
Specifikacija funkcijskega sprejemnika satelitske digitalne interaktivne televizije s povratnim kanalom z nizko podatkovno hitrostjo - Specifikacija modemske plasti

Functional receiver specification of satellite digital interactive television with a low data rate return channel via satellite - Modem layer specification

Funktionale Empfängerspezifikation für digitales interaktives Satellitenfernsehen mit Rückkanal niedriger Datenrate über Satellit - Festlegungen Modemschicht

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of satellite digital interactive television
with a low data rate return channel via satellite -
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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 206, Consumer equipment for entertainment and information and related sub-systems.

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Introduction

This European Standard has been produced by CENELEC Committee TC 206 with the support of the research and development activities carried out within the SATMODE Project. The SATMODE project is part of the ARTES program of the European Space Agency (Contract No 16905/02/NL/US). More information on SATMODE project is available in Annex D.

This document provides the specification containing the essential elements necessary to facilitate the implementation of the interaction channel for interactive television networks using Geostationary Satellites with fixed return channel satellite terminals via low data rate dedicated return link.

The system is called SATMODE and consists of many terminals installed at the user-customer premises, one or several HUB stations, possibly co-located with the broadcaster or interactive service provider uplink stations, and a satellite which is transparent for uplink and downlink signals. The main application for SATMODE system is the implementation of suitable networks for interactive digital television systems requiring a return channel of low data rate.

The document facilitates the use of SATMODE system for individual or collective installation (e.g. SMATV) in a domestic environment applied to interactive digital television (iTV). It also supports the connection of such terminals with in-house data networks. The document may be applied to all frequency bands allocated to GEO satellite services. The solutions provided for interaction channel for satellite interactive networks are a part of a wide set of alternatives to implement interactive services associated to digital television systems following the DVB reference model for interactive services.

The modem layer specification included in this document (physical air interface layer and data link layer components) describes the requirements needed to establish radio communication links between the user earth stations (terminals) and the HUB earth station and between the HUB station and the user terminals.

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The Satmode System

The SATMODE design having led to the present specification was optimized for the iTV case.

The choice of constant envelope modulations was made to minimize the terminal cost. Thanks to this property, very low cost ODU's operating at full saturation and in non-linear mode can be used.

The moderate bit rates of SATMODE allow to use very low power transmitters (typically 100 mW), keeping the cost compatible with the mass-market.

The selected access scheme -slotted ALOHA- is efficient on iTV traffic and very easy to scale up to a very high number of terminals only sending a few packets from time to time.

The SATMODE modem specification aims at fully specifying the behavior SATMODE modem function used in a terminal.

To increase the applicability and the probability of commercial success of SATMODE, it was decided to design SATMODE as a system usable with existing space segments and ready for future satellites improved for point-to-point applications.

Considering this objective, it was considered as mandatory to have built-in flexibility in terminals deployed today and ready for the future.

This flexibility allows SATMODE to be used in extreme scenarios by adjusting the modem parameters:

- very power limited scenarios (it's the case for most VSAT Ku-band satellites);
- aggressive multi-beam space segment, targeting high spectral efficiency.

To reach that goal and nevertheless keep full interoperability of terminals, SATMODE uses a fully specified waveform toolbox.

Each building block has a well-defined space of operation and can be used without limitation in this space.

The building blocks of the SATMODE toolbox are

- symbol Rate: 2 kHz to 128 kHz,
- binary or quaternary CPM,
- programmable phase filter for CPM modulations (GMSK being a specific case),
- flexible Turbo or Turbo-like,
- programmable interleavers (3),
- programmable constituent codes with bypass possibilities (2),
- programmable Unique Word structure,
- tables extraction from a DVB TS (DVB-S or DVB-S2 broadcast).

All the parameters are sent by the HUB through tables, even allowing changes during operation:

- FCT: Spectrum organisation in Carrier Groups;
- FAT: Spectrum Allocation to services.

Signalisation information sent to specific terminals is embedded in the SMT tables.

The terminal is fully defined: it must be able to play the complete waveform space.

The HUB usually only implements one scheme and send the tables to the terminals to instruct them to play that scheme.

Modem Layer providers can thus compete on the modem performances, although using fully interoperable terminals.

1 Scope

This standard applies for the interaction channel for interactive television networks using Geostationary Satellites with fixed return channel satellite terminals via low data rate dedicated return link. It specifies the essential elements for the implementation of the interaction channel.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ETSI EN 300 421, *Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services*

ETSI EN 300 468, *Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems*

ETSI EN 300 802, *Digital Video Broadcasting (DVB); Network-independent protocols for DVB interactive services*

ETSI EN 301 192, *Digital Video Broadcasting (DVB); DVB specification for data broadcasting*

ETSI EN 301 459, *Satellite Earth Stations and Systems (SES); Harmonized EN for Satellite Interactive Terminals (SIT) and Satellite User Terminals (SUT) transmitting towards satellites in geostationary orbit in the 29,5 GHz to 30,0 GHz frequency bands covering essential requirements under Article 32 of the R&TTE Directive*

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ETSI EN 302 307, *Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications*

ETSI ETR 154, *Digital Video Broadcasting (DVB); Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial broadcasting applications*

EN ISO/IEC 13818-1, *Information technology - Generic coding of moving pictures and associated audio information; Part 1: Systems (ISO/IEC 13818-1)*

ETSI TR 101 202, *Digital Video Broadcasting (DVB); Implementation guidelines for Data Broadcasting*

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply:

3.1.1

forward link

satellite link carrying traffic towards the user terminals

3.1.2**return link**

satellite link carrying traffic originating from the user terminals

3.1.3**interactive Digital Television**

service based on the reception of digital television and interaction between the end user and the broadcaster or interactive service provider through a return channel

3.1.4**network**

collection of resources and services providing the SATMODE return channel, which is under the control of a single organisation (the network operator)

3.1.5**beam**

satellite network associated to a return link transponder with its associated bandwidth and geographical coverage

3.1.6**carrier group**

set of return link carriers sharing the same SATMODE physical link parameters (modulation type, symbol rate, coding rate). Different carrier groups are provided in the SATMODE network in order to cope with variable link conditions (fades)

3.1.7**class of service**

set of return link carriers that is shared by return traffic requiring the same Quality of Service

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3.2 Symbols

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For the purpose of this document, the following symbols apply:

- × multiplication;
- ≠ different than, unequal to;
- ≤ lower than or equal to;
- ≥ higher than or equal to;
- ∑ sum;
- Π interleaver.

3.3 Abbreviations

The following acronyms are used in this document:

ACRONYM	MEANING
ACPR	Adjacent Channel Power Ratio
ACK	Acknowledgment
ARQ	Automatic Repeat Request
B	Byte
BAT	Bouquet Association Table
bd	baud
BER	Bit Error Rate
BSS	Broadcast Satellite Service
CC	Convolutional Encoding
CENELEC	European Committee for Electrotechnical Standardization
CG	Carrier Group
COS	Class of Service
CPM	Continuous Phase Modulation
CRC	Cyclic Redundancy Check
DL	Downlink
DMT	Download Messaging Table
DSM-CC	Digital Storage Media - Command and Control
DTH	Direct-To-Home
DVB	Digital Video Broadcast
DVB-S	Digital Video Broadcast by Satellite
EIRP	Effective isotropic radiated power
EIT	Event Information Table
EN	European Norm
EOM	End Of Message
ESA	European Space Agency
ETS	European Telecommunications Standard
ETSI	European Telecommunications Standards Institute
FAT	Frequency Allocation Table
FCT	Frequency Composition Table
FSS	Fixed Services by Satellite
GEO	Geostationary Earth Orbit
GMSK	Gaussian Minimum Shift Keying.
GT	Guard Time
G/T	Gain to Temperature
HUB	SATMODE modem hub

IEC	International Electrotechnical Commission
IF	Intermediate Frequency
IIM	Interactive Interface Module
iLNB	Interactive LNB
IPR	Intellectual Property Rights
iSTB	Interactive set top box
ITT	Invitation to Tender
ITU	International Telecommunication Union
iTV	Interactive Digital Television
LFSR	Linear Feedback Shift Register
LLC	Link Layer Control
LNB	Low Noise Block Converter
LSB	Less Significant Bit
MAC	Medium Access Control
MF-TDMA	Multiple Frequency-Time Division Multiple Access
MPEG	Moving Pictures Expert Group
MSB	Most Significant bit
MTU	Maximum Transmissible Unit
NCR	Network Clock Reference
NIM	Network Interface Module
NIT	Network Information Table
NIU	Network Interface Unit
OSI	Open Systems Interconnection
PAT	Program Association Table
pc	Per cent
PCCC	Parallel Concatenated Convolutional Coding
PDU	Protocol Data Unit
PID	Packet Identifier
PISO	Parallel in serial out block
PMT	Program Mapping Table
PRBS	Pseudo Random Binary Sequence
PSI	Program Specific Information
QPSK	Quaternary Phase Shift Keying
QRCC	Quaternary Ring Convolutional Coding
RTF	Reply To Field
S-ALOHA	Slotted-ALOHA
SAR	Segmentation and Reassembly
SCCC	Serial Concatenated Convolutional Coding
SDT	Service Description Table

SI	Service Information
SIT	Satellite Interactive Terminal
SIPO	Serial in parallel out block
SMATV	Satellite Master Antenna Television
SMT	Signalling message table
STB	Set Top Box
SUT	Satellite User Terminal
SUT	Software Update Table
TDMA	Time Division Multiplex Access
UL	Uplink
UW	Unique Word

3.4 Reference Model for Satellite Interactive Networks

3.4.1 Protocol Stack Model

For interactive services supporting broadcast to the end user with return channel, a simple communications model consists of the following layers:

- **physical layer:** where all the physical (electrical) transmission parameters are defined;
- **transport layer:** defines all the relevant data structures and communication protocols like data containers, etc.;
- **application layer:** is the interactive application software and runtime environment (e.g. home shopping application, script interpreter, etc.).

A simplified model of the OSI layers was adopted to facilitate the production of specifications for these layers. Figure 1 points out the lower layers of the simplified model and identifies some of the key parameters for the lower two layers.

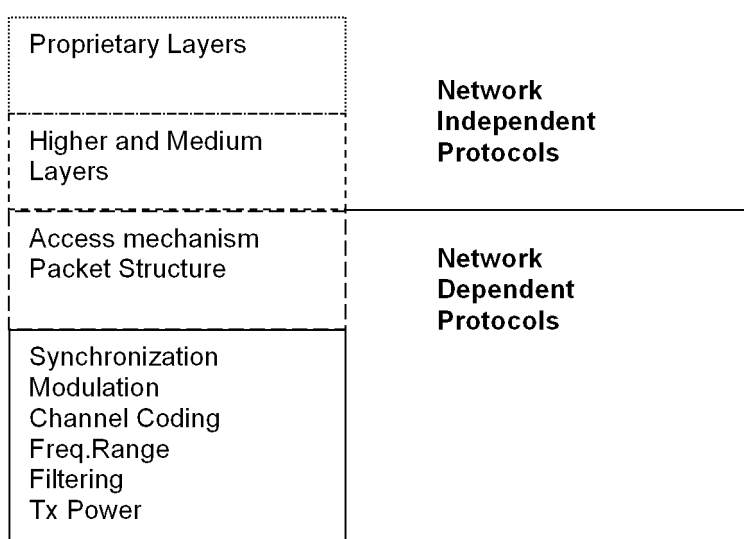


Figure 1 – Layer structure for generic system reference model