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Technical Specification

**Satellite Earth Stations and Systems (SES);
Broadband Satellite Multimedia (BSM);
Interworking and Integration of BSM
in Next Generation Networks (NGNs)**



Reference

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Contents

| | |
|--|----|
| Intellectual Property Rights | 5 |
| Foreword..... | 5 |
| Introduction | 5 |
| 1 Scope | 6 |
| 2 References | 6 |
| 2.1 Normative references | 6 |
| 2.2 Informative references..... | 6 |
| 3 Definitions and abbreviations..... | 7 |
| 3.1 Definitions | 7 |
| 3.2 Abbreviations | 8 |
| 4 NGN Impacts on BSM Networks..... | 10 |
| 4.1 Background | 10 |
| 4.2 NGN Network Architecture | 11 |
| 4.2.1 Service Stratum..... | 12 |
| 4.2.2 Transport Stratum | 12 |
| 4.2.2.1 Transport Control Sublayer..... | 12 |
| 4.2.2.2 Transport Processing Functions | 13 |
| 4.3 Service requirements | 13 |
| 4.3.1 General NGN Service Requirements | 13 |
| 4.3.2 BSM-Specific Service Requirements..... | 14 |
| 4.3.2.1 VOIP and convergence | 14 |
| 4.3.2.2 IPTV and IP video..... | 15 |
| 4.3.2.3 Live/linear TV | 15 |
| 4.3.2.4 Video on Demand (VoD)..... | 15 |
| 4.3.2.5 Emergency/Disaster Services | 15 |
| 4.3.2.6 Primary Infrastructure | 15 |
| 4.3.2.7 Infrastructure Support | 16 |
| 4.3.2.8 Smart Grid/telemetry..... | 16 |
| 4.4 Interworking requirements | 16 |
| 5 BSM/NGN Architecture..... | 16 |
| 5.1 BSM-Specific NGN Architecture..... | 16 |
| 5.2 Scenarios | 17 |
| 5.2.1 IMS Service Access - Star network-based (1) | 18 |
| 5.2.1.1 Message Flow Diagrams | 19 |
| 5.2.2 IMS Service Access - Mesh network based (2) | 21 |
| 5.2.2.1 Message Flow Diagrams | 21 |
| 5.2.3 Efficient IMS Peering (3) | 23 |
| 5.3 Detailed Functional Architecture..... | 23 |
| 5.3.1 BSM RACS | 23 |
| 5.3.1.1 SPDF..... | 24 |
| 5.3.1.2 A-RACF..... | 24 |
| 5.3.2 BSM NASS..... | 25 |
| 5.3.2.1 Network Access Configuration Function (NACF)..... | 26 |
| 5.3.2.2 Connectivity session Location and repository Function (CLF)..... | 26 |
| 5.3.2.3 User Authentication and Authorization Function (UAAF) | 26 |
| 5.3.2.4 Profile Data Base Function (PDBF)..... | 26 |
| 5.3.2.5 CNG Configuration Function (CNGCF)..... | 27 |
| 5.4 Interfaces and Reference Points | 27 |
| 6 BSM Adaptation Functions for NGN..... | 27 |
| 6.1 Signalling Application Server | 28 |
| 6.2 BSM IWF | 29 |
| 6.3 Mobile/Fixed Satellite System Convergence..... | 29 |

| | | |
|-------------------------------|--|-----------|
| Annex A (informative): | The IP Multimedia Subsystem (IMS) | 30 |
| A.1 | Overview | 30 |
| A.2 | IMS Logical Elements..... | 31 |
| A.2.1 | The Call Session Control Functions (CSCF)..... | 31 |
| A.2.2 | Media Gateway Control Function (MGCF) | 32 |
| A.2.3 | Multimedia Resource Function Controller (MRFC) | 32 |
| A.2.4 | Breakout Gateway Control Function (BGCF)..... | 32 |
| A.2.5 | Interconnection Border Control Function (IBCF)..... | 32 |
| Annex B (informative): | BSM/IMS Procedures | 33 |
| B.1 | ST Attachment and Initialization | 33 |
| B.1.1 | SIP Usage | 33 |
| B.1.2 | ST Attachment and Initialization Overview | 33 |
| B.2 | ST Registration..... | 35 |
| B.3 | The SIP-Based Service Discovery Mechanism..... | 35 |
| Annex C (informative): | Further Examples of BSM/NGN Scenarios | 36 |
| C.1 | BSM Access-only scenario | 36 |
| C.2 | Satellite-based IMS | 36 |
| C.3 | Enhanced Satellite-based IMS..... | 37 |
| Annex D (informative): | Bibliography | 38 |
| | History | 39 |

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

Introduction

The Next Generation Network (NGN) is seen as the future universal network based on IP into which different network technologies will be integrated. The BSM network [1] is an example of one of these technologies. Working groups at ETSI (TISPAN), ITU and others (3GPP, TMF etc) have defined many of the functional characteristics of the NGN [4], [8], [9] and their work is continuing.

The BSM network has been defined with many of the same features (IP protocol based packetised transport, modular and interoperable control plane elements, a largely access agnostic architecture, etc.) necessary for compatibility with the NGN. Hence the BSM network is a candidate for NGN integration.

The BSM system has also been defined as a functional architecture to implement IP-based services in a standardised way over a variety of satellite technologies, and with the potential to operate these services when the BSM network is integrated into heterogeneous networks [i.1], [i.2]. The BSM architecture is characterised by the SI-SAP which defines the separation between common Satellite-Independent (SI) protocol layers and alternative lower Satellite-Dependent (SD) layers [2]. In addition, interfaces with higher-layer protocols and peer external networks and customer equipment are provided where appropriate. This is also very compatible with the NGN architecture which wants to clearly distinguish between transport specific and service specific functions.

One of the main functional building blocks of the NGN is the IP Multimedia Subsystem (IMS) [6]. The IMS provides a means initially for fixed-mobile and now many network convergence and interworking functionality for IP-based services. These include today IPTV, fixed and mobile voice and presence, and potential new services like video conferencing, peer-peer gaming etc. in the future. The definition of the NGN and the specifications of the IMS core functionality are still evolving in the standards bodies, but are sufficiently mature and stable to be able to define the potential interactions with the BSM network. Basic BSM network services could be deployed over the current IMS, but as IMS-based networks and applications mature, converged BSM services can be offered in conjunction with other satellite and terrestrial wireline and wireless networks using a common subscriber management system and control plane.

The present document will specify how BSM networks can be integrated into the NGN architecture.

1 Scope

The integration and interoperability of BSM networks with the NGN is specified in terms of the functional architecture and associated functions and interfaces.

The present document is based on and uses TISPAN (release 2) definitions and terminology (since TISPAN release 3 is not yet fully specified).

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

- [1] ETSI TS 102 292: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM) services and architectures; Functional architecture for IP interworking with BSM networks".
- [2] ETSI TS 102 357: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); Common Air interface specification; Satellite Independent Service Access Point SI-SAP".
- [3] ETSI TS 102 462: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); QoS Functional Architecture".
- [4] ETSI TS 102 672: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); Management Functional Architecture".
- [5] ETSI ES 282 001: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Functional Architecture".
- [6] ETSI ES 282 007: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IP Multimedia Subsystem (IMS); Functional architecture".
- [7] ITU-T Recommendation Y.1291: "An architectural framework for support of Quality of Service in packet networks".
- [8] ITU-T Recommendation Y.2011: "General principles and general reference model for NGN".
- [9] ITU-T Recommendation Y.2012: "Functional requirements and architecture of NGN release 1".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI TR 101 984: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); Services and architectures".

- [i.2] ETSI TR 101 985: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP over Satellite".
- [i.3] ETSI TR 180 000: "Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); NGN Terminology".
- [i.4] ETSI TS 123 002: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Network architecture (3GPP TS 23.002)".
- [i.5] IETF RFC 3261: "Session Initiation Protocol".
- [i.6] IETF RFC 3320: "Signalling Compression (SIGCOMP)".
- [i.7] IETF RFC 5049: "Applying Signaling Compression (SigComp) to the Session Initiation Protocol (SIP)".

3 Definitions and abbreviations

3.1 Definitions

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

architecture: abstract representation of a communications system

NOTE: Three complementary types of architecture are defined:

- Functional Architecture: the discrete functional elements of the system and the associated logical interfaces.
- Network Architecture: the discrete physical (network) elements of the system and the associated physical interfaces.
- Protocol Architecture: the protocol stacks involved in the operation of the system and the associated peering relationships.

BSM Network: BSM subnetwork together with the BSM interworking and adaptation functions that are required to provide IP interfaces (i.e. layer 3 and below) to attached networks

BSM Subnetwork: all the BSM network elements below the Satellite Independent Service Access Point (SI-SAP)

BSM System (BSMS): BSM System comprises a BSM Network together with the NMC and NCC plus any additional elements that are required to provide the network services to the subscribers and their users

Connectivity-oriented Interconnection (CoIx): physical and logical linking of carriers and service providers based on simple IP connectivity irrespective of the levels of interoperability

control plane: plane that has a layered structure and performs the call control and connection control functions; it deals with the signalling necessary to set up, supervise and release calls and connections

flow (of IP packets): traffic associated with a given connection-oriented, or connectionless, packet sequence having the same 5-tuple of source address, destination address, Source Port, Destination Port, and Protocol type

forwarding: process of relaying a packet from source to destination through intermediate network segments and nodes

NOTE: The forwarding decision is based on information that is already available in the routing table. The decision on how to construct that routing table is the routing decision.

IP Television (IPTV): operator controlled IP based TV service

NOTE: IPTV is a cable/satellite replacement service that uses multicast over a private IP network.

network Control Centre: equipment at OSI Layer 2 that controls the access of terminals to a satellite network, including element management and resource management functionality

Next Generation Network (NGN): packet-based network able to provide services including Telecommunication Services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies

NOTE: It offers unrestricted access by users to different service providers. It supports generalized mobility, which will allow consistent and ubiquitous provision of services to users. See ETSI [i.3] and ITU [7].

new generation network: See Next Generation Network.

nomadicity: device that is not fixed but is not continuously mobile

NOTE: A nomadic devices changes locations but tends to stay at a new location for an extended amount of time. Examples include laptops and netbooks.

Over-The-Top (OTT): IP based video sent on the public Internet without operator control

Service-oriented Interconnection (SoIx): physical and logical linking of NGN domains that allows carriers and service providers to offer services over NGN (i.e. IMS and PES) platforms with control and signalling (i.e. session-based), which provide defined levels of interoperability

user plane: plane that has a layered structure and provides user information transfer, along with associated controls (e.g. flow control, recovery from errors, etc.)

3.2 Abbreviations

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

| | |
|------------|---|
| (NGN)-GETS | Government Emergency Telecommunications Services (NGN is GETS with NGN) |
| (x)DSL | Digital Subscriber Line |

NOTE: x means the different *flavours* of DSL.

| | |
|--------|---|
| 3GPP | 3 rd Generation Partnership Project |
| AF | Access Function |
| AMF | Access Management Function |
| A-RACF | Access-Resource Admission Control Function |
| ARF | Access Relay Function |
| AS | Application Servers |
| ASF | Application Server Function |
| BGCF | Breakout Gateway Control Function |
| BGF | Border Gateway Function |
| BMAC | BSM Multicast Access Control |
| BSM | Broadband Satellite Multimedia |
| BSMN | BSM Network |
| BSMS | BSM System |
| BTF | Basic Transport Function |
| CAMEL | Call Management Language (TISPAN) |
| CLF | Connectivity session Location and repository Function |
| CNG | Customer Network Gateway |
| CNGCF | CNG Configuration Function |
| CoIx | Connectivity Oriented Interconnection (TISPAN) |
| CPE | Consumer Premise Equipment |
| CPN | Customer Premises Network |
| CSCF | Call Server Control Function |
| DHCP | Dynamic Host Configuration Protocol |
| DNS | Domain Name Service |
| FoIP | Fax over IP |
| FSS | Fixed Satellite Services |
| GETS | Government Emergency Telecommunications Services |
| GW | Gateway |
| HSS | Home Subscriber Server |
| IBCF | Interconnection Border Control Function |
| I-CSCF | Interrogating CSCF |

| | |
|--------|---|
| ID | Identity |
| IETF | Internet Engineering Task Force |
| IMS | Internet Multimedia Subsystem |
| IMS-AF | (IMS) Application Function |
| IMS-SD | (IMS) Service Discovery |
| IP | Internet Protocol |
| IPTV | Internet Protocol TeleVision |
| IPTV | Internet Television |
| IPv4 | Internet Protocol version 4 |
| IPv6 | Internet Protocol version 6 |
| ISC | IMS Service Control |
| ISP | Internet Service Provider |
| IWF | Interworking Function |
| M2M | Machine to Machine |
| MAC | Medium Access Control |
| MGCF | Media Gateway Controller Function |
| MGF | Media Gateway Function |
| MGW | Media GateWay |
| MRFP | Media Resource Function Processor |
| NACF | Network Access Configuration Function |
| NAS | Network Access Server |
| NASS | Network Attachment Subsystem |
| NAT | Network Access Translation |
| NCC | Network Control Centre |
| NGN | Next Generation Network |
| NGN | Next Generation Network or New Generation Network |
| NMC | Network Management Centre |
| NOC | Network Operation Centre |
| NSS | Network Support System |
| OBP | On-Board Processing |
| OSA | Open Service Access (3GPP) |
| OSS | Operational Support System |
| OTT | Over the Top |
| PBNM | Policy Based network Management |
| PCRF | Policy and Charging Rule Function |
| P-CSCF | Proxy CSCF |
| PDBF | Profile Data Base Function |
| PDP | Policy Decision Point |
| PES | Policy Enforcement Subsystem |
| PPP | Point-to-Point Protocol |
| PSTN | Public Switched Telephone Network |
| QID | Queue Identifier |
| QOE | Quality of Experience |
| QoS | Quality of Service |
| RACS | Resource and Admission Control Subsystem |
| RCEF | Resource Control Enforcement Function |
| RTP | Real Time Protocol |
| SBP | Service-Based Policy control |
| S-CSCF | Serving CSCF |
| SD | Satellite Dependent |
| SDAF | Satellite Dependent Adaptation Functions |
| SDP | Session Description Protocol |
| SGF | Signalling Gateway Function |
| SI | Satellite Independent |
| SIAF | Satellite Independent Adaptation Functions |
| SIP | Session Initiation Protocol |
| SI-SAP | Satellite Independent Service Access Point |
| SI-SAP | Satellite Independent Service Access Point |
| SLF | Subscription Locator Function |
| SOIX | Service Oriented Interconnection (TISPAN) |
| SPDF | Service-based Policy Decision Function |
| ST | Satellite Terminal |

| | |
|--------|--|
| STB | Set-top Box |
| TETRA | Terrestrial Trunked Radio |
| TISPAN | Telecommunications and Internet converged Services and Protocols for Advanced Networking |
| TMF | Telecommunications Management Forum |
| TTL | Time to live (protocol timer) |
| UAAF | User Authentication and Authorization Function |
| UDP | User Datagram Protocol |
| UE | User Equipment |
| UPSF | User Profile Server Function |
| URI | Uniform Resource Identifier |
| UT | User Terminal |
| VoIP | Voice over IP |
| XoIP | "Anything" over IP |

4 NGN Impacts on BSM Networks

4.1 Background

The Next Generation Network (NGN) is intended to support a set of assured (and best-effort) end-to-end services over a network composed of heterogeneous sub-networks, and based on the Internet Protocol (IP).

One of the main characteristics of the NGN architecture is the uncoupling of services and underlying transport functions (i.e. network technologies), allowing services and transport to be offered separately and to evolve independently. Therefore in the NGN architectures there is a clear separation between the functions for services and for networks, and open interfaces are provided between them. Provisioning of existing and new services can then be independent of the transport network and the access technology. In addition the "external" network services are allowed to use their native protocols as was specified in the NGN architecture and interwork with other networks over standardised interfaces and interworking modules. This facilitates the inclusion of more networks, from cable to 4G, within the NGN infrastructure. The approach adopted by the NGN is shown in figure 4.1.

Other characteristics of the NGN defined by TISPAN concern the management of overall services and networks (Network Management) through an Operational Support System (OSS). The BSM features required for compatibility with the NGN OSS have been defined in the TS 102 672 [4] on BSM Management and will not be expanded further here.

ITU-T (SG-13), ETSI (TISPAN), IETF and 3GPP have defined NGN networks and services and the work on this subject is continuing (see the informative reference list). There are differences between the details of NGN definitions (including architectures) of the standards organisations; for example, ES 282 007 [6] on the Core IMS Functionality of TISPAN is a subset of the 3GPP UMTS Architecture defined in TS 123 002 [i.4] and is restricted to session control functionalities. In turn the TISPAN session control was adopted by 3GPP.

See annex A for further details of the IMS architecture.

The core IMS excludes Application Servers (AS) that host Access Functions (AF) and transport/media related functions such as the Multimedia Resource Function Processors (MRFP) and the IMS Media Gateway function (IMS-MGW) that are service or network specific. Nevertheless, there is a specific set of features and generally common understanding and convergence across the core functionality, and much of the work on standards is being pursued under the responsibility of the ETSI TISPAN WG. In the present document the TISPAN definitions and terminology for NGN are used. Furthermore the present document is based on the TISPAN release 2 specifications as the BSM system does not address all issues of mobility.

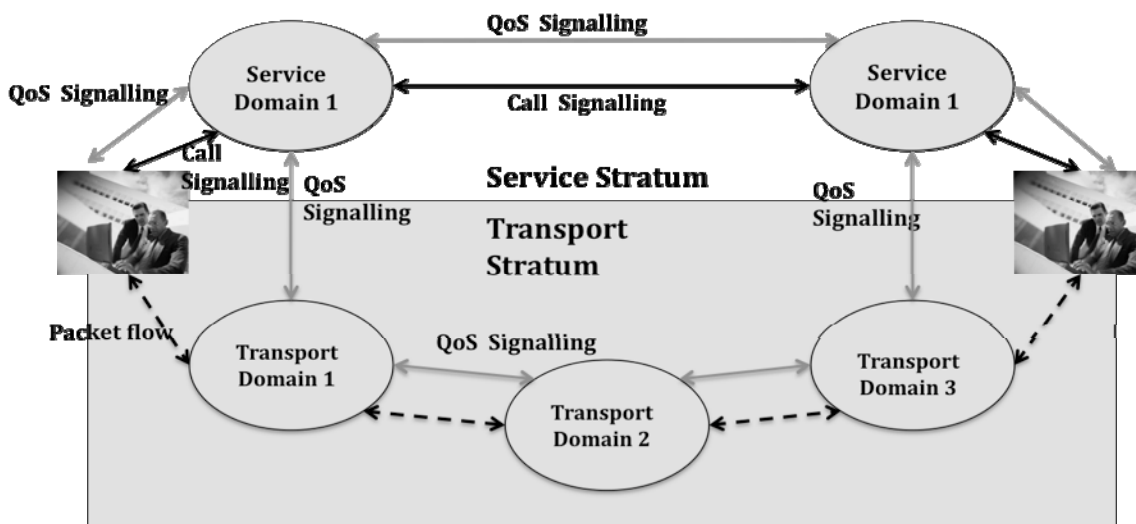


Figure 4.1: NGN Application & Transport Strata

4.2 NGN Network Architecture

Figure 4.2 shows a combined physical and functional overview of the NGN network as defined by ES 282 001 [5] (NGN Functional Architecture). In the figure the BSM network may take the place of an access transport function (network).

The functional entities that make up a subsystem may be distributed over network/service provider domains.

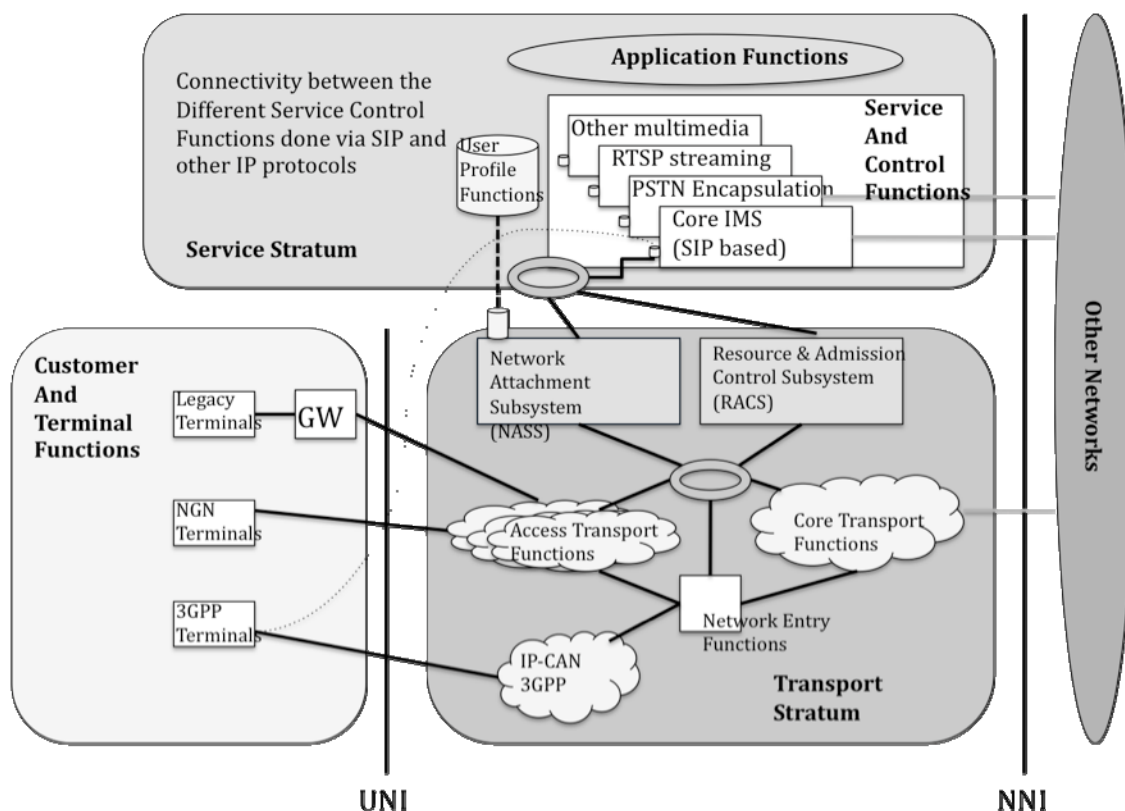


Figure 4.2: NGN Functional Architecture

4.2.1 Service Stratum

The NGN needs to support a wide variety of application services. In the Service Stratum therefore, while IMS (see annex A for a description) is at the heart of all emerging NGN standards, it is just one of a number of Service Control Subsystems. Examples of other Service Control Subsystems include for example PSTN emulation (PES) and streaming services. The IMS was intended for control and delivery of real-time conversational services using SIP-based signalling but has evolved to support other services like advanced IPTV that require service convergence and nomadicity. The Service Stratum subsystems that support nomadicity may be distributed between visited and home networks.

In addition to the Service Control Subsystem, the Service Stratum includes a number of common functional entities that can be accessed by more than one subsystem. These include the:

- User Profile Server Function (UPSF) for common identity management.
- Subscription Locator Function (SLF) for mobile users.
- Application Server Function (ASF) for specific applications.
- Interworking Function (IWF) to integrate legacy networks.

4.2.2 Transport Stratum

IP-connectivity is provided to the NGN customer equipment and to other networks by the Transport Stratum. This transport layer comprises a Transport Control Sublayer on top of transport processing functions in the access and core networks. Equivalent functions should exist in the User Equipment.

4.2.2.1 Transport Control Sublayer

The Transport Control Sublayer is further divided in two subsystems that work closely together:

- Network Attachment Subsystem (NASS):
 - Manages all aspect of network attachment such as IP address provisioning (e.g. DHCP), network level user authentication, authorisation of network access and access network configuration.
- Resource and Admission Control Subsystem (RACS):
 - In charge of admission control, resource reservation, policy control and NAT traversal.

These two subsystems also provide common interfaces to the Service Stratum for any transport technology used in access and core networks below the IP layer.

- The RACS provides dynamic policy-based resource control to deliver the QoS required by applications as well as address mediation and border control capabilities.
- And as mentioned above, the NASS provides attachment control, such as authentication, authorization, and assignment of IP addresses.

The NASS and RACS functions may be logically distributed between access and core networks, and between visited and home networks.

Customer interfaces are supported by both physical and functional (control) interfaces, and both are shown in figure 4.2. No assumptions are made about the diverse customer interfaces and customer networks that may be connected to the NGN access network. All categories of customer equipment are supported in the NGN, from single-line legacy telephones to complex corporate networks and are managed by discovery mechanisms and SIP messaging. Customer equipment may be both mobile and fixed.

Physical transport networks provide the connectivity for all components and physically separated functions within the NGN. Transport is divided into Access Networks and Core Network, with a Border Gateway linking the two transport network categories.

The NGN interface(s) to other networks includes many existing networks, such as the PSTN/ISDN, other NGN, 3GPP networks, the Public Internet, etc. These interfaces generally employ border gateways at both control and transport levels. Border gateways may include access to media transcoding capabilities and bearer adaptation. Interactions between the control and transport functions may take place directly or through the RACS functionality.

4.2.2.2 Transport Processing Functions

Transport processing functions in the access and core networks include functions supporting packet forwarding and routing. These are:

- Media Gateway Function (MGF):
 - The MGF is a translation service that handling the disparate telecommunications networks over the NGN especially transcoding/mapping between IP and legacy circuit-switched networks.
- Border Gateway Function (BGF):
 - The BGF provides media relay for hiding endpoint addresses and prevent bandwidth theft as well as allowing network access translation and acts as a relay between 2 IP transport domains.
- Resource Control Enforcement Function (RCEF):
 - The RCEF implement policy based resource management based on QoS requirements of attached networks.
- Access Relay Function (ARF):
 - The ARF is a relay between user equipment and the NASS; it can insert local configuration information before forwarding a request to the NASS.
- Signalling Gateway Function (SGF):
 - The SGF converts SS7 signalling to IP-based signalling (like SIP).
- Media Resource Function Processor (MRFP):
 - Provides specific media capabilities like announcements and conferencing as well as interactive voice response.
- Access Management Function (AMF):
 - The AMF provides an interface between an access network and the NGN access control functions.
- Basic Transport Function (BTF):
 - The BTF (also Bearer Transport Function) acts as the bearer function for data and media traffic.

A number of these functions relate to legacy network integration. See annex A for more details.

4.3 Service requirements

4.3.1 General NGN Service Requirements

Apart from the "fundamental capabilities" described above namely packet-based transfer, separation of control functions and support for a wide range of services, other capabilities offered by the NGN architecture are summarised in table 4.1.

Table 4.1: NGN capabilities

| Capability | Description |
|--------------------------------------|--|
| Subscriber Nomadicity | Decoupling the subscriber from specific access and specific terminal equipment |
| Application Ubiquity | Application availability from any access network. Content 'tuning' to match access & terminal capabilities |
| Resource Control | Authorization & Availability Accounting: measuring resource usage, revenue assurance Policing resource usage; fraud prevention |
| Subscriber Identity & Authentication | Common Model for all devices, access & applications |
| Service Blending | Service Brokering enables applications to provide adaptive behaviours based upon subscriber events and states |
| Billing and Settlement Mechanisms | Especially beneficial for scenarios crossing multiple providers boundaries. |

In the NGN architecture, because of network heterogeneity, network service providers need to perform additional tasks during the establishment of Internet sessions. These tasks are not conveniently or easily carried out by the application components themselves. They include application selection and routing services, session authorization services, session monitoring services, session detail recording and billing, network resource and admission control services, and integration of complimentary applications or services.

Accordingly, the Session Initiation Protocol (SIP) is becoming more widely used as a common mechanism for establishing sessions of all kinds. SIP has also become the standard session establishment for IMS. SIP based signalling is now standard across policy management elements and is widely used in the RACS architecture for call and resource management. In addition, the TISPAN release 2 [4] contains specifications that allows discovery of devices and networks that use SIP messaging. As a text-based protocol however SIP can lead to large signalling messages and there are many mechanisms envisaged for their compression over bottleneck resources especially in wireless network (e.g. RFC 5049 [i.7]).

4.3.2 BSM-Specific Service Requirements

In order to better identify how and where the NGN architecture and IMS functions a number of use cases are described in this clause. While representative how offered services they are illustrative in nature and of course not a comprehensive list.

- a) VOIP and convergence;
- b) IPTV and IP video:
 - Live/linear TV;
 - Video on Demand (VoD);
- c) Emergency/Disaster Services;
- d) Smart Grid/ telemetry.

4.3.2.1 VOIP and convergence

This is the traditional NGN/IMS service and the impetus behind the original architecture. For the BSM network, which is already all-IP the use of NGN/IMS for voice services completely decouples the BSM network transport from the VOIP service. For example when a VOIP device registers on the VOIP service via the IMS core the Session Description Protocol (SDP) part of the message announces the specifics of the device for the transmission including admissible rates and codecs. Hence while the BSM operator needs to deal with bandwidth requirements, the device specific codecs can be managed at the IMS level. Since those are the most likely to differ greatly from one offering to another, taking these out of the satellite operations into the terrestrial network is advantageous. Also using existing gateways, a BSM-terrestrial-mobile VOIP offering could easily profit from subscriber management and operator federation offered in the IMS core, even interfacing with Public Switched Telephone Networks in areas where legacy services are still dominant, an advantage for emergency services (see details below). In addition the provision of a native VOIP service over BSM may allow standard techniques to be adopted such as SIP compression, voice activity detection and QoS.

4.3.2.2 IPTV and IP video

Current IPTV offerings are based on broadband wireline networks most often Digital Subscriber lines (xDSL). But the expansion of IPTV into underserved areas requires the use of Fixed Satellite Services (FSS) and hence the BSM networks. In addition, BSM networks will most likely see an upsurge of over the top (OTT) IP video services in the next few years. For the BSM operator both IPTV (operator controlled) and OTT IP video will look similar in terms of transport but the business model could be different depending on the relationship of the IPTV operator or the OTT provider with the BSM operator. In addition, the use of cell phone and smartphones for IPTV interactivity is gaining more and more momentum and should be factored in any BSM IPTV scenario and provide further justification for using IMS to federate heterogeneous networks.

For video based services, there are many scenarios that can be defined but the most likely ones are:

- 1) IPTV/IP video over BSM with terrestrial PC or phone interaction;
- 2) IPTV/IP video over BSM with interaction over BSM network(s); and
- 3) IPTV/IP video over BSM with interactivity over Mobile Satellite Service.

The most likely of these is 1), but the actual scenarios remain similar.

With multiple codec technologies and rendering devices co-existing in today's video ecosystem, the use of IMS, as in the case of VOIP allows the BSM network operator to concentrate on IP transport aspects and leave issues of encryption, transcoding, conditional access and right management to the IPTV operator or IP content provider. Common identity management across heterogeneous xDSL, BSM and other terrestrial broadband networks is also an advantage especially when new services incorporating web services (widgets for weather and traffic) and interactivity (via phone texting or Twitter) are involved. In that case the IMS network acts as the *meeting* point and the *service broker* for all services and enables converged applications like social TV to be deployed. The use of NGN policy management also enables to decide which sessions to admit in the IPTV system based on delay or bandwidth restrictions. The location of the policy decisions in the BSM networks will have an influence on the IPTV and IP video quality of experience (QoE).

4.3.2.3 Live/linear TV

Live TV is currently most likely a multicast service using MPEG-4 codecs (of many profiles) over User Datagram Protocol directly or with the Real Time Protocol (RTP) over UDP. With IMS, the role of the BSM operator is to allocate enough resources for the IPTV session and to control QoS elements, like overall delay, especially for interactive applications. The BSM operator does not have to deal with application level requirements.

4.3.2.4 Video on Demand (VoD)

For BSM networks, VoD services are not greatly different than linear TV services except that VoD is more likely to have less stringent QoS requirements. But it is also well known that VoD will soon be a multiscreen and multinetwork offering. Hence the use of the IMS functions allows the BSM networks to deliver VoD services without the need to provide device-specific codecs and operator or content provider-specific encryption/conditional access and DRM services. In addition, IMS readily federate user and subscription management across the multiple networks delivering VoD.

4.3.2.5 Emergency/Disaster Services

There are two potential services for BSM networks in emergency or disaster services: providing emergency telecommunications as defined in the ETSI EMTEL specifications (emtel.etsi.org) and supporting first responders (Government Emergency Telecommunications Services based on NGN - NGN-GETS).

4.3.2.6 Primary Infrastructure

The obvious use case for the BSM system for both EMTEL and NGN-GETS is for the BSM network to provide an instant infrastructure. For the first responders this assumes the BSM system, via the NGN infrastructure will interconnect to the TETRA (Terrestrial Trunked Radio) communication network for example via common gateways but without the need for specific management infrastructure (but eventually needing a specific security mechanism). For the general public the BSM network can provide, via any Internet Gateway, instant access to needed communication networks outside the disaster zone.

4.3.2.7 Infrastructure Support

A second use case is for the BSM system to back an existing terrestrial infrastructure and provide added capacity in the disaster zone. This is a preventive measure to avoid the collapse of that infrastructure under additional traffic requirements. In both cases the NGN architecture provides a policy based resource manager that enables to allocate resources to priority traffic and common user management and federation across the heterogeneous operators customers that are now serviced by the BSM system. The IMS core function will manage subscribers independently of the actual BSM operator while maintaining the BSM operator control over the BSM resources.

4.3.2.8 Smart Grid/telemetry

While it is unlikely that a BSM network will be used to monitor individual elements of the smart grid infrastructure unless these are critical, the use of the BSM system for aggregated traffic is likely. In this use case, we omit the use of smart grid services in disaster areas which is covered in the previous clause but concentrate on a wider use case of self diagnostic and self healing as data management over large areas. With embedded sensor continuously monitoring the grid, a BSM network could act as the main transport of this data to and from management entities and control gateways. With IMS this data could be sent to a variety of providers without necessitating the BSM operator to manage the subscribers individually, only their resources, and allocate these as in the emergency case, to priority traffic especially in times of high demand (failure for example).

Similar consideration could apply to other machine-to-machine (M2M) communications and critical infrastructure monitoring (again with interfacing to TETRA).

4.4 Interworking requirements

There are two fundamental ways of interconnection of the NGN with access networks (such as BSM) as well as with other NGN segments:

- a) Interconnection at the Service Layer - Service-Oriented Interconnection (SOIX).
- b) Interconnection at the Transport Layer - Connectivity-Oriented Interconnection (CoIx).

Only SOIX fully satisfies NGN interoperability requirements. For SOIX, service interoperability is dependent upon the service or the QoS capability of the underlying Transport Layer.

For CoIx, an interconnection is not aware of the specific end-to-end higher layer service and, as a consequence, service-specific network performance, QoS and security requirements are not necessarily assured, but some services may provide a defined level of interoperability. Further details and options are given in [5].

5 BSM/NGN Architecture

In this clause the main functional elements of the BSM/NGN architecture are described with their mapping onto BSM functional elements.

A general overview of the BSM-NGN architecture is given in clause 5.1 followed by specific architectures to be used for specific BSM scenarios in clause 5.2.

5.1 BSM-Specific NGN Architecture

Figure 5.1 illustrates the potential overall BSM integration as an access network in the NGN architecture. More detailed examples are given in clause 5.2.

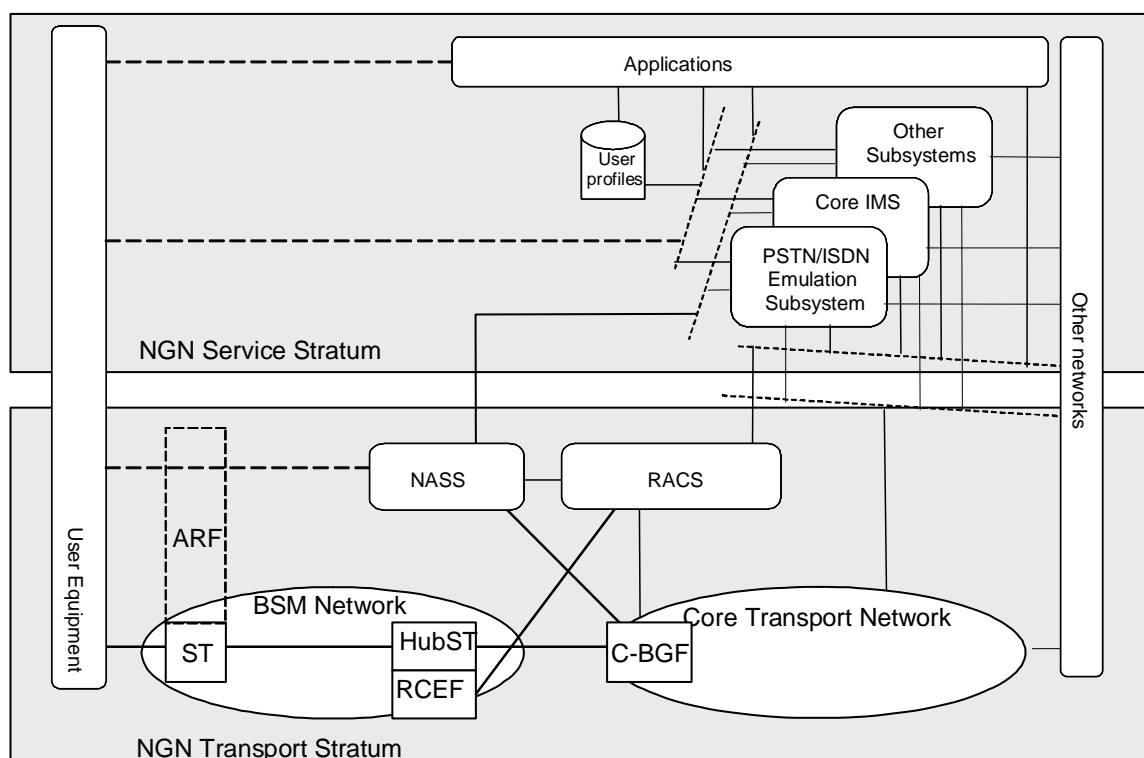


Figure 5.1: Example BSM/NGN Integration

This configuration assumes the following:

- The BSM system has no inherent QoS policy enforcement subsystem and therefore a Resource Control and Enforcement Function (RCEF) is implemented in a BSM IP Edge node (e.g. Hub ST or router) situated at the boundary of the access network.

NOTE 1: For a BSM system with an established QoS Architecture (e.g. as defined in [3]) an Access Function that is essentially a protocol translation between the QoS signalling in the BSM system and that of the NGN is required; the BSM system uses the IMS as a b/w broker; for the NGN the BSM network is an access network.

- Application clients in the UE communicate directly with entities in the NASS, Service Control and Applications.

NOTE 2: Otherwise the UE may communicate indirectly with these entities via an Access Relay Function (ARF) implemented in the Edge node).

- A Core Border Gateway Function (C-BGF) is implemented in a Core Border Node sitting at the boundary between the access network and a core network, at the core network side.

NASS and RACS functions in the Transport Stratum may be logically distributed between access and core networks, and between visited and home networks. In the scenarios below the NASS and RACS are shown in the access network for convenience.

NOTE 3: the interfaces between the BSM network and NGN service control and management functions are attached to the NCC, NMC and to the RCEF(s) above the SI-SAP, and hence no dedicated primitives are needed across the SI-SAP.

5.2 Scenarios

A number of scenarios are possible in which the BSM network may be integrated with the NGN with varying complexity and capabilities to match short term or longer term objectives. Specific BSM/NGN Architecture Scenarios are therefore specified below in which some of the BSM service requirements of clause 4.3.2 are used to illustrate how these architectures can be employed.

A BSM QoS architecture has been defined in [3], and this could be used as a basis for QoS control in the Transport Stratum for the BSM network. However this type of QoS control is assumed not to be generally available and thus in the scenarios below only BSM networks without embedded QoS control at IP level are considered.

IMS integration, as described in the use cases, goes beyond QoS and includes subscriber management and ancillary services. The proposed architecture scenarios below also highlight how the BSM subscribers will be integrated to the NGN in order to facilitate the network convergence that NGN was designed for and which will benefit the BSM network in the future.

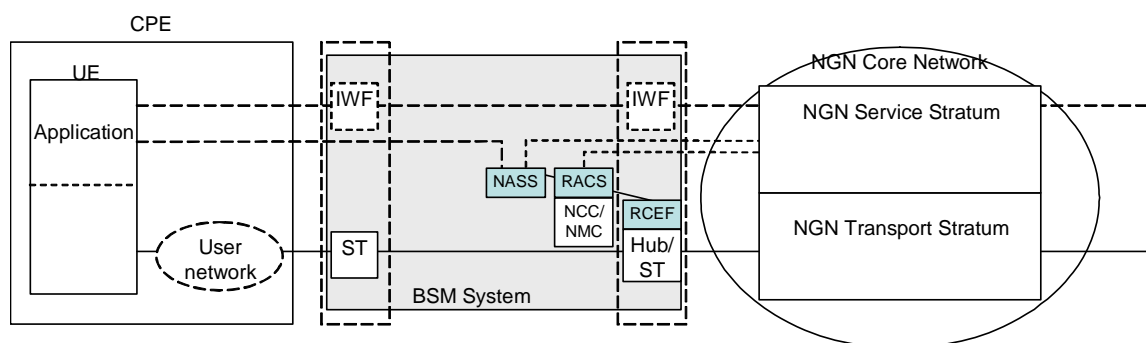
The most likely specific BSM/NGN Architectures are specified below. When appropriate, details will be given on how these architectures apply to the use cases presented in clause 4.3.2. It should be taken as a principle however that all use cases can be accommodated by the architectures below.

Further potential architectural examples are given in annex C.

5.2.1 IMS Service Access - Star network-based (1)

This scenario provide a minimum set of functions, keeping complexity at a low level and making this model suitable for easier transition to NGN by providing dynamic QoS management as well as unified subscriber management across the BSM network and other NGN networks. The scenario concerns a satellite star network topology where the BSM network functions are concentrated around the Hub ST. All additional BSM NGN functions are in the Transport Stratum, and these functions have interfaces to the NGN Core Service Stratum for the control of end-to-end QoS, as well as to the NCC/NMC, etc. for satellite-technology-specific resource control and functionality like UE registration.

QoS in the ST (uplink) is based on fixed packet classification as there are no relevant resource enforcement functions in the STs, but dynamic QoS can be implanted from the Hub on the downlink.



NOTE 1: The dashed boxes within the BSM System indicate the BSM network elements.

NOTE 2: The vertical position of entities in the above diagram does not indicate position in the OSI protocol stack, but only relationship with NGN strata.

Figure 5.2: IMS Service Access with Hub-based RCEF

The Network Attachment Subsystem (NASS) provides registration at access level and initialisation of User Equipment (UE) for accessing TISPAN NGN services. The NASS provides network level identification and authentication, manages the IP address space of the Access Network and authenticates access sessions. The NASS also announces the contact point of the TISPAN NGN Service/Applications Subsystems to the UE (the proxies and application servers that enable specific services). These will be used subsequently for individual subscriber sessions to be initiated over the BSM network without direct implication of the BSM NCC/NMC except for resource management. This is particularly important for session orientated use cases like the VoIP or IPTV where a large number of individual sessions with specific requirements will be handled by the BSM network.

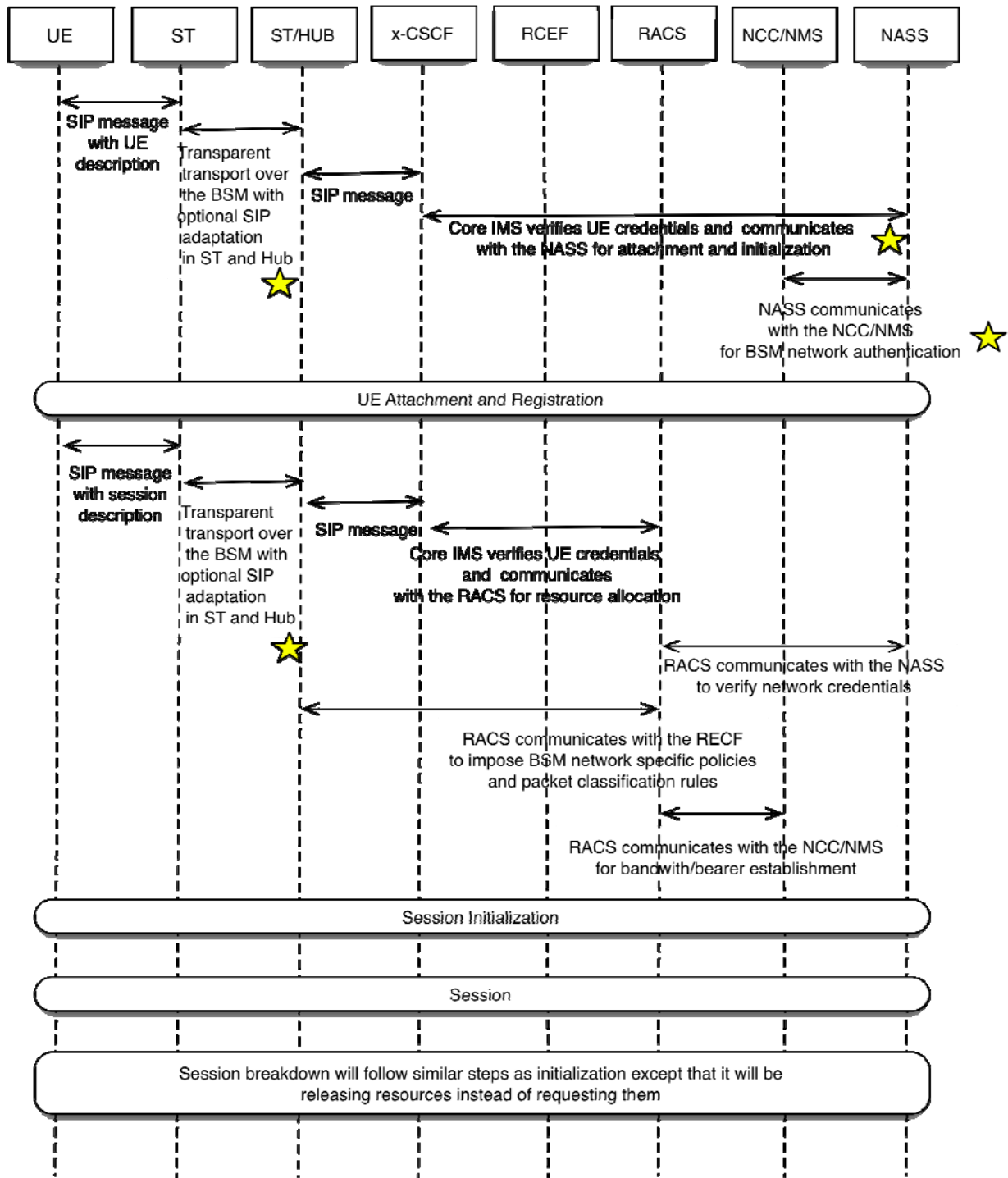
The BSM network, like a number of wireless networks needs to compress the SIP signalling over the BSM bottleneck resources. So while in this scenario the ST does not get involved in QoS management it will be involved in signalling management and compress SIP messaging over the BSM network into either BSM specifics or using standardized approaches like the RFC 3320 [i.6] (SIGCOMP) and its specific adaptation to the SIP protocol in RFC 5049 [i.7]. In addition additional adaptation functions may be required to deal with the BSM delay and its effect on signalling efficiency and performance. It is most likely that the ST and hub would be co-located with a BSM IMS Application Server implementing the Interworking Functions (IWF). These aspects are further detailed in clause 6.

The RACS is responsible for policy-based resource reservation and admission control (unicast and multicast). The RACS also supports Network Address and Port Translation (NAPT) at the edge of the BSM network and assisting in remote NAT traversal. Furthermore the RACS covers aspects related to the setting and modification of traffic policies, end-to-end QoS and transport-level charging. For the emergency services for example the RACS will be used to reassign resources in order to prioritize emergency traffic. In the IPTV use case, the RACS will assign resources to the converged applications as required by specific service offering. Again this can be done with minimal interaction with the BSM NCC/NMC.

A Resource Control and Enforcement Function (RCEF) is implemented in the IP Edge node (Hub) in order to enforce traffic policies.

5.2.1.1 Message Flow Diagrams

The message flow diagrams for the IMS Service Access are show below. These highlight the interactions between NGN and core IMS elements for UE attachment and individual sessions. It is assumed that those sessions require dynamic per-session resource allocations. For permanent or semi-permanent sessions resource allocation in the RACS could be performed at UE attachment.



★ Assumes that any signaling that needs to use the BSM network bottleneck resources will be adequately adapted (compression of text-based messages and delay/loss management).

Figure 5.3: Access Messaging Flow Diagram for Hub Architecture

5.2.2 IMS Service Access - Mesh network based (2)

As a further enhancement of scenario 1, dynamic QoS packet classification can be introduced in both satellite link directions by modification of STs with RCEFs. This would be particularly applicable to mesh satellite networks. This architecture is particularly appropriate for both the emergency services and smart grid application where a local ST could manage and police access to the BSM network without relying on a hub making it more responsive to traffic demands. For the other use cases this scenario could also represent a solution to convergence between different networks attached to the local ST. It can provide both backhauling and access.

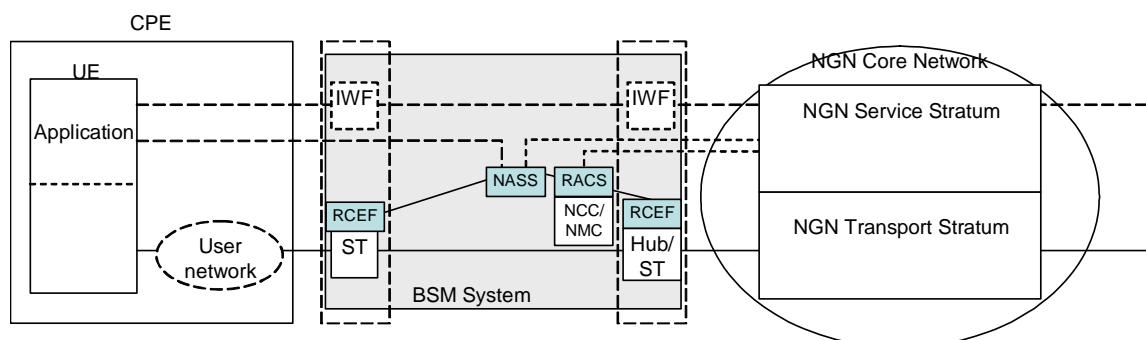
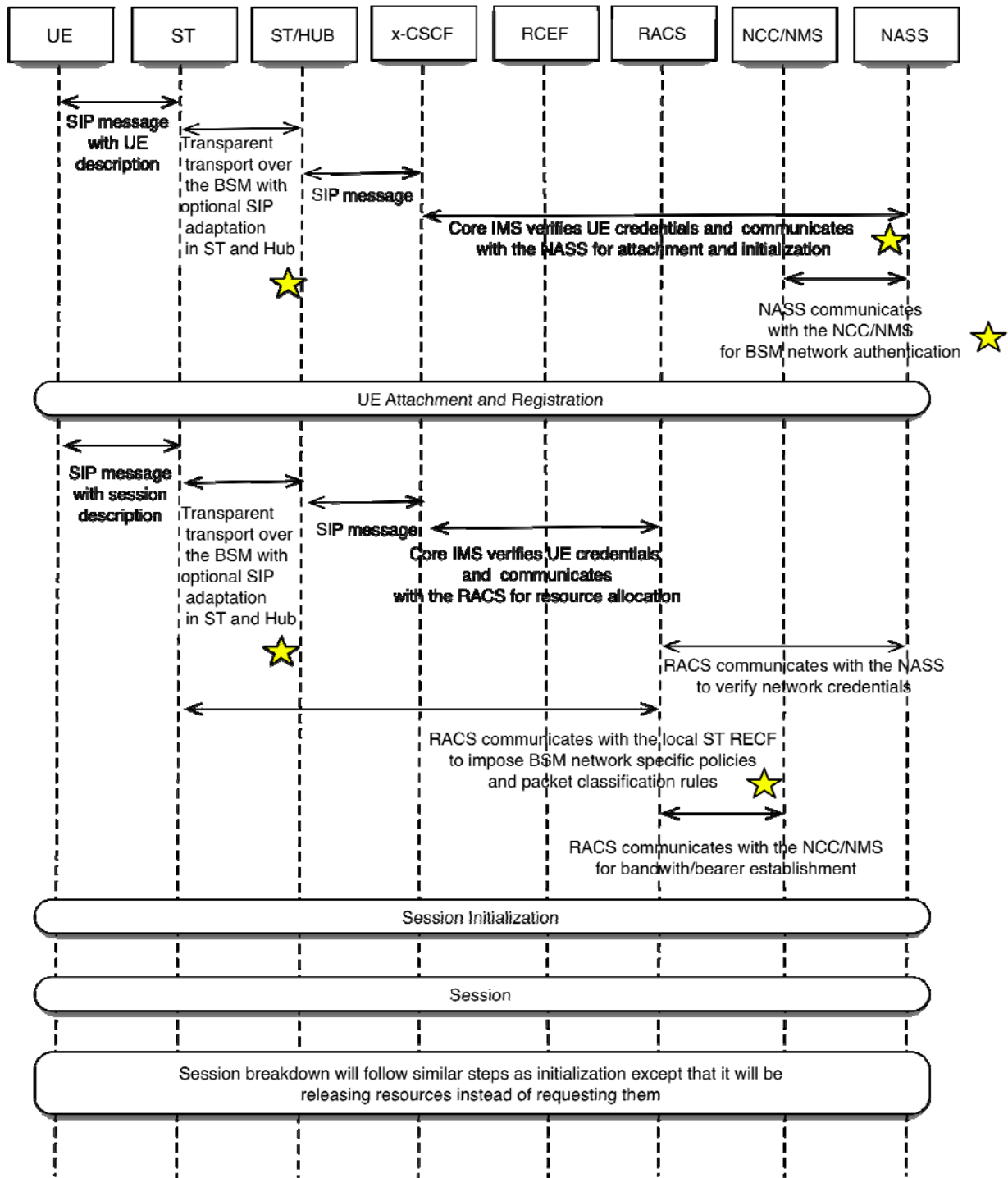


Figure 5.4: IMS Service Access with ST based RCEF

5.2.2.1 Message Flow Diagrams

The message flow diagram for this scenario is similar to the previous one except that now at session establishment the RACS communicated with the local ST RCEF hence results in more BSM network signalling.



★ Assumes that any signaling that needs to use the BSM network bottleneck resources will be adequately adapted (compression of text-based messages and delay/loss management).

Figure 5.5: IMS Service Access with ST-based RCEF

5.2.3 Efficient IMS Peering (3)

Here the BSM network is used as a backbone for interconnecting isolated ISP/MSP (Mobility Service Providers) supporting IMS for backhauling. A BSM mesh network would suit this configuration, avoiding double hop delay. The satellite network operator does not need to be an IMS operator, but should provide functions to manage billing and dynamic QoS control via a minimum set of IMS core elements. This scenario is ideal for the use case where the BSM network is backing up the terrestrial infrastructure in case of emergency. In addition in the converged IPTV use case this architecture could provide instant connectivity between a BSM network offering IPTV and an IPTV terrestrial network to provide added capacity in times of high demand (world wide sport events for example). The ST as is the 2 other architectures is also where NGN and BSM signalling merge and are adapted for carriage over the peered networks.

Although simple peering between IMS networks can be provided by the BSM network without QoS, a more efficient and assured service is provided with QoS. The message flow diagram for this architecture is identical to that of the preceding architecture where the UE is replaced by a NGN entity most likely a proxy function.

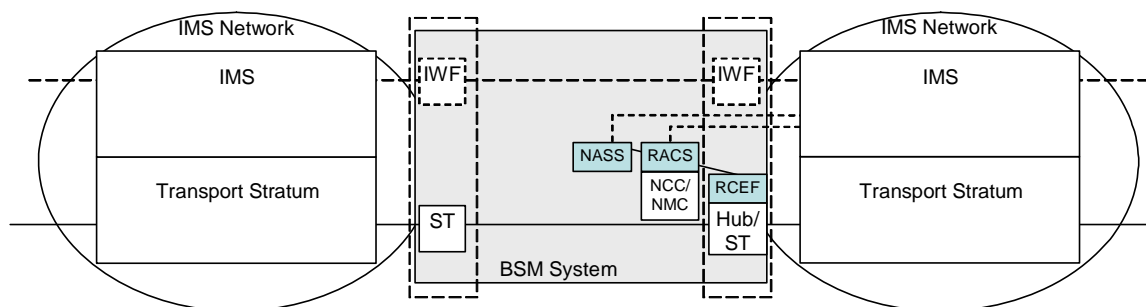


Figure 5.6: IMS Peering

5.3 Detailed Functional Architecture

This clause provides a short description of those elements of the BSM architecture that will require some adaptation to comply with the NGN/IMS architecture. Since the goal of such integration is to move user and session management functions towards standardised NGN functions and integrate resource management into the BSM functionality, the BSM elements mainly interface signalling and resource management between the BSM network and the NGN core.

5.3.1 BSM RACS

The functional architecture of the Resource Admission Control Function (RACS) in the BSM network is shown in figure 5.7.

The BSM Star network architecture case is shown (see clause 5.2.1).

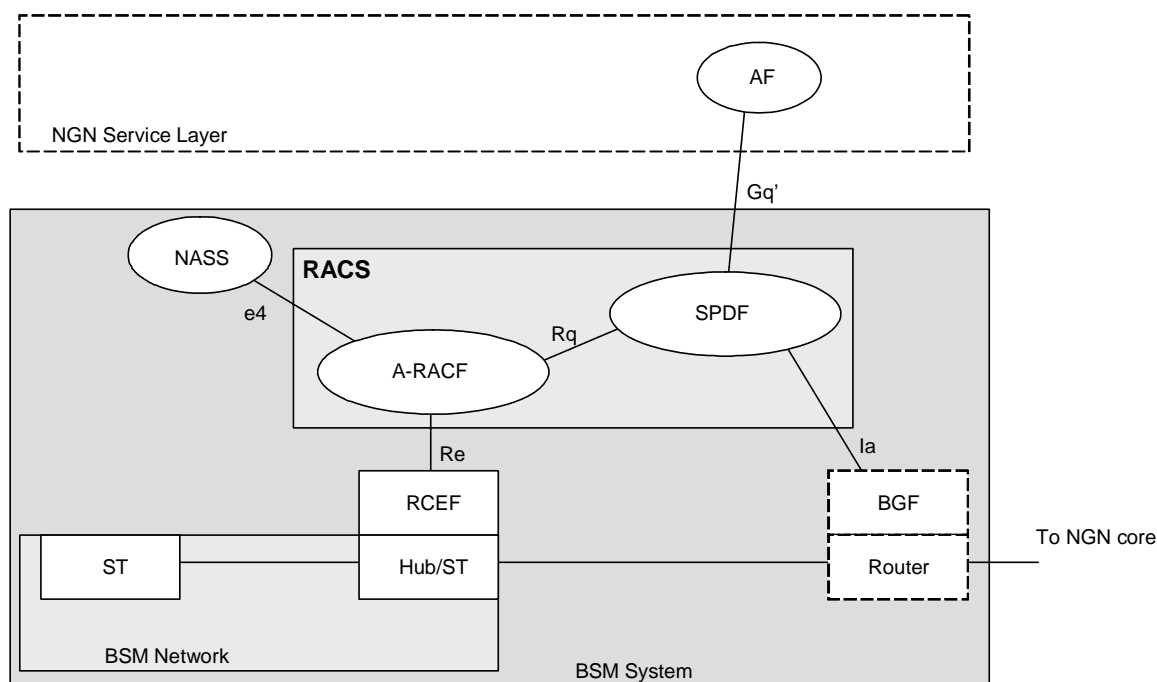


Figure 5.7: BSM/RACS Architecture

The NGN Service Layer includes an Application Function (AF), which offers services that require control of IP bearer resources. Examples of AFs in the case of IMS are the P-CSCF and IBCF. The AF maps the application layer QoS information, e.g. the P-CSCF maps parameters defined in SDP, into QoS request information to be sent via the Gq' reference point to the SPDF.

NOTE: the interfaces shown are TISPAN definitions.

5.3.1.1 SPDF

The Service-based Policy Decision Function (SPDF) provides the Application Function (AF) with a single point of contact.

The Service Policy Decision Function (SPDF) acts as a final Policy Decision Point for Service-Based Policy control (SBP) for each administrative domain (e.g. BSM network) it resides in. It may also communicate with an interconnected SPDF located in an adjacent administrative domain for a reservation request.

The SPDF makes policy decisions by using service policy rules defined by the network operator. The most appropriate service based policy to be applied to a request from an AF or an interconnected SPDF is based on the combined meaning of the Requestor Name, Service Class, Service Priority, Reservation Class, or any other combination of these information elements contained in a transport control service request message received from the AF or from the interconnected SPDF.

The SPDF hides the underlying network topology from applications and from interconnected SPDFs. This allows the SPDF to offer a common view to the AF (e.g. P-CSCF or IBCF) and/or the interconnected SPDF regardless of the underlying network topology and particular access technology in use.

5.3.1.2 A-RACF

The Access-Resource Admission Control Function (A-RACF) is the version of the RACF is appropriate when the BSM network is employed as an access network.

The A-RACF acts as a Policy Decision Point (PDP) in terms of subscriber access admission control, as well as in terms of resource handling control.

The A-RACF receives requests for QoS resources from the SPDF, from the RCEF or from another x-RACF located in the same Operator Domain. Based on these requests and policy information stored in the A-RACF, the A-RACF may accept or reject these requests for the transport resources within its control.

When granting transport resource requests, the A-RACF may derive and install a lower layer traffic policy in the RCEF, which may include indications about the way traffic control should be handled, e.g. gate control, packet marking, or rate limiting control. This derivation process is preceded by the mapping of the network QoS parameters, either related to IP level that is usually associated with technology-independent parameters, or to a lower layer that is usually associated with technology-dependent parameters, as well as by the inclusion of priority indications on the service and media requests related to specific parameters carried in the above traffic policies.

5.3.2 BSM NASS

The functional architecture of the Network Attachment Subsystem (NASS) in the BSM network is shown in figure 5.8.

The NASS comprises the following functional entities:

- Network Access Configuration Function (NACF).
- Connectivity session Location and repository Function (CLF).
- User Authentication and Authorization Function (UAAF).
- Profile Data Base Function (PDBF).
- CNG Configuration Function (CNGCF).
- These functions are described in more detail below.

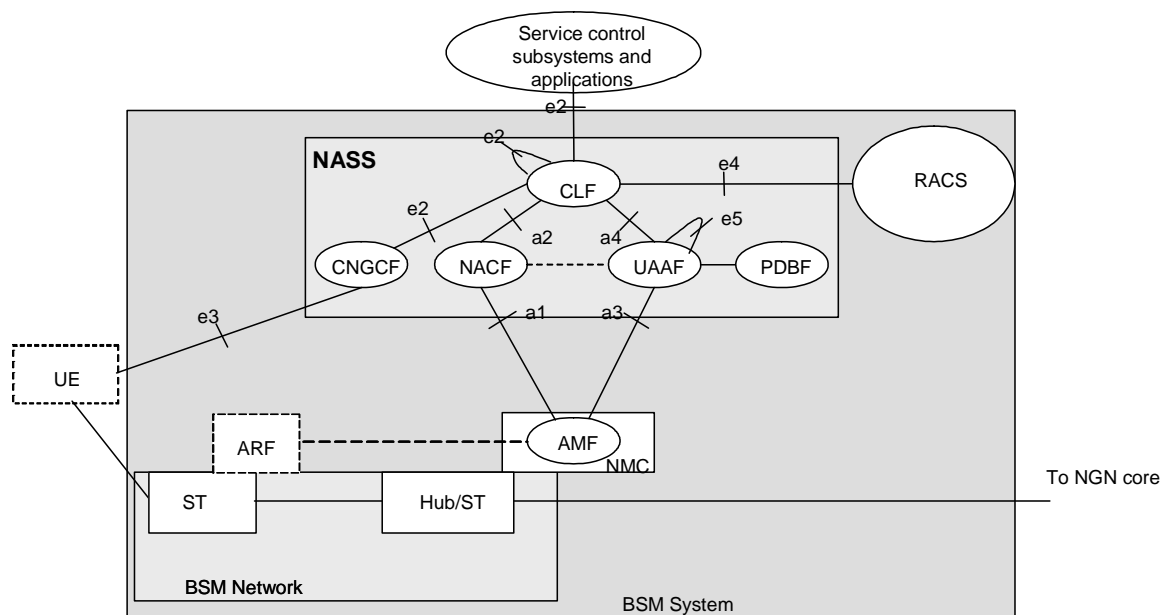


Figure 5.8: BSM/NASS Architecture

In addition two functions may be included as part of the BSM network:

- The Access Management Function (AMF) translates network access requests issued by the UE into a format that can be understood by the NASS.
- The optional Access Relay Function (ARF) acts as a relay between the user equipment and the NASS. It receives network access requests from the user equipment and forwards them to the NASS. Before forwarding a request, the ARF may also insert local configuration information.

5.3.2.1 Network Access Configuration Function (NACF)

The Network Access Configuration Function (NACF) is responsible for the IP address allocation to the UE. It may also distribute other network configuration parameters such as address of DNS server(s), address of signalling proxies for specific protocols (e.g. address of the P-CSCF when accessing to the IMS).

The NACF should be able to provide to the UE an access network identifier. This information uniquely identifies the access network to which the UE is attached. The UE may send this information to applications as a hint to locate the CLF.

5.3.2.2 Connectivity session Location and repository Function (CLF)

The Connectivity session Location and repository Function (CLF) registers the association between the IP address allocated to the UE and related network location information provided by the NACF, i.e.: access transport equipment characteristics, line identifier (Logical Access ID), IP Edge identity, etc. The CLF registers the association between network location information received from the NACF and geographical location information. The CLF may also store the identity of the NASS User to which the IP address has been allocated (information received from the UAAF), as well as the associated network QoS profile and preferences regarding the privacy of location information. In case the CLF does not store the identity/profile of the NASS User, the CLF shall be able to retrieve this information from the UAAF.

The CLF responds to location queries from service control subsystems and applications. The actual information delivered by the CLF may take various forms (e.g. network location, geographical coordinates, post mail address, etc.), depending on agreements with the requestor and on NASS User preferences regarding the privacy of its location. Any privacy information, that may indicate a level of accuracy of the location information to be delivered, is also sent with the actual location information.

5.3.2.3 User Authentication and Authorization Function (UAAF)

The User Authentication and Authorization Function (UAAF) performs NASS User authentication, as well as authorization checking, based on NASS User profiles, for network access. For each NASS User, the UAAF retrieves authentication data and access authorization information from the NASS User network profile information contained in the PDBF. The UAAF may also perform the collection of accounting data for each NASS User authenticated by NASS.

The User Authentication and Authorization Function (UAAF) can also act as a proxy. When acting as a proxy the UAAF can locate and communicate with the UAAF acting as server that contains the PDBF NASS User authentication data. The UAAF proxy can 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 returned to the AMF via the UAAF proxy.

In case the Point-to-Point (PPP) is applied, the AMF terminates the PPP and translates it to signalling on the a3 interface. The UAAF is assumed to be able to contact the NACF via an internal interface to obtain an IP address (UAAF and NACF are in the PPP case internal functions). The a1 reference point does not carry DHCP signalling, instead the a3 interface is used to give the IP configuration information to the AMF.

5.3.2.4 Profile Data Base Function (PDBF)

The Profile Data Base Function (PDBF) is the functional entity that contains NASS User authentication data (NASS User identity, list of supported authentication methods, key materials etc.) and information related to the required network access configuration: This data is called "NASS User network profile". The NASS User network profile may be sub-divided into sub-profiles (see figure 5.2), each of which is associated to one or more Logical Access ID. Support of the Logical Access ID is optional.

The PDBF responds to queries from the UAAF on the full profile or on a particular sub-profile. In the later case, it is the responsibility of the UAAF (or the Proxy-UAAF) to derive a Sub-Profile ID from the Logical Access ID.

In this release the interface between UAAF and PDBF is not specified, i.e. UAAF and PDBF are either co-located or connected by a non-standardized interface.

5.3.2.5 CNG Configuration Function (CNGCF)

The CNGCF is used during initialization and update of the CNG. The CNGCF provides to the CNG additional configuration information (e.g. configuration of a firewall internally in the CNG, QoS marking of IP packets, etc.), with respect to the configuration information provided by the NACF. This data differs from the network configuration data provided by the NACF.

The CNGCF may also handle notifications from the CNG on terminal equipment availability. The CNGCF may indeed provide configuration information for the TEs, indirectly via the CNG or directly to the TEs. It may also trigger maintenance tests and process results sent by the CNG or by the TEs.

The CNGCF may also interface with the CLF in order to retrieve information on the CNG and on the access it is connected to. The information retrieved from the CLF (e.g. line identifier and/or NASS User identifier) may be used as input to the selection of configuration data to be delivered to the CNG.

5.4 Interfaces and Reference Points

The Reference Points below (which have the properties of interfaces) are those between BSM network entities and NGN entities within a BSM System and assume that certain entities are integrated into BSM entities (e.g. the RCEF) as indicated in figures 5.1, 5.2, 5.4 and 5.6. They are all based on the TISPAN definitions for these reference points.

Table 5.1

| Reference Point | Entities | Use |
|-----------------|------------------------|---|
| Re | RCEF to RACF | controlling the L2/L3 traffic policies performed in the transport plane, as requested by the resource management mechanisms, i.e. gating, packet marking, traffic policing and mid-session updates functionalities. |
| e3 | CGNF to CNG (if in UE) | used during initialization and update of the CNG to provide the CNG with additional network configuration information when these information are not available over the interface e1, in order to allow the CNG to access to the TISPAN Service/applications. |
| a1 | AMF to NACF | allows the AMF to request the NACF for the allocation of an IP address to user equipment as well as other network configuration parameters. |
| a3 | AMF to UAAF | allows the AMF to request the UAAF for NASS User authentication and network subscription checking. |

As indicated in clause 5.1, the interfaces between the BSM network and NGN service control and management functions are attached to the NCC, NMC and to the RCEF(s) above the SI-SAP, and hence no dedicated primitives are needed across the SI-SAP.

6 BSM Adaptation Functions for NGN

In this clause the specific elements necessary to provide NGN interoperability in BSM networks and systems are defined. The goal of the clause is not to go into design details of these elements but to provide descriptions of some essential functional elements beyond what the previous clause defined for the management of resources and QoS. These include (but are not limited to) policy and resource management interworking functions, IMS interfacing and SIP signalling adaptation over the bottleneck resources of the BSM network. This clause also provides some of the details for the functionalities introduced in the use cases and the architectures. A number of these functions are system-specific however and involve the BSM operator business models for NGN migration.

The following topics are addressed specifically:

- Converged services offered by NGN/IMS as simple extensions BSM system services via:
 - IWF such as resource management, QoS and policy.
 - Application servers (AS) for higher layer interactions such as signalling and device discovery.
- ST/GWY modifications to support the evolution to NGN/IMS, including any specific necessary for transmission over the BSM network (delay, loss and bottleneck resources).

NOTE: While there are corresponding requirements for the User Equipment (UE) as defined by TISPAN, these are out of scope for the present document.

A simple evolutionary philosophy for the BSM network functionality to be integrated with NGN/IMS can be summarized as:

- Re-use the existing BSM network functions, in particular the Satellite Independent Adaptation Functions as described in TS 102 292 [1].
- Provide converged services with the same infrastructure.
- Provide standards-based solutions.
- Satellite mobile/fixed convergence enabled by the NGN/IMS architecture and the IMS core elements.

The evolution should include the deployment of a BSM/NGN set of added functionality such as:

- Policy based network management for cross-networks implementation via commercially available policy servers and BSM network specific IWFs.
- SIP registrars and SIP based device discovery for interconnectivity via native BSM ST/GWY signalling or using commercially available and customizable signalling application servers.
- BSM user profiles derived from the IMS profiles and used to manage multiple user identities across converged BSM /Terrestrial networks and this without any additional requirements on the BSM operator to manage the subscriber functions.
- Presence and application servers for enhanced personalization of services and value-added services like IP television and mobile video without needing further BSM development.

6.1 Signalling Application Server

The Signalling Application Server is needed to adapt the SIP signalling for transmission over the BSM network and to account for added delay, losses and bottleneck resources.

The SIP message contains the end point addresses as well as the addresses of the different proxies that will handle the session and of the registrars that contain the functions enabling device attachment to the network. STs, GWYs and UEs are pre-provisioned with those addresses. All required session and service information is contained within the SIP "payload" using the Service Description Protocol (SDP). The SDP contains information on codec, rates and end points characteristics; it defines all service parameters but is not involved in the routing of the information. The underlying system is expected to maintain the requested connection during the session and refresh connectivity parameters as requested by mobility, security, etc.

It is very likely that existing BSM STs/GWYs/UEs contain SIP signalling stacks used for voice over IP. These can be modified for use over an NGN/IMS. However there will be also many cases where there is useful no native SIP stack and the BSM network signalling used another protocol. Then it is customary to develop "back to back user agents" essentially protocol translators to connect the BSM network to the NGN.

The operations necessary to attach a device to the NGN network and to establish a reliable end-to-end communication path between source and destination, require many SIP messages in both directions. Over a BSM-network this creates two major challenges:

- SIP and SDP being text based, each message can be large, create overhead and hence can utilize additional BSM resources.
- Delays over the BSM segment can impair the overall quality of experience especially for converged video services where the synchronization of video to ancillary content is crucial.
- Packet Losses on satellite transmission can impact the SIP signalling, leading to increased delays.

In a real-world deployment it would be most appropriate to locate protocol translators at the terrestrial edge of the BSM network. There the bandwidth-efficient BSM signalling can be translated into SIP/SDP signalling and use terrestrial broadband to get to its destination. However, this not being always possible there are a number of both proprietary and standardized SIP compression mechanisms that have been developed such as those presented in RFC 3320 [i.6] and RFC 5049 [i.7]. Over a BSM network these could also be complemented by mechanisms to deal with delay and loss for example by setting existing time-to-live (TTL) timers to higher numbers.

6.2 BSM IWF

We assume that the existing BSM protocols are the basis from which the NGN functionality will be implemented. The primary IWF development effort will be to interface existing resource management functionality to the NGN access elements. The BSM architecture already gives the ability to use IP protocols hence there is no need for legacy services gateways.

The NASS and RACS provide policy based network management (PBNM). The BSM QoS architecture [3] provides policy-based QoS control functions and the IWF can be used to interface between the NASS & RACS and these QoS functions.

As the network scales up the PBNM system will inform the operator of the systems actual traffic demand situations as an aid in system growth management and allow tailoring resource allocation accordingly.

The relationship between RACS element and BSM resource allocation will be system and architecture dependent. Both on-demand and permanent resources can be allocated. An element of the IWF could also be used to monitor traffic and ensure that the right policies are implemented to adjust BSM capacity to match the offered traffic.

6.3 Mobile/Fixed Satellite System Convergence

Satellite mobile/fixed convergence, in particular service and device mobility, should be enabled by the NGN/IMS architecture and the IMS core elements.

This topic is intended for further study.

Annex A (informative): The IP Multimedia Subsystem (IMS)

This annex provides a short summary introduction to the main concepts of the IP Multimedia Subsystem (IMS) as defined in TISPAN [6]. The Next Generation Network (NGN), including the IMS, provides a unified architecture that encompasses and operates across multiple types of access networks and access devices. While originally developed in the 3rd Generation Partnership Program (3GPP) for fixed-mobile convergence, IMS is now seen as a unifying network architecture with the fixed and wireline services specified by the TISPAN.

The "Core IMS" is the term adopted by TISPAN (in agreement with 3GPP) as a subset of the 3GPP IMS as defined in [i.4]. The Core IMS is restricted to session control functionalities, and excludes the original 3GPP Application Servers (AS) that host Access Functions (AF) and transport/media related functions such as the Multimedia Resource Function Processors (MRFP) and the IMS Media GateWay function (IMS-MGW).

The unifying principle of IMS signalling is based on the Session Initiation Protocol or SIP. SIP is used as the IMS control protocol and allows creation of sessions across different network elements. It also provides a unified user-profile across multiple devices and access networks. Finally, it enables multi-party multi-device sessions based on SIP, for example a session on a BSM network and a session on a terrestrial VoIP network. Sessions can be transferred between native networks using Application Functions (AF) that act as user agents, translating SIP signalling into legacy protocols.

To summarize, IMS leverages mechanisms built into SIP communications networks including:

- Single Public user identity and authentication across multiple devices, networks and applications.
- Uniform user authentication, capability discovery and network attachment across devices and operators.
- Tailored services based upon the user agent capabilities.
- Well-known mechanisms of NAT traversal and gateway traversal.
- Investment Protection & Common Infrastructure for all services including IP-based and legacy.

A.1 Overview

IMS is the evolution of the core network vision, where both signalling and bearer are carried over the IP layer, contemplated in the early 2000s by the 3rd Generation Project (3GPP) and the 3GPP2 standards bodies. IMS was later extended by TISPAN for fixed services. It enables the attached end devices to support personalized experience involving simultaneous voice, data, and multimedia sessions. A key feature of IMS is that the IP network is extended all the way to the user equipment, making the core network access agnostic and enabling all-IP communications throughout. The other salient feature of IMS is that the architecture supports call or session models where sessions are routed to one or more Access Functions that are specific to an attached network (a BSM network for example) or a specific operator. IMS therefore performs largely a re-routing function that matches a user profile during a session with an appropriate "handler", and switches the session control over to that designated handler.

The Core IMS functional architecture and its near neighbours in an NGN network are shown in figure A.1. The BSM network is represented by a Transport Processing Function.

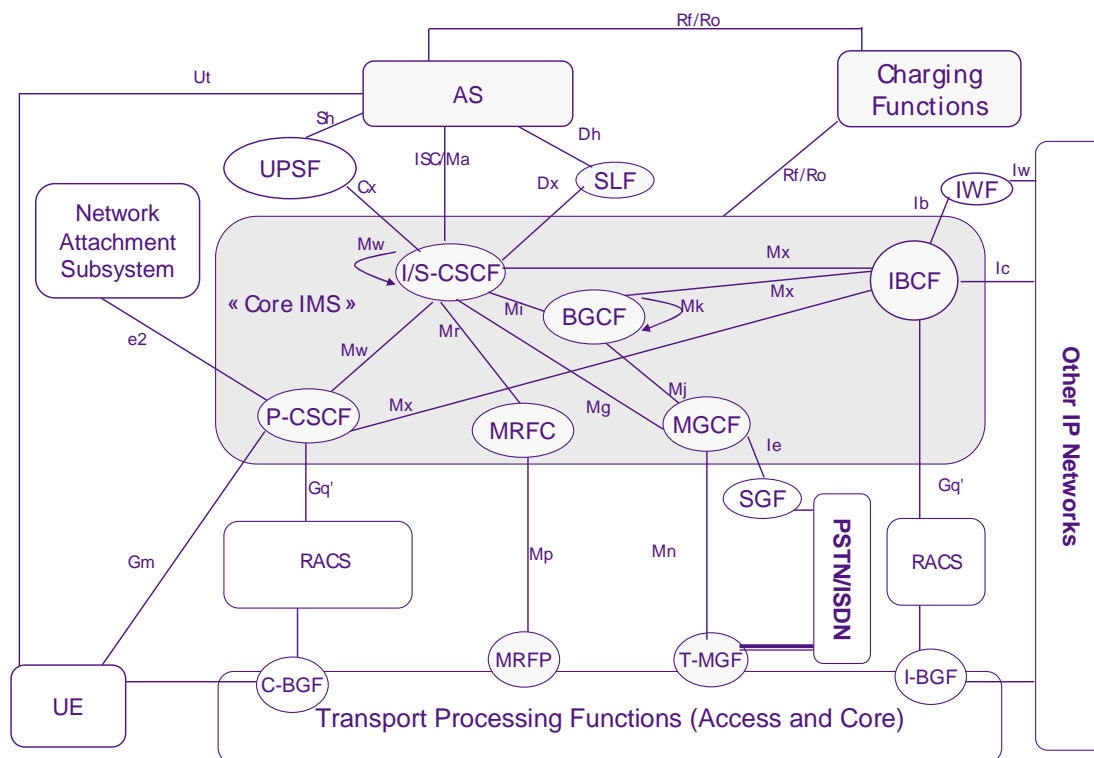


Figure A.1: Core IMS functional elements, interfaces and environment

A.2 IMS Logical Elements

The main IMS elements that concern the BSM network in figure A.1 are as follows:

NOTE: the MGCF, MRFC, BGCF and IBCF are focussed on legacy applications and are out of scope for the present document.

A.2.1 The Call Session Control Functions (CSCF)

The CSCF can act as Proxy CSCF (P-CSCF), Serving CSCF (S-CSCF) or Interrogating CSCF (I-CSCF). The CSCF establishes, monitors, supports and releases multimedia sessions and manages the user's service interactions.

- **P-CSCF:** The Proxy Call Session Control Function (CSCF) is the first contact point for a device (user equipment or UE) in the visited or home IMS network. It behaves like a SIP proxy server, and its key functions involve maintaining a secure communication link with the UE, locating an I-CSCF for the UE in the latter's home network, enforcing Quality of Service (QoS) policy, and providing service control for applications and services deemed local, such as emergency services.
- **S-CSCF:** The Serving CSCF provides multimedia session control and maintains a session state and can also serve as a registrar. It is located in the home network and provides service control for home subscribed services for a roaming subscriber. It interacts with service platforms in the home network as well as external third party service platforms for support of services.
- **I-CSCF:** The Interrogating CSCF is an optional component that primarily acts as a topology hiding gateway so the S-CSCFs are not directly exposed to outside networks. During registration flows, it also assists in locating an appropriate S-CSCF in the home network for the UE, based on the subscriber capabilities downloaded from the Home Subscriber Server (HSS).

An important point to note here is that the above entities represent a 'functional' description of IMS components, and this need not imply an identical 'physical' break-up of components during architecture design or implementation.

A.2.2 Media Gateway Control Function (MGCF)

The Media Gateway Controller Function (MGCF) provides the ability to control a trunking media gateway function (T-MGF) through a standardized interface. Such control includes allocation and de-allocation of resources of the media gateway, as well as modification of the usage of these resources. The MGCF communicates with the CSCF, the BGCF and circuit-switched networks. The MGCF performs protocol conversion between ISUP and SIP. It also supports interworking between SIP and non-call related SS7 signalling (i.e. TCAP-based signalling for supplementary services such as CCBS).

In case of incoming calls from legacy networks, the MGCF determines the next hop in IP routing depending on received signalling information.

This functional entity is identical to the MGCF defined in (3GPP) TS 123 002 [i.4] except that in addition it supports TCAP interworking. A node implementing this functional entity in an NGN network and a node implementing it in a 3GPP network may differ in terms of supported resources (e.g. codecs) and configuration.

A.2.3 Multimedia Resource Function Controller (MRFC)

The Multimedia Resource Function Controller (MRFC), in conjunction with an MRFP located in the transport layer provides a set of resources within the core network for supporting services. The MRFC interprets information coming from an AS via an S-CSCF and control MRFP accordingly. The MRFC, in conjunction with the MRFP, provides e.g. multi-way conference bridges, announcement playback, media transcoding, etc.

A node implementing this functional entity in an NGN network and a node implementing it in a 3GPP network may differ in terms of supported resources and configuration.

A.2.4 Breakout Gateway Control Function (BGCF)

The Breakout Gateway control function (BGCF) determines the next hop in SIP routing. This determination may be based on information received in the protocol, administrative information, and/or database access. For PSTN terminations, the BGCF selects the network in which PSTN breakout is to occur and - within the network where the breakout is to occur - selects the MGCF.

A node implementing this functional entity in an NGN network and a node implementing it in a 3GPP network may differ in terms of configuration (e.g. breakout criteria).

A.2.5 Interconnection Border Control Function (IBCF)

An IBCF provides application specific functions at the SIP/SDP protocol layer in order to perform interconnection between two operator domains. It enables communication between IPv6 and IPv4 SIP applications. network topology hiding, controlling transport plane functions, screening of SIP signalling information, selecting the appropriate signalling interconnect and generation of charging data records.

Based on local configuration, the IBCF may perform transit routing functions.

Annex B (informative): BSM/IMS Procedures

B.1 ST Attachment and Initialization

This clause describes ST attachment and initialization in a NGN context. At a high-level it includes the following high-level functions.

- ST Setup and Configuration, especially with respect to the specification of Identity Credentials (independently of any user specific identification - at this stage the ST acts as an IMS CPE).
- ST Network Attachment - procedures related to obtaining Layer-3 connectivity to an IP network as well as any necessary network-driven host configuration information.
- ST Service Discovery - procedures related to discovering services that may be available to the CPE.

The Attachment and Initialization procedures should, to the extent, possible leverage existing mechanisms that are well defined ETSI TISPAN, ITU 3GPP and IETF.

B.1.1 SIP Usage

The Session Initiation Protocol or SIP [i.5] is now associated with voice communication services. But the protocol was historically designed for a variety of media services. Moreover, driven in large part by the requirements associated with IP-based communication services, SIP has been extended over the years to address many of the same requirements currently facing many next-generation Internet applications and was standardized as the signalling for the IMS. It provides the session service and device discovery, setup, policy and QOS signalling and some stream control across platforms. Hence, some of the key advantages of using NGN/IMS for the BSM network, hence a standards based approach, include important service enablers. In general, in order for a BSM ST to receive and consume IP services, several of prerequisite condition must be met. Specifically, the ST must have network connectivity and have the ability to communicate with service providing elements within the network.

- The ST must be configured with any necessary identity credentials and have either already registered its identity with a BSM service provider or be prepared to do so upon activating a service.
- The ST must have knowledge of the available service and some indication of which services it intends to use and to offer to its own attached devices (the ST could be a IWF for the attached devices).
- The ST must have all the information needed to activate the NGN/IMS services it intends to use.

This is usually provided by NOC applications (and possible satellite dependant) that are outside the scope of the present document. These conditions must generally be maintained throughout the course of service consumption, in a typical scenario they will first be achieved upon the act of booting (or otherwise initializing) the physical device that constitutes the ST. The term 'attachment and initialization' is used to refer to this initial set of activities that prepare a ST to receive and consume IP services.

B.1.2 ST Attachment and Initialization Overview

Figure B.1 illustrates an overall model for ST Attachment and Initialization. This model identifies the main activities and actors associated with ST attachment and initialization.

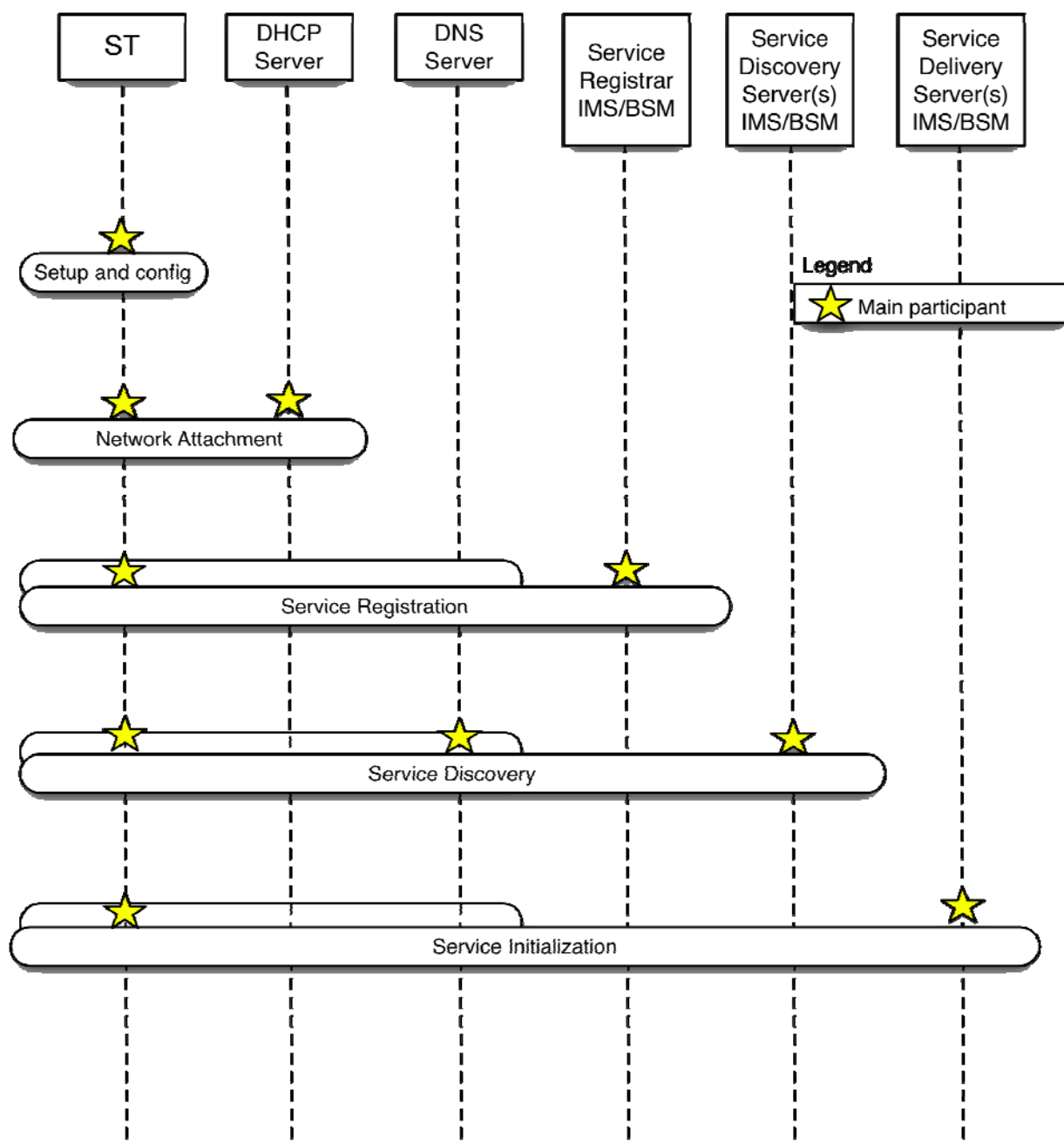


Figure B.1: A high-level model of the ST attachment and initialization process

The generic participants in the ST Attachment and Initialization include:

- **ST:** represents the software and hardware elements of the physical device.
- **Dynamic Host Configuration Server:** the entity with which the ST interacts in order to perform Layer-3 network attachment; for the BSM network it will most likely be an element within the BSM Network Provider's domain.
- **Service Registrar:** a logical entity that is capable verifying the identity credentials of the ST. In deployment scenarios that involve the use of a service-signalling network (such as SIP/IMS), it may be necessary for the ST to register with a Service Registrar before using the service-signalling network (IMS) to contact other service elements. In the context of a SIP/IMS network, the Service Registrar corresponds to a SIP registrar.
- **Domain Name Server(s):** the servers that provide Domain Name Services according to the IETF standards. These entities are used for Domain Name Services in general, but also within the context of service discovery as a means to locate candidate service discovery servers.

- **Service Discovery Server(s):** they are entities with which the ST interacts to discover possible BSM services.
- **Service Delivery Server(s):** the logical entities with which the ST interacts in order to activate (or initialize) a particular service.

The major activities that constitute the ST attachment and initialization process include the following:

- 1) **ST Setup and Configuration:** These are the activities associated with acquiring, setting up and configuring the physical ST device, itself. In general, this may include activities related to physically acquiring and connecting a device to a network, configuring settings and user preference on the device, and establishing a service relationship (accounting and billing) with one or more service providers.
- 2) **Network Attachment:** These are activities associated with establishing Layer-3 connectivity to the IP-network. Through these activities the ST will acquire a network address and all associated information needed to transmit and receive IP packets. In addition, it will receive the necessary bootstrapping information need to begin using BSM network-based services.
- 3) **Service Registration:** This corresponds to activities associated with registering the ST with a service control network. Specifically in SIP/IMS-based scenarios, a before the ST can use the SIP/IMS network for service control, it must identify, authenticate and register itself with the network.
- 4) **Service Discovery:** This corresponds to activities associated with interacting with Service Discovery servers to discover information about services that may be available to the ST.
- 5) **Service Selection and Activation:** This corresponds to activities associated with the ST selecting one or more services for use and interacting with network elements to activate (or otherwise initialize) the use of those services.

B.2 ST Registration

UE registration and initialization assume that the BSM network and ST have already performed network attachment whereby L1-L3 connectivity was established using satellite dependant protocols. As part of the initialization, the ST was provided with the name of the SIP server to which it must register (this corresponds to its P-CSCF) which would generally be accessible via the BSM network in the provider network.

The Registration message creates a binding between the publicly known user identity or address of record and the specific device to be used. For IMS, a public identity corresponds to the subscriber and a private identity corresponds to the device. The HSS is configured with security credentials for each private identity the consumer may utilize. Thus, a ST (or more generally but out of scope for the present document a user device) may have a different key than is used to authenticate with the same subscriber's other devices. Upon successful registration it is assumed that an IP Secure association is made between the ST and the P-CSCF however this security model should be challenged and studied further. Once the IMS has completed the user registration (it is similar to the SIP-REGISTER message), it may use certain criteria to forward the registration on to a list of access functions that are of interest to the ST. For example, it is assumed that minimally the NOC is interested in the registration as to be able to approve of future resource allocations.

B.3 The SIP-Based Service Discovery Mechanism

This clause specifies a mechanism for BSM IMS Service Discovery (IMS-SD) based on the use of the Session Initiation Protocol (SIP). A BSM-CPE compliant with the present document MUST support this mechanism. The SIP Event Notification mechanism is used to implement the abstract Service Discovery Query and Notification functions. The SIP Event Notification mechanism can be used to implement both one-time queries and an asynchronous notification service. Assuming that such a subscription is accepted by the IMS-SD Server, whenever a change in service information state occurs the IMS-SD Server will send the CPE a NOTIFY message that describes the update(s).

Annex C (informative): Further Examples of BSM/NGN Scenarios

These specific BSM/NGN Architectures complement those of clause 5.

C.1 BSM Access-only scenario

The simplest scenario is one in which the BSM network acts only as a broadband access network (in the Transport Stratum only) to the core NGN. No BSM functions related to the standard IMS Service Stratum are implemented i.e. no BSM interfaces to NASS or RACS. IMS services between the user and the core NGN would be transparent to the BSM network. The QoS of NGN services through the BSM network could not be assured via the IMS but only via lower layer methods e.g. directly between the user and the BSM network.

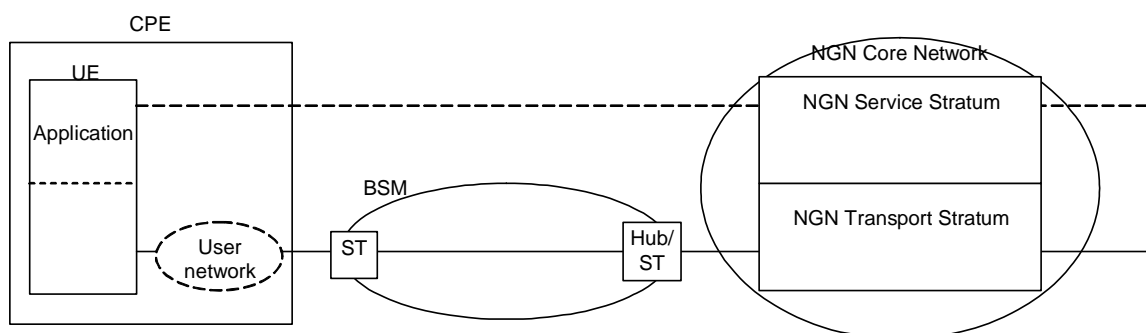


Figure C.1

C.2 Satellite-based IMS

This scenario implements an IMS within the satellite operator domain with a minimum set of functions to provide users with access to IMS services within the satellite network, without having to rely on another operator. The IMS is ideally closely associated with the Hub/NCC/NMC.

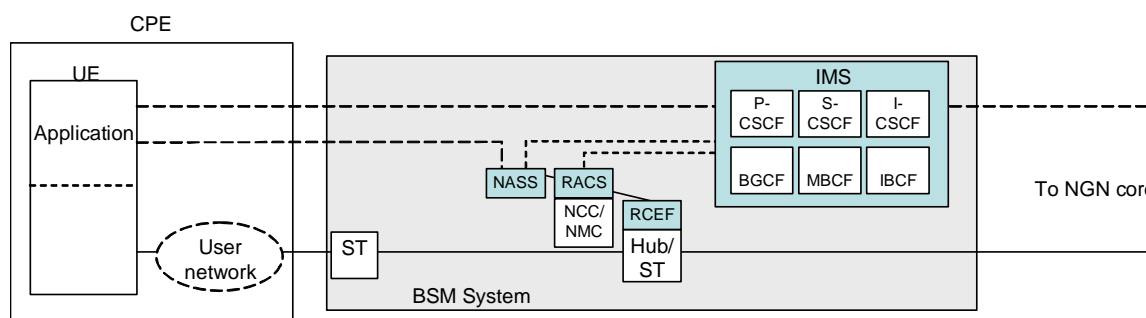


Figure C.2

C.3 Enhanced Satellite-based IMS

To reduce delays and to use satellite resources more efficiently compared to scenario 4, the first IMS contact point from the UE, the P-CSCF, is placed behind, or collocated with, each ST.

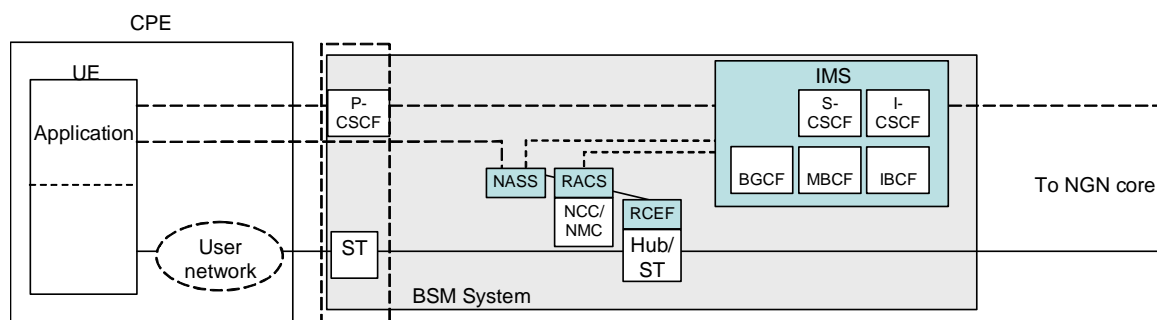


Figure C.3

Annex D (informative): Bibliography

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History

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