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Technical Specification

Digital Video Broadcasting (DVB); System Specifications for Satellite services to Handheld devices (SH) below 3 GHz

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Foreword

This Technical Specification (TS) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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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, etc.), vehicle-mounted, nomadic (laptops, palmtops, etc.) 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 etc.). 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.

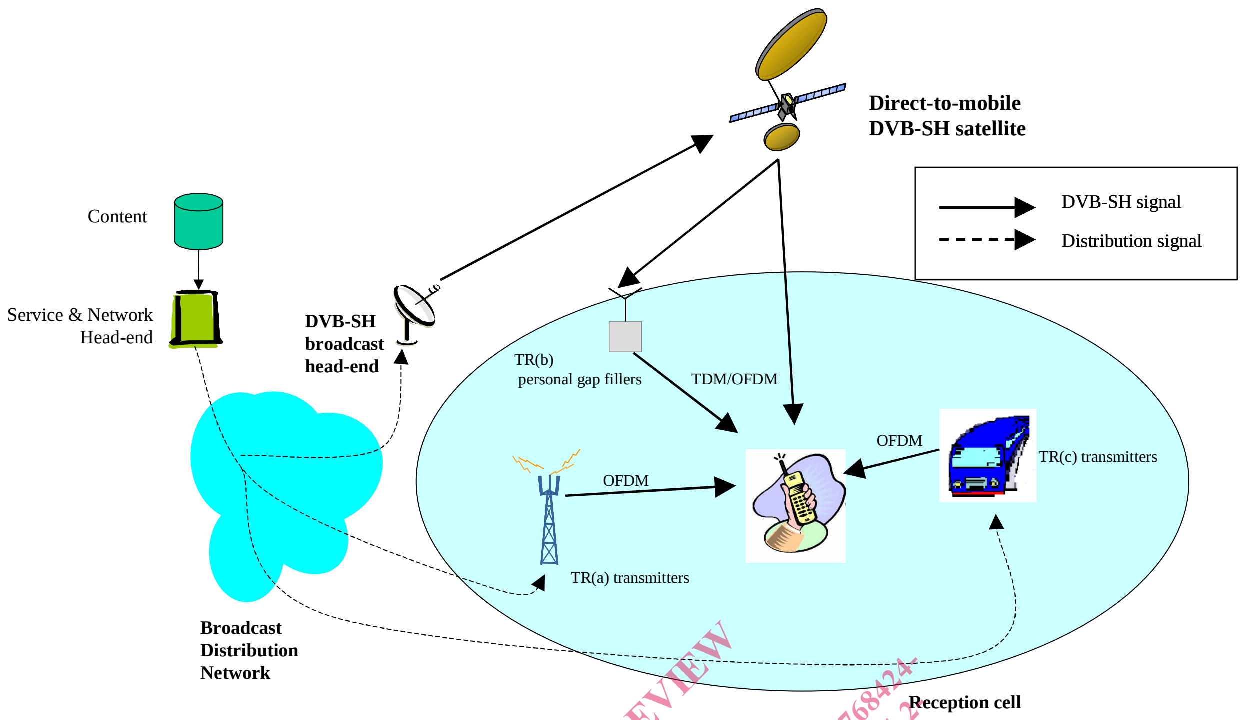

Figure 1: Overall DVB-SH system architecture

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.

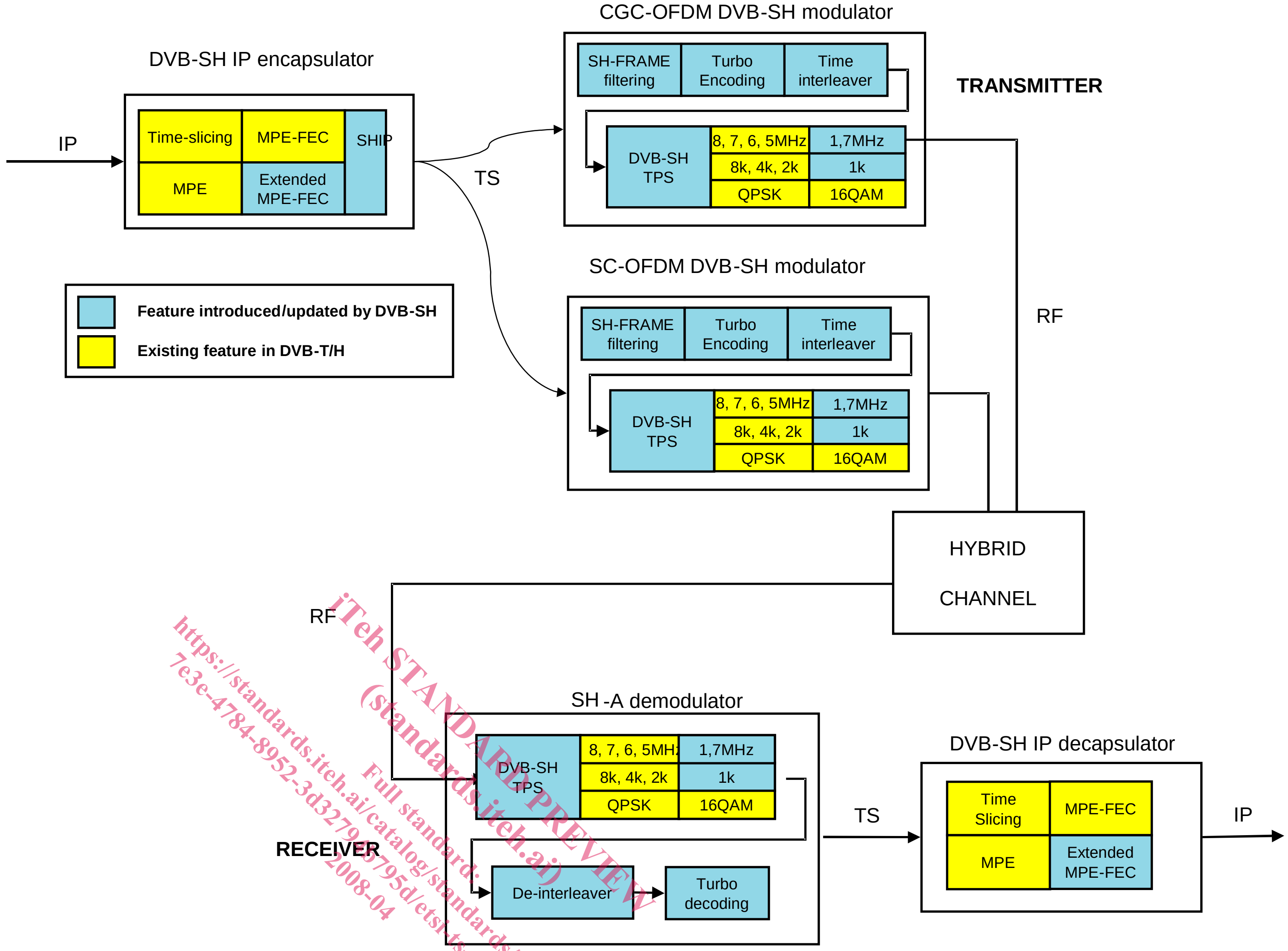

Figure 2: SH-A system architecture

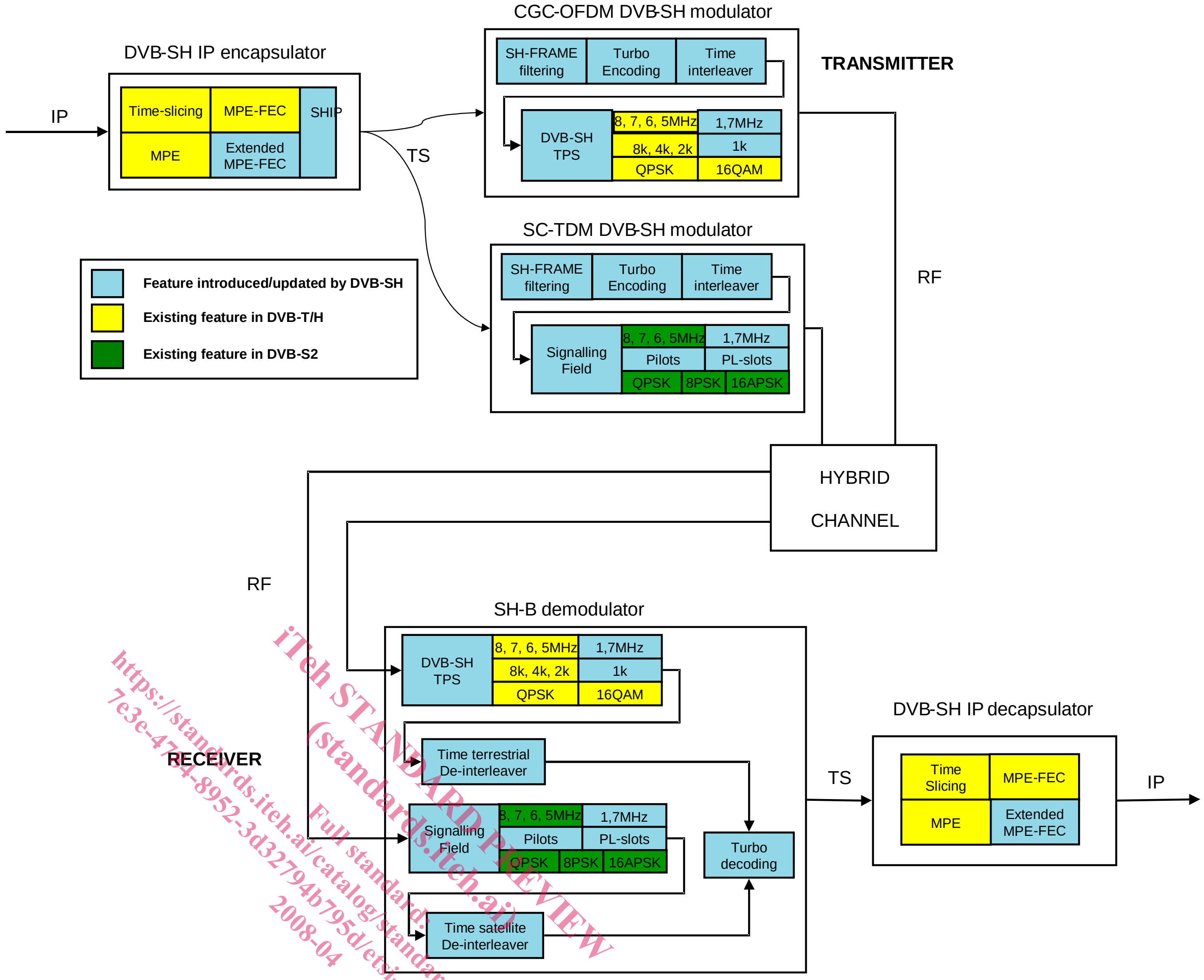

Figure 3: SH-B system architecture

DVB-SH standard addresses the specific satellite channel impairments through long (in the order of several DVB-H bursts, a burst being defined in EN 301 192 [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 EN 301 192 [4]) physical layer protection and multi-burst link layer protection based on Reed-Solomon ([4], clause 9.5.1) sliding FEC algorithm managed at service level..

Class 2 receivers support long physical layer protection (in the order of several DVB-H bursts). This protection managed at channel level can be complemented by same link layer protection as class 1 receivers.

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 and these receiver classes leads to four terminal configurations listed in table 1.

Table 1: Terminal configurations

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

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 MHz, 7 MHz, 6 MHz, 5 MHz, 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], and [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].

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