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Foreword

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

1 Scope

The present document describes the overall TISPAN NGN functional architecture, its subsystems and the relationships between them.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

- [1] ETSI TS 102 144: "Services and Protocols for Advanced Networks (SPAN); MTP/SCCP/SSCOP and SIGTRAN (Transport of SS7 over IP); Stream Control Transmission Protocol (SCTP) [Endorsement of RFC 2960 and RFC 3309, modified]".
- [2] ITU-T Recommendation Y.2011: "General principles and general reference model for next generation networks".
- [3] ETSI TS 123 002: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Network architecture (3GPP TS 23.002)".
- [4] ETSI TS 123 228: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); IP Multimedia Subsystem (IMS); Stage 2 (3GPP TS 23.228)".

3 Definitions and abbreviations

3.1 Definitions

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

access network: collection of network entities and interfaces that provide the underlying IP transport connectivity between end user devices and NGN entities

core network: portion of the delivery system composed of networks, systems equipment and infrastructures, connecting the service providers to the access network

functional entity: entity that comprises a specific set of functions at a given location

NOTE: Functional entities are logical concepts, grouping of functional entities are used to describe practical physical realizations.

User Equipment (UE): one or more devices allowing a user to access services delivered by TISPAN NGN networks

NOTE: This includes devices under user control commonly referred to as CPE, IAD, ATA, RGW, TE, etc., but not network controlled entities such as access gateways.

3.2 Abbreviations

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

3GPP	Third Generation Project Partnership
A-MGF	Access Media Gateway Function
AN	Access Node
ARF	Access Relay Function
AS	Application Server
ASF	Application Server Function
ATA	Analogue Terminal Adaptor
AUC	Authentication Centre
BGF	Border Gateway Function
BGW	Border GateWay
C-BGF	Core Border Gateway Function
CPE	Customer Premises Equipment
CSCF	Call Session Control Function
DHCP	Dynamic Host Configuration Protocol
DSLAM	Digital Subscriber Line Access Multiplexer
ENUM	tElephone NUmber Mapping
HLR	Home Location Register
HSS	Home Subscriber Server
IAD	Integrated Access Device
IBCF	Interconnection Border Control Function
I-BGF	Interconnection Border Gateway Function
I-CSCF	Interrogating Call Session Control Function
IMS	IP Multimedia Subsystem
IMS-MGW	IMS Media Gateway
IP	Internet Protocol
ISDN	Integrated Services Digital Network
IVR	Interactive Voice Response
IWF	Interworking Function
L2TF	Layer 2 Termination Function
MGF	Media Gateway Function
MRFP	Multimedia Resource Function Processor
MTP	Message Transfer Part
NAPT	Network Address and Port Translation
NAPT-PT	NAPT and Protocol Translation
NASS	Network Attachment Subsystem
NGN	Next Generation Network
OSA	Open Service Access
PES	PSTN/ISDN Emulation Subsystem
PPP	Point-to-Point Protocol
PSTN	Public Switched Telephony Network
RACS	Resource and Admission Control Subsystem
RADIUS	Remote Access Dial In User Service
RCEF	Resource Control Enforcement Function
RGW	Residential Gateway
R-MGF	Residential Media Gateway Function
SCCP	Signalling Connection Control Part
SCTP	Stream Control Transmission Protocol
SGF	Signalling Gateway Function
SGW	Signalling Gateway
SLF	Subscription Locator Function
TDM	Time Division Multiplexing
TE	Terminal Equipment
TGW	Trunking GateWay
THIG	Topology Hiding Gateway
T-MGF	Trunking Media Gateway Function
UE	User Equipment
UPSF	User Profile Server Function

4 Overall architecture

The NGN functional architecture described in the present document complies with the ITU-T general reference model for next generation networks [2] and is structured according to a service layer and an IP-based transport layer.

The service layer comprises the following components:

- the core IP Multimedia Subsystem (IMS);
- the PSTN/ISDN Emulation Subsystem (PES);
- other multimedia subsystems (e.g. streaming subsystem, content broadcasting subsystem etc.) and applications;
- common components (i.e. used by several subsystems) such as those required for accessing applications, charging functions, user profile management, security management, routing data bases (e.g. ENUM), etc.

This subsystem-oriented architecture enables the addition of new subsystems over the time to cover new demands and service classes. It also provides the ability to import (and adapt) subsystems defined by other standardization bodies.

IP-connectivity is provided to NGN user equipment by the transport layer, under the control of the network attachment subsystem (NASS) and the resource and admission control subsystem (RACS). These subsystems hide the transport technology used in access and core networks below the IP layer.

The architecture described in the present document and related subsystems specifications is a functional architecture. Each subsystem is specified as a set of functional entities and related interfaces. As a result implementers may choose to combine functional entities where this makes sense in the context of the business models, services and capabilities being supported. Where functional entities are combined the interface between them is internal, is hidden and un-testable.

Figure 1 provides an overview of the NGN architecture. An example of realization of this functional architecture, with an xDSL-based access network is provided in annex A.

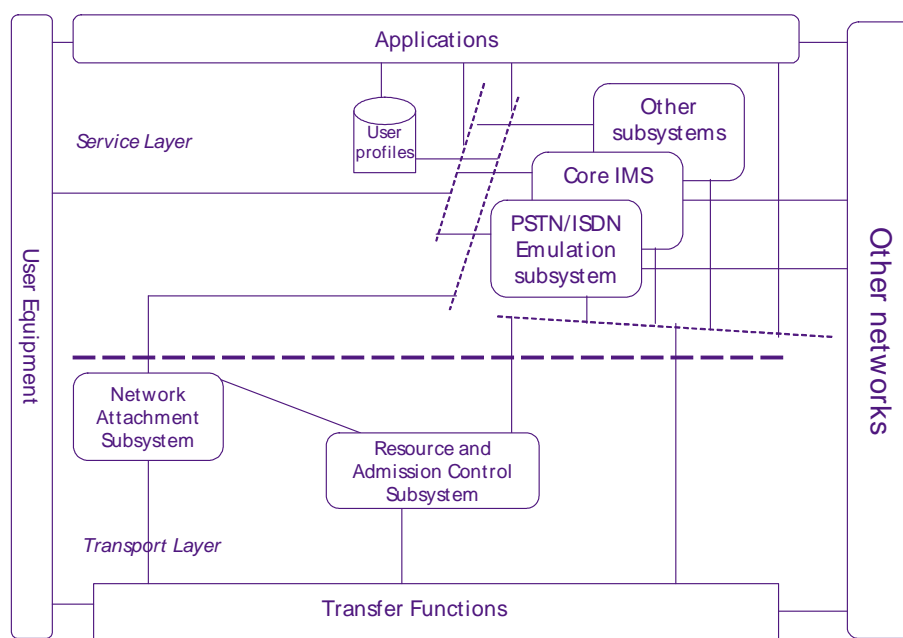


Figure 1: TISPAN NGN overall architecture

The functional entities that make up a subsystem may be distributed over network/service provider domains (see figure 2). The network attachment subsystem may be distributed between a visited and a home network. Service-layer subsystems that support nomadism may also be distributed between a visited and a home network.

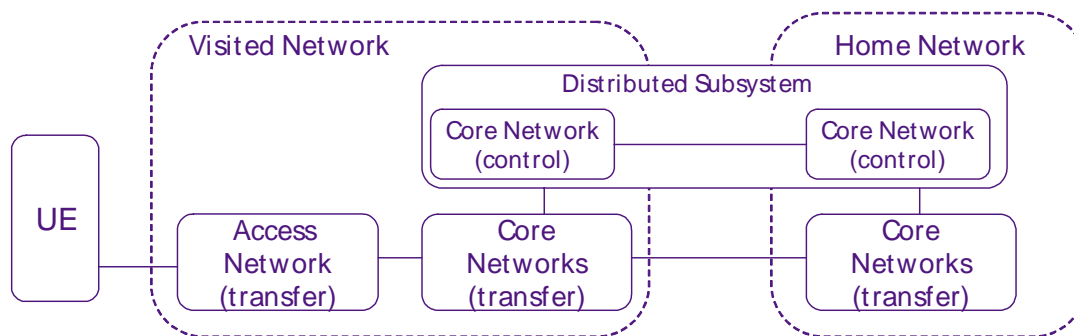


Figure 2: Distributed subsystems

This architecture supports the service capabilities and requirements identified in TS 181 006.

5 Transport layer

The transport layer comprises a transport control sub layer on top of transfer functions. The transport control sub layer is further divided in two subsystems:

- the Network Attachment Subsystem (NASS);
- the Resource and Admission Control Subsystem (RACS).

5.1 Transport control sub layer

5.1.1 Network Attachment Subsystem (NASS)

The Network Attachment Subsystem provides the following functionalities:

- dynamic provision of IP addresses and other terminal configuration parameters;
- authentication taking place at the IP layer, prior or during the address allocation procedure;
- authorization of network access based on user profiles;
- access network configuration based on user profiles;
- location management taking place at the IP layer.

The Release 1 NGN architecture does not mandate a single NASS instance to support multiple access networks. This does not prevent operators from deploying NASS functions that are common to multiple access networks (e.g. one user profile database common to different access networks).

NOTE: The user profiles mentioned above are related to the access subscription only.

Further details about the functionalities and architecture of the NASS can be found in ES 282 004 (see bibliography).

5.1.2 Resource and Admission Control Subsystem (RACS)

The Resource and Admission Control Subsystem (RACS) provides admission control and gate control functionalities (including the control of NAPT and priority marking). Admission control involves checking authorization based on user profiles held in the access network attachment subsystem, on operator specific policy rules and on resource availability. Checking resource availability implies that the admission control function verifies whether the requested bandwidth is compatible with both the subscribed bandwidth and the amount of bandwidth already used by the same user on the same access, and possibly other users sharing the same resources.

Further details about the functionalities and architecture of the RACS are defined in ES 282 003 (see bibliography).

5.2 Transfer functions

Modelling of transfer functions in the present document is limited to aspects which are visible to other components of the architecture. Only the functional entities that may interact with the transport control sub layer or the service layer are visible in the transfer sub layer model. These are:

- Media Gateway Function (MGF);
- Border Gateway Function (BGF);
- Access Relay Function (ARF);
- Signalling Gateway Function (SGF);
- Media Resource Function Processor (MRFP);
- Layer 2 Termination Function (L2TF).

Figure 3 provides an overview of the transfer functions and their relationships to the other components of the architecture.

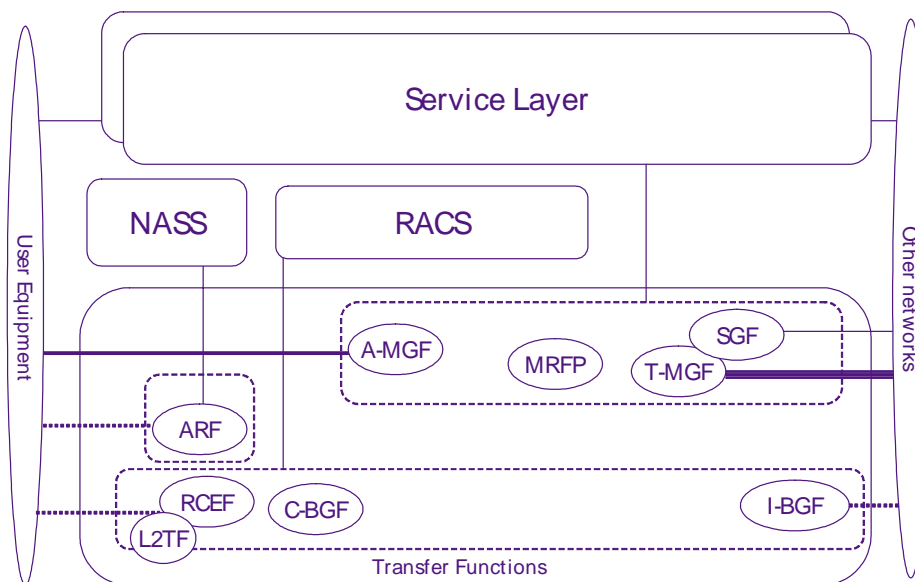


Figure 3: Transfer functions overview

5.2.1 Border Gateway Function (BGF)

A Border Gateway Function (BGF) provides the interface between two IP-transport domains. It may reside at the boundary between an access network and the customer premises equipment, between an access network and a core network or between two core networks. It supports one or more of the following functionalities:

- opening and closing gates (i.e. packets filtering depending on "IP address / port");
- allocation and translation of IP addresses and port numbers (NAPT);
- interworking between IPv4 and IPv6 networks (NAPT-PT);
- topology hiding;
- hosted NAT traversal;
- packet marking for outgoing traffic;
- resource allocation and bandwidth reservation for upstream and downstream traffic;

- policing of incoming traffic;
- antispoofing of IP addresses;
- usage metering.

A BGF may interact with entities in the transport control sub layer for the purpose of controlling one or more of the functionalities it implements.

The present document identifies two main types of BGF:

- the Core BGF (C-BGF) that sits at the boundary between an access network and a core network, at the core network side;
- the Interconnection BGF (I-BGF) that sits at the boundary between two core networks.

Each of these BGF implement different subsets of the functionalities identified for a generic BGF, depending on their location and network operators' policies.

In addition, the present document identifies a specific type of BGF known as Resource Control Enforcement Function (RCEF) that sits in an access network or at one of its edges. This functional entity implements a reduced subset of the functionalities identified for a generic BGF and holds a model of the access network resources.

Further details are available in the RACS specification ES 282 003 (see bibliography).

NOTE: The I-BGF encompasses the functionality of the Translation Gateway defined in TS 123 228 [4].

5.2.2 Layer 2 Termination Function (L2TF)

The Layer 2 Termination Function (L2TF) terminates the "Layer 2" procedures of the access network.

5.2.3 Access Relay Function (ARF)

The Access Relay Function (ARF) acts as a relay between the user equipment and the Network Attachment Subsystem (NASS). It receives network access requests from the user equipment and forwards them to the NASS. Before forwarding a request, the ARF may also insert local configuration information and apply protocol conversion procedures.

NOTE: When using PPP, the Access Relay Function implements the interworking between PPP and the RADIUS protocol. When using DHCP, the ARF acts as a DHCP Relay Agent and may add information before forwarding a message (e.g. insertion of the identity of the ATM Virtual Channel carrying the IP traffic in a DHCP request).

5.2.4 Media Gateway Function (MGF)

A Media Gateway Function (MGF) provides the media mapping and/or transcoding functions between an IP-transport domain and switched circuit network facilities (trunks, loops). It may also perform media conferencing and send tones and announcements.

The present document identifies three types of MGF:

- the Residential MGF (R-MGF), located in customer premises;
- the Access MGF (A-MGF) that sits in the network operator's premises in the IP access network or in the core network;
- the Trunking MGF (T-MGF) that sits at the boundary between an IP core network and the PSTN/ISDN.

The R-MGF and A-MGF provide access to the services of the PSTN/ISDN Emulation subsystem.

NOTE: The T-MGF functional entity is identical to the IMS-MGW defined in TS 123 002 [3], although a network node implementing this functional entity in an NGN network and a network node implementing it in a 3GPP network may differ in terms of supported resources (e.g. codecs) and configuration.

5.2.5 Media Resource Function Processor (MRFP)

A Media Resource Function Processor (MRFP) provides specialized resource processing functions beyond those available in media gateway functions. This includes resources for supporting multimedia conferences, sourcing multimedia announcements, implementing IVR capabilities and media content analysis.

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

5.2.6 Signalling Gateway Function (SGF)

The Signalling Gateway Function (SGF) performs the signalling conversion (both ways) at transport level between the SS7 based transport of signalling and IP based signalling transport. The functionality of the SGF encompasses:

- reliable transport of SS7 upper layer signalling over IP, using SCTP procedures [1];
- SS7 firewall functionality - as far as applicable - by screening within MTP and SCCP headers.

NOTE: This functional entity is identical to the SGW defined in TS 123 002 [3], although a network node implementing this functional entity in an NGN network and a network node implementing it in a 3GPP network may differ in terms of configuration.

6. Service Layer Model

6.1 The "Core" IP Multimedia Subsystem (IMS)

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

NOTE: The "Core IMS" is a subset of the 3GPP IMS defined in TS 123 002 [3] which is restricted to the session control functionalities. Application Servers (AS) and transport/media related functions such as the Multimedia Resource Function Processors (MRFP) and the IMS Media Gateway function (IMS-MGW) are considered to be outside the "Core IMS".

The architecture of this subsystem is further described in ES 282 007 (see bibliography).

6.2 The PSTN/ISDN Emulation subsystem (PES)

The PSTN/ISDN Emulation Subsystem supports the emulation of PSTN/ISDN services for legacy terminals connected to the NGN, through residential gateways or access gateways.

Further details about the functionalities and architecture of the PSTN/ISDN emulation subsystem can be found in ES 282 002 (see bibliography).

6.3 The Streaming Subsystem

The Streaming Subsystem supports the provision of RTSP-based streaming services to NGN terminals.

The architecture of the streaming subsystem is outside the scope of TISPAN NGN Release 1.

6.4 The Content Broadcasting Subsystem

The Content Broadcasting Subsystem supports the broadcasting of multimedia content (e.g. movies, TV channels etc.) to groups of NGN terminals.

The architecture of the content broadcasting subsystem is outside the scope of TISPAN NGN Release 1.

6.5 Common components

The NGN architecture includes a number of functional entities that can be accessed by more than one subsystem. These are:

- the User Profile Server Function (UPSF);
- the Subscription Locator Function (SLF);
- the Application Server Function (ASF);
- the Interworking Function (IWF);
- the Interconnection Border Control Function (IBCF); and
- Charging and Data Collection Functions.

Figure 4 provides an overview of the common components and their relationships to the other elements of the architecture.

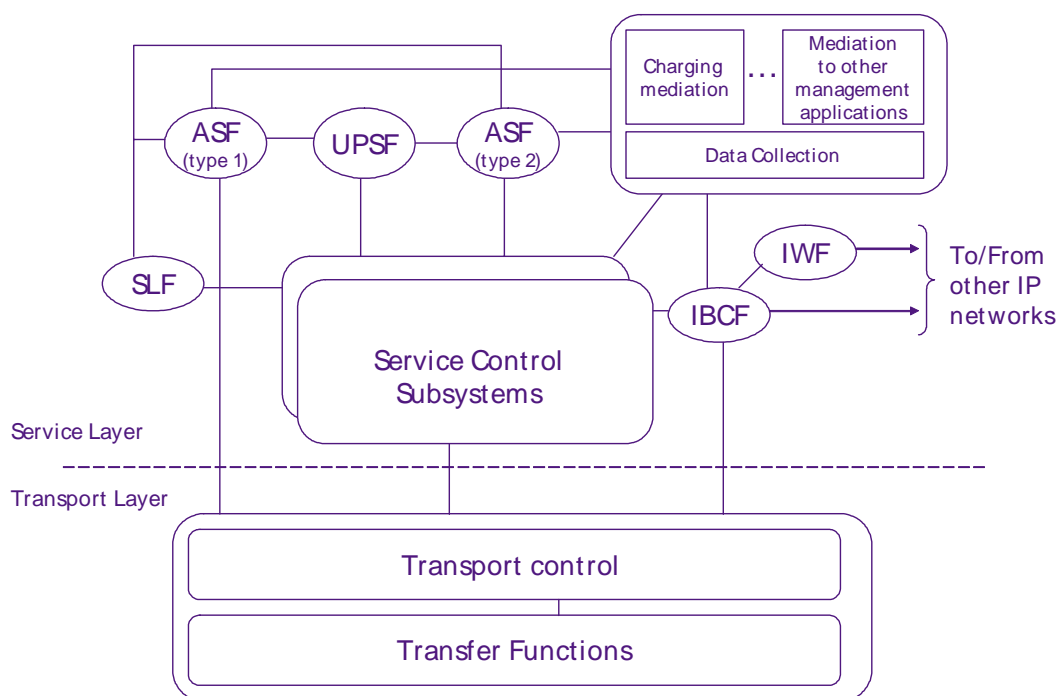


Figure 4: Common components overview

6.5.1 User Profile Server Function (UPSF)

The User Profile Server Function (UPSF) is responsible for holding the following user related information:

- Service-level user identification, numbering and addressing information.
- Service-level user security information: access control information for authentication and authorization.
- Service-level user location information at inter-system level: the UPSF supports the user registration, and stores inter-system location information, etc.
- Service-level user profile information.

The UPSF may store user profile information related to one or more service control subsystems and applications.

The UPSF does not contain profile information related to IP connectivity subscriptions. Such information is held in the Network Attachment Subsystem (NASS). However, where it makes sense in the context of a particular business model, the UPSF may be co-located with the data base function of the NASS.

NOTE: The subset of the UPSF hosting IMS-related data is equivalent to the subset of the HSS entity defined in TS 123 002 [3], excluding the HLR/AUC functionality.

6.5.2 Subscription Locator Function

The Subscription Locator Function (SLF) is a functional entity that can be accessed by service control subsystems and Application Server Functions to retrieve the identity of the UPSF containing the service-level user profile of a particular subscriber.

NOTE: This functional entity is identical to the SLF defined in TS 123 002 [3], although a network node implementing this functional entity in an NGN network and a network node implementing it in a 3GPP network may differ in terms of supported identity formats.

6.5.3 Application Server Function (ASF)

An Application Server Function (ASF) offers value added services and resides either in the user's home network or in a third party location. The third party could be a network or simply a stand-alone AS.

Application Server Functions may provide standalone services or value added services on top of a basic session. For resource control purposes, the first category of Application Server Functions (ASF Type 1) may interact with the RACS, while the second category (ASF Type 2) relies on the control subsystem that provide the basic session over which the valued added service is built (see figure 4).

Examples of Application Server Functions are SIP Application Servers and OSA Application Servers. Further details about which type of Application Server Function can interact with a particular subsystem can be found in the specification of each subsystem.

NOTE: When sitting on top of the IMS, the second type of ASF is identical to the Application Server (AS) function defined in TS 123 002 [3], although a network node implementing this functional entity in an NGN network and a network node implementing it in a 3GPP network may differ in terms of supported services.

6.5.4 Charging and Data Collection Functions

Charging and Data Collection functions include data collection functions and mediation functions to the billing systems (for supporting both on-line and off-line charging) or other management applications that may use the same data.

The specification of a generic architecture of the charging and data collection functions is outside the scope of TISPAN NGN Release 1.

Further details on the use of charging and data collection functions can be found in the specification of each subsystem.

6.5.5 Interworking Function (IWF)

The Interworking Function (IWF) performs the interworking between protocols used within TISPAN NGN service control subsystems and other IP-based protocols (e.g. between the SIP profile used in the IMS and other SIP profiles or IP-based protocols such as the H.323 protocol).

6.5.6 The Interconnection Border Control Function (IBCF)

The Interconnection Border Control Function (IBCF) controls the boundary between two operators' domains. The functionality of the IBCF encompasses:

- interaction with transport resources, through the resource and admission control subsystem (including NAPT and firewall functions);
- insertion of the IWF in the signalling route when appropriate;
- screening of signalling information based on source/destination, beyond what is already performed inside each of the subsystems (e.g. by the THIG functionality of the I-CSCF for the IMS core subsystem).

NOTE: When interacting with the IMS component of the architecture, the IBCF encompasses the functionality of the Application Layer Gateway defined in TS 123 228 [4].

7 Interconnection with other networks/domains

7.1 Interconnection at the transport layer

7.1.1 Transfer Sub layer

Interconnection at the transfer level takes place either with TDM-based networks through T-MGF and SGF entities or with IP-based networks, at the Iz reference point, through an I-BGF entity (see figure 5).

Interconnection with SS7-based networks only applies to the IMS and PSTN/ISDN Emulation subsystems. In such cases, the service layer controls the T-MGF entity behaviour.

Interconnection with IP-based networks depends on the subsystems involved. The I-BGF may behave autonomously or under the control of the service layer, through the RACS, for services that involves the IMS core component or the PSTN/ISDN Emulation subsystem. Future releases of the TISpan specifications will address the control of the I-BGF in other configurations.

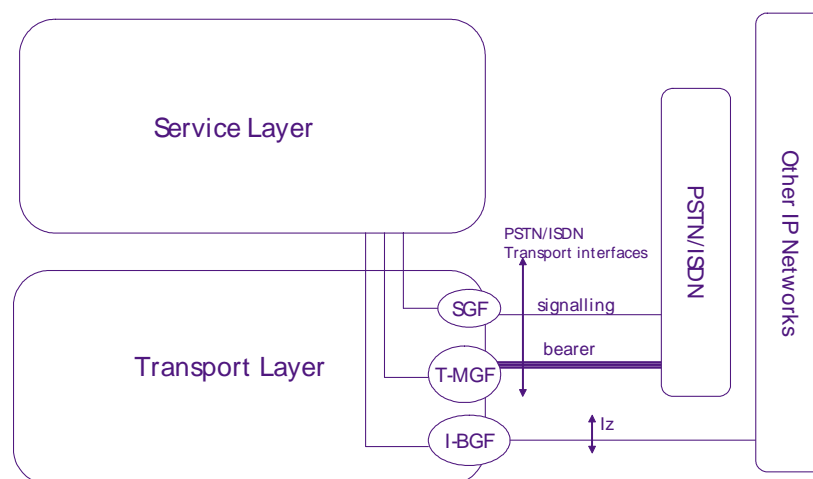


Figure 5: Network interconnection at transfer level

7.1.2 NASS

Interconnection at the NASS level is required for supporting nomadism and is further described in the NASS specification ES 282 004 (see bibliography).

7.1.3 RACS

Interconnection between RACS subsystems is outside the scope of TISpan NGN Release 1.

7.2 Interconnection at the Service Layer

Interconnection at the service layer can take place either with SS7-based networks or IP-based networks. Interconnection with SS7-based networks only applies to the IMS and PSTN/ISDN Emulation subsystems, both of which include appropriate functionality to interact with the T-MGF and the SGF.

Interconnection with IP-based networks depends on the subsystems involved. IP-based interconnection to/from the IMS core component or the PSTN/ISDN Emulation subsystem is performed using the IBCF entity and possibly the IWF entity. (See figure 6.) Direct interconnection between other types of subsystems or applications is outside the scope of TISpan R1. IP-based interconnection with external networks supporting a TISpan-compatible version of SIP is performed at the Ic reference point, via the IBCF. Interconnection with external networks supporting H.323 or a non-compatible version of SIP is performed at the Iw reference point, via the IWF. The IBCF and the IWF communicate via the Ib reference point. The IBCF and the IWF communicate via the Ib reference point.

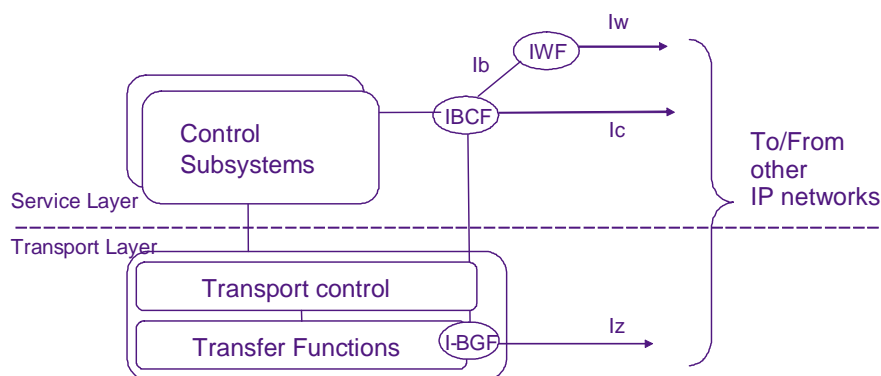


Figure 6: IP Interconnection

8 User Equipment (UE)

The User Equipment (UE) consists of one or more user controlled devices allowing a user to access services delivered by NGN networks. Different components of the customer equipment may be involved depending on the subsystem they interact with. This is further described in each subsystem specification.

8.1 Authentication

Two levels of network identification/authentication are available in the NGN architecture (see figure 7), namely at the level of the network attachment (between UE and NASS) and at the service layer level (NGN Service control subsystems and applications).

At the NGN service layer, application level user authentication is applied. This type of authentication is performed between the UE and the NGN service subsystems / applications and shall be based on the user identity that is relevant at the level of these subsystems/applications. An example of this type of authentication is the user authentication performed by the IMS. Further details are available in the specification of each subsystem.

At the network attachment level, network level authentication is applied. This type of authentication shall be based on implicit or explicit user identity and authentication credentials stored in the NASS ES 282 004 (see bibliography).

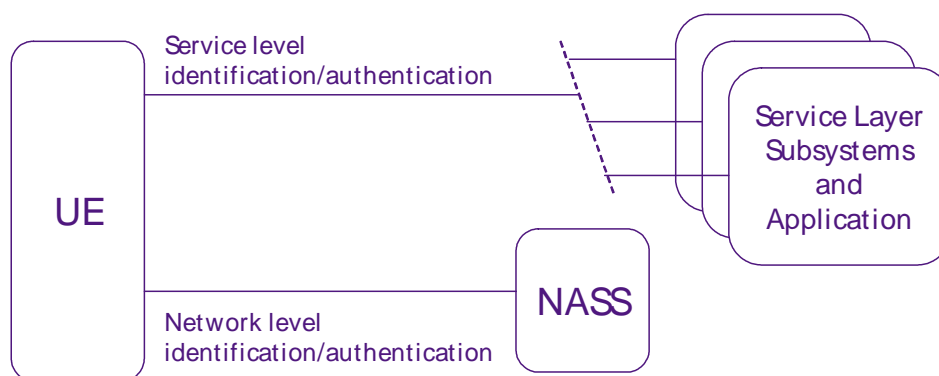


Figure 7: NGN Authentication Levels

8.2 Interfaces

8.2.1 Interfaces to the core IMS

Access to the services of the IP Multimedia Subsystem is provided to SIP-based terminals.

Further details are described in the IMS specification ES 282 007 (see bibliography).

8.2.2 Interfaces to the PSTN/ISDN Emulation subsystem

Access to the services of the PSTN/ISDN Emulation subsystem is provided to legacy terminals through a gateway function, which may reside in customer premises or in the operator's domain. Further details are described in the PSTN/ISDN Emulation subsystem specification.

8.2.3 Interfaces with applications

Interactions with SIP Application Servers take place through the Ut interface. This interface enables the user to manage information related to his services, such as creation and assignment of Public Service Identities, management of authorization policies that are used e.g. by Presence service, conference policy management, etc.

Support of interactions with other types of Application Server Functions is outside the scope of TISPAN NGN Release 1.

8.2.4 Interfaces with the NASS

These interfaces enable the user equipment to attach to the network and received configuration information. Signalling between the UE and the NASS may be relayed via the ARF in the transfer sub-layer. These interfaces are further defined in the NASS specification ES 282 004 (see bibliography).

8.2.5 Interface with the RACS

This interface is outside the scope of TISPAN NGN Release 1.

Annex A (informative): Example of physical configuration for xDSL access

The following figure illustrates a possible realization of the TISPAN NGN functional architecture, with an xDSL-based access network.

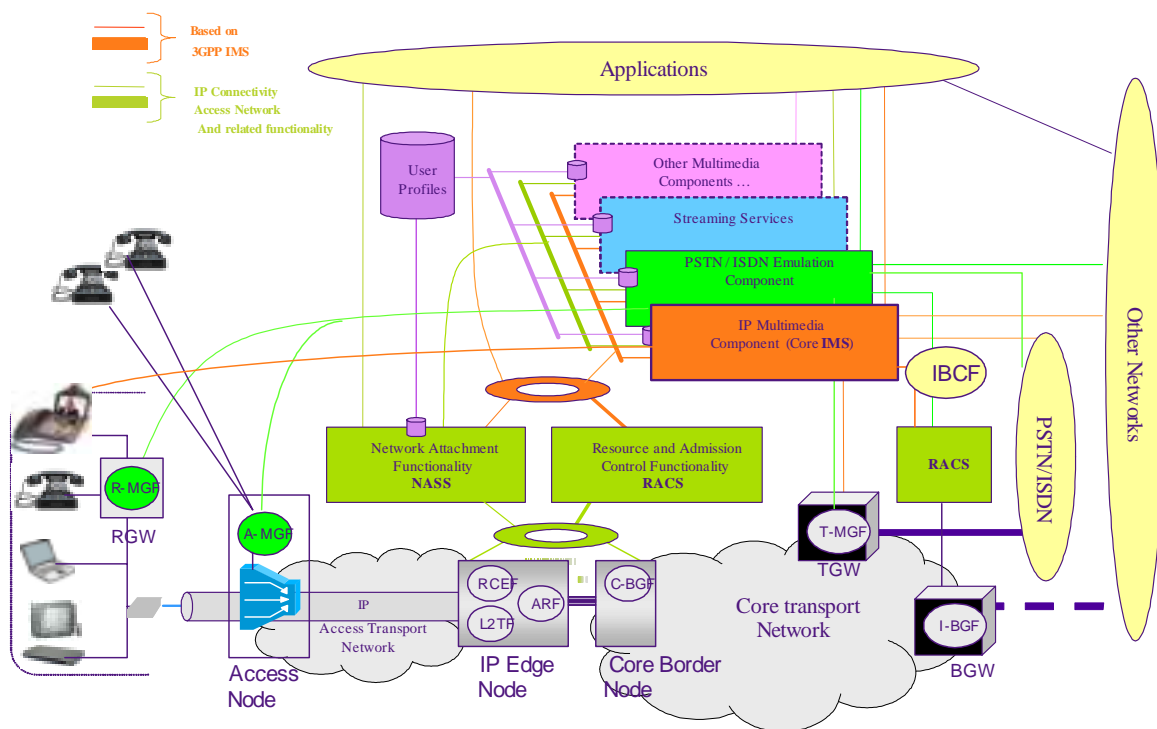


Figure A.1: Example architecture with xDSL access

This configuration assumes the following:

- A Border Gateway Function (C-BGF) is implemented in a Core Border Node sitting at the boundary between the access network and a core network, at the core network side.
- A Resource Control and Enforcement Function (RCEF) is implemented in an IP Edge node sitting at the boundary between core networks, at the access network side. In this example, this node also implements the L2TF and ARF functional entities.
- A Border Gateway Function (I-BGF) is implemented in a Border Gateway (BGW) sitting at the boundary with other IP networks.
- A Media Gateway Function (T-MGF) is implemented in a Trunking media Gateway (TGW) at the boundary between the core network and the PSTN/ISDN.
- A Media Gateway Function (A-MGF) is implemented in an Access Node (AN) which also implements a DSLAM.
- A Media Gateway Function (R-MGF) is implemented in a Residential media Gateway (RGW) located in the customer premises.

Annex B (informative): Bibliography

- ETSI ES 282 004: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture; Network Attachment Sub-System (NASS)".
- ETSI ES 282 003: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Release 1: Functional Architecture; Resource and Admission Control Sub-system (RACS)".
- ETSI ES 282 007: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Release 1; Core IMS architecture".
- ETSI ES 282 002: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Release 1: Functional architecture for PSTN/ISDN Emulation".
- ETSI TS 181 006: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Services and Capabilities Requirements for TISPAN NGN Release 1".

History

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