



ROHDE & SCHWARZ

BROADCASTING DIVISION

APPLICATION NOTE

**The most common abbreviations
used in the standards for digital TV:
MPEG2, DVB and ATSC**

Products:

MPEG2 DTV RECORDER GENERATOR

MPEG2 MEASUREMENT GENERATOR

MPEG2 REAL TIME MONITOR

MPEG2 MEASUREMENT DECODER

QAM TEST RECEIVER/DEMODULATOR

TV TEST TRANSMITTER

DVRG

DVG

DVRM

DVMD

EFA

SFQ

The most common abbreviations used in the standards for digital TV: MPEG2, DVB and ATSC

The introduction of the transmission of compressed TV signals to MPEG2 and DVB for cable, satellite and terrestrial (COFDM) lead to the creation of many abbreviations that have to be explained to the “uninitiated”. In the previous three lines, three abbreviations whose meanings are not obvious have already been mentioned. A table explaining what these abbreviations mean is therefore essential.

1 MPEG2 Abbreviations

Adaptation Field	Ancillary program data (especially PCR) which are uncoded and are transmitted at least every 100ms acc. to MPEG2 or 40 ms acc. to DVB specifications	DFD	Displaced Frame Difference Differential picture if there is motion
BAT	Bouquet Association Table Table describing a bouquet of programs offered by a broadcaster	DPCM	Differential Pulse Code Modulation
Block	8x8 pixel block, <i>MPEG2</i> coded	DTS	Decoding Time Stamp Stamp for decoding time, only transmitted if not identical with PTS; reference to PID
CA	Conditional Access Information of whether the program is scrambled	EIT	Event Information Table TV guide
CAT	Conditional Access Table (PID=1): Reference to scrambled programs	ES	Elementary Stream Compressed data stream for video, audio or data. Preliminary stage to PES
CIF	Common Intermediate Format Picture format	GOP	Group of Pictures I, P, and B pictures Intra-coded pictures (I), predicted pictures (P) and bi-directional prediction pictures (B)
CRC	Cyclic Redundancy Check	IRD	Integrated Receiver Decoder Receiver with (MPEG) decoder
DCT	Discrete Cosine Transform	MPEG	Motion Picture Experts Group sometimes called Moving Picture Experts Group
DCT⁻¹ / IDCT	Inverse Discrete Cosine Transform	MUSICAM	Masking Pattern Adapted Universal Subband Integrated Coding and Multiplexing Compression method for audio coding

NIT	Network Information Table Information about orbit, transponder etc.	PTS	Presentation Time Stamp Time stamp for vision and sound, transmitted at least every 0.7 sec. Integrated into PES
PAT	Program Association Table (PID=0): List of all the programs contained in TS Multiplex with reference to PID of PMT	Q	Quantization
Pay Load	Useful data in TS	Q⁻¹	Inverse quantization
PCM	Pulse Code Modulation	QS	Quantization scaling
PCR	Program Clock Reference Reference in TS for the 27-MHz clock recovery. Transmitted at least every 0.1 sec	RLC	Run Length Coding Coding of data with different number of bits. Frequently reoccurring data has the smallest number of bits, data seldom reoccurring have the highest number of bits.
PES	Packetized Elementary Stream Video and audio data packets and ancillary data of definable length	RST	Running Status Table Accurate and fast adaptation to a new program run if time changes occur in the schedule
PES Header	Ancillary data for an elementary stream	Section	A table is subdivided into several sections. If there is a change, only the section affected is transmitted
PID	Packet Identification Identification of programs in the transport stream	SI	Service Information All the data required by the receiver to demultiplex and decode the various programs in the TS
PMT	Program Map Table: Reference to packets with PCR Name of programs, copyright, reference of the data streams with PIDs etc. belonging to the relevant program	SIF	Source Input Format
Prediction	Prediction of a picture (P or B) with indication of a motion vector	SCR	System Clock Reference Reference in ES for synchronizing the system demultiplex clock in the receiver, transmitted at least every 0.7 sec. Integrated into PES
Profile	Subdivision of video coding into different resolutions	SDT	Service Description Table Description of programs offered
PS	Program Stream Multiplex of several audio and video PES using the same clock.	STC	System Time Clock 27-MHz clock, regenerated from PCR for a jitter-free readout of MPEG data
PSI	Program Specific Information Data transmitted in TS for the demultiplexer in the receiver (eg PAT, PMT, CAT)		

SYNC(_byte)	Synchronization byte in TS header value 0x47	UTC	Universal Time, Co-ordinated Greenwich meantime
TS	Transport Stream	VBR	Variable Bit Rate
TS Header	The first 4 bytes of each TS packet contain the data (PID) required for the demultiplexer in addition to the sync byte (0x47). These bytes are never scrambled.	VLC	Variable Length Coding Coding of data with variable number of bits (also see <i>RLC</i>)
TDT	Time and Date table UTC time and date	ZigZag Scan	Zigzag scan of quantized <i>DCT</i> coefficient matrix. This gives an efficient run length coding (<i>RLC</i>)
TOT	Time Offset Table UTC time and date with indication of local time offset		

2 DVB and ATSC Abbreviations

ADSL **Asymmetric digital subscriber line**

A *COFDM-coded* digital data stream with a rate up to 8 Mbit/s (down stream) and 1 Mbit/s (up stream) is transmitted via telephone lines, mainly for video on demand.

ATSC **Advanced Television Systems Committee**
american standardization group for digital terrestrial transmission

CNR **Carrier to Noise Ratio**
Indicates how far the noise level is down on carrier level

COFDM **Coded Orthogonal Frequency Domain Multiplex**
Up to 6817 single carriers 1.116 kHz apart are QAM-modulated with up to 64 states.
"Coded" means that the data to be modulated has error control.
Orthogonality means that the spectra of the individual carriers do (almost) not influence each other as a spectral maximum always coincides with a spectrum zero of the adjacent carriers.
A *single-frequency network* is used for the actual transmission.

Constellation Diagram

Way of representing the I and Q components for *QAM* or *QPSK* modulation. The position of the points in the constellation diagram provides information about distortions in the *QAM* or *QPSK* modulator as well as about distortions after the transmission of digitally coded signals.

DVB **Digital Video Broadcasting**
Broadcasting TV signals to a digital standard

DVB-C **Digital Video Broadcasting-Cable**

Broadcasting TV signals to a digital standard by cable

DVB-S **Digital Video Broadcasting-Satellite**

Broadcasting TV signals to digital standard via satellite

DVB-T **Digital Video Broadcasting-Terrestrial**

Terrestrial broadcasting of TV signals to digital standard

Convolutional Coding

The data stream to be transmitted via satellite and terrestrial (*DVB-S*, *DVB-T*) is loaded bit by bit into shift registers. The data which is split and delayed as it is shifted through different registers is combined in several paths. This means that double the data rate (2 paths) is usually obtained. Puncturing follows to reduce the data rate: the time sequence of the bits is predefined by this coding and is represented by the *trellis diagram*.

FEC **Forward Error Correction**
Error control bits added to useful data in the *QAM/QPSK* modulator for *DVB-C*, *-S* and *DVB-T*.

Single-frequency network

Transmitter network in which all the transmitters use the same frequency. The coverage areas overlap. Influence of echoes are minimized by *guard intervals*. The transmitters are separated by up to 60 km. The special feature of these networks is efficient frequency utilization

Guard interval additional safety margin between two transmitted sym-

bols in the *COFDM* standard. The guard interval ensures that echoes occurring in the single-frequency network are eliminated until the received symbol is processed.

Interleaver The *RS*-protected transport packets are reshuffled byte by byte by the 12-channel interleaver. (RS FEC Reed Solomon FEC) Due to this reshuffle what were neighbouring bytes are now separated by a maximum of 2244 bytes from other TS packets. The purpose of this is the burst error control for defective data blocks

Mapping Conversion of bytes (8 bits) to 2n-bit wide symbols. n is thus the bit width for the I and Q quantization; eg at 64 QAM the symbol width is 2n = 6 bit, n = 3, ie I and Q are subdivided into $2^3 = 8$ amplitude values each

Puncturing *Puncturing (DVB-S and -T)* follows to reduce the increased data rate after convolutional coding: Various registers are not used. The additional redundancy is used for error control. The two data streams after puncturing are directly applied as I and Q input signals to the QAM or QPSK modulator after filtering to fulfil the first Nyquist criterion.

QAM **Quadrature Amplitude Modulation**
Type of modulation for digital signals (*DVB-C and -T*). Two signal components I and Q are each quantized and modulated onto two orthogonal carriers as appropriate for the QAM level (4, 16, 32, 64, 128, 256). The *constellation diagram* is obtained by plotting the signal components with I and Q as the coordinate axes. Therefore, 2, 4, 5, 6, 7 or 8

bits of a data stream are transmitted with one symbol, depending on the QAM level (4, 16, 32, 64, 128, 256). This type of modulation is used in cable systems and for coding the *COFDM* single carriers

QEF

Quasi Error Free

Less than one uncorrected error per hour at the input of the *MPEG2* decoder. (BER $\leq 10^{-11}$)

QPSK

Quadrature Phase Shift Keying

Type of modulation for digital signals (*DVB-S and -T*). The digital, serial signal components I and Q directly control phase shift keying. The *constellation diagram* with its four discrete states is obtained by representing the signal components using the I and Q signals as coordinate axes. Due to the high nonlinear distortion in the satellite channel, this type of modulation is used for satellite transmission: The 4 discrete states all have the same amplitude that is why non-linear amplitude distortions have no effect.

RS Protection Code RS(204,188,8)

(RS = Reed Solomon)
16-byte long error control code added to every transport packet consisting of 187 (scrambled) bytes +1 syncbyte with the following result: The packet has a length of 204 bytes and the decoder can correct up to T = 8 errored bytes. This code ensures a residual Bit Error ratio BER of approx. 1×10^{-11} at an input error ratio of 2×10^{-4} .

SFN **Single Frequency Network**

searched for through the *trellis diagram* and incorrectly transmitted bits are corrected.

Trellis Diagram

The time sequence of the bits (*DVB-S and -T*) is predefined by convolutional coding and, like the state diagram of a finite automaton, is represented as a trellis diagram.

Viterbi Decoding

Viterbi decoding makes use of the predefined time sequence of the bits through convolutional coding (*DVB-S and -T*). Thanks to a series of logic decisions, the most probably correct way is

n VSB Modulation

Transmission of n discrete amplitude values using the vestigial sideband method on normal terrestrial (*ATSC*) channels and conventional IF modulators. The most common variant is 8-VSB transmission already tested in the US. With 8 VSB, 3 bits ($2^3 = 8$) of the data stream are transmitted per amplitude value

3. ATSC Tables and Protocols

ATSC **Advanced Television Systems Committee**
american standardization group for digital terrestrial transmission

CAT **Conditional Access Table**
(*PID=1*):
Reference to scrambled programs
Table ID 0x01

CVCT **Cable Virtual Channel Table**
Table ID 0xC9

EIT **Event Information Table**
Table ID 0xCB

ETT **Extended Text Table**
Table ID 0xCC

ETM **Extended Text Message**

MGT **Master Guide Table**
Table ID 0xC7

PAT **Program Association Table** (*PID=0*):
List of all the programs contained in TS Multiplex with reference to PID of PMT
Table ID 0x00

PIT **Program Identification Table**

PMT

TS Program Map Table:

Reference to packets with PCR
Name of programs, copyright, reference of the data streams with PIDs etc. belonging to the relevant program
Table ID 0x02

PSIP

Program and System Information Protocol

PTC

Physical Transmission Channel

RRT

Rating Region Table

Table ID 0xCA

SI

System Information

STT

System Time Table

Table ID 0xCD

TVCT

Terrestrial Virtual Channel Table, Table ID 0xC8

8 VSB

Vestigial Side Band Modulation

digital terrestrial broadcast mode

16 VSB

Vestigial Side Band Modulation

High Data Rate mode especially for Cable Systems

4 The Digital TV System

The transmission of digitized vision and sound together with different ancillary data is subdivided into precisely defined areas.

The first area is the *MPEG2* level

In the coder this comprises

- video compression,
- sound compression,
- processing of *all* ancillary data (including SI (see page 3), teletext etc.),
- *PES* generation,
- *TS* generation,
- *TS* multiplexing ,

or the inverse functions in the decoder.

The output of the *MPEG2* block is the output of the *TS* multiplexer.

The second area consists of transmission levels *DVB - C*, *DVB - S*, *DVB - T*

At the transmitter end this comprises

- energy dispersal (scrambler) and the sync inverter in the 8-sync sequence,
- Reed Solomon error-control coder,
- interleaver,
- convolutional coding and puncturing (*DVB - S*),
- symbol mapping (*DVB - C*),
- modulation in *QAM* (*DVB - C*, *DVB - T* in *COFDM*), *QPSK* (*DVB - S*) or *8 VSB* (*DVB - T*),

or the inverse functions in the receiver.

The input of the transmission block is the output of the *TS* multiplexer.