APPLICATION NOTE

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

Products:

MPEG2 DTV RECORDER GENERATOR  DVRG
MPEG2 MEASUREMENT GENERATOR  DVG
MPEG2 REAL TIME MONITOR  DVRM
MPEG2 MEASUREMENT DECODER  DVMD
QAM TEST RECEIVER/DEMODULATOR  EFA
TV TEST TRANSMITTER  SFQ

7BM27_0E
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

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptation Field</td>
<td>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</td>
</tr>
<tr>
<td>BAT</td>
<td>Bouquet Association Table: Table describing a bouquet of programs offered by a broadcaster</td>
</tr>
<tr>
<td>Block</td>
<td>8x8 pixel block, MPEG2 coded</td>
</tr>
<tr>
<td>CA</td>
<td>Conditional Access: Information of whether the program is scrambled</td>
</tr>
<tr>
<td>CAT</td>
<td>Conditional Access Table ((P/I=1)): Reference to scrambled programs</td>
</tr>
<tr>
<td>CIF</td>
<td>Common Intermediate Format: Picture format</td>
</tr>
<tr>
<td>CRC</td>
<td>Cyclic Redundancy Check</td>
</tr>
<tr>
<td>DCT</td>
<td>Discrete Cosine Transform</td>
</tr>
<tr>
<td>DCT(^{-1})/IDCT</td>
<td>Inverse Discrete Cosine Transform</td>
</tr>
<tr>
<td>DFD</td>
<td>Displaced Frame Difference: Differential picture if there is motion</td>
</tr>
<tr>
<td>DPCM</td>
<td>Differential Pulse Code Modulation</td>
</tr>
<tr>
<td>DTS</td>
<td>Decoding Time Stamp: Stamp for decoding time, only transmitted if not identical with PTS; reference to PID</td>
</tr>
<tr>
<td>EIT</td>
<td>Event Information Table: TV guide</td>
</tr>
<tr>
<td>ES</td>
<td>Elementary Stream: Compressed data stream for video, audio or data. Preliminary stage to PES</td>
</tr>
<tr>
<td>GOP</td>
<td>Group of Pictures</td>
</tr>
<tr>
<td>I, P, and B pictures</td>
<td>Intra-coded pictures (I), predicted pictures (P) and bi-directional prediction pictures (B)</td>
</tr>
<tr>
<td>IRD</td>
<td>Integrated Receiver Decoder: Receiver with (MPEG) decoder</td>
</tr>
<tr>
<td>MPEG</td>
<td>Motion Picture Experts Group: sometimes called Moving Picture Experts Group</td>
</tr>
<tr>
<td>MUSICAM</td>
<td>Masking Pattern Adapted Universal Subband Intergrated Coding and Multiplexing: Compression method for audio coding</td>
</tr>
<tr>
<td><strong>NIT</strong></td>
<td><strong>Network Information Table</strong></td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td><strong>PAT</strong></td>
<td><strong>Program Association Table</strong> (PID=0):</td>
</tr>
<tr>
<td><strong>PCM</strong></td>
<td><strong>Pulse Code Modulation</strong></td>
</tr>
<tr>
<td><strong>PCR</strong></td>
<td><strong>Program Clock Reference</strong></td>
</tr>
<tr>
<td><strong>PES</strong></td>
<td><strong>Packetized Elementary Stream</strong></td>
</tr>
<tr>
<td><strong>PES Header</strong></td>
<td>Ancillary data for an elementary stream</td>
</tr>
<tr>
<td><strong>PID</strong></td>
<td><strong>Packet Identification</strong></td>
</tr>
<tr>
<td><strong>PMT</strong></td>
<td><strong>Program Map Table:</strong></td>
</tr>
<tr>
<td><strong>Prediction</strong></td>
<td>Prediction of a picture (P or B) with indication of a motion vector</td>
</tr>
<tr>
<td><strong>Profile</strong></td>
<td>Subdivision of video coding into different resolutions</td>
</tr>
<tr>
<td><strong>PS</strong></td>
<td><strong>Program Stream</strong></td>
</tr>
<tr>
<td><strong>PSI</strong></td>
<td><strong>Program Specific Information</strong></td>
</tr>
<tr>
<td><strong>PTS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Q</strong></td>
<td>Quantization</td>
</tr>
<tr>
<td><strong>Q^{-1}</strong></td>
<td>Inverse quantization</td>
</tr>
<tr>
<td><strong>QS</strong></td>
<td>Quantization scaling</td>
</tr>
<tr>
<td><strong>RLC</strong></td>
<td><strong>Run Length Coding</strong></td>
</tr>
<tr>
<td><strong>RST</strong></td>
<td><strong>Running Status Table</strong></td>
</tr>
<tr>
<td><strong>Section</strong></td>
<td>A table is subdivided into several sections. If there is a change, only the section affected is transmitted</td>
</tr>
<tr>
<td><strong>SI</strong></td>
<td><strong>Service Information</strong></td>
</tr>
<tr>
<td><strong>SIF</strong></td>
<td><strong>Source Input Format</strong></td>
</tr>
<tr>
<td><strong>SCR</strong></td>
<td><strong>System Clock Reference</strong></td>
</tr>
<tr>
<td><strong>SDT</strong></td>
<td><strong>Service Description Table</strong></td>
</tr>
<tr>
<td><strong>STC</strong></td>
<td><strong>System Time Clock</strong></td>
</tr>
</tbody>
</table>
27-MHz clock, regenerated from PCR for a jitter-free readout of MPEG data.

<table>
<thead>
<tr>
<th><strong>SYNC(_byte)</strong></th>
<th>Synchronization byte in TS header value 0x47</th>
<th><strong>UTC</strong></th>
<th>Universal Time, Coordinated</th>
<th>Greenwich meantime</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TS</strong></td>
<td><strong>Transport Stream</strong></td>
<td><strong>VBR</strong></td>
<td>Variable Bit Rate</td>
<td></td>
</tr>
<tr>
<td><strong>TS Header</strong></td>
<td>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.</td>
<td><strong>VLC</strong></td>
<td>Variable Length Coding</td>
<td>Coding of data with variable number of bits (also see \textit{RLC})</td>
</tr>
<tr>
<td><strong>TDT</strong></td>
<td><strong>Time and Date table</strong></td>
<td><strong>ZigZag Scan</strong></td>
<td>Zigzag scan of quantized DCT coefficient matrix. This gives an efficient run length coding (\textit{RLC})</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UTC time and date</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOT</strong></td>
<td><strong>Time Offset Table</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2 DVB and ATSC Abbreviations

**ADSL**  Asymmetric digital subscriber line
A **COFDM-coded** digital data stream with a rate up to 8 Mbit/s (downstream) and 1 Mbit/s (upstream) 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 symbols 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 2^n-bit wide symbols.
- n is thus the bit width for the I and Q quantization; e.g. at 64 QAM the symbol width is 2n = 6 bit, n = 3, i.e.
- 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 fulfill 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.

**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 nonlinear 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. $1 \times 10^{-11}$ at an input error ratio of $2 \times 10^{-4}$.

**SFN**

**Single Frequency Network**

**Trellis Diagram**

The time sequence of the bits \((DVB-S \text{ and } -T)\) 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 \((DVB-S\text{ and } -T)\).

**3. ATSC Tables and Protocols**

**ATSC**

Advanced Television Systems Committee

American standardization group for digital terrestrial transmission

**CAT**

**Conditional Access Table**

\((P/ID=1)\): 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** \((P/ID=0):\)

List of all the programs contained in TS Multiplex with reference to PID of PMT and -T. Thanks to a series of logic decisions, the most probably correct way is searched for through the trellis diagram and incorrectly transmitted bits are corrected.

**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.

**PIT**

Program Identification Table

Table ID 0x00

**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

**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.

5 Additional Information


Please send any comments or suggestions about this Application Note to Broadcasting-TM-Applications@rohde-schwarz.com.