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Foreword

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

Introduction

PIM-SM is the mode of the PIM protocol most widely used in existing and proposed multicast routing applications today. In the following discussion "PIM-SM" is understood to mean the messages and operation of this protocol.

The way in which PIM-SM may be carried over satellite is described herein. In particular, ways in which PIM-SM can be adapted over satellite links are defined, which may lead to more efficient use of satellite resources.

1 Scope

The present document specifies the way in which PIM-SM multicast routing protocols may be used over satellite systems. From the many possible scenarios for PIM-SM implementation over different network configurations, three types of PIM scenarios are initially considered:

- Native PIM-over-Satellite;
- Adapted PIM-over-Satellite (S-PIM);
- PIM Snooping/Proxying.

In particular, an adaptation of the PIM-SM standard to a non-standard BSM-internal version of PIM (i.e. S-PIM) is described. In addition, PIM-SM protocol configuration, and/or proxying needed to enable efficient operation over the satellite system and the associated interworking with terrestrial networks is described.

The present document builds upon previous BSM documents referenced in annex B, and notably:

- TS 102 293 [4]: Multicast Group Management; IGMP adaptation.
- TS 102 294 [1]: BSM Multicast Functional Architecture.
- TS 102 461 [i.2]: Multicast Source Management.

The PIM-SM protocol [2] (including the PIM-SSM variant [3]) is the main subject of the present document since it is most widely used in preference to other multicast routing protocols today.

PIM-SM over satellite is assumed to mean that PIM-SM relating to a given multicast flow is present at a BSM ingress router and is processed by the BSM network in such a way that the PIM-SM relating to the same flow is also made available to attached downstream networks at one or more BSM egress routers. It is also possible that PIM traverses the BSM system but only IGMP is then available downstream from the BSM egress ST, but this configuration is considered a minor variation as far as S-PIM is concerned and is not considered further here.

The PIM over BSM scenarios are outlined in [i.2] and in more detail in clause 4 below.

As PIM-SM is considered to be a control plane protocol, the main subject addressed by the present document function is the "Multicast Control" function as outlined in [i.2], rather than multicast IP flows in the user plane.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ETSI TS 102 294: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM) services and architectures; IP interworking via satellite; Multicast functional architecture".

[2] IETF RFC 4601: "Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)".

[3] IETF RFC 4607: "Source-Specific Multicast for IP".

[4] ETSI TS 102 293: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM) services and architectures; IP Interworking over satellite; Multicast group management; IGMP adaptation".

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.2] ETSI TS 102 461: "Satellite Earth Stations and Systems (SES); Broadband Satellite Multimedia (BSM); Multicast Source Management".

3 Definitions and abbreviations

3.1 Definitions

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

architecture: abstract representation of a communications system

NOTE: Three complementary types of architecture are defined:

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

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

egress ST: ST at which an IP multicast flow (of user data) exits the BSM network

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

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

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

ingress ST: ST at which an IP multicast flow (of user data) enters the BSM network

IP multicast: IP networking protocol that allows members of a specific host group to receive copies of the same IP datagram, identified by a reserved multicast address as the IP destination address

IP multicast address: one of a range of IETF-defined addresses for multicast

NOTE: For IPv4 this corresponds to the range from 224.0.0.0 to 239.255.255.255.

IP host group: set of IP receivers for a given IP multicast group

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

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

3.2 Abbreviations

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

ASM	Any-Source Multicast
BMAC	BSM Multicast Access Control
BMS	BSM Management System
BSM	Broadband Satellite Multimedia
BSM_GID	BSM Group IDentity
BSM_ID	BSM IDentity
BSR	BootStrap Router
CPN	Customer Premises Network
C-RP	Candidate-Rendezvous Point
EUG	End User Group
FDMA	Frequency Division Multiple Access
GID	BSM Group ID address
GW	GateWay
IETF	Internet Engineering Task Force
IGMP	Internet Group Message Protocol
INT	Internet/MAC Notification Table
IntServ	Integrated Services
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISP	Internet Service Provider
MAC	Medium Access Control
MACC	BSM Multicast Access Control Client
MACD	Multicast Access Control-D
MACS	BSM Multicast Access Control Server
MAM	BSM Multicast Address Management
MAMC	BSM Multicast Address Management Client
MAMS	BSM Multicast Address Management Server
MAR	Multicast Address Resolution
MBGP	Multicast Border Gateway Protocol
MCM	BSM Multicast Control Management
MCMC	BSM Multicast Control Management Client
MCMS	BSM Multicast Control Management Server
MER	Multicast Edge Router
MGID	Multicast Group Identification Number
MMT	Multicast Mapping Table
MSDP	Multicast Source Discovery Protocol
NCC	Network Control Centre
NMC	Network Management Centre
OBP	On-Board Processing
OMCS	On-demand multicast connection setup
OUI	Organizationally Unique Identifier
PID	Packet IDentifier

PIM	Protocol Independent Multicast
PIM-ASM	Protocol Independent Multicast - Any-Source Multicast
PIM-SM	Protocol Independent Multicast - Sparse Mode
PIM-SSM	Protocol Independent Multicast - Source Specific Multicast
QID	Queue IDentifier
QoS	Quality of Service
RP	Rendezvous Point
RPF	Reverse Path Forwarding
RSM-A	Regenerative Satellite Mesh - A
SD	Satellite Dependent
SDAF	Satellite Dependent Adaptation Functions
SI	Satellite Independent
SIAF	Satellite Independent Adaptation Functions
SI-SAP	Satellite Independent Service Access Point
S-PIM	BSM Adaptation of PIM
SSM	Source Specific Multicast
ST	Satellite Terminal
UT	User Terminal
VP	Virtual Port

4 PIM-SM Scenarios in BSM

The scenarios described here represent the main ways in which PIM-SM can be employed and configured across a BSM system, which together with its attached networks forms part of an overall IP network.

The two modes of operation of PIM-SM are Any-Source Multicast (ASM) and Specific-Source Multicast (SSM). For example, Join messages in ASM specify only the Group address, G, (not the source address, S) as symbolised by the couple (*, G), while Join messages in SSM specify (S, G). Join messages in ASM are forwarded up the tree towards the Rendezvous Point router (RP), while in SSM they are forwarded to the Source.

ASM is often the default mode, and this mode can transition to the SSM mode during the multicast session.

The relative positions of source and RP for ASM mode play a role in the message flows across the BSM as described in the following clauses.

4.1 Source and Rendezvous Point Scenarios

These scenarios describe ASM and SSM modes, and complement those described in [i.2].

4.1.1 Source and RP in Core Network

A typical scenario for BSM is where the BSM is used as an access network to the Internet and both the source and RP are located in the core network.

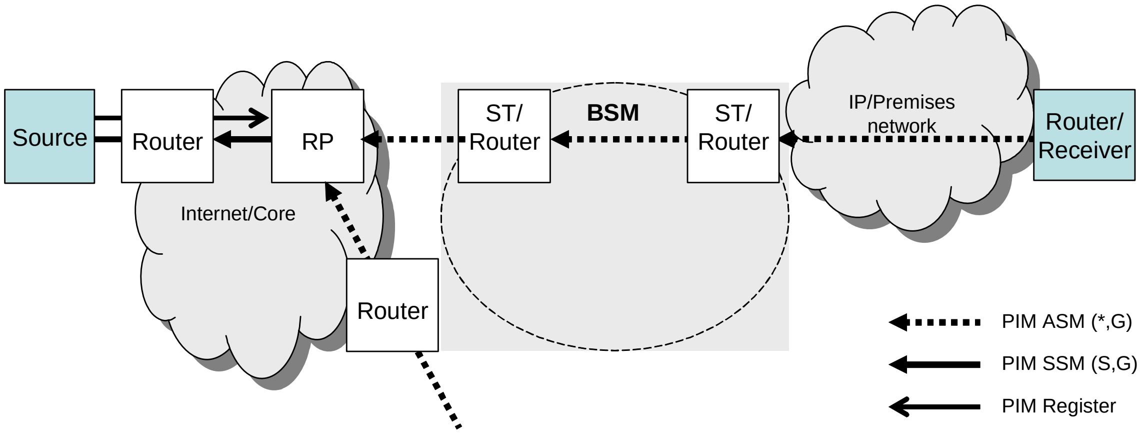

Figure 4.1: PIM-ASM mode, Source and RP in Core Network

The case of an RP located in the CPN with a source in the core is considered unrealistic, and is not discussed here.

4.1.2 RP and Source in Premises Network

In some cases a source may be located in, or attached to, the CPN. Any PIM messages from remote terrestrial network routers would have to be forwarded over the satellite to the RP, leading to increased traffic over the BSM compared to an RP located in the core network. The option for an RP located in the CPN may therefore be disabled for certain sources or network configurations.

This scenario is, however, well suited to multicast trees solely within the satellite network.

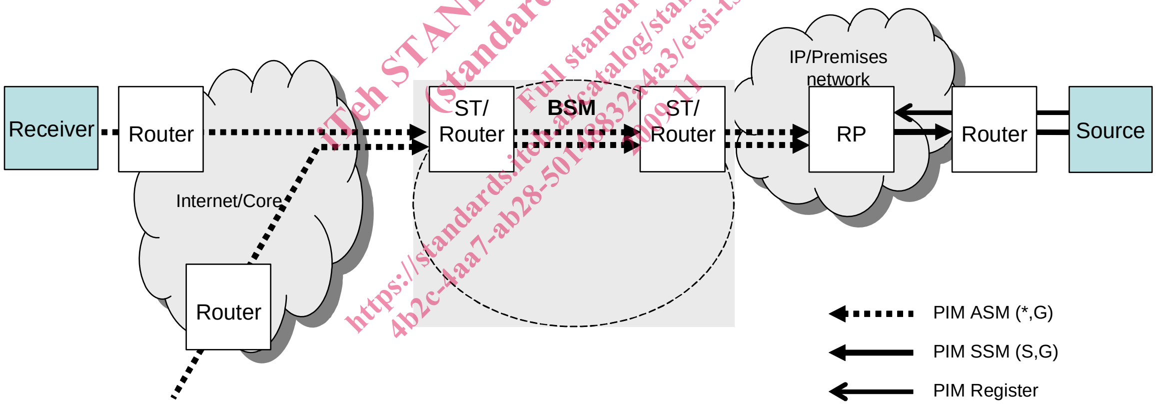

Figure 4.2: PIM-ASM mode, RP and Source in Premises Network

4.1.3 Source in Premises Network, RP in Core Network

As indicated in the previous clause, this scenario avoids PIM messages from remote terrestrial network routers being forwarded over the satellite. However, multicast data flows are forwarded by the source to the RP over the satellite irrespectively of whether any receivers are interested in the source data. This may result in unnecessary capacity being used.

PIM-SSM messages (instead of PIM-ASM) traverse the BSM from the RP to the source, or alternatively unicast register-encapsulated multicast data is forwarded from the source to the RP.

Also it is not an optimal scenario for multicast confined to within the BSM to have an RP outside of the BSM, due to the additional paths incurred.

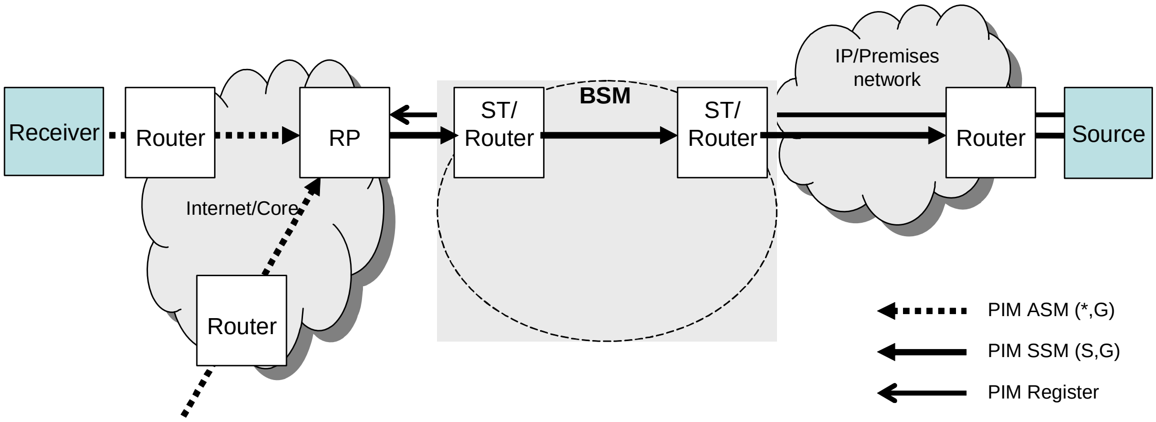

Figure 4.3: PIM-ASM mode, Source in Premises Network, RP in Core Network

4.1.4 PIM-SSM, Source in Core Network (or in CPN)

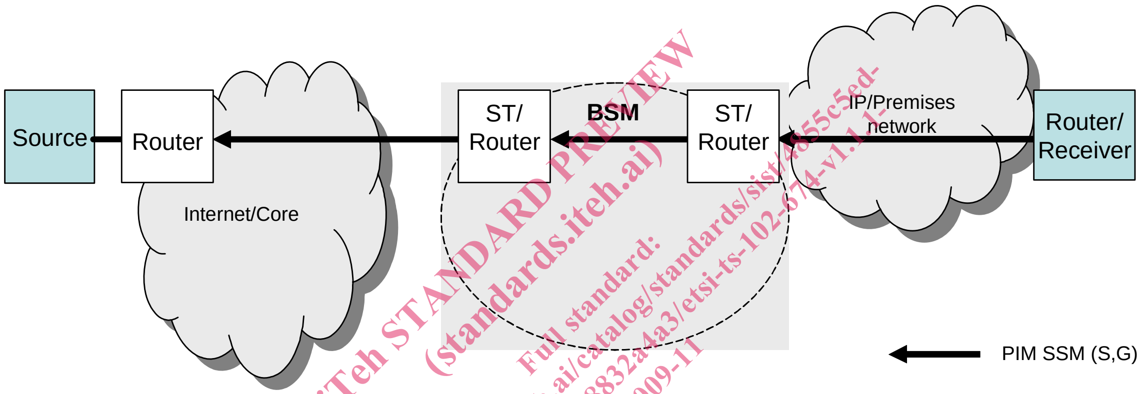

Figure 4.4: PIM-SSM, Source in Core Network

For SSM mode, only PIM-SSM messages traverse the BSM.

As far as the BSM is concerned, the case of a source located in the CPN is identical to this case in terms of PIM-SSM message processing.

4.1.5 Conclusion

In the above scenarios, all BSM ST's are considered identical as is the case in a mesh network. In this case the BSM can be considered symmetrical for PIM purposes, and the above scenarios can be reversed with respect to the BSM. Hence the PIM messages can traverse the BSM identically in either direction.

In the case of a star BSM network including a hub station, the same considerations apply as above providing that ST's and Hub Station have the same PIM functionality.

Both ASM and SSM mode messages should be similarly processed by the BSM without significant impact, as the main difference between these messages is the explicit specification of the source address for forwarding Joins etc. instead of the implicit RP address.