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Satellite Earth Stations and Systems;
Air Interface for S-band Mobile Interactive Multimedia (S-MIM);
Part 2: Forward Link Subsystem Requirements

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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
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Contents

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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 2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [1].

Introduction

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

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

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 optimised radio-interface in the RTN 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.7] is applied for broadcast transmission; ETSI SDR [i.2] is an alternative. Essential requirements under the R&TTE directive are covered by the harmonized standard EN 302 574 [i.4], [i.5] and [i.6].

1 Scope

The present document is part 2 of the standard and concerns the requirements for a forward link radio interface in the S-band Mobile Interactive Multimedia (S-MIM) system; it focuses in particular on DVB-SH usage.

The other parts are listed in the foreword of part 1 [1].

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 102 721-1: "Satellite Earth Stations and Systems; Air Interface for S-band Mobile Interactive Multimedia (S-MIM); Part 1: General System Architecture and Configurations".

[2] 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".

[3] ETSI TS 102 721-6: "Satellite Earth Stations and Systems; Air Interface for S-band Mobile Interactive Multimedia (S-MIM); Part 6: Protocol Specifications, System Signalling".

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] ETSI EN 302 550: "Satellite Earth Stations and Systems (SES); Satellite Digital Radio (SDR) Systems".

[i.3] ETSI EN 302 583 (V1.2.1): "Digital Video Broadcasting (DVB); Framing Structure, channel coding and modulation for Satellite Services to Handheld devices (SH) below 3 GHz".

[i.4] 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.5] 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.6] 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.7] ETSI TS 102 585: "Digital Video Broadcasting (DVB); System Specifications for Satellite services to Handheld devices (SH) below 3 GHz".

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 to 2 010 MHz (earth-to-space) and 2 170 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.

ESR(5): percentage of the 20 second periods that contain 1 erroneous second or less

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

global content: content that is intended for the whole coverage area of a satellite beam

local content: content that is intended for a part of the coverage area of a satellite beam

S-band: equivalent to 2 GHz MSS band

3.2 Abbreviations

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

CGC	Complementary Ground Component
CU	Channel Unit
DVB-SH	Digital Video Broadcasting, Satellites services to Handhelds
EIRP	Equivalent Isotropic Radiated Power
FWD	Forward (link)
GHz	Giga Hertz
GNSS	Global Navigation Satellite System
IP	Internet Protocol
LL	Low Latency
LOS	Line of Sight
MFN	Multi-Frequency Network
MLR	Message Loss Ratio
MPEG	Moving Pictures Experts Group
MPEG-TS	MPEG Transport Stream

MSS	Mobile Satellite Services
NRT	Non-Real Time
OFDM	Orthogonal Frequency Division Multiplex
PLR	Packet Loss Ratio
QoS	Quality of Service
QPSK	Quadrature Phase-Shift Keying
R&TTE	Radio and Telecommunications Terminal Equipment
RL	Regular Latency
RT	Real Time
RTN	Return (link)
SDR	Satellite Digital Radio
SDR	Satellite Digital Radio
SFN	Single Frequency Network
S-MIM	S-band Mobile Interactive Multimedia
SMS	Short Message Service
SS1	Service Segment 1
SS2	Service Segment 2
SS3	Service Segment 3
TDM	Time Division Multiplex
VoIP	Voice over IP

4 General Description

The Forward Link S-MIM protocol stack for access to SS1, SS2 and SS3 services is depicted in Figure 4.1.

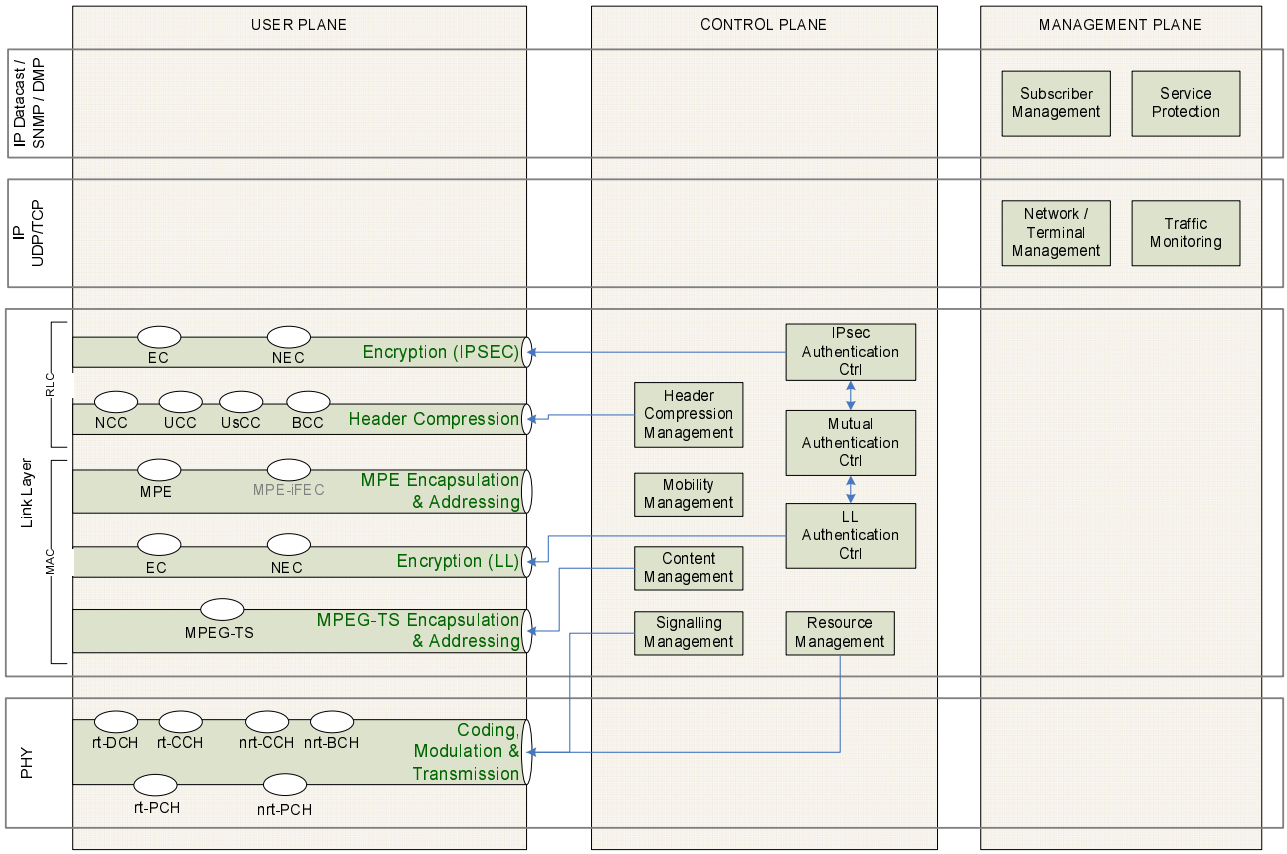

Figure 4.1: Protocol stack for the Forward Link

The present document is concerned with the Physical Layer shown above. A general description of this layer follows and requirements are given in clause 5.

4.1 Physical Layer

Several transport channels are provided in the Forward Link:

- rt-DCH: real time Dedicated Channel. It shall be reserved to flows that correspond to services under SS3.
- rt-CCH: real time Common Channel. It shall be reserved to unicast flows corresponding to SS1 and SS2 with real-time requirements.
- nrt-CCH: non-real time Common Channel. It shall be reserved to unicast flows corresponding to SS1 and SS2 without real-time requirements.
- nrt-BCH: non-real time Broadcast Channel. It shall be reserved to broadcast/multicast flows.

These transport channels are used in practice to manage the multiplexing of various user data with different QoS requirements. Given a number of transport channels, the resource management function will be in charge of determining the share of the multiplex that corresponds to each of the logical channels to perform the multiplex. The share of the multiplex among these logical channels is flexible to accommodate flows dynamically on demand.

These transport channels can be mapped onto 2 different physical channels:

- rt-PCH: real time Physical Channel.
- nrt-PCH: non-real time Physical Channel.

The transport channels are hence mapped into the corresponding physical layer channel according to the real-time requirements of each transport channel and the capacity share amongst them.

5 Forward Link Radio Interface Requirements

5.1 Service Requirements

5.1.1 Service Segment 1

Req-SR-10 The S-MIM system shall provide a radio interface in the forward link that addresses the services grouped under Service Segment 1 in TS 102 721-1 [1] for mobile terminals.

Req-SR-20 This forward link radio interface shall comply with requirements of broadcast and interactive mobile services described in Table 5.1.

Table 5.1: Service Requirements - Service Segment 1

		Streaming	Data Distribution	Interactivity Support for Broadcast/Multicast and Data Distribution
Type of terminal		A, B0, B2, B3, C,	A, B0, B2, B3, C	A, B0, B2, B3, C,
Forward link use		Multimedia stream	Transmission of data	Application ACK Content repair (for data distribution)
Main requirement		Delay Jitter	Reliability of data	Reliability of data
Real time service		NO	NO	NO
Max. overall latency (see note 1) (95th percentile)		N/A	N/A	PayPerView message: < 2 min Teleshopping message: < 2 min Televoting message: < 5 min PayPerUse message: < 2 min Request for content repair message: < 2 min
QoS	Typical throughput	Sport/ Music: 300 kbps News: 256 kbps Radio: 96 kbps	432 kbps (cumulative fast carrousel) 532 kbps (cumulative medium carrousel) 72 kbps (cumulative slow carrousel)	N/A
	Losses	ESR(5): > 90 % (satellite link) (see note 2) ESR(5): > 99 % (terrestrial link)	Quasi Error Free (see note 3)	MLR < 5 %
	Max. one-way-delay (95th percentile)	< 12 s	< 12 s	PayPerView message: < 20 s Teleshopping message: < 20 s Televoting message: < 1 min PayPerUse message: < 20 s Request for content repair message: < 20 s
	RMS Delay Jitter (see note 4)	< 1 ms	N/A	N/A

NOTE 1: Overall latency refers to the time experienced by the user since he/she sends a request (e.g. for PayPerUse, PayPerView, content repair, Tele-shopping order until he/she receives the confirmation from the system to have processed the request.
NOTE 2: These exemplary ESR (5) performance values correspond to the implementation guidelines of DVB-SH [i.1].
NOTE 3: Refers to the application layer: the application layer shall be isolated from packet losses / bit errors at lower layers by recovery mechanism. The IP layer shall deliver PLR < 10^{-4}. It should be noted that for interactive data distribution, the user can request content repair if errors are detected.
NOTE 4: Delay jitter at application layer, after de-jitter buffer.

5.1.2 Service Segment 2

Req-SR-30 The S-MIM system shall provide a radio interface in the forward link that addresses the services grouped under Service Segment 2 in TS 102 721-1 [1] for mobile terminals.

Req-SR-40 This forward link radio interface shall comply with requirements of data acquisition mobile services described in Table 5.2.

Table 5.2: Service Requirements - Service Segment 2

		Messaging		Messaging + GNSS			SMS
		Vehicle Telemetry	Env. Monitoring	Position Messages	Distress Beacon	Interactive Distress Beacon	
Type of terminal		B0, B1, B2, B3	F	A, B0, B1, B2, B3	B0, B1, B2, B3, C	B0, B1, B2, B3, C	A, B0, B1, B2, B3, C
Forward link use		Command & control messages			N/A	Speech message	Messages received by the user
Main requirement		Fast and reliable ACK warning sending	Fast data delivery in emergency mode	Reliability of delivery	Reliability of delivery	Reliability and overall latency	Reliability of delivery
Real time service		NO	YES (emergency mode)	NO	NO	NO	NO
Max. overall latency(see note 1) (95th percentile)		< 30 s	< 30 s	< 30 s	N/A	< 12 s	N/A(see note 3)
QoS	Typical amount of data per message	~140 bytes	~140 bytes	~30 bytes	~30 bytes	62 kbytes	~140 bytes
	Information Loss(see note 2)	< 5 % MLR	< 5 % MLR	< 5 % MLR	< 2 % MLR (see note 4)	< 2 % MLR (see note 4)	< 5 % MLR
	Max. one way delay (95th percentile)	< 10 s	< 10 s (normal mode) < 1 s (emergency mode)	< 10 s	< 20 s	< 1 s	< 1 min
	RMS Delay Jitter	N/A	N/A	N/A	N/A	< 1ms	N/A

NOTE 1: Reception of a command & control message from service centre in < 30 s in case of critical diagnostic.
NOTE 2: Message Loss Ratio;
NOTE 3: ACK of SMS delivery depends on when the recipient receives the message, and if the recipient has the terminal switched on, which cannot be guaranteed here.
NOTE 4: This performance is to be confirmed: in general, it can be expected that a certain percentage of the cases will be affected by shadowing. In such cases, only a high penetration mode would allow the given MLR. Especially for the interactive distress beacon, it will be difficult to achieve, since the delay constraint is more stringent to provide an interactivity perception to the user.

5.1.3 Service Segment 3

Req-SR-50 The S-MIM system shall provide a radio interface in the forward link that addresses the services grouped under Service Segment 3 in TS 102 721-1 [1].

Req-SR-60 This forward link radio interface shall comply with requirements of real-time (emergency) services described in Table 5.3.

Table 5.3: Service Requirements - Service Segment 3

		Public Safety and Emergency			Mobile Broadband for Professional Consumer
		eCalls	2-way IP Connection for Emergency Services	Broadcast of Common Interest Messages	
Type of terminal		C, B3	D	All	E
Forward link use		Audio stream	Data	Data	Data
Main requirement		Availability in LOS and reliability of service		Reliability of delivery	QoS
Availability in LOS conditions		≥ 99,8 %	≥ 99,8 %	≥ 99,8 %	≥ 99 %
Real time service		YES	NO (interactive)	NO	NO (Interactive)
QoS	Typical throughput / message length	4 kbps to 64 kbps	4 kbps to 512 kbps	246 kbps to 65 642 bytes	128 kbps
	Loss(see note 1)	Audio: < 3 % PLR	< 1 % PLR	< 1 % PLR	< 1 % PLR
	Max. one way Delay (95^{th} percentile)	< 800 ms (1 satellite hop)	< 800 ms (VoIP) 2 - 4 s (interactive services)	< 10 s (high priority alert) < 1 hour (low priority message)	2 s to 4 s
	RMS Delay Jitter(see note 4)	< 40 ms	N/A	N/A	N/A
	Max. session setup time (see note 2)	< 6,5 s	< 6.5 s	N/A	< 6,5 s
	Session admission probability	< 99,8 %	< 99,8 %	N/A	< 99 %
	Session dropping probability(see note 3)	$< 10^{-4}$	$< 10^{-4}$	N/A	$< 10^{-3}$

NOTE 1: PLR delivered to the transport layer.
NOTE 2: Setup time assuming terminal already deployed an authenticated in the network.
NOTE 3: Probability that an existing session in the system is dropped. The probability is calculated as number of call dropped over number of total calls.
NOTE 4: Jitter at the IP layer (before the de-jitter buffer).

5.1.4 Signalling

Req-SR-70 The S-MIM system shall provide a radio interface in the forward link able to transport the S-MIM signalling tables defined in [3].

Req-SR-80 This forward link radio interface shall include in the signalling sufficient means to allow the S-MIM terminal to identify its managing hub, satellite beam and (if applicable) terrestrial cell.

Req-SR-90 This forward link radio interface shall comply with requirements of signalling services described in Table 5.4.

NOTE: These requirements apply to signalling for QS-CDMA, E-SSA and the common link layer.

Table 5.4: Service Requirements - FWD Link Signalling

S-MIM Table 3	Periodicity (Min/Typical/Max)	Volume (Min/Typical/Max)	Average Loss Ratio	Critical Loss Pattern	Max Excess Delay	RMS Delay Jitter
SCT	3/10/30 s	320/4 200/46 696 bits	A: 10^{-4} B: 10^{-1}	N.A.	N.A.	N.A.
SAT	3/10/30 s	240/2 560/ 1 060 992 bits	A: 10^{-4} B: 10^{-1}	N.A.	N.A.	N.A.
SDT	0,5/1/2 s	144/2 536/ 131 944 bits	A: 10^{-4} B: 10^{-1}	2 consecutive losses	750 ms	100 ms
QSCT	3/10/30 s	448/2 680/ 13 641 928 bits	A: 10^{-4}	N.A.	N.A.	N.A.
QSDT	0,5/1/2 s	168/600/ 1 048 696 bits	A: 10^{-4}	2 consecutive losses	500 ms	50 ms
QSPCT	64 ms	128/512/262 256 bits	A: 10^{-4}	2 consecutive losses	500 ms	50 ms
QSTIM	0,5/1/2 s	-/1744/- bits	A: 10^{-4}	2 consecutive losses	500 ms	50 ms
LLCT	3/10/30 s	312/816/43 152 bits	A: 10^{-4} B: 10^{-1}	N.A.	N.A.	N.A.

A: nrt-PCH or rt-PCH in LOS conditions.
B: rt-PCH in non-LOS conditions.
Excess dealy does not include latency due to interleaving and deinterleaving in FWD link radio interface and propagation delay.

5.1.5 Interaction between the Services

Req-SR-100 Services from all service segments shall be able to coexist at any given moment.

Req-SR-110 Services corresponding to different service segments may be provided by:
- a dedicated radio interface per service segment in the forward link.
- a dedicated radio interface for any combination of service segments in the forward link.
- a common radio interface for all service segments in the forward link.

Req-SR-120 If a common radio interface is applied to distribute any combination of service segments in the forward link, the radio interface shall provide at least two transport channels: one transport channel that complies with the requirements of streaming and data distribution (non-delay sensitive) traffic and one transport channel that complies with the requirements of real time (delay sensitive) traffic.

Req-SR-130 That radio interface shall be configurable to support flexible capacity share between the transport channels.

Req-SR-140 The forward link radio interface shall implement mechanisms to update on demand the capacity allocation share for delay-sensitive traffic from non-delay sensitive traffic.

5.1.6 Service Distribution

Req-SR-150 The satellite link shall distribute global content through the forward link radio interface.

Req-SR-160 The FWD CGC, if present, shall repeat through its forward radio link the same global content distributed through the satellite link related to SS1 and SS2.

Req-SR-170 The FWD CGC, if present, may distribute, additionally to the global content, local content through its forward radio link.

5.2 System Requirements

5.2.1 Interface Requirements

Req-IR-10 The forward link radio interface shall interface to the S-MIM link layer specified in TS 102 721-5 [2].

Req-IR-20 The link layer shall deliver MPEG-TS to the forward link radio interface for user, control and management data.

Req-IR-30 All types of terminals shall interface with the hub through the satellite(s) link in the forward directions via a dedicated radio interface, for example the forward link radio interface specified here.

Req-IR-40 Terminals of type A, B0, B1, B2, B3, C and F shall interface with Complementary Ground Components (CGCs) through the same radio interface as for the satellite forward link.

Req-IR-50 Terminals of type A, B0, B1, B2, B3, C and F may interface with Complementary Ground Components (CGCs) through the same radio interface as for the satellite forward link, with a different configuration than the satellite link.

Req-IR-60 The configuration of the forward radio interface between terminals and CGCs shall be optimized for terrestrial links.

5.2.2 Interoperability Requirements

Req-IOR-10 If DVB-SH is used as forward link radio interface, TDM or OFDM may be supported for the satellite link.

Req-IOR-20 If DVB-SH is used as forward link radio interface, OFDM shall be supported for the terrestrial link.

Req-IOR-30 The FWD CGC shall support MFN operation for the forward link in conjunction with the space segment.

Req-IOR-40 The FWD CGC may support SFN operation for the forward link in conjunction with the space segment with reduced performance.

Req-IOR-50 The FWD CGC shall support SFN operation for the forward link in conjunction with the other FWD CGCs.

5.2.3 Addressed Spectrum

Req-SpR-10 The forward link radio interface shall use frequencies below 3 GHz (in particular MSS frequencies).

Req-SpR-20 Specifically, the forward link radio interface shall operate in the 2170 MHz to 2 200 MHz frequency band.

Req-SpR-30 The following channelisations shall be supported in the forward link: 5 MHz.

Req-SpR-40 The following channelisations might be supported in the forward link: 3,3 MHz, 1,7 MHz, and 2,5 MHz.

Req-SpR-50 The baseline frequency use of the forward link radio interface is of 5 MHz for hybrid use (satellite and terrestrial). Other frequency allocations may be possible and are not excluded.

Req-SpR-60 The global coverage region of the satellite shall be split into a number of local coverage regions, where different frequency plans may be used.

5.2.4 Operational Requirements

Req-OR-10 The terminals shall be able to receive in any valid sub-band of the forward link.

Req-OR-20 CGCs shall operate in the whole frequency range available in the corresponding region.

Req-OR-30 The forward link radio interface shall be able to operate with reduced coverage or performance in the absence of CGCs.

Req-OR-40 The use of either network element (satellite or CGCs) to access the forward link services shall be transparent to the user.

Req-OR-50 The forward link radio interface shall allow switching from satellite to terrestrial link, and vice versa, in a seamless manner from the point of view of the user.

Req-OR-60 The forward link radio interface may allow combining the satellite and CGC signal at the terminal side to increase the system availability.

Req-OR-70 The forward link radio interface shall allow reallocation of the capacity share between delay-sensitive and non-delay sensitive traffic.

Req-OR-80 The forward link radio interface shall be able to operate despite a basic Doppler drift of 7 kHz, plus daily variation in frequency of 200 Hz and in time of 192 μs.

5.2.5 Design Requirements

The design requirements express guidelines to help the communications system design and specification. In particular, the design requirements will provide useful criteria to perform trade-offs in the specification and design of the communications system.

Req-DR-10 Primarily, the forward link radio interface shall be designed so as to maximize the global capacity of the satellite, in terms of bitrate and number of terminals supported.

Req-DR-20 Secondarily, the forward link radio interface shall be designed so as to maximize the global capacity of the satellite and terrestrial links.

Req-DR-30 The baseline frequency use of the forward link radio interface is of 5 MHz for hybrid use (satellite and terrestrial).

Req-DR-40 The forward link radio interface shall be scalable and allow progressive network deployment of satellite and terrestrial components (CGCs).

NOTE: In the case of deploying further satellites, the frequency resource will remain stable, while the EIRP or overall G/T of the satellite constellation and possibly the degree of space diversity will increase. The scaling should comprise: number of users, frequency of messages.

Req-DR-50 The main target of the CGCs is to increase coverage in area where line-of-sight with satellite is difficult in order to guarantee continuity of service to mobile users.

Req-DR-60 The secondary target of the CGCs is to increase the total capacity of the network in the forward direction and allow more unicast transmission and/or broadcast of local content.

Req-DR-70 The forward link radio interface may implement functions to allow the terminals switching off in suitable periods to save battery (e.g. time slicing).

Annex A (informative): Granularity for real-time traffic allocation for DVB-SH Usage

In case DVB-SH is used for the FWD link the NRT and RT profiles are mapped onto the RL (regular latency) and LL (low latency) profiles respectively, which are defined in version 1.2.1 of the DVB-SH waveform standard [i.3].

Table A.1 shows the granularity for partitioning the SH frames between RL and LL profiles for worst, typical and best case configurations. Note that when a worst case TDM configuration is considered, the associated OFDM configuration does in general not produce a worst case granularity for OFDM, i.e. the OFDM configuration was chosen as displayed in order to generate a worst case granularity for TDM only.

For the case 1,7 MHz/3,3 MHz, it is assumed that the TDM mode is simply a scaling in frequency by a factor of 2 with respect to a 1,7 MHz TDM mode, such that the SH frame capacity (in CUs) is simply doubled.

Table A.1: LL Profile "Worst/Best case" in terms of granularity in percent

Configuration	Worst case OFDM	Worst case TDM	Typical case 5/5 MHz	Typical case 1.7/3.3 MHz	Best case OFDM	Best case TDM
OFDM						
Bandwidth [MHz]	1,7	1,7	5	1,7	8	8
Sig. const.	QPSK	16-QAM	16-QAM	16-QAM	16-QAM	QPSK
Guard interval	1/4	1/32	1/4	1/4	1/32	1/4
Num. CUs per SH frame	816	816	816	816	816	816
Frame duration [ms]	762	314	122	380	63	152
Code rate for LL profile	1/5	N.A.	1/3	1/2	2/3	N.A.
Num. legacy codewords per SH frame	27	N.A.	45	68	90	N.A.
Total legacy throughput [kbps]	426	N.A.	4438	2150	17189	N.A.
Throughput granularity for LL profile	3,7 %	N.A.	2,2 %	1,5 %	1,1 %	N.A.
Throughput granularity for LL profile [kbps]	15,8	N.A.	98,6	31,6	191,5	N.A.
TDM						
Bandwidth [MHz]	N.A.	1.7	5	3.3	N.A.	8
Sig. const.	N.A.	QPSK	QPSK	QPSK	N.A.	16-APSK
Roll-off	N.A.	0,35	0,15	0,15	N.A.	0,15
Num. CUs per SH frame	N.A.	336	476	952	N.A.	1 904
Code rate for LL profile	N.A.	1/5	1/4	2/5	N.A.	2/3
Num. legacy codewords per SH frame	N.A.	11	19	63	N.A.	211
Total legacy throughput [kbps]	N.A.	422	1 874	1 995	N.A.	16 702
Throughput granularity for LL profile	N.A.	9,1 %	5,3 %	1,6 %	N.A.	0,47 %
Throughput granularity for LL profile [kbps]	N.A.	38,3	98,6	31,6	N.A.	79

History

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