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Sistemi digitalne radiodifuzije za televizijske, zvokovne in podatkovne storitve – Distribucijski sistemi s satelitsko televizijo prek glavne antene (SMATV)

Digital Video Broadcasting (DVB); DVB Satellite Master Antenna Television (SMATV) distribution systems

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European Broadcasting Union — Union Européenne de Radio-Télévision

Digital broadcasting systems for television, sound and data services; Satellite Master Antenna Television (SMATV) distribution systems

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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 ETS in the specific field of radio, television and data broadcasting.

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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This ETS describes the modulation, channel coding and framing structure for digital multi-programme television for distribution by Satellite Master Antenna Television (SMATV). It has been prepared by the Project Team PT-55V. The work of the Project Team was based on the studies carried out by the European Digital Video Broadcasting (DVB) Project under the auspices of Ad hoc Group for Digital Television by Cable (DTVC). An important input to the DVB project was delivered by the RACE DIGISMATV project which completed the initial phase of its study in Summer 1994.

This ETS is part of the complete "Multivision system" (this name 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 and Satellite Master Antenna Television (SMATV) distribution and common scrambling system.

Transposition dates	
Date of latest announcement of this ETS (doa):	31 August 1995
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	29 February 1996
Date of withdrawal of any conflicting National Standard (dow):	29 February 1996

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1 Scope

This European Telecommunication Standard (ETS) describes the transmission system proposal for digital multi-programme television suitable for distribution in Satellite Master Antenna Television (SMATV) systems. This ETS is complementary to the ETS 300 429 [1] and it is aligned with ETS 300 421 [2]. The System described in this ETS is compatible with the modulation and channel coding systems used for digital multi-programme television by cable and satellite transmissions (see ETS 300 429 [1] and ETS 300 421 [2], respectively). The System is based on the MPEG-2 System Layer, see ISO/IEC DIS 13818-1 [3], with the addition of appropriate Forward Error Correction (FEC) technique. The System allows for further evolution as technology advances as described in document ETS 300 429 [1] (see also bibliography in annex D) and is capable of starting a reliable service as of now.

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] ETS 300 429 (1994): "Digital broadcasting systems for television, sound and data services; Framing structure, channel coding and modulation - Cable systems".

[2] ETS 300 421 (1994): "Digital broadcasting systems for television, sound and data services; Framing structure, channel coding and modulation for 11/12 GHz satellite services".

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

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

3 Symbols and abbreviations

3.1 Symbols

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

	Roll-off factor
f_0	Channel centre frequency
R_s	Symbol rate corresponding to the bilateral Nyquist bandwidth of the modulated signal
R_u	Useful bit rate after MPEG-2 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

3.2 Abbreviations

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

BB	BaseBand
BER	Bit Error Ratio
BW	BandWidth
DTVC	Digital Television by Cable
EBU	European Broadcasting Union
ETS	European Telecommunication Standard
FEC	Forward Error Correction
IF	Intermediate Frequency
IRD	Integrated Receiver Decoder
LSB	Least Significant Bit
MPEG	Moving Pictures Experts Group
MSB	Most Significant Bit
MUX	Multiplex
PDH	Plesiochronous Digital Hierarchy
PRBS	Pseudo Random Binary Sequence
QAM	Quadrature Amplitude Modulation
QEF	Quasi Error Free
QPSK	Quaternary Phase Shift Keying
RF	Radio Frequency
RS	Reed-Solomon
SMATV	Satellite Master Antenna Television (as defined in clause 4)
SMATV-DTM	SMATV system based on Digital TransModulation
SMATV-IF	SMATV system based on distribution at IF
SMATV-S	SMATV system based on distribution at extended Super band
TDL	Tapped Delay Line
TDT	Transparent Digital Transmodulation
TDM	Time Division Multiplex
TV	Television
UHF	Ultra High Frequency
VHF	Very High Frequency

4 SMATV distribution system concepts

A Satellite Master Antenna Television (SMATV) system is defined as a system which is intended for the distribution of television and sound signals to households located in one or more adjacent buildings. These signals are received by a satellite receiving antenna and may be combined with terrestrial TV signals. SMATV distribution systems are also known as community antenna installations or domestic TV cable networks. A SMATV system represents a means for sharing the same resources among several users for satellite and terrestrial reception.

The SMATV System is designed to perform the adaptation of the satellite TV signals to the SMATV channel characteristics. The primary consideration of the SMATV System is the transparency of the SMATV head-end to the digital TV multiplex from a satellite reception without baseband interfacing, delivering that signal to the user home Integrated Receiver Decoder (IRD); thus permitting simple and cost effective head-end as required for the consumer profile of SMATV equipment.

This ETS considers two main SMATV System approaches for distribution of digital TV signals in SMATV installations, as follows:

SMATV System A: this System approach consists of the transmodulation from satellite Quaternary Phase Shift Keying (QPSK) signals as defined in ETS 300 421 [2] to a Quadrature Amplitude Modulation (QAM) scheme (16-QAM, 32-QAM or 64-QAM) using either a full implementation of the System described in ETS 300 429 [1 (see subclause 5.1), or a simplified transmodulation process as described in subclause 5.2. This process of transmodulation without baseband interfacing is also known as Transparent Transmodulation.

The use of one of the System A or System B approaches depends on the technical performance and cost trade-offs in each particular situation.

NOTE: Digital terrestrial specification is not the subject of this ETS.

5 SMATV System A

SMATV System A is based on the use of the transmodulation from satellite QPSK signals to a QAM modulation scheme (see figure 1). This system is also known as SMATV-DTM.

The System comprises the following elements:

- **Head-end transmodulation unit:** this performs the required decoding and adapts the signal modulation coding to the cable distribution network. This unit is also known as the Transparent Digital Transmodulator (TDT).

- **SMATV UHF distribution network:** this is a physical cable structure for distribution of the signal to several users. The reference channel response of SMATV distribution network is given in annex A.

- **User IRD:** this unit performs the required equalization to compensate the channel distortion as well as demodulating and decoding the QAM signal.

5.1 Full implementation of SMATV System A

A full implementation of the QAM System shall be performed according to ETS 300 429 [1] and ETS 300 421 [2] with a transparent interface between them. To this end, the full implementation of SMATV System A shall make use of the MPEG-2 transport layer, the framing structure, the channel coding, the byte-to-symbol mapping and modulation consistent with ETS 300 429 [1] and ETS 300 421 [2]. The channel coding shall include the randomization for spectrum shaping, the Reed-Solomon (RS) coding and the convolutional interleaving according to Forney [4]. This configuration is shown in figure 2.

5.2 Simplified implementation of SMATV System A

In the complete implementation architecture of SMATV System A, outer error protection (i.e. Reed-Solomon and convolutional interleaving) is performed twice, i.e. independently for the satellite link and the cable link. Therefore, the cable link is fed by a Quasi Error Free (QEF) bit stream. In cases when an adequate satellite link margin is achieved, one Reed-Solomon decoder-encoder and deinterleaving-interleaving process could be eliminated from the System. In such cases, a single RS decoder at the user IRD is capable of correcting errors generated in the cable link added to the remaining burstly errors after Viterbi decoding. This configuration is shown in figure 2 when removing the dashed line blocks.

NOTE: This simplified configuration may imply a non-negligible saving in terms of the number of gates and thus in the total equipment cost. Due to consumer type character of SMATV head-ends, this saving is important when an economy of scale is achieved. Consequently, manufacturers could decide whether to adopt the simplified SMATV System A architecture.