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Sistemi digitalne radiodifuzije za televizijske, zvokovne in podatkovne storitve – Struktura okvirov, kodiranje kanalov in modulacija za satelitske storitve na 11/12 GHz

Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services

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Digital broadcasting systems for television, sound and data services; Framing structure, channel coding and modulation for 11/12 GHz satellite services

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Foreword

This European Telecommunication Standard (ETS) has been produced under the authority of the Joint Technical Committee (JTC) of the European Broadcasting Union (EBU) and the European Telecommunications Standards Institute (ETSI).

NOTE: The EBU/ETSI JTC was established in 1990 to co-ordinate the drafting of ETSs in the specific field of radio, television and data broadcasting.

The EBU is a professional association of broadcasting organisations 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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This ETS describes framing structure, channel coding and modulation for digital television emission by satellite, it has been prepared by the Project Team PT-55V. The work of the Project Team was based on the studies carried out by European DVB Project under the auspices of the Ad hoc Group V4/MOD-B. This joint group of industry, operators and broadcasters provided the necessary information on all relevant matters to the Project Team, see DTVB 1110/GT V4/MOD 252/ DTVC 18 (bibliography).

This ETS is part of the complete "Multivision system" (the name "Multivision system" is currently under review) which covers the baseband image coding, baseband sound coding, baseband data service coding, multiplexing, channel coding and modulation for satellite services, channel coding and modulation for cable distribution and common scrambling system.

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1 Scope

This European Telecommunication Standard (ETS) describes the modulation and channel coding system (denoted the "System" for the purposes of this ETS) for satellite digital multi-programme Television (TV)/High Definition Television (HDTV) services to be used for primary and secondary distribution in Fixed Satellite Service (FSS) and Broadcast Satellite Service (BSS) bands. The System 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, with a likelihood of remodulation, see ETS 300 429 (bibliography).

The System uses Quaternary Phase Shift Keying (QPSK) modulation and concatenated error protection strategy based on a convolutional code and a shortened Reed-Solomon (RS) code.

The System is suitable for use on different satellite transponder bandwidths.

Compatibility with Moving Pictures Experts Group-2 (MPEG-2) coded TV services (see ISO/IEC DIS 13818-1 [1]), with a transmission structure synchronous with the packet multiplex, is provided. Exploitation of the 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.

This ETS:

- gives a general description of the System for satellite digital TV transmission;

- 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 this ETS 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 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ISO/IEC DIS 13818-1 (June 1994): "Coding of moving pictures and associated audio".

[2] Forney, G.D. IEEE Trans. Comm. Tech., COM-19, pp. 772-781, (October 1971): "Burst-correcting codes for the classic bursty channel".

[3] Intelsat Earth Station Standards (IESS) No. 308, revision 6 (26 October 1990): "Performance characteristics for Immediate Data Rate (IDR) digital carriers".

3 Symbols and abbreviations

3.1 Symbols

For the purposes of this ETS, the following symbols apply:

α	Roll-off factor
C/N	Signal-to-noise ratio
d_{free}	Convolutional code free distance
E_b/N_0	Ratio between the energy per useful bit and twice the noise power spectral density
f_N	Nyquist frequency
G_1,G_2	Convolutional code generators
g(x)	RS code generator polynomial
I	Interleaving depth [bytes]
I, Q	In-phase, Quadrature phase components of the modulated signal
j	Branch index of the interleaver
K	Convolutional code constraint length
M	Convolutional interleaver branch depth for j = 1, M = N/I
N	Error protected frame length (bytes)
p(x)	RS field generator polynomial
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 after MPEG-2 [1] transport multiplexer
R_u'	Bit rate after RS outer coder
T	Number of bytes which can be corrected in RS error protected packet
T_s	Symbol period
X,Y	Di-bit stream after rate 1/2 convolutional coding

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

AWGN	Additive White Gaussian Noise
BB	Baseband
BER	Bit Error Ratio
BSS	Broadcast Satellite Service
BW	Bandwidth
CCITT	International Telegraph and Telephone Consultative Committee
DTH	Direct To Home
EBU	European Broadcasting Union
ETS	European Telecommunication Standard
FDM	Frequency Division Multiplex
FEC	Forward Error Correction
FIFO	First-In, First-Out shift register
FIR	Finite Impulse Response
FSS	Fixed Satellite Service
HEX	Hexadecimal notation
HDTV	High Definition Television
IF	Intermediate Frequency
IMUX	Input Multiplexer - Filter
IRD	Integrated Receiver Decoder
ITU	International Telecommunications Union
MPEG	Moving Pictures Experts Group
MSB	Most Significant Bit
MUX	Multiplex
OBO	Output Back Off
OCT	Octal notation
OMUX	Output Multiplexer - Filter
P	Puncturing
PDH	Plesiochronous Digital Hierarchy
PSK	Phase Shift Keying

PRBS	Pseudo Random Binary Sequence
QEF	Quasi-Error-Free
QPSK	Quaternary PSK
R	Randomized sequence
RF	Radio Frequency
RS	Reed-Solomon
SMATV	Satellite Master Antenna Television
TBD	To Be Defined
TDM	Time Division Multiplex
TV	Television
TWTA	Travelling Wave Tube Amplifier

4 Transmission system

4.1 System definition

The System is defined as the functional block of equipment performing the adaptation of the baseband TV signals, from the output of the MPEG-2 transport multiplexer (see ISO/IEC DIS 13818-1 [1]), to the satellite channel characteristics. The following processes shall be applied to the data stream (see figure 1):

- transport multiplex adaptation and randomization for energy dispersal;
- outer coding (i.e. Reed-Solomon);
- convolutional interleaving;
- inner coding (i.e. punctured convolutional code);
- baseband shaping for modulation;
- modulation.

The System functional description is given in annex B.

DTH services via satellite are particularly affected by power limitations, therefore, ruggedness against noise and interference, shall be the main design objective, rather than spectrum efficiency. To achieve a very high power efficiency without excessively penalizing the spectrum efficiency, the System shall use QPSK modulation and the concatenation of convolutional and RS codes. The convolutional code is able to be configured flexibly, allowing the optimization of the system performance for a given satellite transponder bandwidth (see annex C).

Although the System is optimized for single carrier per transponder Time Division Multiplex (TDM), it is able to be used for multi-carrier Frequency Division Multiplex (FDM) type applications.

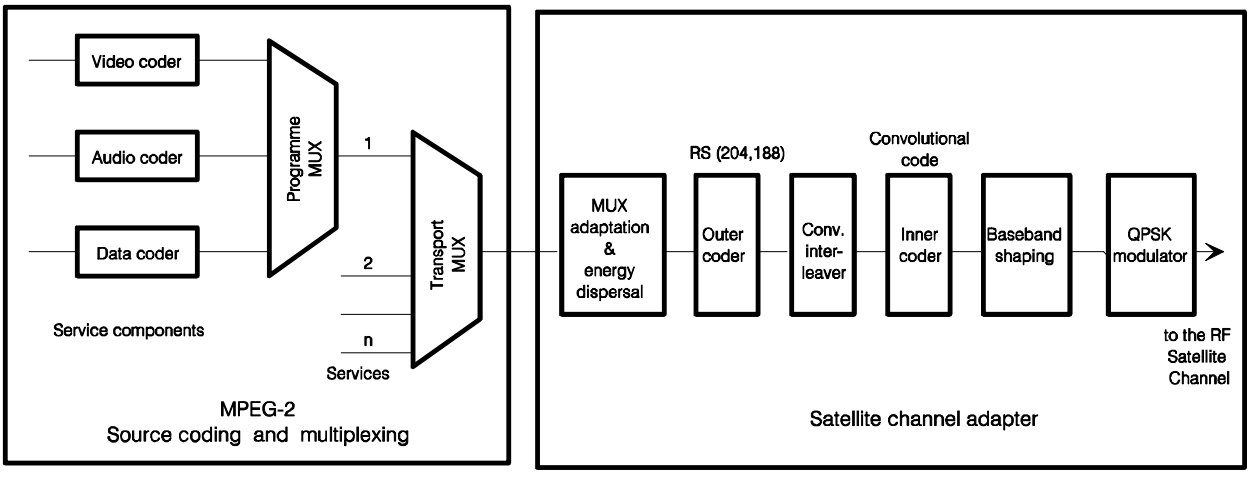

Figure 1: Functional block diagram of the System