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Technical Specification

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

Reference
RTS/JTC-DVB-305

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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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The Digital Video Broadcasting Project (DVB) is an industry-led consortium of broadcasters, manufacturers, network operators, software developers, regulatory bodies, content owners and others committed to designing global standards for the delivery of digital television and data services. DVB fosters market driven solutions that meet the needs and economic circumstances of broadcast industry stakeholders and consumers. DVB standards cover all aspects of digital television from transmission through interfacing, conditional access and interactivity for digital video, audio and data. The consortium came together in 1993 to provide global standardisation, interoperability and future proof specifications.

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 that specifiy functionalities and parameters required for delivering 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 or terrestrial broadcast-type coverage. All types of environment (outdoor, indoor) can then be served, either using the SC and/or the CGC. 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.

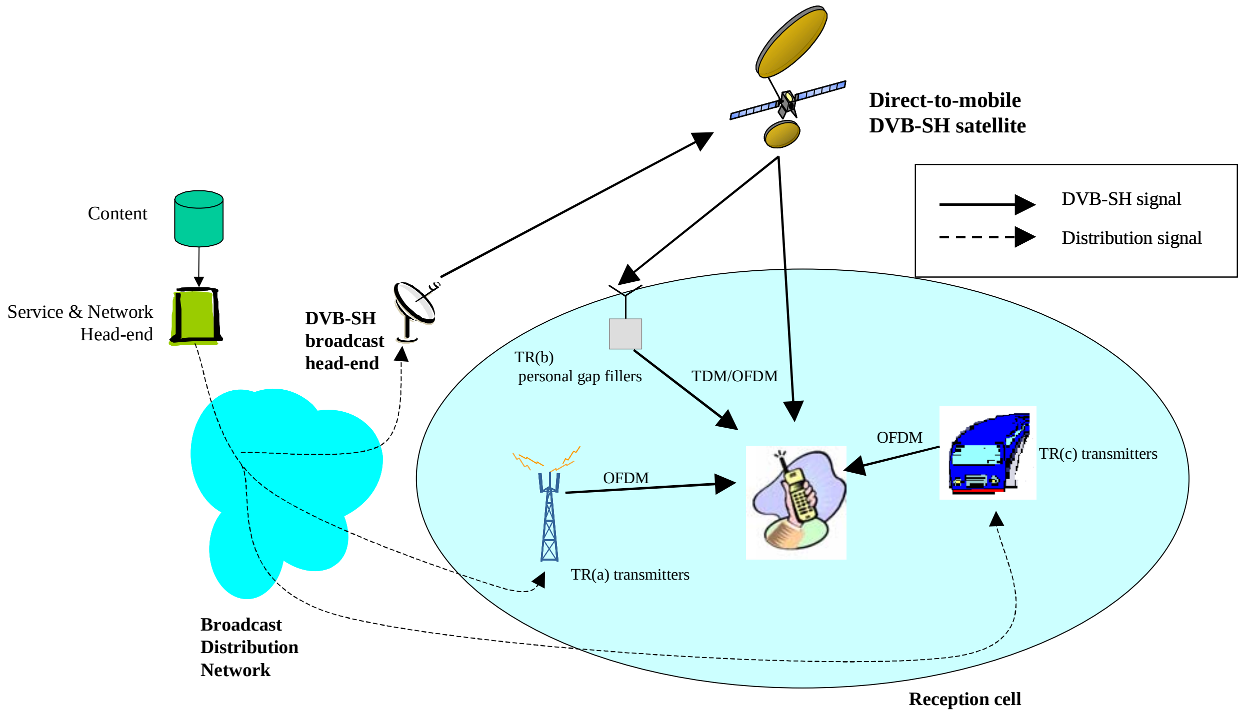

Figure 1: Overall DVB-SH system architecture

OFDM is the natural choice for the terrestrial modulation as selected in DVBT/H/T2 systems. For the satellite, two modulations have been selected, OFDM and TDM. This leads to two reference architectures within the variety of possible hybrid satellite/terrestrial systems architectures:

- SH-A for OFDM terrestrial and OFDM satellite transmission mode (SFN mode is represented in figure 2).
- SH-B for OFDM terrestrial and TDM satellite transmission mode (figure 3).

NOTE: These figures are simplified and do not take into account the additional possible inputs such as local content, low latency services and hierarchical modulation. Please consult [2].

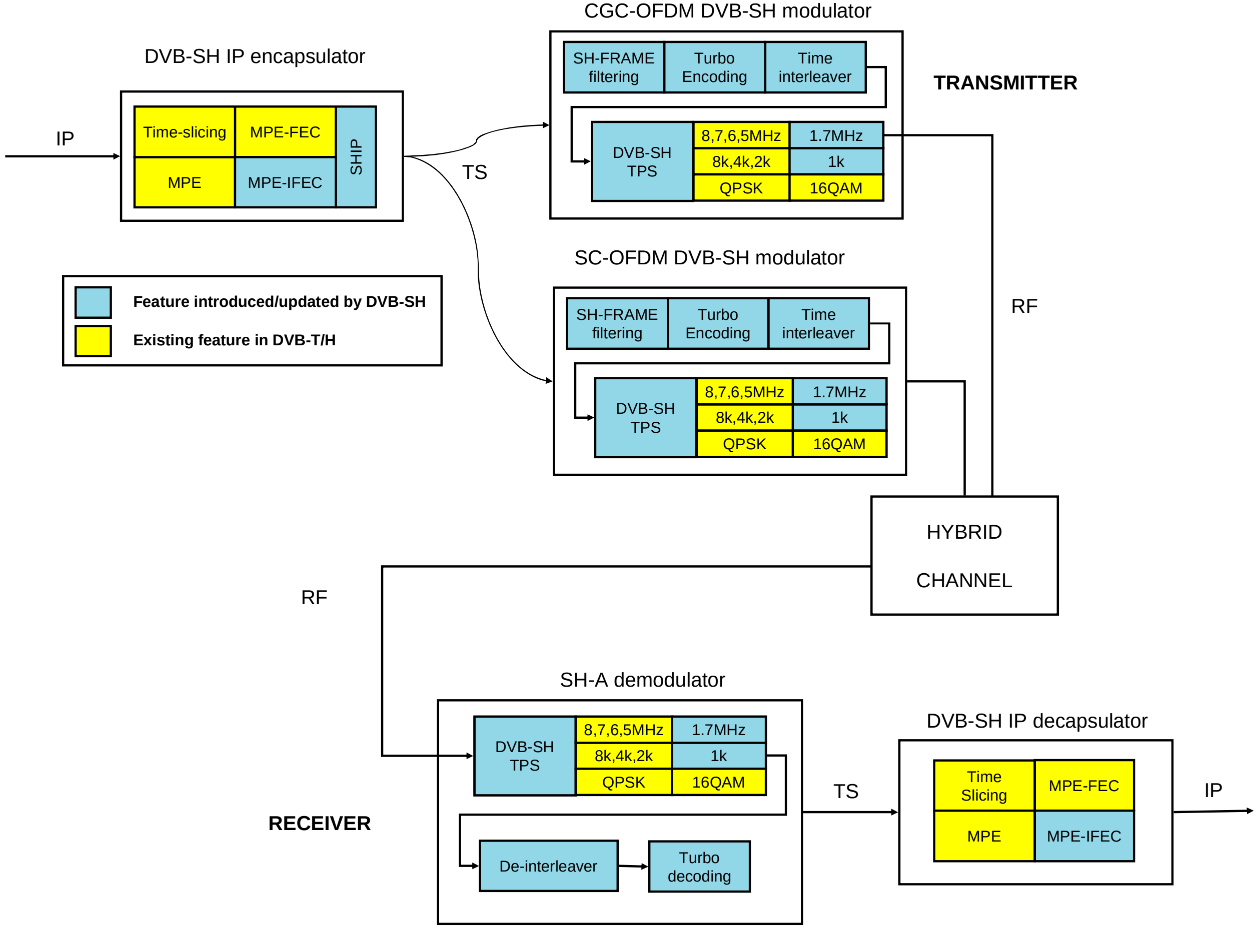

Figure 2: SH-A SFN system architecture

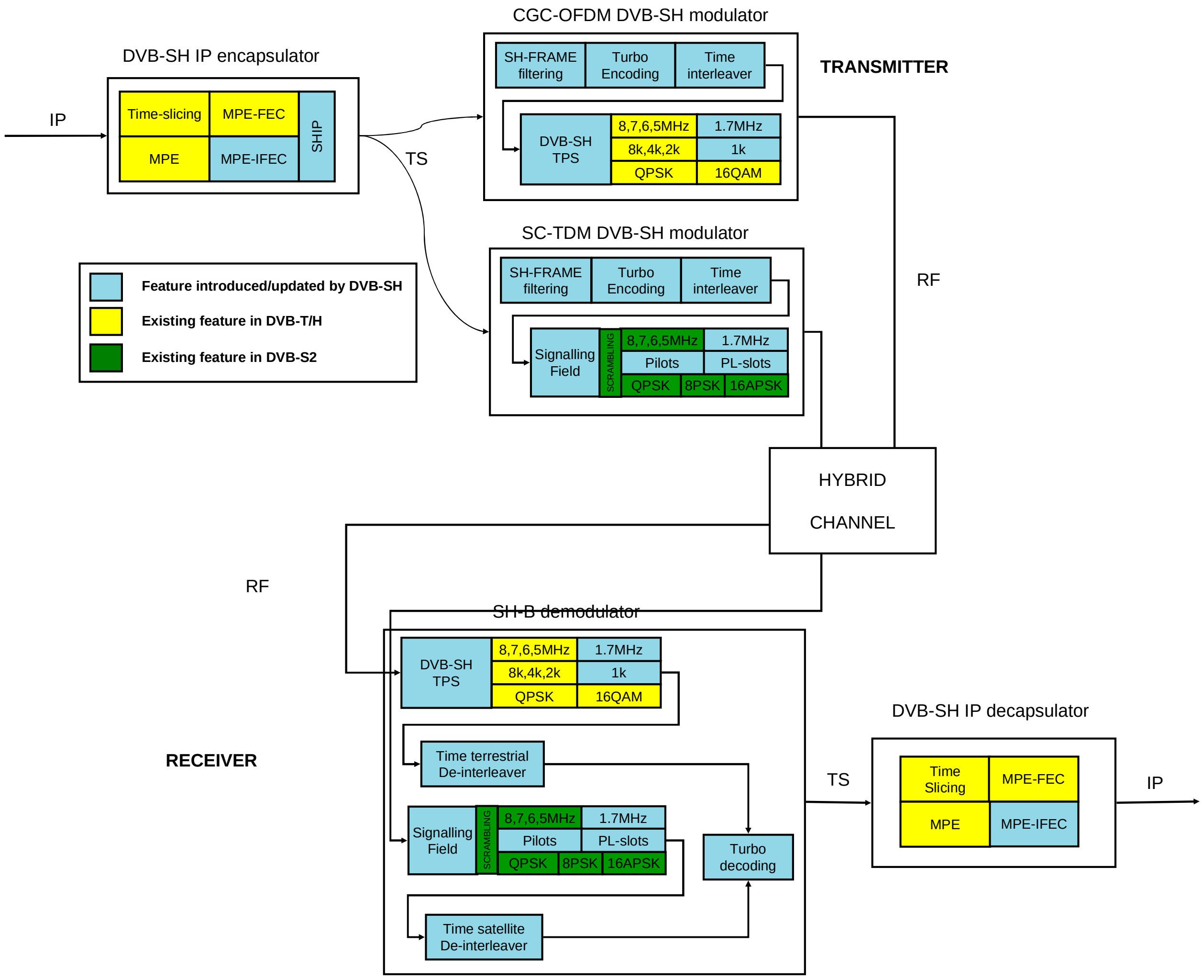

Figure 3: SH-B system architecture

DVB-SH standard addresses the specific satellite channel impairments through long (in the order of several bursts, a burst being defined in EN 301 192 [5]) 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 bursts. The standard allowing a continuous balance between these two solutions, two classes of receivers are defined:

- **Class 1 receivers** support short (in the order of one burst) physical layer protection and multi-burst link layer protection based on MPE-IFEC [6] Reed-Solomon sliding FEC algorithm managed at service level.
- **Class 2 receivers** support long physical layer protection (in the order of several 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 following service categories may be available as content in a DVB-SH system:

- common services are available in both CGC and SC;
- local service(s) may be available in CGC if its capacity extends the SC capacity, or if hierarchical modulation is used;
- regular and low latency services are available in both SC and CGC.

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 as specified in clause 4 of the present document where, in addition to these configurations, a number of features may be selected:

- Local Content Insertion
- MPE-IFEC
- Low Latency (LL) together with long interleaver
- Hierarchical Modulation
- Extended TDM Scrambling
- Unequal Bandwidths
- SH-Services

1 Scope

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

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

[2] ETSI TS 102 584: "Digital Video Broadcasting (DVB); DVB-SH Implementation Guidelines".

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

[4] ETSI TS 102 470-2: "Digital Video Broadcasting (DVB); IP Datacast: Program Specific Information (PSI)/Service Information (SI); Part 2: IP Datacast over DVB-SH".

[5] ETSI EN 301 192: "Digital Video Broadcasting (DVB); DVB specification for data broadcasting".

[6] ETSI TS 102 772: "Digital Video Broadcasting (DVB); Specification of Multi-Protocol Encapsulation - inter-burst Forward Error Correction (MPE-IFEC)".

[7] ETSI TS 102 468: "Digital Video Broadcasting (DVB); IP Datacast over DVB-H: Set of Specifications for Phase 1".

[8] ETSI TS 102 611-1: "Digital Video Broadcasting (DVB); IP Datacast: Implementation Guidelines for Mobility; Part 1: IP Datacast over DVB-H".

[9] ETSI TS 102 611-2: "Digital Video Broadcasting (DVB); IP Datacast: Implementation Guidelines for Mobility; Part 2: IP Datacast over DVB-SH".

[10] ETSI TS 102 472: "Digital Video Broadcasting (DVB); IP Datacast over DVB-H: Content Delivery Protocols".

[11] ETSI TS 102 591-1: "Digital Video Broadcasting (DVB); IP Datacast: Content Delivery Protocols (CDP) Implementation Guidelines; Part 1: IP Datacast over DVB-H".

[12] ETSI TS 102 591-2: "Digital Video Broadcasting (DVB); IP Datacast: Content Delivery Protocols (CDP) Implementation Guidelines; Part 2: IP Datacast over DVB-SH".

[13] ETSI TS 102 474: "Digital Video Broadcasting (DVB); IP Datacast over DVB-H: Service Purchase and Protection".

[14] ETSI TS 102 471: "Digital Video Broadcasting (DVB); IP Datacast over DVB-H: Electronic Service Guide (ESG)".

[15] ETSI TS 102 592-1: "Digital Video Broadcasting (DVB); IP Datacast: Electronic Service Guide (ESG) Implementation Guidelines; Part 1: IP Datacast over DVB-H".

[16] ETSI TS 102 592-2: "Digital Video Broadcasting (DVB); IP Datacast: Electronic Service Guide (ESG) Implementation Guidelines; Part 2: IP Datacast over DVB-SH".

[17] ETSI TS 102 005: "Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in DVB services delivered directly over IP Protocols".

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.

Not Applicable.

3 Definitions 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

low latency service: service interleaved with a fraction of the DVB-SH channel interleaver that has a sub-SH-frame length

regular latency service: service interleaved with the full DVB-SH channel interleaver

repeater: transmitter that delivers a DVB-SH compliant signal at its output for signal field strength amplification purposes

transmitter: equipment that receives a TS and modulates it according to DVB-SH specification

NOTE: A transmitter may be fixed or mobile.

3.2 Abbreviations

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

CGC	Complementary Ground Component
DVB-H	Digital Video Broadcasting transmission system for Handheld terminals
DVB-S2	Digital Video Broadcasting second generation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications
DVB-SH	Digital Video Broadcasting Satellite services to Handheld devices (SH) below 3 GHz
FEC	Forward Error Correction
IFEC	Inter Burst FEC
IP	Internet Protocol
LL	Low Latency
MFN	Multi Frequency Network
MPE	Multi Protocol Encapsulation
MPE-FEC	Multi Protocol Encapsulation Forward Error Correction
MRC	Maximal Ratio Combining
OFDM	Orthogonal Frequency Division Multiplexing
PSI/SI	Program Specific Information/System Information
SC	Satellite Component
SFN	Single Frequency Network
SH-A	SH system configuration A (OFDM/OFDM)

SH-B	SH system configuration B (OFDM/TDM)
SH-FRAME	Service-to-Handheld FRAME
TDM	Time Division Multiplexing
TPS	Transmission Parameters Signalling
TS	Transport Stream
xDSL	(all systems) Digital Subscriber Line

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 standard specification is composed of:

- a physical layer specified in [1];
- a link layer specified in [1], [5] and [6];
- a PSI and SI service information layer specified in [3],[4];
- an IP Datacast service information layer specified in [7], [8], [9], [10], [11], [12], [13], [14], [15], [16] and [17];
- an implementation guideline [2] where additional important information about synchronization between modulators of the CGC and SC and further information and recommendations about how to use and select the appropriate parameters of DVB-SH are provided.

4.2 DVB-SH physical layer

DVB-SH physical layer shall follow reference [1] that defines the waveform. Although reference [1] specifies the available features of the DVB-SH waveform, it is expected that various market conditions, system requirements and regulatory constraints will yield various system implementation and deployment strategies of following key features:

- 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 for OFDM transmission mode with support of hierarchical modulation (satellite and terrestrial) 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. For SH-B architecture, channelization bandwidth flexibility is also possible between satellite and terrestrial links.

NOTE 1: As a result of this radio configuration flexibility, an adequate radio planning can accommodate dedicated frequencies for local content purposes. In MFN, an additional local content insertion technique is also proposed when the difference in capacity between SC and CGC allows it.

- State-of-the-art and field-proven FEC (3GPP2 Turbo code) supporting several coding rates.
- 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 in MFN only) techniques, the latter being possible via a common frame structure shared between SC and CGC.

- 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 interleaver can be set to either a common configuration (SH-A SFN) or two specialized configurations (SH-B or SH-A MFN: one for the TDM/OFDM SC and one for the OFDM CGC).

NOTE 2: Advanced timing pre-compensation techniques enable to adequately synchronize the two links in case of different interleaver configurations.

- Low latency services can be used in parallel with a regular (long) interleaver. This enables a class 2 system to use services with low latency (similar to class 1) in parallel with the regular latency services.
- 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.
- TDM Scrambling: a set of 256 physical layer scrambling sequences allow a reduction of spectral lines in the signal spectrum, as well as a reduction of interference correlation between different services for better channel estimation at the receiver side; the set of sequences is large enough to unequivocally associate a sequence to each satellite operator or each satellite beam or satellite or transponder, thus permitting identification of an interfering signal via the scrambling "signature" detection.

4.3 DVB-SH link layer

References [1], [5] and [6] define the link layer that offers:

- Support of MPEG2 TS packets although the specification allows the introduction of a Generic Stream at a later date.
- IP datagrams shall be encapsulated using Multi-Protocol Encapsulation (MPE) as specified in reference [5], therefore supporting MPE Time Slicing power saving and handover between frequencies/coverage beams on a per elementary stream basis.

NOTE: synchronization between Elementary Streams at MPE and SH levels maintain these features even in the case of class 2 long interleavers and the same synchronization mechanism enables local and low latency content insertion as defined in clause 4.6.

- Compatibility with MPE-FEC (intra-burst FEC) as defined in reference [5] on a per elementary stream basis.
- Support of MPE-IFEC (inter-burst FEC) as defined in [6] relying on same Reed-Solomon erasure code as MPE-FEC, on a per elementary stream basis. MPE-IFEC is required to combat deep and long shadowing encountered in some satellite channels by providing additional time diversity.

4.4 DVB-SH signalling

DVB-SH control part signaling is done via a variety of means:

- at the physical layer by a combination of TPS bits (OFDM part), SH frame Initialization Packet and a Signaling Field (TDM part): they allow together the various parameters of both components to be controlled, transmitter and receiver, in particular when common operation of both different components is required in SH-B;
- at SI level, DVB-SH shall follow references [3] where signalled structures are specified (SH delivery system descriptor) and [4] where usage of these structures are explicated;
- at the service level, the use of MPE-IFEC shall be announced using the structures specified in [5] and [6]. Usage of these structures are explicated in [2].

4.5 DVB-SH IP Datacast

DVB-SH benefits from and is fully compliant with IP datacast protocols suite as defined in references [7], [8], [9], [10], [11], [12], [13], [14], [15], [16] and [17].

4.6 Synchronization

When a separate channel from the satellite channel is used for terrestrial use (relevant for SH-A-MFN and SH-B), the satellite signal may be repeated terrestrially on that channel, requiring synchronization between both signals. For instance in SH-B, 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 A of reference [1] and explicated in [2]. Advanced pre-compensation techniques enable to align both signals even in the presence of different interleaver lengths.

When the same frequency is used to repeat terrestrially the satellite signal, 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.

In some modes (inter-burst physical FEC, local content insertion, low latency services with class 2 receivers), synchronization between service and radio layers is also achieved via the use of a SH Initialization Packet defined in reference [1].

History

Document history		
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