



Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems

EBU DVB[®]

Reference

RTR/JTC-DVB-389

Keywords

broadcasting, digital, DVB, TV, video

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 - Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status.

Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2020.

© European Broadcasting Union 2020.

All rights reserved.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members.

3GPP™ and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

oneM2M™ logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners.

GSM® and the GSM logo are trademarks registered and owned by the GSM Association.

Contents

Intellectual Property Rights	11
Foreword.....	11
Modal verbs terminology.....	11
1 Scope	12
2 References	12
2.1 Normative references	12
2.2 Informative references.....	12
3 Definition of terms, symbols and abbreviations.....	14
3.1 Terms.....	14
3.2 Symbols.....	14
3.3 Abbreviations	15
4 General	18
5 Measurement and analysis of the MPEG-2 Transport Stream	20
5.1 General	20
5.2 List of parameters recommended for evaluation	20
5.2.0 Introduction.....	20
5.2.1 First priority: necessary for de-codability (basic monitoring)	22
5.2.2 Second priority: recommended for continuous or periodic monitoring	23
5.2.3 Third priority: application dependant monitoring	25
5.3 Measurement of MPEG-2 Transport Streams in networks.....	30
5.3.1 Introduction.....	30
5.3.2 System clock and PCR measurements.....	30
5.3.2.1 Reference model for system clock and PCR measurements	30
5.3.2.2 Measurement descriptions.....	31
5.3.2.3 Program Clock Reference - Frequency Offset PCR_FO.....	32
5.3.2.4 Program Clock Reference – Drift Rate PCR_DR	32
5.3.2.5 Program Clock Reference - Overall Jitter PCR_OJ	32
5.3.2.6 Program Clock Reference – Accuracy PCR_AC	33
5.3.3 Bitrate measurement	33
5.3.3.0 General	33
5.3.3.1 Bitrate measurement algorithm	33
5.3.3.2 Preferred values for Bitrate Measurement.....	34
5.3.3.3 Nomenclature	35
5.3.4 Consistency of information check	36
5.3.4.0 General	36
5.3.4.1 Transport_Stream_ID check	36
5.3.5 TS parameters in transmission systems with reduced SI data.....	36
5.4 Measurement of availability at MPEG-2 Transport Stream level	37
5.5 Evaluation of service performance by combination of TS related parameters	38
5.6 Parameters for CI related applications.....	38
5.6.0 Introduction.....	38
5.6.1 Latency	39
5.6.2 CI_module_delay_variation.....	40
5.6.3 Input_output_TS comparison.....	40
5.6.4 CI_module_throughput	40
5.6.5 Valid TS on CI.....	40
6 Common parameters for satellite and cable transmission media	41
6.1 System availability	41
6.2 Link availability	41
6.3 BER before RS decoder	42
6.3.0 Introduction.....	42
6.3.1 Out of service.....	42
6.3.2 In service.....	42

6.4	Error events logging	42
6.5	Transmitter symbol clock jitter and accuracy	43
6.6	RF/IF signal power	43
6.7	Noise power	43
6.8	Bit error count after RS	43
6.9	IQ signal analysis	44
6.9.1	Introduction	44
6.9.2	Modulation Error Ratio (MER)	45
6.9.3	System Target Error (STE) (void)	45
6.9.4	Carrier suppression	45
6.9.5	Amplitude Imbalance (AI)	46
6.9.6	Quadrature Error (QE)	47
6.9.7	Residual Target Error (RTE)	47
6.9.8	Coherent interferer	47
6.9.9	Phase Jitter (PJ)	48
6.9.10	Signal-to-Noise Ratio (SNR)	49
6.10	Interference	49
7	Cable specific measurements	50
7.0	Introduction	50
7.1	Noise margin	50
7.2	Estimated noise margin	50
7.3	Signal quality margin test	50
7.4	Equivalent Noise Degradation (END)	51
7.5	BER vs. E_b/N_0	52
7.6	Phase noise of RF carrier	52
7.7	Amplitude, phase and impulse response of the channel	52
7.8	Out of band emissions	52
8	Satellite specific measurements	53
8.1	BER before Viterbi decoding	53
8.2	Receive BER vs. E_b/N_0	53
8.3	IF spectrum	54
9	Measurements specific for a terrestrial (DVB-T) system	54
9.0	Introduction	54
9.1	RF frequency measurements	56
9.1.0	General	56
9.1.1	RF frequency accuracy (Precision)	56
9.1.2	RF channel width (Sampling Frequency Accuracy)	56
9.1.3	Symbol Length measurement at RF (Guard Interval verification)	57
9.2	Selectivity	57
9.3	AFC capture range	57
9.4	Phase noise of Local Oscillators (LO)	58
9.5	RF/IF signal power	59
9.6	Noise power	59
9.7	RF and IF spectrum	59
9.8	Receiver sensitivity/dynamic range for a Gaussian channel	59
9.9	Equivalent Noise Degradation (END)	60
9.9.0	General	60
9.9.1	Equivalent Noise Floor (ENF)	60
9.10	Linearity characterization (shoulder attenuation)	61
9.11	Power efficiency	61
9.12	Coherent interferer	61
9.13	BER vs. C/N ratio by variation of transmitter power	61
9.14	BER vs. C/N ratio by variation of Gaussian noise power	62
9.15	BER before Viterbi (inner) decoder	62
9.16	BER before RS (outer) decoder	62
9.16.0	General	62
9.16.1	Out of Service	63
9.16.2	In Service	63
9.17	BER after RS (outer) decoder (Bit error count)	63
9.18	IQ signal analysis	63

9.18.1	Introduction.....	63
9.18.2	Modulation Error Ratio (MER)	65
9.18.3	System Target Error (STE) (void)	65
9.18.4	Carrier Suppression (CS)	65
9.18.5	Amplitude Imbalance (AI).....	66
9.18.6	Quadrature Error (QE).....	67
9.18.7	Phase Jitter (PJ).....	68
9.19	Overall signal delay.....	69
9.20	SFN synchronization	70
9.20.1	MIP_timing_error.....	70
9.20.2	MIP_structure_error.....	71
9.20.3	MIP_presence_error.....	71
9.20.4	MIP_pointer_error.....	71
9.20.5	MIP_periodicity_error.....	72
9.20.6	MIP_ts_rate_error.....	72
9.21	System Error Performance	73
10	Recommendations for the measurement of delays in DVB systems.....	73
11	Measurements for the second generation terrestrial (DVB-T2) system.....	73
11.1	Introduction	73
11.2	Measurements at the DVB-T2 Modulator Interface (T2-MI).....	74
11.2.1	Introduction.....	74
11.2.2	Measurements of the syntax of T2 MI packets	75
11.2.2.1	T2MI_packet_type_error_1	75
11.2.2.2	T2MI_packet_type_error_2	76
11.2.2.3	T2MI_packet_count_error	76
11.2.2.4	T2MI_CRC_error.....	76
11.2.2.5	T2MI_payload_error.....	76
11.2.2.6	T2MI_plp_num_blocks_error.....	76
11.2.2.7	T2MI_transmission_order_error.....	77
11.2.2.8	T2MI_DVB-T2_Timestamp_error.....	77
11.2.2.9	T2MI_DVB-T2_Timestamp_discontinuity.....	77
11.2.2.10	T2MI_T2_frame_length_error.....	77
11.2.3	Checks on the T2-MI MIP (Modulator Information Packet)	77
11.2.3.1	T2MI_MIP_timestamp_error.....	77
11.2.3.2	T2MI_MIP_individual_addressing_error	77
11.2.3.3	T2MI_MIP_continuity_error	78
11.2.3.4	T2MI_MIP_CRC_error.....	78
11.2.4	Check on consistency of T2-MI signalling information	78
11.2.4.1	T2MI_bandwidth_consistency_error	78
11.2.4.2	T2MI_DVB-T2_Timestamp_leap_second_error	78
11.2.5	Measurements at T2-MI transport layer.....	78
11.2.5.1	Encapsulation of T2-MI packets into MPEG-2 TS (ASI) streams	78
11.2.5.1.0	General	78
11.2.5.1.1	Parameters relevant to transport of T2-MI packets over MPEG-2 TS.....	79
11.2.5.1.2	Informative parameters.....	79
11.2.5.1.3	Integrity parameters.....	79
11.2.5.2	Encapsulation of T2-MI packets into IP streams	80
11.2.5.2.1	Parameters relevant to transport of T2-MI packets over IP	80
11.3	Measurements for DVB-T2 baseline system.....	82
11.3.0	General.....	82
11.3.1	RF measurements.....	85
11.3.1.0	General	85
11.3.1.1	RF frequency accuracy.....	85
11.3.1.2	RF occupied bandwidth.....	85
11.3.2	Selectivity	85
11.3.3	AFC capture range	86
11.3.4	Phase noise of Local Oscillators (LO).....	86
11.3.5	RF/IF signal power	86
11.3.6	MISO Group Power Ratio	86
11.3.7	Noise power.....	87

11.3.8	RF and IF spectrum.....	87
11.3.9	Receiver sensitivity/dynamic range for a Gaussian channel.....	87
11.3.10	Linearity characterization (shoulder attenuation)	88
11.3.11	Power efficiency	89
11.3.12	PAPR effect	89
11.3.13	P1 Symbol Error Rate	90
11.3.14	BER before LDPC (inner) decoder.....	90
11.3.15	Number of LDPC iterations	90
11.3.16	BER before BCH (outer) decoder.....	91
11.3.17	Baseband Frame Error Rate BBFER	91
11.3.18	Errored Second Ratio ESR	91
11.3.19	IQ signal analysis.....	91
11.3.19.1	Introduction.....	91
11.3.19.2	Modulation Error Ratio (MER).....	92
11.3.19.3	Signal to Interference Noise Ratio (SINR).....	93
11.3.19.4	Carrier Suppression (CS)	93
11.3.19.5	Carrier Phase (CPh).....	93
11.3.19.6	Amplitude Imbalance (AI)	94
11.3.19.7	Quadrature Error (QE)	95
11.3.20	SFN synchronization.....	96
11.3.21	L1 signalling error	96
11.3.22	RMS Delay-Spread (RMS-DS).....	96
11.3.23	Maximum Excess Delay (MED).....	97
11.3.24	Receiver Buffer Model (RBM) validation test.....	97
11.3.25	Relative power level during the non-P1 part of the FEF (RLF_non_P1).....	97
12	Measurements for the second generation cable system (DVB-C2).....	97
12.1	Introduction	97
12.2	Measurements for DVB-C2 baseline system.....	99
12.2.0	General.....	99
12.2.1	RF measurements.....	99
12.2.1.0	General	99
12.2.1.1	RF frequency accuracy.....	100
12.2.1.2	RF sampling frequency	100
12.2.2	AFC capture range	101
12.2.3	Phase noise of Local Oscillators (LO)	101
12.2.4	RF/IF signal power	101
12.2.5	Noise power	102
12.2.6	RF and IF spectrum.....	102
12.2.7	Receiver sensitivity/dynamic range for a Gaussian channel.....	102
12.2.8	Linearity characterization (shoulder attenuation)	102
12.2.9	BER before LDPC (inner) decoder.....	103
12.2.10	Number of LDPC iterations	103
12.2.11	BER before BCH (outer) decoder.....	103
12.2.12	Baseband Frame Error Rate BBFER	103
12.2.13	IQ signal analysis.....	104
12.2.13.1	Introduction.....	104
12.2.13.2	Modulation Error Ratio (MER).....	105
12.2.13.3	Amplitude Imbalance (AI)	106
12.2.13.4	Quadrature Error (QE)	107
12.2.14	L1 signalling error	107
12.2.15	Receiver Buffer Assumptions (RBA) validation test.....	107
Annex A:	General measurement methods	108
A.1	Introduction	108
A.2	Null packet definition.....	108
A.3	Description of the procedure for "Estimated Noise Margin" by applying statistical analysis on the constellation data.....	109
A.4	Set-up for RF phase noise measurements using a spectrum analyser	110

A.5	Amplitude, phase and impulse response of the channel.....	111
A.6	Out of band emissions	112
Annex B:	Examples for test set-ups for satellite and cable systems	113
B.0	Introduction	113
B.1	System availability	113
B.2	Link availability	113
B.3	BER before RS	113
B.3.0	General	113
B.3.1	Out of service measurement	114
B.3.2	In service measurement	114
B.4	Event error logging.....	114
B.5	Transmitter symbol clock jitter and accuracy	115
B.6	RF/IF signal power.....	115
B.7	Noise power.....	115
B.7.0	General	115
B.7.1	Out of service measurement	116
B.7.2	In service measurement	116
B.8	BER after RS.....	116
B.9	I/Q signal analysis	116
B.10	Service data rate measurement	117
B.11	Noise margin	117
B.11.0	General	117
B.11.1	Recommended equipment.....	117
B.11.2	Remarks and precautions.....	118
B.11.3	Measurement procedure	118
B.12	Equivalent Noise Degradation (END).....	119
B.13	BER vs. E_b/N_0	119
B.14	Equalizer specification	119
B.15	BER before Viterbi decoding	121
B.16	Receive BER vs. E_b/N_0	121
B.17	IF spectrum.....	121
Annex C:	Measurement parameter definition.....	122
C.1	Definition of Vector Error Measures.....	122
C.2	Comparison between MER and EVM.....	122
C.3	Conclusions regarding MER and EVM.....	123
Annex D:	Exact values of BER vs. E_b/N_0 for DVB-C systems.....	124
Annex E:	Examples for the terrestrial system test set-ups.....	125
E.0	Introduction	125
E.1	RF frequency accuracy	125
E.1.0	General	125
E.1.1	Frequency measurements in DVB-T (void)	125
E.1.2	Measurement in other cases (void).....	125
E.1.3	Calculation of the external pilots frequency when they do not have continual phase. (void)	126

E.1.4	Measuring the symbol length and verifying the Guard Interval (void)	126
E.1.5	Measuring the occupied bandwidth, and calculation of the frequency spacing and sampling frequency	126
E.2	Selectivity	127
E.3	AFC capture range	127
E.4	Phase noise of Local Oscillators (LO)	127
E.4.0	General	127
E.4.1	Practical information on phase noise measurements	128
E.5	RF/IF signal power	129
E.5.0	General	129
E.5.1	Procedure 1 (power metre)	129
E.5.2	Procedure 2 (spectrum analyser)	130
E.6	Noise power	130
E.6.0	General	130
E.6.1	Procedure 1	130
E.6.2	Procedure 2	130
E.6.3	Procedure 3	131
E.6.4	Measurement of noise with a spectrum analyser	131
E.7	RF and IF spectrum	131
E.8	Receiver sensitivity/dynamic range for a Gaussian channel	132
E.9	Equivalent Noise Degradation (END)	132
E.9.0	General	132
E.9.1	Description of the measurement method for END	132
E.9.2	Conversion method between ENF and END	134
E.10	Linearity characterization (shoulder attenuation)	134
E.10.0	General	134
E.10.1	Equipment	134
E.10.2	Remarks and precautions	135
E.10.3	Measurement procedure (example for UHF channel 47)	135
E.11	Power efficiency	136
E.12	Coherent interferer	136
E.13	BER vs. C/N by variation of transmitter power	137
E.14	BER vs. C/N by variation of Gaussian noise power	137
E.15	BER before Viterbi (inner) decoder	138
E.16	Overall signal delay	138
Annex F:	Specification of test signals of DVB-T modulator	139
F.1	Introduction	139
F.2	Input signal	139
F.3	Test modes	140
F.4	Test points	140
F.5	File format for interchange of simulated data	140
F.5.0	General	140
F.5.1	Test point number	141
F.5.2	Length of data buffer	141
F.5.3	Bit ordering after inner interleaver	141
F.5.4	Carrier allocation	142
F.5.5	Scaling	142
F.5.6	Constellation	142
F.5.7	Hierarchy	142

F.5.8	Code rate LP and HP	143
F.5.9	Guard interval.....	143
F.5.10	Transmission mode.....	143
F.5.11	Data format.....	143
F.5.12	Example.....	143
Annex G:	Theoretical background information on measurement techniques.....	145
G.0	Introduction	145
G.1	Overview	145
G.2	RF/IF power ("carrier")	145
G.3	Noise level.....	146
G.4	Energy-per-bit (E_b)	147
G.5	C/N ratio and E_b/N_0 ratio	147
G.6	Practical application of the measurements	147
G.7	Example.....	148
G.8	Signal-to-Noise Ratio (SNR) and Modulation Error Ratio (MER).....	150
G.9	BER vs. C/N	150
G.10	Error probability of Quadrature Amplitude Modulation (QAM)	151
G.11	Error probability of QPSK	153
G.12	Error probability after Viterbi decoding.....	153
G.13	Error probability after RS decoding.....	154
G.14	BEP vs. C/N for DVB cable transmission.....	155
G.15	BER vs. C/N for DVB satellite transmission.....	155
G.16	Adding noise to a noisy signal	157
Annex H:	Void	159
Annex I:	PCR related measurements.....	160
Annex J:	Bitrate related measurements.....	161
J.1	Introduction	161
J.1.1	Purpose of bitrate measurement	161
J.1.2	User Rate versus Multiplex Rate	161
J.1.3	User rate applications	163
J.2	Principles of Bit rate measurement	163
J.2.0	General	163
J.2.1	Gate or Window function	163
J.2.2	"Continuous window"	164
J.2.3	Time Gate values:.....	164
J.2.4	Rate measurements in a transport stream	164
J.3	Use of the MG profiles.....	165
J.3.0	General	165
J.3.1	MGB1 Profile - the backwards compatible profile.....	165
J.3.2	MGB2 Profile - the Basic bitrate profile	165
J.3.3	MGB3 Profile - the precise Peak bitrate profile	165
J.3.4	MGB4 Profile - the precise profile	165
J.3.5	MGB5 Profile - the user profile.....	166
J.4	Error values in the measurements	166
J.4.0	General	166

J.4.1	Very Precise measurements.....	167
Annex K:	DVB-T channel characteristics.....	168
K.0	Introduction	168
K.1	Theoretical channel profiles for simulations without Doppler shift.....	168
K.2	Profiles for realtime simulations without Doppler shift.....	169
K.3	Profiles for realtime simulation with Doppler shift (mobile channel simulation).....	170
Annex L:	The measurement of MER under ACE.....	171
Annex M:	Bibliography	173
History		174

iTeh STANDARD PREVIEW
 (standards.iteh.ai)
 Full standard:
<https://standards.iteh.ai/catalog/standards/sist/38b432fb-3860-4458-bb9d-ea8914cd8766/etsi-tr-101-290-v1.4.1-2020-06>

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Foreword

This Technical Report (TR) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECTrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast 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.

European Broadcasting Union
CH-1218 GRAND SACCONNEX (Geneva)
Switzerland
Tel: +41 22 717 21 11
Fax: +41 22 717 24 81

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.

Modal verbs terminology

In the present document **"should"**, **"should not"**, **"may"**, **"need not"**, **"will"**, **"will not"**, **"can"** and **"cannot"** are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"must" and **"must not"** are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document provides guidelines for measurement in Digital Video Broadcasting (DVB) satellite, cable and terrestrial and related digital television systems. The present document defines a number of measurement techniques, such that the results obtained are comparable when the measurement is carried out in compliance with the appropriate definition.

The present document uses terminology used in ETSI EN 300 421 [i.5], ETSI EN 300 429 [i.6], ETSI EN 300 468 [i.7] and ETSI EN 300 744 [i.9] and it should be read in conjunctions with them.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ISO/IEC 13818-1 (ITU-T Recommendation H.222.0): "Information technology - Generic coding of moving pictures and associated audio information: Systems".
- [i.2] ISO/IEC 13818-4: "Information technology - Generic coding of moving pictures and associated audio information - Part 4: Conformance testing".
- [i.3] ISO/IEC 13818-9: "Information technology - Generic coding of moving pictures and associated audio information - Part 9: Extension for real time interface for systems decoders".
- [i.4] Void.
- [i.5] ETSI EN 300 421: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services".
- [i.6] ETSI EN 300 429: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems".
- [i.7] ETSI EN 300 468: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems".
- [i.8] ETSI TR 101 211: "Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)".
- [i.9] ETSI EN 300 744: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television".
- [i.10] EN 50083-9: "Cable networks for television signals, sound signals and interactive services - Part 9: Interfaces for CATV/SMATV headends and similar professional equipment for DVB/MPEG-2 transport streams", produced by CENELEC.
- [i.11] Void.

- [i.12] Recommendation ITU-T O.151: "Error performance measuring equipment operating at the primary rate and above".
- [i.13] ETSI EN 300 473: "Digital Video Broadcasting (DVB); Satellite Master Antenna Television (SMATV) distribution systems".
- [i.14] ETSI TS 101 191: "Digital Video Broadcasting (DVB); DVB mega-frame for Single Frequency Network (SFN) synchronization".
- [i.15] ETSI EN 300 748: "Digital Video Broadcasting (DVB); Multipoint Video Distribution Systems (MVDS) at 10 GHz and above".
- [i.16] ETSI EN 300 749: "Digital Video Broadcasting (DVB); Microwave Multipoint Distribution Systems (MMDS) below 10 GHz".
- [i.17] ISO 639: "Code for the representation of names of languages".
- [i.18] ETSI EN 301 210: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for Digital Satellite News Gathering (DSNG) and other contribution applications by satellite".
- [i.19] ETSI ETS 300 813: "Digital Video Broadcasting (DVB); DVB interfaces to Plesiochronous Digital Hierarchy (PDH) networks".
- [i.20] ETSI ETS 300 814: "Digital Video Broadcasting (DVB); DVB interfaces to Synchronous Digital Hierarchy (SDH) networks".
- [i.21] Void.
- [i.22] Void.
- [i.23] EN 50221: "Common interface specification for conditional access and other digital video broadcasting decoder applications", produced by CENELEC.
- [i.24] ETSI TS 102 773 (V1.3.1), January 2012: "Digital Video Broadcasting (DVB); Modulator Interface (T2-MI) for a second generation digital terrestrial television broadcasting system (DVB-T2)".
- [i.25] ETSI TS 102 034 (August 2009): "Digital Video Broadcasting (DVB); Transport of MPEG-2 TS Based DVB Services over IP Based Networks".
- [i.26] SMPTE 2022-1 (May 2007): "Forward Error Correction for Real-Time Video/Audio Transport Over IP Networks".
- [i.27] ETSI EN 302 755 (V1.3.1) (April 2012): "Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)".
- [i.28] ETSI EN 302 769 (V1.2.1) (April 2011): "Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital transmission system for cable systems (DVB-C2)".
- [i.29] ETSI TS 102 991 (V1.2.1) (June 2011): "Digital Video Broadcasting (DVB); Implementation Guidelines for a second generation digital cable transmission system (DVB-C2)".
- [i.30] ETSI TS 101 154: "Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcast and Broadband Applications".
- [i.31] ISO/IEC 13818-2: "Information technology - Generic coding of moving pictures and associated audio information - Part 2: Video".
- [i.32] ISO/IEC 13818-3: "Information technology - Generic coding of moving pictures and associated audio information - Part 3: Audio".
- [i.33] ETSI EN 301 192: "Digital Video Broadcasting (DVB); DVB specification for data broadcasting".