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

Next Generation Networks – Frameworks and functional architecture models

## PSTN/ISDN emulation architecture

ITU-T Recommendation Y.2031

ITU-T Y-SERIES RECOMMENDATIONS

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# ITU-T Recommendation Y.2031

## PSTN/ISDN emulation architecture


**Summary**

This Recommendation describes the functional architecture, interworking with other components, and reference point requirements of the PSTN/ISDN emulation service component (NGN component of the service stratum) including call server based approach and IMS-based approach.



**Source**

ITU-T Recommendation Y.2031 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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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.

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# ITU-T Recommendation Y.2031

## PSTN/ISDN emulation architecture

### 1 Scope

This Recommendation describes the functional architecture, interworking with other components, and reference point requirements of the PSTN/ISDN emulation service component including call server based approach and IMS-based approach.

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 H.248.1] ITU-T Recommendation H.248.1 (2005), *Gateway control protocol: Version 3*.

[ITU-T Q.512] ITU-T Recommendation Q.512 (1995), *Digital exchange interfaces for subscriber access*.

[ITU-T Q.1214] ITU-T Recommendation Q.1214 (1995), *Distributed functional plane for intelligent network CS-1*.

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

[ITU-T Y.2111] ITU-T Recommendation Y.2111 (2006), *Resource and admission control functions in Next Generation Networks*.

### 3 Definitions

This Recommendation uses or defines the following terms:

**3.1 access gateway**: A unit that allows end users with various accesses (e.g., PSTN, ISDN, V5.x) connection to the packet node of NGN.

NOTE – The AG may be embedded in an access node, which serves also other access interfaces (e.g., xDSL, LAN). Such access nodes are also known as multi-service access nodes (MSAN).

**3.2 access media gateway**: A unit that provides interworking between the packet-based transport used in the NGN and analogue lines or ISDN access.

**3.3 call server**: The core element of a CS-based PSTN/ISDN emulation component, which is responsible for call control, media resource control, call routing, user profile and subscriber authentication, authorization and accounting. Depending on its role, the behaviour of the call server may be different. In these cases the role of call server is identified for example as "Access call server", "Breakout call server", "IMS call server", "Routing call server" or "Gateway call server".

**3.4 functional entity**: 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.

**3.5 functional architecture**: 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.

**3.6 media gateway**: The media gateway (MG) converts media provided in one type of network to the format required in another type of network. For example, a MG could terminate bearer channels from a switched circuit network (e.g., DS0s) and media streams from a packet network (e.g., RTP streams in an IP network). This gateway may be capable of processing audio, video and multimedia conferencing alone or in any combination, and will be capable of full duplex media translations. The MG may also play audio/video messages and perform other interactive voice response (IVR) functions, or may perform media conferencing. In this Recommendation, media gateway refers both to access gateways and residential gateways.

**3.7 media gateway controller**: Controls the parts of the call state that pertain to connection control for media channels in a media gateway.

**3.8 reference point**: 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.

**3.9 residential gateway**: A unit that interworks PSTN/ISDN user equipments to a packet network. A residential gateway is located at the customer premises.

**3.10 voice over IP gateway**: A SIP-based gateway that connects legacy terminals to the NGN. When connecting analogue lines, the voice over IP gateway includes at least an analogue telephone adaptor (ATA). A voice over IP gateway (VGW) plays the role of an IMS UE with regard to the P-CSCF.

## 4 Abbreviations

This Recommendation uses the following abbreviations:

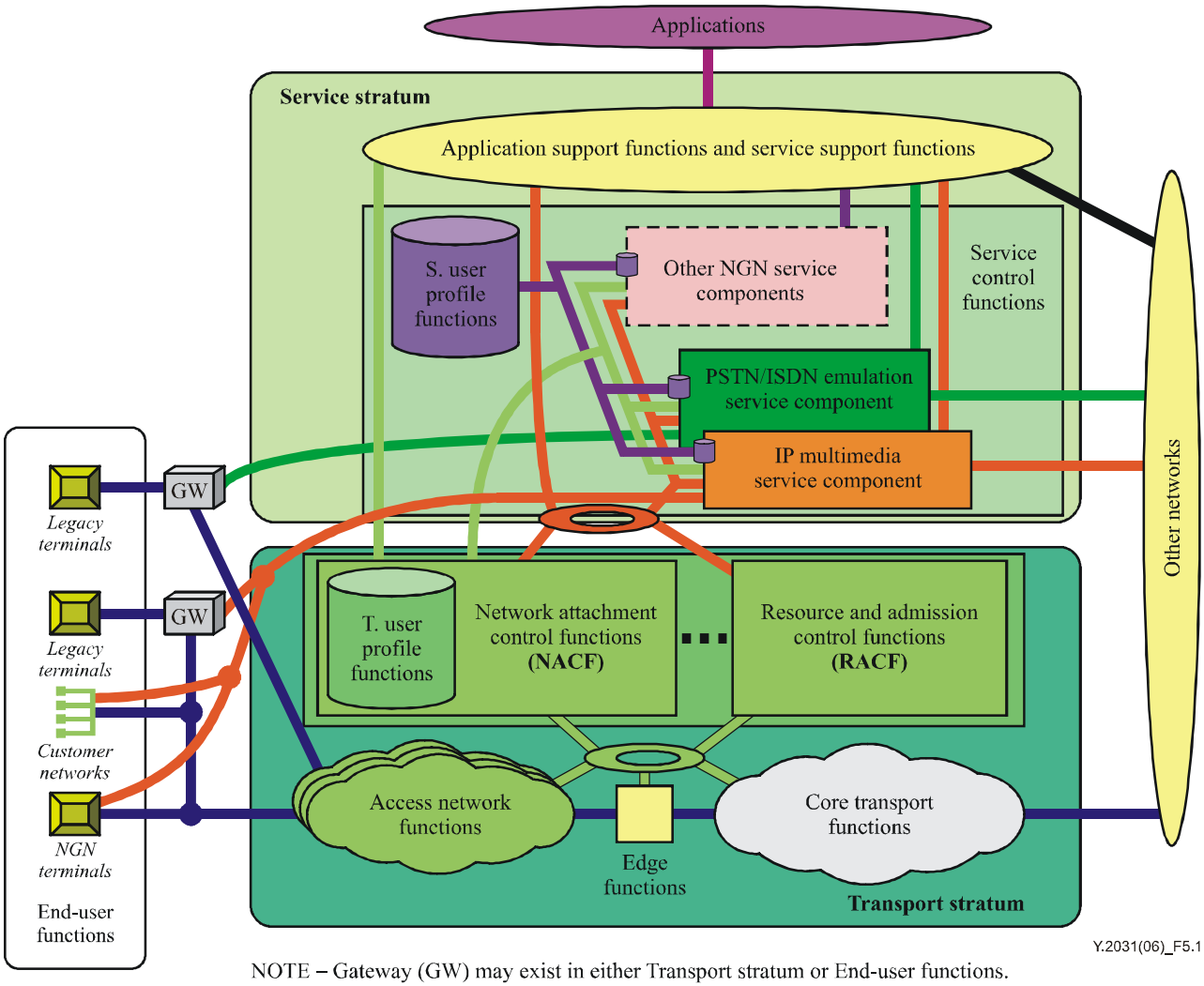
| | |
|---|---|
| ABG-FE | Access Border Gateway Functional Entity |
| AGCF | Access Gateway Control Function |
| AMG | Access Media Gateway |
| AMG-FE | Access Media Gateway Functional Entity |
| APL-GW-FE | Application Gateway Functional Entity |
| AS | Application Server |
| AS-FE | Application Server Functional Entity |
| BGCF | Breakout Gateway Control Function |
| CCF | Call Control Function |
| CS | Call Server |
| CSCF | Call Session Control Function |
| CS-PES | Call Server based PSTN/ISDN Emulation Service component |
| FE | Functional Entity |
| IBC-FE | Interconnection Border Gateway Control Functional Entity |

| | |
|---|---|
| IBG-FE | Interconnection Border Gateway Functional Entity |
| I-CSCF | Interrogating CSCF |
| IFN | IMS for Next Generation Networks |
| IMS | IP Multimedia Service component |
| IMS-PES | IMS based PSTN/ISDN Emulation Service component |
| IN | Intelligent Network |
| IP | Internet Protocol |
| ISDN | Integrated Services Digital Network |
| MGCF | Media Gateway Control Function |
| MRCF | Media Resource Control Function |
| MRP-FE | Media Resource Process Functional Entity |
| NACF | Network Attachment Control Function |
| NGN | Next Generation Network |
| NNI | Network-to-Network Interface |
| NSIW-FE | Network Signalling Interworking Functional Entity |
| OSA | Open Service Architecture |
| P-CSCF | Proxy CSCF |
| PES | PSTN/ISDN Emulation Service component |
| PSTN | Public Switched Telephone Network |
| RACF | Resource and Admission Control Function |
| RF | Routing Function |
| SAA-FE | Service Authentication and Authorization Functional Entity |
| SCP | Service Control Point |
| S-CSCF | Serving CSCF |
| S-CSC-FE | Serving Call Session Control Functional Entity |
| SG | Signalling Gateway |
| SG-FE | Signalling Gateway Functional Entity |
| SIF | Signalling Interworking Function |
| SIP | Session Initiation Protocol |
| SL-FE | Subscription Locator Functional Entity |
| SPF | Service Provider Function |
| SS7 | Signalling System No. 7 |
| SSF | Service Switching Function |
| SUP-FE | Service User Profile Functional Entity |
| TMG | Trunking Media Gateway |
| TMG-FE | Trunking Media Gateway Functional Entity |
| VGW | Voice over IP Gateway |

## 5 PSTN/ISDN emulation in NGN

As shown in Figure 5-1, PSTN/ISDN emulation, as one of the service components of NGN, provides PSTN/ISDN basic and supplementary services, and coexists with the IP multimedia service component, the streaming service component, and other service components.

PSTN/ISDN emulation, as one of the service components of NGN, interworks with the existing network and other service components. It provides the emulation of PSTN/ISDN services for legacy terminal connected via residential gateways and access gateways to the NGN.




NOTE – Gateway (GW) may exist in either Transport stratum or End-user functions.

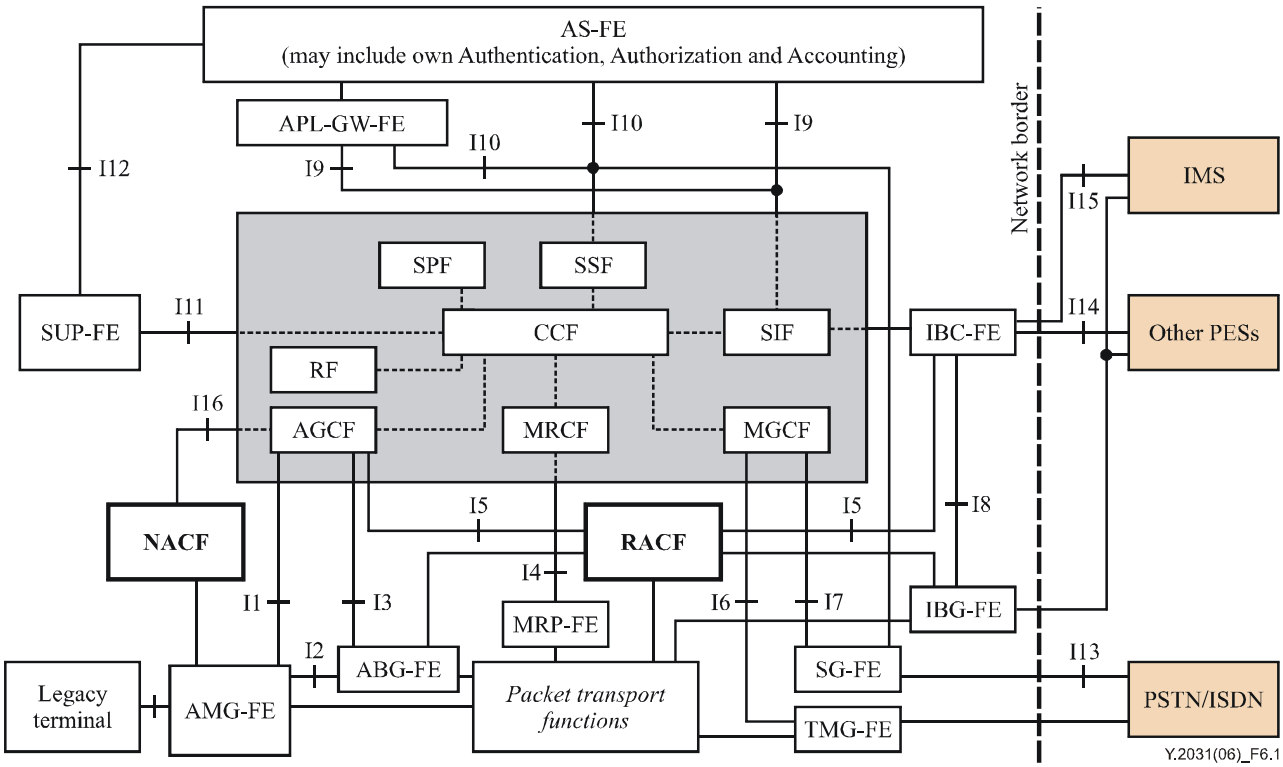
**Figure 5-1 – PSTN/ISDN emulation in NGN**

There are two solutions for PSTN/ISDN emulation service component, which are known as call server based emulation and IMS-based emulation. The two solutions are suitable for different network situations, but can provide equal emulation services.

## 6 Call server based PSTN/ISDN emulation functional architecture

This clause describes a functional architecture for CS-based PSTN/ISDN emulation. Figure 6-1 provides a detailed view of the functional entities and reference points that make up this architecture and shows their relationship with other service components of NGN architecture.

Figure 6-1 shows functions that comprise PSTN/ISDN emulation component. These as well as also several functional entities which are part of overall NGN functional architecture are described in [ITU-T Y.2012].




NOTE 1 – When small size AMG-FE is resident in the user side, the NACF is needed for AMG-FE for initialization and IP address configuration as well as providing location information for AGCF.
NOTE 2 – The functional entities outside of the shadowed area may be identical to the same functional entities which are defined in [ITU-T Y.2012].

**Figure 6-1 – Functional architecture of CS-based PSTN/ISDN emulation**

## 6.1 Description of functions

### 6.1.1 Call control function (CCF)

The call control function (CCF) provides the following functionalities:

a) Two-party call control function and multi-party call control;

b) Access to IN capabilities (e.g., passes events to the SSF);

c) Access to PSTN/ISDN supplementary services in SPF;

d) Access to applications (e.g., passes events to the SIF for AS-FE).

### 6.1.2 Access gateway control function (AGCF)

The access gateway control function (AGCF) controls one or more AMG-FEs to access PSTN or ISDN users. It:

a) is in charge of the registration and authentication of users related to AMG-FE;

b) recognizes the main events such as off-hook, dialling of digits, end of dialling and on-hook events from AMG-FE, and can control AMG-FE to send signalling indications for voice services to users, e.g., dial-up tone, ringing tone and ringing back tone, busy tone, etc.;

c) allocates AMG-FE resources;

d) originates and terminates gateway control flows to control AMG-FE;

e) may initiate and terminate UNI control flows in order to provide ISDN supplementary services;

f) ensures transparent transport of data between the ISDN user side and the IP side from the control level in media negotiation process for ISDN N × 64 kbit/s unrestricted data service scenario;

g) interacts with the resource and admission control function (RACF);

h) interacts with the network attachment control function (NACF) to retrieve line profile information.

### 6.1.3 Media resource control function (MRCF)

The media resource control function (MRCF) controls MRP-FE and allocates resources which are needed for services such as streaming, announcements, and interactive voice response (IVR) support.

The MRCF together with MRP-FE may also provide multi-party conference bridges and media transcoding.

### 6.1.4 Media gateway control function (MGCF)

The media gateway control function (MGCF) controls the TMG-FE to allow interworking with the PSTN/ISDN. The MGCF allocates and releases TMG-FE resources and modifies the usage of the resources. In the ISDN N × 64 kbit/s unrestricted service scenario, it ensures the transparent transport of data between the TDM side and the IP side from the control level in media negotiation process.

### 6.1.5 Routing function (RF)

The routing function（RF) may be implemented within or external to the CS. If the RF is implemented outside the CS, it may be shared between and accessed by more than one call server.

The routing function is specified as the function which analyses user characteristics (such as called party number, service profile) and chooses the route to the destination user. It may include a routing policy function (such as routing based on average load sharing or time of the day, etc.), and the routing database.

NOTE – In [ITU-T Y.2012], the routing function is included in the S-CSC-FE. In this Recommendation, the routing function is regarded as a separate functional entity, and thus the routing function may be implemented in a separate physical box.

### 6.1.6 Service provider function (SPF)

The service provider function (SPF) may provide the PSTN/ISDN supplementary services to the user. It also provides the services logic about PSTN/ISDN supplementary services.

### 6.1.7 Service switching function (SSF)

The service switching function (SSF) provides access to IN service logic programs hosted in legacy service control points (SCPs). The SSF is associated with the CCF, the function required for SSF is interaction between the CCF and SCF.

The detailed behaviour of the SSF is identified with SSF which is defined in [ITU-T Q.1214].

### 6.1.8 Signalling interworking function (SIF)

The signalling interworking function (SIF) is associated with the CCF and performs the function of a protocol adapter. The following functions are provided by the SIF:

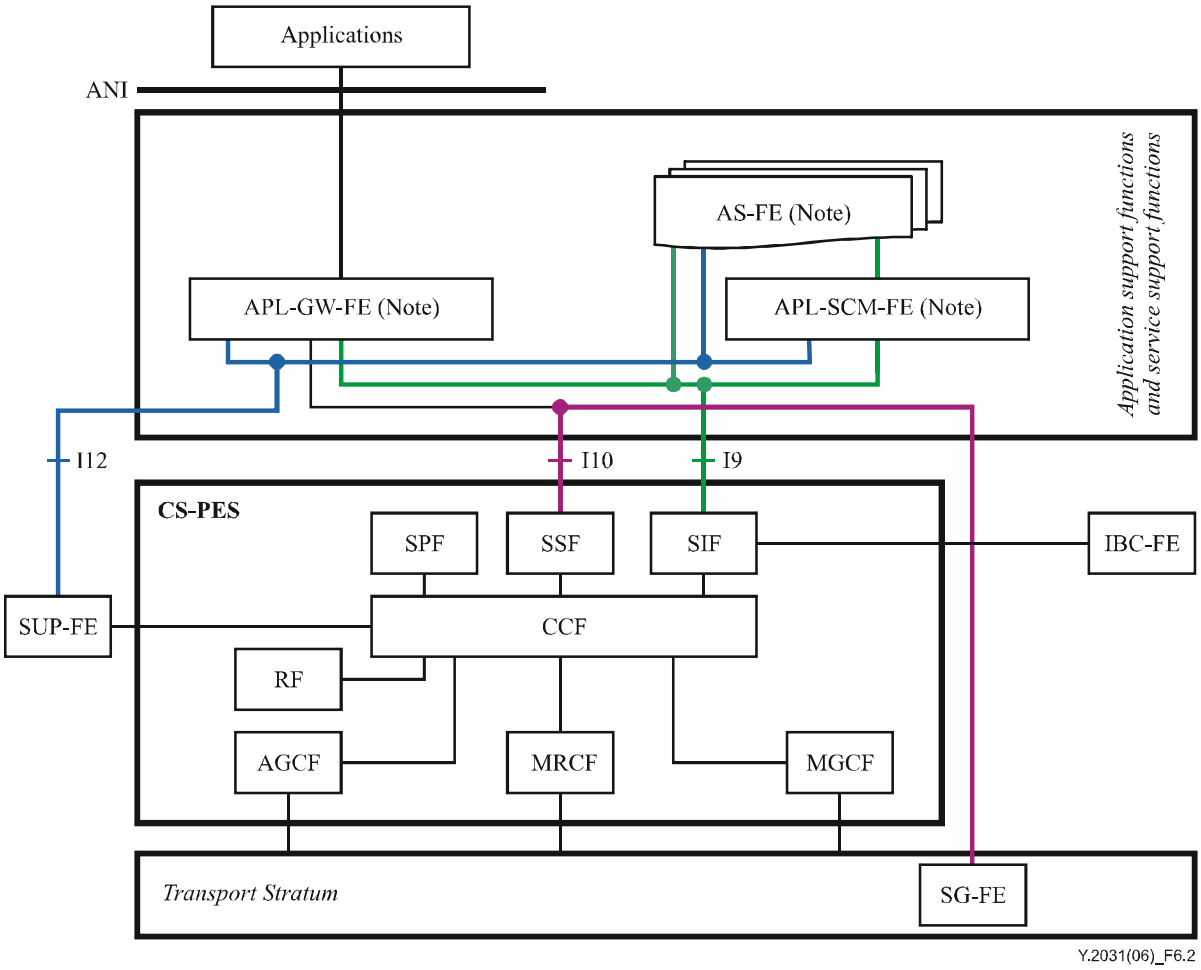
a) may provide SIP user agent function and send/receive SIP messages to/from the SIP application server;

b) provides protocol adaptation functions and connections with other NGNs through the IBC-FE. If it interworks with IMS networks, SIF sends and receives session control messages. If it interworks with other PES networks, SIF may send and receive session control messages with legacy call information.

## 6.2 Service architecture

The services that should be supported by the CS-based PSTN/ISDN emulation component include PSTN/ISDN supplementary services, intelligent network services, and the AS-FE provided services.

The service architecture for the CS-PES component is based on the service architecture of [ITU-T Y.2012] (see Figure 6-2).




NOTE – May include Authentication, Authorization and Accounting.

**Figure 6-2 – CS-PES based services architecture**

In [ITU-T Y.2012], the services are provided in AS-FE in the application layer.

In CS-based PSTN/ISDN emulation architectures, PSTN/ISDN supplementary services are provided by the SPF in the control layer. The SPF only provides service logic, and does not provide the function about application specific authorization and authentication.

In order to provide the IN services, the SSF included in call servers should support the service switching function to interact with the legacy IN SCP through SG-FE. The APL-GW-FE, regarding as an OSA GW, interworks with third-party applications.

The applications connected by the APL-GW-FE and AS-FE provide the services to the NGN subscribers with legacy terminals. APL-SCM-FE may provide the service interaction and coordination function between the APL-GW-FEs and AS-FEs. The CCF provides the trigger mechanism to AS-FE through SIF, and the SIF supports the protocol adaptation function.

## 6.3 Reference points

This clause provides information regarding reference points between functions constituting the CS-based PSTN/ISDN emulation component and a number of NGN functional entities which all together constitute the functional architecture of the CS-based PSTN/ISDN emulation.

### 6.3.1 Reference point between AGCF and AMG-FE (I1 reference point)

Reference point I1 is between AGCF and AMG-FE. The information flows at this reference point are used to send register and event messages such as telephone on-hook, off-hook, and dial-up. Messages to control the resources of the AMG-FE are expected to pass through this reference point. This reference point is usually thought of as being an H.248 interface but that is not the only protocol that can appear and be used at this reference point.

### 6.3.2 Reference point between AMG-FE and ABG-FE (I2 reference point)

Reference point I2 is between AMG-FE and ABG-FE. ABG-FE acts as a signalling proxy between the AMG-FE and AGCF. So, at this reference point, the information flows from AMG-FE to ABG-FE are used to transfer the register and event messages such as telephone on-hook, off-hook and dial-up. The information flows from ABG-FE to AMG-FE are used to transfer the control messages from AGCF.

### 6.3.3 Reference point between AGCF and ABG-FE (I3 reference point)

Reference point I3 is between AGCF and ABG-FE. The information flows at this reference point are used to transfer messages from AMG-FE such as register messages, event messages and the messages for control of the resource of the AMG-FE.

### 6.3.4 Reference point between the MRCF and MRP-FE (I4 reference point)

Reference point I4 is between MRCF and MRP-FE. The information flows at this reference point are used to carry messages for control of the media resources in the MRCF. The message from MRP-FE to MRCF is used to notify its resource information and state.

### 6.3.5 Reference point between the AGCF and RACF, IBC-FE and RACF (I5 reference point)

The information flows at this reference point are used to request the capacity to create, modify and release resources for the media flow(s). When the call is set up, AGCF and IBC-FE will request the RACF to create resources for the media flow of the call. When the call is released, the AGCF and IBC-FE will be requested to withdraw the previously arranged resource.

This reference point is identical to Rs defined in [ITU-T Y.2111].

### 6.3.6 Reference point between the MGCF and TMG-FE (I6 reference point)

Reference point I6 is between MGCF and TMG-FE. The information flows at this reference point are used to carry the register message and state notify message from TMG-FE and control message from MGCF which are used to allocate the resources such as trunk circuits, codec resources, etc.

### 6.3.7 Reference point between the MGCF and SG-FE (I7 reference point)

Reference point I7 is between MGCF and SG-FE. The information flows at this reference point are related to call control and supplementary services, which are used for CS-based PES interworking with the PSTN/ISDN.

### 6.3.8 Reference point between the IBC-FE and IBG-FE (I8 reference point)

The information flows across this reference point are related to control messages, which are used to control the IBG-FE to implement the media codec conversion function.

### 6.3.9 Reference point between the SIF and AS-FE, APL-SCM-FE and APL-GW-FE (I9 reference point)

This reference point is used to provide services to users which are implemented in an AS. The information flows at this reference point are related to service request and response.

### 6.3.10 Reference point between the SSF and legacy IN SCP and APL-GW-FE (I10 reference point)

This reference point is used to provide IN services and third party applications to user. The information flows at this reference point are used to send call related information to legacy IN SCP through SG-FE and APL-GW-FE while the legacy IN SCP and APL-GW-FE will send call control information to the SSF.

### 6.3.11 Reference point between the CCF and SUP-FE (I11 reference point)

This reference point is used to download the user subscription information, such as user service profiles.

### 6.3.12 Reference point between the SUP-FE and AS-FE, APL-SCM-FE and APL-GW-FE (I12 reference point)

This reference point is used to carry the user information or service information to the AS-FE.

### 6.3.13 Reference point between the SG-FE and PSTN/ISDN (I13 reference point)

This reference point is used to carry call control information for when interworking with PSTN/ISDN.

### 6.3.14 Reference point between the IBC-FE and other PESs (I14 reference point)

This reference point constitutes the network-to-network interface (NNI) with other PESs, and the information flows are used to carry the call control information between PESs.

NOTE – I14 is part of Ic reference point (see clause 7).

### 6.3.15 Reference point between the IBC-FE and other IMSs (I15 reference point)

This reference point constitutes a network-to-network interface (NNI) with an IMS network.

NOTE – I15 is part of Ic reference point (see clause 7).

### 6.3.16 Reference point between AGCF and NACF (I16 reference point)

This reference point enables the AGCF to query the location information, such as assigned IP address allocated to the access gateway, subscriber ID, etc. The NACF will give the response depending on the requestor.

The following information flows are used on the AGCF to NACF reference point:

- Location information query;
- Location information response.

## 6.4 Relationship between functional entities in CS-based PSTN/ISDN emulation functional architecture and NGN architecture

### 6.4.1 Correspondence between call server functional entities and NGN functional entities

Table 6-1 shows the relationship of the call server based architecture functional entities to the functional entities identified in the NGN functional architecture as specified in [ITU-T Y.2012].

**Table 6-1 – Correspondence between call server functional entities and NGN functional entities**

| CS-based PES function or functional entity | NGN functional entity |
|---|---|
| CCF | S-CSC-FE |
| RF | RF is particular to CS-based PSTN/ISDN service component |
| SIF | NSIW-FE |
| SSF | SS-FE |
| SPF | AS-FE |
| AGCF | AGC-FE |
| MRCF | MRC-FE |
| MGCF | MGC-FE |
| Legacy terminal | Terminal functions |

### 6.4.2 The unique characteristics of the call server architecture

1) In call server architecture, BICC protocol may be used as signalling protocol besides SIP protocol.

2) Supplementary services can be provided by SPF in the service control layer in call server architecture.

3) ABG-FE in call server architecture may have the following additional functions:

   - Acting as proxy node. All packets including signalling packets and media packets sent to and obtained from untrusted AMG-FE should go through ABG-FE.
   - Address conversion function. ABG-FE needs to modify the address information related to AMG-FE and AGCF in the IP packets with its address information assigned for the session.
   - Security functions. Such as firewall function and preventing DDoS attacks functions.

## 6.5 Interworking with other service components

### 6.5.1 Interworking with other PSTN/ISDN emulation service component

Call server based PSTN/ISDN emulation service component interworks with other PSTN/ISDN emulation service component through CCF, SIF, IBC-FE and IBG-FE functional entities. CCF performs call control function. SIF performs a signalling adaptation function, when call server based PSTN/ISDN emulation interworks with other PES networks, SIF may map the interworking protocols. IBC-FE interconnects with other PSTN/ISDN emulation service components at the I14 reference point, which controls the IBG-FE entity behaviour and performs topology hiding function in control layer. IBG-FE interconnects with other PSTN/ISDN emulation service component at the transport level, which performs the media conversion and QoS marking functions under control of the IBC-FE.

Figure 6-3 shows the architecture of call server based PSTN/ISDN emulation service component interworking with other PSTN/ISDN emulation service components.

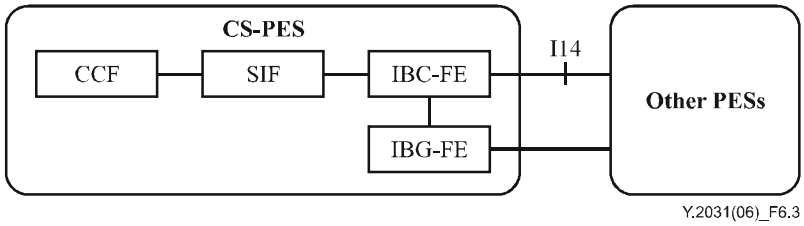



**Figure 6-3 – Architecture of call server based PSTN/ISDN emulation service component interworking with other PSTN/ISDN emulation service components**

### 6.5.2 Interworking with IP multimedia service components

Call server based PSTN/ISDN emulation service components interwork with other IP multimedia service components (IMS) through the CCF, SIF, IBC-FE and IBG-FE functional entities. The CCF, IBC-FE and IBG-FE perform the same functions as when they are used in interworking with other PSTN/ISDN emulation service components. The only difference is that SIF will map the interworking protocol to SIP when interworking with IMS.

Figure 6-4 shows the architecture of call server based PSTN/ISDN emulation service component interworking with IMS.

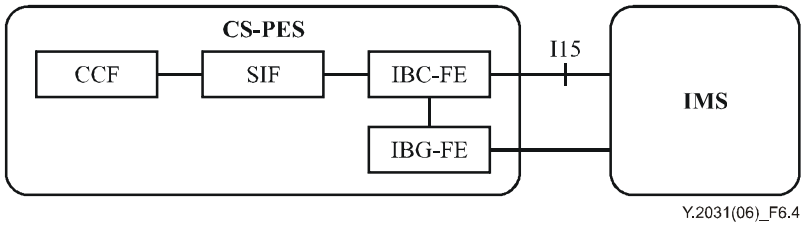



**Figure 6-4 – Architecture of call server based PSTN/ISDN emulation service component interworking with IMS**

## 6.6 Interconnection with RACF

AGCF and IBC-FE interconnect with RACF at the I5 reference point. With regard to the RACF architecture, the AGCF and IBC-FE play the role of an application function. The I5 reference point is used to request resources from the RACF for AGCF and IBC-FE. Reference point I5 is identical to Rs which is defined in [ITU-T Y.2111].

## 6.7 Interconnection with NACF

CS-PES needs to interact with NACF, the main NACF functions are configuration and initialization of AMG-FE, the allocation of IP address(es) and the authentication for AMG-FE. Also AGCF gets the location information of AMG-FE from NACF.

## 6.8 Interworking with other networks

### 6.8.1 Interworking with PSTN/ISDN

Call server based PSTN/ISDN emulation service component interworks with PSTN/ISDN through CCF, MGCF, TMG-FE and SG-FE functional entities. CCF performs call control function. MGCF controls TMG-FE behaviour and maps the interworking protocols. The reference point I13 between

CS-PES and PSTN/ISDN transfers the protocol to be mapped to SS7. TMG-FE interconnects with PSTN in media level which converts the IP packet voice to TDM trunk under the control of MGCF.

Figure 6-5 shows the architecture of call server based PSTN/ISDN emulation service component interworking with PSTN/ISDN.

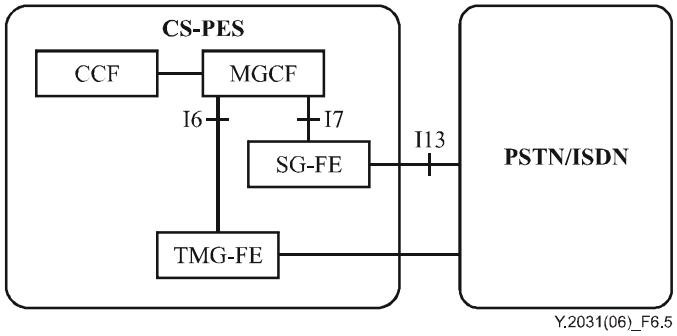



**Figure 6-5 – Architecture of call server based PSTN/ISDN emulation service component interworking with PSTN/ISDN**

# 7 IMS-based PSTN/ISDN emulation functional architecture

## 7.1 Overview

Figure 7-1 illustrates the legacy configurations supported by the IMS-based PSTN/ISDN emulation functional architecture described in this clause.

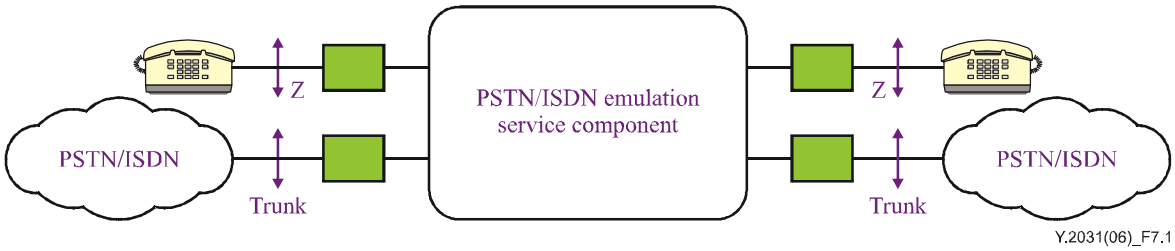



**Figure 7-1 – Legacy configurations supported by IMS-based PES**

Legacy terminals and/or legacy access nodes are connected to VoIP gateways (VGW) or access media gateways (AMG) using standard interfaces. AMG or VGW connect to the IMS-based PES via either the P1 reference point or the Gm reference point. The P1 reference point enables an AMG without session control capabilities to be accommodated in the architecture whilst the Gm reference point extends IMS session control to a VGW. PSTN/ISDN islands may also be connected via trunking media gateway, controlled using the Mn reference point.

Support for transit functionality within IMS-based PES will be provided by the transit capabilities of the core IMS. Support of ISDN access types by the IMS-based PES is outside the scope of this Recommendation.

NOTE 1 – The Z interface is defined in 6.1 of [ITU-T Q.512].

The functional architecture of the IMS-based PSTN/ISDN emulation service component (IMS-PES) described in this Recommendation is based on the same architecture as the IMS. Figure 7-2 provides an overview of the functional entities that make up this architecture and shows their relationships to the other components of the NGN architecture.

NOTE 2 – This Recommendation from the IMS-PES point of view specifies modifications to the 'IMS for Next Generation Networks (IFN)'. Wherever in this Recommendation modifications to IMS are proposed they should be read as modifications to IFN.

NOTE 3 – In clause 7.10, a mapping is provided between the IMS-PES and the NGN functional entities.

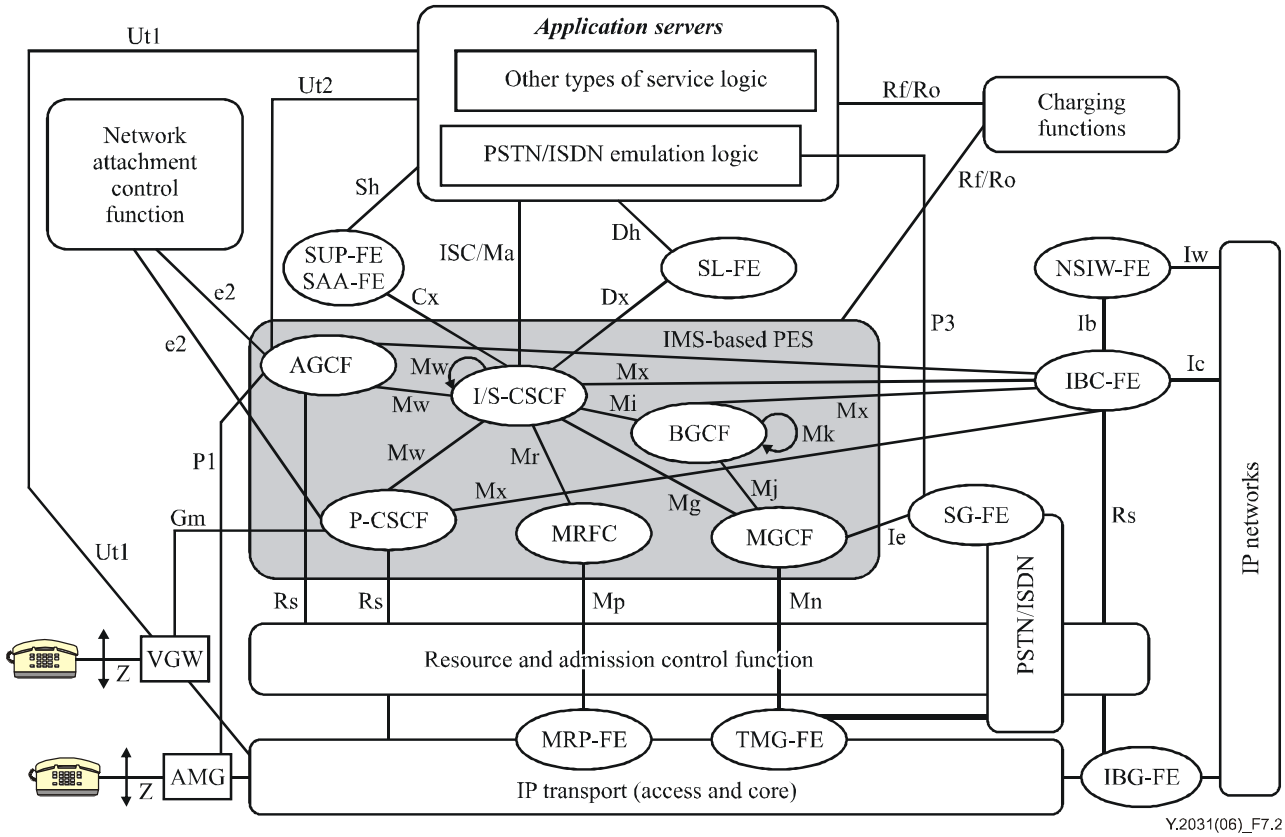



**Figure 7-2 – IMS-based PSTN/ISDN emulation service component functional architecture**

NOTE 4 – The functional entities (FEs) and reference points (RPs) as shown in the IMS-PES may require enhancements as indicated in 7.2 and 7.3.

Most of the functional entities inside the IMS-based PSTN/ISDN emulation service component are identical or derived from their IMS counterparts, with the noticeable exception of an access gateway control function (AGCF) that has the responsibility of controlling residential and access media gateways, using the H.248 protocol. For the other functional entities, the differences are noted in the following clause.

NOTE 5 – SIP-based voice over IP gateways may also be connected to the IMS component.

## 7.2 Overview of functional entities of the IMS-PES

### 7.2.1 Access gateway control function (AGCF)

This functional entity is the first point of contact for residential and access media gateways. This entity is specific to the IMS-based PSTN/ISDN emulation component. It performs the following functions:

- Acts as an MGC for controlling media gateways functions (R-MGF and A-MGF) located in residential and access gateways.
- Interacts with the resource and admission control function (RACF).
- Interacts with the network attachment control function (NACF) to retrieve line profile information.

- Performs necessary interworking between the session control used on the Mw reference point and device control signalling used on the P1 reference point.
- Originates/terminates session control signalling.
- Performs functions normally assigned to a P-CSCF on behalf of legacy terminals connected behind the access media gateways (such as managing registration procedures, generating asserted identities, and creating charging identifiers).

The AGCF appears as a P-CSCF to the other CSCFs. The session control signalling capabilities available to the AGCF are limited to those available at the Mw reference point (e.g., flash-hook events are not explicitly reported to application servers but trigger appropriate session control signalling procedures if required).

Moreover, the AGCF shall provide basic feature logic for:

- delivering the appropriate dial tone pattern;
- processing mid-call events.

NOTE 1 – A solution based on AGCF shall be able to provide similar response time (e.g., dial tone, ring tone) as today in the PSTN networks.

- in case of an AGCF failure, stable calls shall be preserved.

NOTE 2 – If desired, a network operator could choose to deploy an MGC that controls a set of media gateways following most of the AGCF call processing rules defined in this Recommendation, and supports the Gm interface into an IMS or PES network via a P-CSCF, but this entity would fill the role of a "gateway (VGW)" as depicted in Figure 7-2 and would not be part of the trusted IMS core.

### 7.2.2 Multimedia resource function controller (MRFC)

The behaviour of the MRFC is identical in the IMS-based PSTN/ISDN emulation service component and in the IMS.

### 7.2.3 Media gateway control function (MGCF)

The role of the MGCF is identical in the IMS-based PSTN/ISDN emulation service component and in the IMS. Procedures for interworking with legacy systems are slightly different in IMS-PES versus IMS due to the presence of legacy call information inside the IMS-PES and the need to ensure full ISDN transparency in case of ISDN calls transiting through the IMS-PES.

### 7.2.4 Proxy call session control function (P-CSCF)

The behaviour of the P-CSCF is identical in the IMS-based PSTN/ISDN emulation service component and in the IMS. However, the P-CSCF is not used in configurations where an AGCF is required to control residential or access media gateways. In such cases, all functions normally provided by the P-CSCF will be provided directly by the AGCF.

### 7.2.5 Serving call session control function (S-CSCF)

The behaviour of the S-CSCF is identical in the IMS-based PSTN/ISDN emulation service component and in the IMS signalling.

### 7.2.6 Interrogating call session control function (I-CSCF)

The behaviour of the I-CSCF is identical in the IMS-based PSTN/ISDN emulation service component and in the IMS.

### 7.2.7 Breakout gateway control function (BGCF)

The behaviour of the BGCF is identical in the IMS-based PSTN/ISDN emulation service component and in the IMS.

## 7.3 Internal reference points

### 7.3.1 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, and vice versa.

The role of this reference point is identical in the IMS-PES and the IMS.

### 7.3.2 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.

The role of this reference point is identical in the IMS-PES and IMS.

### 7.3.3 Reference point CSCF – CSCF and AGCF – CSCF (Mw reference point)

The Mw reference point allows the communication and forwarding of signalling messages between CSCFs and between an AGCF and a CSCF, e.g., during registration and session control.

Information exchanged over the Mw reference point has to facilitate legacy services. The role of this reference point is identical in the IMS-PES and IMS.

When two CSCFs are located in different networks, signalling information for the Mw reference point crosses the IBC-FE.

### 7.3.4 Reference point CSCF – BGCF (Mi reference point)

This reference point allows the serving CSCF to forward the session signalling to the breakout gateway control function for the purpose of interworking with the PSTN networks.

Information exchanged over the Mi reference point has to facilitate legacy services.

The role of this reference point is identical in the IMS-PES and IMS.

### 7.3.5 Reference point BGCF – MGCF (Mj reference point)

This reference point allows the breakout gateway control function to forward the session signalling to the media gateway control function (and vice versa) for the purpose of interworking with the 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.

Information exchanged over the Mj reference point has to facilitate legacy services.

The role of this reference point is identical in the IMS-PES and IMS.

### 7.3.6 Reference point BGCF – BGCF (Mk reference point)

This reference point allows the breakout gateway control function to forward the session signalling to another breakout gateway control function.

Information exchanged over the Mk reference point has to facilitate legacy services.

The role of this reference point is identical in the IMS-PES and IMS.

### 7.3.7 Reference point AGCF, CSCF or BGCF – IBC-FE (Mx reference point)

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

The role of this reference point is identical in the PES and IMS subsystems.

Information exchanged over the Mx reference point has to facilitate legacy services.

## 7.4 Service architecture

### 7.4.1 Overview

The service architecture for the IMS-based PES component and the IMS is the same. The generic behaviour of application server functions is identical with respect to the PSTN/ISDN emulation service component and the IMS component. However, depending on the type of services to be emulated, certain application servers may need to facilitate legacy services.

Three types of application server functions (ASF) can be accessed by the S-CSCF, through the ISC reference point (see Figure 7-3):

- SIP application servers (SIP AS);
- The IM-SSF application server;
- The OSA SCS application server.

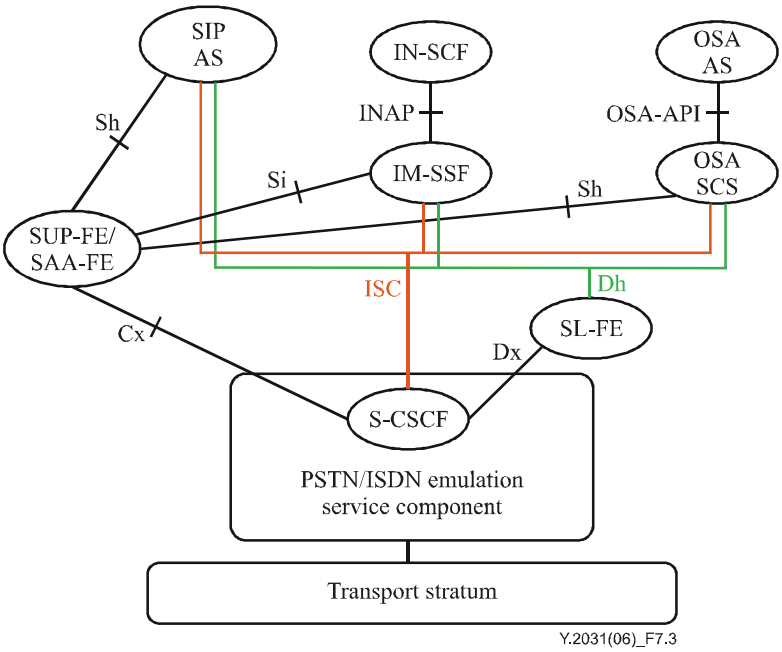



**Figure 7-3 – Services architecture**

A SIP application server may contain "service capability interaction manager" (SCIM) functionality and other application servers. The SCIM functionality is an application which performs the role of interaction management. The internal structure of the application server is outside the scope of this Recommendation.

The purpose of the IM-SSF is to enable access to IN service logic programs hosted in legacy SCFs. The IM-SSF functionality encompasses the emulation of the IN call model (BCSM) on top of SIP signalling, IN triggering and feature management mechanisms, emulation of the IN service switching finite state machine and interworking with INAP.

NOTE 1 – The role of the IM-SSF is identical in the IMS-based PSTN/ISDN Emulation component and in the IMS component. Basic behaviour is also identical. However, in the IMS-based PES case, mapping procedures may have to facilitate legacy services.

NOTE 2 – The IM-SSF is intended to enable access from the IMS-based PES to IN service logic programs hosted in legacy SCFs. Access to IMS-based PES services (i.e., hosted in SIP-based Application Servers) from legacy SSFs in the PSTN/ISDN is outside the scope of this Recommendation. Appropriate gateway functions have to be implemented in the PSTN/ISDN network for supporting such scenarios. The purpose of

the OSA service capability server is to provide access to OSA applications, according to the OSA/Parlay framework.

The S-CSCF to AS reference point is used to forward session control requests, based on filter criteria associated with the originating or destination user. The interrogating-CSCF to AS interface is used to forward session control requests destined to a public service identity hosted by the AS directly to that AS.

### 7.4.2 Reference points

#### 7.4.2.1 Reference point CSCF – ASF (ISC reference point)

The role of the ISC reference point is identical with respect to the IMS-based PSTN/ISDN emulation service component and the IMS component.

#### 7.4.2.2 Reference point SUP-FE/SAA-FE – SIP AS or OSA SCS (Sh reference point)

The role of the Sh reference point with respect to the IMS based PSTN/ISDN emulation service component and the IMS component is identical.

#### 7.4.2.3 Reference point SUP-FE/SAA-FE – IM SSF (Si reference point)

The role of the Si reference point with respect to the PSTN/ISDN emulation service component and the IMS component is identical.

#### 7.4.2.4 Reference point ASF – SL-FE (Dh reference point)

The role of the Dh reference point with respect to the PSTN/ISDN emulation service component and the IMS component is identical.

#### 7.4.2.5 Reference point ASF – UE (Ut1 reference point)

The Ut1 reference point enables a VoIP gateway (VGW) to manage information related to the services provided to the legacy equipment it connects. The Ut1 reference point applies to SIP application servers only.

#### 7.4.2.6 Reference point ASF – AGCF (Ut2 reference point)

The Ut2 reference point enables the AGCF to manage information related to the services provided to the legacy equipment connected to the media gateways it controls. The Ut2 reference point applies to SIP application servers only.

#### 7.4.2.7 Reference point I-CSCF – AS (Ma reference point)

The role of the Ma reference point with respect to the PSTN/ISDN emulation components and the IMS component is identical.

This reference point between interrogating-CSCF and the application servers (i.e., SIP application server, OSA service capability server, or CAMEL IM-SSF) is used to forward session control requests destined to a public service identity hosted by an application server directly to the application server.

## 7.5 External reference points

### 7.5.1 Reference points with entities in the transport stratum

#### 7.5.1.1 Reference point MGCF – TMG-FE (Mn reference point)

The role of this reference point with respect to the IMS-based PSTN/ISDN emulation component and the IMS is identical.

#### 7.5.1.2 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.

#### 7.5.1.3 Reference point AS – SG-FE (P3 reference point)

The IMS-PES uses the SG-FE primarily in support of the MGCF signalling to the PSTN, as does the IMS. In addition, some application servers involved in supporting IMS-PES users may use the SG-FE to support non-call related signalling interactions with the PSTN (e.g., TCAP-based messages for CCBS).

#### 7.5.1.4 Reference point MRFC – MRP-FE (Mp reference point)

The role of this reference point with respect to the IMS-based PSTN/ISDN emulation component and the IMS is identical.

### 7.5.2 Reference point with the UE

In PES, the user equipment comprises one or more legacy terminals and the gateway to which they are connected via the Z reference point. This gateway may be an access media gateway or a VoIP gateway (VGW). A VoIP gateway (VGW) plays the role of a UE with regard to the P-CSCF.

VoIP gateways (VGWs) interact with the IMS-PES via the Gm and Ut reference points.

The role of this reference point is identical in the IMS-PES and IMS.

Access media gateways (AMGs) interact with the IMS-PES via the P1 reference point.

### 7.5.3 Reference points with the user profile

The behaviour of the SUP-FE/SAA-FE and SL-FE in relation to the IMS-based PSTN/ISDN emulation component is identical to its behaviour in relation to the IMS.

#### 7.5.3.1 Reference point with the SL-FE (Dx reference point)

The role of this reference point with respect to the IMS-based PSTN/ISDN emulation component and the IMS is identical.

#### 7.5.3.2 Reference point with the SUP-FE/SAA-FE (Cx reference point)

The role of this reference point with respect to the IMS-based PSTN/ISDN emulation component and the IMS is identical.

### 7.5.4 Reference points with charging functions

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

– AS;

– 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. Rf and Ro interfaces are defined in sections 4.2 and 4.3 of [b-ETSI TS 123 260].

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

## 7.6 Interconnection with other networks

### 7.6.1 Interconnection with the PSTN/ISDN

Interconnection at the signalling level is provided via the SG-FE.

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

### 7.6.2 Ic reference point interconnection with other external IP-based service components

Interconnection with other IP-based service components (including other PSTN/ISDN Emulation service components) is performed via the IBC-FE at the signalling level.

In case of incoming sessions from other IP networks, the IBC-FE determines the next hop in IP routing depending on received signalling information, based on configuration data and/or database look up. The next hop may be an I-CSCF, a BGCF or another IBC-FE.

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

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

## 7.7 Reference points with the network attachment control function (NACF)

The e2 reference point supports information transfer between the P-CSCF or the AGCF and the network attachment control function.

The role of this reference point with respect to the PSTN/ISDN emulation component and the IMS component is identical.

NOTE – Interaction with the NACF is not required in case the AGCF controls access gateways only.

## 7.8 Reference point with the resource and admission control function (RACF)

The Rs reference point enables the P-CSCF or the AGCF to interact with RACF for the following purposes:

– authorization of QoS resources;

– resource reservation;

– gate control (including NAPT binding information relay).

With regard to the RACF architecture, the P-CSCF and the AGCF play the role of an application/service support function.

The role of this reference point with respect to the PSTN/ISDN emulation component and the IMS component is identical.

NOTE – Interaction with the RACF may not be required in case the AGCF controls access media gateways only and dedicated transport resources are used to support PES traffic. In case of network interconnection, interactions with the resource control component may also take place at the edge of the PES, at the IBC-FE level for the following purposes:

– gate control (including NAPT binding information relay).

With regard to the RACF architecture, the IBC-FE plays the role of an application/service support function.

## 7.9 Mode of operation

### 7.9.1 General principles

Emulating PSTN/ISDN services using the IMS-based PES architecture described in this Recommendation assumes that the logic of the service to be emulated resides in one or more application servers rather than in the AGCF or in gateways.

Emulating most PSTN supplementary services requires that at least one application server be inserted in the SIP signalling path.

For certain call configurations, this requires that information sent/received by some of these application servers facilitates legacy services.

The logic embedded in the AGCF is either interworking logic (e.g., the AGCF has to know how to convert the incoming session control request into a presentation message of the protocol for display services over analogue lines) or service independent feature logic (e.g., on receipt of an off-hook or flash-hook event from a media gateway, the AGCF shall autonomously request the media gateway to play a dial tone).

Although some application servers may be dedicated to the provision of PES-specific services, the PES architecture does not restrict the type of applications that a PES-user can access. (See Figure 7-4.)

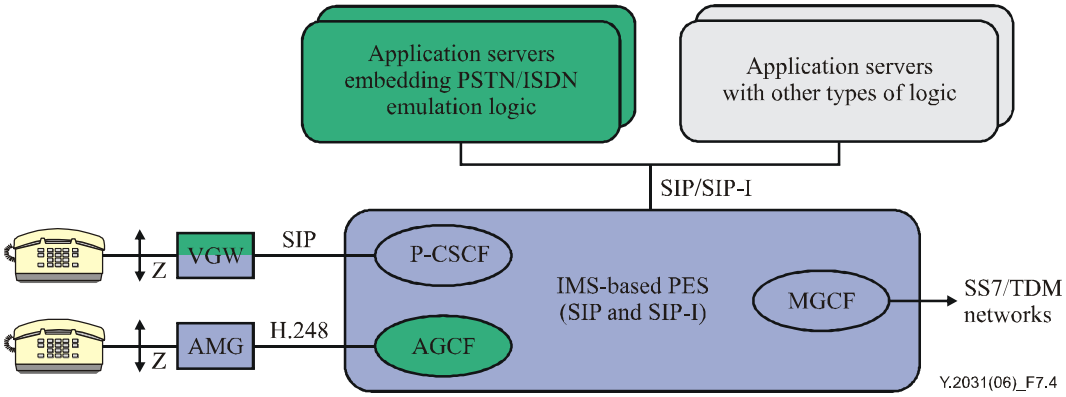



**Figure 7-4 – Service access via the PES**

### 7.9.2 Service provisioning

#### 7.9.2.1 Provisioning in the SUP-FE/SAA-FE

The service profile of PES users is stored in the SUP-FE/SAA-FE as for any other type of user. Appropriate filter criteria are set to ensure that PES-enabled application servers are involved in the processing of calls from/to PES-users. Setting these criteria does not require any specific service point trigger beyond those used in relation to the IMS component.

#### 7.9.2.2 Provisioning in the AGCF

The following IMS parameters are assumed to be available in a local database of the AGCF:

– private user identities;

– public user identities; and

– home network domain names.

The allocation of private and public user identities is left to each operator to decide. Two approaches are identified:

– One private user identity is assigned to a group of lines/subscribers.

– One private user identity is associated with each line connected to the media gateways controlled by the AGCF.

Each private user identity is associated with one home network domain name.

The association between a line (represented by a termination identifier on a media gateway) and one or more public user identities is provisioned in the AGCF.

The public and private user identities must be known by both the AGCF and the SUP-FE/SAA-FE. It is up to the network operators to ensure that the AGCF and SUP-FE/SAA-FE have consistent information.

The following information may also be provisioned on a per-line basis or on a per media gateway basis:

– A default dial-tone;

– A default digit-map.

The AGCF needs to be made aware of dial tone changes in case some specific supplementary services are activated. For that purpose, it subscribes to the appropriate session control events.

### 7.9.3 Registration

Registration and deregistration procedures are initiated by VoIP gateways (VGWs) on behalf of each line it serves. The rest of the procedures are identical in the IMS-PES and IMS components.

Registration and deregistration procedures are initiated by the AGCF on behalf of each line connected to the access media gateways it controls, based on the information contained in service change messages received from those media gateways and local configuration information. The rest of the procedures are identical in the IMS-PES and IMS components.

A group of lines is represented by a set of public user identities sharing the same private user identity and the home domain. One of the public user identities is explicitly registered. Other public user identities are implicitly registered.

The list of implicitly registered identities is returned by the SUP-FE/SAA-FE to the AGCF. It should be noted that creating large registration groups may lead to excessively long signalling messages. If the list of registered identities returned by the SUP-FE/SAA-FE does not match the list of public user identities associated with the private user identity, the AGCF should take appropriate management actions outside the scope of this Recommendation.

## 7.10 Mapping between IMS-PES functional entities and NGN functional entities

See Table 7-1.

**Table 7-1 – Correspondence between IMS-PES functional entities and NGN functional entities**

| IMS-PES 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 |
| MRFP | MRP-FE |
| BGCF | BGC-FE |
| AS | AS-FE |
| UE | Terminal functions |
| IM-SSF | SSF |
| SCIM | APL-SCM-FE |
| SIP-AS | SIP AS-FE |
| OSA AS | OSA AS-FE |
| OSA SCS | OSA APL-GW-FE |
| AGCF | AGC-FE |

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[b-ETSI TS 123 260] ETSI TS 123 260 V6.7.0 (2006), *Universal Mobile Telecommunications System (UMTS); Telecommunication management; Charging management; IP Multimedia Subsystem (IMS) charging*.

[b-ETSI TS 182 012] ETSI TS 182 012 (2006), *Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS-based PSTN/ISDN Emulation Subsystem; Functional architecture*.

[b-ETSI ES 282 002] ETSI ES 282 002 (2006), *Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); PSTN/ISDN Emulation Subsystem (PES); Functional architecture*.

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