# TR 101 200 V1.1.1 (1997-09)

## Digital Video Broadcasting (DVB);
## A guideline for the use of DVB specifications and standards

European Broadcasting Union    Union Européenne de Radio-Télévision

EBU
UER

**DVB**
Digital Video
Broadcasting

**ETSI**

*European Telecommunications Standards Institute*

*ETSI Secretariat*

# Contents

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# Foreword

This Technical Report (TR) has been produced by the DVB Project and submitted for publication to the Joint Technical Committee (JTC) of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE: The EBU/ETSI JTC was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. 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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**Digital Video Broadcasting (DVB) Project**

Founded in September 1993, the DVB Project is a market-led consortium of public and private sector organizations in the television industry. Its aim is to establish the framework for the introduction of MPEG-2 based digital television services. Now comprising over 200 organizations from more than 25 countries around the world, DVB fosters market-led systems, which meet the real needs, and economic circumstances, of the consumer electronics and the broadcast industry.

# 1        Scope

In the course of recent years the DVB Project has very successfully developed a considerable list of specifications for Digital Video Broadcasting (DVB). As a matter of fact, the term "Digital Video Broadcasting" has even become too restricted, since DVB specifications can be used for broadcasting all kinds of data as well as of sound, accompanied by all kinds of auxiliary information. Some of the specifications aim at the installation of bi-directional communication channels, for example, using cable installations.

Due to the considerable complexity of the DVB environment many different documents have to be taken into consideration when planning services or equipment. For those who have been deeply involved in the development of the DVB solutions the list of documents may be comprehensible, but at least for newcomers it would be quite natural to overlook some of the existing specifications, guidelines, standards etc.

The present document gives an overview of the existing DVB documents. The present document should be regarded as a "cookbook", listing all the ingredients for a DVB meal. It does not serve the purpose of giving a detailed description of the contents of the DVB documents.

Some introductory literature that describes the DVB environment globally and/or in detail can be found in annex A, bibliography.

# 2        References

References may be made to:

   a)  specific versions of publications (identified by date of publication, edition number, version number, etc.), in
       which case, subsequent revisions to the referenced document do not apply; or

   b)  all versions up to and including the identified version (identified by "up to and including" before the version
       identity); or

   c)  all versions subsequent to and including the identified version (identified by "onwards" following the version
       identity); or

   d)  publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

Because of the rapid development of specifications and standards, it is recommended to verify in each case whether the following documents have been replaced by more recent versions. The following list was compiled in August 1997.

**CENELEC documents:**

   [1]        CENELEC prEN 50083-9 (March 1996): "Cabled Distribution Systems for Television, Sound and
              Interactive Multimedia Signals; Part 9: Interfaces for CATV/SMATV Headends and similar
              Professional Equipment".

   [2]        CENELEC prEN 50201 (June 1996): "Interfaces for DVB-IRDs".

   [3]        CENELEC prEN 50221 (June 1996): "Common Interface Specification for Conditional Access
              and other Digital Video Broadcasting Decoder Applications".

   [4]        reserved for future use.

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   [9]        reserved for future use.

**ETSI documents:**

[10]        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".

[11]        ETR 162: "Digital Video Broadcasting (DVB); Allocation of Service Information (SI) codes for DVB systems".

[12]        ETR 211: "Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)".

[13]        ETR 289: "Digital Video Broadcasting (DVB); Support for use of scrambling and Conditional Access (CA) within digital broadcasting systems".

[14]        ETR 290: "Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems".

[15]        EN 300 421: "Digital Video Broadcasting (DVB); DVB framing structure, channel coding and modulation for 11/12 GHz satellite services". Known as (DVB-S).

[16]        EN 300 429: "Digital Video Broadcasting (DVB); DVB framing structure, channel coding and modulation for cable systems". Known as (DVB-C).

[17]        prEN 300 468: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems". Known as (DVB-SI).

[18]        EN 300 472: "Digital Video Broadcasting (DVB); Specification for conveying ITU-R System B Teletext in DVB bitstreams". Known as (DVB-TXT).

[19]        EN 300 473: "Digital Video Broadcasting (DVB); Satellite Master Antenna Television (SMATV) distribution systems". Known as (DVB-CS).

[20]        prETS 300 743: "Digital Video Broadcasting (DVB); DVB subtitling system".

[21]        EN 300 744: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television". Known as (DVB-T).

[22]        EN 300 748: "Digital Video Broadcasting (DVB); Multipoint Video Distribution Systems (MVDS) at 10 GHz and above". Known as (DVB-MS).

[23]        EN 300 749: "Digital Video Broadcasting (DVB); Microwave Multipoint Distribution Systems (MMDS) below 10 GHz". Known as (DVB-MC).

[24]        prETS 300 800: "Digital Video Broadcasting (DVB); Interaction channel for Cable TV distribution systems (CATV)".

[25]        ETS 300 801: "Digital Video Broadcasting (DVB); Interaction channel through Public Switched Telecommunications Network (PSTN) / Integrated Services Digital Network (ISDN)".

[26]        prETS 300 802: "Digital Video Broadcasting (DVB); Network-independent protocols for DVB interactive services".

[27]        prEN 300 803: "Digital Video Broadcasting (DVB); Interaction channel for Cable TV distribution systems (CATV)".

[28]        prETS 300 813: "Digital Video Broadcasting (DVB); Interfaces to Plesiochronous Digital Hierarchy (PDH) networks".

[29]        prETS 300 814: "Digital Video Broadcasting (DVB); Interfaces to Synchronous Digital Hierarchy (SDH) networks".

[30]        prEN 300 815: "Digital Video Broadcasting (DVB); Interfaces to Asynchronous Transfer Mode (ATM) networks".

[31]        TR 101 190: "Digital Video Broadcasting (DVB); Implementation guidelines for DVB terrestrial services; Transmission aspects".

[32]        TS 101 191: "Digital Video Broadcasting (DVB); Mega-frame for Single Frequency Network (SFN) synchronization".

[33]        prEN 301 192: "Digital Video Broadcasting (DVB); Specification for data broadcasting".

[34]        prEN 301 193: "Digital Video Broadcasting (DVB); Interaction channel through the Digital Enhanced Cordless Telecommunications (DECT)".

[35]        TR 101 194: "Digital Video Broadcasting (DVB); Guidelines for implementation and usage of the specification of network independent protocols for DVB interactive services".

[36]        prEN 301 195: "Digital Video Broadcasting (DVB); Interaction channel for terrestrial systems based on Synchronous Frequency Division Multiple Access (SFDMA)".

[37]        prTR 101 196: "Digital Video Broadcasting (DVB); Guidelines for use of DVB return channel on Hybrid Fiber Coaxial (HFC) networks; Netrwork-dependent layers for interactive services".

[38]        TS 101 197-1: "Digital Video Broadcasting (DVB); DVB SimulCrypt; Part 1: Head-end architecture and synchronization".

[39]        prTS 101 197-2: "Digital Video Broadcasting (DVB); DVB SimulCrypt; Part 2: Extended interoperability and control".

[40]        TR 101 198: "Digital Video Broadcasting (DVB); Implementation of Binary Phase Shift Keying (BPSK) in DVB satellite transmission systems".

[41]        prEN 301 199: "Digital Video Broadcasting (DVB); DVB interaction channel for Local Multipoint Distribution System (LMDS) distribution systems".

[42]        TR 101 200: "Digital Video Broadcasting (DVB); A guideline for the use of DVB specifications and standards".

[43]        TR 101 201: "Digital Video Broadcasting (DVB); Interaction channel for Satellite Master Antenna TV (SMATV) distribution systems; Guidelines for versions based on satellite and coaxial sections".

[44]        prTR 101 202: "Digital Video Broadcasting (DVB); Guidelines for the implementation and usage of the DVB data broadcasting specification".

[45]        reserved for future use

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[59]        reserved for future use

**Other documents:**

[60]        ISO/IEC 13818-1: "Information Technology - Generic Coding of Moving Pictures and Associated Audio Information. Part 1: Systems".

[61]        ISO/IEC 13818-2: "Information Technology - Generic Coding of Moving Pictures and Associated Audio Information. Part 2: Video".

[62]        ISO/IEC 13818-3: "Information Technology - Generic Coding of Moving Pictures and Associated Audio Information. Part 3: Audio".

[63]        ISO/IEC 13818-6: "Information Technology - Generic Coding of Moving Pictures and Associated Audio Information. Part 6: Extension for Digital Storage Media Command and Control (DSM-CC)".

# 3    Abbreviations

For the purposes of the present document, the following abbreviations apply:

| | |
|---|---|
| API | Application Programming Interface |
| ATM | Asynchronous Transfer Mode |
| BPSK | Binary Phase Shift Keying |
| CA | Condition Access |
| CATV | Community Antenna TeleVision |
| CSA | Common Scrambling Algorithm |
| DAVIC | Digital Audio VIsual Council |
| DECT | Digital Enhanced Cordless Telecommunications |
| DSM-CC | Digital Storage Media Command Control |
| D-SNG | Digital Satellite News Gathering |
| DVB | Digital Video Broadcasting |
| DVD | Digital Video (or Versatile) Disk |
| DVC | Digital Video Cassette |
| D-VHS | Digital - Video Home System |
| SFDMA | Synchronous Frequency Division Multiple Access |
| GSM | Global System for Mobile communication |
| HDTV | High Definition TeleVision |
| HFC | Hybrid Fibre Coax |
| IEC | International Electrotechnical Commission |
| IRD | Integrated Receiver Decoder |
| ISO | International Organization for Standardization |
| IS | Interactive Service |
| ISDN | Integrated Services Digital Network |
| LMDS | Local Multipoint Distribution System |
| LNB | Low Noise Block (down converter) |
| MMDS | Microwave Multipoint Distribution System |
| MPEG | Moving Picture Experts Group |
| MultiCrypt | Is used to describe the simultaneous operation of several CA systems. |
| MVDS | Multipoint Video Distribution System |
| OSI | Open Systems Interconnection |
| PCM/CIA | Personal Computer Memory / Card International Association |
| PDH | Plesiochronous Digital Hierarchy |
| PSTN | Public Switched Telephone Network |
| SDH | Synchronous Digital Hierarchy |
| SAS | Subscriber Authorization System |
| SFN | Single Frequency Network |
| SI | Service Information |
| SMATV | Satellite Master Antenna TeleVision |
| SMS | Subscriber Management System |
| SimulCrypt | A process that facilitates using several Conditional Access (CA) systems in parallel, in conjunction with the DVB common scrambling algorithm, to control access to pay-TV services. SimulCrypt involves the inter-operation o two or more CA streams in a DVB environment. DVB SimulCrypt addresses specifically the requirements for interoperability between to or more CA systems at a head-end (see TR 101 197 [38]). |
| TS | Transport Stream |
| TV | TeleVision |
| PES | Programme Elementary Stream |
| VSAT | Very Small Aperture (satellite) Terminal |
| VHS | Video Home System |

# 4        Baseband processing

One of the fundamental decisions which were taken during the early days of the DVB Project was the selection of MPEG-2 for the source coding of audio and video and for the creation of programme elementary streams, Transport Streams (TS), etc.; the so-called Systems level. The ISO/IEC 13818 Parts 1, 2, 3 [60], [61], [62] are international standards which describe MPEG-2 Systems, Video and Audio. All three are truly generic and can be considered too wide in scope for them to be applied to DVB directly.

Therefore ETR 154 [10] was created by the DVB Project. This "guidelines document" includes restrictions to the syntax and parameter values described by MPEG-2 as well as recommendations for preferred values for the use in DVB applications.

In analogue TV services Teletext has been used for many years. Millions of TV receivers out in the field provide Teletext decoding. Viewers are used to the convenience of obtaining information from Teletext pages. Since for many years to come the existing TV receiver concepts will be used to display DVB services (which have been received and decoded by a "black box" connecting the satellite LNB, the cable outlet or the rooftop aerial to the existing receiver, i.e. the so-called Integrated Receiver Decoder (IRD)) a mechanism needs to be provided which enables the delivery of "analogue" Teletext to the receiver via DVB. This mechanism described in EN 300 472 [18] is known as "DVB-TXT".

In many countries it is customary to broadcast TV programmes with the original soundtrack and to provide a translation into the local language in the form of subtitles. Another practice is to add graphic elements to the transmitted images like, for example, station logos etc. In EN 300 743 [20] a potent mechanism is described which allows the transmission of all kinds of subtitles and graphic elements as part of the DVB signals.

Future DVB services will consist of a wide variety of programmes carried via a large number of transmission channels. In order for the IRD to be able to tune to such channels and in order for the DVB customer to be able to navigate the profusion of programmes, powerful navigational aids need to be provided as part of the DVB streams. The Service Information (SI) described in EN 300 468 [17] constitutes this set of aids, known as "DVB-SI". ETR 211 [12] includes a set of guidelines describing how the SI should be used. In ETR 162 [11] SI codes are being listed which indicate services by different broadcasters.

# 5        Transmission

Specifications for the transmission of the baseband signals (as described in clause 4) via all sorts of broadcast delivery channels have been among the principal deliverables of the DVB Project.

The first specification which it was possible to finalize was that for the satellite delivery of DVB signals EN 300 421 [15], known as "DVB-S". In this document different tools for channel coding were described for the first time, which later on became important for all other delivery media as well.

EN 300 429 [16] describes channel coding and modulation for DVB signal delivery on cable (CATV) systems; known as "DVB-C". This document forms the basis of EN 300 473 [19], in which the use of (Satellite) Master Antenna TV - (S)MATV installations for DVB is described; known as "DVB-CS".

EN 300 744 [21] describes the use of terrestrial transmission for DVB; known as "DVB-T". If a single-frequency network approach is taken for the transmission of "DVB-T" signals, the synchronization of all the transmitters that contribute to the network is of the utmost importance. TS 101 191 [32] contains the specification of a Mega-frame for Single Frequency Network (SFN) synchronization.

If microwaves are used for the delivery of DVB signals, two specifications can be chosen for the Multichannel Microwave Distribution System (MMDS), depending on the frequency range applied. EN 300 748 [22] describes MMDS for use at 10 GHz and above. This transmission system is based on the use of EN 300 421 [15] "DVB-S" technology and has therefore been called "DVB-MS". EN 300 749 [23] is applicable to MMDS transmission at frequencies below 10 GHz and it is based on EN 300 429 [16] "DVB-C" technology. Therefore, it has been called "DVB-MC".

# 6        Conditional Access (CA)

In many cases DVB-based services will either be of the "pay" type or will at least include some elements which are not supposed to be freely available to the public at large. The term "Conditional Access" is frequently used to describe systems that enable the control over the access to programmes, services etc. CA systems consist of several blocks; among others, the mechanism to scramble the programme or service, the "Subscriber Management System (SMS)", in which all customer data are stored and the "Subscriber Authorization System (SAS)", that encrypts and delivers those code words which enable the descrambler to make the programme legible.

It was one of the strategic decisions taken by the DVB Project, that neither SMS nor SAS should be standardized. The only part of a CA system which was developed jointly by members of DVB is the "Common Scrambling Algorithm (CSA)" in ETR 289 [13], a powerful tool to make secure scrambling of Transport Streams (TS) or Programme Elementary Streams (PES) possible. Owing to the peculiar nature of this system, it is not disclosed to the public in detail. The specification can be obtained from ETSI, the "custodian", by way of a process described in the DVB Blue Book A011 (see annex A, bibliography).

All other parts of CA systems for DVB are offered in the form of several competitive, commercial products which are marketed by DVB members.

To enable an Integrated Receiver Decoder (IRD) to descramble programmes which have been broadcast in parallel, using different CA systems, a "Common Interface for Conditional Access and other Digital Video Broadcasting Decoder Applications" (see EN 50221 [3] can be incorporated into the IRD. By way of inserting a PCM/CIA module into the common interface, different CA systems can be addressed sequentially by that IRD. The term "MultiCrypt" is used to describe the simultaneous operation of several CA systems.

Another way of providing the viewer with access to programmes which have been processed by different CA systems is called "SimulCrypt". In this case commercial negotiations between different programme providers have led to a contract which enables the viewer to use the one specific CA system built into his IRD to watch all the programmes, irrespective of the fact that these programmes were scrambled under the control of one of several CA systems. A basic contract to enable SimulCrypt is described by a "Code of Conduct" in DVB General Assembly document GA 2 (94) 9 (see annex A, bibliography).

It is one of the goals of the DVB Project to help create European "Anti-Piracy Legislation", which should allow strict penalizing of so-called "pirates" for the breach of CA systems. A proposal for such legislation is included in the DVB Blue Book A006 (see annex A, bibliography).

If scrambled, programmes received via satellite and terrestrial transmission are to be fed into cable networks it may in certain cases be advisable for the operator of that cable to change the CA system so that all the programmes in his network are under the control of only one CA system. The process of changing the CA system at a cable head end is called "Transcontrol" and is supported by the DVB Project.

# 7        Interactive Services (IS)

Many of the service offers possible in the DVB world will require some form of interaction between, for example, the user and either the programme provider or the network operator. This interaction may consist of the transmission of just a few commands but may be extensive and may thus resemble communication via the Internet.

In DVB the tools for enabling interaction have generally been split into two sets. One is network-independent and can be regarded as a protocol stack which extends approximately via ISO/OSI layers two to three (see ETS 300 802 [26]. An important part of this stack was derived from the Digital Storage Media Command Control (DSM-CC) protocols created by MPEG (see ISO/IEC 13818-6 [63]). Document TR 101 194 [35] was created as a "guideline" in order for users to be able to understand and use this somewhat complicated stack.

The second group of DVB specifications relates to the lower layers (approximately one to two) of the ISO/OSI model and therefore specifies the network-dependent tools for interactivity. So far two specifications have been created. The first is ETS 300 801 [25] which describes ways to use Public Switched Telephone Networks (PSTN) and Integrated Services Digital Networks (ISDN) as physical networks for interaction. The second is ETS 300 800 [24] which deals with a comprehensive solution for the use of CATV networks for the same purpose. In the near future specifications will be designed which connect (S)MATV systems to the outside world of interactivity via Very Small Aperture (satellite) Terminal (VSAT) and which can be used for the interaction channels accompanying terrestrial DVB.

# 8      Miscellaneous

One of the strengths of DVB technology lies in the fact that it enables the point-to-multipoint transmission of very large amounts of data at high data rates while very securely protecting them against all kinds of transmission errors. This data my be audio and video but in many applications the data can be files or other forms of generic information. In order to enable the transmission of such kind of data, including the possibility of repeat transmissions of the same data at regular or irregular time intervals, EN 301 192 [33], a specification for data broadcasting has been produced. EN 301 192 [33] describes four application areas, namely "data piping", "data streaming", "multiprotocol encapsulation", and "data carousel". EN 301 192 [33] is the implementation of such a data broadcasting scheme recommended by DVB. Other (proprietary) implementations may coexist.

At the request of some broadcasters, the DVB Project is currently considering the possible future designing of a set of specifications for Digital Satellite News Gathering (D-SNG). This set will most probably consist of some of the documents mentioned above plus some new tools; for instance, for enabling bi-directional communication between the personnel operating the D-SNG uplink and the downlink, respectively.

Telecommunications networks will play an important role in connecting, for example, the playout centre of a broadcaster and the satellite uplink station in another city. Different types of networks will be used for this purpose (e.g. PDH, SDH, ATM etc.). The DVB Project has designed an interface which will be used for connecting the world of DVB signals to PDH networks (ETS 300 813 [28]). A comparable interface to SDH networks is described in ETS 300 814 [29].

DVB systems are new technology for equipment manufacturers, broadcasters and network providers. The testing and evaluation of such systems therefore require some form of guidelines. These guidelines in ETR 290 [14] should help to distinguish meaningful from useless measurements and help to understand how the measuring should be carried out.

Instead of specifying the architecture of the hardware needed in professional DVB installations and in the IRD or specifying some form of operational software (i.e. the Application Programming Interface (API) of such units) the DVB Project, after lengthy discussions, decided, at the request of the manufacturers, that it would restrict its activities to specifying external interfaces only. EN 50 201 [2] specifies interfaces for the IRD. EN 50 083-9 [1] describes interfaces for the use in cable head ends, satellite uplink stations and similar professional installations.

In order for the IRD to be able to interoperate with future types of storage media (DVD, DVC, D-VHS etc.) certain conditions shall be met by the DVB data streams. These conditions relate, for example, to the maximum bit rate that may be used for the transmission of programmes, which in its turn is defined by the recording capabilities of the respective storage medium. These conditions were included in ETR 154 [10] and EN 300 468 [17].

# 9      Conclusions

The work of the DVB Project has resulted in a comprehensive list of technical and non-technical documents describing solutions required by the market players in order for them to be able to make the best use of the new technology of broadcasting digital signals. These documents are the result of the united efforts of many individuals who spent thousands of hours designing new solutions to new problems.

Many organizations have provided important contributions to the work of the DVB Project in that they have either made available some results of their work (MPEG, DAVIC) or through actively co-operating with the DVB Project in transforming specifications into standards (ETSI, CENELEC).

Both the extremely valuable contributions by the many individuals and the co-operation of the organizations involved are highly appreciated.

The work of the DVB Project has reached a high level of maturity, but it has not ended yet. Numerous design activities are still ongoing. Among these activities is the compilation of a document which describes ways to broadcast High Definition TeleVision (HDTV) using the DVB solutions. Thus DVB is preparing the medium-term to long-term future of television just as it has, over the last few years, provided solutions for the immediate future of our business.

# Annex A (informative):
# Bibliography

The following material, though not specifically referenced in the body of the present document, gives supporting information.

- Ulrich Reimers (editor): "Digitale Fernsehtechnik - Datenkompression und Übertragung für DVB". Berlin, Heidelberg, New York; Springer, 1995.

- David Wood: "Satellites, science and success - The DVB story". EBU Technical Review No. 266 - Winter 1995: pages 4 to 11.

- Hervé Benoit: "La Télévision Numérique; MPEG-1, MPEG-2 et les principes du système européen DVB". Paris: Dunod.

- Hervé Benoit: "Digital Television; MPEG-1, MPEG-2 and principles of the DVB system". Arnold: ISBN 0-340-69190-5.

- DVB Project, DVB Blue Book A 006 (October 1995): "Antipiracy Legislation for Digital Video Broadcasting".

- DVB Project, DVB Blue Book A 011 (September 1996): "DVB Common Scrambling Algorithm".

- DVB Project, DVB GA 2 (94) 9 rev. 1, Appendix 1: "Code of Conduct - Access to Digital Decoders".

# History

| Document history | | |
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| V.1.1.1 | September 1997 | Publication |
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