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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 defines the security architecture of NGN Release 1. The definition complies with the requirements of ITU-T Recommendation I.130 [32] at stage 2.

The present document addresses the security architecture required to fulfil the NGN R1 security requirements defined in [1] and includes the definition of security architectures to provide protection for each of the NGN functional architecture ([3]) and its subsystems ([6], [4], [27], [26] and [5]). Where appropriate the present document endorses security mechanisms defined in other specifications.

This document addresses the security issues of the NGN core network and the NGN access network(s) up to and including the NGN Network Termination (NGN NT) in the residential customer domain. The NGN NT denotes a logical demarcation point between the residential customer domain and the NGN core and access networks and covers the corresponding interfaces.

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 187 001: "Telecommunications and Internet Converged Services and Protocols for Advanced Networking (TISPAN); NGN SECURITY (SEC); Requirements".
- [2] ETSI TR 187 002: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); TISPAN NGN Security (NGN_SEC); Threat and Risk Analysis".
- [3] ETSI ES 282 001: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture Release 1".
- [4] ETSI ES 282 002: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); PSTN/ISDN Emulation Sub-system (PES); Functional architecture".
- [5] ETSI ES 282 003: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control Sub-system (RACS); Functional Architecture".
- [6] ETSI ES 282 004: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture; Network Attachment Sub-System (NASS)".
- [7] ETSI TS 183 033: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia: IP Multimedia Subsystem (IMS) Cx and Dx Interfaces; Signalling flows and message contents & IP Multimedia (IM) Subsystem Cx and Dx Interfaces; Cx and Dx interfaces based on the Diameter protocol [3GPP TS.29.228 v.6.8.0 and 3GPP TS.29.229 v.6.6.0, modified]".
- [8] ETSI TS 133 203: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); 3G security; Access security for IP-based services (3GPP TS 33.203)".

- [9] ETSI TS 133 210: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); 3G security; Network Domain Security (NDS); IP network layer security (3GPP TS 33.210)".
- [10] ETSI TS 133 310: "Universal Mobile Telecommunications System (UMTS); Network domain security; Authentication framework (NDS/AF) (3GPP TS 33.310)".
- [11] ETSI TS 133 141: "Universal Mobile Telecommunications System (UMTS); Presence service; Security (3GPP TS 33.141)".
- [12] ETSI TS 133 222: "Universal Mobile Telecommunications System (UMTS); Generic Authentication Architecture (GAA); Access to network application functions using Hypertext Transfer Protocol over Transport Layer Security (HTTPS) (3GPP TS 33.222)".
- [13] ETSI TS 133 220: "Universal Mobile Telecommunications System (UMTS); Generic Authentication Architecture (GAA); Generic bootstrapping architecture (3GPP TS 33.220)".
- [14] ETSI TS 122 048: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Security Mechanisms for the (U)SIM application toolkit; Stage 1 (3GPP TS 22.048)".
- [15] ETSI TS 123 048: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Security mechanisms for the (U)SIM application toolkit; Stage 2 (3GPP TS 23.048)".
- [16] ETSI TS 131 101: "Universal Mobile Telecommunications System (UMTS); UICC-terminal interface; Physical and logical characteristics (3GPP TS 31.101)".
- [17] ETSI TS 131 102: "Universal Mobile Telecommunications System (UMTS); Characteristics of the Universal Subscriber Identity Module (USIM) application (3GPP TS 31.102)".
- [18] ETSI TS 131 103: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Characteristics of the IP Multimedia Services Identity Module (ISIM) application (3GPP TS 31.103)".
- [19] ETSI TS 129 329: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Sh interface based on the Diameter protocol; Protocol details (3GPP TS 29.329)".
- [20] ETSI ES 283 002: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); PSTN/ISDN Emulation Subsystem (PES); NGN Release 1 H.248 Profile for controlling Access and Residential Gateways".
- [21] ETSI ES 283 018: "Telecommunications and Internet Converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control: H.248 Profile for controlling Border Gateway Functions (BGF) in the Resource and Admission Control Subsystem (RACS); Protocol specification".
- [22] ETSI TS 183 019: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Network Attachment; Network Access xDSL and WLAN Access Networks; Interface Protocol Definitions".
- [23] ETSI ES 283 035: "TISPAN; Network Attachment Sub-System (NASS); e2 interface based on the DIAMETER protocol".
- [24] ETSI ES 283 034: "TISPAN; Network Attachment Sub-System (NASS); e4 interface based on the DIAMETER protocol".
- [25] ETSI ETR 232: "Security Techniques Advisory Group (STAG); Glossary of security terminology".
- [26] ETSI ES 283 003: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Endorsement of "IP Multimedia Call Control Protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP) Stage 3 (Release 6)" for NGN Release 1".

- [27] ETSI ES 282 007: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Subsystem (IMS); Functional architecture".
- [28] ETSI TS 182 006: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Subsystem (IMS); Stage 2 description (3GPP TS 23.228 v7.2.0, modified)".
- [29] IETF RFC 3261: "SIP: Session Initiation Protocol".
- [30] ISO/IEC 10181-1: 1996: "Information technology - Open Systems Interconnection - Security frameworks for open systems: Overview".
- [31] ISO/IEC 11770-1: 1996: "Information technology - Security techniques - Key management - Part 1: Framework".
- [32] ITU-T Recommendation I.130: "Method for the characterization of telecommunication services supported by an ISDN and network capabilities of an ISDN".
- [33] ITU-T Recommendation X.810 (1995): "Information technology - Open Systems Interconnection - Security frameworks for open systems: Overview".
- [34] ITU-T Recommendation X.811: "Information Technology - Open Systems Interconnection - Security Frameworks for Open Systems: Authentication Framework".
- [35] ITU-T Recommendation X.812: "Information Technology - Open Systems Interconnection - Security Frameworks for Open Systems: Access Control Framework".
- [36] ITU-T Recommendation X.814: "Information Technology - Open Systems Interconnection - Security Frameworks for Open Systems: Confidentiality Framework".
- [37] ITU-T Recommendation X.815: "Information Technology - Open Systems Interconnection - Security Frameworks for Open Systems: Integrity Frameworks".
- [38] ETSI TS 183 017: "Telecommunications and Internet Converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control: DIAMETER protocol for session based policy set-up information exchange between the Application Function (AF) and the Service Policy Decision Function (SPDF); Protocol specification".
- [39] IETF RFC 2617: "HTTP Authentication: Basic and Digest Access Authentication".
- [40] ETSI ES 183 043: "Telecommunications and Internet Converged Services and Protocols for Advanced Networking (TISPAN); PSTN/ISDN Emulation; IMS-based PSTN/ISDN Emulation Call Control Protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Protocol specification".
- [41] ETSI TS 182 012: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS-based PSTN/ISDN Emulation Subsystem Architecture; Functional architecture".
- [42] ETSI TS 133 102: "Universal Mobile Telecommunications System (UMTS); 3G security; Security architecture (3GPP TS 33.102)".
- [43] ETSI ES 283 026: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); Resource and Admission Control; Protocol for QoS reservation information exchange between the Service Policy Decision Function (SPDF) and the Access-Resource and Admission Control Function (A-RACF) in the Resource and Protocol specification".
- [44] ETSI ES 202 238: "Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON); Evaluation criteria for cryptographic algorithms".
- [45] IEEE 802.1x: "IEEE Standard for Local and Metropolitan Area Networks Port-Based Network Access Control".

3 Definitions and abbreviations

3.1 Definitions

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

Authentication Service (AUTH): See ITU-T Recommendation X.811 [34].

Authorization Service (AUTHOR): See ITU-T Recommendation X.812 [35].

Confidentiality Service (CONF): See ITU-T Recommendation X.814 [36].

data: any information conveyed in communication packets as well as any other information such as topology information

Integrity Service (INT): See ITU-T Recommendation X.815 [37].

Key Management Service (KM): See ISO/IEC 11770-1 [31].

NGN Network Termination (NGN NT): reference point which denotes a logical demarcation point between the residential customer domain and the NGN core via access networks. It covers the corresponding interfaces

Policy Enforcement Function (PEF): security function that enforces policy rules

NOTE: The PEF encompasses functions for filtering and topology hiding such as typically found in firewalls and/or session border controllers.

security domain: set of elements made of security policy, security authority and set of security relevant activities in which the set of elements are subject to the security policy for the specified activities, and the security policy is administered by the security authority for the security domain

NOTE: The activities of a security domain involve one or more elements from that security domain and, possibly, elements of other security domains

3.2 Abbreviations

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

3G	3 rd Generation
3GPP	3 rd Generation Partnership Project
AAA	Authentication, Authorization, Accounting
AF	Application Functions
AGCF	Access Gateway Control Function
AGW	Access GateWay
AKA	Authentication and Key Agreement
AMF	Access Management Function
AN	Access Network
AN	Access Node
AP	Access Point
AP	Authentication Proxy
A-RACF	Access-Resource Admission Control Function
ARF	Access Relay Function
AS	Application Server
ASP	Application Service Provider
AuC	Authentication Center
AUTH	AUTHentication Service
AUTHOR	AUTHORization Service
BGCF	Breakout Gateway Control Function
BSF	Bootstrapping Server Functionality
CLF	Connectivity session and repository Location Function
CONF	CONFidentiality service

CPE	Customer Premises Equipment
CSCF	Call Session Control Function
DoS	Denial-of-Service
ESP	Encapsulating Security Protocol
FE	Functional Entity
GAA	Generic Authentication Architecture
GBA	Generic Bootstrapping Architecture
GE	Generic Entities
GRE	Generic Routing Encapsulation
HLR	Home Location Register
HSS	Home Subscriber Server
HTTP	HyperText Transport Protocol
IBCF	Interconnection Border Control Function
I-BGF	Interconnection Border Gateway Function
I-CSCF	Interrogating Call Session Control Function
ID	IDentity
IETF	Internet Engineering Task Force
IF	InterFace
IKE	Internet Key Exchange
IMPI	IMS Private User ID
IMPU	IMS Public User ID
IMS	IP Multimedia Subsystem
INT	INTEGRity service
IP	Internet Protocol
IPsec	Internet Protocol Security
IRG	IMS Residential Gateway
ISIM	IMS Subscriber Identity Module
IUA	ISDN Q.921-User Adaptation
KM	Key Management service
MGC	Media Gateway Controller
MGCF	Media Gateway Control Function
MRFC	Multimedia Resource Function Controller
MRFP	Multimedia Resource Function Processor
n.a.	not applicable
NACF	Network Access Configuration Function
NAF	Network Application Function
NASS	Network Access SubSystem
NAT	Network Address Translation
NAPT	Network Address and Port Translation
NDS	Network Domain Security
NGN NT	NGN Network Termination
NGN	Next Generation Network
P-CSCF	Proxy Call Session Control Function
PDBF	Profile DataBase Function
PEF	Policy Enforcement Function
PS	Packet Switched
R1	NGN Release 1
RACS	Resource Admission Control Subsystem
RAND	RANDom
RGW	Residential GateWay
SA	Security Association
SCS	OSA Service Capability Server
S-CSCF	Serving Call Session Control Function
SEGF	SEcurity Gateway Function
SGF	Signalling Gateway Function
SIP	Session Initiation Protocol
SLF	Subscription Locator Function
SPD	Security Policy Database
SPDF	Service Policy Decision Function
TE	Terminal Equipment
THF	Topology Hiding Function
THIG	Topology Hiding Interconnection Gateway

TISPAN	Telecommunication and Internet converged Services and Protocols for Advanced Networking
TLS	Transport Layer Security
T-MGF	Trunking Media Gateway Function
TS	Technical Specification
UA	User Agent
UAAF	User Access Authorization Function
UE	User Equipment
UICC	Universal Integrated Circuit Card
UMTS	Universal Mobile Telecommunication System
UPSF	User Profile Server Function
USIM	UMTS Subscriber Identity Module
VGW	Voice over IP GateWay
WLAN	Wireless Local Area Network
XCAP	XML Configuration Access Protocol
XML	eXtensible Markup Language

4 NGN Security

This clause provides an overview of the NGN security document. The entire document can be seen as a documented output of a security process that loops through several stages; see figure 1, where arrows indicate logical steps and dependencies.

The present document assumes existence of a well-defined NGN architecture ([3]) that includes the IMS architecture (TS 123 002 - see bibliography), the network attachment subsystem (NASS) architecture ([6], the resource admission subsystem (RACS) architecture ([5]), and the PSTN/ISDN emulation (PES) architecture ([4]). Likewise, the present document assumes the corresponding IMS security architecture ([42]). IMS architecture and IMS security architecture are shown as dashed boxes; those prerequisites are not specified further in the present document.

The description of the NGN release 1 security architecture has been divided in a number of smaller blocks describing the security interfaces, the security functions and security protocols, security building blocks and security components.

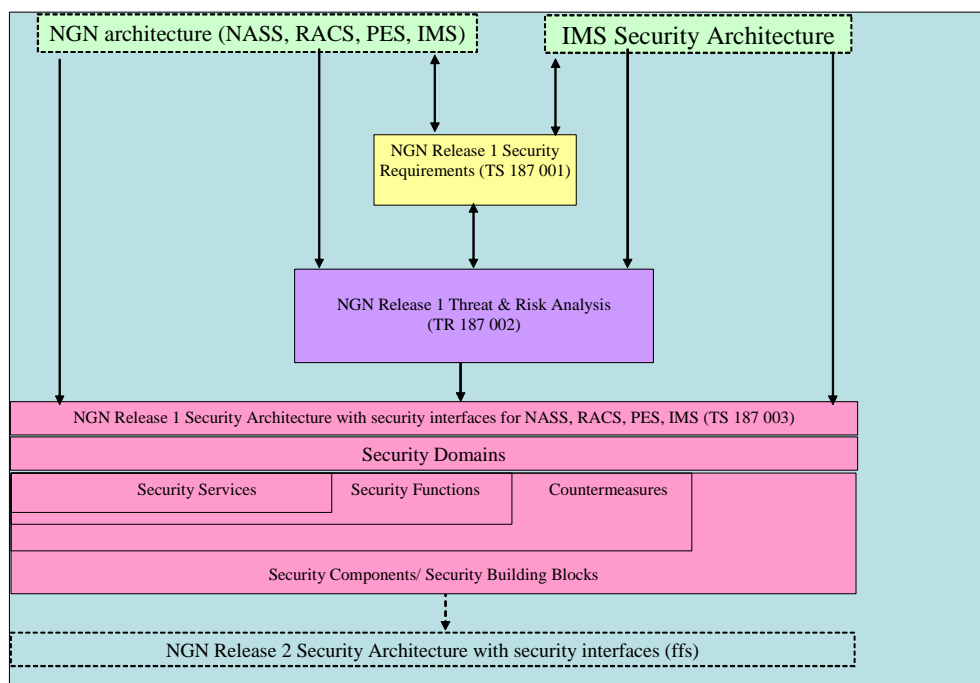


Figure 1: Overview of NGN security documents

Security architecture(s) for further and future NGN releases beyond NGN Release 1 will be specified by separate documents.

4.1 NGN security architecture

The NGN R1 security architecture basically consists of the following major parts:

- NGN security domains (see clause 4.3).
- Security services (see clause 5):
 - authentication;
 - authorization;
 - policy enforcement;
 - key management;
 - confidentiality; and
 - integrity.
- Security protocols including those contained in:
 - IMS Access Security [8] (in case there are no NATs on the Gm interface);
 - SIP HTTP-digest [29] (for NGN legacy UE);
 - XCAP [7], presence security [11].
- Application specific key management.
- SEGFs to secure signalling and control communication among network entities/FEs. Security gateways (SEGs) for IMS network domain security - as defined by [9] - are considered primarily functional components. The present document endorses SEGs and calls them **Security Gateway Function (SEGF)**.
- IMS Residential Gateway to secure access of legacy UEs (see clause 6).
- NGN-specific security mechanisms at various protocols/logical layers such as:
 - NASS authentication based on explicit line authentication;
 - NASS authentication based on implicit physical line authentication; and
 - NASS-IMS bundled authentication.
- NGN subsystem specific security measures (e.g. for PES).

Figure 2 provides a high level overview of the security FEs within the NGN security architecture. Three logical security planes with respective FEs are distinguished:

- NASS security plane;
- IMS security plane;
- GAA/GBA key management plane.

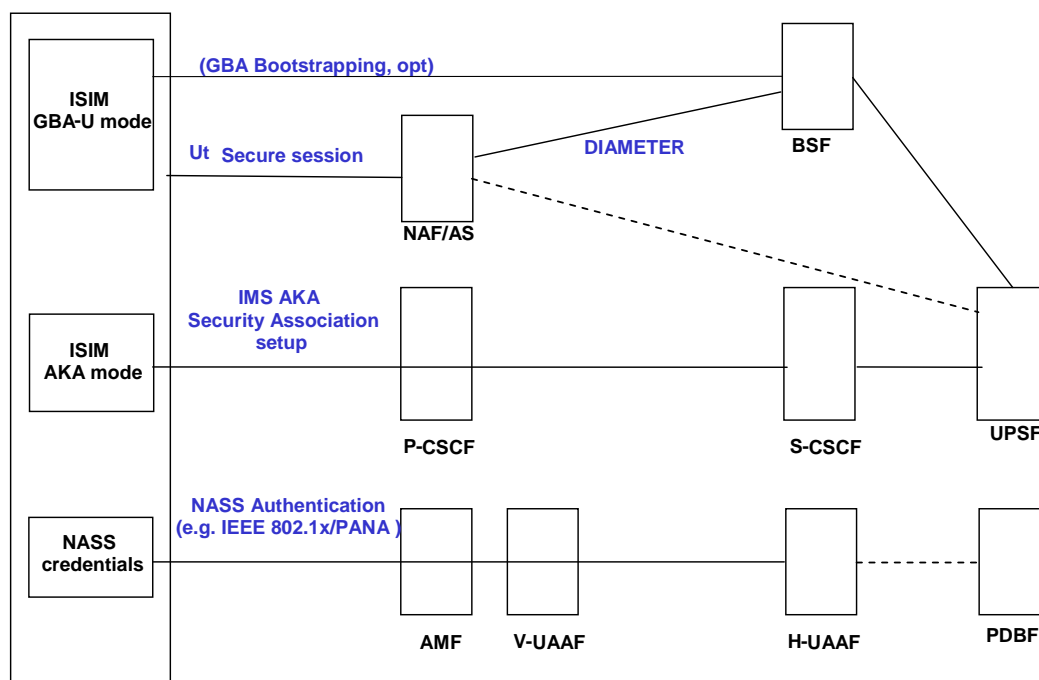


Figure 2: Usage of security FEs in the NGN security architecture

The NASS security plane encompasses the security operations during network attachment for gaining access to the NGN access network. The visited UAAF (V-UAAF) in a visited access network relays authentication message to/from the home NGN network; the V-UAAF (if present) may be a proxy while the home UAAF (H-UAAF) shall process the authentication message and decide authorization. The H-UAAF takes into account user profile information that is stored in the PDBF. The PDBF shall hold the profiles of the NASS user. In NGN, an IMS subscriber may register over an IP access session established by a NASS subscriber, which may not be the same as the IMS subscriber. Hence, in such cases, there is no relation at all between the profile/credentials used at the NASS level and at the IMS level. However, the PDBF may be co-located with the UPSF.

NOTE: The dashed lines between H-UAAF and PDBF and between the NAS/AS and the UPSF indicate interfaces which are not defined and standardized in the present document. Specification of such interfaces is left as further study. Nevertheless, such an UAAF-PDBF interface is generally required for carrying out authentication at NASS level.

The IMS security plane encompasses the P-CSCF, S-CSCF, I-CSCF (not shown in figure 2) and the UPSF. P-CSCF, S-CSCF and I-CSCF shall be involved in the IMS security procedures for authenticating UE and core network, deciding authorization, as well as for supplying fresh key material as specified in [8]. The UPSF shall hold the user profiles used at the IMS level.

The GBA/GAA security plane (optional) encompasses the NAF and BSF FEs for application layer security.

This clause describes the NGN security architecture for Release 1.

4.2 Security domains

A security domain (see [30] and [33]) is a set of elements under a given security policy administered by a single security authority for some specific security relevant activities. The activities of a security domain involve one or more elements from that domain, however at least one of the elements must be in that domain.

In general, a security domain is required to:

- protect the integrity, and optionally the confidentiality, of its functional elements and activities;
- ensure the availability of, and account for the use of, the elements and activities under its protection.

The following principal security domains are identified in the general case where the visited network provider hosts some IMS services and the core IMS provider in the home network domain further provides IMS services:

- Customer's domain that includes UE (owned by customer or by operator).
- Access network security domain with FEs hosted by the access network provider.
- Visited NGN network security domain with FEs hosted by a visited network provider where the visited network may provide access to some application services (AF). The visited network provider may host some applications and may own an own database of subscribers. Alternatively, or additionally, the visited network provider may outsource some application services to the home network provider or even to a 3rd application provider.
- Home NGN network security domain with FEs hosted by the home network provider where the home network may provide some application services (AF). The home network provider hosts some applications and owns a database of subscribers.
- 3rd party application network security domain with FEs hosted by the ASP where the ASP provides some application services (AF). The ASP may be a separate service provider different from the visited or the home network provider. The ASP may need to deploy authorization information offered by the visited or home network provider.

Figure 3 shows the partitioning of the NGN network into security domains.

NOTE: The box labelled "APPL" denotes hosted applications; applications are optional.

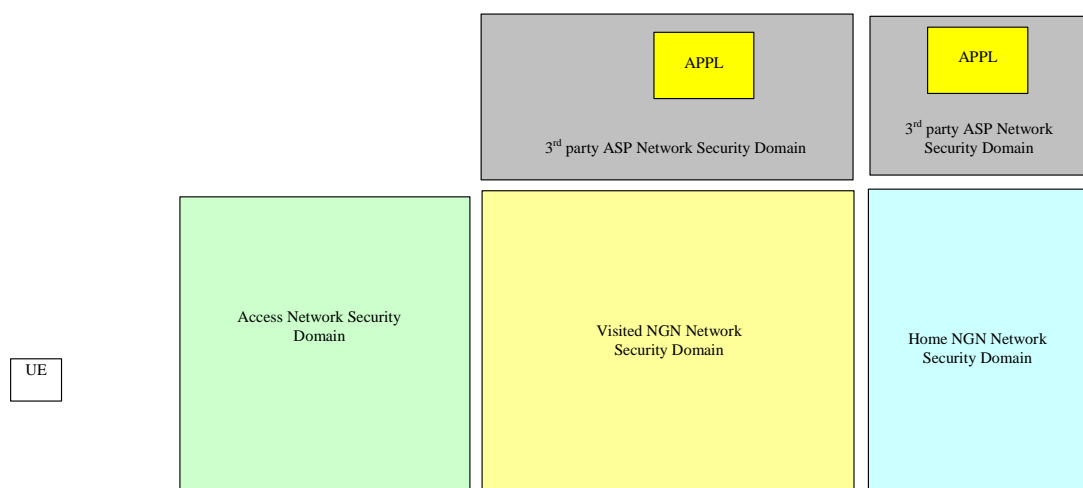


Figure 3: NGN security domains

4.3 NASS and RACS security architecture

Figure 4 shows a high-level view of the NASS and RACS subsystems as mapped to the five NGN security domains.

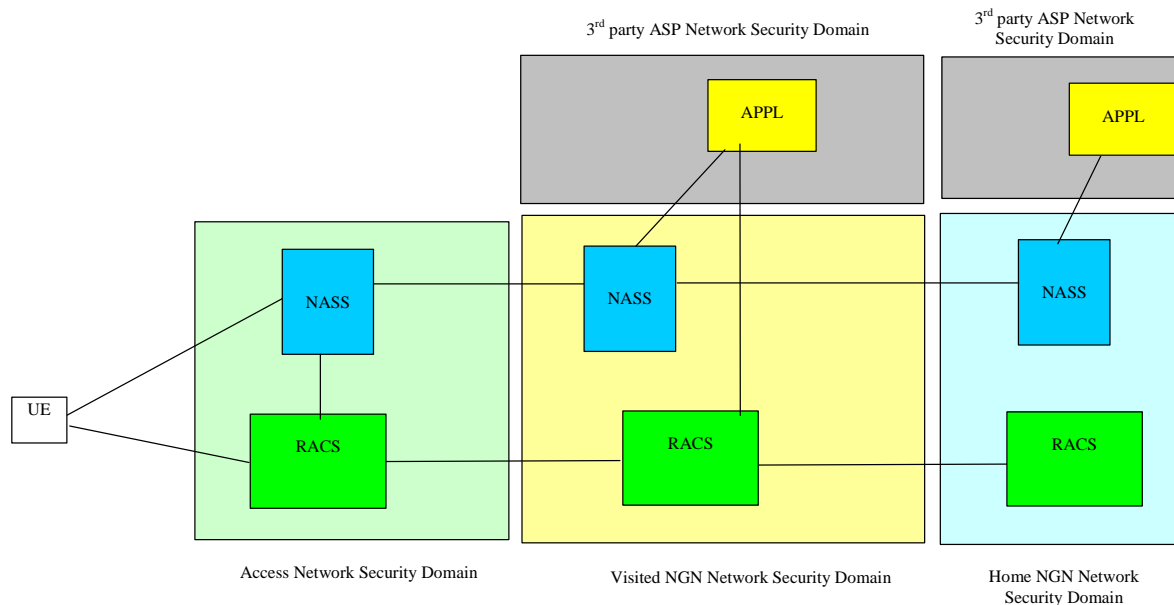


Figure 4: NASS and RACS NGN architecture with security domains

SEGFs security shall protect the interdomain interfaces between the NGN network security domains.

Figure 4 shows the most general case. NASS and RACS functional entities are mapped to the networking domains such as access transport network, visited NGN network and home NGN network. Those networking domains equally represent security domains in the sense of [9] assuming that each networking domain is being operated by a distinct operator. SEcurity Gateway Functions (SEGFs) within each security domain shall protect the exposed interfaces in-between security domains and ensure that a minimal security policy among security domains is enforced.

SEGFs may also optionally protect the (less exposed, internal) interfaces within a security domain; this is left to the discretion of the network operator. The general security architecture case for NASS and RACS subsystems can be collapsed iteratively into fewer (security) domains (not shown): e.g. home network and visited network within one security domain, or access, visited, home network and ASP network all in one security domain. If 3rd party ASP network security domain and home network security domain coincide, then the home network actually hosts the application. The same holds true for the visited network security and the 3rd party ASP network security domain.

It is noted that not all interfaces might occur:

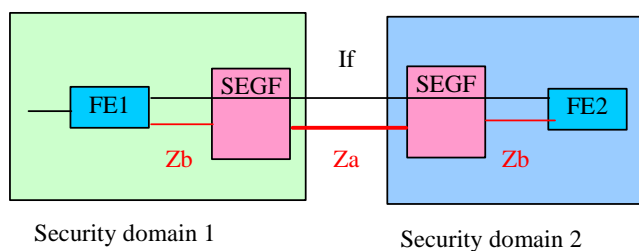
- In NASS scenario 1, the interface e2 with the branches V-CLF-to-H_CLF, V-CLF-to-AF and V-PDBF do not occur.
- In NASS scenario 2, the interface e2 with the branch V-CLF-to-AF and V-PDBF do not occur.
- In NASS scenario 3, the interfaces e5 and e2 with the branches V-UAAF-to-H-UAAF and V-CLF-to-H-CLF do not occur.
- In NASS scenario 4, the interfaces e5 and e2 with the branches V-UAAF-to-H-UAAF and V-CLF-to-AF do not occur.

It is further noted, that several SEGFs shown as separate functional entities may be co-located; such as for example, the SEGFs around Rq and Di interfaces.

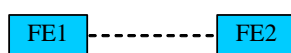
It is noted that there might be further application-specific security protocols (not shown) on top of the Za interfaces. Such security protocols (if any) remain for further study.

NOTE: On the SEG CA in ASP domains it is observed that those CAs are not peering CAs as among the home/visited and access provider. It remains for further study how such SEG CAs could be deployed in the context of NGN.

FE1 and FE2 are located in two distinct security domains. All signaling traffic across interface If exchanged between FE1 and FE2 shall be routed through security gateway functions (SEGF). Za interface (IKE+ESP tunnel) is mandatory to implement; Zb (IKE+ESP tunnel) is optional to implement; see TS 133 210 [10] clause 5.6.2.



Proprietary, non-standard local interface (in NGN R1).



NASS functional entity



RACS functional entity



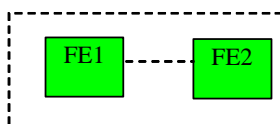
Application functional entity



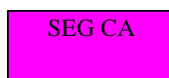
functional entity in the visited (home) NGN network



(Potentially) co-located functional entity



SEG Certification Authority



Interconnection Certification Authority

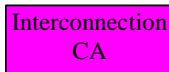


Figure 5: Legend

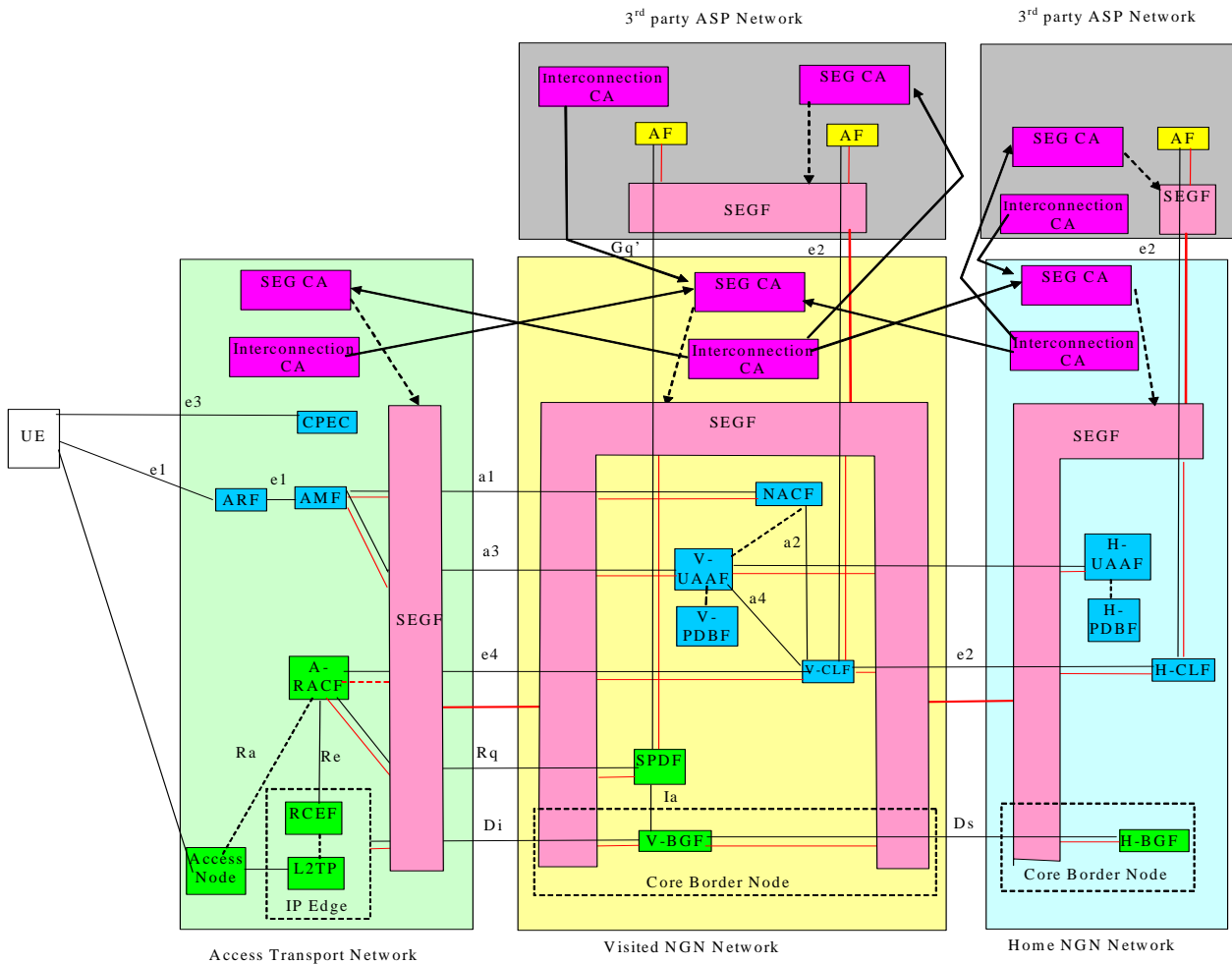


Figure 6: NGN NASS and RACS security architecture with FEs and security gateway functional components around inter-domain interfaces in access, visited, home and other operator's networks

4.3.1 NASS-IMS Bundled Security

Please refer to clause 4.4.1.

4.4 IMS security architecture

The IMS security architecture for both 3G environments and for NGN environments is defined in [8].

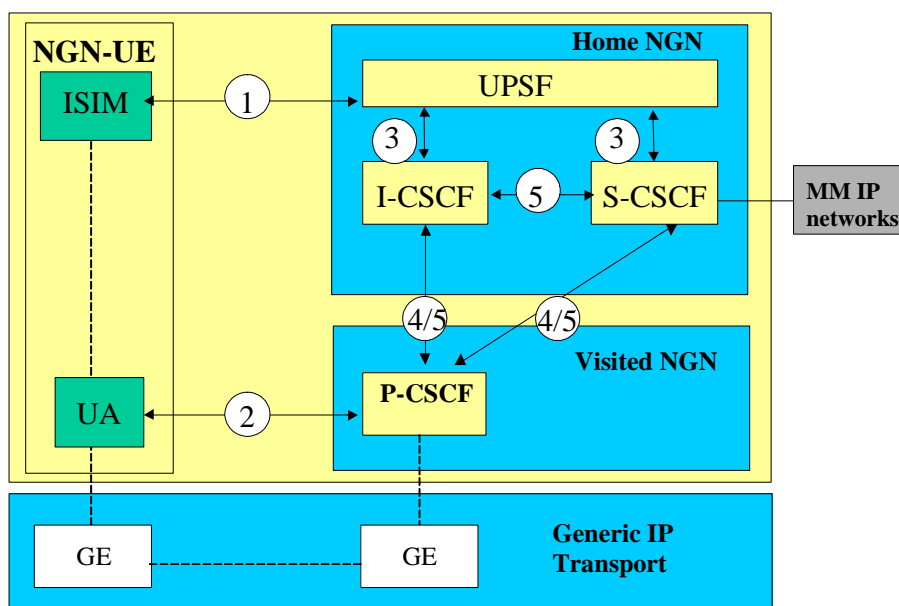


Figure 7: IMS Security architecture in an NGN environment [8]

Figure 7 depicts the IMS security architecture in an NGN environment as defined in [8], where the 3GPP specific transport domain is replaced by the Generic IP transport domain. The following observations support figure 7.

- The IMS is independent of the transport network.
- Generic Entities (GE) equivalent to the 3GPP transport entities will be present in the Generic IP transport domain.
- In NGN the AuC functionality is performed by UPSF.
- The Security Associations (SA) (referring to the corresponding arrows in figure 7) are retained.
 - SA-1, SA-3, SA-4 and SA-5 are endorsed as described in [8].
 - SA-2 is endorsed with the extension to ensure transport across NAT/Firewall boundaries.

There exist other interfaces and reference points in IMS, which have not been addressed above. Those interfaces and reference points reside within the IMS, either within the same security domain or between different security domains (see figure 8). The protection of all such interfaces and reference points (which may include subsystems like NASS/RACS) apart from the Gm reference point are protected as specified in [9].

The present document endorses the interfaces (1) to (5) of [8].

Figure 8 details figure 7 by showing the IMS functional entities in the NGN that runs over a generic IP transport.

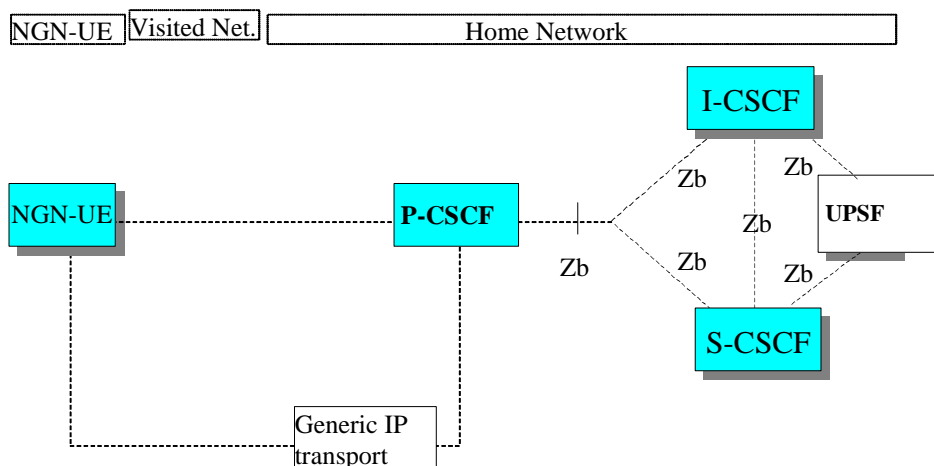


Figure 8: Generic IP Transport underneath IMS ([8])

In the following, IMS components are segregated into the different security domains. Figure 9 shows the IMS components in five different domains. The interconnection between the different IMS components is not shown in the figure and it should be in accordance with [27]. The segregation is explained below.

- 1) **Customer's domain** includes UE and optionally some Residential Gateways (which may be owned by the user/operator). The Residential Gateway shall have ISIM, which has the credentials for IMS authentication.
- 2) **Access network domain** is hosted by the access network provider. The access network provider may or may not be the same as the NGN provider.
- 3) **Visited network domain** is hosted by a visited network provider. The visited network provider may offer multimedia services and may have his own subscribers. Alternatively, the visited network provider may have agreement with some 3rd party Application Service Provider (ASP) to offer services. The visited network domain may encompass IMS functional entities.
- 4) **Home network domain** is hosted by the home network provider. The home network provider offers multimedia services. Alternatively, the visited network provider may have agreement with some 3rd party Application Service Provider (ASP) to offer services. The home network domain encompasses the IMS network.
- 5) **3rd party application service provider domain** is hosted by some ASP different from the operator. The ASP may need to deploy its own AAA infrastructure to interpret the information offered by the visited or home network provider. It should have the IMS functional entities.

Figure 9 shows the partitioning of the NGN network with IMS components (pink boxes) into security domains (boxes with curved edge). The figure also shows the two different authentications the clients usually go through for NGN access, in the scope of NGN Release 1 security architecture.

- 1) The connection marked "Access Authentication" is the authentication between the UE and NASS in the Access Network.
- 2) The connection marked "IMS Authentication" is the authentication between the UE and the S-CSCF in the IMS network. After the successful authentication, a security association is created between the UE and the P-CSCF. 3GPP R5/R6 has recommended IPsec in transport mode for this. The 3GPP R5/R6 solution lacks NAT traversal capability and hence a solution that is capable of NAT traversal is to be used.

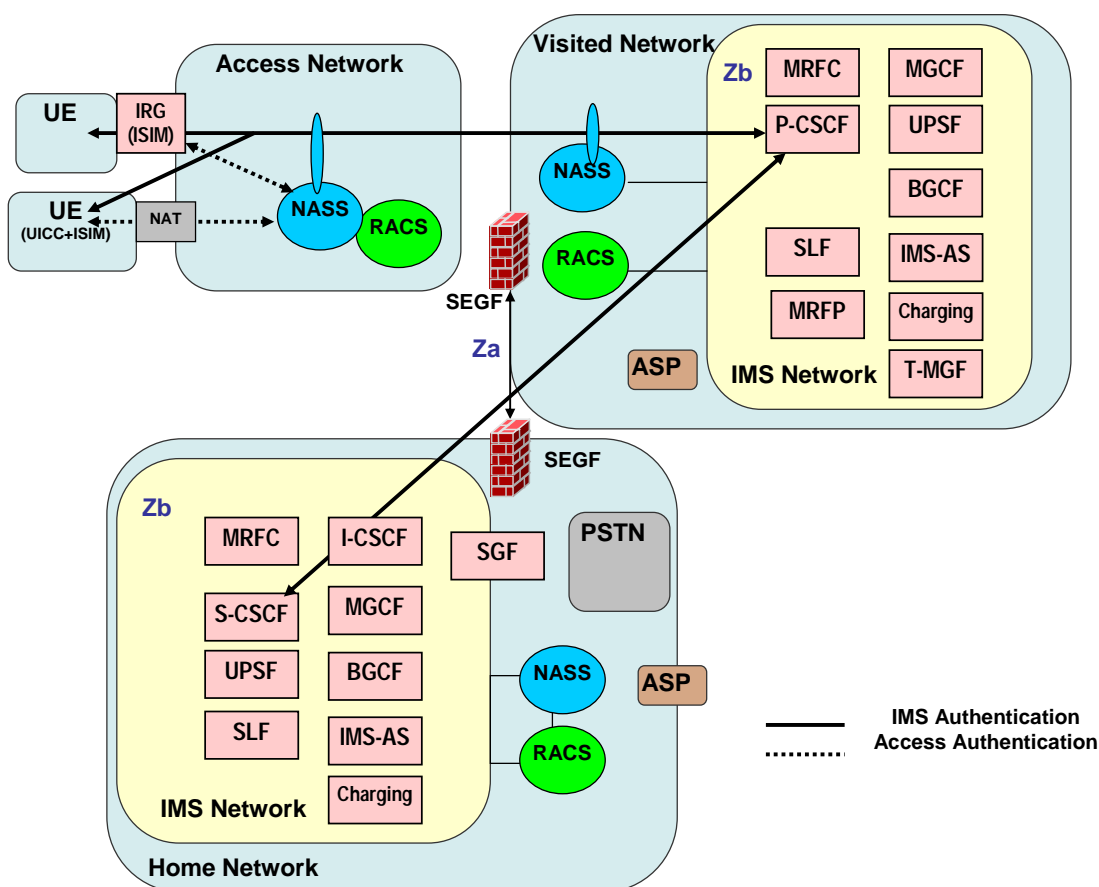
In the figure 9, two distinct interfaces are depicted:

- The connections between the different IMS components (also NGN components) within the same IMS network (NGN network) are the "Zb" interfaces. These interfaces may or may not be protected depending on operator policies.

- The connection between the different Operators, denoted by "Za" in the figure, should be protected (IKE, ESP tunnel). The SEGFs [9] within each security domain protect the exposed interfaces between operators and ensure that a security policy among security domains is enforced. SEGFs may also optionally protect the (less exposed, internal) interfaces within a security domain; this is left to the discretion of the network operator. The outbound IMS/NGN traffic from an operator cannot by-pass the SEGF. SEGFs are used to protect the traffic between two operators. That means traffic from access network IMS entities to IMS entities in the home network of a different operator shall go through SEGF.

The UE may either have ISIM in it (in which case, it can directly authenticate to the S-CSCF) or the ISIM credentials may be in the IMS residential gateway (IRG) (wherein, the service authentication has to go through the IRG). The ISIM may also be in both the devices.

The Service Providers (ASP) may or may not have the same CA as the visited/home network. This depends on the operator policies.



NOTE: Figure 9 does not show any optional SEGF within a security domain for securing the communication among IMS FEs inside the same security domain.

Figure 9: IMS security domains

4.4.1 NASS-IMS Bundled Security

The NASS Bundled Authentication (NBA) works by extending the successful authentication in the NASS layer to the service layer.

During the network attachment, the NASS authenticates the UE and allocates an IP address. It stores the layer-2 and layer-3 identities in the NASS profile. When UE registers with the P-CSCF, the P-CSCF queries the NASS (actually the CLF functional entity), to obtain its location information. The P-CSCF embeds the location information into the SIP message and forwards it towards the S-CSCF for verification. The S-CSCF verifies this location information with the location information obtained from the UPSF. On successful verification, the user is authenticated at the IMS layer.

At the architectural level, two interfaces are affected:

- 1) the "e2" interface over which the location info from the NASS is communicated.
- 2) the "Cx" interface over which the user profile stored in UPSF is transmitted.

This is illustrated in figure 10. See also annex D for a visualization of the network flows.

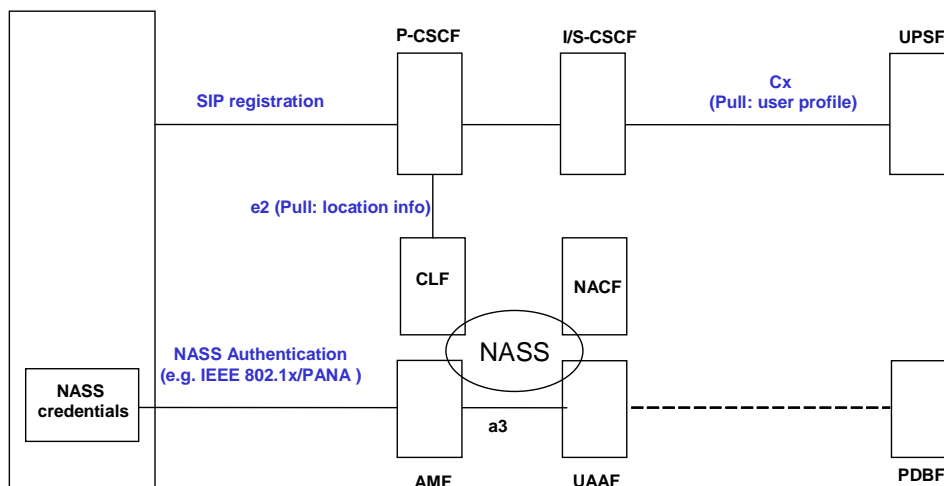


Figure 10: Formal mapping of NASS Bundled Authentication

4.5 PES Security Architecture

4.5.1 Security for H.248 within PES

Figure 11 depicts the security architecture for using H.248.1 for PSTN/ISDN service over IP according to [20]. Access Gateway (AGW), Residential Gateway (RGW), the control subsystem (AGCF with MGC) and the control protocols are considered to belong entirely to a single operator's security domain as indicated by the dashed, red line.

The specified H.248 security options should not be used, as these interfaces are considered to be within a security domain. [20] clause 5.1.3 specifies that no security measures, either IPsec or TLS, are used on the IUA interfaces and no specific countermeasures are applied to the GRE interface carrying packet data.

NOTE: In any other case when the H.248, IUA and GRE interfaces do not fall within a single operator's security domain, a different risk may apply and appropriate countermeasures may be needed. A security architecture for such cases is left as for further study.

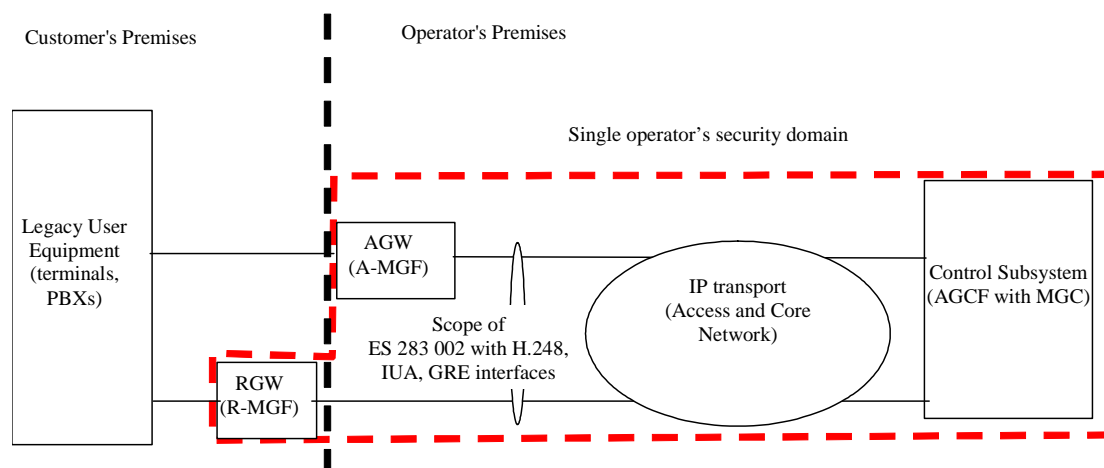


Figure 11: Reference architecture for profile of the Gateway Control Protocol (H.248.1), for controlling access and residential gateways connecting analog lines and ISDN primary and basic accesses, in order to emulate PSTN/ISDN services over IP [20]

4.5.2 IMS-based PES Security

[41] defines the functional architecture for the IMS-based PSTN/ISDN emulation subsystem. The MGCF maps the encapsulated ISUP information within SIP messages sent/received to/from the BGCF (Mj interface) and to/from the I/S-CSCF (Mg interface) to the ISDN/PSTN network. The MGCF implements the role of a PES Interworking Application while the IBCF implements the role of a PES Interconnection application, see [40].

Procedures for filtering ISUP information off from SIP messages are specified in [40] clauses 5.3.3.5.2.4, 5.3.5.4.2.4 and 5.3.6.2.

In the context of PES, TR 183 032 (see bibliography) clause 6.2 and TR 183 014 (see bibliography) provide supplementary information on the feasibility of securing encapsulated ISUP information within SIP.

4.6 Application security architecture

The AS architecture 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.

The XCAP architecture and security architecture is endorsed by [7]. This defines the usage of a set of security protocols for protection of XCAP traffic on the Ut interface between UE and AS. The two optional method endorsed are HTTP digest over TLS and GAA [12]. An authentication proxy may be used optionally for user authentication, as defined in [7] and [12], see figure 12.

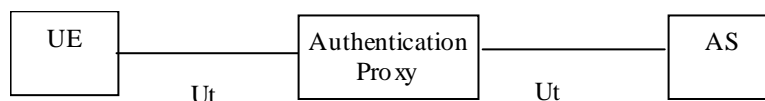


Figure 12: Authentication proxy in the Ut interface path

5 Mapping of Security Requirements to Security Services and NGN FEs

5.1 Security services in NGN R1 security architecture

This clause defines the mapping of security services within the NGN R1 security architecture through security functions. Clause 4.2.3 provides a mapping of security services to NGN FEs.

The following security services are identified for NGN:

- Authentication.
- Authorization.
- Confidentiality.
- Integrity.

Tables 1 to 4 show the security services along with the NGN interfaces between the major NGN subsystems (UE/CNG responsible VGW, NASS, RACS, IMS, PES and AS). The tables only show the interfaces with mandatory security; interfaces with optional security measures are not shown.

NOTE: Since the table is symmetric, the lower left triangular (shaded grey) is supposed to convey the same entries as shown in the upper right triangular.

Table 1: NGN interfaces with required Authentication security services (AUTH)

	UE/CNG, VGW	NASS	RACS	IMS	PES	AS
UE/CNG, VGW	n.a.	e1	n.a.	Gm	Gm	Ua, Ub, Ut, Zn
NASS		a3, e5	e4	n.a.	n.a.	e2
RACS			Rq	n.a.	n.a.	Gq'
IMS				Cx, Dx	n.a.	Sh, Zh
PES					n.a.	n.a.
AS						n.a.

Table 2: NGN interfaces with required Confidentiality Security services (CONF)

	UE/CNG, VGW	NASS	RACS	IMS	PES	AS
UE/CNG, VGW	n.a.	e1	n.a.	Gm	Gm	Ua, Ub, Ut, Zn
NASS		a3, e5	e4	n.a.	n.a.	e2
RACS			Rq	n.a.	n.a.	Gq'
IMS				Cx, Dx, Ic	n.a.	Sh, Zh
PES					n.a.	n.a.
AS						n.a.

Table 3: NGN interfaces with required Integrity security services (INT)

	UE/CNG, VGW	NASS	RACS	IMS	PES	AS
UE/CNG, VGW	n.a.	e1	n.a.	Gm	Gm	Ua, Ub, Ut, Zn
NASS		a3, e5, Za	e4	n.a.	n.a.	e2
RACS			Rq	n.a.	n.a.	Gq'
IMS				Cx, Dx	n.a.	Sh, Zh
PES					n.a.	n.a.
AS						n.a.

Table 4: NGN interfaces with required Key Management security services (KM)

	UE/CNG, VGW	NASS	RACS	IMS	PES	AS
UE/CNG, VGW	n.a.	e1	n.a.	Gm	Gm	Ua, Ub, Ut, Zn
NASS		a3, e5, Za	e4	n.a.	n.a.	e2
RACS			Rq	n.a.	n.a.	Gq'
IMS				Cx, Dx	n.a.	Sh, Zh
PES					n.a.	n.a.
AS						n.a.

5.2 Security Services in NGN FEs

Table 5 identifies the security services with the security mechanism(s) and countermeasures for each NGN FE.

NOTE: Security functions of security services may actually be specified in documents that are referenced indirectly only.

Table 5: Security services and countermeasures provided by NGN FEs

NGN FE	Security Services	Countermeasure and security mechanism in NGN R1
Access Point (AP)	AUTH	Authentication for AP are as specified by [22].
	AUTHOR	Authorization functions for AP are as specified by [22].
	CONF	Confidentiality functions for AP are as specified by [22].
	INT	Integrity functions for AP are as specified by [22].
	KM	Key management functions for AP are as specified by [22].
	PEF	n.a.
AGCF, AGW, RGW	AUTH	Assumed to be in the trusted domain, see [20].
	AUTHORF	Assumed to be in the trusted domain, see [20].
	CONF	Assumed to be in the trusted domain, see [20].
	INT	Assumed to be in the trusted domain, see [20].
	KM	Assumed to be in the trusted domain, see [20].
	PEF	Assumed to be in the trusted domain, see [20].
A-RACF	AUTH	Authentication functions for securing the e4 interface for A-RACF are as specified by [24]. Authentication functions for securing the Rq interface for A-RACF are as specified by [43].
	AUTHOR	Authorizations functions for securing the e4 interface for A-RACF are as specified by [24]. Authorizations functions for securing the Rq interface for A-RACF are as specified by [43].
	CONF	Confidentiality functions for securing the e4 interface for A-RACF are as specified by [24]. Confidentiality functions for securing the Rq interface for A-RACF are as specified by [43].
	INT	Integrity functions for securing the e4 interface for A-RACF are as specified by [24]. Integrity functions for securing the Rq interface for A-RACF are as specified by [43].
	KM	Key management functions for securing the e4 interface for A-RACF are as specified by [24]. Key management functions for securing the Rq interface for A-RACF are as specified by [43].
	PEF	Policy enforcement functions for securing the e4 interface for A-RACF are as specified by [24]. Policy enforcement functions for securing the Rq interface for A-RACF are as specified by [43].

NGN FE	Security Services	Countermeasure and security mechanism in NGN R1
AS	AUTH	Authentication functions for AS are as specified by [11] and by [7]. Authentication functions for securing the DIAMETER protocol for AS are as specified by [19] and by [9].
	AUTHOR	Authorization functions for AS are as specified by [11] and by [7]. Authorization functions for securing the DIAMETER protocol for AS are as specified by [19] and by [9].
	CONF	Confidentiality functions for AS are as specified by [11] and by [7]. Confidentiality functions for securing the DIAMETER protocol for AS are as specified by [19] and by [9].
	INT	Integrity functions for AS are as specified by [11] and by [7]. Integrity functions for securing the DIAMETER protocol for AS are as specified by [19] and by [9].
	KM	Key management functions for AS are as specified by [11] and by [7]. Key management functions for securing the DIAMETER protocol for AS are as specified by [19] and by [9].
	PEF	Policy enforcement functions for filtering encapsulated ISUP within SIP in the AS are specified by [40] clauses 5.3.3.5.2.4 and 5.3.5.4.2.4.
Authentication Proxy (AP)	AUTH	Authentication functions for AP are as specified by [7] and [12].
	AUTHOR	Authorization functions for AP are specified by [7] and [12].
	CONF	Confidentiality functions for AP are specified by [7] and [12].
	INT	Integrity functions for AP are specified by [7] and [12].
	KM	Key management functions for AP are as specified by [7] and [12].
	PEF	Policy enforcement functions for AP are as specified by [7] and [12].
BGCF	AUTH	n.a.
	AUTHOR	n.a.
	CONF	n.a.
	INT	n.a.
	KM	n.a.
	PEF	n.a.
BSF	AUTH	Authentication functions for BSF are as specified by [13].
	AUTHOR	Authorization functions for BSF are as specified by [13].
	CONF	Confidentiality functions for BSF are as specified by [13].
	INT	Integrity functions for BSF are as specified by [13].
	KM	Key management functions for BSF are as specified by [13].
	PEF	n.a.
CLF	AUTH	Authentication functions for securing the e2 interface of the CLF are as specified by [23].
	AUTHOR	Authorizations functions for securing the e2 interface of the CLF are as specified by [23].
	CONF	Confidentiality functions for securing the e2 interface of the CLF are as specified by [23].
	INT	Integrity functions for securing the e2 interface of the CLF are as specified by [23].
	KM	Key management functions for securing the e2 interface of the CLF are as specified by [23].
	PEF	Policy enforcement functions for securing the e2 interface of the CLF are as specified by [23].
IBCF	AUTH	n.a.
	AUTHOR	Authorization functions for IBCF are as specified by [28].
	CONF	Confidentiality functions for IBCF are as specified by [28].
	INT	n.a.
	KM	n.a.
	PEF	Policy enforcement functions for IBCF are as specified by [28]. Policy enforcement functions for filtering encapsulated ISUP within SIP in the IBCF are specified by [40], clause 5.3.6.2.
IRG	AUTH	IMS-AKA authentication functions for IRG shall are as specified in [8]; Authentication functions for IPsec packet authentication in the IRG are as specified in [8]. Optional authentication functions for SIP HTTP-digest in the IRG are as defined in [29].
	AUTHOR	Authorization functions in the IRG are as specified in [8].
	CONF	Confidentiality functions in the IRG protect IMS-AKA key distribution against loss of confidentiality as specified in [8]. Confidentiality functions in the IRG encrypt IPsec packets as specified in [8].

NGN FE	Security Services	Countermeasure and security mechanism in NGN R1
	INT	Integrity functions in the IRG protect IMS-AKA key distribution against loss of integrity as specified in [8]. Integrity functions in the IRG protect IPsec packets against loss of integrity as specified in [8].
	KM	Key management functions in the IRG provide IMS-AKA as specified in [8].
	PEF	n.a.
MGCF	AUTH	n.a.
	AUTHOR	n.a.
	CONF	n.a.
	INT	n.a.
	KM	n.a.
	PEF	Policy enforcement functions for filtering encapsulated ISUP within SIP in the MGCF are specified by [40].
NAF	AUTH	Authentication functions in NAF are as specified by [12].
	AUTHOR	Authorization functions in NAF are specified by [12].
	CONF	Confidentiality functions in NAF are specified by [12].
	INT	Integrity functions in NAF are specified by [12].
	KM	Key management functions in NAF are as specified by [12].
	PEF	n.a.
PDBF	AUTH	Authentication functions in the PDBF retrieve authentication data (e.g. user identity, list of supported authentication methods, authentication keys etc.) as outlined in [6].
	AUTHOR	Authorization functions in the PDBF access PDBF to retrieve authorization data (e.g. user network profile) as outlined in [6].
	CONF	n.a.
	INT	n.a.
	KM	n.a.
	PEF	n.a.
P-CSCF	AUTH	Authentication functions in the P-CSCF provide IMS-AKA as specified in [8]. Authentication functions in the P-CSCF provide IPsec packet authentication as specified in [8]. Optional authentication functions in the P-CSCF provide NASS-IMS bundled authentication as specified in [26] and [7]. Optional authentication functions in the P-CSCF support SIP HTTP-digest as defined in [29]. Authentication functions in the P-CSCF secure the e2 interface as specified by [23]. Authentication functions in the P-CSCF secure the e4 interface as specified by [24].
	AUTHOR	Authorization functions in the P-CSCF provide authorization functions as specified in [8]. Authorization functions in the P-CSCF provide authorizations functions for securing the e2 interface as specified by [23]. Authorization functions in the P-CSCF provide authorizations functions for securing the e4 interface as specified by [24]. Optional authorization functions in the P-CSCF for NASS-IMS bundled authentication feature as specified in [26] and [7]. Optional authorization functions in the P-CSCF support SIP HTTP-digest as defined in [29].
	CONF	Confidentiality functions in the P-CSCF provide IMS-AKA key distribution against loss of confidentiality specified in [8]. Confidentiality functions in the P-CSCF provide IPsec packet encryption as specified in [8]. Confidentiality functions in the P-CSCF secure the e2 interface as specified by [23]. Confidentiality functions in the P-CSCF secure the e4 interface as specified by [24].
	INT	Integrity functions in the P-CSCF protect IMS-AKA key distribution against loss of integrity as specified in [8]. Integrity functions in the P-CSCF protect IPsec packets against loss of integrity as specified in [8]. Integrity functions in the P-CSCF secure the e2 interface as specified by [23]. Integrity functions in the P-CSCF secure the e4 interface as specified by [24].

NGN FE	Security Services	Countermeasure and security mechanism in NGN R1
	KM	Key management functions in the P-CSCF provide IMS-AKA as specified in [8]. Key management functions in the P-CSCF shall secure the e2 interface as specified by [23]. Key management functions in the P-CSCF secure the e4 interface as specified by [24].
	PEF	Policy enforcement functions in the P-CSCF secure the e2 interface as specified by [23]. Policy enforcement functions in the P-CSCF secure the e4 interface as specified by [24]. Policy enforcement functions for filtering encapsulated ISUP within SIP in the P-CSCF are specified by [40] clause 5.3.3.5.2.4.
S-CSCF	AUTH	Authentication functions for securing DIAMETER over SCTP using IPsec in the S-CSCF are as specified by [7] and by [9].
	AUTHOR	Authorization functions for securing DIAMETER over SCTP using IPsec in the S-CSCF are as specified by [7] and by [9].
	CONF	Confidentiality functions for securing DIAMETER over SCTP using IPsec in the S-CSCF are as specified by [7] and by [9].
	INT	Integrity functions for securing DIAMETER over SCTP using IPsec in the S-CSCF are as specified by [7] and by [9].
	KM	Key management functions for securing DIAMETER over SCTP using IPsec in the S-CSCF are as specified by [7] and by [9].
	PEF	n.a.
SEGF	AUTH	Authentication functions in the SEGF provide IKE as specified in [9]. Authentication functions in the SEGF provide IPsec packet authentication as specified in [9].
	AUTHOR	Authorization functions in the SEGF provide IKE/IPsec SPD as specified in [9].
	CONF	Confidentiality functions in the SEGF provide IPsec packet encryption as specified in [10].
	INT	Integrity functions in the SEGF provide IPsec packet integrity as specified in [10].
	KM	Key management functions in the SEGF provide IKE as specified in [10].
	PEF	Policy enforcement for AUTH, AUTHOR, CONF, INT and KM in the SEGF are as specified in [10].
THF, I-CSCF (THIG)	AUTH	n.a.
	AUTHORF	n.a.
	CONF	n.a.
	INTF	n.a.
	KM	n.a.
	PEF	Topology hiding functions in THF, I-CSCF (THIG) are as specified in [29] (see TS 124 229 - see bibliography).
UAAF	AUTH	Explicit and/or implicit authentication functions for NASS in the UAAF are as specified by [22]; see also [6]. The UAAF terminates the AAA protocol (RADIUS or DIAMETER) as a AAA server, see [6].
	AUTHOR	Authorization functions for NASS (supported by PDBF) in the UAAF are as specified by [22].
	CONF	n.a.
	INT	n.a.
	KM	n.a.
	PEF	The UAAF supports the Privacy Indicator to indicate whether location information can be exported to services and applications; see [6].
UPSF NOTE: UPSF does not directly correspond to a security function, nor does UPSF provide a security service.	AUTH	For IMS, the authentication function in the UPSF accesses authentication data stored in the UPSF (see also [3], TR 182 005 - see bibliography, see also clause A.2).
	AUTHOR	For IMS, the authorization function in the UPSF accesses authorization data stored in the UPSF (see also [3], TR 182 005 - see bibliography, see also clause A.2).
	CONF	For IMS, the confidentiality function in the UPSF accesses keys stored in the UPSF (see also [3], TR 182 005 - see bibliography, see also clause A.2).
	INT	For IMS, the integrity function in the UPSF accesses integrity data stored in the UPSF (see also [3], TR 182 005 - see bibliography, see also clause A.2).
	KM	For IMS, the key management function accesses key management data stored in the UPSF (see also [3], TR 182 005 - see bibliography, see also clause A.2).

NGN FE	Security Services	Countermeasure and security mechanism in NGN R1
	PEF	For IMS, the policy enforcement function in the UPSF accesses policy information stored in the UPSF (see also [3], TR 182 005 - see bibliography, see also clause A.2).

5.3 Security Services on NGN Interfaces

Table 6 identifies the security services (AUTH, INT, CONF, KMF) with the security mechanism(s) and countermeasures for each NGN interface.

NOTE 1: Interfaces are not listed in this clause where no security functions are identified.

NOTE 2: Security functions of the security services may actually be specified in documents that are referenced indirectly only.

Table 6: Security services and countermeasures provided by NGN interfaces

NGN IF	Security Services	Countermeasure and security mechanism in NGN R1
a3 (UAAF - AMF)	AUTH	Authentication functions for the a3 IF are as specified by [22].
	CONF	Confidentiality functions for the a3 IF are as specified by [22].
	INT	Integrity functions for the a3 IF are as specified by [22].
	KM	Key management functions for the a3 IF are as specified by [22].
a4 (UAAF - CLF)	AUTH	n.a.
	CONF	n.a.
	INT	n.a.
	KM	n.a.
Cx (S-CSCF - UPSF)	AUTH	Authentication functions for securing DIAMETER over SCTP using IPsec for the CX IF are as specified by [7] and by [9].
	CONF	Confidentiality functions for securing DIAMETER over SCTP using IPsec for the CX IF are as specified by [7] and by [9].
	INT	Integrity functions for securing DIAMETER over SCTP using IPsec for the CX IF are as specified by [7] and by [9].
	KM	Key management functions for securing DIAMETER over SCTP using IKE for the CX IF are as specified by [7] and by [9].
Dx (S-CSCF - UPSF - SLF)	AUTH	Authentication functions for securing DIAMETER for the DX IF are as specified by [7] and by [9].
	CONF	Confidentiality functions for securing DIAMETER for the DX IF are as specified by [7] and by [9].
	INT	Integrity functions for securing DIAMETER for the DX IF are as specified by [7] and by [9].
	KM	Key management functions for securing DIAMETER for the DX IF are as specified by [7] and by [9].
e1 (CNG-AMF)	AUTH	Authentication functions for e1 IF are as specified by [22] and by [9].
	CONF	Confidentiality functions for e1 IF are as specified by [22].
	INT	Integrity functions for e1 IF are as specified by [22].
	KM	Key management functions for e1 IF are as specified by [22].
e2 (CLF - AF)	AUTH	Authentication functions for securing the e2 interface are as specified by [23].
	CONF	Confidentiality functions for securing the e2 interface are as specified by [23].
	INT	Integrity functions for securing the e2 interface are as specified by [23].
	KM	Key management functions for securing the e2 interface are as specified by [23].
e4 (CLF - A-RACF)	AUTH	Authentication functions for securing the e4 interface are as specified by [24].
	CONF	Confidentiality functions for securing the e4 interface are as specified by [24].
	INT	Integrity functions for securing the e4 interface are as specified by [24].
	KM	Key management functions for securing the e4 interface are as specified by [24].
e5 (UAAF - UAAF)	AUTH	Authentication functions for the e5 IF are as specified by [22]. e5 provides the AAA protocol (RADIUS or DIAMETER) as specified by [6].
	CONF	Confidentiality functions for the e5 IF are as specified by [22].
	INT	Integrity functions for the e5 IF are as specified by [22].
	KM	Key management functions for the e5 IF are as specified by [22].

NGN IF	Security Services	Countermeasure and security mechanism in NGN R1
Gm (UE/IRG - P-CSCF) (VGW - P-CSCF)	AUTH	Authentication functions for the Gm IF provide IMS-AKA as specified in [8]. Authentication functions for the Gm IF provide IPsec packet authentication as specified in [8]. Optional authentication functions for the Gm IF provide SIP HTTP-digest as defined in [29]. Optional authentication functions for the Gm IF provide NASS-IMS bundled authentication as specified in [26] and [7].
	CONF	Confidentiality functions for the Gm IF protect IMS-AKA key distribution against loss of confidentiality specified in [8]. Confidentiality functions for the Gm IF protect IPsec packet encryption as specified in [8].
	INT	Integrity function for the Gm IF protect IMS-AKA key distribution against loss of integrity as specified in [8]. Integrity function for the Gm IF protect IPsec packet integrity as specified in [8].
	KM	Key management functions for the Gm IF provide IMS-AKA as specified in [8].
Gq' (AF - SPDF)	AUTH	Authentication functions for securing DIAMETER for Gq' are as defined by [38].
	CONF	Confidentiality functions for securing DIAMETER for Gq' are as defined by [38].
	INT	Integrity functions for securing DIAMETER for Gq' are as defined by [38].
	KM	Key management functions for securing DIAMETER for Gq' are as defined by [38].
Ia (SPDF - BGF)	AUTH	Ia IF does not provide any authentication functions; see [21].
	CONF	Ia IF does not provide any confidentiality functions; see [21].
	INT	Ia IF does not provide any integrity functions; see [21].
	KM	Ia IF does not provide any key management functions; see [21].
Ic (IBCF - IBCF)	AUTH	n.a.
	CONF	Confidentiality functions for Ic are as specified by [28].
	INT	n.a.
	KM	n.a.
ISC (CSCF - AS)	AUTH	n.a.
	CONF	n.a.
	INT	n.a.
	KM	n.a.
Mg (CSCF - MGCF)	AUTH	n.a.
	CONF	n.a.
	INT	n.a.
	KM	n.a.
Mj (BGCF - MGCF)	AUTH	n.a.
	CONF	n.a.
	INT	n.a.
	KM	n.a.
Rq (SPDF - A-RACF)	AUTH	Authentication functions for securing the DIAMETER protocol for the Rq IF are as specified by [43].
	CONF	Confidentiality functions for securing the DIAMETER protocol for the Rq IF are as specified by [43].
	INT	Integrity functions for securing the DIAMETER protocol for the Rq IF are as specified by [43].
	KM	Key management functions for securing the DIAMETER protocol for the Rq IF are as specified by [43].
Sh (AS - UPSF) (SCS - UPSF)	AUTH	Authentication functions for securing the DIAMETER protocol for the Sh IF are as specified by [19] and by [9].
	CONF	Confidentiality functions for securing the DIAMETER protocol for the Sh IF are as specified by [19] and by [9].
	INT	Integrity functions for securing the DIAMETER protocol for the Sh IF are as specified by [19] and by [9].
	KM	Key management functions for securing the DIAMETER protocol for the Sh IF are as specified by [19] and by [9].
Ua (NAF - UE)	AUTH	Authentication functions for Ua IF are as specified by [13].
	CONF	Confidentiality functions for Ua IF are as specified by [13].
	INT	Integrity functions for Ua IF are as specified by [13].
	KM	Key management functions for Ua IF are as specified by [13].
Ub (BSF - UE)	AUTH	Authentication functions for Ub IF are as specified by [13].
	CONF	Confidentiality functions for Ub IF are as specified by [13].
	INT	Integrity functions for Ub IF are as specified by [13].
	KM	Key management functions for Ub IF are as specified by [13].

NGN IF	Security Services	Countermeasure and security mechanism in NGN R1
Ut (UE - (AP) - AS)	AUTH	Authentication functions for Ut IF are as specified by [11], [12] and by [7].
	CONF	Confidentiality functions for Ut IF are as specified by [11], [12] and by [7].
	INT	Integrity functions for Ut IF are as specified by [11], [12] and by [7].
	KM	Key management functions for Ut IF are as specified by [12], [11] and by [7].
Za (SEGF - SEGF)	AUTH	Authentication functions for Za IF are as specified in [9].
	CONF	Confidentiality functions for Za IF are as specified in [9].
	INT	Integrity functions for Za IF are as specified in [9].
	KM	Key management functions for Za IF are as specified in [9].
Zb (SEGF - FE)	AUTH	Optional authentication functions for Zb IF areas specified in [9].
	CONF	Optional confidentiality functions for Zb IF are as specified in [9].
	INT	Optional integrity functions for Zb IF are as specified in [9].
	KM	Optional key management functions for Zb IF are as specified in [9].
Zh (BSF - UPSF)	AUTH	Authentication functions for Zh IF are as specified by [13].
	CONF	Confidentiality functions for Zh IF are as specified by [13].
	INT	Integrity functions for Zh IF are as specified by [13].
	KM	Key management functions for Zh IF are as specified by [13].
Zn (BSF - UE)	AUTH	Authentication functions for Zn IF are as specified by [13].
	CONF	Confidentiality functions for Zn IF are as specified by [13].
	INT	Integrity functions for Zn IF are as specified by [13].
	KM	Key management functions for Zn IF are as specified by [13].

5.4 Mapping of 3GPP security FEs to NGN FEs

NGN shall re-use 3GPP security entities (AuC, HLR and HSS; see TS 123 002) as follows; see also figure 13 that illustrates a mapping of 3GPP FEs to NGN FEs:

- The PDBF at the NASS level shall conceptually encompass the same functionality that is provided by the AuC, see TS 123 002 clause 4.1.1.1.2. Additionally, the PDBF shall contain the NASS level profiles needed for the NASS layer authentication.

NOTE 1: Conceptually means that the functionality is not the same as AuC operates at IMS level while PDBF operates at NASS level. Thus, the functions of the AuC need to be transposed into some conceptually equivalent functions at the PDBF.

- When mapping the 3GPP PS domain architecture to the NASS architecture, the H-UAAF conceptually covers the part of the HLR that is used to access the AuC; see figure 13, see TS 123 002 clause 4.1.1.1.1. When mapping the 3GPP WLAN architecture to the NASS architecture, the H-UAAF is equivalent to the WLAN H-AAA server, while the V-UAAF is equivalent to a WLAN AAA proxy; see figure 14, see TS 133 234 clause 4.1.4.
- The UPSF as a generic FE shall encompass:
 - authentication data for the IMS are held in the non-HLR part of the HSS. However, this part of the HSS is not explicitly termed AuC. This part is shown as AuC' to represent the AuC functionality for the IMS (i.e. ISIM-based). This AuC' functionality is inherited by the UPSF.
 - some other HSS functionality (different from AuC and HLR).

NOTE 2: The HSS is defined in TS 123 002 clause 4.1.1.1.

Generally, NGN FEs shall not encompass any 3GPP functionality that relates to supporting the CS and PS domain.

Figures 13 and 14 show interfaces:

- PDBF - UAAF: This interface is not defined in R1.
- Components and interfaces within UPSF are not defined in R1.
- Internal interfaces within HSS are not defined in 3GPP.

NOTE 3: Figures 13 and 14 show relationships and are not meant to imply exact correspondences. appears to be correct on a high level. Some details can of course not be mapped precisely. This is because the architectural assumptions on the environment of user data in 3GPP and in NGN are somewhat different. In particular, the scopes of UAAF and HLR are different.

NOTE 4: IMS data also contains AuC data related to ISIM.

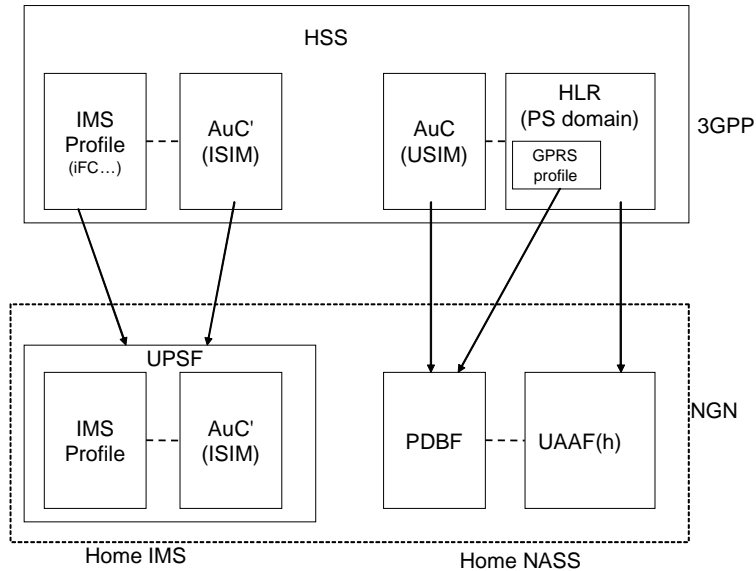


Figure 13: Mapping of HSS (AuC, HLR) to PDBF, UPSF, UAAF (PS domain)

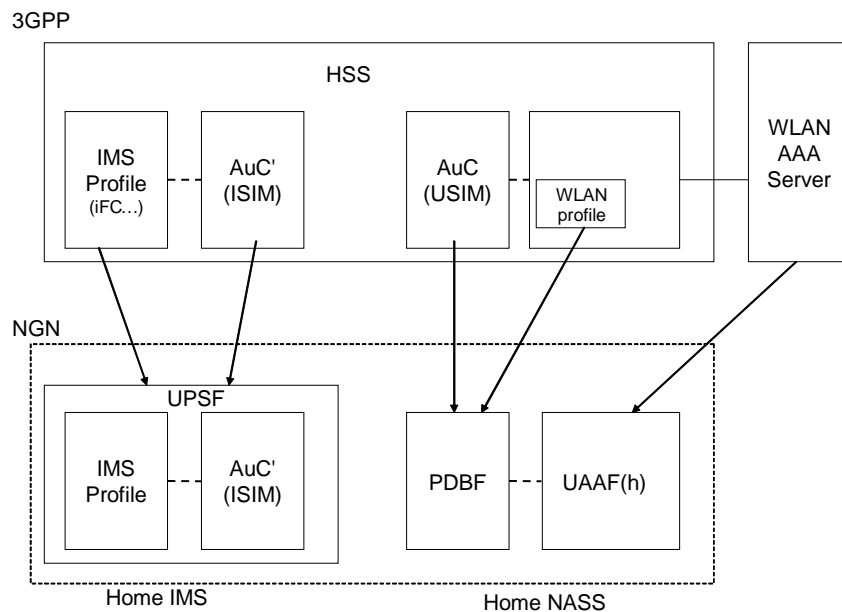


Figure 14: Mapping of HSS (AuC, HLR) to PDBF, UPSF, UAAF (WLAN case)

6 NGN IMS Residential Gateway

User may gain access to NGN IMS services by using a non-ISIM capable SIP UA via a NGN IMS Residential Gateway (IRG). NGN IMS Residential Gateway is an optional functional element within the NGN architecture and serves the purpose to securely connect legacy, non-NGN UE equipment to the NGN that does not have the capability of using an ISIM/UICC. The IRG holds a SIP B2BUA, which has a full NGN IMS Release 1 UA interface towards the NGN IMS network. The interface towards the local user is not specified by the present document; however, it could be for example IETF compatible SIP UA [29], softphone, IP phone, IAD/DECT or some other possibly proprietary phone system. The IMS Residential Gateway is placed in the customer's domain. One potential realization of IMS Residential Gateway is presented in figure 15.

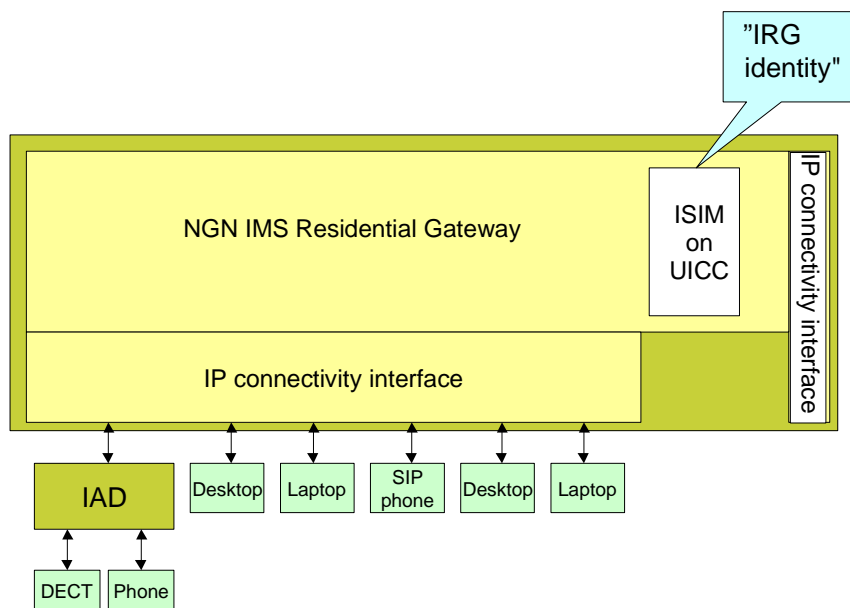


Figure 15: Potential realization of NGN IMS Residential Gateway

The ISIM within the IRG represents the required security functionality for IMS in NGN. In NGN R1, the ISIM [18] shall be deployed in conjunction with a UICC [14], [15], [16],[17].

The operator shall disable all implicit registrations sets from the HSS, on behalf of those ISIMs that are dedicated to IMS Residential Gateways. If there are implicit registrations sets defined in the HSS, then the implementation of IMS Residential Gateway gets a lot harder. It is recommended that the ISIM include only one Public User Identity.

IMS Residential Gateway when implemented in a device should be robust, and therefore it should store the registrations states (local and IMS registration states) and security connections states to a memory that is not erased during outages. It is recommended that the IMS Residential Gateway and the local UAs authenticate each other, and communicate using some security mechanism. The content of these security measures are out of the scope of the present document.

If the IMS Residential Gateway has phone capabilities by itself, then that phone should be treated like any other local phone.

NOTE 1: A typical IMS Residential Gateway would work as follows. When the IMS Residential Gateway device is switched on, and the first local UA is registered, then the IMS Residential Gateway registers the IMS Residential Gateway identity. The gateway identity is one of the public user identities that are stored to the ISIM. IMS Residential Gateway gets all the associated URIs from P-Associated-URI header field during the registration of explicit line identity. Then the IMS Residential Gateway continues processing the local registration request, assuming that the local registration request is related to one of the associated Public User Identities. After these steps the IMS Residential Gateway should monitor the registration state by subscribing to the registration event package in S-CSCF. Subsequent local registration requests do not initiate the registration of explicit line identity. The incoming calls that are directed to the IMS Residential Gateway identity are automatically directed to all connected UAs. Personal identities are always explicitly registered, and incoming calls to them are always directed only to associated UAs.

NOTE 2: Devices that have an ISIM do not have to use IMS Residential Gateway.

NOTE 3: How to secure the link(s) between UE and IRG is outside the scope of the present document.

Annex B includes some informative implementation notes on the IMS Residential Gateway.

Annex A (informative): NGN-relevant security interfaces:

This clause identifies the security interfaces that are relevant in NGN. This annex extracts relevant material from other NGN specifications.

A.1 Network attachment security interfaces

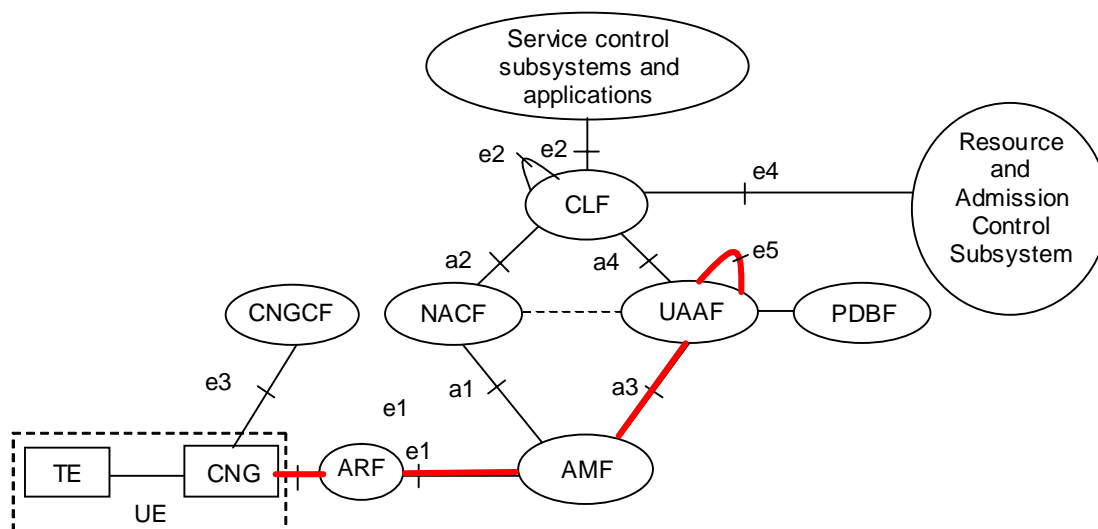
The Network Attachment Subsystem provides the following security functionalities; see [6], clause 4.1:

- User authentication taking place prior or during the IP address allocation procedure.
- Authorization of network access based on user profiles.

The Network Attachment Subsystem (NASS) comprises the following security related functional entities that are relevant for Access Domain Security:

- **Customer Network Gateway (CNG)** requests access from the network.
- The **Access Management Function (AMF)** (see [6], clause 5.2.2) forwards requests to the User Access Authorization Function (UAAF) to authenticate the user, authorize or deny the network access, and retrieve user-specific access configuration parameters.
In case PPP is applied, the AMF terminates the PPP connection and provides the inter-working with the reference point to the network attachment subsystem e.g. using an AAA protocol (RADIUS or Diameter). The AMF acts as a RADIUS client if the UAAF is implemented in a RADIUS server (the AMF terminates the PPP and translates it to signalling on the a3 reference point).
- **User Access Authorization Function (UAAF)** (see [6], clause 5.2.4) performs user authentication, as well as authorization checking, based on user profiles, for network access. For each user, the UAAF retrieves authentication data and access authorization information from the user network profile contained in the Profile Data Base Function (PDBF). The UAAF also collects accounting data for the changing of the service usage. The User Access Authorization Function (UAAF) acting as proxy can locate and communicate with the UAAF acting as server which can visit the PDBF user authentication data stored in, and forward access and authorization requests, as well as accounting messages, received from the AMF, to the UAAF acting as server. Responses received back in return from the UAAF acting as server will be forwarded to the AMF.
- The **Profile Database Function (PDBF)** (see [6], clause 5.2.5) is the functional entity that contains user authentication data (e.g. user identity, list of supported authentication methods, authentication keys...) and information related to the required network access configuration: these data are called "user network profile". In this release the reference point between UAAF and PDBF is not specified, i.e. UAAF and PDBF are either collocated or connected by a non-standardized interface.
The PDBF can be co-located with the UPSF (described in [3]) where this makes sense in the context on the business models being supported (e.g. if the same provider operates both the IP connectivity services and the IMS services).

Figure A.1 provides an overview of the relationships between these functional entities and related reference points. Further details about these and other NASS functionalities and the complete NASS architecture can be found in [6], clause 5.1.



NOTE: UAAF and PDBF are either co-located, or an interface exists among both FEs. This interface is not specified in NGN Release 1 and is left as for further study.

Figure A.1: NASS functions involved with secure network attachment [6]

A.1.1 Reference Point e1 (CNG - AMF)

This reference point enables the user equipment to provide user credentials (password, token, certificate, etc.) to the Network Attachment Subsystem (NASS) in order to perform network access authentication. This reference point may also enable the NASS to provide authentication parameter to the UE to perform the network authentication when mutual authentication procedure is required. Based on the authentication result, the NASS authorizes or denies the network access to the user equipment; see also [6], clause 5.5.2.

A.1.2 Reference Point e2 (CLF - AF)

This reference point enables applications and service control subsystems to retrieve from the CLF network location information. The primary parameter to retrieve the location information shall be the Assigned IP address allocated to the UE; see also [6], clause 5.5.1.

The form of location information that is provided by the CLF depends on the requestor.

The following information flows are used on the CLF to AF reference point:

- Location Information Query.
- Location Information Response.

A.1.3 Reference Point a3 (AMF - UAAF)

This reference point allows the AMF to request the UAAF for user authentication and network subscription checking; see also [6], clause 5.5.3.

A.1.4 Reference Point e5 (UAAF - UAAF)

This reference point is intended to be used by a UAAF proxy and a UAAF server, which may be in different administrative domains. This reference point allows the UAAF-proxy to request the UAAF-server for user authentication and authorization, based on user profiles. It also allows the UAAF-proxy to forward accounting data for the particular user session to the UAAF-server; see also [6], clause 5.3.6.

A.2.1.2 Reference Point Cx (CSCF - UPSF)

The Cx reference point supports information transfer between CSCF and UPSF. Further information on the Cx reference point is provided in [27], clause 9.3.2. The following security related procedures are supported:

- 1) Procedures related to authorization (e.g. checking of roaming agreement).
- 2) Procedures related to authentication: transfer of security parameters of the subscriber between UPSF and CSCF.

Cx reference point shall support IMS AKA as mandatory authentication mechanism.

A.2.1.3 Reference Point Gq' (P-CSCF - RACS)

The Gq' reference point is used by P-CSCF to reserve resources from the transport layer; see [27], clause 5.3.2. Important security functionality is related to traffic filtering. C-BGF filters unauthorized media streams, i.e. it only passes media packets through if P-CSCF has authorized them. P-CSCF uses the content of SDP payload of existing SIP sessions when making the authorization decisions.

A.2.1.4 Reference Point Iw (IWF - non-compatible SIP)

Interconnection with external networks supporting a non-compatible version of SIP is performed at the Iw reference point, via the IWF, see [27]. This interface may support TLS as specified in [9].

A.2.1.5 Reference Point Ic (IBCF - IMS)

IP-based interconnection with external networks supporting IMS is performed at the Ic reference point, via the IBCF; see [27], [28]. Ic interface is protected using 3GPP Network Domain Security as specified in [9].

Network Domain Security refers to security within a NGN operator domain and between NGN operator domains that have a fixed roaming agreement. NGN Domains are networks that are managed by a single administrative authority. The same level of security and usage of security services will be typical within a NGN Domain. A network operated by a single operator will typically constitute one NGN Domain although an operator may subsection its network into separate sub-networks.

A.2.1.6 Reference Point Id (IBCF - I-BGF)

Id interface is used by IBCF to reserve resources from the transport layer. Important security functionality is related to traffic filtering. I-BGF filters unauthorized media streams, i.e. it only passes media packets through if IBCF has authorized them. IBCF uses the content of SDP payload of existing SIP sessions when making the authorization decisions.

Id reference point is seen as internal interface in the operator network. Network configuration shall take care that this interface is not accessible outside the trust domain.

A.2.1.7 Reference Point Ut (UE - AS)

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.

[7] defines the Ut interface between a UE and an AS for the purpose of manipulating user controlled setting and variables at the AS; see figure A.3.

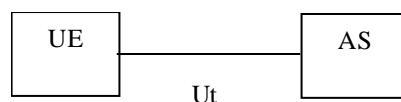


Figure A.3: Ut interface

Ut interface is protected with TLS. Authentication may be based on the Generic Authentication Architecture (GAA) as defined in [12] or the HTTP Digest mechanisms defined [39].

A.3 Interconnection security interfaces

NGN may interconnect with several types of networks, e.g. at the service layer with SS7-based networks or IP-based networks, and at the transfer level with TDM-based or with IP-based networks. Interconnection may take place within the NGN trust domain, or between NGN and non-NGN trust domains. More details of NGN Release 1 interconnections are available in [3] and in [27]. Figure A.4 represents IP-based interconnection.

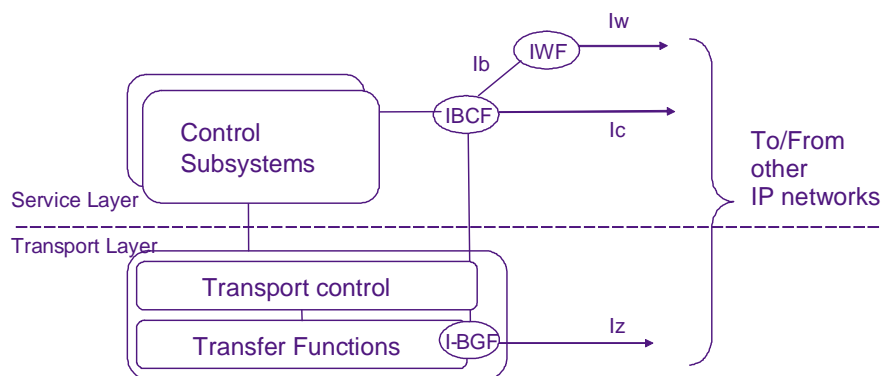


Figure A.4: IP Interconnection [3]

Figure A.5 illustrates the case where no I-BGF is inserted. Figure A.6 illustrates the case where an I-BGF is inserted by the visited network; see also [27].

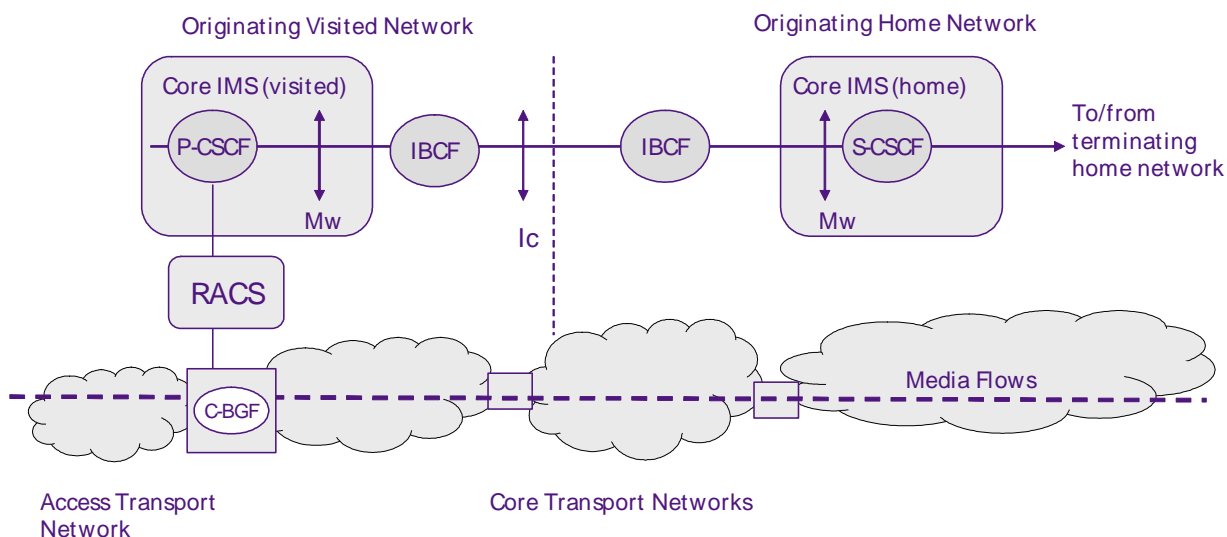
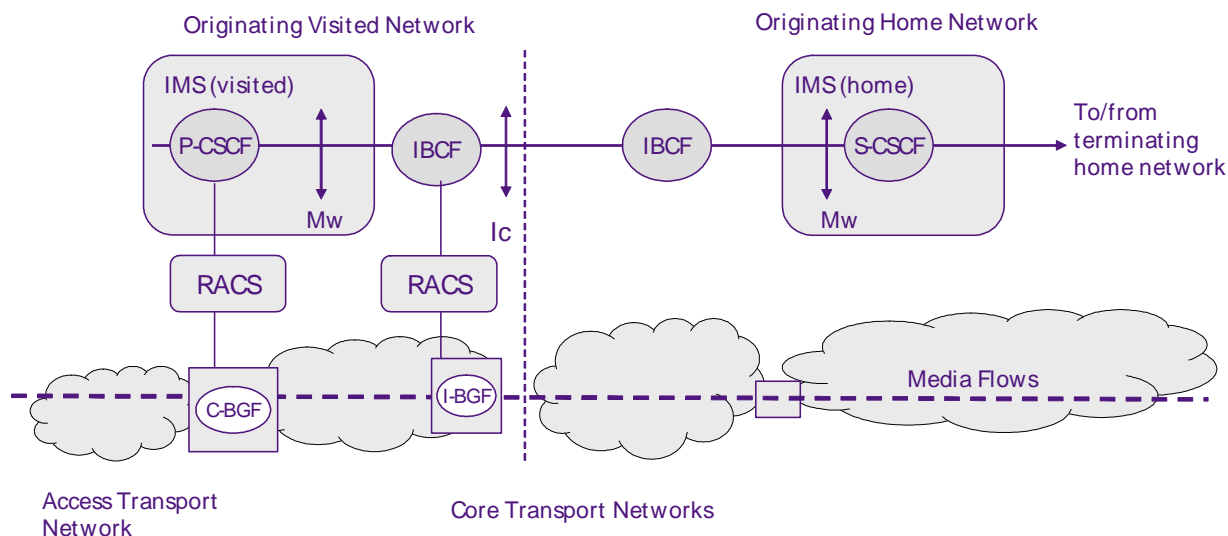


Figure A.5: IMS interconnect scenario without I-BGF [27]



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

Figure A.6: IMS interconnect scenario with I-BGF [27]

[28] describes further interconnect scenarios showing usage of the optional IBCF.

A.3.1 Interconnecting security at the transport layer

Iz interface is used by IBCF to reserve resources from the transport layer. Important security functionality is related to firewall control. I-BGF act as the so-called "pinhole firewall" for media streams, i.e. it only passes media packets through if IBCF has authorized them. IBCF uses the content of SDP payload of existing SIP sessions when making the authorization decisions.

Iz reference point is seen as internal interface in the operator network. Network configuration shall take care that this interface is not accessible outside the trust domain.

A.3.2 Interconnecting security at the service layer

Security measures when interconnecting with SS7 networks are out of the scope of the present document.

IP-based interconnection with external networks supporting is performed at the Ic reference point, via the IBCF.

Annex B (informative): Mapping of NGN R1 Security Requirements to Security Services

Table B.1 identifies which security functions (AUTH, AUTHOR, KM, CONF, INT, PEF) are required in the NGN R1 security architecture to fulfil the NGN R1 security requirements [1].

Table B.1: Mapping of NGN-R1 requirements to security functions

Requirement Reference	Statement of Requirement	Specific Security Function required ?	Security Functional Element
Security Policy Requirements			
R-SP-1	The NGN network shall be logically and physically divided into security domains allowing for separation of application (e.g. IMS) and transport (e.g. ADSL or UMTS). Also different operators of similar networks (e.g. IMS) shall be able to operate their own security policies.	No NOTE: The split is a mandate of the regulatory regime but of itself does not require security functional entities, however at deployment the logical and physical separation requires that at the FE level some consideration has to be made for the existence of relay or proxy functions.	
R-SP-2	Security mechanisms and other parameters beyond default security mechanisms shall be configurable. This shall be static for NNI interface and may be negotiated for UNI interfaces. The security mechanism negotiation shall have a certain minimum level to be defined by the security domain; e.g. avoid bidding-down attacks. Users shall be able to reject communications that do not conform to their minimum security policy.	No	
R-SP-3	The security mechanisms shall be partitioned such that the functions of authentication, data integrity, replay detection, and confidentiality may be implemented and selected independently of each other, insofar as this makes sense.	No	
R-SP-4	The UE shall always offer encryption algorithms for P-CSCF to be used for the session and the P-CSCF policy shall define whether to use encryption or not.	No NOTE: The detail definition of the UE is considered out of scope of NGN. However for confidentiality functions the configuration protocol should be capable of algorithm selection.	
R-SP-5	UE and the P CSCF shall negotiate the integrity algorithm that shall be used for the session.	Yes	KM
R-SP-6	The policy of the HN shall be used to decide if an authentication shall take place for the registration of different IMPUs e.g. belonging to same or different service profiles.	Yes	PEF, AUTH
R-SP-7	The security gateway functions (SEGF) shall be responsible for enforcing security policies for the interworking between networks. NOTE: The actual inter-security domain policy is not standardized and is left to the discretion of the roaming agreements of the operators.	Yes	PEF
R-SP-8	SEGFs are responsible for security sensitive operations and shall offer capabilities for secure storage of long-term keys used for IKE authentication.	Yes	SEGF, AUTH
Authentication, Authorization, Access Control and Accountability Requirements			
R-AA-1	Access to NGN networks, services, and applications shall be provided for authorized users only.	Yes	PEF, AUTHORF
R-AA-2	NGN R1 IMS authentication shall support early deployment scenarios (with support for legacy equipments).	No	

Requirement Reference	Statement of Requirement	Specific Security Function required ?	Security Functional Element
R-AA-3	In non-early deployment scenarios, IMS authentication shall be independent from access authentication.	No	
R-AA-4	An ISIM shall be used to access any IMS service, however, exceptions may be allowed for emergency calls and early deployment scenarios.	No. Insofar as ISIM is not detectable at the interface between UE and NGN. NOTE: In the provision phase rather than in the activation phase the role of ISIM is clearer.	
R-AA-5	ISIM based Authentication between the IMS-subscriber and the network shall comply to the authentication part of Access Security for IP-based services [8].	No	
R-AA-6	ISIM based Re-authentication of an IMS-subscriber shall comply to the authentication part of Access Security for IP-based services [8].	No	
R-AA-7	It shall be possible to prevent the use of a particular ISIM to access NGN networks and services and it should be possible to revoke a specific ISIM.	Yes	PEF
R-AA-8	NGN relevant ISIM specific information shall be protected against unauthorized access or alteration.	No	
R-AA-9	User authentication may either be hardware-based (for 3GPP UE: ISIM; i.e. proof by possession of a physical token) or be software-based (i.e. proof by knowledge of some secret information).	No	
R-AA-10	User Authentication to the NGN IMS using SIP Digest mechanisms shall be supported as a early deployment scenario.	Yes	AUTH
R-AA-11	Where both Digest and ISIM solutions are deployed by an NGN IMS operator, that operator shall determine the authentication mechanism (SIP Digest or ISIM-based) on a per-user basis. The authentication mechanism shall be enforced according to both the subscription information in the user's service profile and the specific policies of the NGN IMS operator.	Yes	PEF
R-AA-12	Transmitted passwords shall be sufficiently protected; e.g. by encryption or other techniques.	Yes	CONF, INTF
R-AA-13	For the special early deployment scenarios (see note 1), where IMS authentication is linked to access authentication, it shall be possible to gain access to IMS services after an authentication procedure. This authentication provides simultaneous access to the access network and IMS services. NOTE 1: The two special early deployment scenarios are (also referred to as NASS Bundled authentication): (A). IMS authentication is linked to access line authentication (no nomadicity) (B). IMS authentication is linked to access authentication for IP Connectivity (limited nomadicity can be provided). NOTE 2: Access authentication may result in IMS services being tied to the access point (line) or to the current IP Connectivity (device). In the latter case limited nomadicity may be available. No IMS specific authentication is therefore required from the CPE/Terminal to gain access to IMS services.	Yes	AUTH
R-AA-14	The NGN subsystems shall be able to define and enforce policy with respect to validity of user authorization.	Yes	PEF
R-AA-15	Mutual authentication shall be supported between the UE and the AS before providing authorization.	Yes	AUTH, AUTHOR

Requirement Reference	Statement of Requirement	Specific Security Function required ?	Security Functional Element
R-AA-16	It SHOULD also be possible to support an Authentication Proxy based architecture. NOTE: The purpose of the AP is to separate the authentication procedure and the AS specific application logic to different logical entities.	Yes	AUTH
R-AA-17	Mutual authentication shall be supported between the UE and the AP.	Yes	AUTH
R-AA-18	The AP shall decide whether a particular subscriber (i.e. the UE), is authorized to access a particular AS.	Yes	AUTHOR
R-AA-19	If an AP is used, the AS shall only authorize the access request to the requested resource. NOTE: The AS does not need to explicitly authenticate the user.	Yes	AUTHOR
R-AA-20	Mutual authentication should be supported between the UE and the NASS during access network level registration.	Yes	AUTH
R-AA-21	The access network shall be able to authenticate and authorize the access subscriber.	Yes	AUTH, AUTHOR
R-AA-22	Authentication and authorization to the Access Network is controlled by the operator of the Access Network.	Yes	AUTH, AUTHOR, PEF
R-AA-23	The attributes required for authentication of a user by the access network maybe provided by the network operator to whom the user has a NGN IMS subscription.	Yes	AUTHOR
R-AA-24	NASS shall support both the use explicit (e.g. PPP or IEEE 802.1x [45]) and/or implicit line authentication (e.g. MAC address authentication or line authentication) of the users/subscribers. In the case of the implicit access authentication, it shall rely only on an implicit authentication through physical or logic identity on the layer 2 (L2) transport layer.	Yes	AUTH
R-AA-25	In case the CNG is a routing modem and the Customer Premises Network (CPN) is a private IP realm, authentication shall be initiated from the CNG.	Yes	AUTH, PEF
R-AA-26	In case the CNG is a bridge, each UE shall authenticate with the NASS as the IP realm in the CPN is known to the Access Network.	Yes	AUTH
R-AA-27	As the interface between the Application Function (AF) and RACS can be inter-operator, the RACS shall authenticate and authorize the Application Function (AF).	Yes	AUTH, AUTHOR
R-AA-28	A media gateway controller must be able to handle authentication of multiple media gateways, i.e. to maintain multiple security associations with different media gateways.	Yes	AUTH
R-AA-29	Authentication of NGN users and authentication of NGN terminals shall be separate.	No	
R-AA-30	Caller id and location information shall be stored according to the Common European regulatory framework by the EMTEL Service Provider. Caller ID and location information shall be validated by the EMTEL Service Provider.	No	
Identity and Secure Registration Requirements			
R-IR-1	It shall be possible to implicitly register IMPU(s). The implicitly registered IMPU(s) all belong to the same Service Profile. All the IMPU(s) being implicitly registered shall be delivered by the HSS to the S-CSCF and subsequently to the P-CSCF. The S-CSCF shall regard all implicitly registered IMPU(s) as registered IMPU(s).	No	
R-IR-2	An access identity shall be used for access authentication. This identity may or may not be used for other purposes.	No	

Requirement Reference	Statement of Requirement	Specific Security Function required ?	Security Functional Element
R-IR-3	The line ID shall be possible to use for line authentication.	No NOTE: Identity and the association of identity to service does not imply an FE but may imply an information element within an information flow.	
Communications and Data Security Requirements			
R-CD-1	Confidentiality and integrity of IMS signalling shall be applied in a hop-to-hop fashion. (UE-to-P-CSCF and among other NEs).	Yes	CONF, INTF
R-CD-2	Network Domain Security (NDS) shall be provided at the network layer and comply to [9].	Yes	SEGF(AUTH, AUTHOR, KM, CONF, INT, PEF)
R-CD-3	All NDS/IP traffic shall pass through a SEGF (Security Gateway Function) before entering or leaving the security domain. IMS operators shall operate NDS/IP Za interface between SEGFs according to [9].	Yes	SEGF(AUTH, AUTHOR, KM, CONF, INT, PEF)
R-CD-4	Security shall be provided within the network domain for the Cx interface.	Yes	SEGF(AUTH, AUTHOR, KM, CONF, INT, PEF)
R-CD-5	An ISIM based solution for IMS access security (authentication, confidentiality and integrity protection) of signalling to and from the user, shall be supported.	Yes	AUTH, INT, CONF
R-CD-6	Secure link shall be provided between UE and the P-CSCF for protection of the Gm reference point.	Yes	AUTH, AUTHOR, CONF, INT
R-CD-7	In case access authentication is independent from IMS authentication: <ul style="list-style-type: none"> Solutions for access to the NGN core shall provide for secure transfer of signalling to the NGN core independent of the access technology. Solutions for access to the NGN core shall provide for secure transfer of signalling to the NGN core independent of the presence of intermediate IP networks connecting the NGN access with the NGN core. Solutions for access to the NGN core shall allow for mutual authentication of end user and NGN core. It shall be possible for the terminal to authenticate the user. 	Yes	CONF, INT, AUTH, AUTHOR
R-CD-8	In the case where IMS authentication is linked to access line authentication the underlying access technology shall provide protection of NGN signalling and user data.	No	
R-CD-9	ISIM specific information shall be updated in a secure manner.	No	
R-CD-10	It shall be possible to protect sensitive data (such as Presence information and notifications) from attacks (e.g. eavesdropping, tampering, and replay attacks).	Yes	CONF, INT, AUTH, AUTHOR
R-CD-11	The Rq and Gq' reference points shall provide mechanism to assure security of the information exchanged.	Yes	SEGF(AUTH, AUTHOR, KM, CONF, INT, PEF)
R-CD-12	All data related to configuring the UE through the e3 if shall be protected against loss of confidentiality and against loss of integrity.	Yes	AUTH, AUTHOR, KM, CONF, INT, PEF
Integrity and Replay Protection Requirements			

Requirement Reference	Statement of Requirement	Specific Security Function required ?	Security Functional Element
R-CD-13	Integrity protection of signalling, control communications and of stored data shall be provided.	Yes	INT, AUTH, AUTHOR
R-CD-14	It shall be possible to ensure the origin, integrity and freshness of authentication data, particularly of the cipher key.	Yes	INT, AUTH, AUTHOR
R-CD-15	Integrity protection shall be applied between the UE and the P-CSCF for protecting the SIP signalling.	Yes	INT, AUTH, AUTHOR
R-CD-16	Integrity protection between Network Elements (e.g. between CSCFs, and between CSCFs and the HSS) shall rely on mechanisms specified by Network Domain Security in [9].	Yes	SEGF(AUTH, AUTHOR, KM, CONF, INT, PEF)
R-CD-17	Data integrity shall be supported between the UE and the Application Server.	Yes	INT, AUTH, AUTHOR
Confidentiality Requirements			
R-CD-18	Confidentiality of communications should be achieved by cryptographic encryption. Confidentiality of stored data shall be achieved by cryptographic encryption or by access controls.	Yes	CONF
R-CD-19	Confidentiality of signalling and control messages shall be enforced if required by the application or in environments where the security policy demands confidentiality. The mechanism should allow a choice in the algorithm to be used.	Yes	CONF
R-CD-20	IMS specific confidentiality protection shall be provided for the SIP signalling between UE and P-CSCF.	Yes	CONF
R-CD-21	Confidentiality protection between Network Functions (e.g. between CSCFs, or between CSCFs and the HSS) shall rely on mechanisms specified by Network Domain Security in [9].	Yes	SEGF(AUTH, AUTHOR, KM, CONF, INT, PEF)
R-CD-22	It shall be possible to protect the confidentiality of user-related data which is stored or processed by a provider.	Yes	CONF
Privacy Requirements			
R-P-1	It shall be possible to protect the network topology from exposure toward other domains. It shall also be possible for a security domains to define and implement protection against traffic analysis for signalling and management protocols.	Yes	PEF
R-P-2	User location and usage patterns shall be kept from unwanted disclosure.	Yes	PEF
R-P-3	It shall be possible to protect the confidentiality of user identity data.	Yes	CONF
R-P-4	Anonymous communication sessions shall be supported in NGN either in a permanent mode or in a temporary mode communication by call. In this case the originating party identity shall not be presented to the destination party. The network to which the destination party is connected to is responsible to handle this service.	Yes	PEF
R-P-5	NGN shall support the specific case where the destination party has an override right (e.g. emergency communication sessions), and the originating party identity is provided to the destination party independent whether or not this communication session is anonymous.	Yes	PEF
R-P-6	The Anonymous Communications Rejection (ACR) simulation service shall allow the served user to reject incoming communication from users or subscribers who have restricted the presentation of their originating identity according to the OIR simulation service.	Yes	PEF

Requirement Reference	Statement of Requirement	Specific Security Function required ?	Security Functional Element
R-P-7	The NGN shall support mechanisms for the network operator to guarantee the authenticity of a user identity presented for an incoming call to a user where the call is wholly within that operator's network (i.e. originating and terminating parties are subscribers to, and resident in, a single NGN).	Yes	PEF, AUTH
R-P-8	The NGN shall provide mechanisms that allow to present the identity of the session originator, if this is not restricted by the session originator.	Yes	PEF
R-P-9	The privacy aspect of presence information and the need for authorization before providing presence information shall be configurable by the user (i.e. presentativity).	No	
R-P-10	A principal of a presentativity shall, at any time, be able to control to whom, for how long and what (all or part of) presence information of the presentativity is provided, and a principal of a watcher shall, at any time, be able to control to whom, for how long and what (all or part of) watcher information of the watcher is provided.	Yes	PEF, AUTHOR
R-P-11	Any services using the presence information shall ensure privacy agreement before releasing presence information. The presence service does not address deployment specific issues (e.g. where agreements are stored or how they are negotiated). It only gives requirements for privacy management.	Yes	PEF
R-P-12	It shall be possible for the sender of the message to request to hide its public ID from the recipient.	No	
R-P-13	Users may select the Identity presented when starting a session or sending a message. It shall be possible to verify this identity and to initiate a session or message in reply.		
Key Management Requirements			
R-KM-1	Key management and key distribution between SEGFs shall comply to the Network Domain Security [9].	Yes	KM
R-KM-2	The UE and the AS shall be able to resume a previously established secure session.	Yes	KM
R-KM-3	The key management mechanism must be able to traverse a NAT/NATP device.	Yes	KM
NAT/Firewall Interworking Requirements			
R-NF-1	NGN security protocols shall work with commonly-used firewalls and shall work in environments with NAT/NATP.	No	
R-NF-2	Filters to screen the IP packets to restrict/grant access to specific bearer streams shall be supported.	Yes	PEF
R-NF-3	The SEGFs may include filtering policies and firewall functionality not required in [9].	Yes	PEF
Availability and DoS protection Requirements			
R-AD-1	Mechanisms shall be provided to mitigate denial-of-service attacks.	No	
R-AD-2	Provide access control mechanisms to ensure that authorized users only can access the service.	Yes	AUTHOR, PEF
R-AD-3	It shall be possible to prevent intruders from restricting the availability of services by logical means.	Yes	AUTHOR, PEF
R-AD-4	Availability of and accuracy of location information shall be provided for the EMTTEL services.	No	
R-AD-5	Availability of EMTTEL PSAPs shall not be decreased by DoS attacks. EMTTEL PSAPs shall be able to reconnect.	No	
Assurance Requirements			
R-AS-1	The NGN shall provide guidance for evaluating and certifying NGN equipment and systems.	No	

Requirement Reference	Statement of Requirement	Specific Security Function required ?	Security Functional Element
R-AS-2	Security implications of potential misuse of protocols used in NGN shall be documented through a TVRA. This enables users to assess the security they need before deploying the given protocol.	No	
Requirements on Strength of Security Mechanisms			
R-SS-1	The guidelines defined in ES 202 238 [44] shall be followed when defining or selecting cryptographic algorithms in NGN.	No	

Annex C (informative): Implementation notes on the IMS Residential Gateway

The following use cases describe how a non-ISIM SIP User Agent (UA) can register and establish calls via the SIP B2BUA within an IMS Residential Gateway. The use cases are based on [7]. The different parts are how the UA is connected and how the SIP B2BUA maps the identities and the messages.

It must be noted, that the operator must not define any implicit registration sets in HSS, on behalf of those ISIMs that are dedicated to B2BUAs.

C.1 B2BUA registration

The I-CSCF has been excluded in the use case just for simplification. It is still there in the real use case.

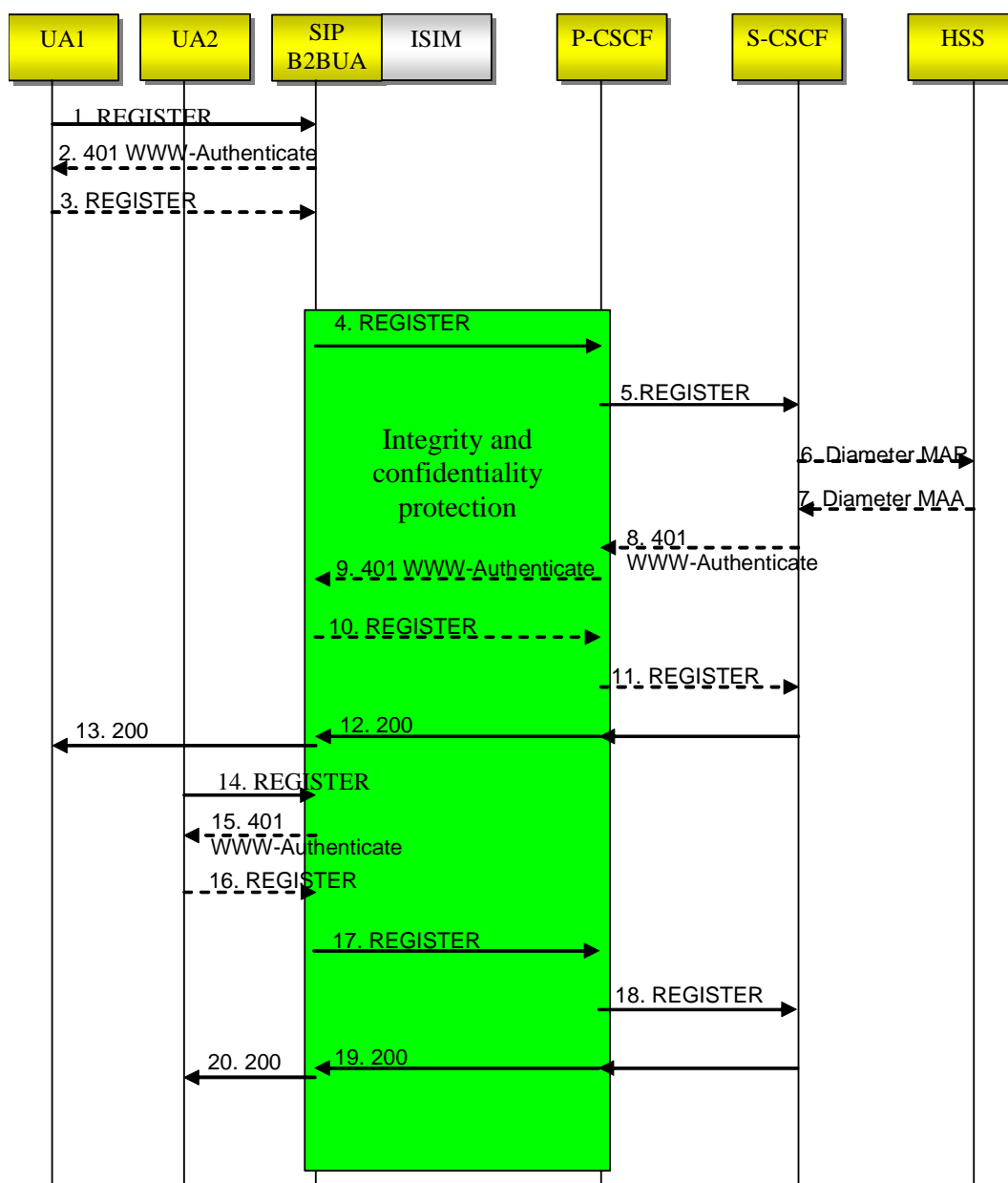


Figure C.1: IMS Residential Gateway registration message flow

- 1) The UA1 registers to the SIP B2BUA with a To header including a local username (bob) that is associated to the subscription for the ISIM.
example message:
REGISTER To: <sip:bob>
- 2) The B2BUA optionally challenges the user. The subscriber can for example locally configure if local users should be challenged and the passwords to use for the local users.
Example message:
401 WWW-Authenticate Digest
- 3) The UA1 resends the register message if challenged. The message then contains an Authorization header including the identity (bob) of the challenged user included in the username parameter.
Example message:
REGISTER Authorization Digest username=bob
- 4) The B2BUA use the Private User Identity stored in the ISIM as the username. The Contact header contains the IP address (or domain name) of the B2BUA. The selected Public User Identity in the To header is the value in the To header from the UA1 or a mapped name (bob.smith@operator.net) where a local username used by the UA1 is mapped to a Public User Identity. The subscriber can locally configure this mapping.
Example message:
REGISTER Authorization Digest username=IMPI, Security-Client To:<sip:bob.smith@>operator.net>
- 5) The P-CSCF sends the request to the S-CSCF after excluding some headers (Proxy-Require and Security-Client) and some header information (e.g. sec-agree from the Require header).
Example message:
REGISTER Authorization Digest username=IMPI
To:<sip:bob.smith@>operator.net>
- 6) The S-CSCF request authentication vectors from HSS in case the client must be authenticated and there are no authentication vectors. The client must initially be authenticated (indicated e.g. by the lack of a downloaded service profile).
Example message:
Diameter MAR
- 7) The HSS then returns one or several authentication vectors.
Example message:
Diameter MAA
- 8) The S-CSCF challenges the B2BUA/ISIM with a 401 including RAND and AUTN in case client authentication is necessary.
Example message:
401 WWW-Authenticate (RAND, AUTN)
- 9) The P-CSCF adds some headers to the 401 before sending it to the B2BUA.
Example message:
401 WWW-Authenticate (RAND, AUTN) Security-Server
- 10) The B2BUA calculates a RES and verifies the AUTN if challenged by a 401. The B2BUA then sends a new REGISTER including an Authorization header with the digest where RES has been used as the shared key.
Example message:
REGISTER Authorization username=IMPI, RES Security-Client, Security-Verify
To:<sip:bob.smith@>operator.net>
- 11) The P-CSCF sends the request to the S-CSCF after excluding some headers (Proxy-Require, Security-Verify and Security-Client) and some header information (e.g. sec-agree from the Require header). The S-CSCF verifies the digest based on RES from the B2BUA with the digest calculated with XRES. This is only necessary if the B2BUA has been challenged.
Example message:
REGISTER Authorization Username=IMPI, RES
To:<sip:bob.smith@>operator.net>
- 12) The S-CSCF responds with a 200 including Path, Service-Route and P-Associated-URI headers.
Example message:
200 Path Service-Route P-Associated-URI

- 13) The B2BUA stores the content of the Service-Route and P-Associated-URI headers and then removes the Path, Service-Route and P-Associated-URI headers before sending a 200 to the UA1.
Example message:
200
- 14) The UA2 registers to the SIP B2BUA with a To header including a local username (alice) that is associated to the subscription for the ISIM.
Example message:
REGISTER To: <sip:alice>
- 15) The B2BUA optionally challenges the user.
Example message:
401 WWW-Authenticate Digest
- 16) The UA2 resends the register message if challenged. The message then contains an Authorization header including the identity (alice) of the challenged user included in the username parameter.
Example message:
REGISTER Authorization Digest username=alice
- 17) The B2BUA use the Private User Identity stored in the ISIM as the username. The selected Public User Identity in the To header is the mapped name (alice.smith@operator.net).
Example message:
REGISTER Authorization username=IMPI, Security-Client Security-Verify
To:<sip:alice.smith@operator.net>
- 18) The P-CSCF sends the request to the S-CSCF after excluding some headers (Proxy-Require, Security-Verify and Security-Client) and some header information (e.g. sec-agree from the Require header).
Example message:
REGISTER Authorization: username=IMPI,
To: <sip:alice.smith@operator.net>
- 19) Since the S-CSCF has already authenticated the Private User Identity (there is a service context) there is no need to do it again. The S-CSCF responds with a 200 including Path, Service-Route and P-Associated-URI headers.
Example message:
200 Path Service-Route P-Associated-URI
- 20) The B2BUA stores the content of the Service-Route and P-Associated-URI headers and then removes the Path, Service-Route and P-Associated-URI headers before sending a 200 to the UA1.
Example message:
200

C.2 B2BUA originating session establishment

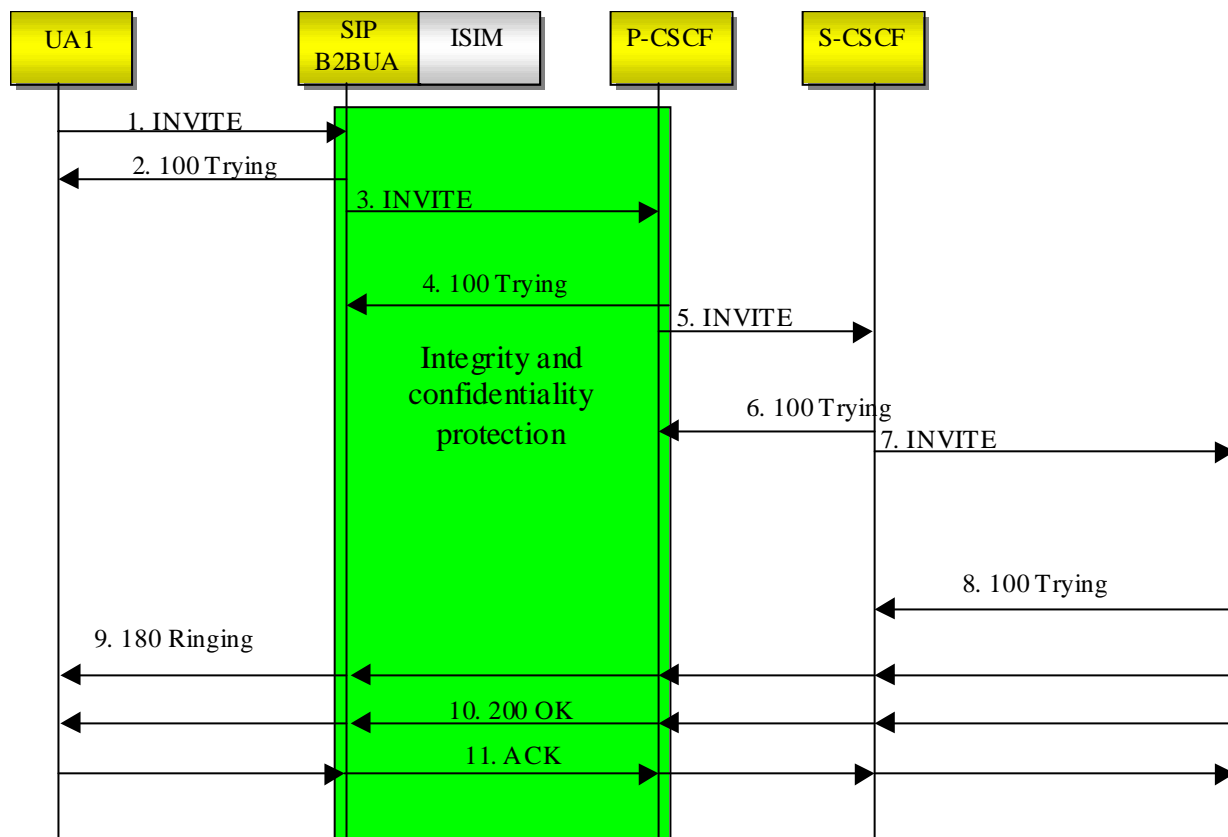


Figure C.2: B2BUA originating session establishment message flow

- 1) The UA1 sends an INVITE to the B2BUA:
Example message:
INVITE sip:carl.jones@otheroper.net Contact <sip:192.168.1.2> From: <sip:bob>
- 2) The B2BUA responds with a 100 Trying.
- 3) The B2BUA adds some headers to the INVITE message. The From header is converted to the Public User Identity that is equal to the personal identity for the user. The P-Preferred-Identity header contains as well the personal identity. The B2BUA changes the Contact header and sends the INVITE to the P-CSCF.
Example message:
INVITE sip:carl.jones@otheroper.net Contact <sip:130.1.2.3 :5678>
From:<sip:bob.smith@operator.net>
- 4) The P-CSCF responds with 100 Trying.
Example message:
100 Trying
- 5) The P-CSCF removes the P-Preferred-Identity and inserts instead a P-Asserted-Identity that contains the content of P-Preferred-Identity if that was authorized from the network point of view. The P-CSCF then sends the INVITE to the S-CSCF.
Example message:
INVITE sip:carl.jones@otheroper.net Contact <sip: 130.1.2.3 :5678>
From:<sip:bob.smith@operator.net>
- 6) The S-CSCF responds with 100 Trying.
Example message:
100 Trying

- 7) The S-CSCF removes the P-Access-Network-Info before the INVITE is sent out from the network.
Example message:
INVITE sip:carl.jones@otheroper.net
Contact <sip: 130.1.2.3 :5678>
From:<sip:bob.smith@operator.net>
- 8) A remote CSCF responds with 100 Trying.
Example message:
100 Trying
- 9) The other party sends a 180 Ringing
Example message:
180 Ringing Record-Route
- 10) The other party sends a 200 OK
Example message:
200 OK Record-Route SDP
- 11) The UA1 acknowledges the 200 OK with an ACK.
Example message:
ACK

C.3 B2BUA terminating session establishment

The I-CSCF and HSS are excluded for simplicity. The I-CSCF is the initial point of contact.

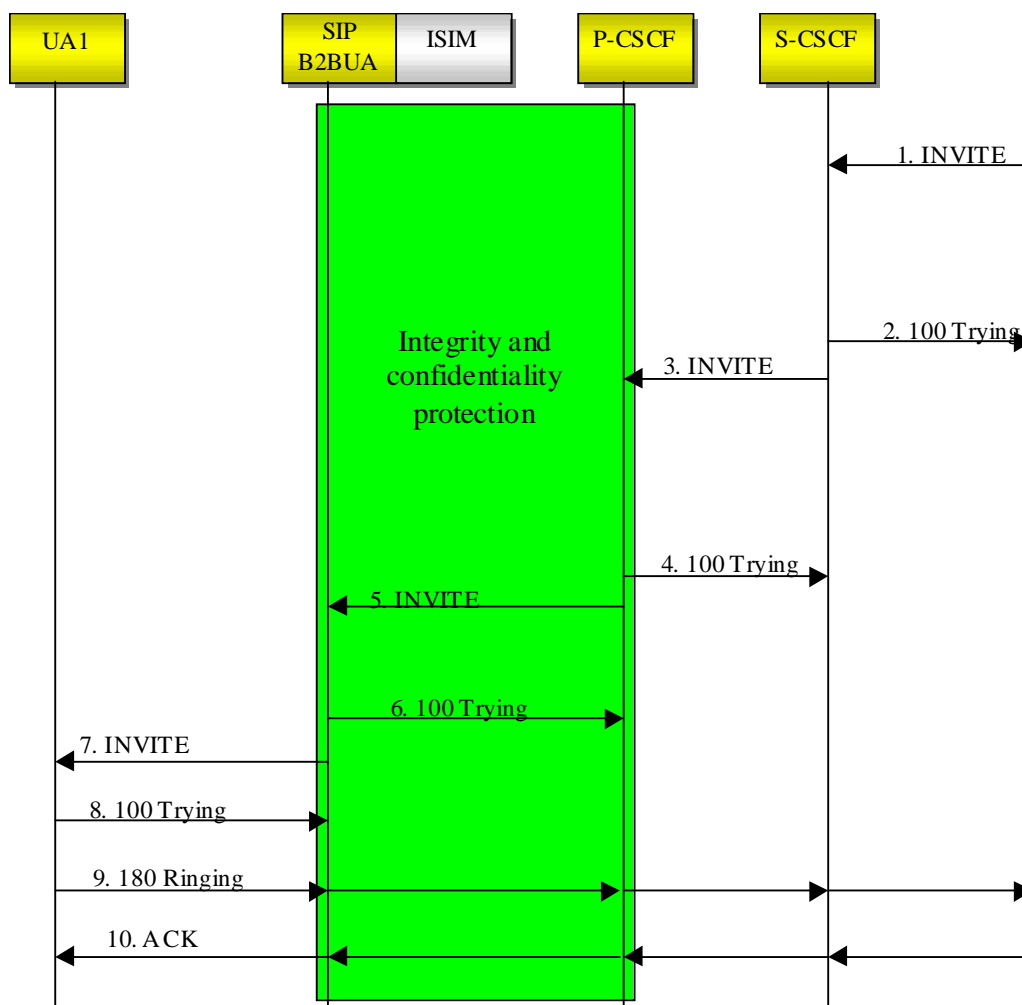


Figure C.3: B2BUA terminating session establishment message flow

- 1) The remote UA sends an INVITE to the S-CSCF.
Example message:
INVITE sip:bob.smith@operator.net
Contact <sip:132.100.101.102 :7654>
From:<sip:carl.jones@otheroperator.net>
- 2) The S-CSCF responds with 100 Trying.
Example message:
100 Trying
- 3) The S-CSCF picks the contact address stored at registration and inserts it as the Request-URI. The S-CSCF inserts the original Request-URI in the P-Called-Party-ID header and sends the INVITE to the P-CSCF.
Example message:
INVITE sip:130.1.2.3 :5678
Contact <sip:132.100.101.102 :7654>
From:<sip:carl.jones@otheroperator.net>
- 4) The P-CSCF responds with 100 Trying.
Example message:
100 Trying
- 5) The P-CSCF removes the P-Charging-Vector and sends the INVITE to the B2BUA.
Example message:
INVITE sip:130.1.2.3 :5678 Contact <sip:132.100.101.102 :7654>
From:<sip:carl.jones@otheroperator.net>
- 6) The B2BUA responds with 100 Trying.
Example message:
100 Trying
- 7) The B2BUA uses the Request-URI in the received request to find the home user that has previously registered. The Request-URI is replaced with the locally stored contact address. The B2BUA sends the INVITE to the UA1.
Example message:
INVITE sip:192.168.1.2 Contact <sip:192.168.1.1> From:<sip:carl.jones@otheroperator.net>
- 8) The UA1 responds with 100 Trying.
Example message:
100 Trying
- 9) The UA1 responds with 180 Trying.
Example message:
180 Trying
- 10) The remote UA sends an ACK to the UA1 via the S-CSCF and P-CSCF.
Example message:
180 Ringing

Annex D (informative): Supplementary Information on NASS-IMS Bundled Authentication

D.1 Flow Diagram for NASS Bundled Authentication

This clause describes how clients authenticate to NASS and simultaneously also gain service layer authentication using the "single-sign-on" NASS bundled authentication. The sequence diagram is depicted in figure D.1.

- 1) The UE gets network attachment after the authentication at the NASS level. The CLF in the NASS (network attachment subsystem) holds a binding between the IP address and the location information (contains the Line Identifier), which the user holds per the xDSL connectivity. The selection of the authentication (whether NBA is possible or not) is done at UPSF level on IMS-user basis.
- 2) As the SIP REGISTER message reaches P-CSCF, the P-CSCF knows whether or not a security association is required at this point, based on:
 - the SIP signalling;
 - presence of local policies (such as network interface);
 - L3/L2 address.

During the SIP registration, the P-CSCF locates the CLF based on the UE's IP address or/and based on the information of the access network from which the P-CSCF receives the IP packet (P-CSCF may have several logical/physical interfaces toward different Access Networks). P-CSCF performs a "Location Information Query" towards the CLF over the e2 interface. The key for the query is the IP address used by the UE.

- 3) The CLF sends the response to the P-CSCF including the location information of the UE.
- 4) The P-CSCF appends the NASS location information to the SIP REGISTER message and forwards the REGISTER message to I-CSCF and eventually to S-CSCF.
- 5) S-CSCF queries the UPSF over the Cx interface using MAR request.
- 6) The UPSF returns a message with the location information of the user identified by the IMPI and IMPU (if NASS Bundling is preferred authentication scheme).
- 7) S-CSCF finally authenticates by comparing the location info embedded in REGISTER message with location information received from the UPSF. If they match the user is successfully authenticated and 200 OK message is sent to the UE.

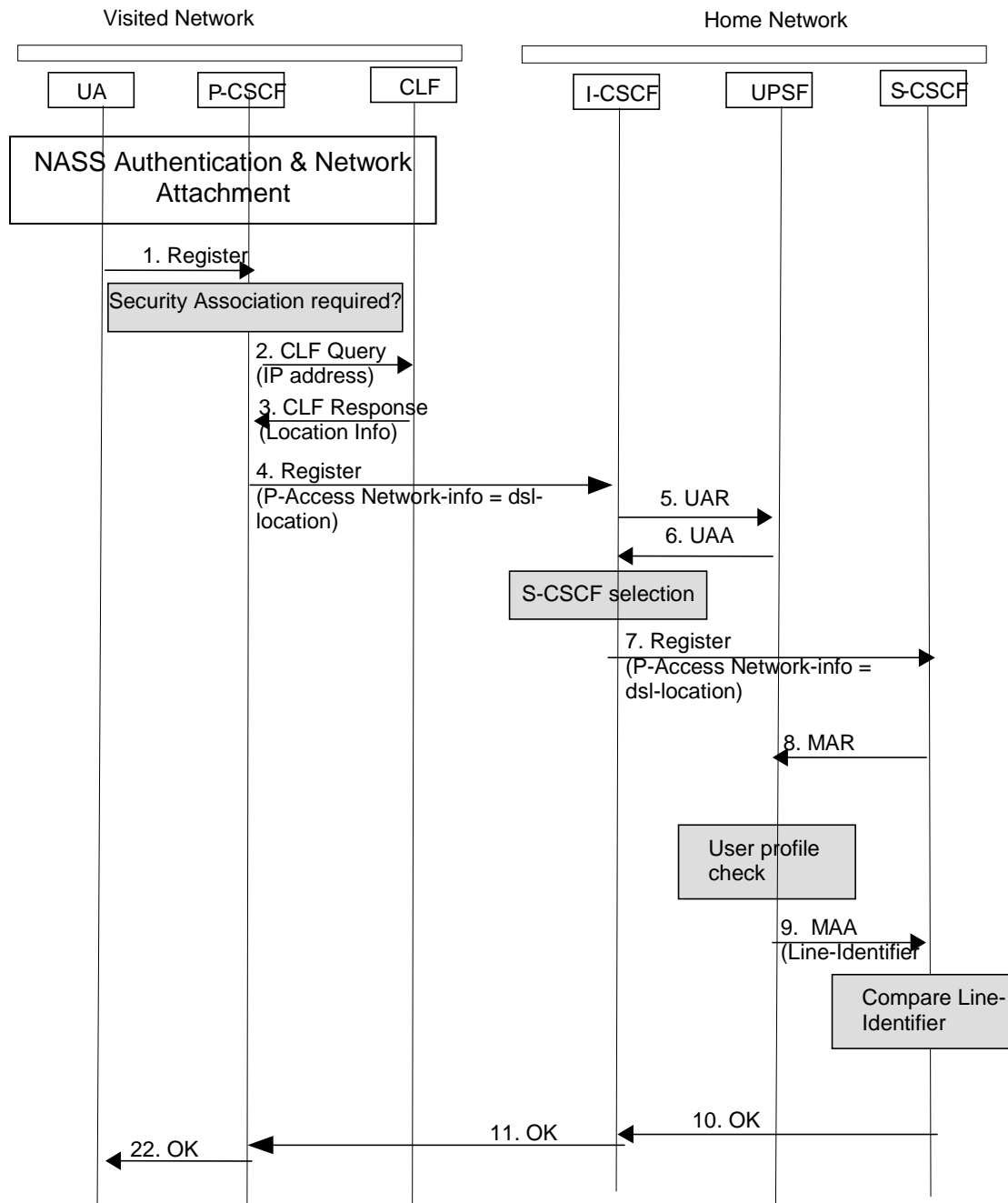


Figure D.1: Flow Diagram for NASS Bundled Authentication (see [7])

Annex E (informative): Open Issues in NGN Security

The following open issues are identified and remain as for further study:

- 1) ISIM chaining: Usage of ISIM in terminals connected through other ISIM-enabled entities (e.g. IRG).
- 2) PES/H.248 security: Investigate the H.248 security in case the NGN R1 assumptions do not apply.
- 3) Usage/licensing of 3GPP security algorithms in NGN context.
- 4) How to secure the Ic IF? SEGFs could be one possibility; security functions (e.g. integrated SEGF) as part of the IBCF could be another possibility. The current text is not clear on this.
- 5) Security aspects of Emergency Telecommunications are not addressed yet in the present document.

Annex F (informative): Bibliography

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History

Document history		
V1.1.1	March 2006	Publication