ETSI TR 101 984 V1.2.1 (2007-12)

Technical Report

Satellite Earth Stations and Systems (SES);
Broadband Satellite Multimedia (BSM);
Services and architectures

Reference
RTR/SES-00274

Keywords
architecture, broadband, IP, multimedia, satellite

ETSI

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

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

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

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

Introduction

The present document has been prepared by the TC-SES Broadband Satellite Multimedia (BSM) working group based on the recommendations from the work of STF-126 [1].

1 Scope

The present document defines the BSM services and architectures. It contains a set of definitions and reference models in the following main areas:

- BSM roles and actors;
- BSM reference architectures and models;
- BSM bearer services.

The present document is intended to define the possible roles that Broadband Satellite Multimedia systems may have, to define the main actors, to define a set of reference architectures and to define the services they can provide. These definitions are intended as a common set of definitions for BSM standardization.

The overall objectives of BSM standardization are:

- to enable users to access a wide range of telecommunications services, including many that are today undefined, with particular emphasis on IP-based multi-media services and high data rates;
- to provide an efficient means of using satellite network resources (particularly radio spectrum);
- to facilitate the provision of a high quality of service similar to that provided by fixed networks;
- to facilitate the provision of easy to use, low cost terminals.

2 References

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.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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

For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

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

2.1 Informative references

[1] ETSI TR 101 374-2: "Satellite Earth Stations and Systems (SES); Broadband satellite multimedia; Part 2: Scenario for standardization".

[2] ETSI TS 122 101: "Universal Mobile Telecommunications System (UMTS); Service aspects; Service principles (3GPP TS 22.101 Release 7)".

[3] MFA Forum: "Technology: ATM Forum Specifications".

NOTE: Available at http://www.mfaforum.org/tech/atm_specs.shtml.

[4] ETSI TS 123 107: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); Quality of Service (QoS) concept and architecture (3GPP TS 23.107 version 6.4.0 Release 6)".

[5] ETSI TR 101 865: "Satellite Earth Stations and Systems (SES); Satellite component of UMTS/IMT-2000; General aspects and principles".

[6] ETSI TR 102 353: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); Guidelines for the Satellite Independent Service Access Point (SI-SAP);".

[7] 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".

[8] ETSI TS 102 295: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM) services and architectures; BSM Traffic Classes".

[9] ETSI TR 102 187: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; Overview of BSM families".

3 Definitions and abbreviations

3.1 Definitions

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

broadcast: communication capability which denotes unidirectional distribution to an unspecified number of access points connected to the network

NOTE: The communication may reach any or all access points and each terminal may select which broadcast information to receive.

BSM bearer service: user plane (U-plane) data transmission services provided by the BSM subnetwork at the SI-SAP interfaces.

NOTE 1: A BSM bearer service includes all QoS and other bearer service properties, as viewed at those SI-SAP interfaces.

NOTE 2: BSM bearer services are a specific form of layer 2 service access point services. BSM bearer services are therefore not the same as a Telecommunications bearer service as defined below.

BSM Network: a BSM subnetwork together with the BSM interworking and adaptation functions that are required to provide an interface into the attached networks

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

BSM System (BSMS): A BSM System corresponds to 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.

channel: means of unidirectional transmission of signals between two points

NOTE: Channel is a generic term that can be used at different layers of the interface (e.g. physical channel, logical channel). Several channels may share a common transport mechanism.

connection oriented: communication method in which communication proceeds through three well-defined phases: connection establishment, data transfer, connection release

connectionless: communication method which allows the transfer of information between users without the need for connection establishment procedures

control plane (C-plane): plane which has a layered structure and performs control functions for the various services

NOTE: The C-plane deals with the signalling necessary to set up, maintain and release bearer services.

gateway (GW): network element that provides interworking between the BSM network and one or more external networks.

layer management functions: management functions (e.g. meta-signalling) relating to resources and parameters residing in its protocol entities

link: capability to exchange data between two points

NOTE 1: Link is a generic term that can be used at different layers of the interface. For example:
data link: capability of the data link layer to exchange data; and
physical link: capability of the physical layer to exchange data.

NOTE 2: Physical link (radio link) names can be used to indicate the direction and/or the usage and/or the operating band. For example, "uplink", "feeder link" or "Ku-band link".

management plane (M-plane): plane which provides two types of functions, namely layer management functions and network management functions

multicast: communication capability which denotes unidirectional distribution from a single ingress service access point to a number of specified egress service access points

multipoint: communication configuration attribute which denotes that the communication involves more than two service access points

Network Control Centre (NCC): equipment that provides the central control functions for a satellite network.

Network Management Centre (NMC): equipment that provides the central management functions for a satellite network.

Satellite Independent Service Access Point (SI-SAP): the interface between the satellite dependent lower layers and the satellite independent upper layers of the Satellite Terminal air interface

Satellite Terminal (ST): network element that contains at least one satellite network interface.

NOTE: An ST normally contains at least one other network interface and two different types of ST can be defined:
User ST: that provides interworking between the satellite network and a premises network.
Gateway ST: that provides interworking between the satellite network and an external network.

service attribute: specified characteristic of a telecommunication service

NOTE: The value(s) assigned to one or more service attributes may be used to distinguish that telecommunication service from others.

telecommunication service: service offered by a network operator or service provider to its customers in order to satisfy a specific telecommunication requirement

NOTE: Telecommunication services are divided into two broad families: bearer services and teleservices:
telecommunications bearer service: type of telecommunication service that provides the capability of transmission of signals between user access points, typically the user-network interface (UNI);
teleservice: type of telecommunication service that provides the complete capability, including terminal equipment functions, for communication between users according to standardized protocols and transmission capabilities established by agreement between operators

traffic class (or service class): service offered to the users described by a set of performance parameters and their specified values, limits or ranges

NOTE: The set of parameters provides a comprehensive description of the service capability.

user plane (U-plane): plane which has a layered structure and provides for user data transfer

3.2 Abbreviations

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

ASP	Application Service Provider
AESA	ATM End System Addresses
ATM	Asynchronous Transfer Mode
BSM	Broadband Satellite Multimedia
BSMS	Broadband Satellite Multimedia System
CP	Customer Premises
CPE	Customer Premises Equipment
DAMA	Demand Assigned Multiple Access
Diffserv	Differentiated services
DL	DownLink
DLL	Data Link Layer
DVB-RCS	Digital Video Broadcast-Return Channel by Satellite
DVB-S	Digital Video Broadcast by Satellite
GSM	Global System for Mobile communication
GW	GateWay
IB	InBound
ID	IDentifier
IETF	Internet Engineering Task Force
Intserv	Integrated services
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ITSP	Internet Telephony Service Provider
IWF	InterWorking Functions
LAN	Local Area Network
MAC	Medium Access Control
MM	MultiMedia
MSP	Multimedia Service Provider
MTM	Multipoint-To Multipoint
NAP	Network Access Provider
NCC	Network Control Centre
NMC	Network Management Centre
NOC	Network Operations Centre
NSP	Network Service Provider
OB	OutBound
OBP	On Board Processing
OSI	Open System Interconnection
PHY	PHYsical
PILC	Performance Implications of Link Characteristics
PSTN	Public Switched Telephone Network
QID	Queue IDentifier
QoS	Quality of Service
RSVP	Resource reSerVation Protocol
SAT	SATellite
SCC	Satellite Control Centre
SD	Satellite Dependent
SDAF	Satellite Dependent Adaptation Function
SI	Satellite Independent
SIAF	Satellite Independent Adaptation Function
SI-SAP	Satellite Independent Service Access Point
SLA	Service Level Agreements
SLC	Satellite Link Control
SMAC	Satellite Medium Access Control
SME	Small to Medium sized Enterprises
SNO	Satellite Network Operator

SO	Satellite Operator
SP	Service Provider
SPHY	Satellite PHYsical
ST	Satellite Terminal
TCP	Transmission Control Protocol
TM/TC	TeleMetry/TeleCommand
TOS	Type Of Service
UDP	User Datagram Protocol
UL	UpLink
UMTS	Universal Mobile Telecommunication System
UT	User Terminal
VCI	Virtual Connection Identifier
VPI	Virtual Path Identifier
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal (satellite)
EH	End Host
TSS	Transparent Satellite Star
TSM	Transparent Satellite Mesh

4 Overview of BSM

4.1 Satellite network scenarios

For the present document, we divide the BSM satellite networks into 3 different scenarios: Core network, Distribution network and Access network as illustrated in figure 4.1:

- Access network, providing services to end users.
- Distribution network, providing content distribution to the edge.
- Core network, providing trunk interconnect services.

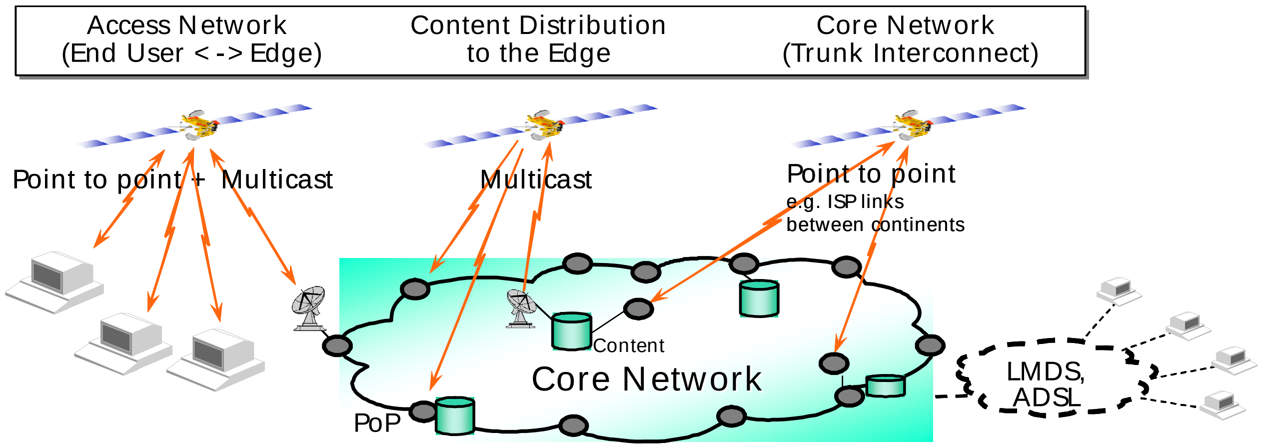

Figure 4.1: Core network, distribution network and access network

Telecommunication satellites can be used to provide broadcasting and multicasting services as well as point-to-point services as illustrated in figure 4.1. In addition to international or long haul communications, figure 4.1 shows satellites being used to provide regional backbone networks and access networks, including access to added value services such as Internet applications.

Due to their natural coverage of large mass of land or ocean satellites are also used to deliver broadcast broadband services such as Digital Video and in this case interactivity can be provided either by the satellite or though a terrestrial telecommunication infrastructure (e.g. PSTN, ISDN and GSM).

4.2 IP networking scenarios

In the global Internet, a BSM system (BSMS) acts as another IP subnetwork. Only a small percentage of IP hosts will be directly connected to that BSMS and it is unrealistic to require that any IP host (including both end hosts and intermediate hosts such as routers) whose traffic transits a BSMS (at some point) should modify its IP-layer protocols. Consequently, the main guideline for interworking IP services over a BSMS is that on the external (non-satellite) side of a Satellite Terminal (ST) all IETF internet protocols should be supported unchanged.

On the satellite side of an ST the IP layer protocols can, when applicable, be adapted to better respond to the specifics of the BSMS to accommodate a combination of the following differences relative to terrestrial wired and wireless networks:

- Longer delays and large delay-bandwidth product.
- High utilization and capacity restrictions of satellite networks.
- Natural multicasting capabilities.
- Large coverage.
- Multiple spot beams.
- On-board switching and routing.
- On-board bandwidth control.
- Independence from ground infrastructure.

This approach of constraining any adaptation of the IETF internet protocols to be fully contained within the boundary of the BSMS is not specific to BSM and can be found in many IP networks in the Next Generation Networks (NGN) such as Virtual Private Networks and Mobile IP. This ensures that the BSMS can be complementary to terrestrial infrastructure, reinforcing the inherent advantages of satellite systems for providing services to remote regions.

The different types of BSM IP networking scenarios are summarized in table 4.1.

Table 4.1: BSM IP networking scenarios

Access network scenarios	Point-to-point	Multicast	Broadcast
Corporate intranet	Corporate VSAT network, i.e. site interconnections	Corporate Multicast e.g. Data distribution e.g. Video conferencing	Datacasting TV broadcast (private)
Corporate internet	Internet Access via corporate ISP or via 3rd party ISP	IP multicast RT streaming ISP caching	ISP caching
SME intranet	Small VSAT network	SME multicast	
SME internet	Internet Access via 3rd party ISP	IP multicast RT streaming ISP caching	ISP caching
Soho Residential	Internet Access via ISP Company access via VPN Internet Access via ISP	IP multicast RT streaming ISP caching IP multicast RT streaming ISP caching	ISP caching ISP caching

Distribution network scenarios	Point-to-point	Multicast	Broadcast
Content to Edge	ISP to Backbone	IP multicast RT streaming Caching at ISP/Edge	TV broadcast (public)

Core network scenarios	Point-to-point	Multicast	Broadcast
ISP interconnect	Trunk interconnect	N/A	N/A

5 BSM roles, actors and equipment

5.1 General

The following roles and actors are defined as a framework for the business aspects of a BSM network. The definitions are designed to provide a clear separation between the different roles, but this strict separation of roles may be less clear in deployed networks.

- The **role** defines a functional entity that is responsible for a defined set of business processes, where each process implies a set of management functions.
- The **actor** defines a real entity, which performs one or more roles. For example, a company is an actor, which can perform more than one role (e.g. Satellite Network Operator and Network Access Provider, etc.).

The roles are linked to the BSM architecture defined in clause 6, and are intended to be compatible with the separation of transport and services as defined for Next Generation Networks (NGNs).

Selected pieces of network equipment are then defined in order to illustrate the responsibilities of the different roles for this equipment. This strict separation of responsibilities may be less clear in deployed networks: for example, a single actor (a single business entity) may perform all or most of the roles in a given BSM network.

5.2 Roles

5.2.1 Definitions

The different roles identified in the whole network business interacting with a BSM system are:

1) **Satellite Operator (SO):** The Satellite Operator is responsible for maintaining, managing, deploying and operating the satellite platform. The SO business involves launching and operating satellites and selling their transponder capacity to Satellite Network Operators. SO activities are performed at the Satellite Control Centre (SCC) and TM/TC (TeleMetry/TeleCommand) stations.

2) **Satellite Network Operator (SNO):** The Satellite Network Operator owns and is responsible for maintaining, managing, deploying and operating the Satellite Network, i.e. leasing satellite transponders and providing the associated ground segment equipment It is responsible for the global traffic and the Satellite Network management functions in terms of network availability and performance. It offers a given coverage, connectivity and bandwidth to NAPs. It manages the partitioning of the resources between the NAPs according to their contract and is in charge of the satellite payload configuration. It can delegate the actual operations on the satellite to the SO. SNO activities are performed at the Network Operations Centre (NOC).

3) **Network Access Provider (NAP):** The Network Access Provider uses the services from one or more SNOs to provide bulk transmission resources to the Service Providers (SPs) for use by their subscribers. The NAP is responsible managing and operating the network access elements in the Satellite Terminals (STs) and one or more Gateways (GWs). The NAP typically shares its network capacity between several SPs. The NAP is linked to each SP by a contract specifying the Service Level Agreement (SLA) of the services that they are allowed to use. The activities of each NAP is performed at a given Network Management Centre (NMC) and Network Control Centre (NCC) and at one or several GWs.

4) **Service Providers (SP):** The Service Provider provides transmission resources to subscribers via one or more of the STs associated with that subscriber. The SP is responsible managing and operating the related service provider elements in the Satellite Terminals (STs) and one or more Gateways (GWs). The SP gives access to a wide range of services involving terrestrial networks or not. In the "satellite bandwidth model", they buy bulk (wholesale) capacity from the NAP and resell that capacity to their Subscribers.

NOTE 1: Several types of service provider can be identified. They can be Network Service Providers (NSP) or Application Service Providers (ASP). Examples of NSP are Internet Service Providers (ISP) or Corporations (e.g. VPN). Examples of ASP are Multicast Service Provider (MSP), Internet Telephony Service Provider (ITSP). Only the Service Providers have a contractual interface with the subscribers: they sell the service and/or the equipment, bill their subscribers, eventually based on information received from the NAPs.

5) **Subscriber:** The subscriber buys services from SPs. It has a contract with one or several SPs for the provision of services. The subscriber can subscribe for services for one or several STs and each ST can itself serve one or more end hosts (EHs). Usually one of these SPs provides the STs to the Subscriber. The subscriber delegates service usage to end-users.

6) **User (or end-user):** The user is the entity that makes use of the services via an End Host (EH). The EHs can connect directly or via a Local Area or Distribution Network its ST; several EHs and hence several users can share the same ST. The user (via the EH) is connected to applications provided by SPs.

NOTE 2: The network equipment on the user side (i.e. routers, switches, firewalls etc. that are used to connect the end hosts to the ST) is collectively referred to as the Customer Premises Equipment (CPE).

5.2.2 Relationships between roles

Figure 5.1 shows the relationships and cardinality between roles: the cardinality of each relationship is indicated by the numbers on each line.

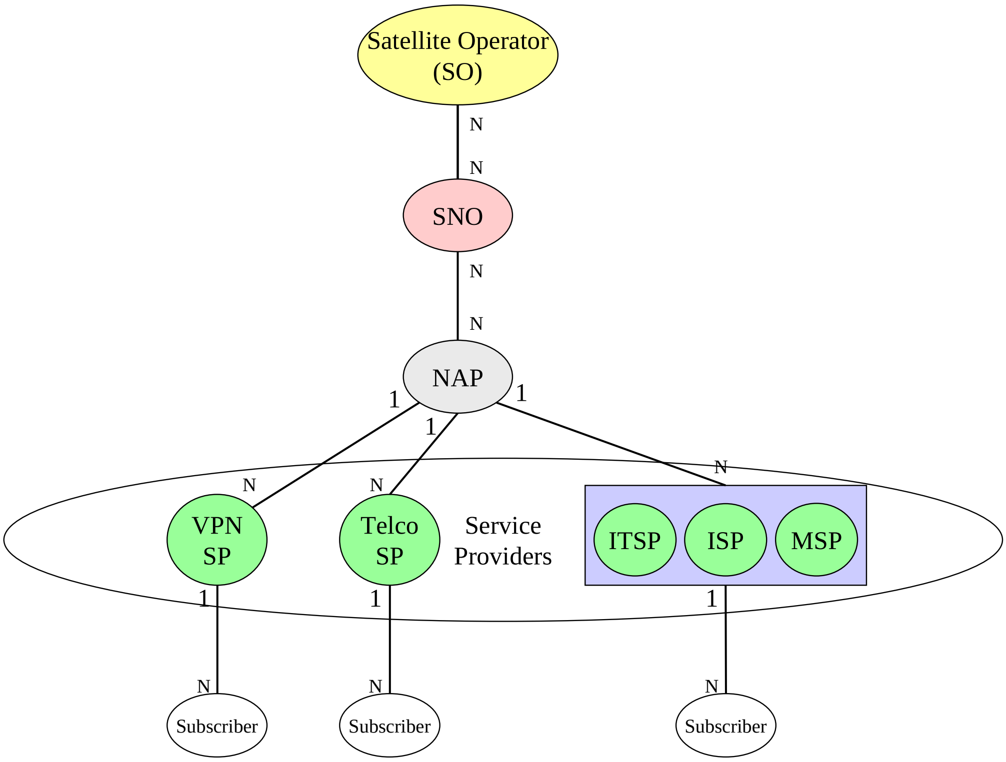

Figure 5.1: Relationships between roles

The following cardinalities are shown in figure 5.1:

a) A single SO can provide services to multiple SNOs (cardinality 1:N). But equally a single SNO can use multiple satellites, including satellites operated by different SOs, to provide services (cardinality N:1). This gives an overall cardinality of N:N.

b) A single SNO can be associated with multiple NAPs (cardinality 1:N). Likewise a given NAP can obtain services from multiple SNOs, hence the overall cardinality is N:N.

c) A single NAP can be associated with multiple SPs (cardinality 1:N). But a given SP can only resell services from a single NAP, hence the overall cardinality is 1:N.

The above definitions only restrict the relationship between roles to 1 NAP per SP. However, a single actor can perform multiple roles and hence; a single company (one actor) can be an SP for multiple NAPs by performing multiple SP roles.

Figure 5.1 shows a few different examples of SPs; namely a Corporate Virtual Private Network SP, a Telco SP or a multiservice SP (ITSP, ISP plus MSP). These are examples only and other types of service provider may exist.

5.3 Equipment

5.3.1 Definitions

A **Gateway (GW)** is the equipment that is used to provide interworking between the satellite network and one or more external networks. Examples of external networks include a public network giving access to the global internet or a private corporate network or even another wireless network.

A given GW belongs to only one NAP: the NAP is responsible for the GWs that it uses to provide its network services. One or more SPs can be associated with the GW to provide access to their external networks. The SPs are responsible for the upper layers of the GW (network layer and above) and they have appropriate visibility and control via the NAP.

A **Satellite Terminal (ST)** is the equipment that is used to provide interworking between the satellite network and one or more users, either via direct connection or via a local network.

A given ST may be owned by either the NAP or the SP, depending on the business model. In both cases, the management and control of the ST is made by the NAP: the NAP is responsible for the lower layers and the SP is responsible for the upper layers and these upper elements are indirectly managed by SP via the NAP NCC.

The overall model of resource management between the SPs and the NAP is formalized by a "bandwidth" contract: the SP either pays for a dedicated bandwidth which it partitions between its customers. Alternatively, some SPs may not need to have a dedicated bandwidth but would prefer to pay for bandwidth on a usage basis (session per session). This is formalized by a "wholesale connectivity" contract: the SP pays for a given number of STs that are connected, or for a given number of User/ Application sessions which are in progress. These services can be simultaneously delivered by the same NAP to one or several SPs through one or several GWs.

The Satellite Independent Service Access Point (SI-SAP) (as defined in clause 6.4) is recommended as the boundary between the ST elements for which the SP is responsible and the ST elements for which the NAP is responsible. The SI-SAP is primarily designed to separating the responsibilities of the ST, but the SI-SAP can also be used to separate the GW responsibilities.

5.3.2 Relationship between roles and equipment

Figure 5.2 shows the relationships between equipment and roles:

- A square shape (square box) corresponds to a piece of equipment.
- A rounded shape (rounded box) corresponds to one of the roles (as defined above).
- A solid line between roles represents a business relationship and its cardinality.
- A solid line between a role and an equipment means the role directly controls some aspects of the equipment. They also define the cardinality of the relationship.
- A dashed line between a role and an equipment means the role indirectly controls some aspects of the equipment. They also define the cardinality of the relationship.
- A solid double line between equipment boxes represents a physical interface (communication link) and its cardinality; and a dashed double line between equipment boxes represents a logical interface and its cardinality.

This model is valid for both star and mesh system scenarios.

One can note the following restrictions of the model:

- A given SP is related to only one NAP.

NOTE 1: An actual SP actor can be linked to several NAPs, but in this case a separate SP role would be considered for each NAP (an actor can hold several roles).

- A given ST is related to one NAP, one SP and one Subscriber. The ST is also linked via the satellite network to 0 or 1 Gateway.

- The network operations of a given ST is managed by one NMC and controlled by one NCC. The NMC and NCC (NMC/NCC) are associated with one NAP.

NOTE 2: A network may also contain a secondary NMC and/or multiple NCCs to provide more resilience.

- The SP may have some indirect control and management of the STs via the NAP. Likewise, the SP may offer some indirect control and management to the subscriber.

NOTE 3: A subscriber may subscribe to multiple SPs (and hence use services from multiple NAPs) but a given ST can only be associated with a single NAP.

- A given User is related to one End Host and via that End Host to one Customer Premises Equipment (CPE) and one ST.

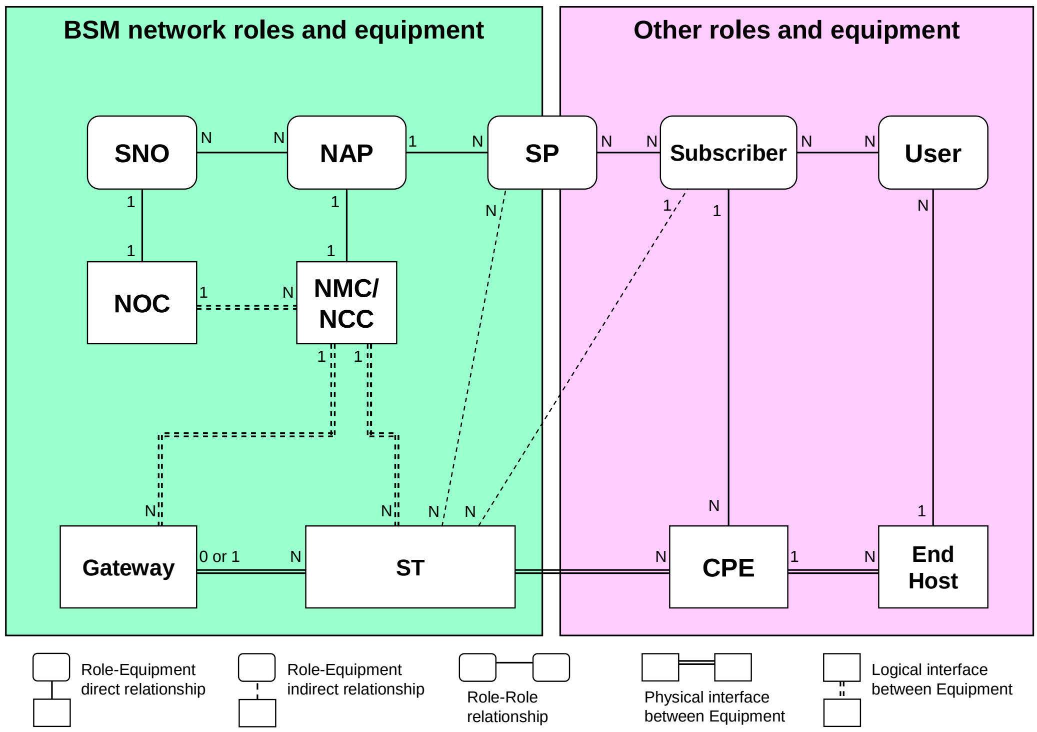

Figure 5.2: Relationship between roles and equipment

5.4 Billing and usage relationships

An example of the billing and usage relationships that could exist between the satellite network operators and service providers and some other roles is illustrated in figure 5.3.

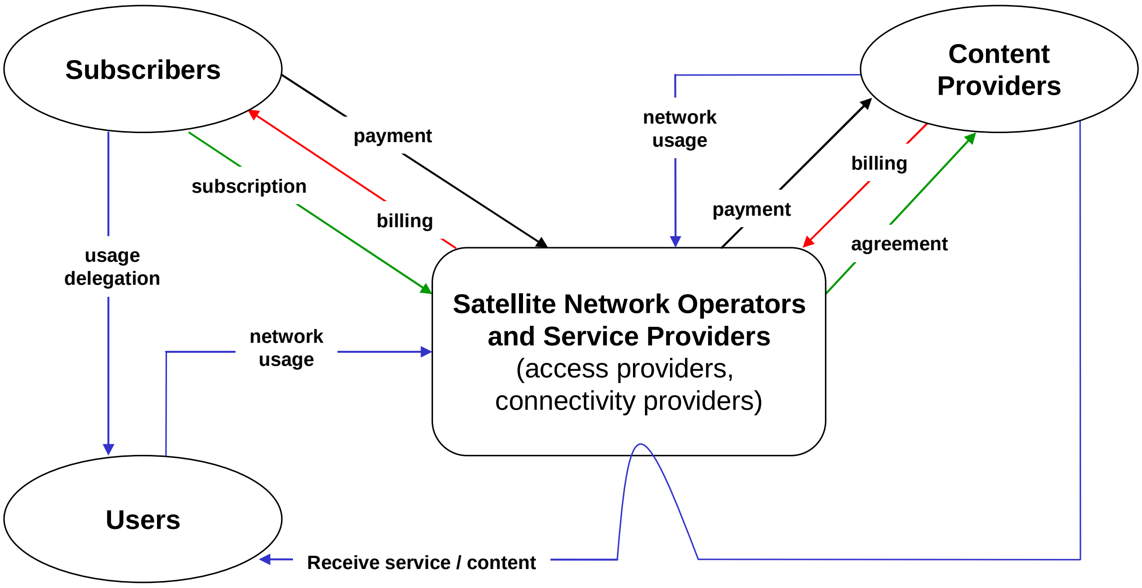

Figure 5.3: Billing and usage relationships

NOTE: Figure 5.3 shows the billing and usage relationships that affect the satellite network operators and service providers. Additional billing and usage relationships that may exist (e.g. between Users and content providers) are out of scope for the present document and hence are not shown in this figure.

6 BSM reference models and architectures

6.1 Definitions

6.1.1 BSM System; Network and Subnetwork

The following three groupings of BSM elements are defined (in order of decreasing complexity):

- **BSM System (BSMS)**: A BSM System corresponds to 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.

NOTE 1: The NMC and NCC represent a functional separation of the management and control functions and does not imply any particular implementation.

- **BSM Network:** A BSM network corresponds to a BSM subnetwork together with the BSM interworking and adaptation functions that are required to provide an interface into the attached networks.

NOTE 2: The boundaries of the BSM Network are the physical interfaces to those attached networks.

- **BSM Subnetwork:** A BSM subnetwork is all the BSM network elements below the Satellite Independent Service Access Point (SI-SAP).

NOTE 3: The Satellite Independent Service Access Point (SI-SAP) is the interface between the satellite dependent lower layers and the satellite independent upper layers of the Satellite Terminal air interface. The SI-SAP is described in clause 6.4.

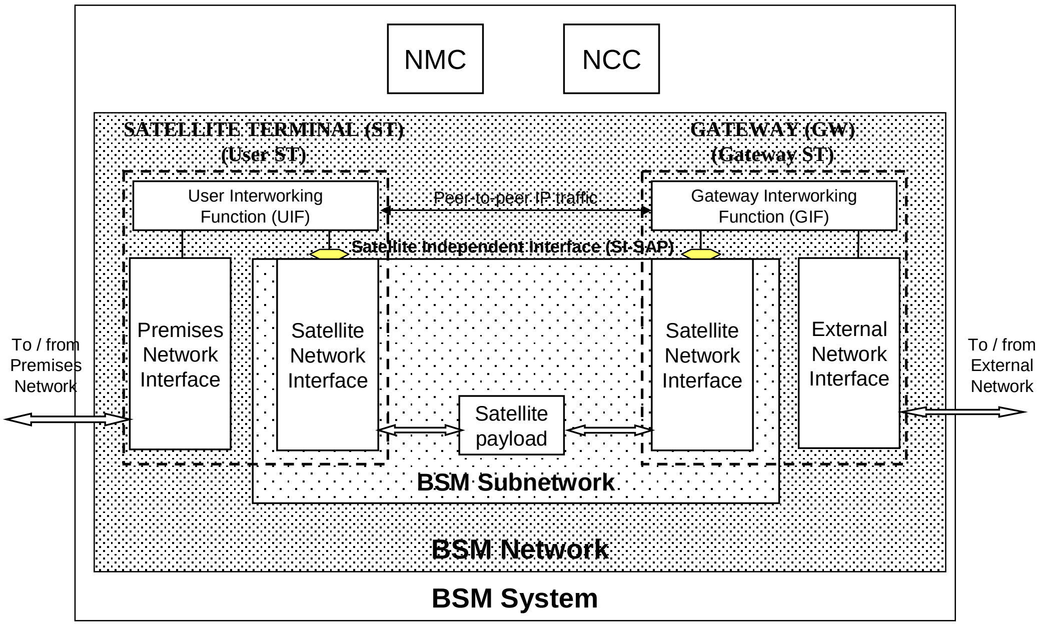

Figure 6.1: BSM System, Network and Subnetwork

Figure 6.1 also illustrates two main types of satellite terminals (STs):

- **Satellite Terminal (User ST):** A User ST provides interworking between the satellite network and a premises network.

NOTE 4: A premises network provides a connection to one or more end hosts, either via direct connection or via a local network such as a LAN.

- **Gateway (Gateway ST)**: A Gateway ST provides interworking between the satellite network and an external network.

NOTE 5: An external network provides access to the global internet and/or to a company network servers, and/or similar shared network access.

This model illustrates a functional difference in the interworking function provided by a User ST and a Gateway ST. The same type of equipment may be used in both cases and in some cases a given ST may provide both types of interworking function within the same physical ST.

The functionality provided by a given ST is also dependent on the satellite architecture and the network topology, as described in the following clauses.

6.1.2 Transparent and regenerative satellite architecture

A BSM network may use either a transparent or a regenerative satellite architecture:

- A transparent satellite architecture refers to a single architecture, commonly called a "bent-pipe architecture". In this architecture the satellite payload only contains physical layer functions (e.g. transponders) and does not terminate any other layers of the air interface in the satellite. The satellite payload transfers each set of uplink signals to the corresponding downlink transparently.

- A regenerative satellite architecture is the range of other architectures that provide additional functionality in the satellite payload. In these architectures, the satellite payload contains functions at the physical layer and at other layers. The satellite payload typically terminates the physical layer plus one or more other layers of the air interface.

6.1.3 Topologies

The topology refers to the arrangement of the links (logical links) between the Hub and the STs and between STs via the satellite. A BSM network may support either a mesh or star topology as illustrated in figure 6.2:

- A star topology is defined by the star arrangement of links between the Hub (or Gateway ST) and multiple remote STs. In this topology the User ST is usually referred to as the "Remote ST" (or simply "ST") and the Gateway ST is usually referred to as the "Hub". A Remote ST can only establish a direct link with the Hub and cannot establish a direct link to another Remote ST.

- A mesh topology is defined by the mesh arrangement of links between the STs, where any ST can link directly to any other ST. In this topology any ST can perform the functions of a User ST or a Gateway ST. The star topology can be considered as one special case of the mesh topology.

NOTE: A star topology can be used to provide mesh connectivity by establishing an indirect "double-hop" link between remote STs via the Hub station.

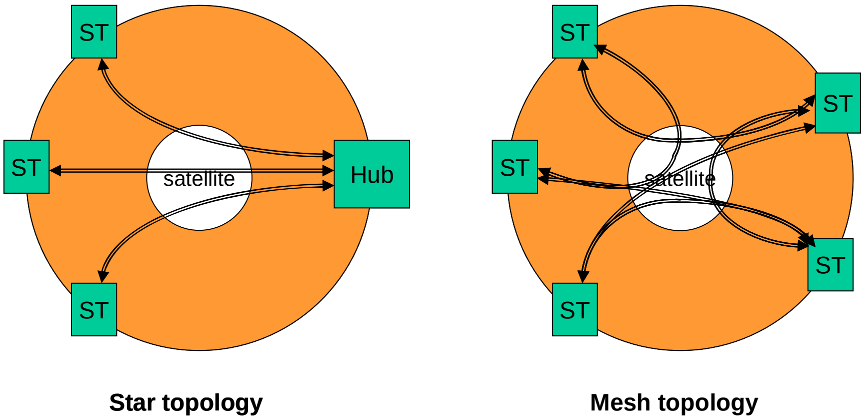

Figure 6.2: Star and Mesh topology

6.1.4 Link and channel attributes

Within either a star or mesh network topology, the links can have the following attributes:

- Point-To-Point links.
- Point-To-Multipoint links.
- Multipoint-To-Multipoint links.
- Multipoint-To-Point links.
- Broadcast links.

Links (both logical and physical) between an ST and the satellite can be defined by reference to the direction of the link relative to the ST as follows:

- UpLink (UL): a link from the ST to the satellite (i.e. a link transmitted by the ST).
- DownLink (DL): a link from the satellite to the ST (i.e. a link received by the ST).

These definitions are illustrated in figure 6.3.

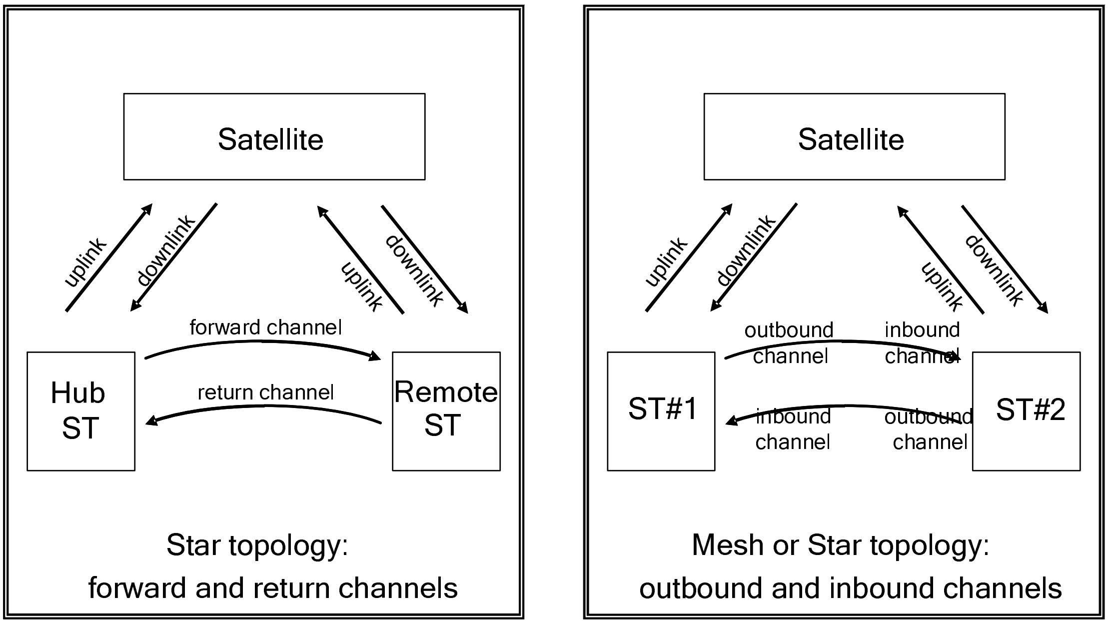

Figure 6.3: Links and channels

Channels (both logical and physical) can also be defined by reference to the network topology as illustrated in figure 6.3.

In the case of a Star topology we can define the direction of a channel as follows:

- Forward channel: a channel from the central hub ST to the remote STs.
- Return channel: a channel from one of the remote STs to the central hub ST.

In the case of a Mesh or Star topology we can define the direction of a channel at a given ST as follows:

- OutBound channel (OB): a channel originating from the ST (i.e. the ST is the data source).
- InBound channel (IB): a channel terminating at the ST (i.e. the ST is the data sink).

NOTE: OutBound and InBound channel definitions are relative to a given ST. An OutBound channel from one ST becomes the Inbound channel at the peer ST.

6.2 BSM Network Types

6.2.1 Naming conventions

BSM networks can be classified into one of three different types according to the satellite OBP architecture, the return channel and the network topology. The main BSM network types are summarized in table 6.1 using the naming conventions defined in TR 102 187 [9].

Table 6.1: BSM Network Types

BSM Network Type	TSS	TSM	RSM
Satellite OBP Architecture	Transparent	Transparent	Regenerative
Return Channel	Satellite	Satellite	Satellite
Network Topology	Star	Mesh	Mesh

All of these three main network types use a Satellite return channel. However, the BSM architecture can also be applied to networks that use a Hybrid (non-satellite) return channel with the addition of an additional network interface as shown in annex C.

There are two main differences between these different types of BSM network:

d) The cardinality of the relationship between the User STs and the Gateway STs is restricted to N:1 for a star topology (i.e. a given User ST is associated with only one Gateway ST) but can be N:N (any to any) for a mesh topology.

NOTE: As noted in clause 6.1.3 the star topology can be considered as a special case of the mesh topology and hence a network that supports mesh connectivity can also support star connectivity.

e) The Satellite Radio Interface is usually different in the forward and reverse directions. For a transparent satellite this means that the Gateway ST and the User ST usually have a different satellite radio interface (i.e. the Uplink and Downlink are reversed at the Gateway ST relative to the User STs); but in the case of a regenerative satellite the STs on both sides usually have the same satellite network interface (i.e. the Uplink and Downlink are the same at both the User STs and the Gateway STs).

An example of each of these main network types, illustrating and elaborating these differences, is given in the following clauses.

Clause 6.3 then defines a set of generic reference models that are applicable to all of the different network types.

6.2.2 Transparent Satellite Star (TSS)

In a transparent satellite star network the communication links between the Satellite Terminals (STs) and the Gateway/ Network Control Centre (GW/NCC) use a transparent satellite architecture.

The satellite links are bidirectional and both directions (both forward and return links) use a transparent satellite architecture.

A schematic network diagram for a transparent satellite star BSM subnetwork is shown in figure 6.4.

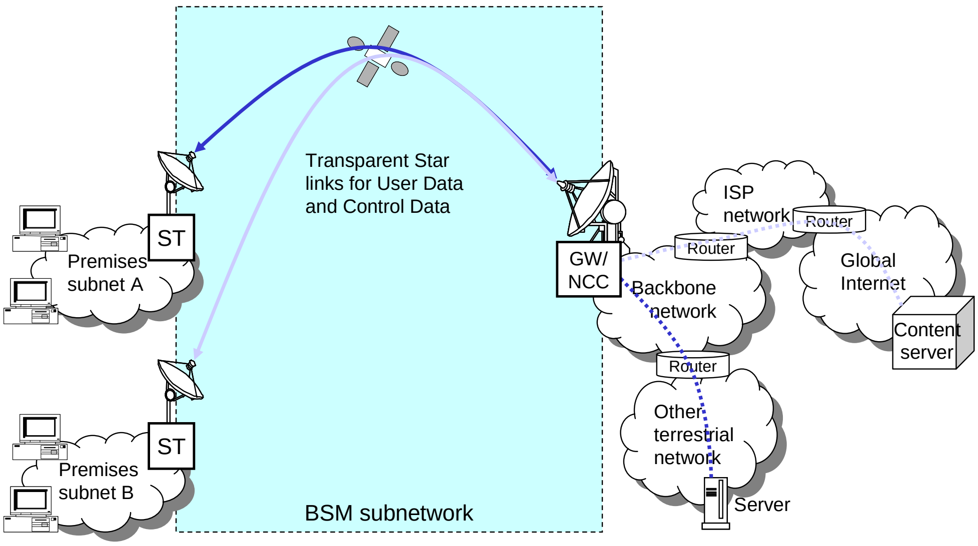

Figure 6.4: Transparent Satellite Star (TSS)

The following points are noted in this example:

a) The BSM subnetwork uses a star topology for all links. In this example a single Hub ST connects to multiple remote STs.

b) The GW/NCC represents the Gateway ST at the Hub of the star topology that is shared by the Gateway functions and the NCC. The GW element contains the IP interworking functions and the NCC element processes the control data (C-plane).

NOTE 1: It is also possible to use separate STs for the GW and NCC elements.

c) The ST represents the remote ST (the User ST) of the star topology. Typically, each customer premises will have a separate ST connected to their local premises subnet, but it is also possible to connect multiple independent subnets via a single remote ST.

d) The radio interface is usually different in the forward and reverse directions.

NOTE 2: For example, a typical TSS network may use DVB-S or DVB-S2 for the forward link and DVB-RCS for the reverse link.

e) The forward links can support either point-to-point links (to a single remote ST) or point-to-multipoint links (to multiple remote STs.). The reverse link can only support point-to-point links from any remote ST to the GW/NCC.

NOTE 3: A remote ST can act as the indirect source for point-to-multipoint services by forwarding the data via the GW (i.e. double hop).

f) The forward and reverse links use multiplexing to combine the traffic for multiple different User STs into the available channels.

NOTE 4: The reverse links typically use Demand Assigned Multiple Access (DAMA) protocols to assign some or all of the capacity to STs on a demand driven (per-request) basis. However, other capacity assignment methods (e.g. reserved fixed rate capacity) are also possible.

6.2.3 Transparent Satellite Mesh (TSM)

In a transparent satellite mesh network direct single-hop communication between two remote STs (User STs) is permitted using a transparent satellite architecture. The transparent mesh network can only exist as an overlay to a transparent satellite star network: the mesh overlay is only used for user data and the star network is used for both control data to/from the NCC and for user data to/from the GW.

The satellite links are bidirectional (for both the mesh and the star links) and all these links use a transparent satellite architecture.

A schematic network diagram for a transparent satellite mesh BSM subnetwork is shown in figure 6.5.

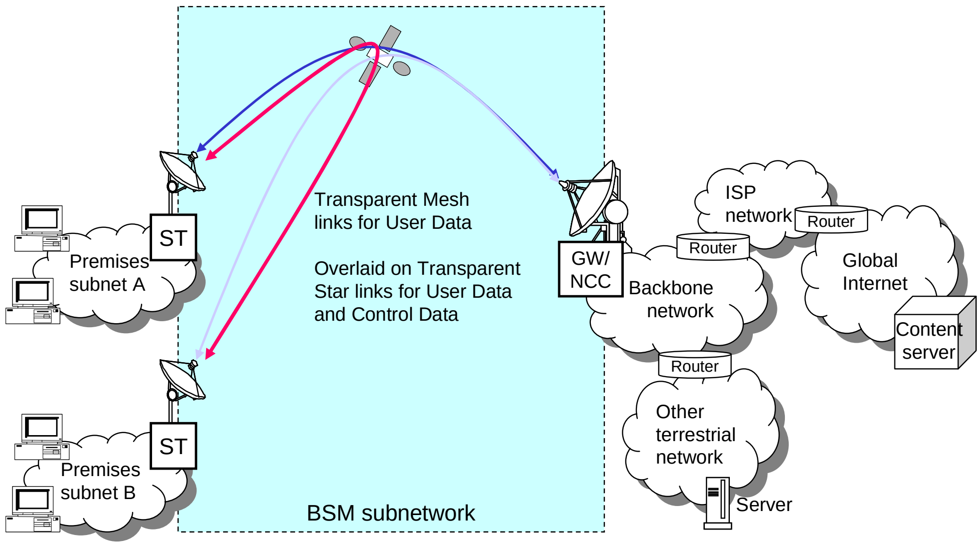

Figure 6.5: Transparent Satellite Mesh (TSM)

The following points are noted in this example:

a) The BSM subnetwork contains both a mesh and a star topology. The star topology is identical to the transparent star network described in clause 6.2.2. The mesh topology can be used to provide direct, single-hop links between pairs of remote STs.

b) The remote ST is required to provide additional processing to handle the mesh links, since the mesh link transmissions from another remote ST will typically use a different radio interface to the star link transmissions from the GW/NCC.

NOTE: For example, in a DVB system the star link from the GW/NCC may use DVB-S2 but the mesh link from the other remote ST may use DVB-RCS. In this example the remote STs transmit using DVB-RCS for both mesh links and star return links.

c) The mesh links are controlled by the NCC using additional mesh control procedures via dual transparent star control links from each remote ST to the NCC (a separate control link is needed for each remote ST).

d) The mesh topology can support both point-to-point or point-to-multipoint links.

6.2.4 Regenerative Satellite Mesh (RSM)

In a regenerative satellite mesh network direct single-hop communication between any two Satellite Terminals (User STs or Gateway STs) is possible using a regenerative satellite architecture.

A star topology is also possible as a special case of this fully meshed topology, with any ST acting as the Gateway ST (i.e. as the "hub") for a set of star links. As a result, a regenerative satellite star (RSS) network type is not considered as a separate type: it is included in the RSM network type.

The mesh links are used to provide single-hop links for user data between any two terminals. Typically this is combined with a separate set of star links for the control data between both STs and the NCC. In general, this means that the GW function is both physically and logically separated from the NCC.

A schematic network diagram for a regenerative satellite mesh BSM subnetwork is shown in figure 6.6.

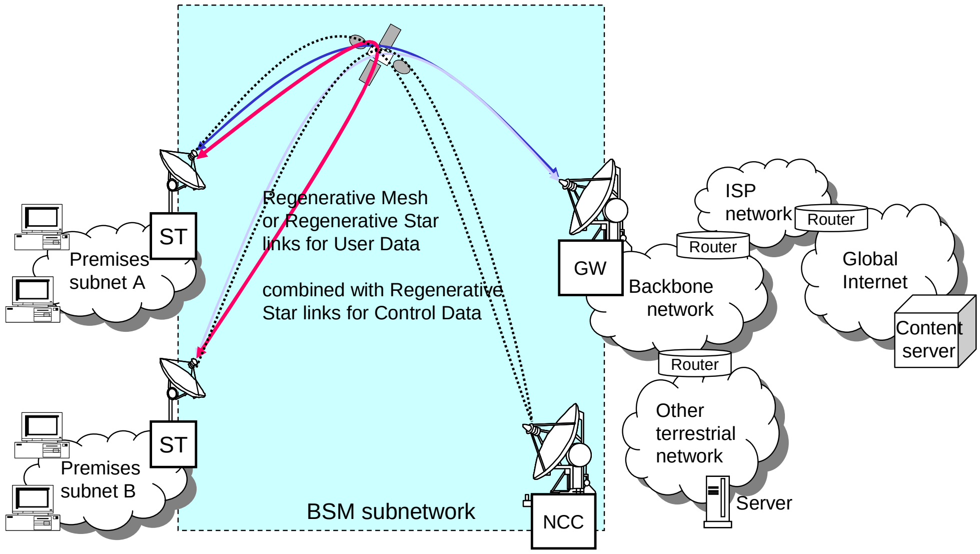

Figure 6.6: Regenerative Satellite Mesh (RSM)

The following points are noted in this example:

a) The BSM subnetwork contains a variable mix of mesh and star topologies. Any ST can act as a Gateway for user data.

b) The radio interface is typically different for the uplink (ST to satellite) and the downlink (satellite to ST). But all of the STs can use the same radio interface since the regenerative satellite payload converts from the uplink radio interface to the downlink radio interface as part of the payload processing.

c) The complete network (both star and mesh links) is controlled by the NCC via star topology control links between each ST and the NCC (a separate control link is needed for each active ST).

NOTE 1: Typically a dedicated ST is used by the NCC to transmit and receive the control links.

d) This meshed topology can support both point-to-point or point-to-multipoint links.

e) The forward and reverse links for the mesh topology also use multiplexing to combine the traffic for multiple different STs into the available radio channels. The uplink typically uses Demand Assigned Multiple Access (DAMA) protocols to assign capacity to STs on a demand driven (per-request) basis.

NOTE 2: The uplink traffic from a given ST may be connected to multiple different downlink channels via the regenerative satellite payload and hence the uplink capacity allocations may need to take account of downlink capacity restrictions as well as any uplink capacity restrictions.

6.3 Reference models

6.3.1 Reference models for access network scenario

This clause gives a detailed reference model for the satellite access network scenario. The reference interfaces are divided into physical and logical interfaces defined as follows:

- **Physical interfaces** correspond to physical connections between equipment, either wired or wireless, typically corresponding to physical transmissions over a wired or wireless medium.
- **Logical interfaces** correspond to logical associations between peer protocol entities, typically corresponding to peer-to-peer protocol message exchanges using one or more logical channels that are transported via one or more physical channels.

6.3.1.1 U-plane reference model

The U-plane reference model is shown in figure 6.7. Each labelled interface is described in more detail in the corresponding table 6.2.

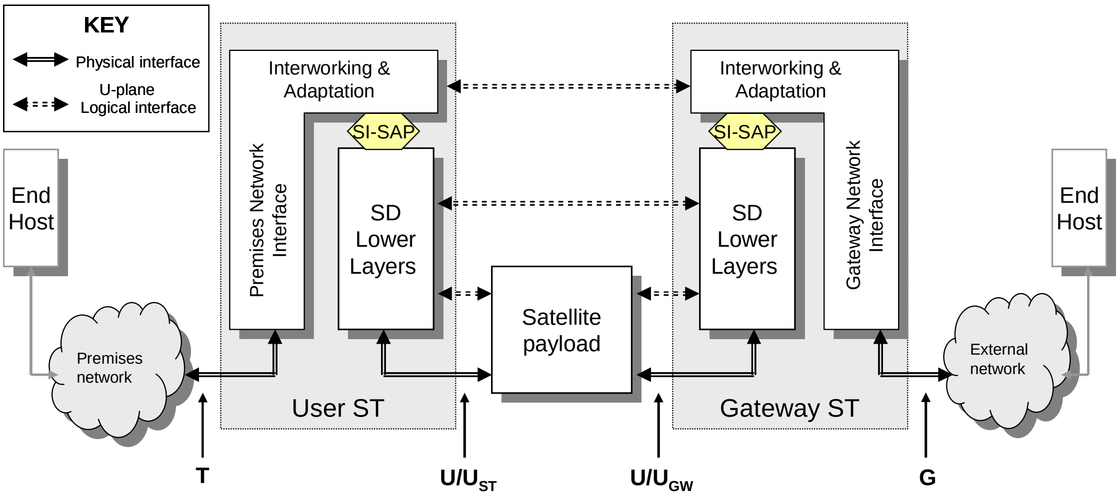

Figure 6.7: U-plane reference model for satellite access

Table 6.2: U-plane interfaces for satellite access

Ref	Physical interface Name	Description of interface
T	ST/ External Network Interface	Interface between User ST and premises network
G	ST/ External Network Interface	Interface between Gateway ST and external network
U / U_{ST}	ST/ Satellite Network Interface	Satellite Radio Interface for User ST (see note 1).
U / U_{GW}	ST/ Satellite Network Interface	Satellite Radio Interface for Gateway ST (see note 1).
NOTE 1: The radio interface label U indicates that both sides have the same radio interface. Alternatively the radio interface labels U_{ST} and U_{GW} indicate that the two sides have a different radio interface (i.e. the User ST and the Gateway ST have a different radio interface). NOTE 2: The SI-SAP interface is described in clause 6.4.		

Three logical interfaces are shown at the radio interface, corresponding to the peer-to-peer interactions of the different layers of radio interface protocols. The SD lower layers of each ST have two logical interfaces: one interfacing with the satellite payload and one with the peer ST. The boundary between these two interfaces is satellite dependent (i.e. it depends on the satellite payload capabilities).

As shown in this reference model, IP InterWorking Functions (IP IWFs) occur at two points:

- In the User ST, IP IWFs provide interworking and adaptation between the BSM SI-SAP and the Premises Network.
- In the Gateway ST, IP IWFs provide interworking and adaptation between the BSM SI-SAP and the External Network.

In both cases, these IP IWFs are logical entities and no particular physical location is implied by their position in the reference diagram.

6.3.1.2 C-plane and M-plane reference model

The C-plane and M-plane reference model is shown in figure 6.8. Each labelled interface is described in more detail in the corresponding table 6.3.

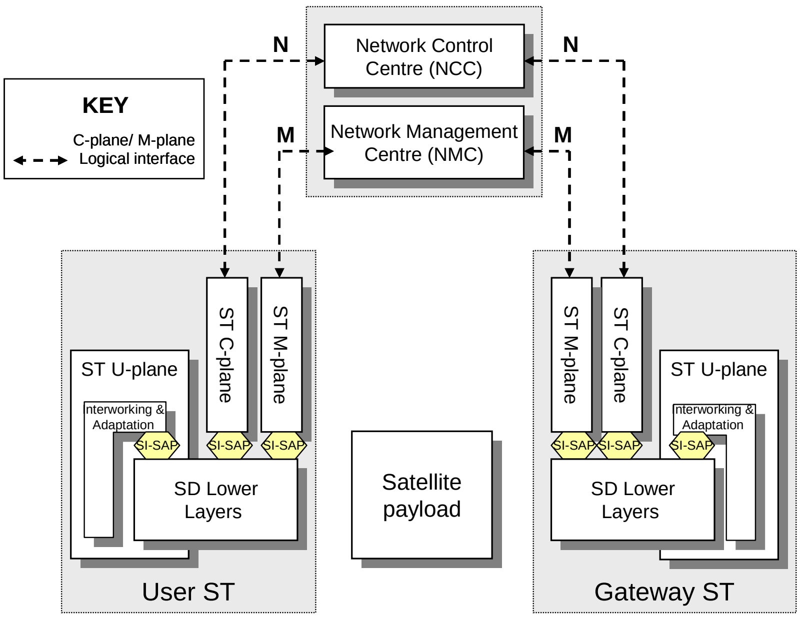

Figure 6.8: C-plane and M-plane reference model for satellite access

Table 6.3: C-plane and M-plane Interfaces for satellite access

Ref	Logical interface Name	Description of interface
N	Control interface between NCC and ST	Internal C-plane protocols
M	Management interface between NMC and ST	Internal M-plane protocols
NOTE: The SI-SAP interface is described in clause 6.4.		

As shown in this diagram, both the NMC and NCC have a logical interface to the User STs and to the Gateway STs.

6.3.2 Generalized reference models

The detailed reference model as defined above for the access network scenario can now be applied to the different network types and to the other BSM scenarios.

6.3.2.1 BSM network types

The access network reference model can be applied to all the BSM network types. Two variants of the U-plane reference model are noted as illustrated in figure 6.9.

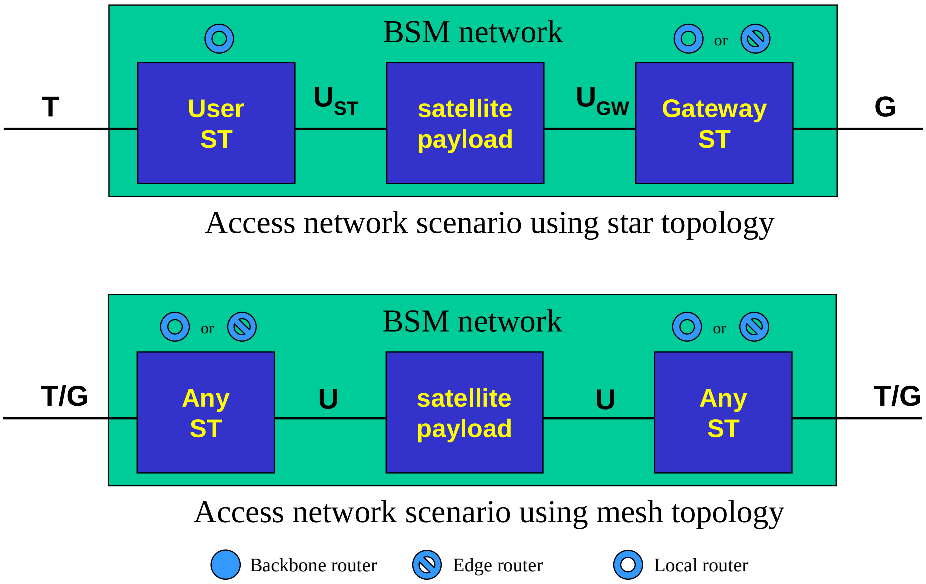

Figure 6.9: U-plane reference models for different network types

For the star topology, only one reference model is possible, with the BSM network proving an access network link between the external network attached to a Gateway ST and the premises network attached to a User ST.

For the mesh topology, several similar reference models are possible. The BSM network can provide an access network link between any two terminals: either two User STs, two Gateway STs or one of each.

6.3.2.2 Other BSM scenarios

The access network reference model can also be applied to the other scenarios defined in clause 4 as shown in figure 6.10. These mappings differ only in the functionality provided by the satellite terminals: for the core network and distribution network scenarios, both ends of the BSM network are provided by Gateway ST functions.

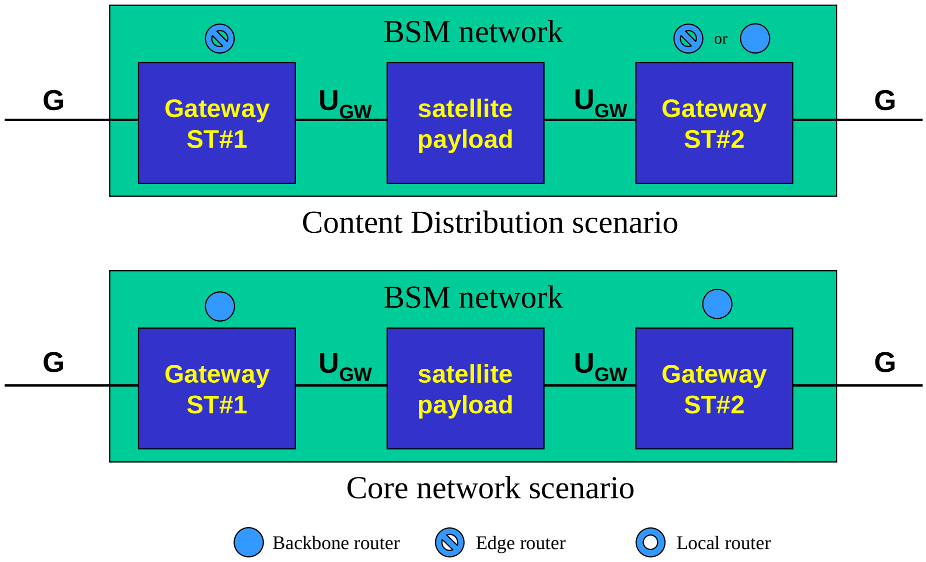

Figure 6.10: U-plane reference models for other BSM scenarios

As shown in figure 6.10, a BSM network can provide data transport services between any pair of G interfaces.

6.4 Protocol architecture

6.4.1 BSM protocol architecture

The BSM protocol architecture for satellite access terminal to satellites is illustrated in figure 6.11.

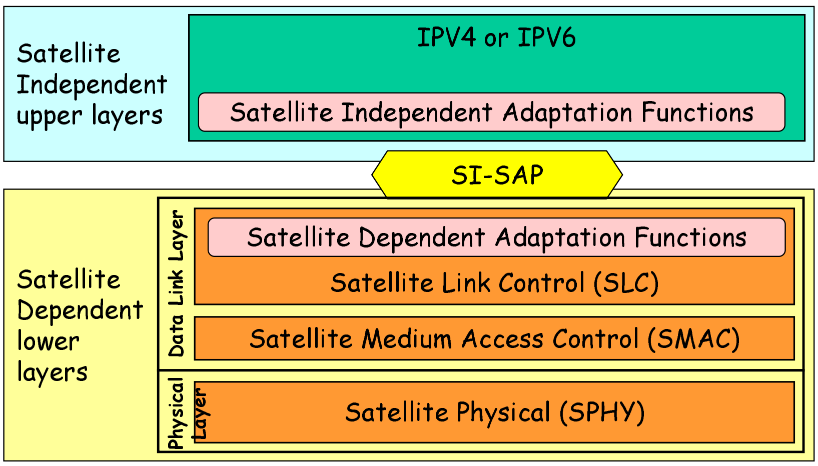

Figure 6.11: BSM protocol architecture

The different layers of the BSM protocol architecture are defined in table 6.4.

Table 6.4: Main layers of the BSM protocol architecture

Layer	Description of Layer	Comments
1	PHYSICAL LAYER (PHY) Satellite Physical Layer (SPHY)	Satellite dependent layer conforms to ETSI Harmonized Standards
2	DATA LINK LAYER (DLL) Satellite Link Control (SLC) and Satellite Medium Access Control (SMAC)	Satellite dependent layer SLC and SMAC may be combined into a single layer, or may be separate sublayers
3+	IP LAYERS (and higher layers)	Satellite independent layers

As shown in figure 6.11, the Satellite Independent Service Access Point (SI-SAP) is the interface between the satellite dependent lower layers and the satellite independent upper layers. The SI-SAP and the associated adaptation functions are described in clause 6.4.3.

6.4.2 SI-SAP and BSM families

The BSM protocol architecture supports families of air interface protocols, where each family defines a complete stack of air interface protocols for the physical layer and the data link layer. Each air interface family is expected to use a combination of a SLC, SMAC and SPHY layers that are jointly optimized for a specific range of satellite architectures and/or for a specific range of traffic types. The naming conventions for BSM families are defined in TR 102 187 [9].

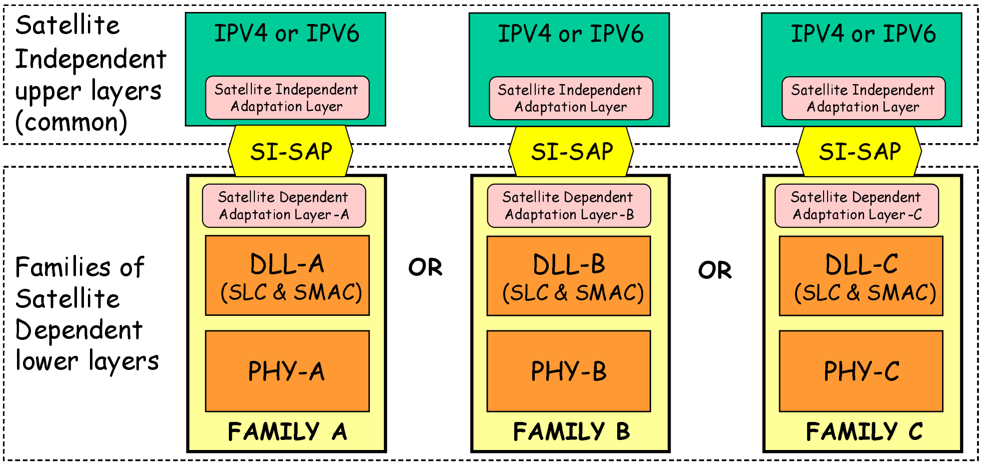

Figure 6.12: BSM families

The concept behind the BSM protocol architecture is a clear separation between functions that are applicable to all satellite systems (satellite independent or SI) and the functions that are specific to a satellite technology (satellite dependent or SD) and hence define a satellite independent interface that can be used to provide essentially the same services across all families (i.e. across all implementations of the BSM SD layers). This interface is called the Satellite Independent Service Access Point (SI-SAP); a common interface that applies to all air interface families.

6.4.3 Satellite Independent Service Access Point (SI-SAP)

The Satellite Independent Service Access Point (SI-SAP) is the common interface between any BSM family of satellite dependent lower layers and the satellite independent upper layers.

The BSM protocol architecture also defines two sets of adaptation functions that are associated with the SI-SAP. These functions are used to provide a mechanism for adapting to and from the SI-SAP services:

- The Satellite Independent Adaptation Functions (SIAF) operate at the bottom of Layer 3 to adapt between the layer 3 protocols and the SI-SAP services.
- The Satellite Dependent Adaptation Functions (SDAF) operate at the top of Layer 2 to adapt between the SI-SAP services and the native services of the given BSM family.

As shown in figure 6.4.3 the SI-SAP and the associated adaptation functions can be logically divided into U-plane, C-plane and M-plane services. This is a logical (functional) separation of the SI-SAP interface functions and does not imply any particular physical implementation of the interface.

The SI-SAP U-plane services correspond to the endpoints of the BSM bearer services as described in clause 6.4.4. The SI-SAP is used to define a common set of satellite independent bearer services that are mapped (via the SDAF) into the satellite dependent lower layer services. This enables ETSI and other standards bodies to define standard mappings from the higher layers to these BSM bearer services via the SIAF.

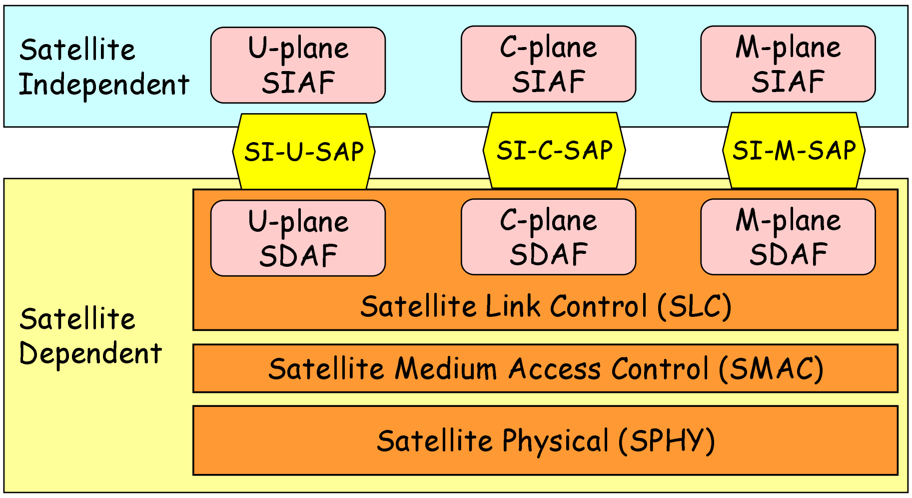

Figure 6.13: Satellite Independent Service Access Point (SI-SAP)

6.4.4 BSM bearer services layered architecture

BSM bearer services are defined in terms of a layered architecture that is based on the 3GPP QoS architecture [4].

BSM bearer services are the user plane (U-plane) data transmission services provided by the BSM subnetwork at the SI-SAP interfaces. BSM bearer services include all aspects to enable the provision of U-plane data transport service between SI-SAP interfaces, including both the contracted QoS and other bearer service properties, as viewed at those SI-SAP interfaces.

NOTE: BSM bearer services do not include the associated control plane (C-plane) and management plane (M-plane) services such as control signalling and QoS management functionality.

The layered architecture for bearer services is illustrated in figure 6.14, showing how each bearer service on a specific layer offers it is individual services using services provided by the layers below. The BSM bearer services use service provided by the underlying native bearer services, which in turn use the services of the transmission bearer services.

The BSM bearer services are defined with more detail in clause 8.

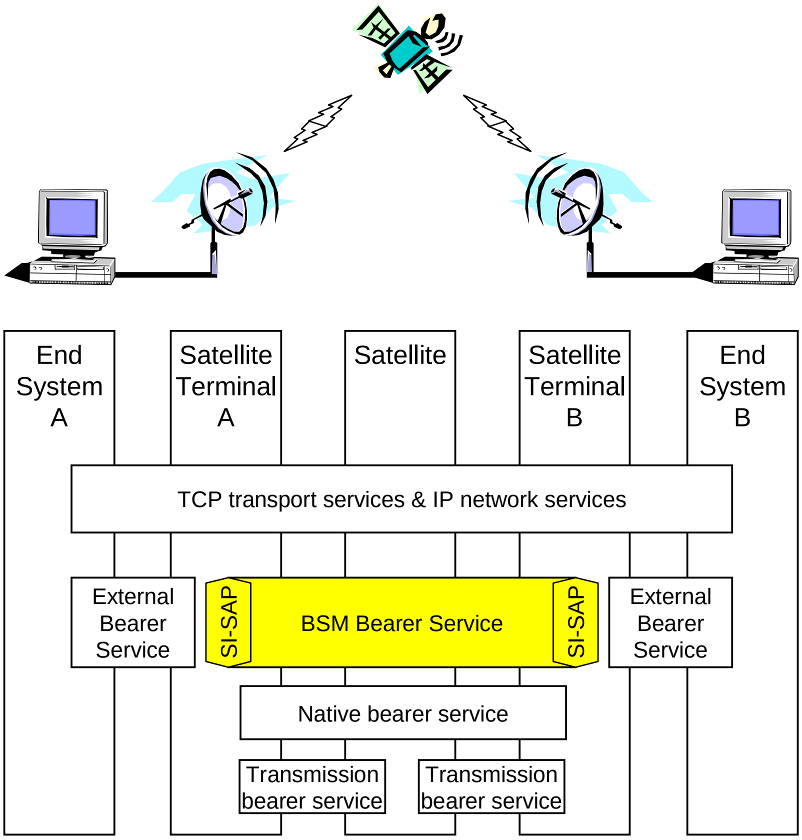

Figure 6.14: BSM bearer services

A BSM system will typically use a combination of different native bearer services and transmission bearer services (i.e. different channels) to support a range of BSM bearer services.

The higher layer services (IP and above) are built on the BSM bearer services and these higher layer services can be mapped to different BSM bearer services depending on the particular service requirements (e.g. the quality of service and the topology required).

6.4.5 Air interface lower layer service elements

Figure 6.15 illustrates the relationship between the BSM bearer services and the underlying lower layer bearer services and associated elements of service at the different layers of the satellite air interface.

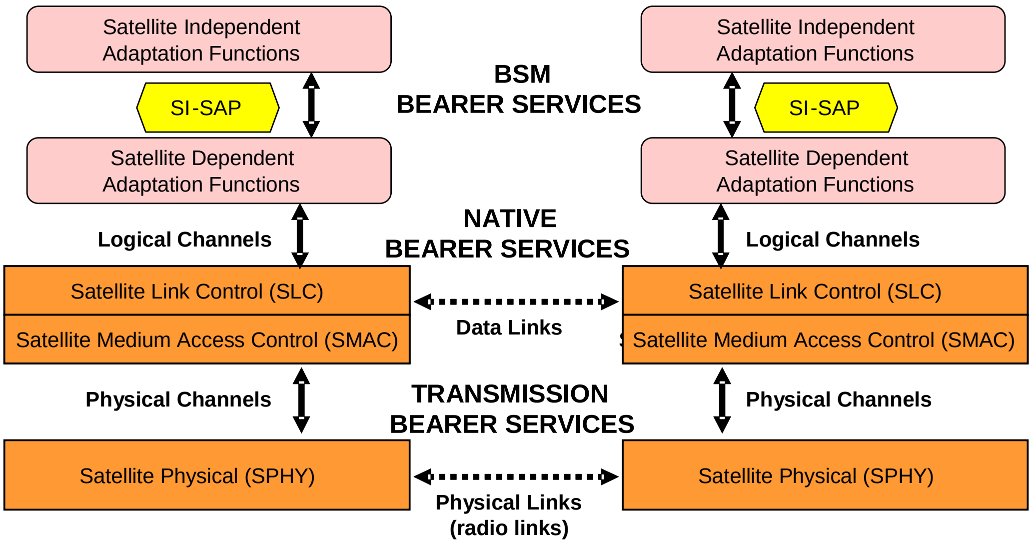

Figure 6.15: Air interface lower layer elements of service

Figure 6.15 shows both the layered bearer services and the associated peer-to-peer relationships at each layer. Typically the layer to layer interfaces are defined in terms of primitive exchanges and the peer-to-peer interfaces are defined in terms of message or Protocol Data Unit (PDU) exchanges.

The following bearer services are defined:

- **BSM bearer services** are the user data transfer services provided at the SI-SAP interfaces as illustrated above.
- **Native bearer services** are the lower layer data transfer services provided at the SLC/SMAC interfaces of the STs as illustrated above.

NOTE 1: The Satellite Dependent Adaptation Functions (SDAF) are used to adapt between the Native bearer services (which are family dependent) and the BSM bearer services.

- **Transmission bearer services** are the data transmission services provided by the Physical Layer interfaces of the STs as illustrated above.

The following layer-to-layer elements of services are defined:

- **The SI-SAP** is the Satellite Independent Service Access Point as defined in clause 6.4.3.
- **Logical channels** are the channels that correspond to the native bearer services (i.e. a logical channel corresponds to the endpoint of a specific instance of the native bearer services).
- **Physical channels** are the transmission bearer services provided by the physical layer protocols (i.e. a physical channel corresponds to the endpoint of a specific instance of the transmission bearer services).

The following peer-to-peer elements of service are also defined:

- **A data link** is defined as the capability of the data link layer to exchange data. This is a peer-to-peer association at the data link layer. The peer entity for the data link of a given ST may be either the satellite payload or another ST depending on the capabilities of the satellite payload.

NOTE 2: A data link will typically support multiple logical channels (e.g. by multiplexing).

- **A physical link** is defined as the capability of the physical layer to exchange data. This is a peer-to-peer association at the physical layer.

NOTE 3: A physical link will typically support multiple physical channels (e.g. by multiplexing).

7 General service definitions

7.1 Media components

The telecommunication services supported by involve in general one or more media components. The following types of media components are distinguished in the present document:

speech: voice telecommunication.

audio: telecommunication of sound in general.

video: telecommunication of full motion pictures, and of stills.

data: telecommunication of information-files (text, graphics, etc.).

MultiMedia (MM): a combination of two or more of the above components (speech, audio, video, data), with a temporal relationship (e.g. synchronization) between at least two components.

7.2 BSM connections

A BSM connection provides a means for communication between two or more devices in, or attached to, a Broadband Satellite Multimedia telecommunication network.

In the case of IP traffic, BSM connections are referred to as "flows":

- **IP Flows (Flows)** are defined as a sequence of IP packets that are routed (end-to-end), based on the destination IP address contained in the IP header. An IP flow is a logical concept introduced to describe IP traffic at a particular node. IP packets belonging to the same flow can (and often do) travel via differing sets of nodes.
- An IP Flow may be associated with a traffic class and a path through a network using the Integrated services (Intserv) model, in which case reservations are made using RSVP. IP networks may also support traffic classes without explicit reservation using the Differentiated services (Diffserv) model. Intserv and Diffserv are described in more detail in TR 101 865 [5], clause 8.2.
- IP Flows are identified in network nodes on the basis of information found in the IP datagram header fields (e.g. IP source and destination address, source and destination port, protocol ID, Type Of Service (TOS) field).

In case of ATM traffic, BSM connections are referred to as "virtual circuits":

- **Virtual circuits** are defined as a sequence of ATM cells that are switched identically based on a label that is unique on a link per link basis, and contained in the ATM header (i.e. the Virtual Channel Identifier (VCI) + Virtual Path Identifier (VPI)). From a network perspective, a virtual connection is an edge-to-edge service, travelling from one edge of a network to another edge.
- Virtual circuits are established by means of signalling on the basis of ATM End System Addresses (AESA) e.g. as defined by ATMF in af-uni-0010.002 [3]. Virtual connections are identified in ATM switches on the basis of the VCI/VPI.
- ATM edge devices are seldom co-located with the end hosts, and are more often co-located with IP routers.

7.3 BSM service capabilities

Existing systems have largely standardized the complete sets of teleservices, applications and supplementary services which they provide. As a consequence, substantial re-engineering is often required to enable new services to be provided and the market for services is largely determined by operators and standardization. This makes it more difficult for operators to differentiate their services.

BSM will therefore standardize service capabilities and not the services themselves. Service capabilities consist of bearer services defined by QoS parameters and the mechanisms needed to realize and access those bearer services. These mechanisms include the functionality provided by various network elements, the communication between them and the storage of associated data. Clause 6 provides a conceptual description of a service architecture and architecture requirements which aim to provide service capabilities. It is intended that these standardized capabilities should provide a defined platform which will enable the support of speech, video, multi-media, messaging, data, other teleservices, user applications and supplementary services and enable the market for services to be determined by users and home environments.

NOTE: This is based on the approach used in the 3GPP specifications [2].

7.4 Interoperability

Interoperability can be defined at several different levels as follows:

- **Terminal interoperability** is defined as the ability of a Satellite Terminal (ST) designed and built according to given standards to interoperate with a satellite system designed and built independently to the same standards and to provide a defined profile of services.

NOTE 1: Terminal interoperability implies that a conforming terminal could be used to access more than one BSM satellite system using the same BSM family. In addition, any manufacturer can use the standards to design and produce interoperable terminals for that family.

- **Protocol interoperability** is the ability to operate the same protocols over different systems.

NOTE 2: Protocol interoperability implies that a BSMS should support a specified set of protocols, for example IPv4 and related IP layer protocols, including BSM defined adaptations of IETF protocols.

- **Service interoperability** is the ability to offer the same services over different systems. Once protocol interoperability between networks is attained, service interoperability is dominated by the respective Service Level Agreements (SLAs) of the interoperating networks.

NOTE 3: Service interoperability implies that BSM networks should support an open service interface, in principle allowing the possibility of 3rd party service providers offering services over their networks.

8 Bearer services

8.1 Definitions

8.1.1 Telecommunications bearer services

Telecommunications bearer services provide the capability for information transfer between access points, typically the User-Network Interface. These functions are sometimes referred as low layer capabilities (in reference to OSI layers). The user may choose any set of high layer protocols for his communication and these telecommunications bearer services do not ascertain compatibility at these layers between users.

The characterization of a telecommunication bearer service is made by using a set of characteristics that distinguishes it from other bearer services. Particular values are assigned to each characteristic when a given bearer service is described and defined.

In the general case, the networks between the two access points can use different control mechanisms. In this case the bearer services of each network throughout the communication link have to be translated at the network interfaces to realize an end to end bearer service. Each network contributes to the end-to-end QoS perceived by the end-user. Therefore all of the intervening networks (between two access points) have to attain service interoperability in order to support the end-to-end QoS.

8.1.2 Connectionless and connection-oriented bearer services

Connectionless bearer services refer to services which allows the transfer of information between users without the need for separate connection establishment procedures.

Connection-oriented bearer services refer to services in which communication proceeds through three well-defined phases: connection establishment, data transfer, connection release.

8.1.3 Unidirectional and bidirectional bearer services

Bearer services may be unidirectional or bidirectional as follows:

- **unidirectional bearer service:** bearer service where data are transferred in one direction only from the source user-network interface to the destination user-network interface(s).
- **bidirectional bearer service:** bearer service where data are transferred in both directions between the source user-network interface(s) and the destination user-network interface(s).

NOTE: A bidirectional bearer service can be realized by combining two or more unidirectional bearer services in opposite directions.

8.1.4 Bearer service symmetry

Bidirectional bearer services may be symmetric or asymmetric. For asymmetric bearer services the service may define a forward direction and a reverse direction as follows:

- **forward direction:** dominant direction of data transfer over an asymmetric network. It corresponds to the direction with better link characteristics in terms of bandwidth, latency, error rate, etc. We term data transfer in the forward direction as a "forward transfer".
- **reverse direction:** direction in which acknowledgements of a forward TCP transfer flow. Data transfer could also happen in this direction (and it is termed "reverse transfer"), but it is typically less voluminous than that in the forward direction.

NOTE: These definitions are adopted from the IETF PILC Working Group (PILC WG).

8.1.5 Bearer service configurations

The following bearer service configurations are defined:

- **Point-To-Point Bearer Service:** a unidirectional service in which one or more packets are sent from a single source "A" to a single destination "B".
- **Point-To-Multipoint Bearer Service:** a unidirectional service in which one or more packets are sent from a single source "A" to one or more destinations "D1", "D2", …"Dn".
- **Multipoint-To-Multipoint Bearer Service:** a unidirectional service in which one or more packets are sent from any one of a defined group of sources "C1", "C2", …"Cn" to one or more destinations "D1", "D2", …"Dn". The source group "C1", "C2", …"Cn" may overlap in whole or in part with the destination group "D1", "D2", …"Dn".
- **Broadcast Bearer Service:** a unidirectional service in which one or more packets are sent from any one of a defined group of sources " "C1", "C2", …"Cn" to an unaddressed group of destinations.

NOTE: The broadcast bearer service differs from the multipoint services by using a broadcast address for transmission.

8.2 BSM bearer services

8.2.1 General

BSM bearer services are the user plane (U-plane) data transfer services provided at the SI-SAP interfaces. A BSM bearer service defines all the properties of the user-data transfer between SI-SAP interfaces, including both the contracted QoS and other bearer service properties.

NOTE: The SI-SAP interface is defined in clause 6.4.3.

A range of BSM bearer services is possible, combining the QoS properties of the service with a selection of other characteristics as described above. In general, the characteristics of the available bearer services will be satellite dependent.

8.2.2 Queue Identifiers (QIDs)

The SI-SAP U-plane interface defines an abstract representation of the available bearer services via a series of SI-SAP labels called Queue Identifiers (QIDs). A QID is a local label that identifies a specific bearer service at the SI-SAP of the sending ST: the QID is only used at the SI-SAP interface and is not transmitted to the receiving ST. QIDs are used as labels to identify the wanted bearer service when sending user data and are also used as the labels for controlling those bearer services as follows:

- In the U-plane a specific QID is associated when sending data - i.e. associated with every sending-side user data transfer via the SI-SAP. The satellite dependent layers are responsible for mapping these SI-SAP bearer services to the appropriate native bearer services and assigning satellite capacity in order to transport the user data in accordance with the QoS and other properties associated with that QID.

- In the C-plane the lower layers resources can be dynamically controlled (e.g. to open, close or modify bearer services) using SI-SAP primitives. Each bearer service is identified by a QID and hence the QID is used in the C-plane primitives as the label to identify the relevant bearer service. This C-plane control of bearer services is optional: QIDs may also be assigned statically (e.g. invoked only by management configuration) and hence C-plane control is only required in cases of dynamic control of QIDs via the SI-SAP.

The QoS properties associated with a given QID are defined by QoS specific parameters and each QID is mapped onto suitable lower layer transfer capabilities (e.g. to different capacity request categories in the DVB-RCS model) in order to realize that QoS. Some QID could be assigned statically and others could be dynamically created to satisfy certain QoS.

The QID however is not limited to the QoS properties (e.g. to a capacity allocation class); it also relates to other flow/behaviour properties of the BSM bearer service. For example a QID may be associated with a specific set of satellite connectivity resources such as a specific transponder, or a specific set of satellite spot beams, or even a specific range of destination addresses, in order to reflect differences in the bearer services that are linked to these additional satellite specific properties. However, in all cases, any such satellite dependent properties are abstracted (or hidden) behind the single QID which provides a single label for the complete aggregate properties of the BSM bearer service.

Queue Identifiers (QIDs) are defined in more detail in the SI-SAP Guidelines [6] and the SI-SAP specification [7]. The BSM traffic classes are central to the concept of the QID. Traffic classes available at the SI-SAP describe QoS, performance management and resource allocation and they are defined in detail in TS 102 295 [8].

Annex A:
Example protocol models

A.1 A protocol model for regenerative satellites

A protocol model for a satellite with On Board Processing (OBP) is illustrated in figure A.1. The SIAF provides a local mapping from the standard TCP/IP traffic into the SI-SAP in order to provide peer-to-peer transport of TCP/IP traffic between STs.

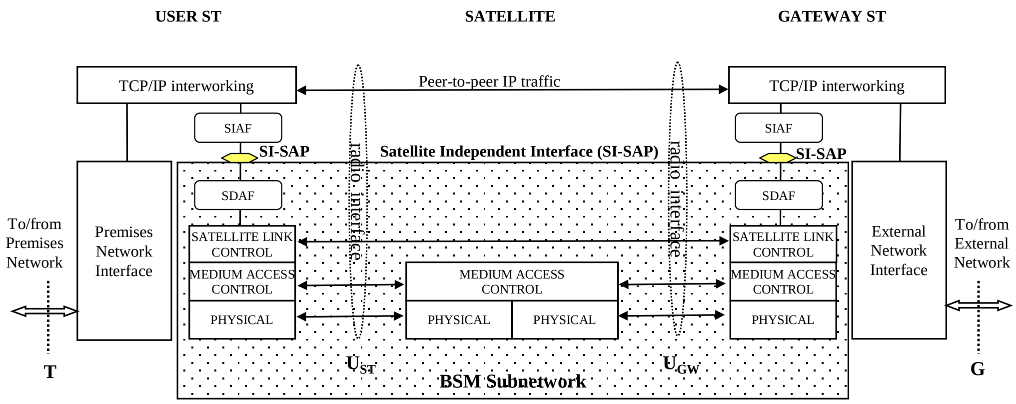

Figure A.1: Protocol model for satellite with OBP

A.2 A protocol model for transparent satellites

A protocol model for a transparent satellite is illustrated in figure A.2. The SIAF provides a local mapping from the standard TCP/IP traffic into the SI-SAP in order to provide peer-to-peer transport of TCP/IP traffic between STs. In this case, no MAC layer processing is performed by the satellite.

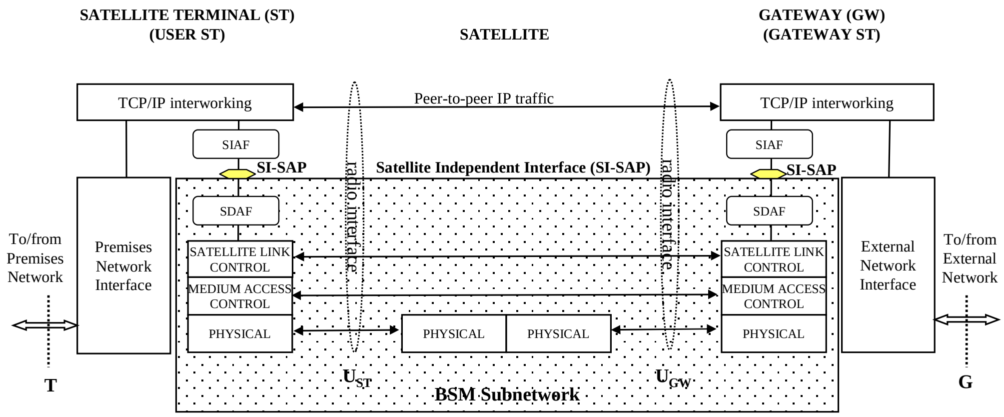

Figure A.2: Protocol model for transparent satellite

Annex B: Topology examples

Examples of mesh topology and star topology are illustrated in figures B.1 and B.2 respectively.

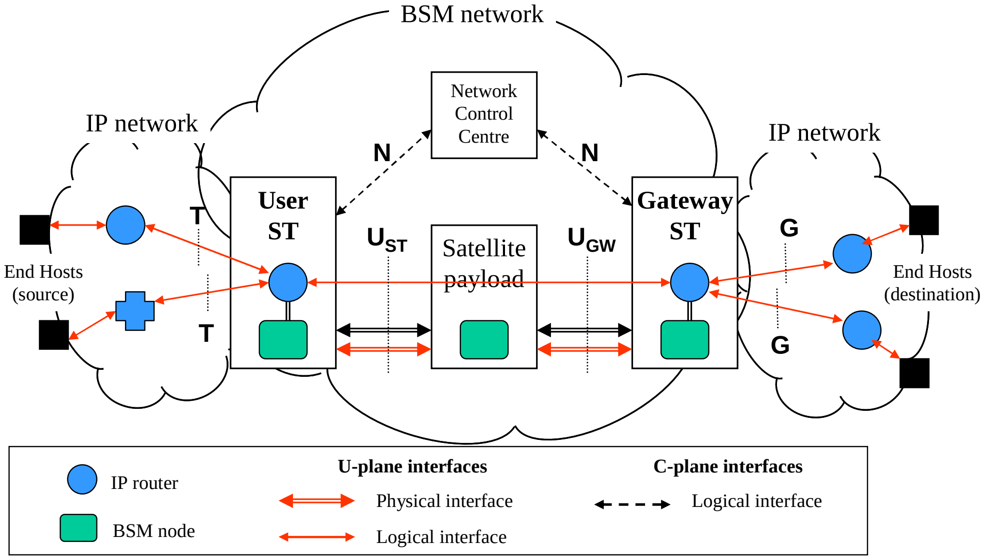

Figure B.1: Example of Mesh topology

As illustrated in figure B.1, the Network Control Centre (NCC) for a mesh topology is typically a separate element from the satellite terminals. The satellite terminals can provide either a user side interface (T interface) or a gateway side interface (G interface).

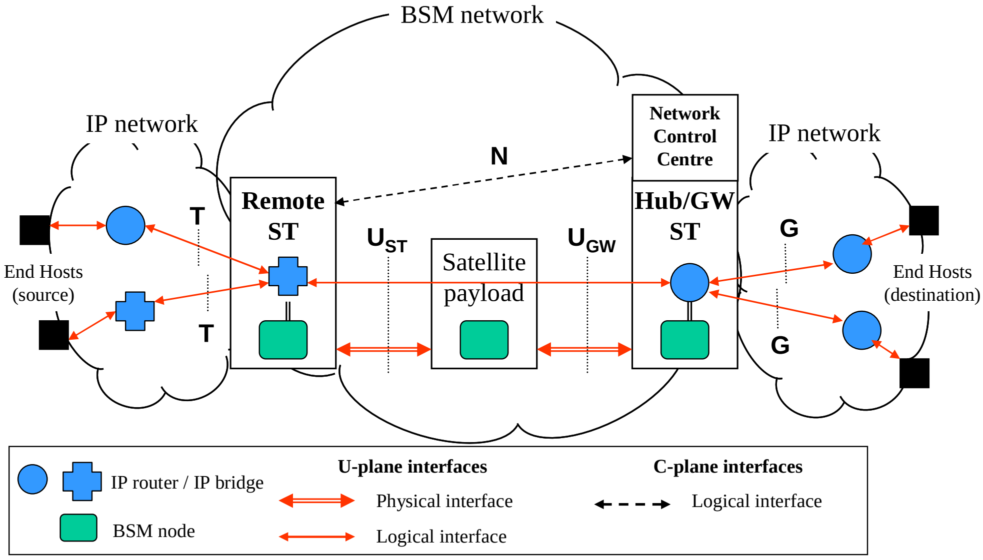

Figure B.2: Example of Star topology

As illustrated in figure B.2, the Network Control Centre (NCC) for a star topology is typically co-located with the Hub/Gateway ST. Other GW locations are also possible: the network may have multiple GWs and some or all of these may be located separately from the NCC and Hub.

Annex C: Network interface examples

The reference network interfaces are shown in figures C.1 and C.2. In these models the satellite radio interfaces are separated into an UpLink (UL) and a DownLink (DL).

Figure C.1 shows the interfaces for the case of a satellite return channel and figure C.2 shows the case where the satellite return channel at the User ST is replaced with a bi-directional hybrid channel that uses terrestrial networks to transport all of the return traffic and may also transport some of the forward traffic (e.g. time critical traffic).

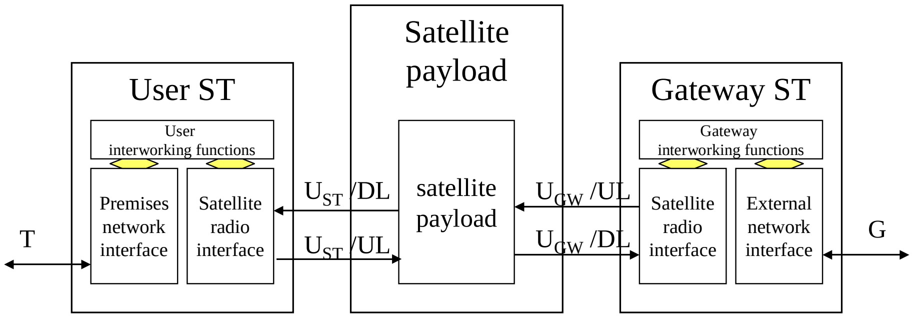

Figure C.1: BSM network interfaces: satellite return channel

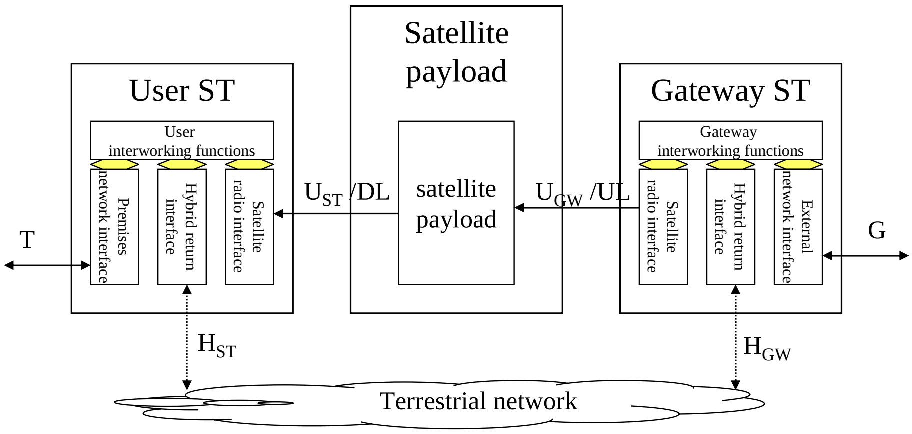

Figure C.2: BSM network interfaces: terrestrial return channel

Figure C.2. introduces two new reference interfaces for the hybrid return path: H_{ST} and H_{GW}. These interfaces may either be realized as separate interfaces (e.g. a dial-up modem or ADSL connection at the User ST) or may be combined with the External interface (e.g. H_{GW} may be physically combined with the G interface in the Gateway ST).

Annex D: Bibliography

ETSI TR 101 374-1: "Satellite Earth Stations and Systems (SES); Broadband satellite multimedia; Part 1: Survey on standardization objectives".

History

Document history		
V1.1.1	November 2002	Publication
V1.2.1	December 2007	Publication