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TECHNICAL REPORT

Satellite Earth Stations and Systems (SES);
Broadband Satellite Multimedia (BSM);
Guidelines for the Satellite Independent
Service Access Point (SI-SAP)

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Contents

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Foreword

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

Modal verbs terminology

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1 Scope

The present document provides a guide to the underlying models and assumptions that have been used to specify the BSM Satellite Independent Service Access Point (SI-SAP) interface.

2 References

2.1 Normative 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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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 TS 102 292: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM) services and architectures; Functional architecture for IP interworking with BSM networks".

[i.3] ETSI TS 102 295: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM) services and architectures; BSM Traffic Classes".

[i.4] ETSI TR 102 375: "Satellite Independent Service Access Point (SI-SAP) interface: Services".

3 Definitions and abbreviations

3.1 Definitions

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

BSM_IDentity (BSM_ID): SI-SAP address that defines the BSM Subnetwork Point of Attachment (SNPA)

NOTE: The BSM_ID is divided into BSM Unicast ID (BSM_UID) and BSM Group ID (BSM_GID).

BSM Subnetwork Point of Attachment (SNPA): SI-SAP endpoint of the BSM data transport services

NOTE: The BSM_ID is used to address data sent to and received from the BSM Subnetwork Point of Attachment.

Queue IDentifier (QID): SI-SAP parameter that identifies an abstract queue at the SI-SAP

NOTE: The QID is used to identify a specific lower layer resource when sending (submitting) data via the SI-SAP.

SI-SAP Instance (SAPI): specific independent instance of the SI-SAP in one ST

NOTE: A single unicast BSM_ID (UID) is associated with each instance of the SI-SAP (each SAPI). In addition one or more group BSM_IDs (GIDs) may be associated with each instance of the SI-SAP.

3.2 Abbreviations

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

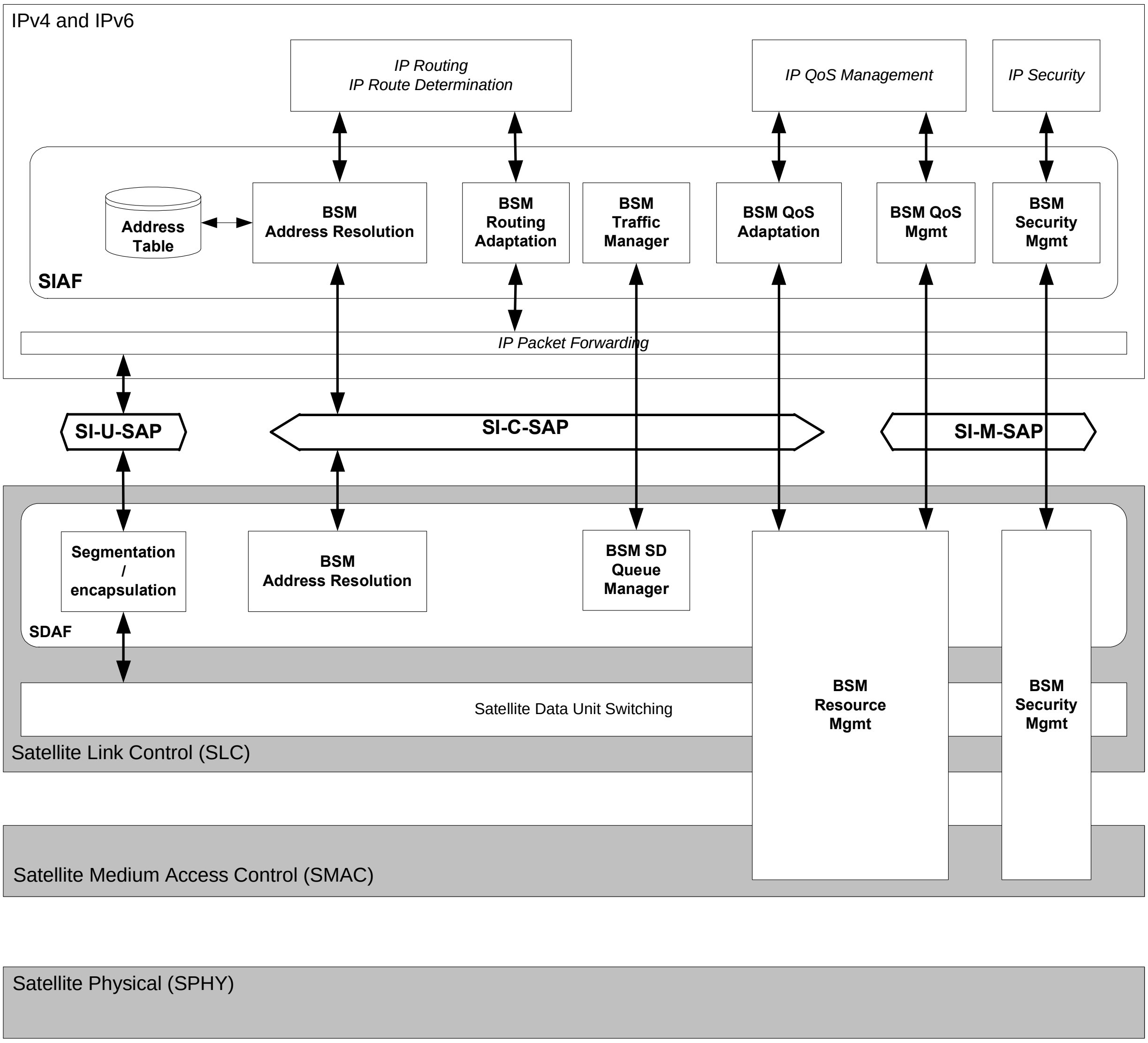
ARP	Address Resolution Protocol
ASM	Any Source Multicast
BSM	Broadband Satellite Multimedia
BSM_GID	BSM Group Identity
BSM_ID	BSM IDentity
BSM_UID	BSM Unicast IDentity
CSF	Client Server Function
Flowspec	flow specification
GID	Group ID
ID	IDentity
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
L2Add	Layer 2 Address
LL	Lower Layer
LN	Local Network
MAC	Medium Access Control
NAT	Network Address Translation
ND	Neighbor Discovery
PEP	Performance Enhancing Proxy
QID	Queue IDentifier
QoS	Quality of Service
RSVP	Resource ReserVation Protocol
SAPI	SI-SAP Instance
SD	Satellite Dependent
SDAF	Satellite Dependent Adaptation Functions
SD-ARP	Satellite Dependent Address Resolution Protocol
SDU	Service Data Unit
SI	Satellite Independent
SIAF	Satellite Independent Adaptation Functions
SI-SAP	Satellite Independent Service Access Point
SN	Satellite Network
SNPA	BSM SubNetwork Point of Attachment
SSM	Source Specific Multicast
ST	Satellite Terminal
UID	Unicast ID
UL	Upper Layer

4 SI-SAP architecture

4.1 BSM functional architecture

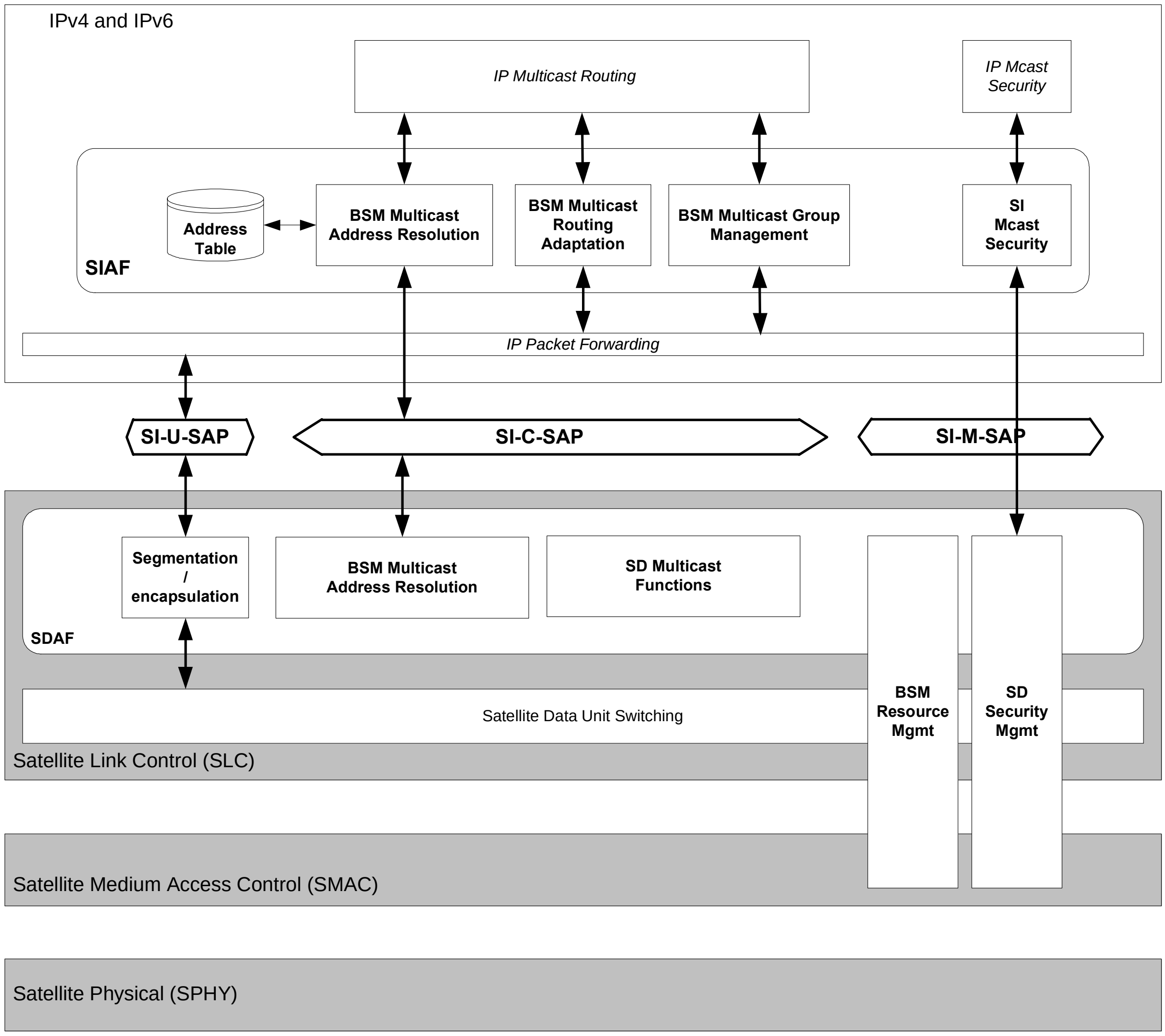
The Satellite Independent Service Access Point (SI-SAP) is introduced in the BSM services and architectures report (see ETSI TR 101 984 [i.1]) and a more detailed functional model of this interface is provided in the BSM functional architecture (see ETSI TS 102 292 [i.2]).

Figure 4.1.1, which is reproduced from the BSM functional architecture (see ETSI TS 102 292 [i.2]) presents the BSM protocol stack for unicast services and figure 4.1.2 presents the same stack showing the multicast functions. Both figures show the location of the Satellite Independent Service Access Point (SI-SAP) interface. This interface provides the BSM with a layer of abstraction for the lower layer functions and makes use of a BSM specific identity, the BSM_ID, to address the BSM subnetwork point of attachment (SNPA). It allows the BSM protocols developed in the Satellite Independent layer to operate over any BSM family. Moreover, the SI-SAP also enables the use of standard Internet protocols for example address resolution or multicast group management, directly over the BSM or with minimal adaptation to lower layer physical characteristics. Lastly the SI-SAP even makes it possible to envisage switching from one satellite system to another while preserving the BSM operator's investment in layer 3 software development.



NOTE: This figure is taken from ETSI TS 102 292 [i.2].

Figure 4.1.1: BSM protocol stack for unicast services



NOTE: This figure is taken from ETSI TS 102 292 [i.2].

Figure 4.1.2: BSM protocol stack for multicast services

4.2 Client-Server model

The BSM functional architecture (see ETSI TS 102 292 [i.2]) defines a Client-Server model that includes three logical interfaces called Client Server Function (CSF) interfaces.

4.3 SI-SAP model

The SI-SAP model divides the protocol stack at an ST into two parts as illustrated in figure 4.3.1:

1) The Satellite Independent (SI) Upper Layers (UL).

2) The Satellite Dependent (SD) Lower Layers (LL).

The SI-SAP model also defines two adaptation layers. These are also shown in figure 4.3.1:

1) The Satellite Independent Adaptation Functions (SIAF) to adapt between the upper layers and the SI-SAP services.

2) The Satellite Dependent Adaptation Functions (SDAF) to adapt between the lower layers and the SI-SAP services.

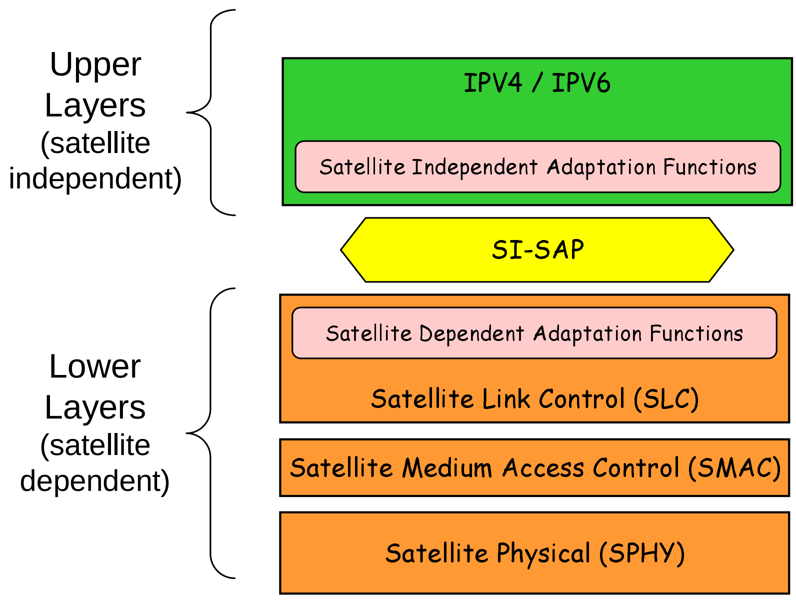


Figure 4.3.1: SI-SAP interface and the protocol stack

4.4 Protocols for the CSF-3 interface

The protocols that are used for the CSF-3 interface (see ETSI TS 102 292 [i.2]) can be divided into satellite independent upper layer protocols and satellite dependent lower layer protocols as illustrated in figure 4.4.1.

NOTE: The adaptation functions (SIAF and SDAF) do not include any protocols. The protocols are assumed to be located in either the IP layer (satellite independent case) or in the SLC/SMAC layer (satellite dependent case).

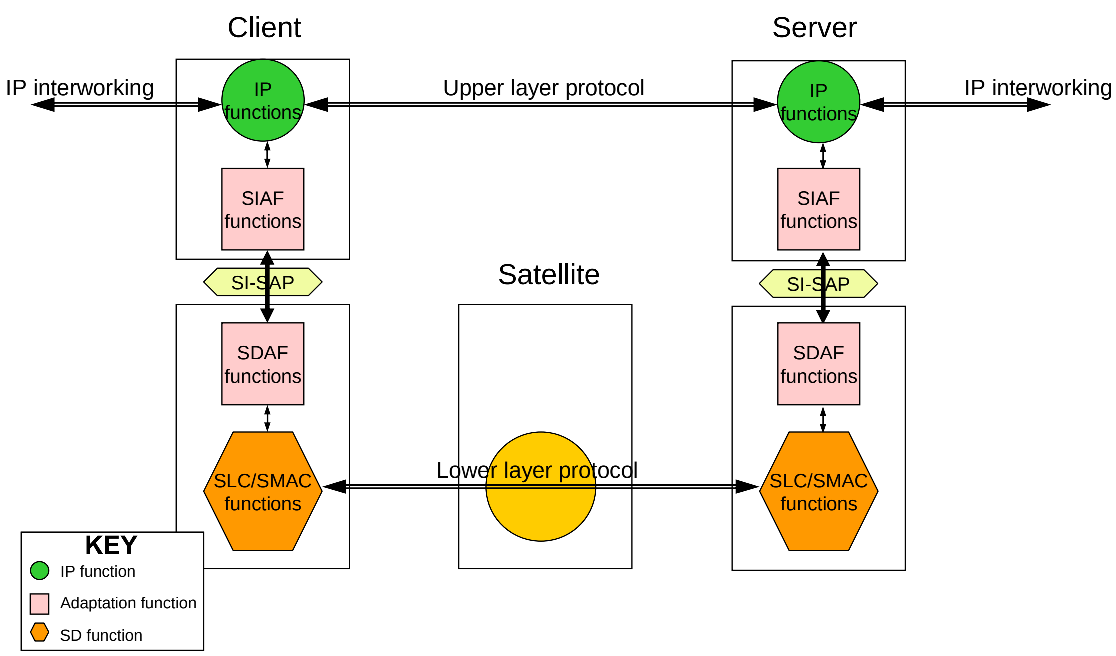


Figure 4.4.1: Protocols for the CSF-3 interface

A given IP interworking function can be realized using either the upper layer protocols or the lower layer protocols as follows:

a) Upper Layer protocol (figure 4.4.2): In this case the IP interworking functional exchanges between the Client and Server are carried using a satellite independent upper layer protocol(s). This upper layer protocol is then carried transparently by the SI-SAP U-plane data transport services. The upper layer protocols can be any suitable network layer protocol; for example, standard IETF protocols; or adapted IETF protocols, or non-standard network layer protocols.

b) Lower Layer protocol (figure 4.4.3): In this case, the IP interworking functional exchanges between the Client and Server are carried using a satellite dependent lower layer protocol(s). The network layer at the Client and the Server interwork these functions into an SI-SAP C-plane primitive. Below the SI-SAP these primitives activate the appropriate lower layer protocol(s). The available set of SI-SAP C-plane primitives (and the associated functions) is defined in clause 6 of the present document.

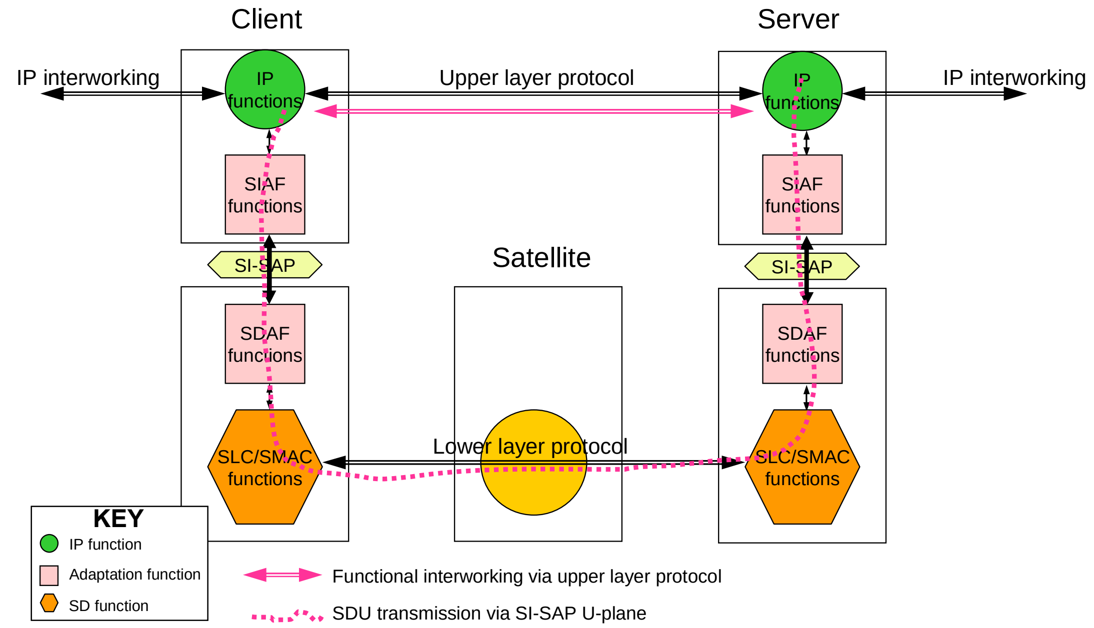


Figure 4.4.2: Interworking using upper layer protocols

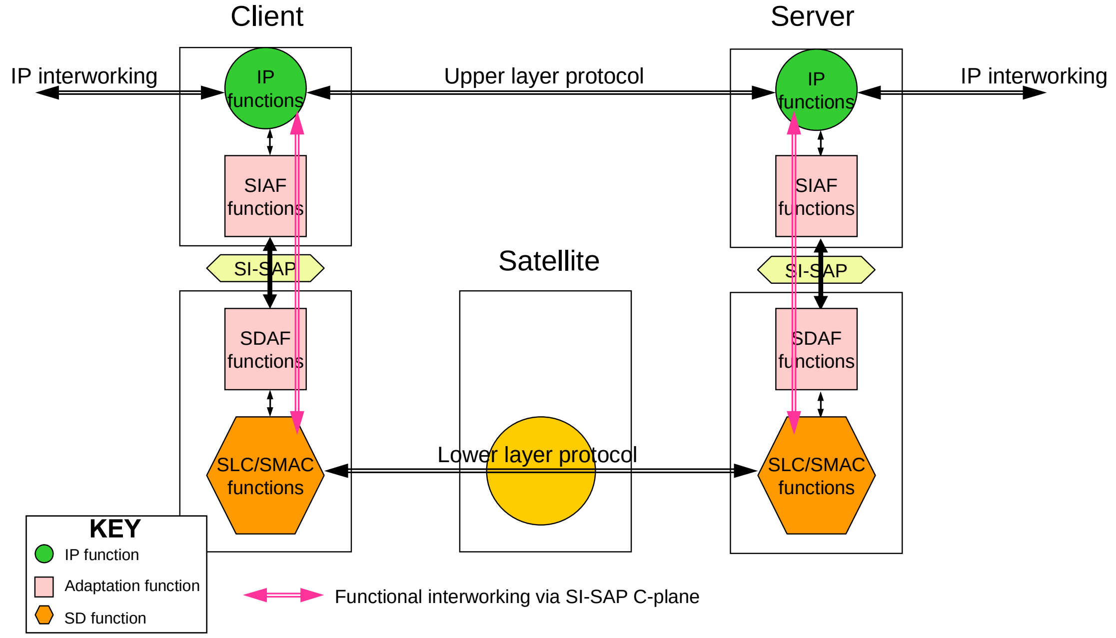


Figure 4.4.3: Interworking using lower layer protocols

A given BSM network can only use either of the two aforementioned configurations.. Hence, a given implementation may only support a subset of the SI-SAP functions defined in clause 6. In more detail, upper layer protocols require the exclusive use of the SI-SAP U-plane primitives, whereas the lower layer protocol require the use of SI-SAP C-plane primitives to handle the IP interworking functions.

It is worth, however, remarking, that SI-SAP U-plane primitives will be also used in the latter configuration for the transport of data traffic across the ETSI BSM architecture.

5 SI-SAP addresses and identifiers

5.1 General

The addresses and identifiers defined below represent a set of satellite independent addresses and identifiers that are used as parameters in the SI-SAP primitives. These addresses and identifiers are designed to be directly mapped into the appropriate satellite dependent identifiers by the Satellite Dependent Adaptation Functions (SDAF).

The SI-SAP provides an abstract interface allowing BSM protocols to be truly System Independent (SI) and to apply to all BSM families. The SI-SAP is the interface at which services from the lower layers are translated into system independent semantics.

For traffic handling the SI-SAP uses a BSM IDentity (BSM_ID) and a Queue IDentifier (QID):

- The BSM_ID uniquely identifies a BSM subnetwork point of attachment and allows IP layer address resolution protocols (equivalent to ARP for IPv4 and ND for IPv6) to be used over the BSM subnetwork.
- The QID enables the BSM data transfer (IP packets) to be queued, policed and transmitted properly across the BSM.

5.2 SI-SAP addressing

5.2.0 Overview

Table 5.2.0.1 summarizes the SI-SAP identities that are used as SI-SAP addresses. The table also shows their relationships to each SI-SAP Instance (SAPI). These identities are described in more detail in clauses 5.2.1 to 5.2.4.

Table 5.2.0.1: SI-SAP addresses

IDentities	Relationship	Comment
BSM_UID per SAPI	1:1	The SAPI is uniquely identified by the BSM_UID
BSM_GID per SAPI	N:1 {N = 0 to many}	The same GID may be used at many SAPI

5.2.1 BSM_IDentity (BSM_ID)

The BSM_ID is an SI-SAP address that identifies the BSM subnetwork point of attachment (SNPA). The SNPA corresponds to the endpoint of the BSM data transport services and the BSM_ID is the address that is used to address the data that is sent to and received from that endpoint.

In some cases the BSM_ID may be identical to the Layer 2 Address (L2Add) of the lower layer air interface family. However, in the most general case, the BSM_ID may be a separate intermediate address.

The BSM_ID is unique within the entire BSM subnetwork and it is intended that each BSM_ID is associated with a unique Layer 2 Address (e.g. via a direct mapping).

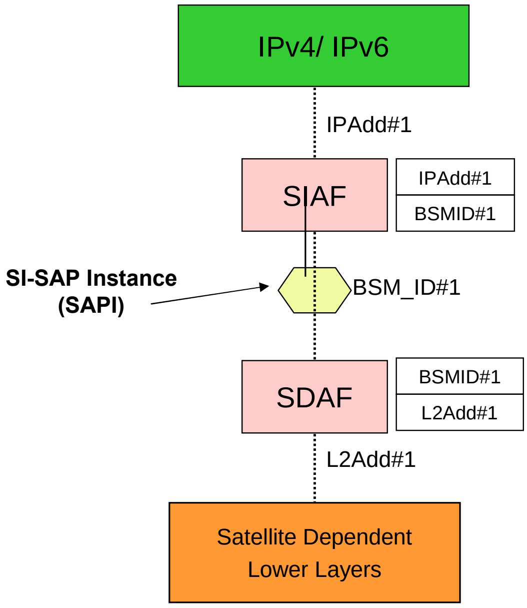


Figure 5.2.1.1: SI-SAP address model

Figure 5.2.1.1 shows the relationship between the BSM_ID and the related addresses above and below the SI-SAP. The BSM_ID is used to associate an upper layer IP address to the corresponding satellite dependent lower layer address:

- Above the SI-SAP, the BSM_ID is mapped to an IP address.
- Below the SI-SAP, the BSM_ID is mapped to a system dependent Layer 2 Address (L2Add); this Layer 2 Address can either be a link address or a MAC address, or any other satellite dependent address.

The BSM_ID corresponding to a given IP address may be defined statically (e.g. by management configuration) or may be discovered dynamically (on-demand) using the SI-SAP address resolution procedures described in clause 6.3.

5.2.2 Unicast and group BSM_IDs

Both unicast and group BSM_IDs are defined:

- A BSM Unicast ID (UID) defines a single SNPA. A given instance of an SI-SAP (SAPI) is associated with exactly one UID.
- A BSM Group ID (GID) defines a lower layer multicast group. A given instance of an SI-SAP (SAPI) may be associated with zero or more GIDs.

The UID and GIDs are assigned from the same numbering space, with no defined boundary between the UID portion and the GID portion of the address space. The actual division between unicast and group addresses is dependent on the lower layers (i.e. the GIDs are allocated as a satellite dependent subset of the overall BSM_ID address space).

NOTE 1: The above rule means that UID and GID formats are identical, and hence the same primitive parameter can be used to encode UID or GID.

NOTE 2: The BSM GID differs from an Ethernet multicast address by allowing a variable portion of the address space to be assigned for group addresses. It also differs by allowing dynamic address resolution for GIDs, unlike the fixed mapping defined for Ethernet. A fixed (static) assignment can also be used and hence the BSM GID could be mapped to Ethernet (or any other static assignment) as a special case.

5.2.3 IP unicast addressing

For IP unicast addressing, an IP unicast address is mapped to a BSM_UID. This IP unicast address corresponds to the satellite-facing port of an IP router (or end host). This IP address is therefore the "next-hop" IP address that is used for forwarding IP packets across the BSM satellite subnetwork.

An example of this interworking model is illustrated in figure 5.2.3.1. This shows two IP addressing domains - the satellite network domain (SN addresses) and the local network domain (LN addresses). In the general case, these can be separately managed domains, in which case the IP router in the ST performs Network Address Translation (NAT) functions.

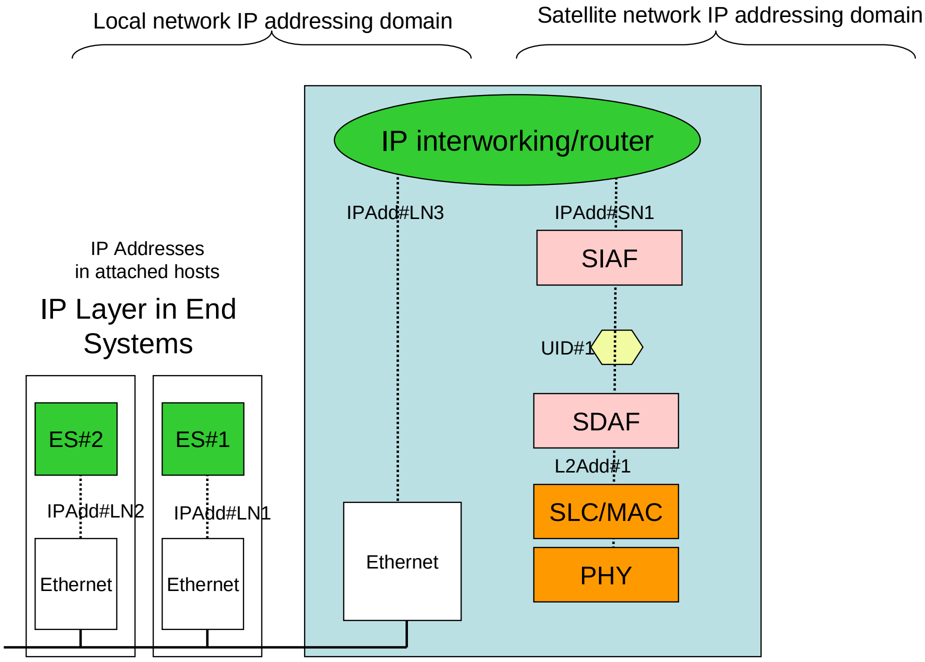


Figure 5.2.3.1: IP interworking example: unicast addressing

The IP unicast address is associated with a unique BSM Unicast ID (UID).The associated UID is unique within the whole BSM network.

A SAP instance (SAPI) is defined as containing exactly one UID; i.e. a given UID identifies one specific SNPA.

5.2.4 IPv4 multicast addressing

IPv4 Multicast addresses are handled by associating each wanted IPv4 Class D address with a BSM Group ID (GID). The associated GID is applicable to the whole BSM network; i.e. the same GID would be used at every SI-SAP where a given IP multicast group is received or sent. This relationship is illustrated in figure 5.2.4.1.

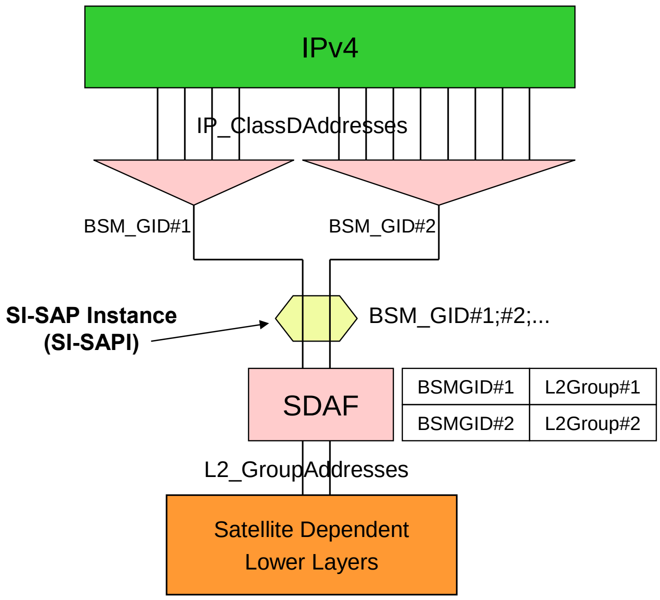


Figure 5.2.4.1: Multicast address model

Any subset of the complete range of IPv4 Class D address may be associated with a BSM GID. In general, only the specific "wanted" values of IPv4 Class D addresses need to be associated with a GID.

The same BSM GID is used for both sending and receiving a given IP multicast group (i.e. the same BSM GID can be used for both sending and receiving packets with a given IP multicast destination address).

NOTE: The use of the same BSM GID for both sending and receiving multicast data is an important property of the GID. This is designed to hide some of the inherent asymmetry in satellite multicasting (i.e. to hide the fact that send and receive may use different lower layer services).

A given BSM_GID may be associated with more than one IPv4 multicast address. In the limit, a single GID could be used for every wanted IP multicast group. In general, however, multiple GIDs can be used to provide finer grained control over which groups are received using the group receive services defined in clause 6.5.

5.3 Queue IDentifiers (QIDs)

The Queue IDentifier (QID) (see ETSI TS 102 292 [i.2]) is an SI-SAP parameter that specifies an abstract queue: a specific QID is used for every user data transfer via the SI-SAP. The satellite dependent lower layers are responsible for assigning satellite capacity to these abstract queues according to the specified queue properties (e.g. QoS).

QIDs may be assigned statically (e.g. by management configuration) or dynamically using the SI-SAP resource reservation procedures defined in clause 6.4.

The traffic classes are central to the concept of the Queue IDentifier (QID). Traffic classes available at the SI-SAP enable QoS, performance management and resource allocation. They are defined in detail in ETSI TS 102 295 [i.3]. The BSM queues can be defined by QoS specific parameters (flowspec, path labels or DiffServ markings) and associated to lower layer transfer capabilities (e.g. to different capacity request categories in the DVB-RCS model). Some QIDs could be assigned statically and others could be dynamically created to target certain QoS levels . The QID however is not limited to a capacity allocation class; it relates also to flow/behaviour with defined properties.

A QID is only required for submitting (sending) data via the SI-SAP and the QID is assigned when the associated queue is opened. An open queue is uniquely identified by the associated QID: in particular, the QID is used to label all subsequent data transfers via that queue.

6 SI-SAP functions

6.1 General

6.1.0 Overview of functional planes and groups

The functions provided by the SI-SAP are divided into functional groups as follows:

1) Planes:

   The functions are divided into 3 logical planes:

   - the User-plane (U-plane);
   - the Control-plane (C-plane); and
   - the Management-plane (M-plane);

   as defined in the BSM architecture (see ETSI TR 101 984 [i.1]).

2) Functional groups:

   Within each plane, the functions are divided into functional groups, where each group corresponds to a discrete subset of the SI-SAP functionality.

The resulting functional groups provide a set of functional elements that can be used in various combinations for a given IP interworking scenario. Example combinations for some typical IP interworking scenarios are described in clause 7. In all cases, the descriptions provided in the present document only provide guidelines.

6.1.1 U-plane functions

The U-plane functions are defined in table 6.1.1.1.

Table 6.1.1.1: U-plane functions

Function	Description
Data transfer	A function for sending and receiving user data via the SI-SAP. This function can be used for both unicast and multicast data transfer.

6.1.2 C-plane functions

The C-plane functions are defined in table 6.1.2.1.

Table 6.1.2.1: C-plane services

Function	Description
Address resolution	A function to associate a BSM_ID address to a given IP address
Resource reservation	A function to open, modify and close queues in the SD layers for use by the SI layers.
Group receive	A function to activate and configure the SD layers to receive a wanted multicast service
Group transmit	A function to activate and configure the SD layers to transmit a wanted multicast service

6.1.3 M-plane functions

No M-plane functions are currently defined.

6.2 SI-SAP data transfer

SI-SAP data transfer is the function that is used to send and receive user data via the SI-SAP. A functional model of the data transfer functions is shown in figure 6.2.1.

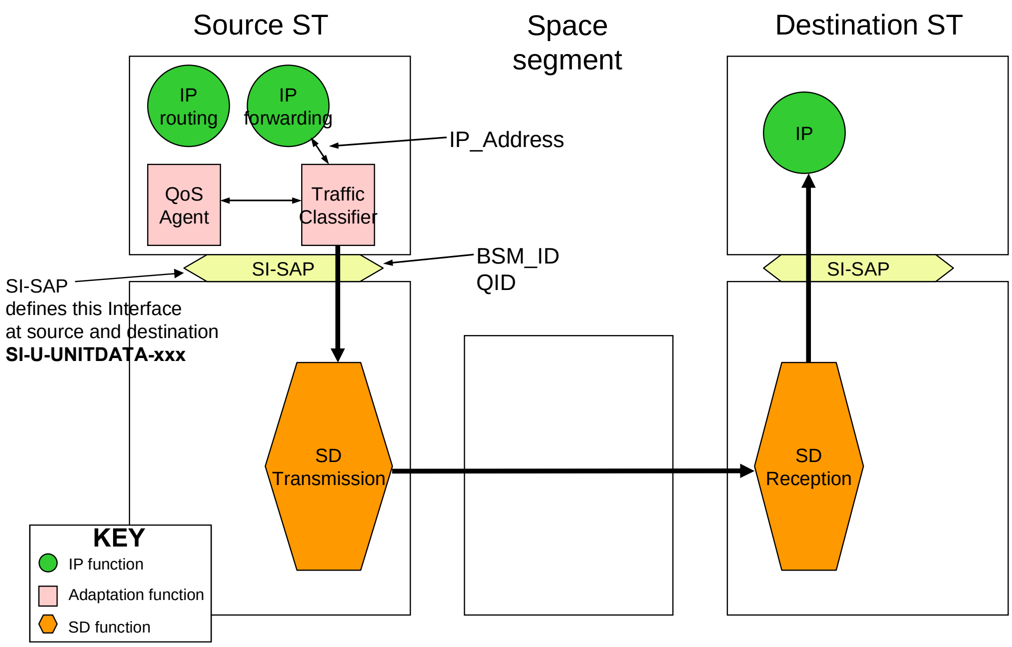


Figure 6.2.1: SI-SAP data transfer functions

The source ST sends data by submitting it to via the SI-SAP using the SI-U-UNITDATA-REQ primitive. The SIAF traffic classifier function creates the primitive and inserts the user data in the Service Data Unit (SDU). The primitive also includes the BSM_ID of the destination port and the QID. If necessary, the destination BSM_ID is first obtained using the address resolution functions described in clause 6.3.

The traffic classifier invokes the wanted QoS in the SI-U-UNITDATA-REQ by selecting the appropriate value of QID: the QID provides an explicit link to the Quality of Service (QoS) as a result of the resource reservation procedures defined in clause 6.4.

The submitted data is then processed by a series of Satellite Dependent (SD) lower layer functions before being transported over the physical media. The SD Transmission and Reception functions represents all of these lower layer data transfer functions such as segmentation, mapping of SI-SAP queues onto physical layer resources, bandwidth on demand, etc.

After reception at the destination ST, the transferred data is issued from the destination SI-SAP using the SI-U-UNITDATA-IND primitive. The SI layers at the destination then extracts the data packet (as contained in the Service Data Unit (SDU)) and processes it according to normal IP packet processing rules. In the general case, the packet will be forwarded via a terrestrial port at the destination ST, since the router in this ST will (in general) just be the next-hop in a longer path.

6.3 SI-SAP address resolution

6.3.1 General

SI-SAP address resolution is the function that is used to determine the BSM_ID that is associated with a given IP address. SI-SAP address resolution provides two similar, but different services: unicast address resolution and multicast address resolution. These two cases are distinguished by the MULTICAST FLAG parameter in the primitives. In both cases, the SI-SAP address resolution is used to provide the BSM_ID that is associated with a given network IP address.

Two functional modes are defined:

1) In the QUERY mode: the SI upper layer sends the wanted network address (an IP address) to the SD layer in the SI-C-AR_QUERY-REQ primitive and the SD layer responds with the BSM_ID that is associated with that network address using the SI-C-AR_QUERY-CFM primitive.

2) In the INFO mode: the SD lower layer sends out an unsolicited SI-C-AR_INFO-IND primitive that contains a BSM_ID and the associated network address.

The address resolution functions are only used in cases where the address resolution is provided by the lower layers using a Satellite Dependent Address Resolution Protocol (SD-ARP) or a similar lower layer function. Address resolution functions may alternatively be provided by the upper layers, in particular by the IP layer, in which case these SI-SAP address resolution functions would not be used.

A functional model of the address resolution functions is shown in figure 6.3.1.1.

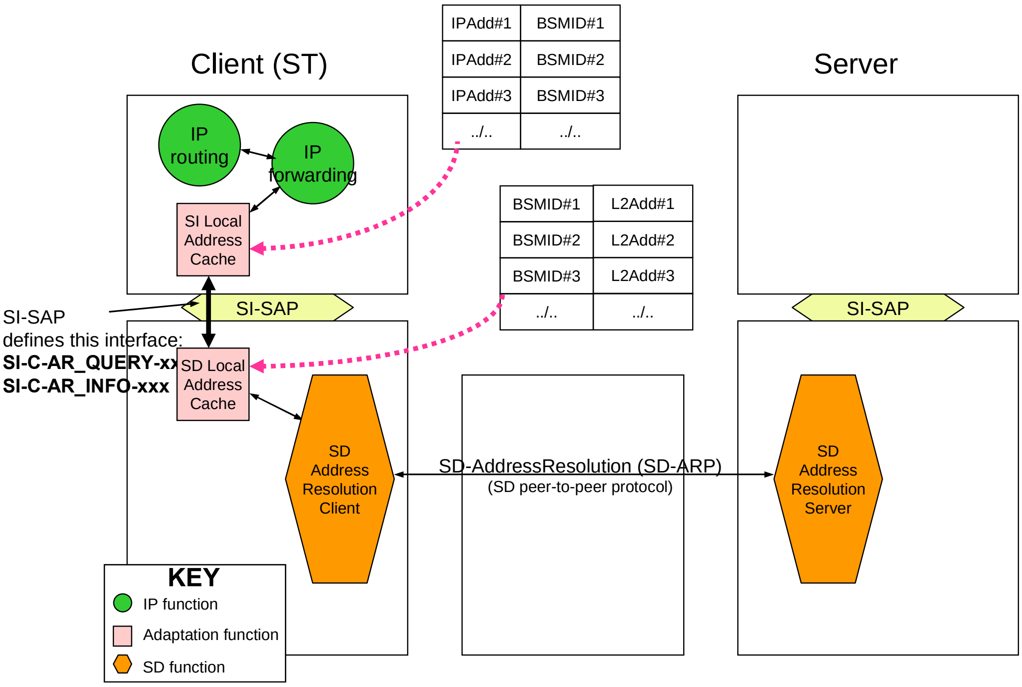


Figure 6.3.1.1: SI-SAP address resolution functions

6.3.2 Static vs. dynamic address resolution

The address resolution procedures described in this clause are dynamic address resolution procedures; they should only be required if dynamic address assignment is used and they may not be needed in all cases.

In some cases, a BSM system may operate using static address assignments, where the SI and/or SD local address caches are filled by management configuration. In the general case, a BSM system will use a combination of dynamic and static address resolution. For example, unicast addresses may be assigned using dynamic procedures and multicast addresses may be assigned using static procedures.

The following detailed descriptions only apply to the dynamic address resolution case.

6.3.3 Unicast address resolution

Unicast address resolution is used to determine the destination unicast BSM_ID (BSM_UID) that is associated with a given next-hop (destination) unicast IP address. The resulting destination BSM_UID is then used as the destination address parameter for any subsequent unicast data transfers to that destination.

NOTE: The QUERY mode unicast address resolution is intended to be similar to the standard Ethernet address resolution protocol as defined in RFC-826. The SI-C-AR_QUERY-REQ contains the "next-hop" network address to which the SI layer wishes to forward a packet. It is assumed that routing has been applied and hence this "next-hop" address lies within the domain of the satellite system. The SI-C-AR_QUERY-CFM contains the BSM_ID of the SI-SAP instance (SAPI) that is associated with this network address.

6.3.4 Multicast address resolution

Multicast address resolution is used to determine the destination group BSM_ID (BSM_GID) that is associated with a given (destination) multicast IP address. The BSM Group IDentity (BSM_GID) is defined as subset of the BSM_ID. This is a global address that applies throughout the BSM subnetwork: i.e. the same BSM_GID is used for sending to the group and receiving data from the group.

Multicast receive is expected to be the main usage of the multicast address resolution. In this case, the network address is the destination address of the IP multicast flow (i.e. the content) that the SI layer wants to receive. The SD response contains the receiver BSM_GID that is associated with this IP network address.

NOTE: It is important to note that obtaining a multicast BSM_GID (either statically, or via dynamic address resolution) does not necessarily mean that the relevant multicast service is supported at that ST. An ST may not support certain multicast services; e.g. an ST may support multicast send only, or multicast receive only or neither. The support for a given multicast service (in other words the ability to actually send or receive multicast data using a given BSM_GID) is indicated via the success or failure of the group receive primitives and group transmit primitives as described in clauses 6.5 and 6.6.

In the general case, different lower layer services may be used to enable the sending and the receiving of multicast data. The common BSM_GID simply provides a common identity for accessing these multicast services.

6.4 Resource reservation

6.4.1 General

Resource reservation is the function that assigns the Queue IDentifier (QID) and defines or modifies the properties of the abstract queue that is associated with that QID. Once assigned, the QID is used for user data transfer via the SI-SAP. The satellite dependent layers are responsible for assigning satellite capacity to these abstract queues according to the specified queue properties (e.g. QoS).

Resource reservation is used to open, modify and close queues for both unicast and multicast flows. Resource reservation is only required for sending data and is not required for receiving data.

Every open queue is identified with an associated Queue IDentifier (QID). The QID uniquely identifies the queue and is used as the label for all subsequent use and control of those queues.

NOTE 1: The SI-SAP queue is intended to be a completely general model that includes all possible lower layer services. In particular a given queue may refer to a specific point-to-point service (e.g. for sending data to a defined BSM_ID); or to a non-specific point-to-point service (e.g. for sending data to a range of different BSM_IDs) or to a point-to-multipoint service (e.g. to send multicast data).

Resource reservation defines three methods for creating a queue and assigning a QID to that queue:

a) **Static queues:** These are queues that are created "a-priori" by management configuration. The QIDs that are associated with these queues are predefined and these QIDs can be used to send data without requiring any activation; i.e. without requiring the use of the dynamic procedures defined in this clause.

b) **Dynamic queues:** These are queues that are created dynamically using the procedures defined in this clause. There are two variants:

   1) Queues that are dynamically invoked by the Satellite Independent Adaptation Functions (SIAF) at the source ST by issuing a SI-C-QUEUE_OPEN-REQ primitive.

   2) Queues that are dynamically invoked by the Satellite Dependent Adaptation Functions (SDAF) at the source ST using the SI-C-QUEUE_OPEN-IND primitive.

NOTE 2: A particular example of a static queue could be a default QID = N that corresponds to **"best efforts unicast service for sending data to the default address (e.g. to the gateway)"** which can be preconfigured in all STs and could apply to all packets that do not have a specified service.

In the dynamic case, an open queue can be subsequently modified or closed. For example, the lower layers may close an existing resource at any time by issuing an unsolicited SI-C-QUEUE_CLOSE-IND primitive.

6.4.2 Resource reservation

A functional model for resource reservation is shown in figure 6.4.2.1.

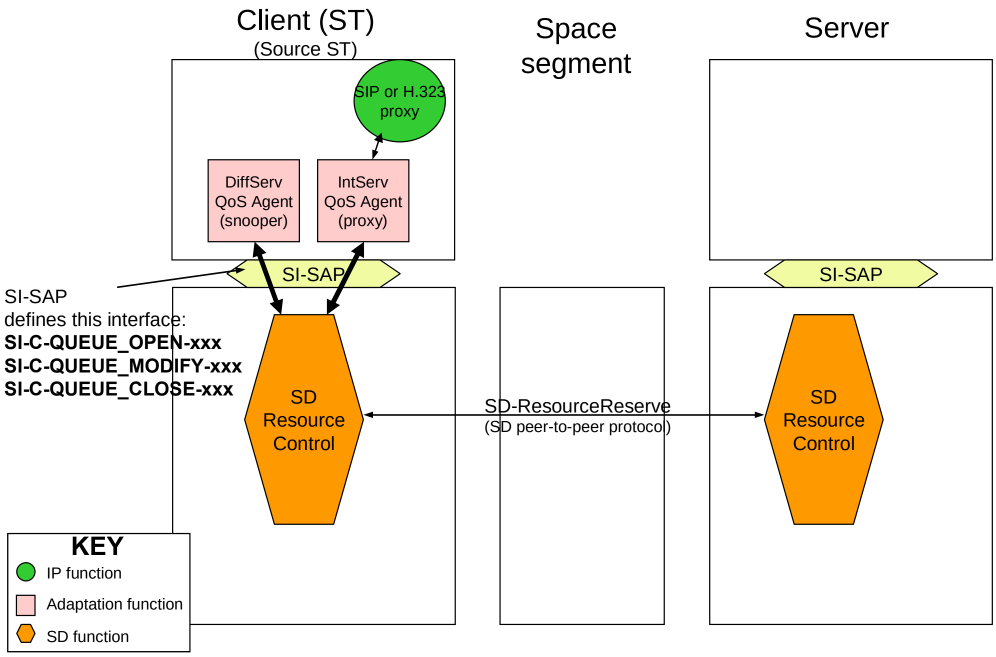


Figure 6.4.2.1: SI-SAP resource reservation functions

In the static case, the packet forwarding would use one of the available static queues. In this case the forwarding agent should select the appropriate static QID based on selected attributes; e.g. by mapping the DiffServ codepoints in the IP packet header to the QID that provides the most suitable service.

In the dynamic case, the upper layers at the invoking ST are required to directly request a queue in response to local events using some form of QoS agent. Two examples are illustrated in figure 6.4.2.1:

a) DiffServ QoS agent. This could operate by snooping on IP flows (e.g. by detecting a new IP flow that meets certain defined criteria).

b) IntServ QoS agent. This could operate by acting as a proxy as part of a QoS process (e.g. as part of an RSVP procedure, or in response to a local application such as a PEP).

6.4.3 Quality of Service

The Quality of Service for each queue is defined when the queue is created or modified. In the case of static queues, the QoS parameters for each QID are pre-defined (e.g. using management configuration). In the case of dynamic queues, these parameters are defined in the SI-C-QUEUE_OPEN-XXX and SI-C-QUEUE_MODIFY-XXX primitives.

NOTE: Multiple separate static queues can be defined. For example, a given ST could be preconfigured with a range of static QIDs, one for each of the BSM traffic classes; this is equivalent to configuring the ST to support the full set of BSM traffic classes.

A given implementation is not required to support the full range of possible QoS that is implied by using all possible values for all the QoS parameters. In general, only a small number of different QoS may be supported and the lower layers are responsible for defining a consistent mapping between the assigned QIDs and the available services.

EXAMPLE: The lower layers may map a range of different classes of service to a single lower layer service (e.g. collapse the traffic classes into a smaller number of different services).

6.5 Group receive

6.5.1 General

The group receive function is used by the SI multicast group management functions to communicate with the SD multicast group control functions at the destination ST (i.e. at each destination of the multicast flow) to enable the ST to receive a specific multicast traffic flow (or flows).

The lower layers are assumed to operate in a non-promiscuous mode, whereby multicast data is only received in response to an explicit command from the upper layers. The group receive function is used to configure the lower layers at the receiving ST (i.e. the destination of the data) to enable the wanted traffic to be received by the lower layers and delivered to the upper layers via the SI-SAP. A functional model of the group receive function is shown in figure 6.5.1.1.

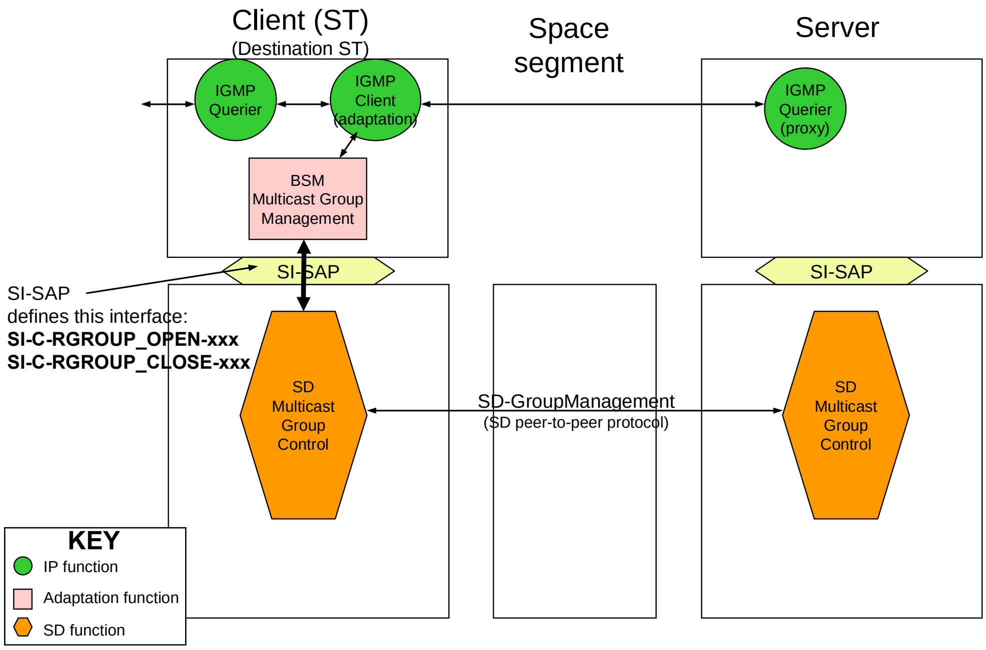


Figure 6.5.1.1: SI-SAP group receiver functions

Once enabled, the multicast data is delivered to the upper layers using the SI-U-UNITDATA-REQ primitive. The primitive includes the BSM_GID of the destination group address.

Each activation of the group receiver enable functions refers to a specific BSM_GID. If necessary the BSM_GID is first obtained using the multicast address resolution functions described in clause 6.3.

6.6 Group transmit

6.6.1 General

The group transmit function is used by the SI multicast group management functions to communicate with the SD multicast group control functions at the source ST to enable the ST to transmit a specific multicast traffic flow (or flows).

This function is defined and fully documented in ETSI TS 102 375 [i.4].

7 IP interworking scenarios

7.1 General

The following scenarios are examples of how a BSM network may group together the elementary SI-SAP functions (i.e. the functions described in clause 6) in order to provide IP data transport services.

The examples shown are not intended to provide a complete set of possible scenarios, nor are they intended to restrict other possible uses for the SI-SAP functions.

More detailed description of IP interworking cases is provided in annex A of ETSI TS 102 375 [i.4].

7.2 Sending unicast data

This case applies to both mesh topology and star topology where address resolution is provided by the SI-SAP address resolution function. It also includes an optional step where the address resolution Server interrogates the destination ST to obtain the wanted address: this option is for further study.

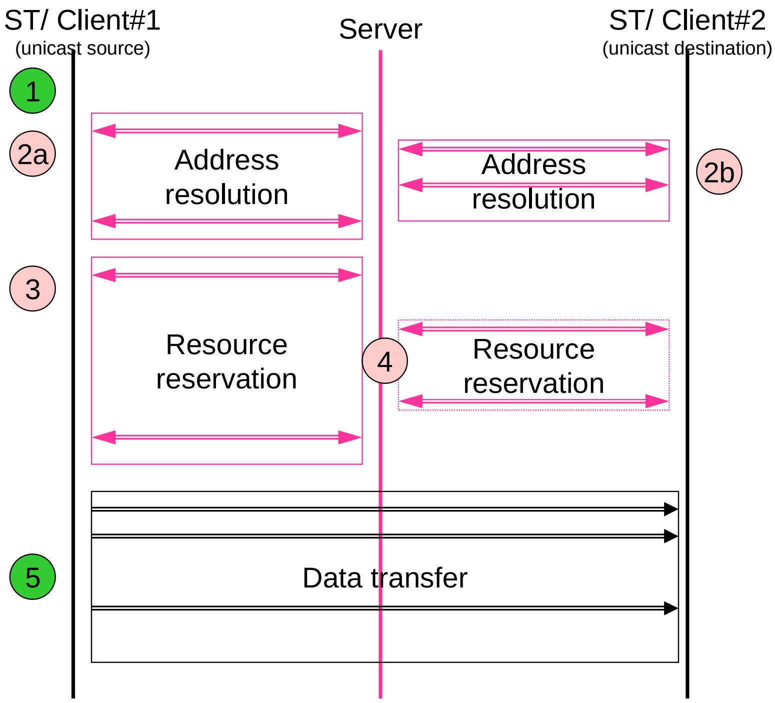


Figure 7.2.1: Sending unicast data

In this scenario, the ST/Client#1 wishes to send IP datagrams to ST/Client#2. The following steps are shown in table 7.2.1.

Table 7.2.1: Unicast data flow

Step	Description
Step 1	IP router at ST#1 determines next-hop IP address to forward the packet.
Step 2a	SIAF at the ST#1 uses address resolution function to find the BSM_ID that is associated with the next-hop IP address from step 1. The address pair (IPAdd + BSM_ID) can be stored in a local cache for future use.
Step 2b	Optionally the Server may use address resolution to request the BSM_ID that is associated with the next-hop IP address from step 1 from the destination ST. [This option is for further study]
Step 3	SIAF at the ST#1 uses the BSM_ID from step 2 to request resources (i.e. open a queue) for sending data with the wanted QoS.
Step 4	The Server reserves resources from ST#1 to ST#2. In some cases the Server may need to interact with ST#2 to reserve these resources.
Step 5	The queue is opened and the ST#1 can start to submit data via the SI-SAP. Packets will be delivered to the destination ST#2.

7.3 Receiving multicast data

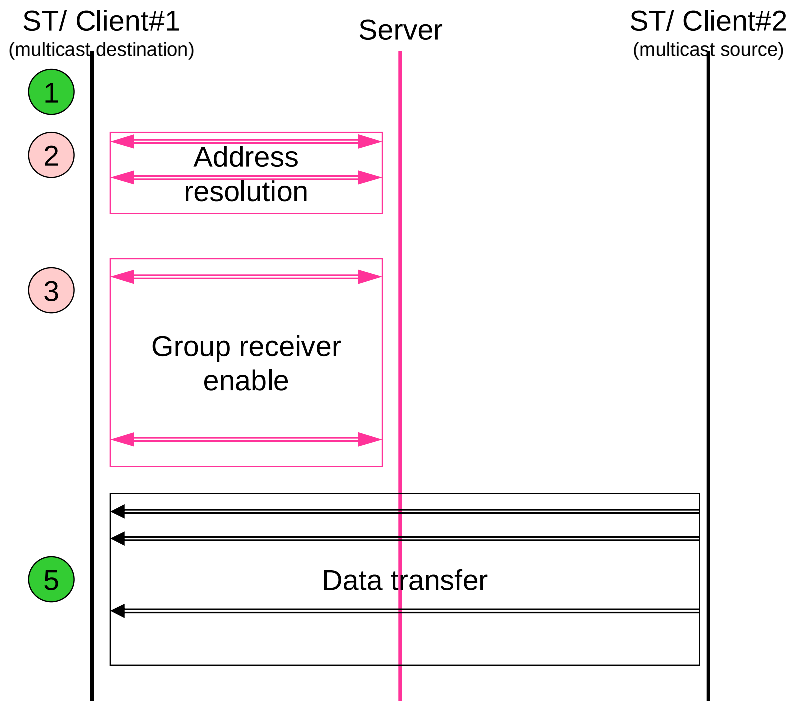


Figure 7.3.1: Receiving multicast data

In this scenario, the ST/Client#1 wishes to receive multicast IP datagrams. The wanted IP multicast group is assumed to be already available within the BSM network via the source at ST/Client#2. The following steps are shown in table 7.3.1.

Table 7.3.1: Multicast data reception

Step	Description
Step 1	IP router at ST#1 determines the wanted Class D IPv4 address to receive.
Step 2	SIAF at the ST#1 uses address resolution function to find the BSM_GID that is associated with this Class D IPv4 address. The address pair (IPAdd + BSM_GID) can be stored in a local cache for future use.
Step 3	SIAF at the ST#1 uses the BSM_GID from step 2 to enable the group reception of the wanted GID. The Server performs any necessary configuration of the ST#1 receiver.
Step 4	Null.
Step 5	The ST#1 starts to receive the wanted multicast flow and any received packets are delivered via the SI-SAP U-plane.

NOTE: The above scenario only shows basic Any-Source multicast (ASM) reception where a BSM_GID maps to an IPv4 multicast group from any source {*, G}. This scenario may also apply to Source Specific Multicast (SSM) {S,G} in the case where the SSM aspects are fully handled at the IP layer and do not impact the lower layers or the SI-SAP primitives. Alternatively, the SSM case could be realized by mapping each specific pairing of {Si, Gj} to a different GID; i.e. {S1, G1} = GID#1; {S2, G1} = GID#2, etc.

Annex A (informative): Bibliography

ETSI TR 101 985: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP over Satellite".

History

Document history		
V1.1.1	November 2004	Publication
V1.2.1	December 2015	Publication