# Final draft ETSI EN 302 307 V1.2.1 (2009-04)

*European Standard (Telecommunications series)*

# Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2)

European Broadcasting Union    Union Européenne de Radio-Télévision

EBU·UER

Reference

REN/JTC-DVB-238

Keywords

BSS, digital, DVB, modulation, satellite, TV

***ETSI***

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
Sous-Préfecture de Grasse (06) N° 7803/88



### *Important notice*

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, please send your comment to one of the following services:
http://portal.etsi.org/chaircor/ETSI_support.asp

# Contents

# Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

# Foreword

This European Standard (Telecommunications series) 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), and is now submitted for the ETSI standards One-step Approval Procedure.

The work of the JTC was based on the studies carried out by the European DVB Project under the auspices of theAd Hoc Group on DVB-S2 of the DVB Technical Module. This joint group of industry, operators and broadcasters provided the necessary information on all relevant technical matters (see bibliography).

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.

European Broadcasting Union
CH-1218 GRAND SACONNEX (Geneva)
Switzerland
Tel: +41 22 717 21 11
Fax: +41 22 717 24 81



Founded in September 1993, the DVB Project is a market-led consortium of public and private sector organizations in the television industry. Its aim is to establish the framework for the introduction of MPEG-2 based digital television services. Now comprising over 200 organizations from more than 25 countries around the world, DVB fosters market-led systems, which meet the real needs, and economic circumstances, of the consumer electronics and the broadcast industry.

| Proposed national transposition dates | |
|---|---|
| Date of latest announcement of this EN (doa): | 3 months after ETSI publication |
| Date of latest publication of new National Standard or endorsement of this EN (dop/e): | 6 months after doa |
| Date of withdrawal of any conflicting National Standard (dow): | 6 months after doa |

# 1 Scope

DVB-S (EN 300 421 [2]) was introduced as a standard in 1994 and DVB-DSNG (EN 301 210 [3]) in 1997. The DVB-S standard specifies QPSK modulation and concatenated convolutional and Reed-Solomon channel coding, and is now used by most satellite operators worldwide for television and data broadcasting services. DVB-DSNG specifies, in addition to DVB-S format, the use of 8PSK and 16QAM modulation for satellite news gathering and contribution services.

Since 1997, digital satellite transmission technology has evolved somewhat:

- New channel coding schemes, combined with higher order modulation, promise more powerful alternatives to the DVB-S/DVB-DSNG coding and modulation schemes. The result is a capacity gain in the order of 30 % at a given transponder bandwidth and transmitted EIRP, depending on the modulation type and code rate.
- Variable Coding and Modulation (VCM) may be applied to provide different levels of error protection to different service components (e.g. SDTV and HDTV, audio, multimedia).
- In the case of interactive and point-to-point applications, the VCM functionality may be combined with the use of return channels, to achieve Adaptive Coding and Modulation (ACM). This technique provides more exact channel protection and dynamic link adaptation to propagation conditions, targeting each individual receiving terminal. ACM systems promise satellite capacity gains of up to 100 % - 200 %. In addition, service availability may be extended compared to a constant protection system (CCM) such as DVB-S or DVB-DSNG. Such gains are achieved by informing the satellite up-link station of the channel condition (e.g. C/N+I) of each receiving terminal via the satellite or terrestrial return channels.
- DVB-S and DVB-DSNG are strictly focused on a unique data format, the MPEG Transport Stream (ISO/IEC 13818-1 [1] or a reference to it). Extended flexibility to cope with other input data formats (such as multiple Transport Streams, or generic data formats) is now possible without significant complexity increase.



The present document defines a "second generation" modulation and channel coding system (denoted the "System" or "DVB-S2" for the purposes of the present document) to make use of the improvements listed above. DVB-S2 is a single, very flexible standard, covering a variety of applications by satellite, as described below. It is characterized by:

- a flexible input stream adapter, suitable for operation with single and multiple input streams of various formats (packetized or continuous);
- a powerful FEC system based on LDPC (Low-Density Parity Check) codes concatenated with BCH codes, allowing Quasi-Error-Free operation at about 0,7 dB to 1 dB from the Shannon limit, depending on the transmission mode (AWGN channel, modulation constrained Shannon limit);
- a wide range of code rates (from 1/4 up to 9/10); 4 constellations, ranging in spectrum efficiency from 2 bit/s/Hz to 5 bit/s/Hz, optimized for operation over non-linear transponders;
- a set of three spectrum shapes with roll-off factors 0,35, 0,25 and 0,20;
- Adaptive Coding and Modulation (ACM) functionality, optimizing channel coding and modulation on a frame-by-frame basis.

The System has been optimized for the following **broadband satellite applications:**

**Broadcast Services (BS) Digital multi-programme Television (TV)/High Definition Television (HDTV)**

Broadcasting services to be used for primary and secondary distribution in the Fixed Satellite Service (FSS) and the Broadcast Satellite Service (BSS) bands.

DVB-S2 is intended to provide Direct-To-Home (DTH) services for consumer Integrated Receiver Decoder (IRD), as well as collective antenna systems (Satellite Master Antenna Television - SMATV) and cable television head-end stations (possibly with remodulation, see EN 300 429 [5]). DVB-S2 may be considered a successor to the current DVB-S standard EN 300 421 [2], and may be introduced for new services and allow for a long-term migration. BS services are transported in MPEG Transport Stream format. VCM may be applied on multiple transport stream to achieve a differentiated error protection for different services (TV, HDTV, audio, multimedia). Two modes are available:

- **NBC-BS** (Non Backwards Compatible Broadcast Services) is not backwards-compatible with EN 300 421 [2].
- **BC-BS** (Backwards-Compatible Broadcast Services) is backwards-compatible to EN 300 421 [2] (see annex F).

In fact, with a large number of DVB-S receivers already installed, backwards compatibility may be required for a period of time, where old receivers continue to receive the same capacity as before, while the new DVB-S2 receivers could receive additional capacity broadcasts. When the complete receiver population has migrated to DVB-S2, the transmitted signal can be modified to a non-backward compatible mode, thus exploiting the full potential of DVB-S2. To facilitate the reception of DVB-S services by DVB-S2 receivers, implementation of DVB-S in DVB-S2 chips is highly recommended.

**Interactive Services (IS) Interactive data services including Internet access**

DVB-S2 is intended to provide interactive services to consumer IRDs and to personal computers, where DVB-S2's forward path supersedes the current DVB-S standard EN 300 421 [2] for interactive systems. The return path can be implemented using various DVB interactive systems, such as DVB-RCS (EN 301 790 [6]), DVB-RCP (ETS 300 801 [7]), DVB-RCG (EN 301 195 [8]), DVB-RCC (ES 200 800 [9]). Data services are transported in (single or multiple) Transport Stream format according to EN 301 192 [4] (e.g. using Multiprotocol Encapsulation), or in (single or multiple) generic stream format. DVB-S2 can provide Constant Coding and Modulation (CCM), or Adaptive Coding and Modulation (ACM), where each individual satellite receiving station controls the protection mode of the traffic addressed to it. Input Stream Adaptation for ACM is specified in annex D.

**Digital TV Contribution and Satellite News Gathering (DTVC/DSNG)**



Digital television contribution applications by satellite consist of point-to-point or point-to-multipoint transmissions, connecting fixed or transportable uplink and receiving stations. They are not intended for reception by the general public. According to ITU-R Recommendation SNG.770-1 [10], SNG is defined as "Temporary and occasional transmission with short notice of television or sound for broadcasting purposes, using highly portable or transportable uplink earth stations ...". Services are transported in single (or multiple) MPEG Transport Stream format. DVB-S2 can provide Constant Coding and Modulation (CCM), or Adaptive Coding and Modulation (ACM). In this latter case, a single satellite receiving station typically controls the protection mode of the full multiplex. Input Stream Adaptation for ACM is specified in annex D.

**Data content distribution/trunking and other professional applications (PS)**

These services are mainly point-to-point or point-to-multipoint, including interactive services to professional head-ends, which re-distribute services over other media. Services may be transported in (single or multiple) generic stream format. The system can provide Constant Coding and Modulation (CCM), Variable Coding and Modulation (VCM) or Adaptive Coding and Modulation (ACM). In this latter case, a single satellite receiving station typically controls the protection mode of the full TDM multiplex, or multiple receiving stations control the protection mode of the traffic addressed to each one. In either case, interactive or non-interactive, the present document is only concerned with the forward broadband channel.

DVB-S2 is suitable for use on different satellite transponder bandwidths and frequency bands. The symbol rate is matched to given transponder characteristics, and, in the case of multiple carriers per transponder (FDM), to the frequency plan adopted. Examples of possible DVB-S2 use are given in clause H.1.

Digital transmissions via satellite are affected by power and bandwidth limitations. Therefore DVB-S2 provides for many transmission modes (FEC coding and modulations), giving different trade-offs between power and spectrum efficiency (see clause H.1). For some specific applications (e.g. broadcasting) modes such as QPSK and 8PSK, with their quasi-constant envelope, are appropriate for operation with saturated satellite power amplifiers (in single carrier per transponder configuration). When higher power margins are available, spectrum efficiency can be further increased to reduce bit delivery cost. In these cases also 16APSK and 32APSK can operate in single carrier mode close to the satellite HPA saturation by pre-distortion techniques. All the modes are appropriate for operation in quasi-linear satellite channels, in multi-carrier Frequency Division Multiplex (FDM) type applications.

DVB-S2 is compatible with Moving Pictures Experts Group (MPEG-2 and MPEG-4) coded TV services (see ISO/IEC 13818-1 [1]), with a Transport Stream packet multiplex. Multiplex flexibility allows the use of the transmission capacity for a variety of TV service configurations, including sound and data services. All service components are Time Division Multiplexed (TDM) on a single digital carrier.

The present document:

- gives a general description of the DVB-S2 system;
- specifies the digitally modulated signal in order to allow compatibility between pieces of equipment developed by different manufacturers. This is achieved by describing in detail the signal processing principles at the modulator side, while the processing at the receive side is left open to different implementation solutions. However, it is necessary in the present document to refer to certain aspects of reception;
- identifies the global performance requirements and features of the System, in order to meet the service quality targets.

# 2 References

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.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

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 indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] ISO/IEC 13818 (parts 1 and 2): "Information technology - Generic coding of moving pictures and associated audio information".

[2] ETSI EN 300 421 (V.1.1.2): "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services".

[3] ETSI EN 301 210: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for Digital Satellite News Gathering (DSNG) and other contribution applications by satellite".

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

[5] ETSI EN 300 429: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems".

[6] ETSI EN 301 790: "Digital Video Broadcasting (DVB); Interaction channel for satellite distribution systems".

[7] ETSI ETS 300 801: "Digital Video Broadcasting (DVB); Interaction channel through Public Switched Telecommunications Network (PSTN)/ Integrated Services Digital Networks (ISDN)".

[8] ETSI EN 301 195: "Digital Video Broadcasting (DVB); Interaction channel through the Global System for Mobile communications (GSM)".

[9] ETSI ES 200 800: "Digital Video Broadcasting (DVB); DVB interaction channel for Cable TV distribution systems (CATV)".

[10] ITU-R Recommendation SNG.770-1: "Uniform operational procedures for satellite news gathering (SNG)".

[11] ETSI ETS 300 802: "Digital Video Broadcasting (DVB); Network-independent protocols for DVB interactive services".

## 2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] 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".

[i.2] ETSI EN 300 744: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television".

[i.3] ETSI TR 101 154: "Digital Video Broadcasting (DVB); Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial broadcasting applications".

[i.4] ETSI TR 101 162: "Digital Video Broadcasting (DVB); Allocation of Service Information (SI) codes for DVB systems".



# 3 Symbols and abbreviations

## 3.1 Symbols

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

| | |
|---|---|
| α | Roll-off factor |
| γ | Ratio between constellation radii for 16APSK and 32APSK |
| c | codeword |
| C/N | Carrier-to-noise power ratio (N measured in a bandwidth equal to symbol rate) |
| C/N+I | Carrier-to-(Noise+Interference) ratio |
| $d_{n_{bch}-k_{bch}-1}, d_{n_{bch}-k_{bch}-2}, \ldots, d_1, d_0$ | BCH code redundancy bits |
| d(x) | BCH code remainder of the division between the generator polynomial and $x^{n_{bch}-k_{bch}}\ m(x)$ |
| DFL | Data Field Length |
| dmin | LDPC code minimum distance |
| $E_b/N_0$ | Ratio between the energy per information bit and single sided noise power spectral density |
| $E_s/N_0$ | Ratio between the energy per transmitted symbol and single sided noise power spectral density |
| $f_N$ | Nyquist frequency |
| $f_0$ | Carrier frequency |
| G | PLS code generator matrix |
| g(x) | code generator polynomial |

| | |
|---|---|
| $g_1(x), g_2(x), \ldots, g_{12}(x)$ | polynomials to obtain BCH code generator polynomial |
| $\mathbf{i}$ | LDPC code information block |
| $i_0, i_1, \ldots, i_{k_{ldpc}-1}$ | LDPC code information bits |
| H(f) | RC filters frequency transfer function |
| $H_{(n-k)xn}$ | LDPC code parity check matrix |
| I, Q | In-phase, Quadrature phase components of the modulated signal |
| $K_{bch}$ | number of bits of BCH uncoded Block |
| $N_{bch}$ | number of bits of BCH coded Block |
| $k_{ldpc}$ | number of bits of LDPC uncoded Block |
| $n_{ldpc}$ | number of bits of LDPC coded Block |
| $\eta$ | PLFRAMING efficiency |
| $\eta_c$ | code efficiency |
| $\eta_{MOD}$ | number of transmitted bits per constellation symbol |
| $\eta_{tot}$ | System spectral efficiency |
| m | BCH code information word |
| m(x) | BCH code message polynomial |
| $m_{k_{bch}-1}, m_{k_{bch}-2}, \ldots, m_1, m_0$ | BCH code information bits |
| M | number of modulated symbols in SLOT |
| $p_0, p_1, \ldots p_{n_{ldpc}-k_{ldpc}-1}$ | LDPC code parity bits |
| P | number of pilot symbols in a pilot block |
| q | code rate dependant constant for LDPC codes |
| $\theta$ | deviation angle in hierarchical constellations |
| $r_m$ | In-band ripple (dB) |
| $R_s$ | Symbol rate corresponding to the bilateral Nyquist bandwidth of the modulated signal |
| $R_u$ | Useful bit rate at the DVB-S2 system input |
| S | Number of Slots in a XFECFRAME |
| $T_s$ | Symbol period |



## 3.2 Abbreviations

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

| | |
|---|---|
| 8PSK | 8-ary Phase Shift Keying |
| 16APSK | 16-ary Amplitude and Phase Shift Keying |
| 32APSK | 32-ary Amplitude and Phase Shift Keying |
| ACM | Adaptive Coding and Modulation |
| ASI | Asynchronous Serial Interface |
| AWGN | Additive White Gaussian Noise |
| BB | BaseBand |
| BC | Backwards-Compatible |

NOTE: Referred to the system allowing partial stream reception by DVB-S receivers.

| | |
|---|---|
| BCH | Bose-Chaudhuri-Hocquenghem multiple error correction binary block code |
| BER | Bit Error Ratio |
| $B_S$ | Bandwidth of the frequency Slot allocated to a service |
| BS | Broadcast Service |
| BSS | Broadcast Satellite Service |
| BW | BandWidth (at -3 dB) of the transponder |
| CBR | Constant Bit Rate |
| CCM | Constant Coding and Modulation |
| CNI | Carrier to Noise plus Interference ratio |
| CRC | Cyclic Redundancy Check |
| D | Decimal notation |
| DD | Decision Directed |

| | |
|---|---|
| DEMUX | DEMUltipleXer |
| DF | Data Field |
| DNP | Deleted Null Packets |
| DSNG | Digital Satellite News Gathering |
| DTH | Direct To Home |
| DTT | Digital Terrestrial Television |
| DVB | Digital Video Broadcasting project |
| DVB-S | DVB System for satellite broadcasting |

NOTE: As specified in EN 300 421 [2].

| | |
|---|---|
| DVB-S2 | second generation DVB System for satellite broadcasting and unicasting |

NOTE: As specified in the present document.

| | |
|---|---|
| EBU | European Broadcasting Union |
| EN | European Norm |
| FDM | Frequency Division Multiplex |
| FEC | Forward Error Correction |
| FIFO | First In First Out |
| FSS | Fixed Satellite Service |
| GF | Galois Field |
| GS | Generic Stream |
| HDTV | High Definition TeleVision |
| HEX | HEXadecimal notation |
| HP | High Priority |
| IBO | Input Back Off |
| IF | Intermediate Frequency |
| IMUX | Input MUltipleXer - filter |
| IRD | Integrated Receiver Decoder |
| IS | Interactive Services |
| ISCR | Input Stream Clock Reference |
| ISI | Input Stream Identifier |
| ISSY | Input Stream SYnchronizer |
| ISSYI | Input Stream SYnchronizer Indicator |
| ITU | International Telecommunications Union |
| LDPC | Low Density Parity Check (codes) |
| LNB | Low Noise Block |
| LP | Low Priority |
| LSB | Least Significant Bit |
| MIS | Multiple Input Stream |
| MPE | Multi-Protocol Encapsulation |
| MPEG | Moving Pictures Experts Group |
| MSB | Most Significant Bit |

NOTE: In DVB-S2 the MSB is always transmitted first.

| | |
|---|---|
| NBC | Non-Backwards-Compatible |
| MUX | MUltipleX |
| NA | Not Applicable |
| NP | Null Packets |
| NPD | Null-Packet Deletion |
| OBO | Output Back Off |
| OCT | OCTal notation |
| OMUX | Output MUltipleXer - filter |
| PER | (MPEG TS) Packet Error Rate |
| PID | Packet IDentifier |
| PL | Physical Layer |
| PLL | Phase-Locked Loop |
| PLS | Physical Layer Signalling |
| PRBS | Pseudo Random Binary Sequence |
| PS | Professional Services |
| PSK | Phase Shift Keying |

| | |
|---|---|
| QEF | Quasi-Error-Free |
| QPSK | Quaternary Phase Shift Keying |
| RF | Radio Frequency |
| RO | Roll-Off |
| SDTV | Standard Definition TeleVision |
| SIS | Single Input Stream |
| SNG | Satellite News Gathering |
| SMATV | Satellite Master Antenna TeleVision |
| SOF | Start Of Frame |
| TDM | Time Division Multiplex |
| TS | Transport Stream |
| TV | TeleVision |
| TWTA | Travelling Wave Tube Amplifier |
| UPL | User Packet Length |
| VCM | Variable Coding and Modulation |
| TSDT | Transport Stream Descriptor Table |

# 4 Transmission system description

## 4.1 System definition

The System is defined as the functional block of equipment performing the adaptation of the baseband digital signals, from the output of a single (or multiple) MPEG transport stream multiplexer(s) (ISO/IEC 13818-1 [1]), or from the output of a single (or multiple) generic data source(s), to the satellite channel characteristics. The System is designed to support source coding as defined in ISO/IEC 13818 [1], TR 101 154 [i.3] and TS 102 005 [i.1]. Data services may be transported in Transport Stream format according to EN 301 192 [4] (e.g. using Multi-protocol Encapsulation), or Generic Stream format.

If the received signal is above the C/N+I threshold, the Forward Error Correction (FEC) technique adopted in the System is designed to provide a "Quasi Error Free" (QEF) quality target. The definition of QEF adopted for DVB-S2 is "less than one uncorrected error-event per transmission hour at the level of a 5 Mbit/s single TV service decoder", approximately corresponding to a Transport Stream Packet Error Ratio PER< $10^{-7}$ before de-multiplexer.



## 4.2 System architecture

According to figure 1, the DVB-S2 System shall be composed of a sequence of functional blocks as described below.

**Mode adaptation** shall be application dependent. It shall provide input stream interfacing, Input Stream Synchronization (optional), null-packet deletion (for ACM and Transport Stream input format only), CRC-8 coding for error detection at packet level in the receiver (for packetized input streams only), merging of input streams (for Multiple Input Stream modes only) and slicing into DATA FIELDs. For Constant Coding and Modulation (CCM) and single input Transport Stream, Mode Adaptation shall consist of a "transparent" DVB-ASI (or DVB-parallel) to logical-bit conversion and CRC-8 coding. For Adaptive Coding and Modulation (ACM), Mode Adaptation shall be according to annex D.

A Base-Band Header shall be appended in front of the Data Field, to notify the receiver of the input stream format and Mode Adaptation type. To be noted that the MPEG multiplex transport packets may be asynchronously mapped to the Base-Band Frames.

For applications requiring sophisticated merging policies, in accordance with specific service requirements (e.g. Quality of Service), Mode Adaptation may optionally be performed by a separate device, respecting all the rules of the DVB-S2 specification. To allow standard interfacing between Mode and Stream Adaptation functions, an optional modulator interface (Mode adaptation input interface) is defined, according to clauses I.1 (separate signalling circuit) or I.2 (in-band signalling).

**Stream adaptation** shall be applied, to provide padding to complete a Base-Band Frame and Base-Band Scrambling.

**Forward Error Correction (FEC) Encoding** shall be carried out by the concatenation of BCH outer codes and LDPC (Low Density Parity Check) inner codes (rates 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10). Depending on the application area, the FEC coded block shall have length $n_{ldpc}$= 64 800 bits or 16 200 bits. When VCM and ACM is used, FEC and modulation mode may be changed in different frames, but remains constant within a frame. For Backwards Compatible modes, the bit-stream at the output of the FEC encoder shall be processed according to annex F. Bit interleaving shall be applied to FEC coded bits for 8PSK, 16APSK and 32APSK.

**Mapping** into QPSK, 8PSK, 16APSK and 32APSK constellations shall be applied, depending on the application area. Gray mapping of constellations shall be used for QPSK and 8PSK.

**Physical layer framing** shall be applied, synchronous with the FEC frames, to provide Dummy PLFRAME insertion, Physical Layer (PL) Signalling, pilot symbols insertion (optional) and Physical Layer Scrambling for energy dispersal. Dummy PLFRAMEs are transmitted when no useful data is ready to be sent on the channel. The System provides a regular physical layer framing structure, based on SLOTs of M = 90 modulated symbols, allowing reliable receiver synchronization on the FEC block structure. A slot is devoted to physical layer signalling, including Start-of-Frame delimitation and transmission mode definition. This mechanism is suitable also for VCM and ACM demodulator setting. Carrier recovery in the receivers may be facilitated by the introduction of a regular raster of pilot symbols (P = 36 pilot symbols every 16 SLOTs of 90 symbols), while a pilot-less transmission mode is also available, offering an additional 2,4 % useful capacity.

**Base-Band Filtering and Quadrature Modulation** shall be applied, to shape the signal spectrum (squared-root raised cosine, roll-off factors 0,35 or 0,25 or 0,20) and to generate the RF signal.

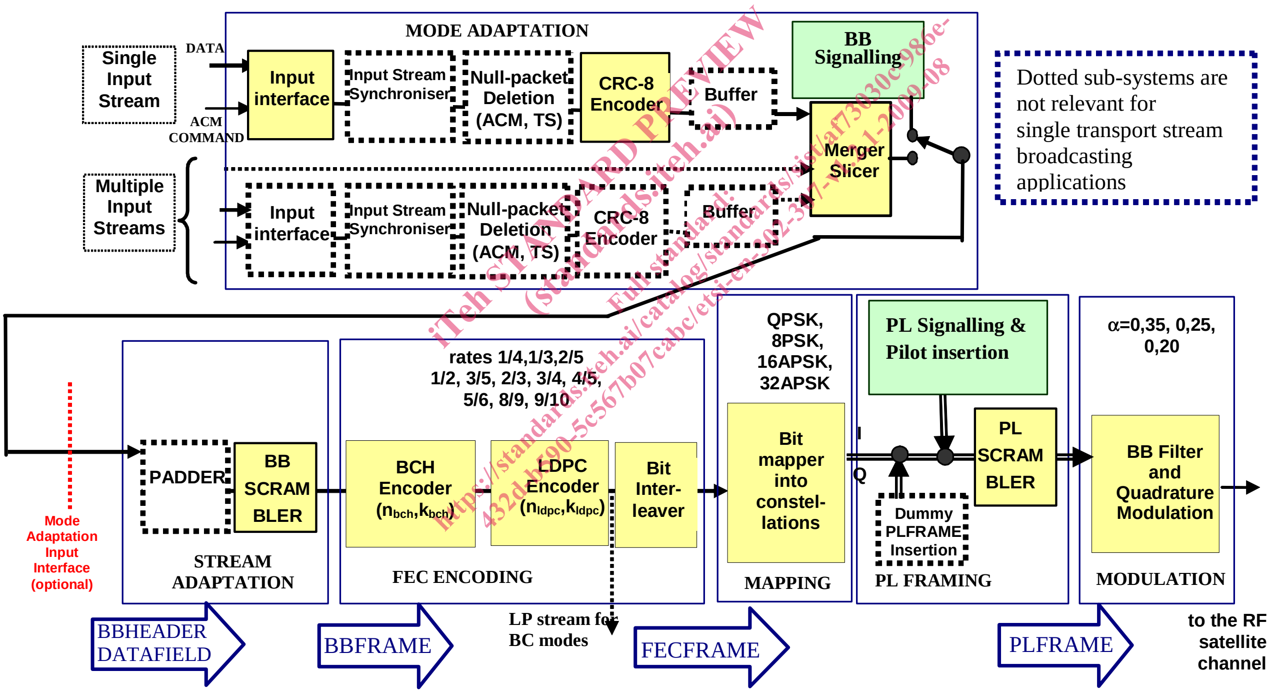



**Figure 1: Functional block diagram of the DVB-S2 System**

## 4.3 System configurations

Table 1 associates the System configurations to the applications areas. According to table 1, at least "Normative" subsystems and functionalities shall be implemented in the transmitting and receiving equipment to comply with the present document Guidelines for mode selection are given in annex H.