCM}$ respectively. The SCR-FE interacts with SM-FE through the I_{SM-SCR} to get information (e.g., response time, status (available or not) or billing) which is needed to perform the coordination process.

7.2.1.1 Selection functions

Given that many services can be supported by NGN and also many relationships exist between these services in NGN, functions are required for selecting a service in order to fulfill a given application requirement.

Although a given service is characterized by its own intrinsic functionality, this service may have a similar functionality than another service. For example, let's assume that there are two services which can be used to support a VoIP service: one which does not guarantee QoS but is cheaper, while the other can guarantee QoS but is expensive. Selection functions of the SCR-FE identify which service is more suitable to fulfill an application's request.

The SCR-FE has the responsibility of selecting a service depending upon application requirements. The SCR-FE has abilities to classify each service according to characteristics such as service category (voice, data or video distribution), service level (fixed, nomadic, mobile, interactive and broadcasting) and service status (e.g., availability or response time). Selection functions of the SCR-FE comply with the rules which are provided by the service policy enforcement FE (SPE-FE) such as rules related to authorization, charging, service level agreement and logging.

7.2.1.2 Tracking and notifying information functions

The service coordination FE (SCR-FE) provides tracking of NGN capabilities or service components from different service providers and the relationship between these capabilities or service components, as indicated in [ITU-T Y.2234]. The SCR-FE interacts with the SM-FE to track NGN capabilities or services through the I_{SM-SCR} reference point.

7.2.2 Service discovery functional entity (SD-FE)

The service discovery FE (SD-FE) provides a service discovery capability to applications or other OSE FEs such as the SPE-FE, the SCR-FE and the service development support FE (SDS-FE). The SD-FE interacts with the service management FE (SM-FE) and the service coordination FE (SCR-FE) to discover the appropriate services from a physically distributed set of NGN services according to [ITU-T Y.2234].

The SD-FE supports a variety of discovering criteria such as based on a specific field (e.g., name or address), classification system (e.g., medical classification or scientific classification) and variety of scoping criteria such as location, cost, specific capabilities and preference.

Figure 7-4 shows the service discovery FE (SD-FE) and the related reference points.

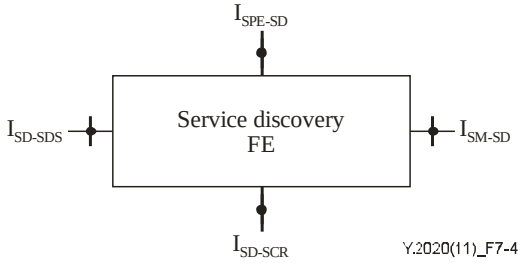


Figure 7-4 – Service discovery functional entity

The SD-FE handles procedures related to service discovery to support OSE capabilities or services to applications or other OSE FEs (e.g., SPE-FE or SDS-FE). Basically the services are registered in

the database which is managed by the registered service management functions located in the SM-FE. Therefore, the SD-FE interacts with the registered service management functions of the SM-FE to discover services and capabilities.

The service discovery requests occur in the following two cases:

– An application requests services from the OSE.

– The service development support FE (SDS-FE) request services.

In the first case, the application requests services through the SPE-FE. Then the SPE-FE requests the discovery from the SD-FE through the reference point I_{SPE-SD}. In the second case, the SDS-FE request services in order to support the service composition FE (SCM-FE). The SCM-FE can build a new service using already existing services.

When the SD-FE receives a service request, the SD-FE sends a query to the service management FE (SM-FE) through the reference point $I_{SD-SM.}$ The query contains service characteristics, discovery specific field, in addition to discovering scope or cost. The registered service management functions in the SM-FE check whether the service exists or not. If the service does not exist, it sends a message to the SD-FE indicating that the requested service is not part of the services registered in the SM-FE. Otherwise, the SM-FE returns the registered service or services with related information (e.g., service characteristics, service scope, service provider or service enable environment) to the SD-FE through the reference point I_{SM-SD}.

The SD-FE compares whether the received service or services and information matches the requested service or not. If the SD-FE received two or more services and if there is a need to coordinate, the SD-FE requests coordination from the SCR-FE through the reference point I_{SD-SCR}.

NOTE – The procedure for service discovery is described in clause II.1.

7.2.3 Service registration functional entity (SR-FE)

The service registration FE (SR-FE) allows the registration and deregistration of capabilities and services in the service management (SM-FE). The SR-FE has the ability to analyze (e.g., classify, categorize or classify) capabilities and services for registration in terms of their characteristics (e.g., service category, service scope, service provider, service enable environment and information about service charging).

Figure 7-5 shows the service registration FE and its related reference points.

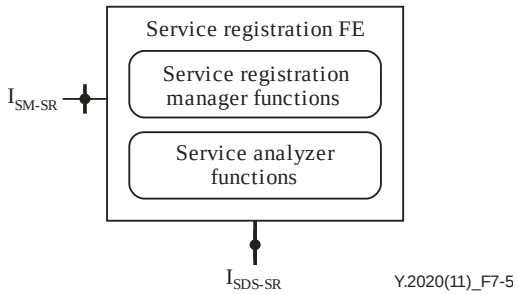


Figure 7-5 – Service registration FE

The service registration manager functions are invoked by the service development FE (SDS-FE) through the reference point I_{SDS-SR} in order to register and deregister services. Upon receiving a registration request from the SDS-FE, the service analyzer functions investigate and distinguish the services in order to extract characteristics (e.g., service category or service scope) and other information (e.g., service provider, service name or service location) of a service. Then when the analysis is completed, the service registration manager functions send a registration request to the

service management FE (SM-FE) through the reference point I_{SM-SR} in order to register the service along with its characteristics and information in the SM-FE.

NOTE – The procedure for service registration is described in clause II.2.

The service registration FE can optionally support registration services in a centralized and de-centralized implementation. It can also support multiple concurrent service registrations according to [ITU-T Y.2234].

The service registration FE provides the following service registration features according to [ITU-T Y.2234]:

– configuration information;

– activation information;

– publication information.

The service registration FE is recommended to support the following registration mechanisms according to [ITU-T Y.2234]:

– manual;

– autonomous.

7.2.4 Service management functional entity (SM-FE)

The service management FE (SM-FE) provides the functions to manage the OSE capabilities such as service tracking, update management, auditing, version control, logging and access control management.

The service management FE (SM-FE) interacts with the service registration FE (SR-FE) at the reference point I_{SM-SR} to register and manage services. The SM-FE also interacts with the service discovery FE (SD-FE) and the service coordination FE (SCR-FE). The service discovery FE (SD-FE) interacts with the registered service management functions located in the SM-FE using the I_{SM-SD} reference point in order to query for available services. The service coordination FE (SCR-FE) interacts with the SM-FE through the I_{SM-SCR} to get service related characteristics and information to help the SCR-FE to coordinate between services.

Functions of service management FE are depicted in Figure 7-6.

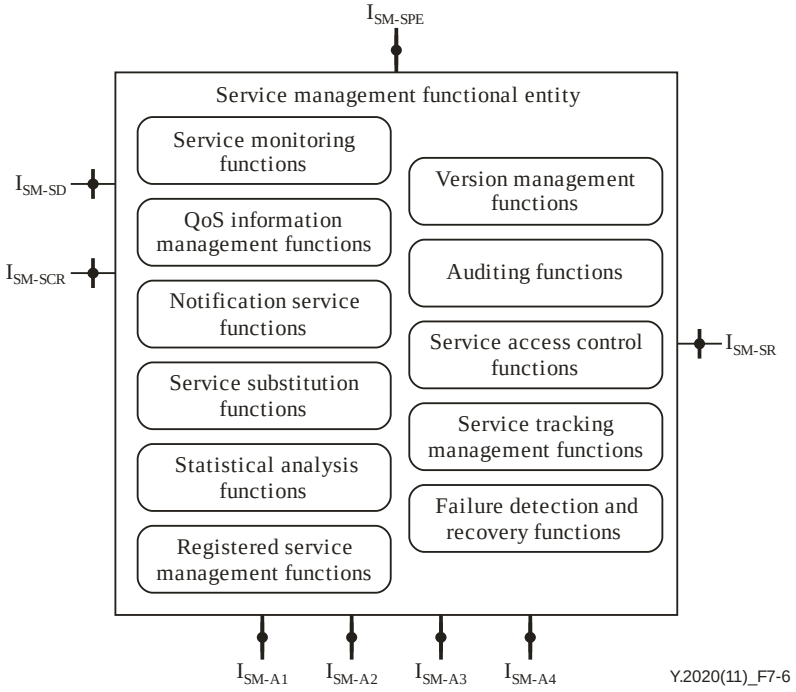


Figure 7-6 – Service management functional entity

The following clauses describe in detail the functions included in the service management FE (SM-FE).

NOTE – The relationship of OSE service management functions and management functions of the NGN functional architecture described in [ITU-T Y.2012] is under study.

7.2.4.1 Service monitoring functions

The service management FE (SM-FE) includes monitoring functions of registered services for availability and predicted response time. NGN service and applications can optionally use monitoring information related to the availability or predicted response time of targeted registered services before executing services.

7.2.4.2 QoS information management functions

The service management FE (SM-FE) manages QoS information about registered services such as accessibility, performance, integrity or reliability, as described in [ITU-T Y.2234].

QoS information about registered services is recommended to be saved in the database which stores registered services. QoS information management functions are recommended to perform the following:

– storing QoS information about registered services;

– providing QoS information to applications;

– monitoring of QoS change about registered services.

7.2.4.3 Version management functions

The service management FE (SM-FE) includes version management functions. These functions are responsible for managing versions of registered services. If a service version is changed, this information is reflected in the registered service.

7.2.4.4 Notification service functions

The notification service functions are recommended to interact with service monitoring functions and QoS information management functions. If the monitoring functions identify a change of any registered capabilities or services (such as: program update, version change, availability change and QoS change), the information about such change will be notified to applications through the reference point $I_{SM\text{-}SPE}$.

7.2.4.5 Failure detection and recovery functions

Failure detection and recovery functions provide the ability to detect failures of services as well as recovery from such failures. If a service failure occurs when an application is using a registered service, the failure detection and recovery functions investigate the causes of the failure in order to recover from such failure. If the failed service cannot be recovered, these functions query the service discovery FE (SD-FE) at the $I_{SM\text{-}SD}$ reference point in order to find a service which can provide the same level of service.

7.2.4.6 Service tracking management functions

The service tracking management functions provide the capability to capture and log all the relevant information for each component within a service chain, and tracking of the capabilities of components or multiple third parties according to [ITU-T Y.2234].

The service tracking management functions support the collection and storage of log records, as well as coordination and association of captured data, associated with a specific service, as described in [ITU-T Y.2234], during the process of service tracking. The service tracking management functions can capture and log tracking information including service interaction, execution process, and capability or components through $I_{SM\text{-}A1}$, $I_{SM\text{-}A2}$, $I_{SM\text{-}A3}$ and $I_{SM\text{-}A4}$.

7.2.4.7 Service substitution functions

The service substitution functions allow replacement of a service with another service, as long as the replacing service produces the same or better output and satisfies the same requirements as the replaced service. The service management FE (SM-FE) interacts with the service coordination FE (SCR-FE) through reference point $I_{SM\text{-}SCR}$ to obtain a service which performs service substitution with the least possible impact on the ongoing service.

Service substitutions happen when the following events occur:

– at service failure;

– when an application requests it (for better performance, lower price, etc.);

– when the service-supporting environment changes.

7.2.4.8 Service access control functions

The service management FE (SM-FE) provides service access control functions to control the accessibility of a specific service by an application. The service access control functions provide the necessary authentication and authorization actions required to ensure that an application has the appropriate access rights to the requested service.

7.2.4.9 Statistical analysis functions

The service management FE (SM-FE) provides capabilities to analyse registered services in order to provide the following usage information which is stored in a database:

– number of registered services;

– utilization frequency of registered services;

– number of applications currently using registered services.

7.2.4.10 Auditing functions

The service management FE (SM-FE) provides auditing functions. The auditing functions are able to review the overall operations of open service environment capabilities during a specific period required according to [ITU-T Y.2234].

7.2.4.11 Registered service management functions

The service management FE (SM-FE) is responsible for managing registered services through registered service management functions. The registered service management functions are responsible for registering services and response to queries for registered services. The registered services are stored in one database or separated into several databases.

7.2.5 Service composition functional entity (SCM-FE)

The service composition FE (SCM-FE) provides the capabilities to compose existing NGN services in order to create a new composite service. The SCM-FE provides a composition language that describes the interaction among services. It supports the composition of services statically or dynamically (i.e., for the static type, the services are composed during service design; while for the dynamic type, the services are composed during service runtime) as indicated in [ITU-T Y.2234].

The functions of the service composition FE are depicted in Figure 7-7.

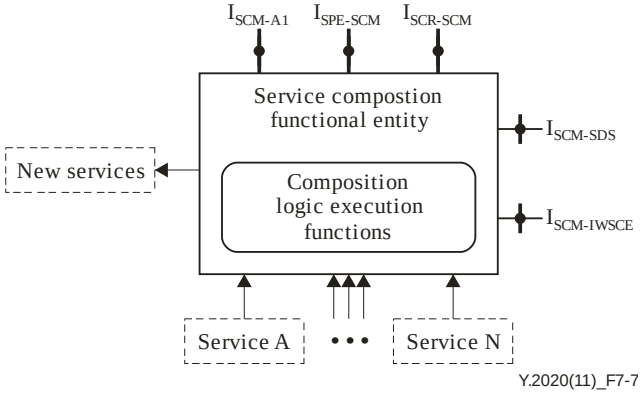


Figure 7-7 – Service composition functional entity

NOTE – In Figure 7-7, "new services" mean composite services which are defined based on existing OSE services.

The service composition FE (SCM-FE) interacts with the service development support FE (SDS-FE) to create a new composite service through the reference point $I_{SCM-SDS}$. The SCM-FE also interacts with the service coordination FE (SCR-FE) to support an appropriate service to the service composite through the reference point $I_{SCR-SCM}$.

7.2.5.1 Composite logic execution functions

The composite logic execution functions process the service composition using composite logics. The composite logic execution functions trigger the service composition adaptation. The composite logics are stored in a database which is managed by the composite logic execution functions. The composition logics are described in composition language. A service composition is invoked based on composition logic which is described in composition language.

7.2.5.1.1 Composition language

Composition language describes the composition logic among existing services in the perspectives of service creation. Additionally, the language should support expression capabilities for describing the composition logic among services. The composition language is used in the composition logic

execution and composition logics are stored in the database managed by the composite logic execution functions.

The composition language can support composition style such as orchestration and choreography. The primary difference between orchestration and choreography is the way they are executed and controlled.

An orchestration specifies an executable process that involves message exchanges with other systems, such that the message exchange sequences are controlled by the orchestration designer. Choreography specifies a protocol for peer-to-peer interactions, defining, e.g., the legal sequences of messages exchanged with the purpose of guaranteeing interoperability. Such a protocol is not directly executable, as it allows many different realizations (processes that comply with it).

Choreography can be realized by writing an orchestration for each peer involved in it. The orchestration and the choreography distinctions are based on analogies: orchestration refers to the central control (by the conductor) of the behaviour of a distributed system (the orchestra consisting of many players), while choreography refers to a distributed system (the dancing team) which operates according to rules but without centralized control.

7.2.6 Service development support functional entity (SDS-FE)

Development support for services is a key aspect of the service delivery chain, both within the service provider and within third parties who can extend the set of capabilities and broaden the overall service offering.

The service development support FE (SDS-FE) interacts with the service discovery FE (SD-FE) to search NGN services through the reference point $I_{SD\text{-}SDS}$. The SDS-FE interacts with the service composition FE (SCM-FE) and the interworking with service creation environments FE (IWSCE-FE) to help create new composite services through reference point $I_{SCM\text{-}SDS}$ and reference point $I_{SDS\text{-}IWSCE}$ respectively.

Newly created services are registered in a database which is managed by the registered service management functions located in service management FE (SM-FE) through the reference point $I_{SDS\text{-}SR}$.

The functions of service development support FE are depicted in Figure 7-8.

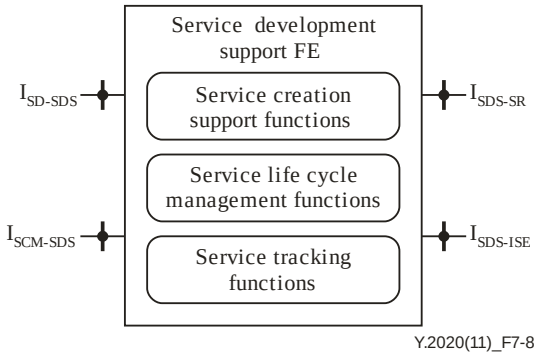


Figure 7-8 – Service development support FE

7.2.6.1 Service life cycle management functions

The service life cycle management functions have the ability to support the full life cycle of services, covering installation, configuration, administration, publishing, versioning, maintenance and removal.

7.2.6.2 Service creation support functions

The role of the service creation support functions is to facilitate the creation of new services. These functions support service re-use and allow service interchangeability. They also support mixing-and-matching of services and consistent semantics of shared data and/or schema across these services. Service developers can implement services without requiring re-design for each subsequent development scenario.

7.2.6.3 Service tracking functions

The service tracking functions provide the capability of tracking dependencies among services. Some services which are used by the service provider to develop and create new services may have dependency on each other. This dependency information is stored in one database or separated into several databases. The database is managed by the service tracking functions.

7.2.7 Interworking with service creation environments functional entity (IWSCE-FE)

OSE may use the services of legacy network. In order to do this, legacy services need to be accessible by OSE.

The interworking with service creation environments FE (IWSCE-FE) allows interworking between service creation environment and network entities for creation and provisioning of applications and services. It supports the service development support FE (SDS-FE) enabling it to use other open service creation environments such as those supported via Parlay or provided by the intelligent network as described in [ITU-T Y.2234].

The interworking with service creation environments FE (IWSCE-FE) is shown in Figure 7-9.

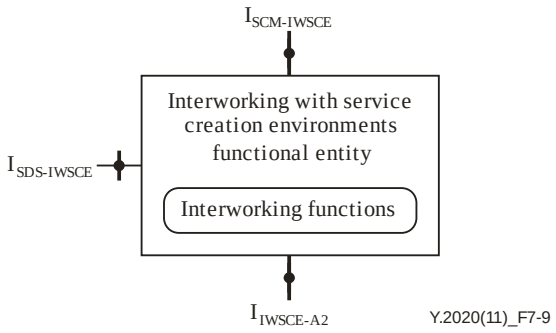


Figure 7-9 – Interworking with service creation environments FE

Interworking with service creation environments FE (IWSCE-FE) has abilities to support APIs which are provided by other open service environments such as Parlay and intelligent network (IN) in order to interwork with other non-NGN open service environments.

Interworking functions located in this FE play the role of intermediary between NGN OSE functions and functions in other environments. These functions help service creation to use non NGN through a reference point $I_{IWSCE-A2}$.

NOTE – The procedure for interworking with service creation environments is described in clause II.3.

7.2.8 Service policy enforcement functional entity (SPE-FE)

The service policy enforcement FE (SPE-FE) in OSE is responsible for enforcing policies with respect to the authentication of end-users and/or applications. The SPE-FE is responsible for protecting resources (service and capabilities) from unauthorized requests.

The policy in the SPE-FE consists of combinations of policy rules.

Figure 7-10 illustrates the service policy enforcement (SPE-FE).

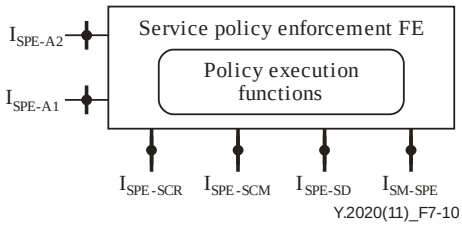


Figure 7-10 – Service policy enforcement FE

As shown in Figure 7-10, the service policy enforcement FE (SPE-FE) consists of policy execution functions and policy repository.

7.2.8.1 Policy execution functions

The policy execution functions are responsible for the processing of policy rules. The policy execution functions also help the SCM-FE which can select the appropriate services.

For the processing of the policy in OSE, the SPE-FE maintains policy rules which were managed by the policy execution functions. The policy rules provide overall policy rules operations (e.g., insert, delete, update and find) for related functional entities of the OSE. The rules are used by the policy execution functions. The policy rules are stored in one database or separated into several databases.

A description language of policy rules expresses various kinds of policy rules, such as authorization, charging, service level agreement and logging. This language provides modular mechanisms to enable re-use of policies. The XACML (eXtensible Access Control Markup Language) is an example of policy description language.

7.2.9 Reference points

7.2.9.1 Reference points internal to the OSE

The reference points within the OSE are the following:

I_{SM-SPE} reference point between the service policy enforcement functional entity (SPE-FE) and the service management functional entity (SM-FE). The SM-FE interacts with the SPE-FE to receive the policy to manage OSE through this reference point.

I_{SM-SR} reference point between the service management FE (SM-FE) and the service registration functional entity (SR-FE). The service registration FE can register services in the SM-FE through this reference point.

I_{SM-SCR} reference point between the service coordination FE (SCR-FE) and the service management FE (SM-FE). The SCR-FE can get service characteristics and information such as service response time, service availability and service version, etc. from the SM-FE through reference point I_{SM-SCR}.

I_{SM-SD} reference point between the service discovery service FE (SD-FE) and the service management FE (SM-FE). The SD-FE can discover services through reference point I_{SM-SD}.

I_{SPE-SD} reference point between the service policy enforcement functional entity (SPE-FE) and the service discovery FE (SD-FE). The SD-FE interworks with SPE-FE through the reference point I_{SPE-SD} to apply discovery-related policies (e.g., discovery authentication, discovery authorization, etc.) to the discovery process.

$I_{SPE-SCR}$ reference point between the service policy enforcement functional entity (SPE-FE) and the service coordination FE (SCR-FE). The service coordination FE receives policy through this reference point. The SCR-FE interworks with SPE-FE through the reference point $I_{SPE-SCR}$ to apply policies related to service coordination (e.g., authentication and/or authorization related to coordination, etc.).

I_{SD-SCR} reference point between the service discovery FE (SD-FE) and the service coordination FE (SCR-FE). The SD-FE sends a coordination request to the SCR-FE through reference point I_{SD-SCR}. The SCR-FE replies through this reference point.

$I_{SCM-SDS}$ reference point between the service composition FE (SCM-FE) and the service development support FE (SDS-FE). The SDS-FE helps the SCM-FE to create a new composition service through reference point $I_{SCM-SDS}$.

$I_{SDS-IWSCE}$ reference point between the service development support FE (SDS-FE) and the interworking with service creation environments FE (IWSCE-FE). The SDS-FE interacts with the IWSCE-FE in order to interwork with other non-NGN open service environments through reference point $I_{SCM-IWSCE}$.

I_{SDS-SR} reference point between the service development support FE (SDS-FE) and the service registration FE (SR-FE). The SDS-FE can register services through the service registration FE (SR-FE).

$I_{SCR-SCM}$ reference point between the service composition FE (SCM-FE) and the service coordination FE (SCR-FE). The SCR-FE can help the SCM-FE to choose the appropriate services or capability.

$I_{SPE-SCM}$ reference point between the service policy enforcement FE (SPE-FE) and the service composition FE (SCM-FE). The SPE-FE interacts with SCM-FE to call composition services through the reference point $I_{SPE-SCM}$.

$I_{SCM-IWSCE}$ reference point between the service composition FE (SCM-FE) and the interworking with service creation environments FE (IWSCE-FE). The SCM-FE interacts with IWSCE-FE in order to interwork with other non-NGN open service environments through the reference point $I_{SCM-IWSCE}$.

I_{SPE-SD} reference point between the service discovery FE (SD-FE) and the service policy enforcement FE (SPE-FE). The SD-FE interworks with the SPE-FE through this reference point to apply policies to the service discovery process related to service discovery (e.g., authentication and authorization related to discovery).

7.2.9.2 Reference points between OSE and other ASF&SSF

The reference points between OSE and other ASF&SSF are as follows:

I_{SM-A1} reference point between the service management FE (SM-FE) and A1-AS-FE. The SM-FE interworks with A1-SS-FE to capture and log the tracking information through reference point I_{SM-A1}.

I_{SM-A2} reference point between the service management FE (SM-FE) and A2-APL-GW-FE. The SM-FE interworks with A2-APL-GW-FE to capture and log the tracking information through reference point I_{SM-A2}.

I_{SM-A3} reference point between the service management FE (SM-FE) and A3-APL-SCM-FE. The SM-FE interworks with A3-APL-SCM-FE to capture and log the tracking information through reference point I_{SM-A3}.

I_{SM-A4} reference point between the service management FE (SM-FE) and A4-SS-FE. The SM-FE interworks with A4-SS-FE to capture and log the tracking information through reference point I_{SM-A4}.

I_{SPE-A2} reference point between the service policy enforcement FE (SPE-FE) and A2-APL-GW-FE. The APL-GW-FE requests the OSE services to the service policy enforcement FE (SPE-FE) through the reference point I_{SPE-A2}.

I_{SPE-A1} reference point between the policy enforcement FE (SPE-FE) and A1-AS-FE. The SPE-FE interacts with each basic service in AS-FE to use the service through the reference point I_{SPE-A1}.

I_{SCM-A1} reference point between the service composition FE (SCM-FE) and A1-AS-FE. The SCM-FE interacts with each basic service in AS-FE through the reference point I_{SCM-A1}.

$I_{IWSCF-A2}$ reference point between the interworking with service creation environments FE (IWSCE-FE) and A2-APL-GW-FE. The IWSCE-FE plays the role of intermediary to help service creation to use non-NGN through the reference point $I_{IWSCE-A2}$.

7.2.9.3 Reference points between OSE and end-user functions

The reference point between OSE or ASF&SSF and end-user functions is A-U1 as shown in Figure 9-1 of [ITU-T Y.2012]. ASF&SSF interacts with the end-user functions via A-U1 (i.e., UNI) reference point to allow the end users to securely manage and configure data for their services and applications as described in [ITU-T Y.2012]. OSE also interacts with the end-user functions via A-U1 (i.e., UNI) reference point.

7.2.9.4 Reference points between OSE and applications

Capabilities and services registered in OSE are exposed through the ANI.

8 Security considerations

The security requirements within the open service environment functional architecture for NGN are addressed by the security requirements for NGN in [ITU-T Y.2701] as well as the security requirements for NGN authorization and authentication in [ITU-T Y.2702].

Appendix I

Mapping of OSE capabilities into ITU-T Y.2012 FEs and ITU-T Y.2020 FEs

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

The following table describes the relationship the between OSE capabilities as described in [ITU-T Y.2234] and functional entities defined in this Recommendation and in [ITU-T Y.2012].

ITU-T Y.2234 OSE capabilities	**ITU-T Y.2012 FEs**	**ITU-T Y.2020 FEs**
Coordination of application and services with capabilities	APL-SCM-FE has a role as a coordinator between NGN applications and services	Service coordination FE
Tracking of NGN capabilities or service component and relationship	Not defined	
Supporting the information on state change	Not defined	
Service discovery function	Not defined (* AS-FE can optional have role as a discovery server)	Service discovery FE
Service registration functions	Not defined	Service registration FE
Service monitoring functions	Not defined	Service management FE
QoS information managing functions	Not defined	
Version management function	Not defined	
Notification service function for updated services	Not defined	
Failure detection and recovering functions	Not defined	
Service tracking management functions	Not defined	
Service substitution functions	Not defined	
Service access control function	Not defined	
Statistical analysis functions	Not define	
Auditing functions	Not defined	
Service composition execution functions	Not defined	Service composition FE
Composition language	Not defined	
Service creation support functions	Not defined	Service development support FE
Service life cycle management functions	Not defined	
Service tracking functions	Not defined	

ITU-T Y.2234 OSE capabilities	ITU-T Y.2012 FEs	ITU-T Y.2020 FEs
Interwork functions	Not defined	Interworking with service creation environments FE
Policy repository and description language of policy enforcement	Not defined	Service policy enforcement FE
Policy executions functions	Not defined	

Appendix II

Procedures related to OSE

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

This appendix describes three procedures with information flows related to OSE.

II.1 Procedure for service discovery

Figure II.1 shows an example of the information flows describing how the application can discover OSE registered services.

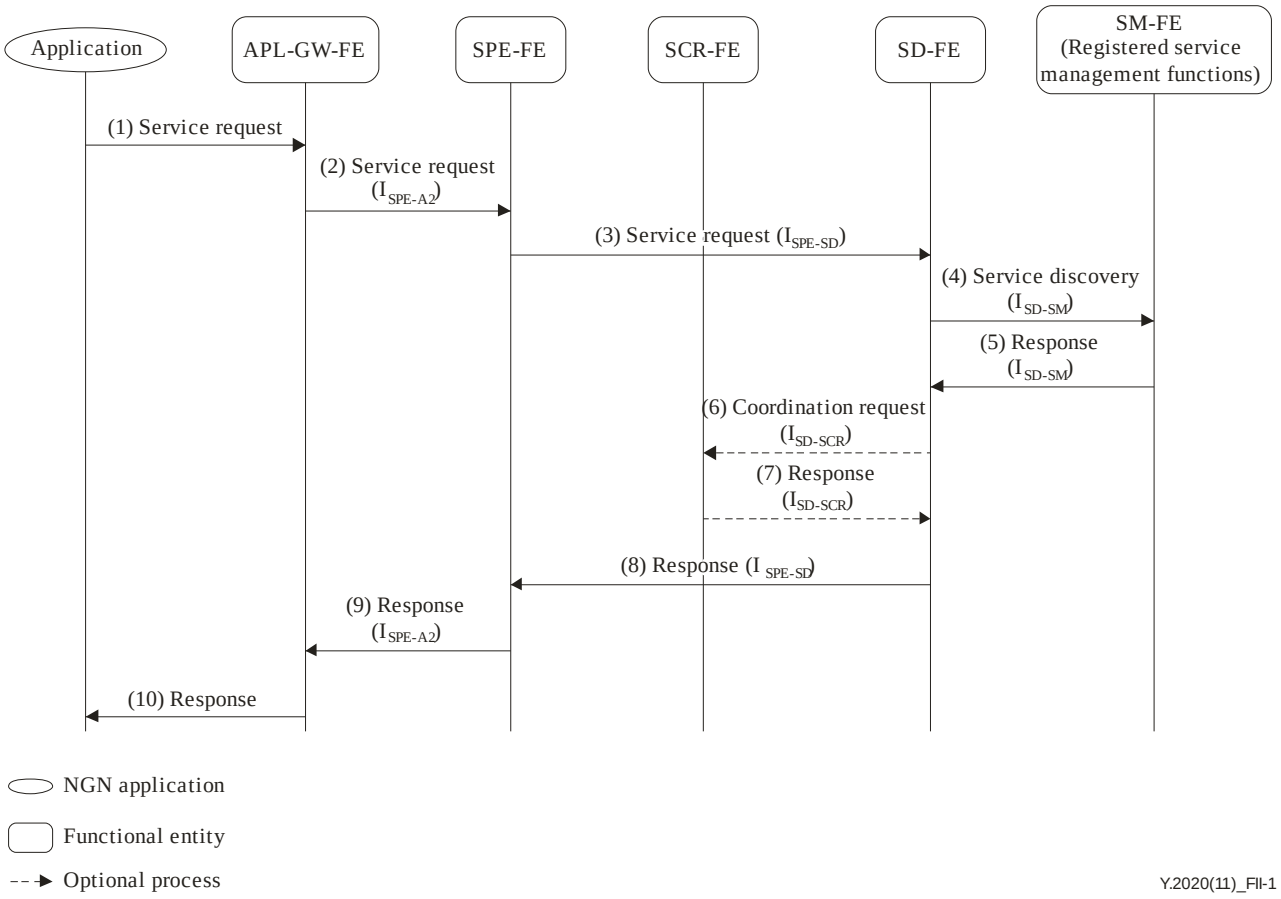


Figure II.1 – Example of information flow for service discovery

1) An application requests a service through ANI.
2) The APL-GW-FE requests the request to the SPE-FE through the reference point I_{SPE-A2}.

   NOTE – The APL-GW-FE provides a secure open interface for the applications to use the capabilities and resources of the NGN as described in [ITU-T Y.2012].
3) The SPE-FE checks the request and forwards it to the service discovery FE.
4) The SD-FE starts service discovery process and sends a service discovery request to the registered service management functions located in the service management FE (SM-FE) through reference point I_{SD-SM}.
5) The SM-FE sends the result of the service discovery to the SD-FE through reference point I_{SD-SM}.
6) The SD-FE checks the result of the request. If the result has two or more services or capabilities and needs to coordinate, this FE sends a coordination request to the service

coordination FE through the reference point I_{SD-SCR}. Otherwise it follows the procedure in step 8).

7) If the SCR-FE receives a coordination request, it executes a coordination process and returns the result of the coordination process to the SD-FE through the reference point I_{SD-SCR}.

8) The service discovery FE returns the result of the service discovery to the SPE-FE through the reference point I_{SPE-SD}.

9) The SPE-FE returns the result of the service request through the reference point I_{SPE-A2}.

10) The APL-GW-FE returns the result of the service discovery to the application.

II.2 Procedure for service registration

Figure II.2 shows an example of the information flows describing how a new service can be registered in the database which is managed by registered service management functions.

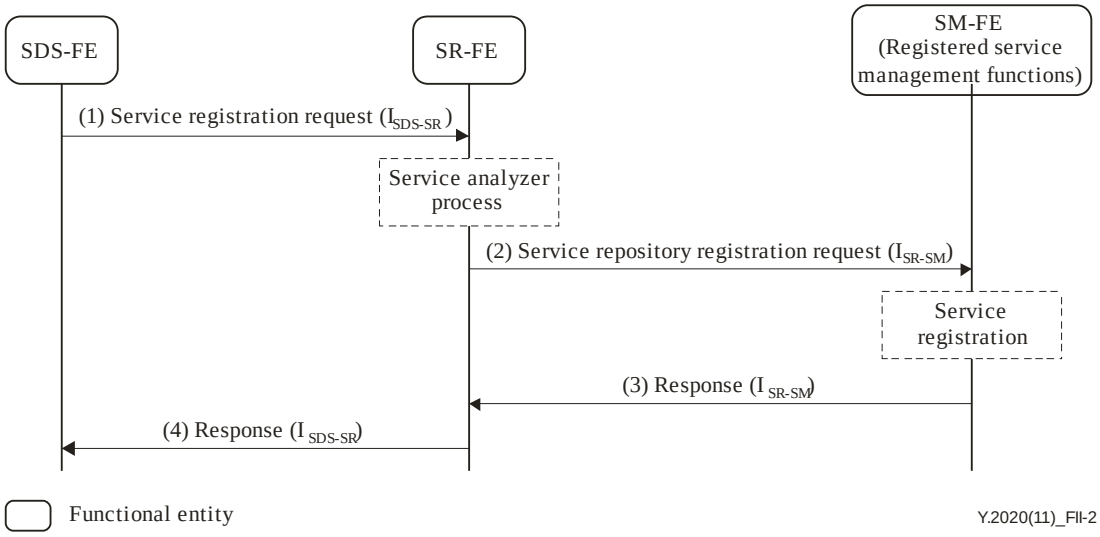


Figure II.2 – Example of information flow for service registration

1) Once a new service has been created, the SDS-FE requests a service registration through reference point I_{SDS-SR}.

2) The SR-FE analyses the service and sends a service request with derived information about the service through reference point I_{SR-SM}.

3) The registered service management functions registers the service in the database and sends the response to the SR-FE through reference point I_{SR-SM}.

4) The SR-FE acknowledges the registration of the service back to the SDS-FE through reference point I_{SDS-SR}.

II.3 Procedure for service interworking with other open service environments

Figure II.3 shows an example of the information flows describing how to interwork with other service environments in NGN.

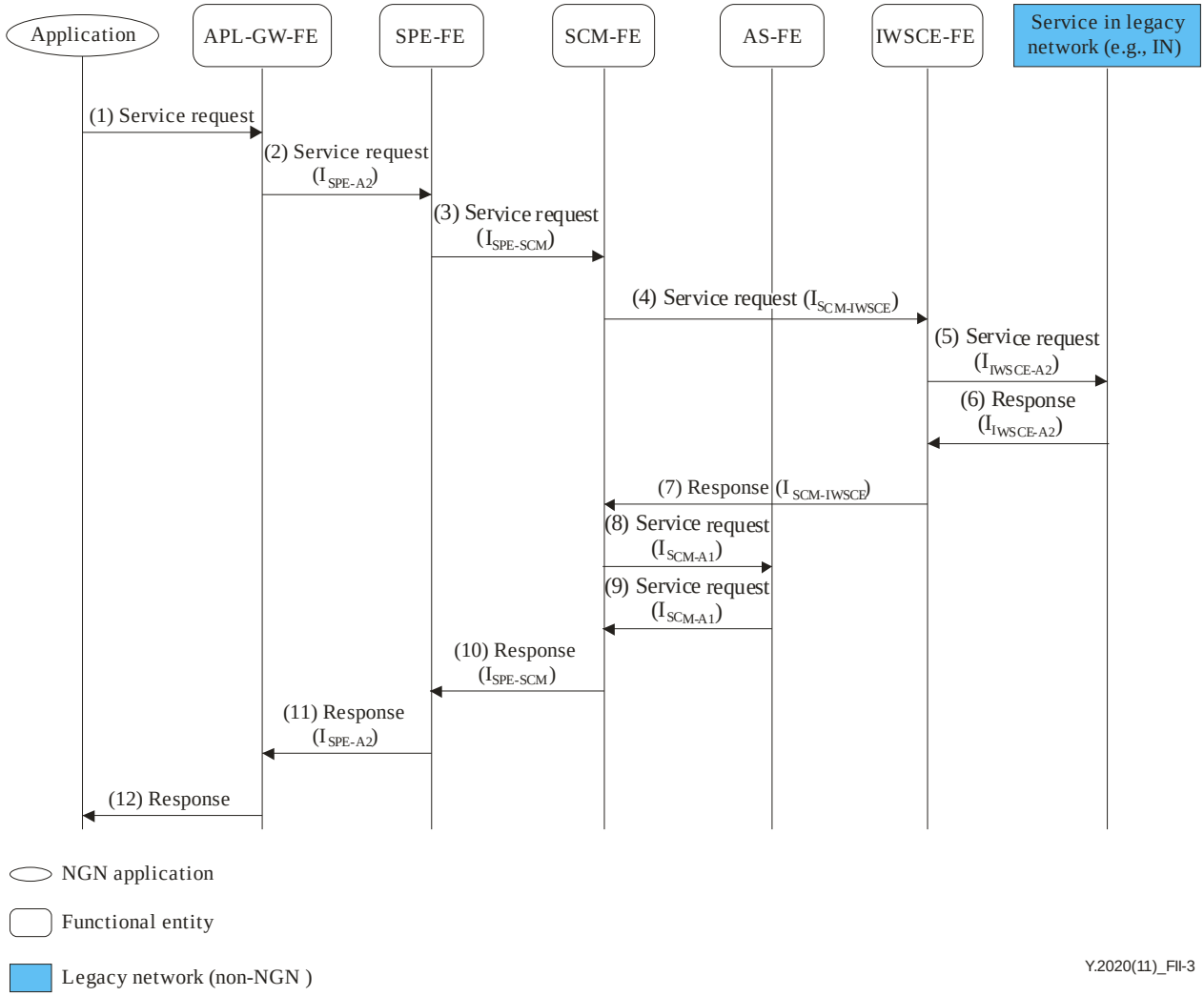


Figure II.3 – Example of information flow of using interworks with other open service environments

1) Application requests a service to the APL-GW-FE.
2) The APL-GW-FE requests the service to the SPE-FE through reference point I_{SPE-A2}.
3) The SPE-FE checks the service request and, if acceptable, sends it to the SCM-FE through reference point $I_{SPE-SCM}$.
4) The SCM-FE interacts with the IWSCE-FE (interworking with service creation environments FE) to request a service through reference point $I_{SCM-IWSCE}$.
5) The IWSCE-FE requests the service of legacy network (e.g., intelligent network) through reference point $I_{IWSCE-A2}$.
6) The IWSCE-FE received the result of service through reference point $I_{IWSCE-A2}$.
7) The IWSCE-FE returns the result of the service to the service composition FE through reference point $I_{SCM-IWSCE}$.
8) The SCM-FE interacts with the AS-FE to request a service through reference point I_{SCM-A1}.
9) AS-FE returns the result of service to the SCM-FE through reference point I_{SCM-A1}.
10) The SCM-FE returns the result of service to the policy enforcement FE.
11) The SPE-FE returns it to the APL-GW-FE through reference point I_{SPE-A2}.
12) The APL-GW-FE returns it to the application.

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

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