



**Satellite Earth Stations and Systems (SES);  
Air Interface for S-band Mobile Interactive Multimedia (S-MIM);  
Part 1: General System Architecture and Configurations**

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## Foreword

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

The present document is part 1 of a multi-part deliverable covering the Air Interface for S-band Mobile Interactive Multimedia (S-MIM), as identified below:

- Part 1: "**General System Architecture and Configurations**";
- Part 2: "Forward Link Subsystem Requirements";
- Part 3: "Physical Layer Specification, Return Link Asynchronous Access";
- Part 4: "Physical Layer Specification, Return Link Synchronous Access";
- Part 5: "Protocol Specifications, Link Layer";
- Part 6: "Protocol Specifications, System Signalling";

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## Introduction

The S-MIM system specified herein is designed to provide:

- Interactive mobile broadcast services.
- Messaging services for handhelds and vehicular terminals, capable of serving millions of terminals due to a novel optimized air-interface in the return link.
- Real-time emergency services such as voice and file transfer, mainly addressing institutional users on-the-move such as fire brigades, civil protection, etc.

Inside the S-band, the 2 GHz MSS band is of particular interest for interactive multimedia, since it allows two-way transmission. Typically, the DVB-SH standard [i.8] is applied for broadcast transmission of user services; ESDR [i.6] or DVB-NGH [i.12] standards are other alternatives. Essential requirements under the R&TTE directive are covered by the harmonized standard EN 302 574 [i.3], [i.4] and [i.5].

The present document supersedes the previous version of the document and is recommended for new implementations. In case DVB-SH is used in the forward link, the changes with respect to the previous version are backward compatible.

The technology applied has been developed in the framework of the ESA funded project "DENISE" (ESTEC/Contract Number 22439/09/NL/US).

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# 1 Scope

The present document specifies the S-MIM (S-band Mobile Interactive Multimedia) system in which a standardized S-band satellite mobile broadcast system is complemented by the addition of a return channel.

The present document is part 1 of the multi-part deliverable and defines the general S-band Mobile Interactive Multimedia (S-MIM) system architecture and configurations.

The other parts are listed in the foreword.

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# 2 References

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

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

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

## 2.1 Normative references

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

- [1] ETSI TS 102 721-2: "Satellite Earth Stations and Systems; Air Interface for S-band Mobile Interactive Multimedia (S-MIM); Part 2: Forward Link Subsystem Requirements".

## 2.2 Informative references

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

- [i.1] ETSI TS 102 584: "Digital Video Broadcasting (DVB); DVB-SH Implementation Guidelines".
- [i.2] IEEE Journal on Selected Areas in Communications: "Bandlimited Quasi-Synchronous CDMA: A Novel Satellite Access Technique for Mobile and Personal Communications Systems". R. De Gaudenzi, C. Elia, R. Viola, 1992.
- [i.3] ETSI EN 302 574-1: "Satellite Earth Stations and Systems (SES); Harmonized standard for satellite earth stations for MSS operating in the 1 980 MHz to 2 010 MHz (earth-to-space) and 2 170 MHz to 2 200 MHz (space-to-earth) frequency bands; Part 1: Complementary Ground Component (CGC) for wideband systems: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".
- [i.4] ETSI EN 302 574-2: "Satellite Earth Stations and Systems (SES); Harmonized standard for satellite earth stations for MSS operating in the 1 980 MHz to 2 010 MHz (earth-to-space) and 2 170 MHz to 2 200 MHz (space-to-earth) frequency bands; Part 2: User Equipment (UE) for wideband systems: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".
- [i.5] ETSI EN 302 574-3: "Satellite Earth Stations and Systems (SES); Harmonized standard for satellite earth stations for MSS operating in the 1 980 MHz to 2 010 MHz (earth-to-space) and 2 170 MHz to 2 200 MHz (space-to-earth) frequency bands; Part 3: User Equipment (UE) for narrowband systems: Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive".

- [i.6] ETSI EN 302 550 (all parts and sub-parts): "Satellite Earth Stations and Systems (SES); Satellite Digital Radio (SDR) Systems".
- [i.7] ETSI TS 102 824 (V1.1.1): "Digital Video Broadcasting (DVB); Remote Management and Firmware Update System for DVB IPTV Services (Phase 2)".
- [i.8] ETSI TS 102 585: "Digital Video Broadcasting (DVB); System Specifications for Satellite services to Handheld devices (SH) below 3 GHz".
- [i.9] ETSI TS 102 721-3: "Satellite Earth Stations and Systems; Air Interface for S-band Mobile Interactive Multimedia (S-MIM); Part 3: Physical Layer Specification, Return Link Asynchronous Access".
- [i.10] ETSI TS 102 721-4: "Satellite Earth Stations and Systems; Air Interface for S-band Mobile Interactive Multimedia (S-MIM); Part 4: Physical Layer Specification, Return Link Synchronous Access".
- [i.11] ETSI TS 102 721-5: "Satellite Earth Stations and Systems; Air Interface for S-band Mobile Interactive Multimedia (S-MIM); Part 5: Protocol Specifications, Link Layer".
- [i.12] DVB BlueBook A160: "Next Generation broadcasting system to Handheld, physical layer specification (DVB-NGH)".
- [i.13] ETSI TS 102 721-6: "Satellite Earth Stations and Systems; Radio interface for S-band Mobile Interactive Multimedia (S-MIM); Part 6: "Satellite Earth Stations and Systems; Air Interface for S-band Mobile Interactive Multimedia (S-MIM); Part 6: Protocol Specifications, System Signalling".

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## 3 Definitions and abbreviations

### 3.1 Definitions

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

**2 GHz MSS band:** 1 980 MHz to 2 010 MHz (earth-to-space) and 2 170 MHz to 2 200 MHz (space-to-earth) frequency bands

NOTE: These paired bands are assigned to MSS.

**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.

**collector:** terrestrial components (Complementary Ground Component) that "collect" return link transmissions from terminals and forward them towards the ground segment

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

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

**management plane:** plane that provides two types of functions, namely Layer Management and plane management functions:

- **plane management functions:** performs management functions related to a system as a whole and provides co-ordination between all the planes. Plane management has no layered structure
- **layer Management functions:** performs management functions relating to resources and parameters residing in its protocol entities

**repeater:** terrestrial components (Complementary Ground Component) that (mainly) repeat the satellite signal in the forward link

**S-band:** equivalent to 2 GHz MSS band

**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:

2G/3G	Second/Third generation mobile services,
AAA	Authentication, Authorization, Accounting
AuC	Authentication Centre
CAC	Call Admission Control
CDMA	Code Division Multiple Access
CDR	Call Detail Records
CGC	Complementary Ground Component
CWMP	Customer premises equipment WAN Management Protocol
DAMA	Dynamic Assignment Multiple Access
DVB-H	Digital Video Broadcasting, services to Handhelds
DVB-SH	Digital Video Broadcasting, Satellites services to Handhelds
EIRP	Equivalent Isotropic Radiated Power
ESDR	ETSI Satellite Digital Radio
ESG	Electronic Service Guide
ETSI	European Telecommunication Standards Institute
FLUTE	File Delivery Over Unidirectional Transport
FTP	File Transfer Protocol
FUS	Firmware Update System
FWD	Forward (link)
GEO	Geostationary Earth Orbit
GHz	Giga Hertz
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
GW	GateWay
HLR	Home Location Register
HTTP	Hypertext Transfer Protocol
IC	Interference Cancellation/Interleaver Cycle
ID	Identifier
IETF	Internet Engineering Task Force
IKE	Internet Key Exchange
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
IPSec	IP Security
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
IS	Interface Satellite
ISDN	Integrated Services Digital Network
ITSP	Internet Telephony Service Provider
IU	Interleaver Unit/Interface User
LAN	Local Area Network



MMS	Multimedia Message Service
MPEG	Moving Pictures Experts Group
MPEG-TS	MPEG Transport Stream
MSS	Mobile Satellite Services
NCC	Network Control Centre/Non-Compressed Channel
NRT	Non-Real-time
OBU	On-Board Unit
PEP	Performance Enhancement Proxy
PHY	Physical Layer
PID	Program Identifier
PSI/SI	Program Specific Information/Service Information
PSTN	Public Switched telephone Network
QoS	Quality of Service
QS-CDMA	Quasi Synchronous CDMA
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
RFC	Request for Comment
RMS	Remote Management System
RT	Real-time
RTCP	Real-Time Control Protocol
RTN	Return (link)
RTP	Real-time Protocol
SDR	Satellite Digital Radio
SEL	Service Enabling Layer
SEP	Service Enabling Platform
SFN	Single Frequency Network
SIP	Session Initiation Protocol
SLR	SEP Location Register
S-MIM	S-band Mobile Interactive Multimedia
SMP	S-MIM Messaging Protocol
SMS	Short Message Service
SNMP	Simple Network Management Protocol
SOAP	Simple Object Access Protocol
SS	Subsystem
SS1	Service Segment 1
SS2	Service Segment 2
SS3	Service Segment 3
SSA	Spread Spectrum Aloha
SSM <sub>x</sub>	Server Side Middleware for Service Segment x
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module
VLR	Visitor Location Register
VoIP	Voice over IP
WAN	Wide Area Network

## 4 System Overview

### 4.1 General

An integrated satellite/terrestrial mobile system is described in the present document that provides interactive broadcast/multicast, data acquisition and two-way real-time services to subscribers. The S-band payload of a GEO satellite is assumed to provide communication links to users; however, non-GEO satellites are also compatible with this integrated system provided that Doppler pre-compensation countermeasures are put in place. Figure 4.1 shows an example of the system configuration.

NOTE: Satellites with payloads that are "transparent" to communication protocols (rather than "regenerative") are assumed throughout the present document.

On the forward link, a broadcast radio access interface shall be used according to the requirements specified in TS 102 721-2 [1].

On the return link, the radio interface is based on two non-exclusive options depending on the service required:

- 1) Asynchronous access using Spread Spectrum Aloha (SSA) random access.
- 2) Synchronous access using Quasi-synchronous Code Division Multiple Access (QS-CDMA) [i.2].

A number of terminals with different capabilities are foreseen to enable users to access different sets of services. Access to services may be complemented by terrestrial Complementary Ground Components (CGCs).

Ku-band feeder links are shown as examples of feeder links to the satellite S-band payload and the CGCs. In general the feeder links to the S-band satellite payload and the CGCs are independent, i.e. the same feeder link can be used, but also different feeder links can be used, even in different frequency bands. Furthermore, the CGC feeder link can also be implemented by terrestrial networks.

Although not shown in Figure 4.1, interconnection with 2G/3G and IP networks is also foreseen to extend the access of the user devices to services.

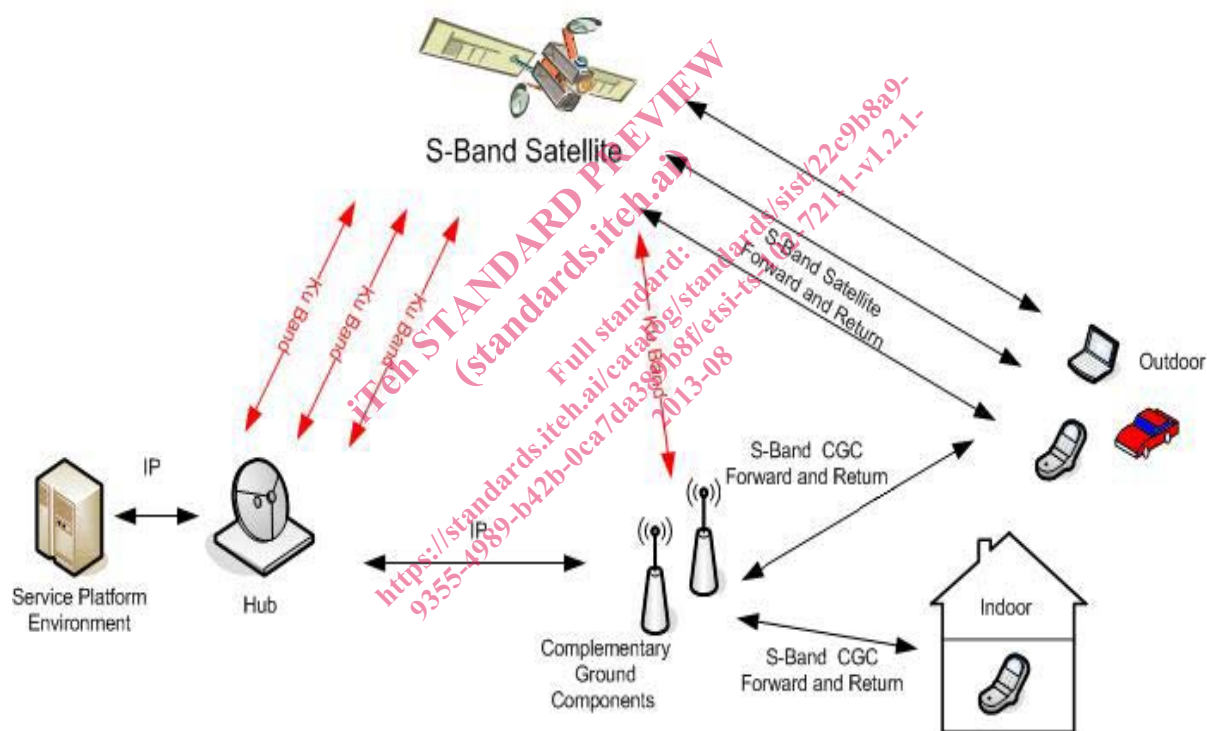


Figure 4.1: S-MIM System Elements

## 4.2 User Services of the S-MIM System

The S-MIM system provides three sets of user services: Service Segments 1, 2 & 3 (SS1, SS2, SS3), which can be provided concurrently and in different combinations.

Each Service Segment is defined by the inclusion of a number of services and service components each with similarities in their use of FWD and RTN links and in their QoS. Table 4.1 indicates the list of services that can be provided through S-MIM and their classification in terms of Service Segments.

Table 4.1: S-MIM Service Segments

Service Segment 1 - Broadcast and Interactive Services		
Service	Service Components	
One-way broadcast/multicast services	Streaming	
	Data distribution	
Interactive broadcast/multicast services	Interactive streaming	PayPerView
		Televoting
		Home-shopping
	Interactive data distribution	PayPerUse
		Content repair
Service Segment 2 - Data Acquisition Services		
Service	Service Components	
Messaging services	Vehicle telemetric	
	Environmental Monitoring	
Messaging Services in Combination with GNSS Applications	Anti-theft Services	
	Traffic Monitoring	
	Automatic Toll Payment	
	Distress Beacon	
	Interactive Distress Beacon	
SMS	-	
Service Segment 3 - Real-Time (Emergency) Services		
Service	Service Components	
Public safety and emergency services	eCall	
	Two-way IP connection	
	Broadcast of Common Interest Messages	
Broadband for Professional Use	DSL-like connectivity	

### 4.3 Mapping of Service Segments to Radio Interfaces

Given the different performance requirements of the services between SSs, the S-MIM system is designed so that in each SS the transport of a service is mapped into a suitable specific radio interface. The mapping of services into radio interfaces in the FWD and RTN links is shown in Figure 4.2, where two types of radio interface are shown in each case.

Accordingly, different configurations of the S-MIM system in terms of its FWD and RTN links will support one or several of the Service Segments indicated in clause 4.2.

FWD link capacity is shared between two profiles; a real-time (RT) profile and a non-real-time (NRT) profile. Flexible assignment between RT and NRT will allow most of the services to be offered when the RT profile is not available, although with (reduced) QoS guarantees of the NRT profile.

An overview of preferred and mandatory mappings of services into Forward Link Physical Layer Channels is shown in Annex A.

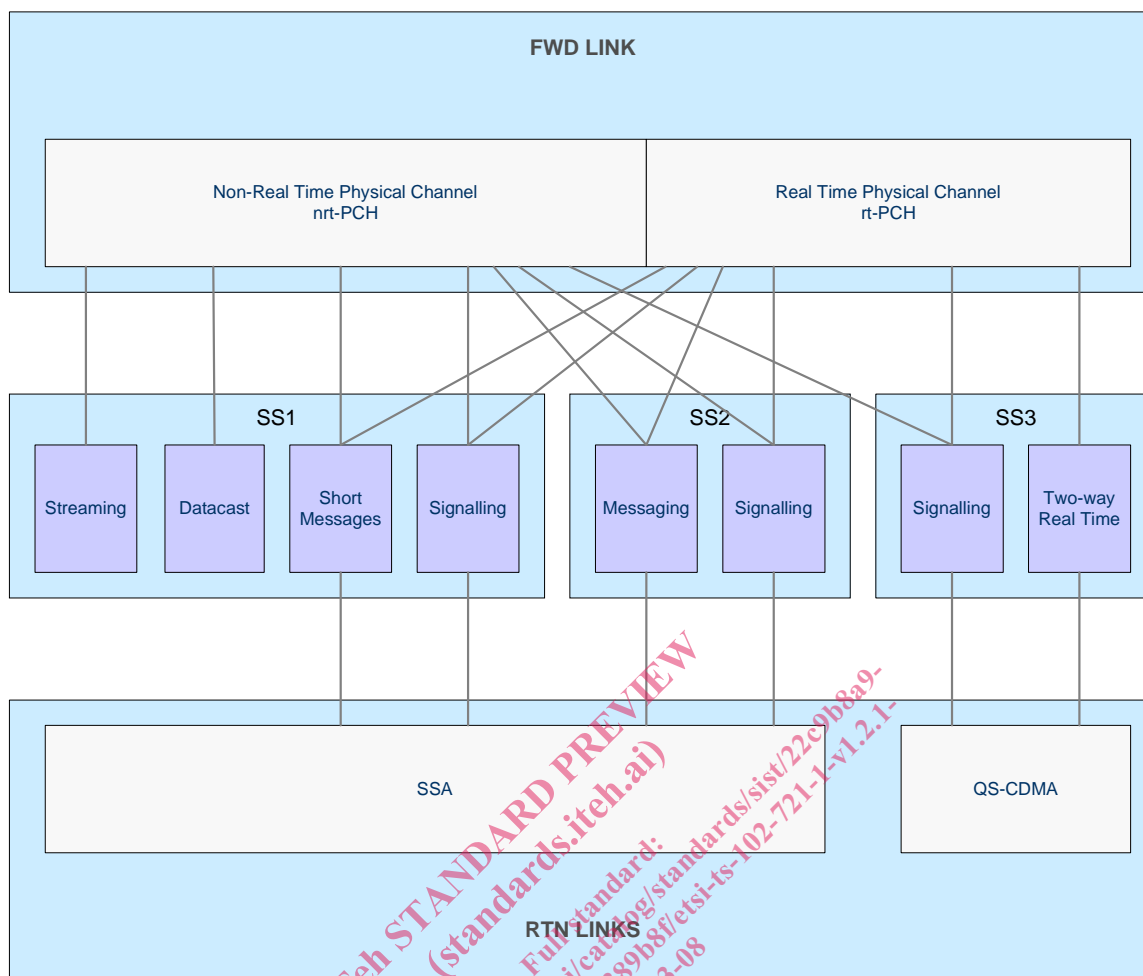


Figure 4.2: Mapping of Service Segments into available radio interfaces

## 4.4 Terminal Classes

The S-MIM terminal classes related to Service Segments, etc. are defined in Table 4.2. Further details, including the differences between Bx terminals, are available in Table 6.1.

Table 4.2: Overview of S-MIM Terminal Classes

Terminal Class	Name	Service segments	Mobility
A	Handheld	1, 2	Mobile
B0	Vehicular	1, 2	Mobile
B1		2	
B2		1, 2	
B3		1, 2, 3 (see note)	
C	Specific	1, 2, 3 (see note)	High speed
D	Emergency	3	Nomadic
E	Fixed	3	Fixed
F	Sensor	2	Fixed

NOTE: Access to eCall service only, excluding all other SS3 services.