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

Next Generation Networks – Frameworks and functional architecture models

IMS for Next Generation Networks

ITU-T Recommendation Y.2021

International Telecommunication Union

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ITU-T Recommendation Y.2021

IMS for Next Generation Networks

Summary

The IP multimedia subsystem (IMS) has been adopted, and will be adapted as required, to support session-based services, and other services based on session initiation protocol (SIP). This Recommendation describes how the IMS can be used in the NGN context following the fundamental principles described in [ITU-T Y.2001] and [ITU-T Y.2011] for providing the IP multimedia service component of the NGN functional architecture and describes its relationships to other service components.

Source

ITU-T Recommendation Y.2021 was approved on 13 September 2006 by ITU-T Study Group 13 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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IMS for Next Generation Networks

1 Scope

The IP multimedia subsystem (IMS) as specified by the 3rd Generation Partnership Project (3GPP) and the 3rd Generation Partnership Project 2 (3GPP2), has been adopted, and will be adapted as required, to support session-based services, and other services based on session initiation protocol (SIP). This Recommendation describes how the IMS can be used in the NGN context following the fundamental principles described in [ITU-T Y.2001] and [ITU-T Y.2011]. This Recommendation identifies the IMS for use in NGN and describes the use of the IMS in providing the IP multimedia service component of the NGN functional architecture and describes its relationships to other service components. It further identifies those IMS architecture documents that are relevant in the context of NGN. For more detail refer to [ITU-T Y.2012].

Administrations may require operators and service providers to take into account national regulatory and national policy requirements in implementing this Recommendation.

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.1741.4] ITU-T Recommendation Q.1741.4 (2005), *IMT-2000 references to release 6 of GSM evolved UMTS core network.*

[ITU-T Q.1742.4] ITU-T Recommendation Q.1742.4 (2005), *IMT-2000 references (approved as of 30 June 2004) to ANSI-41 evolved core network with cdma2000 access network.*

[ITU-T Y.101] ITU-T Recommendation Y.101 (2000), *Global Information Infrastructure terminology: Terms and definitions.*

[ITU-T Y.2001] ITU-T Recommendation Y.2001 (2004), *General overview of NGN.*

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

[ITU-T Y.2012] ITU-T Recommendation Y.2012 (2006), *Functional requirements and architecture of the NGN.*

[ETSI TS 123 002] ETSI TS 123 002 V7.1.0 (2006), *Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Network architecture.*

[ETSI TS 123 228] ETSI TS 123 228 V7.3.0 (2006), *Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); IP Multimedia Subsystem (IMS); Stage 2.*

[TIA-873.002] TIA-873.002-A (2006), *All-IP Core Multimedia Domain, IP Multimedia Subsystem – Stage 2.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 reference point [ITU-T Y.101]: A conceptual point at the conjunction of two non-overlapping functional groups.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 home network: The network to which a mobile user is normally connected, or the service provider with which the mobile user is associated, and where the user's subscription information is managed.

3.2.2 visited network: The network outside a home network that provides service to a mobile user. This term is more business significant than geographically significant.

4 Abbreviations

This Recommendation uses the following abbreviations:

ALG Application Layer Gateway

AS-FE Application Server Functional Entity

BGCF Breakout Gateway Control Function

CSCF Call Session Control Function

HSS Home Subscriber Service

IBC-FE Interconnection Border gateway Controller Functional Entity

IBG-FE Interconnection Border Gateway Functional Entity

I-CSCF Interrogating CSCF

IMS IP Multimedia Subsystem

IP Internet Protocol

ISC IMS Service Control

I-SIM IMS Subscriber Identity Module

MGCF Media Gateway Control Function

MRFC Multimedia Resource Function Controller

MRP-FE Multimedia Resource Processor Functional Entity

NAPT Network Address and Port Translation

NGN Next Generation Network

NSIW-FE Network Signalling Interworking Functional Entity

P-CSCF Proxy CSCF

PLMN Public Land Mobile Network

PSTN Public Switched Telephone Network

RACF Resource and Admission Control Functions

SAA-FE Service Authentication and Authorization Functional Entity

S-CSCF Serving CSCF

SDP Session Description Protocol

SG-FE Signalling Gateway Functional Entity

SIP Session Initiation Protocol

SL-FE Subscription Locator Functional Entity

SPIRITS Service in the PSTN/IN Requesting InTernet Services

SUP-FE Service User Profile Functional Entity

TMG-FE Trunking Media Gateway Functional Entity

UE User Equipment

WLAN Wireless Local Area Network

xDSL x-Digital Subscriber Line

5 Conventions

None.

6 Overview

6.1 Introduction to IMS

IMS is a collection of core network functional entities for the support of SIP-based services [ETSI TS 123 228], [TIA-873.002]. IMS supports the registration of the user and the terminal device at a particular location in the network. As part of registration, IMS supports authentication and other security arrangements. IMS utilizes SIP-based control. The services supported by IMS may include multimedia session services and some non-session services such as Presence services or message exchange services.

In addition to services for the user, IMS defines a number of network reference points to support operator-provided services. IMS supports various application services via the services support architecture. IMS supports operation and interworking with a variety of external networks via defined reference points. IMS supports defined reference points for the collection of accounting data in support of charging and billing operations.

IMS also supports defined reference points within the underlying transport infrastructure for the enforcement of QoS negotiated by session signalling and for flow gating. These reference points also support the exchange of information in support of correlation of charging between IMS and the underlying transport.

Appendix I contains a list of documents defining IMS which are relevant in the context of NGN.

6.2 Use of IMS in NGN

6.2.1 General

The NGN IP multimedia service (IMS) component supports the provision of SIP-based multimedia services to NGN terminals. It also supports the provision of PSTN/ISDN simulation services.

This clause provides details about the IP multimedia subsystem and the adaptation and extension of the IMS specifications to support additional access network types, such as those based on xDSL and WLAN. IMS and its extensions support the following:

- control of IP connectivity access networks (QoS, admission control, authentication, etc.);

- coordination of multiple control components to a single core transport for resource control;
- interworking and interoperability with legacy and other networks;
- mutual de-coupling of the applications from the session/call control and the transport;
- access technology independence of session/call control and applications.

Functional entities of an IMS may be used by an operator in support of transit network scenarios. The routing may be performed, depending on the entity performing the routing, and depending on the traffic case, signalling information, configuration data, and/or database lookup.

The references contained in Appendix I are considered to be relevant in the NGN architecture. The access networks able to be supported by the Release 7 versions of these documents mostly focus on DSL access.

6.2.2 Relationship between IMS and NGN

IMS is comprised of a number of functional entities that together can provide support for the capabilities of the service stratum of NGN [ITU-T Y.2012]. The following functional entities are defined in IMS as specified by the documents in Appendix I. The IMS functional entities and their environment are illustrated in Figure 6-1.

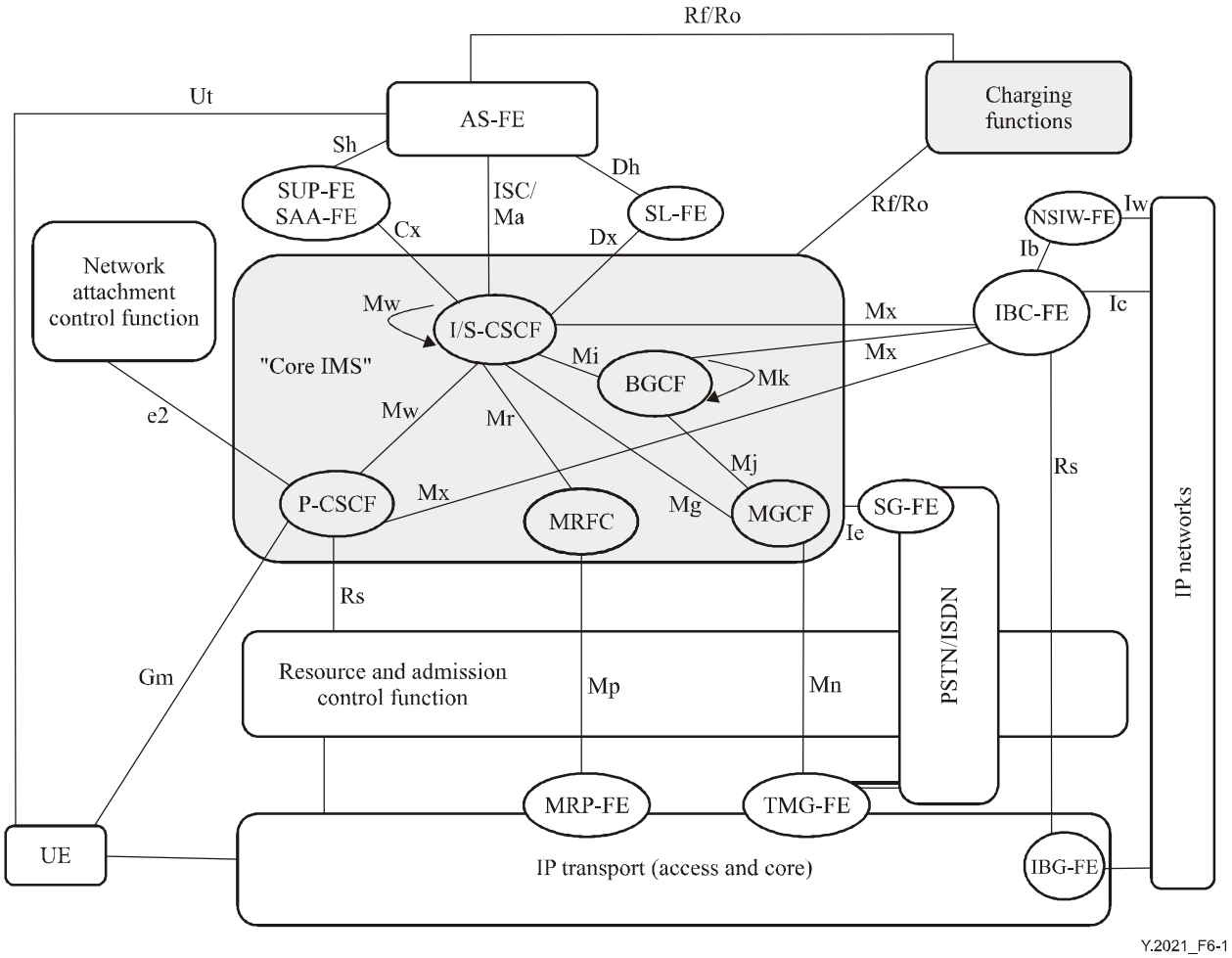

Figure 6-1 – IMS and its environment

Figure 6-1 shows the set of functional entities that comprise IMS. IMS, as a collection of core network functional entities may be utilized by both home networks and by visited networks in roaming situations. Figure 6-1 shows these functional entities but it does not represent the possible distribution of these entities among home and visited NGN core networks. Figure 6-2 shows the IMS session control entities along with an indication of the core networks within which they may reside.

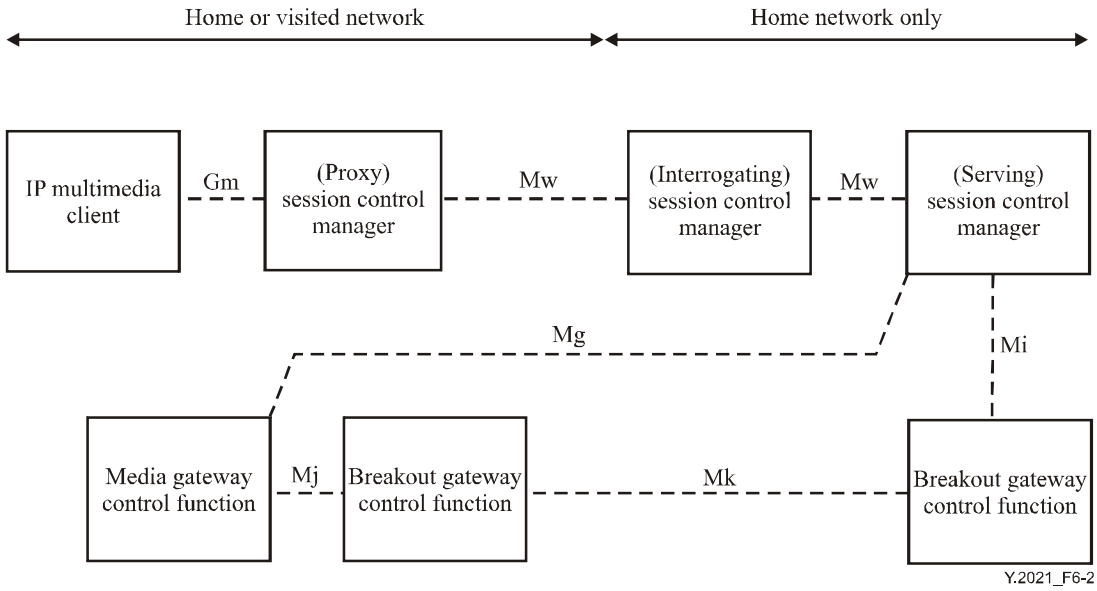

Figure 6-2 – Relationship of session control entities to NGN core networks

As can be seen from Figure 6-2, the first SIP session control entity (P-CSCF) and the reference point to the PSTN can be supported in the visited network as well as in the home network assuming that the operators have the appropriate business relationship. However the S-CSCF, which controls the access to IMS services, is always located in the home network.

7 Functional entities

The functional entities identified in this clause are identical to those defined in [ETSI TS 123 002] except when a difference is explicitly highlighted.

7.1 Call session control function (CSCF)

The call session control function (CSCF) establishes, monitors, supports and releases multimedia sessions, and manages the user's service interactions. For more details see clause 4a.7.1 in [ETSI TS 123 002].

NOTE – The CSCF can act as a proxy CSCF (P-CSCF), serving CSCF (S-CSCF) or interrogating CSCF (I-CSCF). The P-CSCF is the first contact point for the UE within the IMS; the S-CSCF actually handles the session states in the network; the I-CSCF is mainly the contact point within an operator's network for all IMS connections destined to a subscriber of that network operator, or a roaming subscriber currently located within that network operator's service area.

This functional entity is identical to the CSCF defined in [ETSI TS 123 002], except for when acting as a P-CSCF. The P-CSCF behaviour differs from the behaviour described in [ETSI TS 123 002] by the following main points:

– The P-CSCF defined in this Recommendation encompasses ALG functionality required to interact with network address and port translation functions located in the transport plane, via the RACF.

– The P-CSCF defined in this Recommendation interfaces with the network attachment subsystem (NACF) in order to retrieve information related to the IP-connectivity access session (e.g., physical location of the user equipment).

In case of transit traffic the I-CSCF may have extra functionality for routing.

Further definitions of the P-, S- and I-CSCF are provided in [b-ETSI TS 182 006].

7.2 Media gateway control function (MGCF)

The media gateway control function (MGCF) provides the ability to control a trunking media gateway functional entity (TMG-FE) through a standardized interface. Such control includes allocation and deallocation of resources of the media gateway, as well as modification of the usage of these resources. The MGCF communicates with the CSCF, the breakout gateway control function (BGCF) and circuit-switched networks. The MGCF performs protocol conversion between ISUP and SIP. It also supports interworking between SIP and non-call related SS7 signalling (i.e., TCAP-based signalling for supplementary services such as CCBS).

In case of incoming calls from legacy networks, the MGCF determines the next hop in IP routing depending on received signalling information.

In case of transit traffic, the MGCF may use necessary functionality for routing.

This functional entity is identical to the MGCF defined in [ETSI TS 123 002], except that it also supports TCAP interworking. A node implementing this functional entity in an NGN network, and a node implementing it in a 3GPP network, may differ in terms of supported resources (e.g., codecs) and configuration.

7.3 Multimedia resource function controller (MRFC)

The multimedia resource function controller (MRFC), in conjunction with an MRP-FE located in the transport layer, provides a set of resources within the core network for supporting services. The MRFC interprets information coming from an AS-FE via an S-CSCF and control MRP-FE accordingly. The MRFC, in conjunction with the MRP-FE, provides, e.g., multi-way conference bridges, announcement playback and media transcoding.

This functional entity is intended to be identical to the MRFC defined in [ETSI TS 123 002], although a node implementing this functional entity in an NGN and a node implementing it in a 3GPP network may differ in terms of supported resources and configuration.

7.4 Breakout gateway control function (BGCF)

The breakout gateway control function (BGCF) selects the network in which PSTN breakout is to occur and selects the MGCF within that network.

In case of transit traffic, the BGCF may have extra functionality for routing.

This functional entity is identical to the BGCF defined in [ETSI TS 123 002], although a node implementing this functional entity in an NGN and a node implementing it in a 3GPP network may differ in terms of configuration (e.g., breakout criteria).

8 Internal reference points

The reference points identified in this clause are identical to those defined in [ETSI TS 123 002] except when a difference is explicitly highlighted.

8.1 Reference point MGCF – CSCF (Mg reference point)

The Mg reference point allows the MGCF to forward incoming session signalling (from the PSTN) to the CSCF for the purpose of interworking with PSTN networks.

This reference point is identical to the reference point MGCF – CSCF (Mg) defined in [ETSI TS 123 002].

8.2 Reference point CSCF – MRFC (Mr reference point)

The Mr reference point allows the S-CSCF to relay signalling messages between an application server function and an MRFC.

Details are described in [b-ETSI TS 182 006].

This reference point is identical to the reference point CSCF – MRFC (Mr) defined in [ETSI TS 123 002].

8.3 Reference point CSCF – CSCF (Mw reference point)

The Mw reference point allows the communication and forwarding of signalling messaging between CSCFs, e.g., during registration and session control.

Details are described in [b-ETSI TS 182 006].

This reference point is identical to the reference point CSCF – CSCF (Mw) defined in [ETSI TS 123 002].

8.4 Reference point CSCF – BGCF (Mi reference point)

The Mi reference point allows the serving CSCF to forward the session signalling to the BGCF for the purpose of interworking with PSTN networks.

Details are described in [b-ETSI TS 182 006].

This reference point is identical to the reference point CSCF – BGCF (Mi) defined in [ETSI TS 123 002].

8.5 Reference point BGCF – MGCF (Mj reference point)

The Mj reference point allows the BGCF to forward the session signalling to the MGCF for the purpose of interworking with PSTN networks.

This reference point may also be used by an MGCF to forward session signalling to the BGCF in case of transit scenarios, if the MGCF supports transit routing.

Details are described in [b-ETSI TS 182 006].

This reference point is identical to the reference point BGCF – MGCF (Mj) defined in [ETSI TS 123 002].

8.6 Reference point BGCF – BGCF (Mk reference point)

The Mk reference point allows the BGCF to forward the session signalling to another BGCF.

Details are described in [b-ETSI TS 182 006].

This reference point is identical to the reference point BGCF – BGCF (Mk) defined in [ETSI TS 123 002].

8.7 Reference point CSCF or BGCF – IBC-FE (Mx reference point)

The Mx reference point allows the communication and forwarding of signalling messages between a CSCF or a BGCF and an IBC-FE.

This reference point is identical to the reference point CSCF or BGCF – IBC-FE (Mx) defined in [ETSI TS 123 002].

9 IMS external reference points

9.1 Reference points with entities in the transfer plane

Transport plane entities are defined in [b-ETSI ES 282 001].

9.1.1 Reference point MGCF – TMG-FE (Mn reference point)

The Mn reference point is identical to the reference point MGCF – TMG-FE (Mn) defined in [ETSI TS 123 002].

The Mn reference point between the MGCF and a TMG-FE has the following properties:

– Full compliance with the legacy information required for IMS – PSTN/PLMN interworking.

– Open architecture where extensions/packages definition work on the reference point may be carried out.

– Dynamic sharing of TMG-FE physical node resources. A physical TMG-FE can be partitioned into logically separate virtual media gateways/domains.

– Dynamic sharing of transmission resources between the domains as the MGCF controls bearers and manages resources and functions for IMS.

9.1.2 Reference point MGCF – SG-FE (Ie reference point)

The Ie reference point enables the MGCF to exchange SS7 signalling information over IP with the SG-FE, according to the SIGTRAN architecture.

9.1.3 Reference point MRFC – MRP-FE (Mp reference point)

The Mp reference point allows an MRFC to control media stream resources provided by an MRP-FE.

The Mp reference point has the following property:

– Open architecture where extensions (packages) definition work on the reference point may be carried out.

Details are described in [b-ETSI TS 182 006].

This reference point is identical to the reference point MRFC – MRP-FE (Mp) defined in [ETSI TS 123 002].

9.2 Reference point CSCF – UE (Gm reference point)

The Gm reference point is identical to the reference point CSCF – UE (Gm) defined in [ETSI TS 123 002].

The Gm reference point supports the communication between the UE and the IMS, i.e., it is related to registration and session control.

Details are described in [b-ETSI TS 182 006].

9.3 Reference points with the user profile

The SL-FE and SUP-FE entities are defined in [b-ETSI ES 282 001].

9.3.1 Reference point CSCF – SL-FE (Dx reference point)

The Dx reference point between a CSCF and a SL-FE is used to retrieve the address of the SUP-FE which holds the subscription for a given user. This reference point is identical to the reference point CSCF – SL-FE (Dx) defined in [ETSI TS 123 002].

This reference point is not required in a single SUP-FE environment. An example for a single SUP-FE environment is a server farm architecture.

Details are described in [b-ETSI TS 182 006].

9.3.2 Reference point CSCF – SUP-FE (Cx reference point)

The Cx reference point is identical to the reference point HSS – CSCF (Cx) defined in [ETSI TS 123 002].

The Cx reference point supports information transfer between a CSCF and an SUP-FE.

The main procedures that require information transfer between a CSCF and an SUP-FE are:

1) Procedures related to serving CSCF assignment.
2) Procedures related to routing information retrieval from an SUP-FE to a CSCF.
3) Procedures related to authorization (e.g., checking of roaming agreements).
4) Procedures related to authentication (e.g., transfer of subscriber security parameters between an SUP-FE and a CSCF).
5) Procedures related to filter control (e.g., transfer of subscriber filter parameters from an SUP-FE to a CSCF).

Further information on the Cx reference point is provided in [b-ETSI TS 182 006].

9.4 Reference points to application servers

IMS supports various reference points between the IMS and application servers. These reference points support the interactions between the S-CSCF and various types of application servers, possibly through mediation devices. They also support the interaction between application servers and the HSS, which is the subscriber information database. This supports the downloading of subscriber data from the HSS to the AS (as well as subscriber data updating by the AS) and enables the SUP-FE/SAA-FE to notify an AS of changes occurring on subscriber data. No specific extensions to these reference points are identified for IMS use in NGN.

9.5 Reference points to the charging environment

The following functional entities in the core IMS may act as charging trigger points:

– AS-FE;
– BGCF;
– (I-/P-/S-) CSCF;
– MGCF;
– MRFC.

For off-line charging the Rf reference point is used. For on-line charging the Ro reference point is used. Details are described in [b-ETSI TS 282 010].

NOTE – The IBC-FE to which the core IMS is connected may also act as a charging trigger point.

10 Reference points to external networks

10.1 Reference points with the PSTN/ISDN

Interconnection at the signalling level is provided via the SG-FE (transport) and MGCF (call/service control).

Interconnection at the media level is provided by the trunk reference points at the TMG-FE.

Further details can be found in [b-ETSI ES 283 027].

10.2 Reference points with other IP-based service components

Interconnection with other IP-based service components (including PSTN/ISDN emulation subsystems and another IMS) is performed via the IBC-FE reference point (Ic) at the signalling level and the IBG-FE at the media level. In case of interconnection with other IP-based protocols (e.g., between the SIP profile used in the IMS and other SIP profiles or IP-based protocols such as H.323) the NSIW-FE performs interworking via the Iw reference point.

For more details refer to [ITU-T Y.2012].

In case of transit traffic, the IBC-FE may have extra functionality for routing, e.g., to retain legacy signalling information for incoming PSTN/ISDN calls that are switched through to a following network.

Interconnection between IMS components occurs either between two home domains (e.g., session originating and terminating domains) or between a visited domain and a home domain (i.e., support of roaming capabilities).

Based on signalling information received from the core IMS and local policy rules, the IBC-FE decides on a per session basis whether the RACF should be involved in the interconnection.

NOTE – Depending on the operator policies, the decision as to whether or not media level interconnection is required (i.e., an IBG-FE shall be inserted in the media path) for a particular session may be taken by the RACF, based on information received from the IBC-FE. The RACF shall also choose the appropriate interconnection link for media traffic based on the information received from the IBC-FE.

Further details can be found in [b-ETSI TS 183 021].

11 Mapping between 3GPP IMS functional entities and NGN functional entities

The mapping between 3GPP IMS functional entities and NGN functional entities is shown in Table 11-1.

Table 11-1 – Correspondence between 3GPP IMS functional entities and NGN functional entities

3GPP functional entities	NGN functional entities
S-CSCF	S-CSC-FE
P-CSCF	P-CSC-FE
I-CSCF	I-CSC-FE
MGCF	MGC-FE
MRFC	MRC-FE
BGCF	BGC-FE

Appendix I

Relevant IMS specifications in the context of the NGN functional architecture

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

Table I.1 provides a list of documents that define IMS and are considered relevant in the context of the NGN functional architecture. This list identifies the documents developed by 3GPP and 3GPP2, published by their various partner regional standards bodies, for the access-independent portion of the IMS. These document identifiers are associated with documents published by standards development organizations as identified in ITU-T Rec. Q.1741.x sub-series (i.e., [ITU-T Q.1741.4]) and ITU-T Rec. Q.1742.x sub-series (i.e., [ITU-T Q.1742.4]).

NOTE – Table I.1 reflects the content of [ITU-T Q.1741.4] and [b-ITU-T Q.1742.5] pertaining to architecture. For the current situation, the content of this table should be updated to reflect the most recent 3GPP and 3GPP2 releases per the most recent Recommendations in ITU-T Rec. Q.1741.x sub-series and ITU-T Rec. Q.1742.x sub-series.

Table I.1 – Specifications for IMS

ETSI release 6 specifications	TIA revision A specifications
ETSI TS 123 002: "Network architecture"	TIA-873.000-A: "All IP Network Multimedia Domain – Overview"
ETSI TS 123 218: "IP Multimedia (IM) session handling; IM call model; Stage-2"	TIA-873.003-A: "IP Multimedia (IM) Session Handling; IM call model; Stage 2"
ETSI TS 123 228: "IP Multimedia Subsystem (IMS); Stage 2"	TIA-873.002-A: "IP Multimedia Subsystem; Stage 2"
ETSI TS 129 228: "IP Multimedia (IM) Subsystem Cx and Dx Interfaces; Signalling flows and message contents"	TIA-873.005-A: "IP Multimedia (IM) Subsystem Cx Interface; Signalling flows and message contents"
ETSI TS 129 328: "IP Multimedia Subsystem (IMS) Sh Interface; signalling flows and message contents"	TIA-873.010-A: "IP Multimedia (IM) Subsystem Sh interface; signalling flows and message contents; Stage 2"
ETSI TS 132 260: "Telecommunication management; Charging management; IP Multimedia Subsystem (IMS) charging"	TIA-873.008-A: "IP Multimedia Subsystem – Offline Accounting Information Flows and Protocol"
ETSI TS 132 296: "Telecommunication management; Charging management; On line Charging System (OCS): Applications and interfaces"	TIA-873.015-0: "IP Multimedia Subsystem – Online Accounting Information Flows and Protocol"
ETSI TS 133 203: "3G security; Access security for IP-based services"	
ETSI TS 123 141: "Presence service; Architecture and functional description; Stage 2"	TIA-1032.001: "Presence service; Architecture and functional description"
ETSI TS 133 141: "Presence service; Security"	TIA-1032.003: "Presence Security"

Bibliography

[b-ITU-T Q.1742.5] ITU-T Recommendation Q.1742.5 (2006), *IMT-2000 references (approved as of 31 December 2005) to ANSI-41 evolved core network with cdma2000 access network.*

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