System Specifications for Satellite services to Handheld devices (SH) below 3 GHz

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Contents

Introduction

The present document specifies the transmission system using ETSI Digital Video Broadcasting standards to provide an efficient way of carrying multimedia services over hybrid satellite and terrestrial (DVB-SH) networks at frequencies below 3 GHz to a variety of mobile and fixed terminals having compact antennas with very limited directivity. Target terminals include handheld (PDAs, mobile phones), vehicle-mounted, nomadic (laptops, palmtops…) and stationary terminals. The present document identifies ETSI standards in which functionalities and parameters shall be implemented to deliver compliant services.

The DVB-SH standard provides a universal coverage by combining a Satellite Component (SC) and a Complementary Ground Component (CGC): in a cooperative mode, the SC ensures geographical global coverage while the CGC provides cellular-type coverage. All types of environment (outdoor, indoor) can then be served, either using the SC from its first day of service, and/or the CCG that is to be progressively deployed building on the success of DVB-H. A typical DVB-SH system (see Figure 1) is based on a hybrid architecture combining a Satellite Component and, where necessary, a CGC consisting of terrestrial repeaters fed by a broadcast distribution network of various kinds (DVB-S2, fiber, xDSL…). The repeaters may be of three kinds:

- TR(a) are broadcast infrastructure transmitters which complement reception in areas where satellite reception is difficult, especially in urban areas; they may be collocated with mobile cell site or standalone. Local content insertion at that level is possible, relying on adequate radio frequency planning and/or waveform optimizations.
- TR(b) are personal gap-fillers of limited coverage providing local on-frequency re-transmission and/or frequency conversion; typical application is indoor enhancement under satellite coverage; no local content insertion is possible.
- TR(c) are mobile broadcast infrastructure transmitters creating a “moving complementary infrastructure”. Depending on waveform configuration and radio frequency planning, local content insertion may be possible.

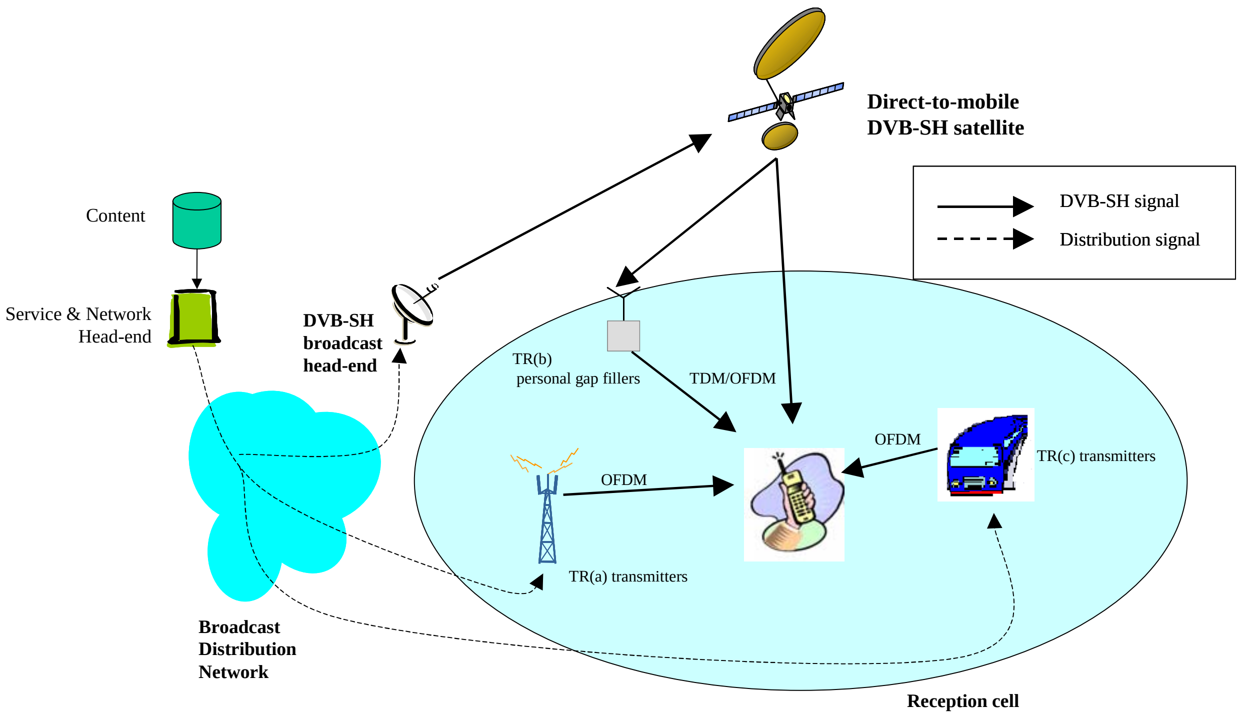

Figure 1 :Overall DVB-SH system architecture

OFDM is the natural choice for the terrestrial modulation as selected in DVBT/H systems deployed over the past few years. For the satellite, two modulations have been selected, which leads to two reference architectures within the variety of possible hybrid satellite/terrestrial systems architectures. These two architectures are both covered by DVB-SH and are described in the waveform document [1]:

- SH-A for OFDM terrestrial and OFDM satellite transmission mode (Figure 2)
- SH-B for OFDM terrestrial and TDM satellite transmission mode (Figure 3).

Specification [1] maximizes the commonalities between the two architectures so that the terrestrial OFDM part of SH-B is identical to the OFDM part of SH-A and terminals designed for SH-B architectures can also be used with SH-A architectures, their TDM processing branch being simply switched off. It is expected that various market conditions, system requirements and regulatory constraints will yield various system implementation and deployment strategies.

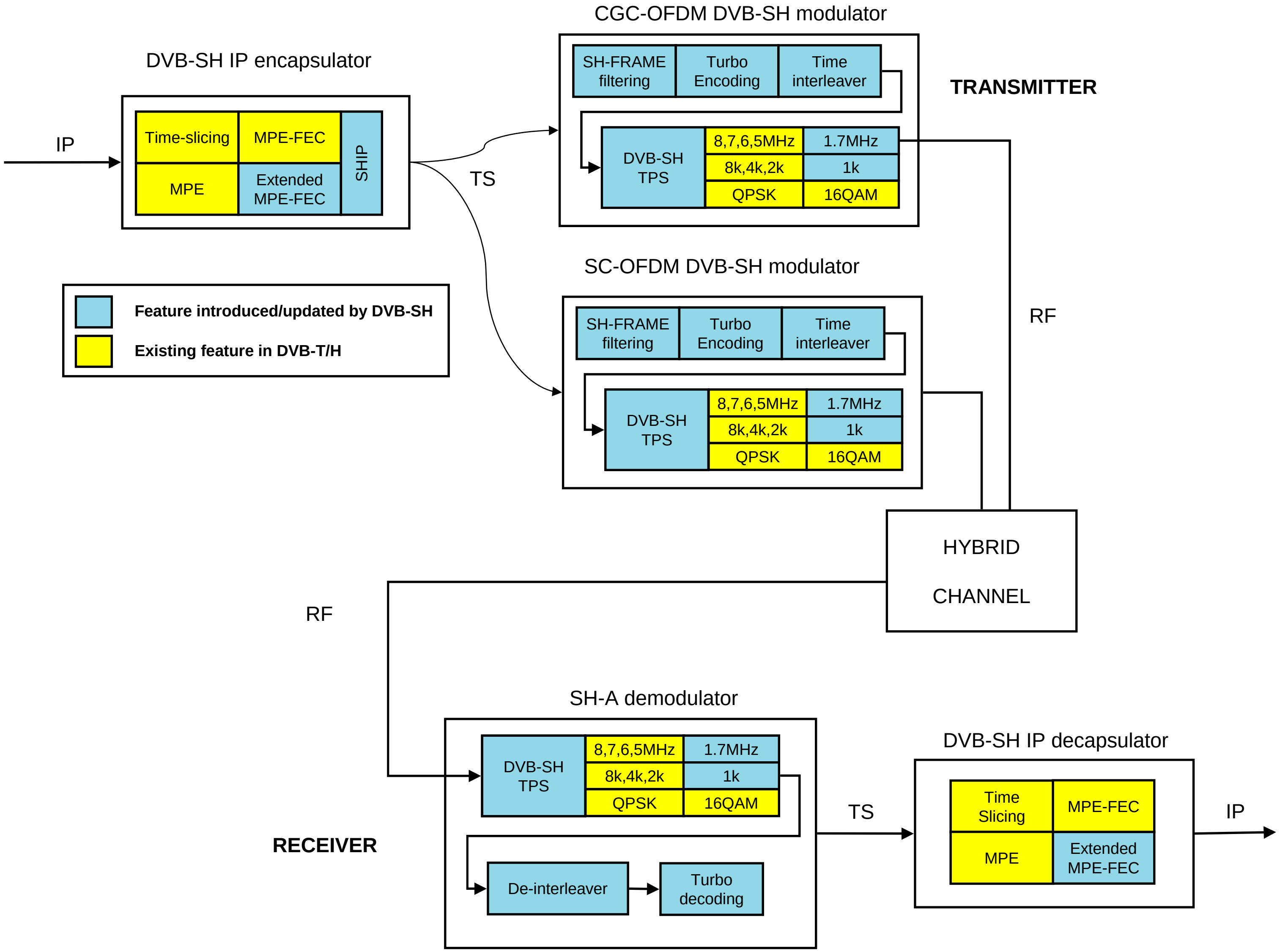

Figure 2: SH-A system architecture

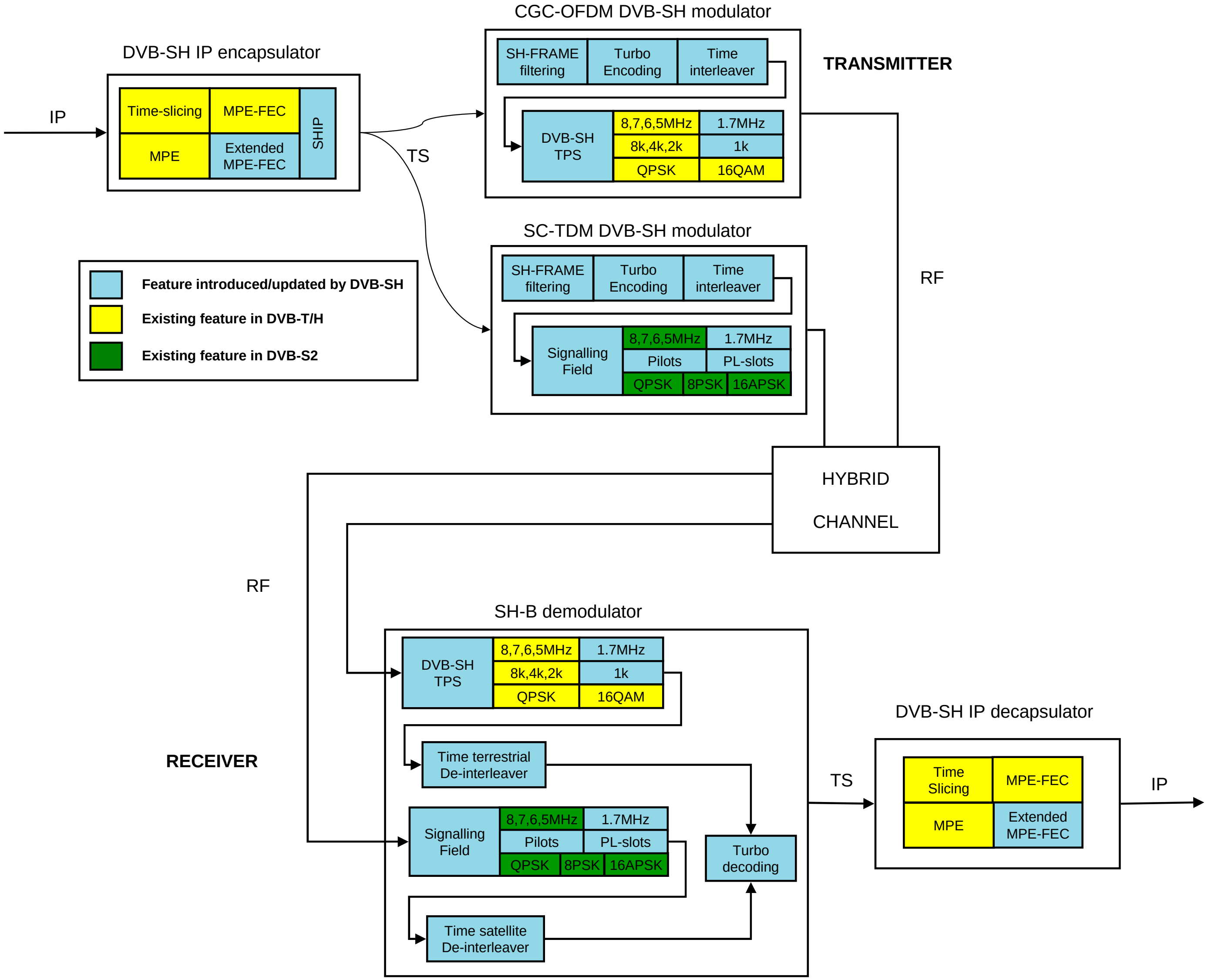

Figure 3: SH-B system architecture

DVB-SH standard addresses the specific satellite channel impairments through long (in the order of several DVB-H bursts, a burst being defined in reference [4]) time diversity protection. Different solutions based either on physical (channel interleaver) and/or link (service interleaver) layers can be applied, summing up their protection to this duration of several DVB-H bursts. Since the standard, thanks to the interleaver high degree of flexibility, allows a continuous balance between these two solutions, two classes of receivers are defined that limit the number of possible configurations:

- **Class 1 receivers** support short (in the order of one DVB-H burst as defined in reference [4]) physical layer protection and multi-burst link layer protection based on Reed-Solomon ([4] §9.5.1) sliding FEC algorithm managed at service level.

- **Class 2 receivers** support in addition longer physical layer protection (in the order of several DVB-H bursts) managed at channel level.

It is up to the service and network operators to allocate the protection between the different layers, depending on the targeted quality of service, service categories and commercialized classes of receivers.

The combination of both system architecture specified in 2.2 and these receiver classes leads to four terminal configurations listed in Table 1.

Terminal configurations	System architecture	Receiver class
Configuration A-1	SH-A	Class 1
Configuration A-2	SH-A	Class 2
Configuration B-1	SH-B	Class 1
Configuration B-2	SH-B	Class 2

Table 1: terminal configurations

A DVB-SH system is defined by combining elements in the physical, link and service layers.

Reference [1] specifies the available features of the DVB-SH waveform:

- OFDM modulation for the CGC, and either OFDM or TDM modulations for SC with the flexibility for network providers to choose between SH-A and SH-B, according to satellite characteristics and regulatory considerations. Possible choice is QPSK, 8PSK, 16APSK for power and spectral efficient modulation format in TDM transmission mode with a variety of roll-off factors (0.15, 0.25, 0.35) on the one hand, QPSK, 16QAM and non-uniform 16QAM for OFDM transmission mode with support of hierarchical modulation on the other hand.

- Flexibility for network providers to choose, according to their transmission band (below 3 GHz), various channelization bandwidths – among 8,7,6,5,1.7 MHz -, FFT length – among existing 8k, 4k, 2k and an additional 1k directly scaled from the 2k mode -.

- As a result of this radio configuration flexibility, an adequate radio planning can accommodate dedicated frequency for local content purposes. In SH-B, an additional local content insertion technique is also possible that mitigates the loss of the terrestrial frequency required for repeating satellite TDM signal when the difference in capacity between SC and CGC allows it.

- Seamless reception of satellite and terrestrial signals using signal diversity either via single frequency network (SFN, SH-A only), maximal ratio combining (MRC, both SH-A and SH-B) or code diversity (complementary puncturing, SH-B only) techniques, the latter being possible via a common frame structure shared between TDM and OFDM modes.

- State-of-the-art and field-proven FEC (3GPP2 Turbo code) supporting several coding rates.

- A highly flexible channel time interleaver that offers time diversity from about one hundred milliseconds to several seconds depending on the targeted service level and corresponding capabilities (essentially memory size) of terminal class. The same interleaver allows Class 1 receivers to co-exist with Class 2 receivers, within the same network. The interleaver can be set to either a common configuration (SH-A) or two specialized configurations (SH-B: one for the TDM SC and one for the OFDM CGC).

- Pilot symbols to make robust signal estimation and fast re-acquisition after a deep and long shadowing/blockage event for both TDM and OFDM modes.

References [1] and [4] define the link layer that offers:

- Support of MPEG2 TS packets at input although the specification allows the introduction of a Generic Stream at a later date.
- Benefit from MPE encapsulation as defined in reference [4] and support of MPE Time Slicing power saving and handover between frequencies/coverage beams.
- Compatibility with MPE-FEC (intra-burst FEC).
- Support of MPE-FEC extension (inter-burst FEC), potentially relying on erasure codes other than Reed-Solomon codes (pending selection process). The MPE-FEC extension is required to combat deep and long shadowing encountered in some satellite channels by providing additional time diversity.

Service layer has the following characteristics:

- DVB-SH benefits from and is fully compliant with IP datacast protocols suite as defined in references [5], [6], [7], [8], [9], for both classes.
- DVB-SH Signaling is done via a combination of TPS bits (OFDM part), and a Signaling Field (TDM part). They allow together the various parameters of both components to be controlled, in particular when common operation of both different components is required in SH-B. In terms of PSI/SI, DVB-SH is fully compatible with references [2] and [3].
- In some modes (inter-burst physical FEC, local content insertion), straightforward synchronization between service and radio layers is achieved via the use of a SH Initialization Packet defined in reference [1].

This document together with references [1], (pending) updated [2] and [4] constitutes the DVB-SH standard.

1 Scope

The present document specifies DVB-SH by referencing and making use of ETSI Digital Video Broadcasting standards.

2 References

The following documents contain provisions that, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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

[1] ETSI EN 302 583: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for satellite transmission to handheld (DVB-SH)"

[2] ETSI EN 300 468: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems" (DVB-SI)"

[3] ETSI TS 102 470 v1.1.1: "IP Datacast over DVB-H: PSI/SI"

[4] ETSI EN 301 192: "Digital Video Broadcasting (DVB); DVB specification for data broadcasting (DVB-DATA)"

[5] ETSI TS 102 468 v1.1.1: "IP Datacast Set of Specifications for Phase 1"

[6] ETSI TS 102 474 v1.1.1: "IP Datacast Service Purchase and Protection (SPP)"

[7] ETSI TS 102 472 v1.2.1: "IP Datacast Content Delivery Protocols (CDP)"

[8] ETSI TS 102 471 v1.2.1: "IP Datacast Electronic Service Guide (ESG)"

[9] ETSI TS 102005 v1.2.1: "Specification for the use of video and audio coding in DVB services delivered directly over IP (AVC)"

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Gap filler: Repeater that receives an already DVB-SH modulated signal and performs physical layer operations on it (no demodulation) like filtering, amplifying, frequency shifting.

Repeater: Equipment that delivers a DVB-SH compliant signal at its output for signal field strength amplification purposes.

Transmitter: Repeater that receives a TS and modulates it according to DVB-SH specification. A transmitter may be fixed or mobile.

3.3 Abbreviations

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

CGC	Complementary Ground Component
SFN	Single Frequency Network
SC	Satellite Component

4 System definition

4.1 General

DVB-SH is a broadcast transmission system for datagrams, including IP. They may contain data that pertain to multimedia services, file-downloading services, or to other services not mentioned here.

DVB-SH specifies:

- Physical layer;
- Link layer;
- Service information.

Recommendations about synchronization between modulators of the CGC and SC are also provided. Further information and recommendations about how to use and select the appropriate parameters of DVB-SH are provided in the text and through documents that are listed in the bibliography.

4.2 Physical Layer

DVB-SH physical layer shall follow reference [1].

4.3 Link Layer

Datagrams shall be encapsulated using Multi-Protocol Encapsulation (MPE) as specified in reference [4].

Time-slicing shall be used on elementary streams carrying MPE sections as specified in reference [4].

Intra burst MPE-FEC as specified in reference [4] may be used on elementary streams.

Inter burst MPE-FEC may be used on elementary streams. Inter burst MPE-FEC will be specified at a later stage and will be updated in reference [4].

4.4 Service Information

DVB-SH shall follow references [2] and [3] with relevant updates on the NIT descriptor “delivery_descriptor”.

The use of inter-burst MPE FEC shall be announced using the time_slice_fec_identifier_descriptor present in the INT table (specified in updated reference [4]).

4.5 Synchronization

If a separate channel from the satellite channel is available for terrestrial use, the satellite signal may be repeated terrestrially on that channel. In this case SH-B architecture should be preferred since TDM modulation optimizes satellite power resource and allows the use of code diversity. TDM and OFDM modulators are synchronized by time alignment of TDM and OFDM SH-frames and absolute reference given by SH-Initialization Packet specified in Annex 1 of reference [1].

When it is preferred or necessary to repeat terrestrially the satellite signal on the same frequency, OFDM modulation shall be used by the satellite component to constitute an SFN between SC and its CGC using SH-A architecture. OFDM modulators are time synchronized by the absolute reference given by SH initialization packet.