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Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM) services and architectures; Functional architecture for IP interworking with BSM networks

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Contents

List of figures

List of tables

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Foreword

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

Modal verbs terminology

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Introduction

Terrestrial Internet protocols, in particular for signalling, management and control, are often ill adapted to the specifics of satellite networks (ETSI TR 101 984 [i.5]). It has been the goal of the BSM work to investigate which protocols should be adapted to the BSM world and propose a number of specific technical specifications to achieve this goal. In order to link all those documents under a common framework, the present document defines a BSM functional architecture. The architecture is not satellite system specific and relies on client server architectures to perform the needed tasks without interference with IP protocol operations.

1 Scope

The present document presents the architecture that relates the work done in SES BSM TRs on standardization (see ETSI TR 101 984 [i.5] and ETSI TR 101 985 [i.1], Addressing and Routing (see ETSI TR 102 155 [i.2]), Multicasting (see ETSI TR 102 156 [i.3]) and Performance and QoS (see ETSI TR 102 157 [i.4]). The present document provides the introduction to the subsequent Technical Specifications (TSs). The focus of the BSM work is on IP version 4 (IPv4). Actual protocol specification is beyond the scope of the present document and will be issued in specific Technical Specifications (TSs).

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 necessary for the application of the present document.

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

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

[i.2] ETSI TR 102 155: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP interworking over satellite; Addressing and routing".

[i.3] ETSI TR 102 156: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP interworking over satellite; Multicasting".

[i.4] ETSI TR 102 157: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia; IP Interworking over satellite; Performance, Availability and Quality of Service".

[i.5] ETSI TR 101 984: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); Services and architectures".

3 Definitions and abbreviations

3.1 Definitions

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

adaptation: process of adapting standard protocols for better performance over a satellite (or other) subnetwork

architecture: abstract representation of a communications system

function: any discrete element that forms a defined part of an architecture

scenario: predicted sequence of events

3.2 Abbreviations

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

3GPP	Third Generation Partnership Project
ARP	Address Resolution Protocol
ATM	Asynchronous Transfer Mode
BGP	Border Gateway Protocol
BSM	Broadband Satellite Multimedia
BSM_ID	BSM IDentifier
CSF	Client Server Function
DSCP	Differentiated Services Code Point
DVB-S	Digital Video Broadcast-Satellite
HTTP	Hyper Text Transfer Protocol
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IPv4/v6	Internet Protocol version 4/6
MAC	Media Access Control
MPE	Multi-Protocol Encapsulation
MPLS	Multi Protocol Label Switching
NAT	Network Address Translation
ND	Neighbour Discovery
OBP	On-Board Processing
OSI	Open System Interconnection
PEP	Performance Enhancing Proxy
PIM	Protocol Independent Multicast
QID	Queuing IDentifier
QoS	Quality of Service
RSVP	Resource reSerVation Protocol
SAP	Service Access Point
SD	Satellite Dependent
SDU	Service Data Unit
SI	Satellite Independent
SMAC	Satellite Medium Access Control
SNPA	Sub Network Point of Attachment
SPHY	Satellite PHYsical
ST	Satellite Terminal
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
VLAN	Virtual Local Access Network

4 Architectural framework

4.1 Principles

The BSM architectural framework is based on the principle that the recommended Technical Specifications should be linked by a common thread. Obviously all BSM protocols can be classified in the OSI layered model: the protocols the BSM uses to transport IP traffic mostly belong to the layers 2, 3 and above as they deal with MAC layer adaptation to support IP services and address resolution, network protocols such as routing, and finally policy control and management protocols for quality of service and resource management ETSI TR 101 985 [i.1]. It has been a recommendation of the IP interworking over satellite ETSI TR 102 155 [i.2], ETSI TR 102 156 [i.3] and ETSI TR 102 157 [i.4] that the "adaptation" of the IP protocol at the ingress and egress of the BSM be located in a "Protocol Manager". This entity is mainly a control path entity that intercepts the appropriate IP protocols and ensures that they are correctly supported over the BSM.

In the BSM protocol stack, the "manager" resides mostly above the SAP. Its major functions include:

- How IP protocols and packet markings are to be interpreted and transmitted through the BSM.
- Which Satellite Independent (SI) protocols are used.
- And how they in turn trigger the Satellite Dependent (SD) functions.

4.2 Basic concepts

In addition to the definitions provided in clause 3.1 some concepts that are basic the BSM architecture are further explained below:

- **Adaptation:** as defined in clause 3.1, adaptation refers to the process of adapting standard protocols for better performance over, in the present document, a BSM satellite subnetwork. Adaptation, which should be transparent to the general Internet, involves, for example, changing timers, filtering traffic and reducing the transmission of messages over the satellite link to the protocol servers.
- **Architecture:** the architecture is an abstract representation of a communications system. Three complementary types of architecture are defined:
  - **Protocol architecture:** the protocol stacks involved in the operation of the system and the associated peering relationships.
  - **Functional architecture:** the discrete functional elements of the system and the associated logical interfaces.
  - **Network architecture:** the discrete physical (network) elements of the system and the associated physical interfaces.
- **Scenario:** in the present document a scenario will describe a realistic worked example, showing how a defined set of functions operate and apply to a specific IP interworking situation (or situations). Scenarios demonstrate both "why" a given set of functional specifications is needed and "how" the proposed functional decomposition works to provide the desired result. In general, a scenario will be described by reference to one or more architectures.
- **Function:** a function converts a set of inputs into a set of outputs. A function is formally defined by the sets of inputs and of outputs. The set of inputs can be a continuum (e.g. an analog signal) or discrete (e.g. a digital signal). It might be that some inputs produce no output e.g. silent discard in address resolution. Inputs and outputs can be assembled in blocks or vectors (datagrams, packets, frames, etc.). This is the most basic definition and it proves to be sufficient in some cases (black box diagram). At the opposite, a function is ultimately defined when it is possible to derive an output from any input. Between these two ends, all intermediate definitions are possible. In the BSM, a function can use any combination of the following:
  - a protocol element (e.g. a complete stack or an single protocol entity);
  - a logical element (e.g. a process or procedure); and
  - a physical element (e.g. a router or server).

- Network engineering:
    1) In telephony, the discipline concerned with determining internetworking service requirements for switched networks, and developing and implementing hardware and software to meet them. In addition, network engineering includes the end-to-end provisioning of network resources to meet service needs.
    2) In computer science, the discipline of hardware and software engineering to accomplish the design goals of a computer network.
    3) In radio communications, the discipline concerned with developing network topologies. Because the BSM is concerned with all three functions all of those definitions apply.
- **Traffic engineering:** the determination of the numbers and kinds of circuits and quantities of related terminating and switching equipment required to meet anticipated traffic loads throughout a communications system. Traffic engineering also targets the reduction and suitable distribution of loads across the network.

5 Overview

Figure 1 presents the BSM protocol stack for unicast services and figure 2 the same stack with the added multicast protocols. An important feature of both figures is the Satellite Independent Service Access Point interface or 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 identifier, the BSM_ID (BSM_Identity), to address BSM points of attachment. It allows the BSM protocols developed in the Satellite Independent layer to perform 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 BSM physical characteristics. Finally the SI-SAP even makes it possible to envisage switching from one satellite system to another and to even a non-satellite technology while preserving the BSM operator's investment in layer 3 software development.

Figure 1 shows that there are only a small number of generic functions that need to cross the SI-SAP and those are related to connection/session management, resource management or security. As seen in figures 1 and 2, the BSM protocols are based on the OSI layered protocol stack. For the IP services most of the work has concentrated on the network layers with links to the underlying data link and MAC layers. The reason for this is simple: the developed protocols for IP over BSM should primarily be located in the satellite independent part of the BSM stack to be applicable to a range of different satellite dependent lower layers such as for example, DVB-S and DVB-RCS.