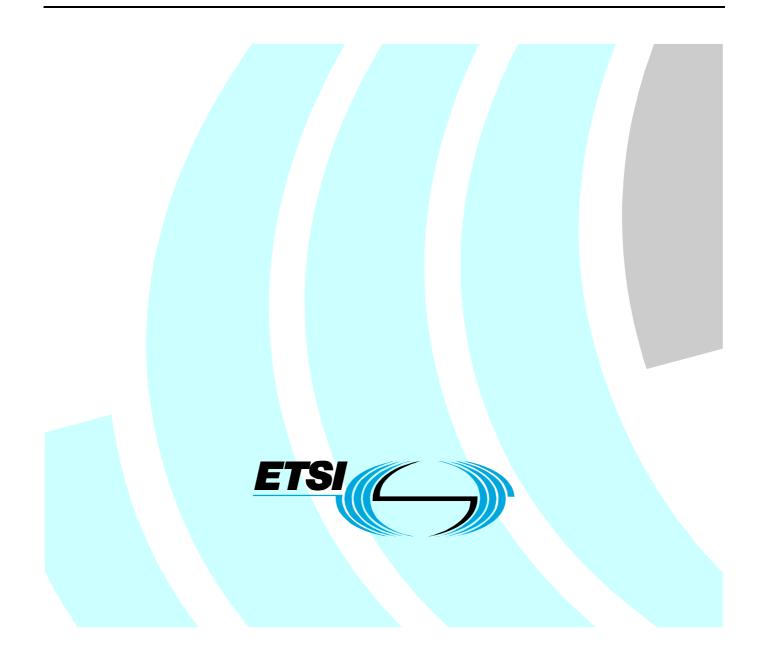# ETSI ES 282 001 V2.0.0 (2008-03)

ETSI Standard

Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture

ETSI

Reference

RES/TISPAN-02046-NGN-R2

Keywords

architecture, functional

ETSI

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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

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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 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 version 7.3.1)".

[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)".

[5] ETSI ES 282 004: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture; Network Attachment Sub-System (NASS)".

[6] ETSI ES 282 003: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control Sub-system (RACS); Functional Architecture".

[7]   ETSI ES 282 007: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Subsystem (IMS); Functional architecture".

[8]   ETSI ES 282 002: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); PSTN/ISDN Emulation Sub-system (PES); Functional architecture".

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

[10]   ETSI TS 182 027: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IPTV Architecture; IPTV functions supported by the IMS subsystem".

[11]   ETSI TS 182 028: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IPTV Architecture; Dedicated subsystem for IPTV functions".

[12]   ETSI TS 185 003: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); TISPAN CNG Architecture and Interfaces and Reference Points;".

[13]   ETSI TS 185 006: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); TISPAN Customer Devices architecture and interfaces".

[14]   ETSI TS 181 006: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Direct Communication Service in NGN; Service Description [Endorsement of OMA-ERELD-PoC-V1]".

[15]   ITU-T Recommendation G.8010: "Architecture of Ethernet layer networks".

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: one or more devices allowing a user to access services delivered by TISPAN NGN networks

NOTE: This includes devices when under user control commonly referred to as IAD, ATA, RGW, TE, etc., UE does not include network controlled entities such as network terminations and 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
BNG	Broadband Network Gateway
BRAS	Broadband Remote Access Server
BTF	Basic Transport Function
C-BGF	Core Border Gateway Function
CND	Customer Network Device
CNG	Customer Network Gateway
CPN	Customer Premises Network
CSCF	Call Session Control Function
DHCP	Dynamic Host Configuration Protocol
DSLAM	Digital Subscriber Line Access Multiplexer
ENUM	tElephone NUmber Mapping
ECF	Elementary Control Function
EFF	Elementary Forwarding Function
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
IGMP	Internet Group Management Protocol
IMS	IP Multimedia Subsystem
IMS-MGW	IMS-Media Gateway
IP	Internet Protocol
ISDN	Integrated Services Digital Network
IVR	Interactive Voice Response
IWF	InterWorking Function
MGCF	Media Gateway Control Function
MGF	Media Gateway Function
MLD	Multicast Listener Discovery
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
PIM	Protocol Independent Multicast
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
SGCF	Signalling Gateway Control Function
SGF	Signalling Gateway Function
SGW	Signalling GateWay
SLF	Subscription Locator Function
TDM	Time Division Multiplexing
TE	Terminal Equipment
TGCF	Trunking GateWay Function
TGW	Trunking 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. IPTV Dedicated Subsystem) 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.
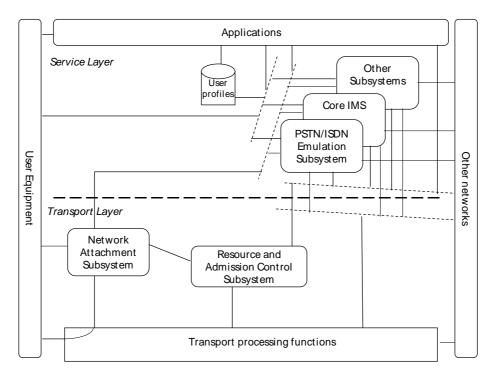

Figure 1: TISPAN NGN overall architecture

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.
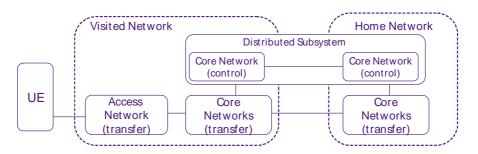

Figure 2: Distributed subsystems

This architecture supports the service capabilities and requirements identified in TS 181 006 [14].

An access network comprises an access segment and an aggregation segment (figure 2a). The access segment (also known as "last mile segment" stretches from the customer premises to the first network node (also known as the "access node"). The aggregation segment comprises the transport network elements enabling one or more access nodes to be connected to a core network through an IP Edge Router, at the Di reference point.

NOTE: In configurations where the access segment uses the DSL technology, the aggregation segment generally uses ATM or Giga Ethernet. The IP Edge is known as a Broadband Remote Access Server (BRAS) or Broadband Network Gateway (BNG).

Figure 2a: Access and aggregation segments

5   Transport layer

The transport layer comprises a transport control sublayer on top of transport processing functions in the access and core networks. Equivalent functionality in the User Equipment is defined in clause 8.

The transport control sublayer is further divided in two subsystems:

- the Network Attachment Subsystem (NASS);

- the Resource and Admission Control Subsystem (RACS).

5.1 Transport control sublayer

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 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.

The NASS interfaces with the following entities (see figure 2b):

- the user equipment at the e3 reference point for configuration purposes;

- transport processing entities acting as relays to/from the user equipment for address allocation, authentication and authorization purposes (a1 and a3 reference points);

- the Resource and Admission Control Subsystem at the e4 reference point for exporting subscriber access profile information;

- service-control subsystems and applications in the service layer at the e2 reference point for exporting information on access sessions and supporting notification services.
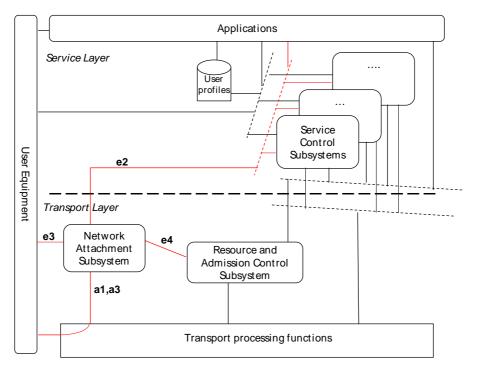

Figure 2b: NASS external reference points

Further details about the functionalities and architecture of the NASS can be found in ES 282 004 [5].
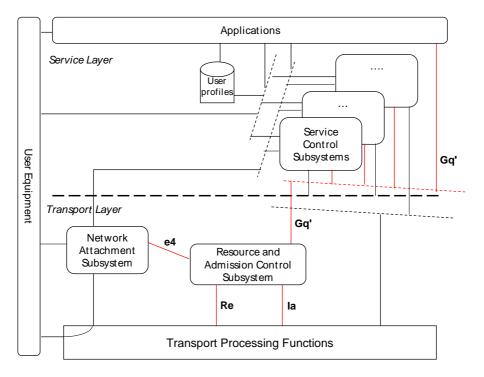
5.1.2   Resource and Admission Control Subsystem (RACS)

RACS is the TISPAN NGN subsystem responsible for the implementation of procedures and mechanisms handling policy-based resource reservation and admission control for both unicast and multicast traffic in access networks and core networks.

Besides acting as a resource control framework, RACS also includes support for controlling Network Address Translation (NAT) at the edge of networks and assisting in remote NAT traversal. Furthermore, RACS also covers aspects related to the setting and modification of traffic policies, end to end quality of service and transport-level charging.

The RACS interfaces with transport processing functions at the Re and Ia reference points and with the following subsystems (see figure 2c):

- The Network Attachment Subsystem at the e4 reference point for obtaining subscriber access profile information.

- Service-control subsystems and applications in the service layer at the Gq' reference point for exposing the services it provides.

Figure 2c: RACS external reference points

Further details about the functionalities and architecture of the RACS are defined in ES 282 003 [6].

5.2   Transport processing functions

Transport processing functions in the access and core networks include basic elementary functions supporting packet forwarding and routing, and more specific group of functions defined as functional entities.

These are:

- Media Gateway Function (MGF).

- Border Gateway Function (BGF).

- Resource Control Enforcement Function (RCEF).

- Access Relay Function (ARF).

- Signalling Gateway Function (SGF).

- Media Resource Function Processor (MRFP).

- Access Management Function (AMF).

- Basic Transport Function (BTF).

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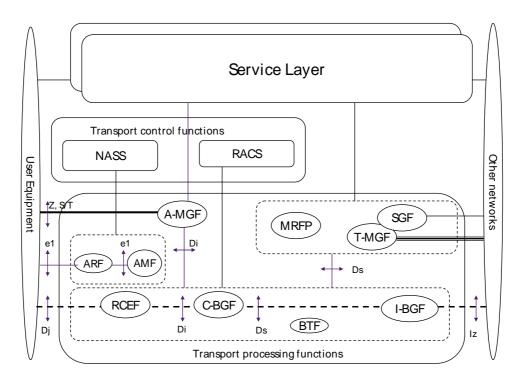

Figure 3: Transport processing functions overview

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 encompasses the functionality of a Resource Control Enforcement Function (RCEF) defined in clause 5.2.1A and may also support one ore more of the following elementary functions:

- usage metering;

- allocation and translation of IP addresses and port numbers (NAPT);

- interworking between IPv4 and IPv6 networks (NAPT-PT);

- assistance in hosted NAT traversal; and

- Transcoding (see notes 1 and 2).

   NOTE 1: The BGF is not the only place in the architecture where transcoding may be performed: MRFPs can also perform transcoding.

   NOTE 2: To support this function a BGF needs to be media aware.

A BGF may interact with entities in the transport control sublayer for the purpose of controlling one or more of the functionalities it implements.
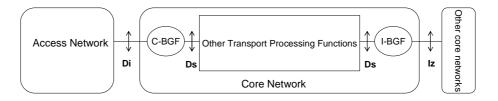
The present document identifies two main types of BGF:

- 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.

The C-BGF interfaces access networks at the Di reference point and other transport processing functions of the core network at the Ds reference point.

The I-BGF interfaces other core networks at the Iz reference point and other transport processing functions of the core network at the Ds reference point.

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

Figure 3a: Border Gateway Control Functions

Further details are available in the RACS specification ES 282 003 [6].

NOTE 3: The C-BGF and the I-BGF encompass, respectively, the functionality of the IMS Access Gateway and of the Translation Gateway defined in TS 123 228 [4].

5.2.1A Resource Control Enforcement Function (RCEF)

A Resource Control Enforcement Function (RCEF) is a transport processing functional entity that supports one or more of the following elementary functions:

- opening and closing gates (i.e. packets filtering depending on "IP address/port");

- packet marking for outgoing traffic;

- policing of incoming traffic;

- resource allocation for upstream and downstream traffic.

An RCEF can reside in any transport segment (i.e. access, aggregation, or core) or at its edges. Multiple RCEF instances may exist in the same transport segment.

A RCEF may interact with entities in the RACS for the purpose of controlling one or more of the elementary functions it implements (see ES 282 003 [6] for more details). It can receive/send information flows from/to a BTF and handle corresponding requests/answers to/from the RACS.

NOTE: Interaction with the RACS from an RCEF in a core segment is not further standardized in the present TISPAN release.

5.2.2 Void

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.

NOTE: When using PPP, the ARF may act as a PPPoE relay. When using DHCP, the ARF acts as a DHCP Relay
          Agent.

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 two types of MGF that may exist in the operator's network:

- the Access MGF (A-MGF) that connects legacy access types (e.g. analogue or ISDN) to the NGN;

- the Trunking MGF (T-MGF) that sits at the boundary between an IP core network and a Circuit-Switched
  network.

NOTE 1:   An MGF may also be embedded in the user equipment (see clause 8). This type of MGF is known as a
          Residential MGF (R-MGF).

NOTE 2:   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.

5.2.7   Access Management Function (AMF)

The Access Management Function (AMF) translates network access requests issued by the UE into a format that can be
understood by the NASS.

NOTE: In case PPP is applied, the AMF terminates the PPP connection and provides the inter-working with the
          interface to the network attachment subsystem e.g. using an AAA protocol (RADIUS or Diameter).

5.2.8   Basic Transport Function (BTF)

All transport segments comprise one or more basic transport functions (BTF) which contain two elementary transport
processing functions: Elementary Forwarding Functions (EFF) and Elementary Control Functions (ECF). Physical
network elements (e.g. a bridge, a router etc.) - typically contain a BTF and might contain additional functional entities,
e.g. RCEF.

Figure 3b shows the BTF, the elementary functions comprising the BTF as well as the relation to other functional entities of the NGN. Reference points BTF-BTF, RCEF-BTF, and BGF-BTF are outside the scope of the standardization of NGN Release 2 due to their implementation specific nature and the fact that some of which are typically internal to a device.
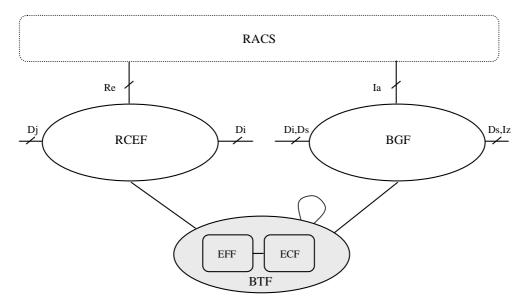

Figure 3b: Transport Function (TF) in the context of other functional entities of the NGN

5.2.8.1   Elementary Forwarding Function (EFF)

An Elementary Forwarding Function (EFF) forwards traffic data received on one flow point "In-FP" (flow point is used here similar to ITU-T Recommendation G.8010 [15]) to one or more flow point(s) "Out-FP(i)", i = 0..n of a transport element; where "In-FP" is not contained within the set of "Out-FP(i), i = 0..n". Consequently, for a unicast type of operation there is exactly one Out-FP (i.e. i = 1), while for multicast type of operation the set of "Out-FP(i)" can contain any number of flow points (including the case where "Out-FP(i)" equals the empty set).

5.2.8.2   Elementary Control Function (ECF)

An Elementary Control Function (ECF) processes control protocol data (e.g. routing protocol data) for unicast as well as multicast data received on one flow point. As a result of this processing, the ECF might decide to:

- send control protocol data (including events to trigger policy evaluation) to other ECF;

- interact with one or more EFF to establish new or modify existing forwarding behaviour of the EFF;

- interact with one or more instances of RCEF and/or BGF. This includes the ability to create events to trigger policy evaluation in RCEF and/or BGF.

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 [7].

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 [8] and TS 182 012 [9] which define alternative functional architectures for this subsystem.

6.3   The IPTV Subsystem

The IPTV subsystem supports the provision of content on demand services and broadcast services using a dedicated service control architecture described in TS 182 028 [11].

The TISPAN architecture also enables supporting IPTV services using the IP Multimedia Subsystem (see clause 6.1) as described in TS 182 027 [10].

6.4   Void

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).

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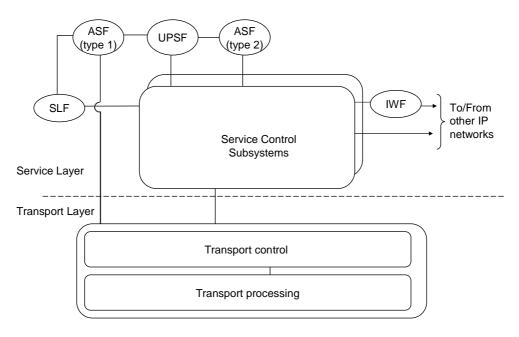

Figure 4: Common components overview

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

- Service-level user location information.

- 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.

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 (SLF)

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 where the service-level profile of a particular user or public service is available.

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 Void

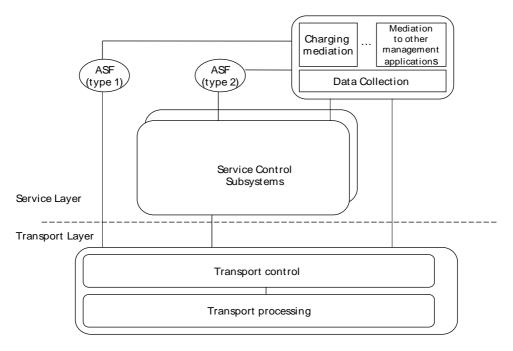## 6.5.5 Interworking Function (IWF)

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).

6A   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 subsystem-independent generic architecture of the charging and data collection functions is outside the scope of TISPAN NGN Release 2.

Functional entities interfacing with Charging and Data Collection functions may exist in both the service layer and the transport layer (see figure 4a). Further details on the use of charging and data collection functions can be found in the specification of each of the subsystems in these layers.

Figure 4a: Charging and Data Collection Functions

7   NGN Interconnection

7.1   General

The functions and reference points available for supporting NGN interconnection are identified in clause 7.2. Various NGN interconnection types may be implemented using these reference points and functions, some of which are described in clause 7.3.

7.2   Interconnection reference points and functions

7.2.1   Interconnection at the transport layer

7.2.1.1   Transport processing sublayer

Interconnection at the transport processing sublayer 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.
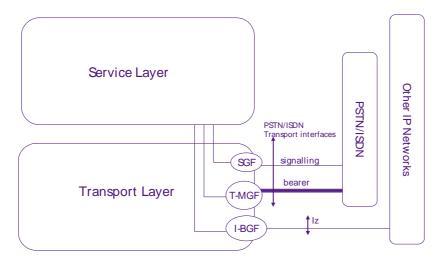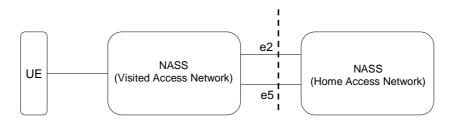
Figure 5: Network interconnection at transfer level

7.2.1.2 NASS

Interconnection at the NASS level is required for supporting nomadism and is further described in the NASS specification ES 282 004 [5].

Interconnection between NASS instances occurs at the e2 and e5 reference points. The e2 reference point enables information on active IP connectivity sessions to be exchanged across networks. The e5 reference point enables distributed execution of user authorization and authentication procedures to take place between a visited network and a home network.
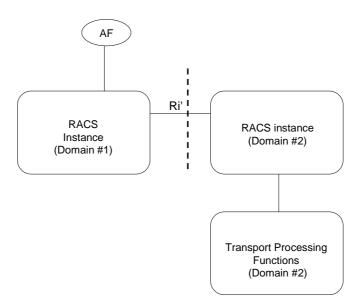
Figure 6: Network interconnection at the NASS level

7.2.1.3 RACS

Interconnection between RACS subsystems may take place at the Ri' reference point.

The resource management model established through the Ri' Reference Point supports a granularity of resource management services at the level of interconnected domains or at the level of application sessions. In the later case, the Ri' reference point is used when an AF can not communicate directly with the RACS of a certain domain but requires reservation of resources in this domain. The RACS in the AF's domain relays the AF requests through the Ri' reference point towards the RACS in the other domain (see figure 6a).

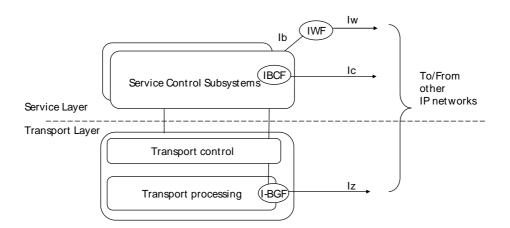**Figure 6a: Network interconnection at the RACS level**

7.2.2   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. Each subsystem includes the appropriate functions in support of interconnection with other domains. These functions typically include, but are not limited to:

- 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; and

- screening of signalling information.

In case of IP-based interconnection to/from the IMS core subsystem or the PSTN/ISDN Emulation subsystem, interconnect functions are embedded in the IBCF (see ES 282 007 [7]). IP-based interconnection with external networks supporting TISPAN-compatible protocol profiles takes place at the Ic reference point. Interconnection with external networks supporting other protocols than those supported by TISPAN NGN or supporting a non-compatible protocol profile takes place at the Iw reference point, via the IWF. The service-control subsystems and the IWF communicate via the Ib reference point (see figure 7). In case of IP-based interconnection to/from the IMS core subsystem or the PSTN/ISDN Emulation subsystem, the IWF may support H.323 to SIP interworking or interworking between the SIP profile used in these subsystems and the SIP profile used in other domains.
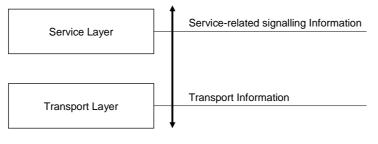
Figure 7: IP Interconnection

7.3   NGN Interconnection types

7.3.1   SoIx in the NGN Architecture

As illustrated in figure 7a, SoIx interconnection is typically characterized by the presence of two types of information exchanged between the two interconnected domains:

- Service-related signalling information, that allows to identify the end-to-end service that has been requested. For example, in case of IMS-to-IMS SoIx interconnection, this is mapped to SIP signalling on the Ic reference point.
- Transport information, that carries the bearer traffic.

SoIX NNI

Figure 7a: SoIx Interconnection architecture and NNI

The presence of the service-related signalling shall be considered mandatory in SoIx interconnection, because it enables the end-to-end service awareness.

An NGN interconnection could be a SoIx even if the transport information is not exchanged between the interconnected domains, as long as service-related signalling is exchanged.

An NGN transport layer interconnection is considered being part of an NGN SoIx interconnection if the transport layer is controlled from the service layer in both of the interconnected domains.

Figure 7b describes the two types of interfaces for the SoIx interconnection reference model:

- **SoIx Interconnection interface** includes at least Ic and Iz reference points between two interconnected domains that have same or compatible service control sub systems/domains.

- **SoIx Interconnection interface with Interworking** includes at least the Iw and Iz reference points between two interconnected domains that have non- compatible service control sub systems/domains.
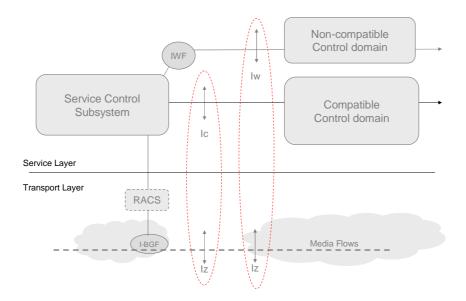
Figure 7b: SoIx interconnection reference model

7.3.2   CoIx in the NGN Architecture

As illustrated in figure 7c, CoIx interconnection is characterized by the absence of the service-related signalling. This implies that there is no end-to-end service awareness in CoIx Interconnection.

CoIx Interconnection can comprise both the following cases:

- CoIx #1, where only transport information, carrying the bearer traffic, is exchanged at the interconnection point. The CoIx#1 NNI corresponds to the Iz reference point.

- CoIx#2, where two types of information are exchanged between the two interconnected domains through the CoIx#2 NNI:

  - Transport control signalling, that does not carry any service-related signalling information;

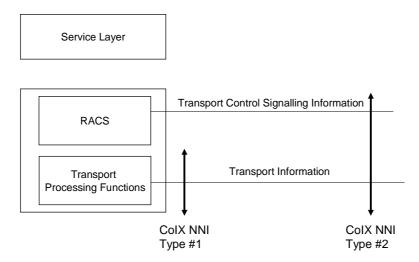 - Transport information, that carries the bearer traffic.

Figure 7c: CoIx Interconnection architecture and NNIs

CoIx interconnection does not involve any functionality in the service layer, and even in those case where some signalling is exchanged at the interconnection point, no end-to-end service information is present in that signalling.

An NGN transport layer interconnection is considered a CoIx interconnection if it is not controlled from the service layer in both of the interconnected domains.

7.3.3   PSTN Interconnection types

Interconnection with PSTN/ISDN networks only applies to the IMS and PSTN/ISDN Emulation subsystems, both of which include the appropriate functional entity required to interact with the T-MGF and the SGF in the transport layer, at the Mn and Ie reference points. The behaviour of the functional entity depends on the type of signalling information used inside the subsystem (SIP, SIP with encapsulated ISUP, SIP with narrowband signalling syntax, etc.). Further details are available in the specifications of these subsystems (ES 282 002 [8], ES 282 007 [7] and TS 182 012 [9]).
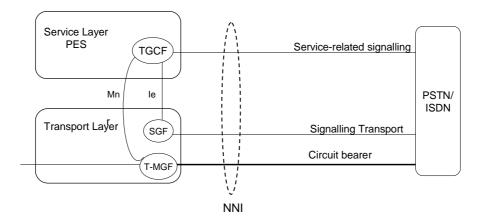
In all cases ISUP messages are exchanged between the subsystem and the PSTN/ISDN through the SGF that provides appropriate transport adaptation between SCTP/IP and MTP.

Figure 7d describes the NNI and the functions involved to establish the interconnection between a PES whose architecture conform to ES 282 002 [8] and a PSTN/ISDN network.
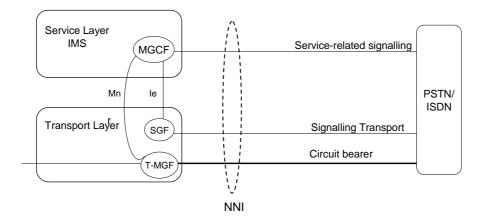
> NOTE 1: ES 282 002 [8] uses slightly different acronyms to represent the SGF and T-MGF functional entities of the transport layer. The SGF is known as a Signalling Gateway Control Function (SGCF) and the T-MGF is simply known as an MGF.

> NOTE 2: At the service layer, the functional entity responsible for the control of the T-MGF and SGF is known as a TGCF when the PES conforms to ES 282 002 [8] or as a MGCF when the PES conforms to ES 282 007 [7].

Figure 7e describes the NNI and the functions involved to establish the interconnection between an IMS or a PES whose architecture conform to TS 182 012 [9] (i.e. IMS-based PES) and a PSTN/ISDN network.

Figure 7d: NNI for Interconnection between ES 282 002 [8] PES subsystem and a PSTN/ISDN network

Figure 7e: NNI for Interworking between an IMS or IMS-based PES and a PSTN/ISDN network

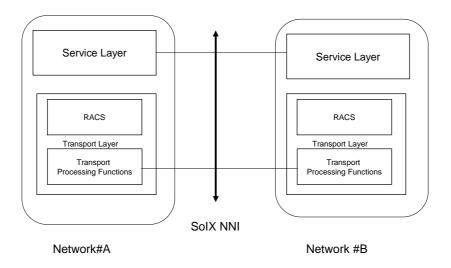## 7.3.4   NGN Direct and Indirect interconnection modes

An NGN interconnection mode can be direct or indirect. Direct interconnection refers to the interconnection between two network domains without any intermediate network domain. Indirect interconnection at one layer refers to the interconnection between two network domains with one or more intermediate network domain(s) acting as transit networks. The intermediate network domain(s) provide(s) transit functionality to the two other network domains.

Different interconnection modes may be used for carrying service layer signalling and media traffic.

All figures in the present clause provide examples of typical interconnection configurations. For the sake of simplicity it is assumed that an NGN domain comprises one network only.

Figures 7f and 7g illustrate respectively the case of a direct SoIx and CoIx interconnection between two NGNs using the principles described in clauses 7.3.1 and 7.3.2.

In the case of SoIx interconnections, where the service layer does not include per session resource signalling capabilities, interconnection at the RACS layer may be required. Independently from the service layer capabilities, interconnection at the RACS layer may also be required for supporting reservation of aggregated transport resources. This is not shown on the figures of the present clause for the sake of simplicity.
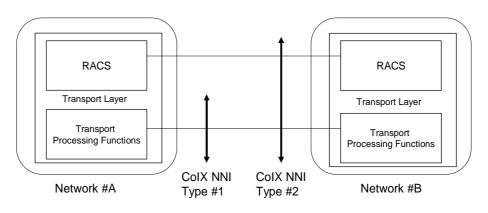
Figure 7f: Direct SoIx Interconnection

Figure 7g: Direct CoIx Interconnection

Figure 7h illustrates the case of an indirect interconnection between two NGNs where each of the networks uses SoIx interconnection with an intermediate domain providing transit services.
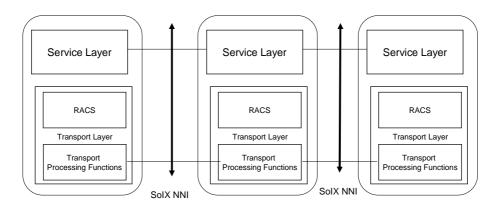
Figure 7h: Indirect SoIx Interconnection

Figure 7i illustrates the case of a hybrid interconnection mode between two NGNs where an intermediate domain intervenes at the service layer only.

NOTE 1:   The direct link between the two transport layer instances carries media traffic. For the sake of simplicity, transport functions required for carrying/relaying service layer signalling are not shown but are assumed to exist in the intermediate domain.
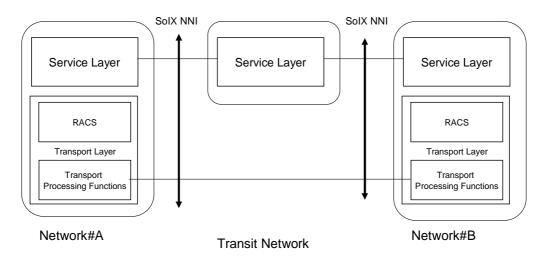

Figure 7i: Indirect Interconnection with service layer intermediary

Figure 7j illustrates the case of a hybrid interconnection mode between two NGNs where an intermediate domain intervenes at the transport layer only on media traffic. There is a SoIx (without media) between the two networks and each of these networks has a CoIx with the intermediate domain.

NOTE 2:   The links crossing the transport layer in the intermediate domain represent media traffic and possibly transport control signalling. For the sake of simplicity, transport functions required for carrying/relaying service layer signalling are not shown explicitly but may exist in intermediate networks. The intermediate networks involved in the transport of service layer signalling may be different from the intermediate networks involved in the transport of media traffic and related transport control signalling.
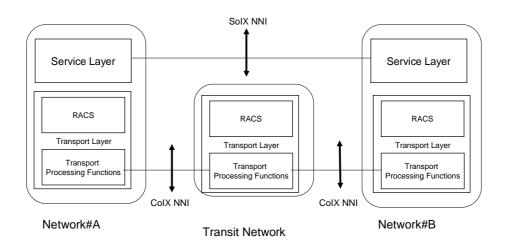

Figure 7j: Indirect Interconnection with transport layer intermediary

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   Overview

The User Equipment may be in the form of a terminal equipment unit (TE) or in the form of a Customer Premises Network (CPN) with one or more Customer Network Devices (CND) connected to a Customer Network Gateway (CNG) as shown on figure 7k.

A CNG may incorporate an MGF known as a Residential MGF (R-MGF) or other gateway functions for the purpose of connecting devices that do not support the protocols required by the network (see clause 5.2.4 for a definition of an MGF).

Further details on the internal structure of a CNG and on customer network devices are available in TS 185 003 [12] and TS 185 006 [13].
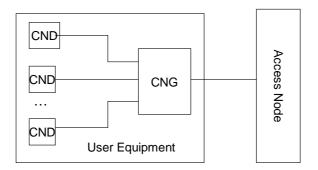

Figure 7k: User Equipment with a CNG

8.2   Authentication

Two levels of network identification/authentication are available in the NGN architecture (see figure 8), 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 [5].
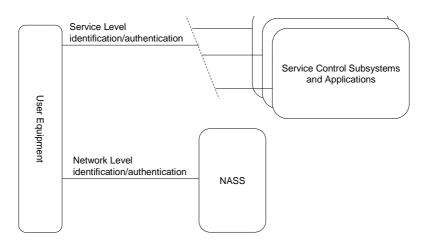
Figure 8: NGN Authentication Levels

8.3   Reference points

Figure 8a provides an overview of the reference points between the User Equipment and the NGN. Further details are provided in the following clauses.
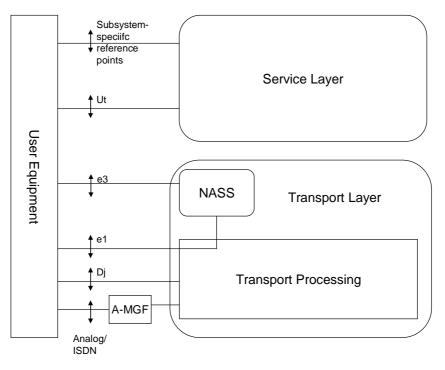

Figure 8a: UE reference points

8.3.1   Reference points to the core IMS

Access to the services of the IP Multimedia Subsystem is provided to SIP-based user equipment at the Gm reference point. Further details are described in the IMS specification ES 282 007 [7].

8.3.2   Reference points 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 specifications.

8.3.3   Reference points with applications

Interactions with SIP Application Servers take place at the Ut reference point. This reference point enables the user to manage information related to his services.

Support of interactions with other types of Application Server Functions is outside the scope of TISPAN NGN Release 2.

8.3.4   Reference points with the NASS

These reference points enable the user equipment to attach to the network (e1) and receive configuration information (e3). Signalling between the UE and the NASS may be relayed via the ARF and AMF in the transport processing sublayer. These reference points are further defined in the NASS specification ES 282 004 [5].

8.3.5   Reference points with the RACS

Reference points between the user equipment and the RACS are outside the scope of TISPAN NGN Release 2.

8.3.6   Reference points with transport processing functions

The UE sends and receives media and media control flows to/from the NGN at the Dj reference point.

8.3.7   Reference points with access media gateway functions

These reference points coincide with standards analog or ISDN reference points for connecting analog and ISDN customer equipment.

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

Figure A.1 illustrates a possible realization of the TISPAN NGN functional architecture, with an xDSL-based access network.
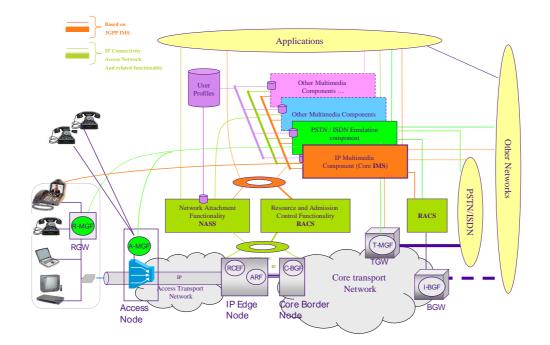

Figure A.1: Example architecture with xDSL access

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 ARF functional entity.

- 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):
Transport architecture for multicast

B.1   Introduction

Figure B.1 shows an example of a typical transport network architecture and the transport network nodes in each network segment. The Access Network contains an Access Segment and a Layer-2 Aggregation Segment which connects the Access Nodes to the IP-Edge Nodes.
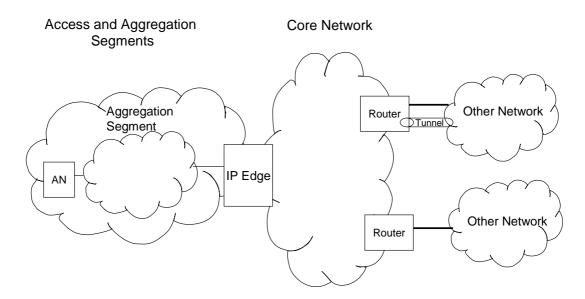

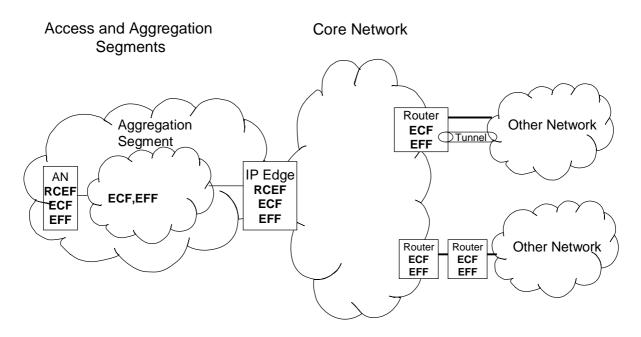**Figure B.1: Transport Node Elements in an Overall NGN Network Architecture**

Typically the other network domains/segments may connect to the Core Network via an MPLS Tunnel for example, or have packets forwarded directly. When multicast services from the Other Networks are tunnelled (via MPLS for example) to the Core Network, intermediate networks when applicable are not required to be multicast aware.

B.2   Multicast Functions in Transport Plane

Considering the transport network node elements in a transport network architecture as shown in figure B/1, we can correlate this architecture to the type of multicast functions required in the transport network nodes. These functions and their functional relation to Multicast are listed below:

•   Elementary Forwarding Function (EFF): This function is responsible for packet replication and forwarding.

•   Elementary Control Function (ECF): This function is responsible for processing of multicast control packets (IGMP Snooping, Protocol Independent Multicast (PIM), Multicast Listener Discovery (MLD), etc.), creation of events to trigger policy evaluation and forwarding of triggered policy evaluation.

•   Resource Control Enforcement Function (RCEF): This function is to enforce multicast traffic policies and to forward events of triggered policy evaluation.

The optional functions are based on the type of Multicast network being utilized to distribute the multicast services. For example, MLD is only required in an IPv6 network being utilized for the multicast service distribution. Figure B.2 shows an example of an overall NGN network architecture and the multicast functions correlated to the transport network nodes.

Figure B.2: Example of an NGN Network Architecture with Multicast Functions in Transport Network Nodes

The architecture represented on figure B.2 is built under the following assumptions:

- The access and aggregation segments shown here are simplified to show the functions required in these network segments in support of multicast. It is assumed that all intermediate Layer-2 transport nodes are multicast aware. Resources are requested only at the edge of the access network segment, i.e. the Access Node and IP_Edge node.

- The Core Network is composed of Core and Border Edge Routers, which are multicast aware and perform multicast routing and forwarding.

- The "Other Intermediate Network" transport network nodes are not required to be multicast aware when traffic is tunnelled over the network.

- The "Other Networks" providers networks may host the Content Server.

- Multicast forwarding in the Access and Core Network segments may be dynamic or statically provisioned to deliver content to the Access Nodes.

History

Document history		
V1.1.1	August 2005	Publication
V2.0.0	November 2007	Membership Approval Procedure MV 20080125: 2007-11-27 to 2008-01-25
V2.0.0	March 2008	Publication