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Technical Specification

Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS-based PSTN/ISDN Emulation Sub-system (PES); Functional architecture



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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN).

1 Scope

The present document describes an IMS-based functional architecture for the PSTN/ISDN Emulation Subsystem (PES) of the ETSI TISPAN NGN overall architecture. The IMS-based PSTN/ISDN Emulation Subsystem described herein supports the emulation of PSTN services for analog terminals and ISDN services for ISDN terminals and PBXs. These may be connected directly to residential gateways or access gateways, or via V5 access networks.

The present document provides a framework for an IMS-based functional architecture and is considered to be a preliminary version. In addition, in order to fulfil the requirements of different operators and national regulatory requirements, this architecture will need to be enhanced.

See annex A for a list of potential open areas.

2 References

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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

- [1] ETSI ES 282 001: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture Release 1".
- [2] ETSI ES 282 007: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Subsystem (IMS) Functional architecture".
- [3] ETSI TS 182 006: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Subsystem (IMS); Stage 2 description".
- [4] ETSI ES 283 003: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Call Control Protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP) Stage 3 [3GPP TS 24.229 [Release 7], modified]".

- [5] ETSI TS 183 043: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS-based PSTN/ISDN Emulation; Stage 3 specification".
- [6] ETSI TS 183 021: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Release 1; Endorsement of 3GPP TS 29.162 Interworking between IM CN Sub-system and IP networks".
- [7] ETSI ES 282 010: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Charging management Endorsement of 3GPP TS 32.240 Release 7, 3GPP TS 32.260 Release 7, 3GPP TS 32.297 Release 7, 3GPP TS 32.298 Release 7 and 3GPP TS 32.299 Release 7, modified".
- [8] ETSI ES 201 915-1: "Open Service Access (OSA); Application Programming Interface (API); Part 1: Overview (Parlay 3)".
- [9] IETF RFC 3136: "The SPIRITS architecture".
- [10] ETSI ETS 300 738: "Human Factors (HF); Minimum Man-Machine Interface (MMI) to public network based supplementary services".
- [11] ITU-T Recommendation H.248: "Gateway control protocol".
- [12] ETSI EN 300 659 (all parts): "Access and Terminals (AT); Analogue access to the Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display (and related) services".
- [13] ETSI ETR 150: "V5 interface; Public Switched Telephone Network (PSTN) mappings".

2.2 Informative references

Not Applicable.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Access Gateway (AG): gateway device that interworks a significant number of analogue lines/ISDN accesses (directly or via an V5 Access Network) to a packet network and is located at the operator's premises

NOTE: An AG can take the form of a Media Gateway (A-MGW) or a Voice over IP Gateway (A-VGW).

Media Gateway (MGW): gateway device acting at the media/transport plane, providing the functions of an MGF as defined in ES 282 001 [1]

NOTE 1: A MGW may additionally relay signalling traffic, in which case it also provides the functions of an SGF as defined in ES 282 001 [1].

NOTE 2: In the present document, Media Gateway refers both to Access Gateways and to Residential Gateways, to form a A-MGW, or a R-MGW, respectively.

Media Gateway Controller (MGC): See ITU-T Recommendation H.248 [11].

Residential Gateway (RG): gateway device that interworks a small number of analogue lines/ISDN accesses

NOTE: A residential gateway typically contains one or two analogue lines/ISDN accesses and is located at the customer premises. A RG can take the form of a Media Gateway (R-MGW) or a Voice over IP Gateway (R-VGW).

Voice over IP Gateway (VGW): SIP-based gateway device that connects legacy equipment to the NGN

NOTE 1: A Voice over IP Gateways (VGW) plays the role of an IMS UE with regards to the P-CSCF.

NOTE 2: A Voice over IP Gateway can be classified as a AG or RG, to form a A-VGW, or a R-VGW, respectively.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AF	Application Function
AG	Access Gateway
AGCF	Access Gateway Control Function
A-MGF	Access Media Gateway Function
A-MGW	Access Media GateWay
AN	Access Node
AS	Application Server
ASF	Application Server Function
ATA	Analogue Terminal Adaptor
A-VGW	Access Voice over IP GateWay
BCSM	Basic Call State Model
BGCF	Breakout Gateway Control Function
BGF	Border Gateway Function
CCBS	Call Completion on Busy Subscriber
CSCF	Call Session Control Function
DDI	Direct Dialling In
DNS	Domain Name Server
DSS1	Digital Subscriber Signalling System No.1
GW	GateWay
HSS	Home Subscriber Server
IBCF	Interconnection Border Control Function
I-CSCF	Interrogating-Call Session Control Function
IM	IP Multimedia
IMS	IP Multimedia Subsystem
IM-SSF	IP Multimedia-Service Switching Function
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
IWF	InterWorking Function
MG	Media Gateway
MGC	Media Gateway Controller
MGCF	Media Gateway Control Function
MGF	Media Gateway Function
MGW	Media Gateway
MRFC	Multimedia Resource Function Controller
MRFP	Multimedia Resource Function Processor
NAPT	Network Address Port Translation
NASS	Network Attachment SubSystem
NGN	Next Generation Network
OSA	Open Service Access
PBX	Private Branch Exchange
P-CSCF	Proxy-Call Session Control Function
PES	PSTN/ISDN Emulation Subsystem
PSTN	Public Switched Telephone Network
RACS	Resource and Admission Control Subsystem
RG	Residential Gateway
R-MGF	Residential-MGF
R-MGW	Residential Media GateWay
R-VGW	Residential Voice over IP GateWay
SCIM	Service Capability Interaction Manager
SCS	Service Capability Server
S-CSCF	Serving-Call Session Control Function

SIGTRAN	SIGNalling TRANsport
SIP	Session Initiation Protocol
SLF	Subscription Locator Function
SS7	Signalling System n°7
SSF	Service Switching Function
TDM	Time Division Multiplexing
TGW	Trunking Gateway
T-MGF	Trunking Media Gateway Function
UE	User Equipment
UPSF	User Profile Server Function
VGW	Voice over IP GateWay
VoIP	Voice over IP

4 Overview

4.1 PSTN/ISDN Emulation subsystem environment

Figure 1 shows the PSTN/ISDN Emulation Subsystem and its relationships with other TISPAN NGN subsystem.

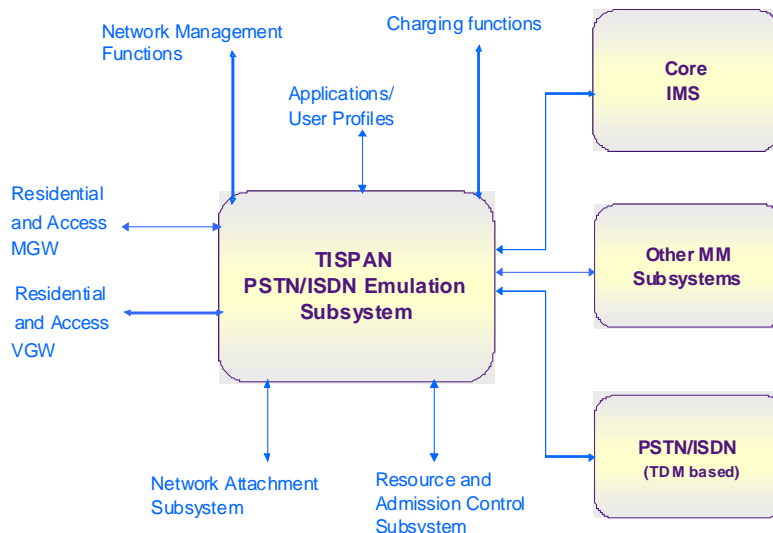


Figure 1: PSTN/ISDN Emulation Subsystem and its environment

4.2 Signalling configurations

Figure 2 illustrates the signalling configurations supported by the PSTN/ISDN Emulation Subsystem (PES) described in the present document.

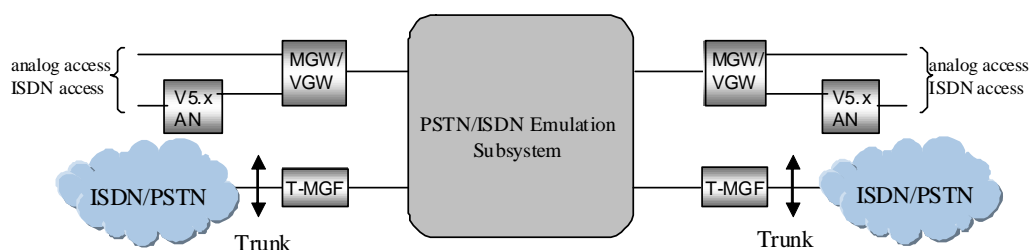


Figure 2: Signalling Configurations

Legacy terminals, i.e. analog phones and ISDN phones may be connected to R-VGW, R-MGW, A-VGW and A-MGW, using the interfaces based on the Z, S/T and U reference point, respectively.

ISDN PBXs may be connected to an A-VGW or A-MGW using the interfaces based on the T reference point.

When connected to an AG (A-VGW or A-MGW) a legacy terminal or ISDN PBX may be connected directly to the AG or indirectly via a V5.xAccess Node.

The R-VGW and A-VGW are connected to the IMS PES via the Gm reference point.

The R-MGW and A-MGW are connected to the IMS PES via the P1 reference point.

PSTN/ISDN islands may also be connected via trunking media gateway function (T-MGF), controlled via the Mn reference point. Transit network functionality is supported as provided by the IMS ES 282 007 [2].

4.3 Constraints on services

The range of services that can be emulated in TISPAN NGN Release 1 is constrained by the functional architecture and the IMS SIP profile defined in ES 283 003 [4] on the Mw/Mx and ISC reference points, and of the Gm reference points in case of VGW.

4.4 Overlap signalling

Overlap sending is a mechanism that is used for dialling over analogue and ISDN accesses, and is inbuilt in the inter-exchange signalling systems of the PSTN/ISDN networks. As such, it is a mechanism that the IMS-based PSTN/ISDN emulation subsystem architecture shall support, in a similar manner as for the PSTN.

To support overlap signalling the PES shall support the following functionality:

- at the originating side, the VGW and the AGCF shall support the ability to collect digits sent by the user to the extent of its knowledge of the dialling plan in use. As a result, the completeness of the number may be unknown, and the VGW and AGCF may, dependent on operator policy, use overlap sending;
- Networks supporting overlap sending should provide a B2BUA function that has the ability to collect digits, before routing to another network that does not support overlap sending, such that the address information is provided in a single message;
- at the terminating side, e.g. when connected to a legacy PBX, the VGW and the AGCF should support based on operator policy the ability to transfer digits to the user using overlap sending;
- at the terminating side, e.g. when connected to a legacy PBX, an AS may support the ability to transfer digits to the user dependent on operator policy, using overlap sending;
- In case of an incoming call (from another network), the I-CSCF or TrRF or O-MGCF, possibly in combination with HSS/DNS/ENUM, will forward the call only when a sufficient number of digits have been received:
 - for terminating cases to access the service profile assigned to a user. Only for cases additional digits not relevant for the IMS service profile lookup are received as overlap signalling, e.g. for DDI towards a PBX, based on network options this additional overlap signalling should be sent towards the terminating user;
 - for transit cases when the number received points towards another network to select and forward the call to an appropriate network egress point (e.g. IBCF or I-MGCF). the solution shall interoperate with IMS networks not supporting overlap signalling without requiring any changes in those networks.

NOTE 1: A terminating IMS network not supporting overlap signalling will perform a database lookup to assign a S-CSCF for an incoming call and will return a 404 error response to an INVITE with an incomplete number.

- in interconnection scenarios, as a network option, it shall be possible to support overlap signalling.

NOTE 2: In the PES network the service level provided to the user should not be dependent on using overlap or en-bloc sending.

- Perform signalling interworking between SIP at the Mw/Mx reference point and analog/ISDN signalling. The analog and ISDN signalling information is conveyed over the P1 reference point.
- Perform signalling interworking between XCAP at the Ut reference point and legacy subscriber line (e.g. ISDN) signalling via the P1 reference point.

NOTE 1: The main use-case for the interworking between **XCAP** and legacy subscriber line signalling is supplementary service control (registration, activation, deactivation, interrogation).

- Act as a SIP User Agent with regard to IMS SIP functional entities.
- Perform functions normally assigned to a P-CSCF on behalf of legacy terminals connected behind the media gateways (such as managing SIP registration procedures, generating asserted identities, and creating charging identifiers).

The AGCF appears as a P-CSCF to the other CSCFs. The SIP signalling capabilities available to the AGCF are limited to those available at the Mw/Mx reference.

Moreover, the AGCF shall provide basic feature logic for:

- delivering the appropriate dialtone pattern;
- processing mid-call events, as described in clause 12.

NOTE 2: A solution based on AGCF will provide similar response time (e.g. dial tone, ring tone) as today in the PSTN networks.

In case of AGCF failure, stable calls shall be preserved.

Depending on implementation options, the AGCF may or may not be capable of implementing service-independent feature logic for dealing with register recall events, when it does, it can make certain decisions such as whether or not to apply dial tone on register recall, whereas in implementations where the AGCF does not implement feature logic, such decisions must be left for the AS to make.

Further details on the AGCF structure and behaviour are provided in clause 12.

NOTE 3: 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 the present document, and supports the Gm interface into an IMS or PES network via a P-CSCF, but this entity would fill the role of "Gateway (VGW)" depicted in figure 3 and would not be part of the trusted IMS core.

AGCF/VGW shall support a generic solution for calls without dialling information, e.g. fixed destination call or deferred fixed destination call.

5.2.2 Multimedia Resource Function Controller (MRFC)

The behaviour of the MRFC is identical in the PSTN/ISDN Emulation Subsystem and in the IMS subsystem ES 282 007 [2].

5.2.3 Media Gateway Control Function (MGCF)

The role of the MGCF is identical in the PSTN/ISDN Emulation Subsystem and in the IMS subsystem ES 282 007 [2]. Signalling procedures for interworking with ISUP signalling are slightly different due to the presence of encapsulated ISUP information inside the PES and the need to ensure full ISDN transparency in case of ISDN calls transiting through the PES.

5.2.4 Proxy Call Session Control Function (P-CSCF)

The behaviour of the P-CSCF is identical in the PSTN/ISDN Emulation Subsystem and in the IMS subsystem ES 282 007 [2]. 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.

5.2.5 Service Call Session Control Function (S-CSCF)

The behaviour of the S-CSCF is identical in the PSTN/ISDN Emulation Subsystem and in the IMS subsystem ES 282 007 [2].

5.2.6 Interrogating Call Session Control Function (I-CSCF)

The behaviour of the I-CSCF is identical in the PSTN/ISDN Emulation Subsystem and in the IMS subsystem ES 282 007 [2].

5.2.7 Breakout Gateway Control Function (BGCF)

The behaviour of the BGCF is identical in the PSTN/ISDN Emulation Subsystem and in the IMS subsystem ES 282 007 [2].

5.3 Internal Reference Points

5.3.1 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.

The protocol used for the Mg reference point is SIP. SIP messages may contain encapsulated ISUP information.

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

Details are described in TS 182 006 [3].

5.3.2 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 protocol used for the Mr reference point is SIP.

The role of this reference point is identical in the PES and IMS subsystems ES 282 007 [2].

Details are described in TS 182 006 [3].

5.3.3 Reference Point CSCF - CSCF and AGCF - CSCF (Mw Reference Point)

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

The protocol used for the Mw reference point is SIP. SIP messages exchanged over the Mw reference point may contain encapsulated ISUP information, except between the AGCF and a CSCF.

The role of this reference point is identical in the PES and IMS subsystems ES 282 007 [2].

Details are described in TS 182 006 [3].

5.3.4 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 to the PSTN networks.

The protocol used for the Mi reference point is SIP. SIP messages exchanged over the Mi reference point may contain encapsulated ISUP information.

The role of this reference point is identical in the PES and IMS subsystems ES 282 007 [2].

Details are described in TS 182 006 [3].

5.3.5 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 to 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. The protocol for the Mj reference point is SIP, possibly with encapsulated ISUP information.

The role of this reference point is identical in the PES and IMS subsystems ES 282 007 [2].

Details are described in TS 182 006 [3].

5.3.6 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.

The Mk reference point is SIP, possibly with encapsulated ISUP information.

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

Details are described in TS 182 006 [3].

5.3.7 Reference Point AGCF, CSCF or BGCF - IBCF (Mx Reference Point)

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

NOTE: The protocol used for the Mx reference point is SIP.

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

SIP messages exchanged over the Mx reference point may contain encapsulated ISUP information, except between the AGCF and the IBCF.

Details are described in TS 182 006 [3].

6 Service Architecture

6.1 Overview

The service architecture for the PES and the IMS subsystems is the same. The generic behaviour of a application server functions is identical with respect to the PSTN/ISDN Emulation Subsystem and the TISpan IMS. However, depending on the type of services to be emulated, certain application servers may need to understand and terminate the ISUP protocol encapsulated in SIP.

Three types of Application Server Functions (ASF) can be accessed by the IMS-based PES, through the ISC or Ma reference point (see figure 4).

- SIP Application Servers (SIP AS).
- The IM-SSF Application Server.
- The OSA SCS Application Server.

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 standards.

The purpose of the IM SSF is to enable access to IN service logic programs hosted in legacy SCPs. 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 PSTN/ISDN Emulation Subsystem and in the IMS subsystem ES 282 007 [2]. Basic behaviour is also identical. However, in the PES case, mapping procedures may take into account ISUP information encapsulated in SIP messages.

NOTE 2: The IM SSF is intended to enable access from the PES to IN service logic programs hosted in legacy SCPs. Access to PES services (i.e. hosted in SIP-based Application Servers) from legacy SSPs in the PSTN/ISDN is outside the scope of the present document. Appropriate gateway functions (e.g. SPIRITS gateway as defined in RFC 3136 [9]) 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 ES 201 915-1 [8].

Further details can be found in TS 182 006 [3].

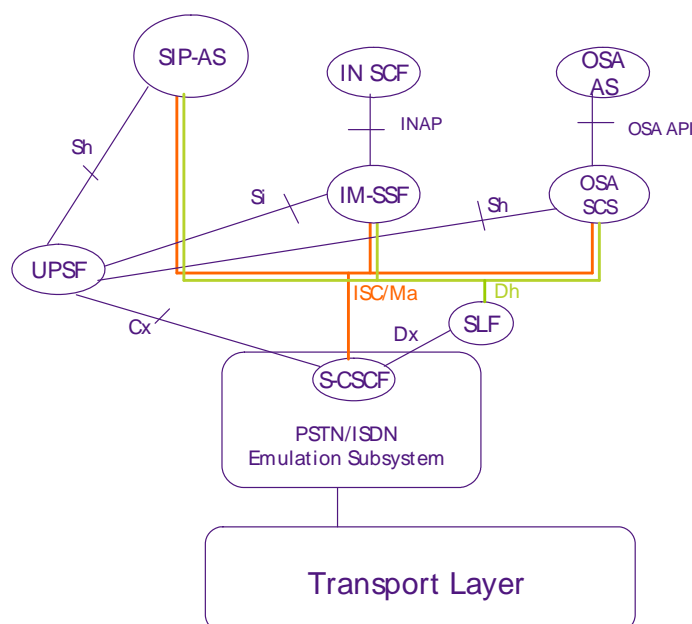


Figure 4: Value Added Services architecture

The Service-CSCF to AS interface is used to forward SIP requests, based on filter criteria associated with the originating or destination user.

The Interrogating-CSCF to AS interface is used to forward SIP requests destined to a Public Service Identity hosted by the AS directly to that AS.

The procedures between AGCF and AS (using reference points Mw, Mx, Ic and ISC) shall be standard and open to allow for interoperability of equipment from different vendors which may be located in different operators' networks.

6.2 Reference points

6.2.1 Reference Point S-CSCF - ASF (ISC Reference Point)

The role of the ISC reference point is identical with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem.

The information provided over the ISC reference point shall enable an AS to distinguish between access lines receiving PES services via a VGW and access lines receiving PES services via an AGCF both of which use the same public user identity.

6.2.2 Reference Point UPSF - SIP AS or OSA SCS (Sh Reference Point)

The role of the Sh reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem is identical.

6.2.3 Reference Point UPSF - IM SSF (Si Reference Point)

The role of the Si reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem is identical.

6.2.4 Reference Point ASF- SLF (Dh Reference Point)

The role of the Dh reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem is identical.

6.2.5 Reference Point ASF - UE and ASF-AGCF (Ut Reference Point)

The role of the Ut reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem is identical.

The Ut reference point enables a A-VGW or R-VGW acting as a UE to manage information related to the services provided to the legacy equipment (e.g. ISDN terminal, ISDN PBX) it connects.

The Ut reference point enables the AGCF to manage information related to the services provided to the legacy equipment (e.g. ISDN terminal, ISDN PABX) connected to the Residential or Access Media Gateways it controls.

The Ut reference point applies to SIP Application Servers only.

Details are described in ES 282 007 [2].

6.2.6 Reference Point I-CSCF - AS (Ma Reference Point)

The role of the Ma reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem is identical.

This interface between Interrogating-CSCF and the Application Servers (i.e. SIP Application Server, OSA Service Capability Server, or CAMEL IM-SSF) is used to forward SIP requests destined to a Public Service Identity hosted by an Application Server directly to the Application Server.

Details are described in TS 182 006 [3].

7 External interfaces

7.1 Interfaces with entities in the transfer plane

Transfer plane entities are defined in ES 282 001 [1].

7.1.1 Reference Point MGCF - T-MGF (Mn Reference Point)

The role of this reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem is identical.

7.1.2 Reference Point MGCF - SGF (Ie Reference Point)

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

7.1.3 Reference Point AS - SGF (P3 Reference Point)

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

7.1.4 Reference Point MRFC - MRFP (Mp Reference Point)

The role of this reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem is identical.

7.2 Interface with the UE

Conventional SIP UEs do not exist in PES. In PES, the User Equipment comprises one or more analogue/ISDN terminals and gateway to which they are connected, via either the Z, U, S/T or T reference point.

This gateway may be an Access or Residential Media Gateway or a SIP based Access or Residential Voice over IP Gateway. When the user equipment is connected to an Access Gateway, this may be via existing V5.x Access Nodes.

A Voice over IP Gateways (A-VGW and R-VGW) plays the role of a UE with regards to the P-CSCF-.

VoIP gateways (A/R-VGW) interact with IMS PES via the Gm and Ut reference points. The protocol used for the Gm reference point is SIP. Details are described in ES 282 007 [2].

The role of these reference point (Gm and Ut) are identical in the PES and IMS subsystems.

Media Gateways connecting legacy equipment (analog/ISDN terminals and ISDN PBXs) interact with the PES via the P1 reference point. The protocols used for the P1 reference point are H.248.

When connecting ISDN terminals/PBXs to the MGW (directly or via a V5 AN), the P1 reference point also comprises back hauled DSS1. In case the access is connected via V5 Access Nodes, the analog signalling information is conveyed over the P1 reference point using back hauled V5 signalling or H.248.

7.3 Interfaces with the user profile

The SLF and UPSF entities are defined in ES 282 001 [1].

The behaviour of the UPSF and SLF in relation to the PSTN/ISDN Emulation Subsystem is identical to its behaviour in relation to the IMS subsystem ES 282 007 [2].

7.3.1 Interface with the SLF (Dx Reference Point)

The role of this reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem are identical.

7.3.2 Interface with the UPSF (Cx Reference Point)

The role of this reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem are identical.

7.4 Interfaces with Charging Functions

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

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

For off-line charging the Rf interface is used. For on-line charging the Ro interface is used. Details are described in ES 282 010 [7].

NOTE: The IBCF to which the PES is connected may also act as a charging trigger point.

8 Interconnection with other networks

8.1 Interfaces with the PSTN/ISDN

Interconnection at the signalling level is provided via the SGF.

Interconnection at the media level is provided by the trunk interfaces at the T-MGF.

8.2 Interfaces with other external IP-based Subsystems

Interconnection with other IP-based subsystems (including other PSTN/ISDN Emulation subsystems) is typically performed via the IBCF at the signalling level.

NOTE 1: Use of the IBCF is dependant on the implementations of the interconnected operators.

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

Interconnection between PSTN/ISDN emulation subsystems 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, see note 2).

NOTE 2: Roaming scenarios are inherently supported in the IMS-based PES just as the IMS architecture enables UEs in a visited network to access their home IMS via a P-CSCF in the visited IMS. When serving lines via an AGCF, due to the static characteristics of access lines connected to an AGCF, the roaming scenario supported by the IMS-based PES will typically be permanent (i.e. non-nomadic), unless rewiring of the access line to a different A-MGW is performed; typically known as wholesale scenario, this form of permanent roaming is achieved by means of an access line being physically connected to a A-MGW and an AGCF in one operator's domain and receiving its home PES services from another operator's IMS (as shown in figures 5 and 6).

The above also implies that different access lines connected to the same AGCF in a visited network can receive PES services from different operators' home IMS-based PES.

As in any roaming agreement, certain information will have to be exchanged off-line between the visited and home operators; for the particular scenario where the AGCF resides in a different operator's network than the rest of the IMS, this information includes the configuration of the lines being served (see clause 11.2.2) as well as an indication of the respective capabilities of the AGCF and the PES AS for them to interoperate (e.g. whether or not the AGCF supports service-independent feature logic for dealing with mid-call events). The format or the means to exchange such information is outside the scope of the present document.

Based on signalling information received from the PES and local policy rules, and if an IBCF is used, the IBCF decides on a per session basis whether the RACS should be involved in the interconnection.

NOTE 3: Depending on the operator policies, the decision as to whether or not media level interconnection is required (i.e. an I-BGF is inserted in the media path) for a particular session may be taken by the RACS, based on the "resource reservation service class" information that may be received from the IBCF. The RACS also choose the appropriate interconnect link for media traffic based on the information received from the IBCF, if an IBCF exists and is used.

Figure 5 illustrates the case where no I-BGF is inserted. Figure 6 illustrates the case where an I-BGF is inserted by the visited network. All other interconnect scenarios identified in ES 282 007 [2] annex B are also applicable to the PES.

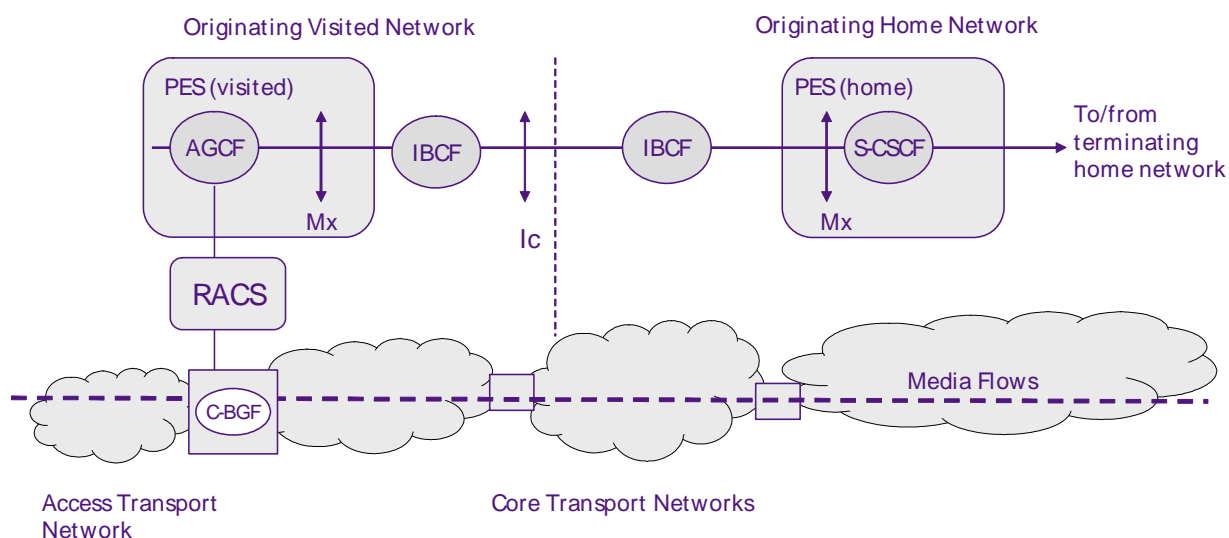


Figure 5: PES interconnect scenario without I-BGF

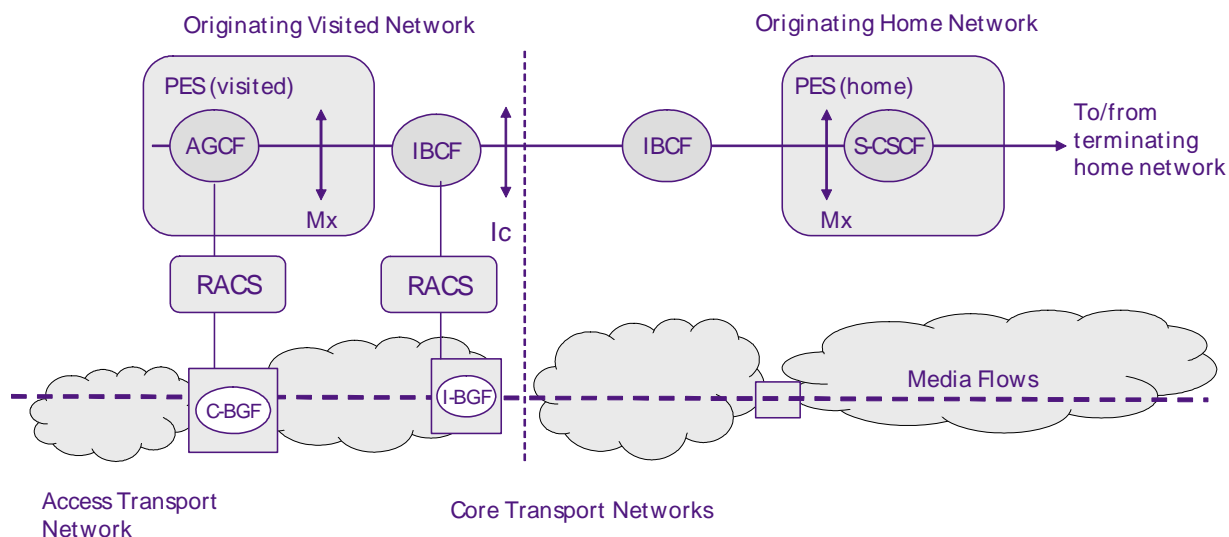


Figure 6: PES interconnect scenario with I-BGF

NOTE 4: As a network operator's option, an I-CSCF with encryption-based topology hiding capabilities (THIG) may also be inserted in the PES before the IBCF. This is not represented on figures 5 and 6.

9 Interfaces with the Network Attachment Subsystem (NASS)

The e2 reference point supports information transfer between the P-CSCF or the AGCF and the Network Attachment Subsystem.

The role of this reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem is identical.

NOTE: Interaction with the NASS is not be required in case the AGCF controls access gateways only.

10 Interface with the Resource and Admission Control Subsystem (RACS)

The Gq' reference point enables the P-CSCF or the AGCF to interact with the resource control subsystem for the following purposes:

- authorization of QoS resources;
- resource reservation;
- gate control (including NAPT binding information relay).

With regard to the RACS architecture; the P-CSCF and the AGCF play the role of an Application Function (AF).

The role of this reference point with respect to the PSTN/ISDN Emulation Subsystem and the IMS subsystem is identical.

NOTE: Interaction with the NASS may not be required in case the AGCF controls access gateways only and dedicated transport resources are used to support PES traffic.

In case of network interconnection, interactions with the resource control subsystem may also take place at the edge of the PES, at the IBCF level for the following purposes:

- gate control (including NAPT binding information relay).

With regard to the RACS architecture; the IBCF plays the role of an Application Function (AF).

Details are described in TS 183 021 [6].

11 Mode of operation

11.1 General Principles

Emulating PSTN/ISDN services using the IMS-based PES architecture described in the present document 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 encapsulated ISUP information be sent/received by some of these application servers (TS 183 043 [5]).

The logic embedded in the AGCF is either interworking logic (e.g. the AGCF has to know how to convert the information contained in an incoming SIP INVITE into a presentation message of the protocol for display services over analog lines as defined in EN 300 659 [12]) or service independent feature logic.

On receipt of an off-hook event from a media gateway at the beginning of a call initiation sequence, the AGCF shall apply dial tone unless not required by a feature associated with that line (e.g. fixed destination call).

The AGCF's behaviour on receipt of other line events depends on whether or not the AGCF is capable of implementing the feature logic associated with that line, as an example, on a register recall event notification from a media gateway, the AGCF shall determine whether or not to apply dial tone if the AGCF is capable of implementing feature logic for that line; however, if the AGCF is not aware of the feature logic associated with a line and supports mid-call invocation of supplementary services, then it shall send an indication to the AS that register recall has occurred and wait for an indication back as to whether or not dial tone should be applied.

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).

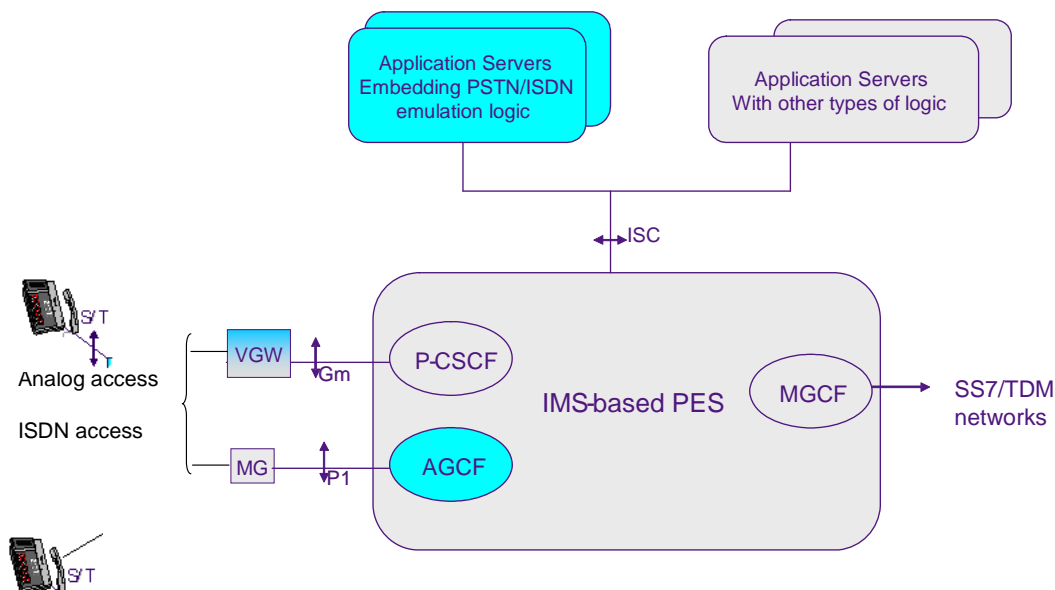


Figure 7: Service Access via the PES

11.2 Service Provisioning

11.2.1 Provisioning in the UPSF

The service profile of PES users is stored in the UPSF 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 subsystem ES 282 007 [2].

11.2.2 Provisioning in the AGCF

The following IMS parameters are assumed to be available, for every line, in a local data base of the AGCF:

- private user identities;
- public user identities;
- home network domain names;
- address of the AS to be used for service configuration management (for use over the Ut reference point); and

NOTE: Some of the line parameters mentioned above may be shared across a number of lines (e.g. private user identities are shared by all the lines belonging to an implicitly registered group and home network domain names can be shared across all the lines belonging to the same home IMS-based PES operator). The present document does not mandate a particular data model to be implemented in the AGCF provided that the above information is available and uniquely identifiable by the AGCF on a per-line basis.

- (optionally) a temporary public user identity that the line will be implicitly registered against.

The use of temporary public user identities in the present document is the same as that described in TS 182 006 [3], i.e. a temporary public user identity is used in the initial registration to register a group of public user identities associated with it. Temporary public user identities shall be, for the present document, provisioned into the AGCF (which contains the functionality of a UE) by means outside the scope of the present document.

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.

In this scenario, the operator may choose to allocate a temporary public user identity for a group of lines to be implicitly registered against. When available, such temporary public user identity shall be used in the initial registration request.

- 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 UPSF. It is up to the network operators to ensure that the AGCF and UPSF have consistent information.

In addition to the above, each line may be characterized by a line type (e.g. loop calling, PBX, line reversal on answer etc. as described in ETR 150 [13]).

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; and
- a default ring cadence.

Depending on operator-specific requirements and the features implemented, certain "feature marks" may also be needed in the AGCF on a per-line basis; examples of this include:

- Calling Line Identity display to user equipment - this feature mark may be needed in cases where, even if no Calling Line Identity information is signalled to the AGCF, the AGCF needs to instruct to the A-MGW whether to send a "Calling Line Identity unavailable" indication or no indication at all to that line depending on whether or not the user has subscribed to Calling Line Identity presentation services.
- Priority line – this feature mark may be required in cases where the AGCF needs to treat calls from or to that line as having priority over other lines controlled by the same AGCF.
- Fixed destination call/deferred destination call/ normal line - this feature mark may be required for the AGCF to know whether or not dial tone needs to be applied after off-hook event is detected in the line. In the case of deferred destination call lines, dial tone needs to be applied for a period of time after which dial tone needs to be removed and a call to the fixed destination address (as specified below) be placed.
- Fixed destination address - this feature mark is required for the AGCF to know the address it needs to place a call to for lines marked as fixed destination call or deferred destination call lines.
- Mid-call Malicious Call Indication - this feature mark may be needed when mid-call Malicious Call Indication is required since, an AGCF that implements service independent feature logic for dealing with mid-call events would autonomously apply dial tone after a register recall event unless this feature mark is activated.

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 SIP events.

11.3 Registration

Registration and deregistration procedures are initiated by Voice over IP gateways (A-VGW and R-VGW) at the Gm reference point on behalf of each line or group of lines it serves. The rest of the procedures are identical in the PES and IMS subsystems.

Registration and deregistration procedures are initiated by the AGCF on behalf of each line or group of lines connected to the 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 PES and IMS subsystems.

A group of lines is represented by a set of public user identities sharing the same private user identity, home domain and, optionally, a temporary public user identity (to be used in the initial registration). One of the public user identities is explicitly registered; note that, if present, the temporary public user identity shall be used for the initial explicit registration. Other public user identities are implicitly registered.

The list of implicitly registered identities is returned by the UPSF to the AGCF. It should be noted that creating large registration groups may lead to excessively long signalling messages, any issues associated with this need to be solved by implementation. If the list of registered identities returned by the UPSF 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 the present document.

11.4 Service code commands

Users of analog terminals usually manage supplementary services using service code commands using the syntax defined in ETS 300 738 [10], clause 6.1.1.

The AGCF has the necessary service independent logic to determine whether a special dial tone needs to be delivered after the service prefix. In case dial tone needs to be applied, the AGCF can also determine whether a special dial tone needs to be delivered.

12 AGCF behaviour

12.1 AGCF components

The AGCF can be decomposed into three logical components:

- The Media Gateway Controller.
- The Feature Manager.
- The IMS Agent.

Figure 8 provides an overview of the AGCF logical structure.

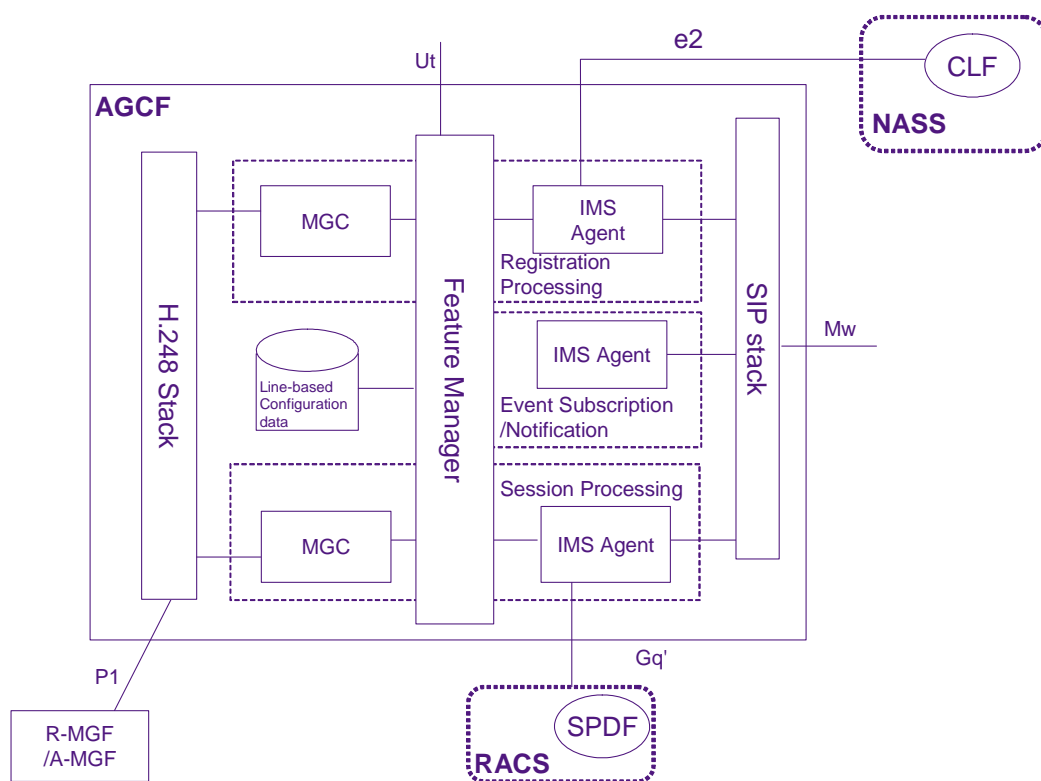


Figure 8: AGCF internal structure

12.2 Media Gateway Controller

The Media Gateway Controller component performs the following functions:

- keep track of the media gateway state (e.g. registration/deregistration);
- keep track of the line state (e.g. idle, active, parked, out of service, etc.);
- control the connection configuration (media flows topology and directionality) in media gateways;
- control the connection of tones and announcements in media gateways;
- receive line events and DTMF digits from media gateways;
- request media gateways to monitor line events and DTMF digits;
- perform basic digit analysis sufficient to determine end of dialling to detect emergency calls (see note);
- provide line signals to media gateways;
- download "Digit Maps" to media gateways;
- controls media mapping and transcoding;
- controls signal processing features such as echo cancellation in media gateways.

NOTE: The full digit analysis procedure required for normal call routing purposes is performed by the S-CSCF and Application Servers.

12.3 Feature Manager

The Feature Manager is the functional block in AGCF that provides the coordination between the IMS core and the Media Gateways. For that, it holds a call and connection model that associate lines to call states and IMS dialogs.

Figure 9 shows a call and connection configuration where an analogue line is connected to two parties, each of these relationships being associated with a call state and a SIP dialogue.

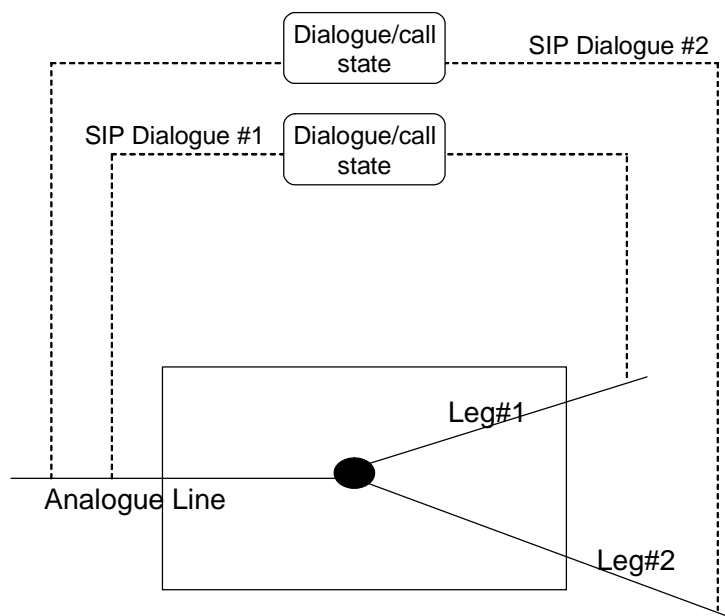


Figure 9: AGCF Call and Connection model

The feature manager component performs the following functions:

- Perform mediation of signalling events between Media gateways and S-CSCF in accordance with the connection model of AGCF.
- Request the registration of lines to the IMS core. Two possible mechanisms are supported:
 - registration/deregistration of individual endpoints or registration/deregistration of the group of lines.
- Interacts with Application Servers to retrieve the current dial tone from the subscriber profile.
- When the AGCF supports service-independent feature logic for mid-call events, the feature manager shall invoke basic features logic for processing mid call events, based on the call state and connection configuration.
- When the AGCF does not support service-independent feature logic for mid-call events, the feature manager shall send an indication to the AS that a certain mid-call event has occurred and wait for an indication back as to what actions should be performed next

NOTE: User input leading to mid call events may take various forms (e.g. register-recall, register-recall followed by one or more digits, one or more digits, etc.) depending on the network policies.

Signalling procedures in support of the above processing logic is outside the scope of this technical specification but shall be compatible with the constraints of the P1 and Mw reference points.

- Perform the mapping between alert information received from SIP signalling and ring patterns.
- Subscribe to the state of the lines behind media gateways in order to be informed when an individual line is deregistered (e.g. due to operational action a line may be no longer active).
- Manage the subscription for event report request from AS. The notification is delivered to the right AS.

12.4 IMS Agent

The IMS agent encompasses the functionality of an IMS UE and P-CSCF. It communicates with other IMS entities using the SIP profile described in ES 283 003 [4].

The following functionality is implemented in the IMS agent:

- Send/receive messages to/from the IMS entities. The received messages are sent to the Feature Manager that is responsible for processing them in accordance with the actual connection model of the line.
- Communicate with an I-CSCF (potentially via an IBCF) in order to address the right S-CSCF in the same or a different operator's network. The identity of I-CSCF can be derived from DNS query.
- Interact with the Resource and Admission Control Subsystems (RACS).
- Interfaces with the Network Attachment Subsystem (NASS) in order to retrieve information related to the IP-connectivity access session (e.g. physical location of the user equipment), when the media gateway is located in the customer premises (i.e. residential media gateway).

The IMS agent is considered a trusted network element and therefore, security is equivalent to other IMS network elements.

13 Physical scenarios

Various physical scenarios can be derived from the functional architecture described in the previous clauses. How this functional architecture maps to physical devices and how many of the functional interfaces remain visible in a network implementation is outside the scope of standardization. Possible implementations range from obvious scenarios with a one to one mapping between functional entities and physical entities, to physical architectures mimicking the hierarchical architecture of legacy networks (i.e. local and transit levels), based on only two types of physical nodes: call servers and media gateways.

Annex A (informative): Areas of discussion and potential open items

So far, areas of discussion and potential open items include at least the following:

- Registration through the AGCF:
 - Overlap sending.
- Interworking between AGCF and AS:
 - Clarify what parts of encapsulated ISUP are needed. Alternative solutions to it.
 - Usage of Ut reference point.
- Alignment with 3GPP:
 - Clarify the usage of encapsulated ISUP information.

History

Document history		
V2.1.4	March 2008	Publication