



**SLOVENSKI STANDARD**  
**SIST EN 302 878-2 V1.1.1:2012**

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**Dostop, priključki, prenos in multipleksiranje (ATTM) - Tretja generacija prenosnih sistemov za storitve interaktivne kableske televizije - IP-kabelski modemi - 2. del: Fizična plast - DOCSIS 3.0**

Access, Terminals, Transmission and Multiplexing (ATTM) - Third Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems - Part 2: Physical Layer - DOCSIS 3.0

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# ETSI EN 302 878-2 V1.1.1 (2011-11)



**Access, Terminals, Transmission and Multiplexing (ATTM);  
Third Generation Transmission Systems for  
Interactive Cable Television Services - IP Cable Modems;  
Part 2: Physical Layer;**

**DOCSIS 3.0**

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# Contents

Intellectual Property Rights .....	9
Foreword.....	9
1 Scope .....	10
1.1 Introduction and Purpose.....	10
1.2 Requirements.....	10
1.3 Conventions.....	10
2 References .....	11
2.1 Normative references .....	11
2.2 Informative references.....	12
3 Definitions and abbreviations.....	12
3.1 Definitions .....	12
3.2 Abbreviations .....	18
4 Void.....	20
5 Functional Assumptions .....	20
5.1 Equipment Assumptions.....	20
5.1.1 Frequency Plan .....	20
5.1.2 Compatibility with Other Services.....	20
5.1.3 Fault Isolation Impact on Other Users .....	20
5.1.4 Cable System Terminal Devices .....	21
5.2 RF Channel Assumptions .....	21
5.2.1 Transmission Downstream .....	21
5.2.2 Transmission Upstream .....	21
5.2.2.1 Availability.....	22
5.3 Transmission Levels.....	22
5.4 Frequency Inversion .....	22
6 Physical Media Dependent Sublayer Specification.....	23
6.1 Scope .....	23
6.2 Upstream .....	23
6.2.1 Overview .....	23
6.2.2 Signal Processing Requirements.....	24
6.2.3 Modulation Formats.....	26
6.2.4 R-S Encode .....	27
6.2.4.1 R-S Encode Modes.....	27
6.2.4.2 R-S Bit-to-Symbol Ordering .....	27
6.2.5 Upstream R-S Frame Structure for DOCSIS 3.0 Multiple Transmit Channel mode Enabled .....	27
6.2.5.1 R-S Codeword Length.....	28
6.2.5.1.1 Burst Size .....	28
6.2.5.1.2 Fixed Codeword Length .....	28
6.2.5.1.3 Shortened Last Codeword .....	29
6.2.5.2 R-S FEC Disabled.....	29
6.2.6 Upstream R-S Frame Structure for DOCSIS 3.0 Multiple Transmit Channel mode Not Enabled .....	29
6.2.7 TDMA Byte Interleaver.....	29
6.2.7.1 Byte Interleaver Parameters .....	29
6.2.7.2 Interleaver Operating Modes.....	30
6.2.7.2.1 Fixed Mode.....	30
6.2.7.2.2 Dynamic Mode .....	31
6.2.8 Scrambler (Randomizer).....	32
6.2.9 TCM Encoder .....	33
6.2.9.1 Byte to TCM Symbol Mapping.....	33
6.2.10 Preamble Prepend .....	35
6.2.11 Modulation Rates.....	36
6.2.11.1 DOCSIS 3.0 Modulation Rates .....	36
6.2.11.2 Backward Compatibility Modulation Rates .....	36

6.2.12	S-CDMA Framer and Interleaver .....	36
6.2.12.1	S-CDMA Framing Considerations .....	36
6.2.12.2	Mini-slot Numbering .....	36
6.2.12.2.1	Mini-slot Numbering Parameters in UCD .....	38
6.2.12.2.2	Mini-slot Numbering Examples .....	39
6.2.12.3	Transmission Time .....	40
6.2.12.4	Latency Considerations .....	40
6.2.12.5	Spreader-off Bursts for Maintenance on S-CDMA channel .....	40
6.2.12.6	Limiting the Number of Codes Assigned to a CM .....	42
6.2.13	S-CDMA Framer .....	42
6.2.13.1	Subframe Definition .....	42
6.2.13.2	Framer Operation .....	43
6.2.13.2.1	Rules for Preamble and Coded TCM Symbols .....	43
6.2.13.2.2	Rules for Uncoded Symbols and the Uncoded TCM Subsymbols .....	44
6.2.13.2.3	Subframe Example .....	44
6.2.13.2.4	Frame Transmission .....	45
6.2.14	Symbol Mapping .....	45
6.2.15	S-CDMA Spreader .....	51
6.2.15.1	Code Hopping .....	52
6.2.15.1.1	Code Hopping Mode 1 .....	53
6.2.15.1.2	Code Hopping Mode 2 .....	53
6.2.15.1.3	Code hopping generator .....	55
6.2.16	Transmit Pre-Equalizer .....	57
6.2.17	Spectral Shaping .....	59
6.2.17.1	Upstream Frequency Agility and Range .....	59
6.2.17.2	Spectrum Format .....	59
6.2.18	Relative Processing Delays .....	59
6.2.19	Transmit Power Requirements .....	60
6.2.19.1	TDMA Transmit Power Calculations .....	64
6.2.19.2	S-CDMA Transmit Power Calculations .....	65
6.2.19.2.1	S-CDMA Transmit Power Calculations when Maximum Scheduled Codes Is Not Enabled .....	65
6.2.19.2.2	S-CDMA Transmit Power Calculations When Maximum Scheduled Codes is Enabled .....	66
6.2.19.3	Transmit Power Step Size .....	69
6.2.19.4	Transmit Power Requirements for Multiple Transmit Channel mode Not Enabled .....	69
6.2.20	Burst Profiles .....	70
6.2.20.1	Ranging Offset .....	71
6.2.20.2	TDMA Reconfiguration Times .....	72
6.2.20.3	S-CDMA Reconfiguration Time .....	73
6.2.20.4	CM Timing Offsets When Changing Modulation Rate .....	74
6.2.21	Burst Timing Convention .....	75
6.2.22	Fidelity Requirements .....	76
6.2.22.1	Spurious Emissions .....	76
6.2.22.1.1	Adjacent Channel Spurious Emissions .....	79
6.2.22.1.2	Spurious Emissions in the Upstream Frequency Range .....	79
6.2.22.2	Spurious Emissions During Burst On/Off Transients .....	80
6.2.22.3	Modulation Error Ratio (MER) .....	80
6.2.22.3.1	Definitions .....	80
6.2.22.3.2	Requirements .....	81
6.2.22.4	Filter Distortion .....	82
6.2.22.4.1	Amplitude .....	82
6.2.22.5	Carrier Phase Noise .....	83
6.2.22.6	Channel Frequency Accuracy .....	83
6.2.22.7	Modulation Rate Accuracy .....	83
6.2.22.8	Modulation Timing Jitter .....	83
6.2.22.8.1	Symbol Timing Jitter for TDMA Upstream Channels in Asynchronous Operation .....	83
6.2.22.8.2	Modulation Timing Jitter for Synchronous Operation .....	84
6.2.23	Upstream Demodulator Input Power Characteristics .....	84
6.2.24	Upstream Electrical Output from the CM .....	85
6.2.25	Upstream CM Transmitter Capabilities .....	86
6.2.25.1	Description of CM Upstream Transmit Channel Set Capability .....	86
6.3	Downstream .....	87
6.3.1	Downstream Protocol and Interleaving Support .....	87

6.3.2	Downstream Electrical Input to CM .....	87
6.3.3	CM BER Performance .....	87
6.3.3.1	64-QAM .....	88
6.3.3.1.1	64-QAM CM BER Performance .....	88
6.3.3.1.2	Image Rejection Performance .....	88
6.3.3.1.3	64-QAM Adjacent Channel Performance.....	88
6.3.3.2	256-QAM .....	88
6.3.3.2.1	256-QAM CM BER Performance .....	88
6.3.3.2.2	256-QAM Image Rejection Performance .....	88
6.3.3.2.3	256-QAM Adjacent Channel Performance.....	89
6.3.4	Downstream Multiple Receiver Capabilities .....	89
6.3.4.1	Receive Module Parameters.....	89
6.3.4.2	Receive Channel Parameters .....	90
6.3.4.3	Standard Receive Channel Profile.....	90
6.3.4.4	Example Manufacturer Receive Channel Profile .....	91
6.3.4.5	Reconfiguration of CM Receive Channels.....	92
6.3.5	Non-Synchronous DS Channel Support .....	92
<b>Annex A (normative): Timing Requirements for Supporting Business Services over DOCSIS .....</b>		<b>93</b>
A.1	CMTS .....	93
A.2	CM.....	93
<b>Annex B (normative): Additions and Modifications for European Specification .....</b>		<b>94</b>
B.1	Scope .....	94
B.1.1	Introduction and Purpose .....	94
B.1.2	Background .....	94
B.1.2.1	Broadband Access Network .....	94
B.1.2.2	Network and System Architecture .....	94
B.1.2.2.1	The DOCSIS Network .....	94
B.1.2.3	Service Goals .....	95
B.1.2.4	Statement of Compatibility .....	95
B.1.2.5	Reference Architecture .....	95
B.1.2.6	Void .....	95
B.1.3	Requirements.....	95
B.1.4	Conventions.....	95
B.1.5	Void.....	95
B.2	References .....	95
B.2.1	Normative References .....	95
B.2.2	Informative References .....	95
B.2.3	Reference Acquisition .....	95
B.3	Terms and Definitions .....	95
B.4	Abbreviations and Acronyms .....	96
B.5	Functional Assumptions .....	96
B.5.1	Equipment Assumptions.....	96
B.5.1.1	Frequency Plan .....	96
B.5.1.2	Compatibility with Other Services.....	96
B.5.1.3	Fault Isolation Impact on Other Users .....	96
B.5.1.4	Cable System Terminal Devices .....	96
B.5.2	RF Channel Assumptions.....	96
B.5.2.1	Transmission Downstream .....	97
B.5.2.2	Transmission Upstream .....	98
B.5.2.2.1	Availability.....	98
B.5.3	Transmission Levels.....	98
B.5.4	Frequency Inversion.....	98
B.6	Physical Media Dependent Sublayer Specification.....	98
B.6.1	Scope .....	98

B.6.2	Upstream .....	99
B.6.2.1	Overview .....	99
B.6.2.2	Signal Processing Requirements .....	100
B.6.2.3	Modulation Formats .....	100
B.6.2.4	R-S Encode .....	100
B.6.2.4.1	R-S Encode Modes .....	100
B.6.2.4.2	R-S Bit-to-Symbol Ordering .....	100
B.6.2.5	Upstream R-S Frame Structure for DOCSIS 3.0 Multiple Transmit Channel mode Enabled .....	100
B.6.2.5.1	R-S Codeword Length .....	100
B.6.2.5.1.1	Burst Size .....	100
B.6.2.5.1.2	Fixed Codeword Length .....	101
B.6.2.5.1.3	Shortened Last Codeword .....	101
B.6.2.5.2	R-S FEC Disabled .....	101
B.6.2.6	Upstream R-S Frame Structure for DOCSIS 3.0 Multiple Transmit Channel mode Not Enabled .....	101
B.6.2.7	TDMA Byte Interleaver .....	101
B.6.2.7.1	Byte Interleaver Parameters .....	101
B.6.2.7.2	Interleaver Operating Modes .....	101
B.6.2.7.2.1	Fixed Mode .....	101
B.6.2.7.2.2	Dynamic Mode .....	101
B.6.2.8	Scrambler (Randomizer) .....	101
B.6.2.9	TCM Encoder .....	101
B.6.2.9.1	Byte to TCM Symbol Mapping .....	101
B.6.2.10	Preamble Prepend .....	101
B.6.2.11	Modulation Rates .....	101
B.6.2.11.1	DOCSIS 3.0 Modulation Rates .....	102
B.6.2.11.2	Backward Compatibility Modulation Rates .....	102
B.6.2.12	S-CDMA Framing and Interleaver .....	102
B.6.2.12.1	S-CDMA Framing Considerations .....	102
B.6.2.12.2	Mini-slot Numbering .....	102
B.6.2.12.2.1	Mini-slot Numbering Parameters in UCD .....	102
B.6.2.12.2.2	Mini-slot Numbering Examples .....	102
B.6.2.12.3	Transmission Time .....	102
B.6.2.12.4	Latency Considerations .....	102
B.6.2.12.5	Spreader-off Bursts for Maintenance on S-CDMA channel .....	102
B.6.2.12.6	Limiting the Number of Codes Assigned to a CM .....	102
B.6.2.13	S-CDMA Framing .....	102
B.6.2.13.1	Subframe Definition .....	102
B.6.2.13.2	Framing Operation .....	102
B.6.2.13.2.1	Rules for Preamble and Coded TCM Symbols .....	102
B.6.2.13.2.2	Rules for Uncoded Symbols and the Uncoded TCM Subsymbols .....	103
B.6.2.13.2.3	Subframe Example .....	103
B.6.2.13.2.4	Frame Transmission .....	103
B.6.2.14	Symbol Mapping .....	103
B.6.2.15	S-CDMA Spreader .....	103
B.6.2.15.1	Code Hopping .....	103
B.6.2.15.1.1	Code Hopping Mode 1 .....	103
B.6.2.15.1.2	Code Hopping Mode 2 .....	103
B.6.2.15.1.3	Code Hopping Generator .....	103
B.6.2.16	Transmit Pre-Equalizer .....	103
B.6.2.17	Spectral Shaping .....	105
B.6.2.17.1	Upstream Frequency Agility and Range .....	105
B.6.2.17.2	Spectrum Format .....	105
B.6.2.18	Relative Processing Delays .....	105
B.6.2.19	Transmit Power Requirements .....	106
B.6.2.19.1	TDMA Transmit Power Calculations .....	109
B.6.2.19.2	S-CDMA Transmit Power Calculations .....	110
B.6.2.19.2.1	S-CDMA Transmit power Calculations with Maximum Scheduled Codes Not Enabled .....	110
B.6.2.19.2.2	S-CDMA Transmit Power Calculations With Maximum Scheduled Codes Enabled .....	112
B.6.2.19.3	Transmit Power Step Size .....	114
B.6.2.19.4	Transmit Power Requirements for Multiple Transmit Channel mode Not Enabled .....	114
B.6.2.20	Burst Profiles .....	115
B.6.2.20.1	Ranging Offset .....	116



B.6.2.20.2	TDMA Reconfiguration Times .....	116
B.6.2.20.3	S-CDMA Reconfiguration Times .....	118
B.6.2.20.4	CM Timing Offsets When Changing Modulation Rate.....	118
B.6.2.21	Burst Timing Convention .....	118
B.6.2.22	Fidelity Requirements.....	118
B.6.2.22.1	Spurious Emissions .....	118
B.6.2.22.1.1	Adjacent Channel Spurious Emissions .....	120
B.6.2.22.1.2	Spurious Emissions in the Upstream Frequency Range .....	121
B.6.2.22.2	Spurious Emissions During Burst On/Off Transients .....	121
B.6.2.22.3	Modulation Error Ratio (MER).....	121
B.6.2.22.3.1	Definitions .....	122
B.6.2.22.3.2	Requirements .....	122
B.6.2.22.4	Filter Distortion.....	122
B.6.2.22.4.1	Amplitude.....	123
B.6.2.22.5	Carrier Phase Noise.....	123
B.6.2.22.6	Channel Frequency Accuracy .....	123
B.6.2.22.7	Modulation Rate Accuracy .....	123
B.6.2.22.8	Modulation Timing Jitter .....	123
B.6.2.22.8.1	Symbol Timing Jitter for TDMA Upstream Channels in Asynchronous Operation.....	123
B.6.2.22.8.2	Modulation Timing Jitter for Synchronous Operation.....	123
B.6.2.23	Upstream Demodulator Input Power Characteristics.....	123
B.6.2.24	Upstream Electrical Output from the CM.....	123
B.6.2.25	Upstream CM Transmitter Capabilities .....	124
B.6.2.25.1	Description of CM Upstream Transmit Channel Set Capabilities.....	124
B.6.3	Downstream .....	124
B.6.3.1	Downstream Protocol and Interleaving Support.....	124
B.6.3.2	Downstream Electrical Input to CM .....	125
B.6.3.3	CM BER Performance.....	125
B.6.3.3.1	64-QAM.....	125
B.6.3.3.1.1	64-QAM CM BER Performance .....	125
B.6.3.3.1.2	64-QAM Image Rejection Performance.....	126
B.6.3.3.1.3	64-QAM Adjacent Channel Performance.....	126
B.6.3.3.2	256-QAM.....	126
B.6.3.3.2.1	256-QAM CM BER Performance.....	126
B.6.3.3.2.2	256-QAM Image Rejection Performance .....	126
B.6.3.3.2.3	256-QAM Adjacent Channel Performance.....	126
B.6.3.4	Downstream Multiple Receiver Capabilities .....	126
B.6.3.4.1	Receive Module Parameters.....	126
B.6.3.4.2	Receive Channel Parameters.....	127
B.6.3.4.3	Standard Receive Channel Profile.....	127
B.6.3.4.4	Example Manufacturer Receive Channel Profile.....	127
B.6.3.4.5	Reconfiguration of CM Receive Channels.....	128
B.6.3.5	Non-Synchronous DS Channel Support .....	128
<b>Annex C (normative):</b>	<b>MPEG Header Synchronization and Recovery.....</b>	<b>129</b>
C.1	MPEG Header Synchronization and Recovery in the North American Technology Option.....	129
C.2	MPEG Header Synchronization and Recovery in the European Technology Option.....	129
<b>Annex D (informative):</b>	<b>Example Preamble Sequence Introduction .....</b>	<b>130</b>
D.1	Example Preamble Sequence .....	130
<b>Annex E (informative):</b>	<b>S-CDMA Framing.....</b>	<b>132</b>
E.1	Coded Subsymbol Numbering .....	132
E.2	Uncoded Subsymbol Numbering .....	132
E.3	Framer Output Numbering .....	133
E.4	Comments.....	133
<b>Annex F (informative):</b>	<b>Ambient Temperature and Wind Loading Effects .....</b>	<b>134</b>

F.1	Synchronization Tolerances to Plant Delay Variations .....	134
F.2	Change in Propagation Delay Due to Temperature Changes .....	135
F.2.1	Fibre Delay Changes Due to Temperature .....	135
F.2.2	Coaxial Cable Delay Changes Due to Temperature .....	136
F.2.3	Delay Change Due to Wind.....	136
<b>Annex G (informative):</b>	<b>Description of Upstream Transmit Channel Set Capability: Example Calculations for Reporting and Figuring the Number of Active Channels Supported .....</b>	<b>137</b>
<b>Annex H (informative):</b>	<b>Description of Upstream Channel Power Control with Multiple Upstream Channels.....</b>	<b>139</b>
H.1	DOCSIS 2.0 Parameters Extended to Multiple Transmit Channel mode.....	139
H.2	New Parameters in DOCSIS 3.0 Upstream Power Control ("loading," $P_{load\_n}$ , $P_{load\_min\_set}$ , Dynamic Range Window, $P_{low\_multi\_n}$ ) .....	139
H.3	Example Upstream Power Control with Multiple Transmit Channel mode Enabled .....	140
H.4	Examples Regarding Concurrent and Consecutive Changes in $P_{r\_n}$ and $P_{load\_min\_set}$ .....	142
<b>Annex I (informative):</b>	<b>Example Spurious Emissions Noise Power Limits with Multiple Channels Bursting.....</b>	<b>144</b>
History .....		149

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## Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

The present document is part 2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.4].

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# 1 Scope

## 1.1 Introduction and Purpose

The present document is part of a series that defines the third generation of high-speed data-over-cable systems. This series was developed for the benefit of the cable industry and includes contributions by operators and vendors from North America, Europe and other regions.

There are differences in the cable spectrum planning practices adopted for different networks in the world. Therefore, two options for physical layer technology are included, which have equal priority and are not required to be interoperable. One technology option is based on the downstream multi-program television distribution that is deployed in North America using 6 MHz channelling. The other technology option is based on the corresponding European multi-program television distribution. Both options have the same status, notwithstanding that the document structure does not reflect this equal priority. The first of these options is defined in clauses 4 and 6, whereas the second is defined by replacing the content of those clauses with the content of annex B. Correspondingly, [17] and [1] apply only to the first option and [3] only to the second. Compliance with the present document requires compliance with the one or the other of these implementations, not with both. It is not required that equipment built to one option will interoperate with equipment built to the other.

These optional physical-layer technologies allow operators flexibility in mandated areas of operation, including any frequency planning, EMC (electromagnetic compatibility) and safety requirements. For example, the 6 MHz downstream based option defined in clauses 5 and 6 might be deployable within an 8 MHz channel plan. Compliance with frequency planning and EMC requirements is not covered by this specification and remains the operators' responsibility. In this respect, [13] and [14] are relevant to North America and [i.1], [5], [7], [8], [6], [9], [10] and [11] are relevant to the European Union.

Backwards compatibility with earlier versions of that technology [12] is only ensured within the same technology options referred to above and not between the two options.

## 1.2 Requirements

Throughout the present document, the words that are used to define the significance of particular requirements are capitalized. These words are:

"MUST"	This word means that the item is an absolute requirement of this specification.
"MUST NOT"	This phrase means that the item is an absolute prohibition of this specification.
"SHOULD"	This word means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
"SHOULD NOT"	This phrase means that there may exist valid reasons in particular circumstances when the listed behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.
"MAY"	This word means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

The present document defines many features and parameters and a valid range for each parameter is usually specified. Equipment (CM and CMTS) requirements are always explicitly stated. Equipment must comply with all mandatory (MUST and MUST NOT) requirements to be considered compliant with this specification. Support of non-mandatory features and parameter values is optional.

## 1.3 Conventions

In this specification the following convention applies any time a bit field is displayed in a figure. The bit field should be interpreted by reading the figure from left to right, then, top to bottom, with the MSB being the first bit read and the LSB being the last bit read.

## 2 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 reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

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

### 2.1 Normative references

The following referenced documents are necessary for the application of the present document.

- [1] CEA-542-C (2009): "Cable Television Channel Identification Plan".
- [2] Cable Television Laboratories, Inc., CM-SP-DTI-I05-081209 (December 2008): "Data-Over-Cable Service Interface Specifications - Modular Headend Architecture - DOCSIS Timing Interface Specification".
- [3] ETSI EN 300 429 (V1.2.1): "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems".
- [4] ETSI EN 302 878-3 (V1.1.1): "Access, Terminals, Transmission and Multiplexing (ATTM); Third Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems; Part 3: Downstream Radio Frequency Interface; DOCSIS 3.0".
- [5] CENELEC EN 60728-11 (2005): "Cable networks for television signals, sound signals and interactive services - Part 11: Safety".
- [6] CENELEC EN 50083-10 (2002): "Cable networks for television signals, sound signals and interactive services - Part 10: System performance for return paths".
- [7] CENELEC EN 50083-2 (2006): "Cable networks for television signals, sound signals and interactive services - Part 2: Electromagnetic compatibility for equipment".
- [8] CENELEC EN 50083-7 (1996): "Cable networks for television signals, sound signals and interactive services - Part 7: System performance".
- [9] CENELEC EN 60950-1 (2006): "Information technology equipment - Safety - Part 1: General requirements".
- [10] CENELEC EN 61000-6-4 (2007): "Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments".
- [11] CENELEC EN 61000-6-3 (2007): "Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments".
- [12] ETSI ES 202 488-2 (V1.1.1): "Access and Terminals (AT); Second Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems; Part 2: Radio frequency interface specification".
- [13] Code of Federal Regulations, Title 47: "Telecommunication, Part 15: Radio Frequency Devices".
- [14] Code of Federal Regulations, Title 47: "Telecommunication, Part 76: Multichannel Video and Cable Television Service".
- [15] ISO/IEC 13818-1 (2007): "Information technology -- Generic coding of moving pictures and associated audio information: Systems".

- [16] ISO/IEC 61169-24 (2009): "Radio-frequency connectors - Part 24: Sectional specification - Radio frequency coaxial connectors with screw coupling, typically for use in 75  $\Omega$  cable networks (type F)".
- [17] ITU-T Recommendation J.83 (2007), Annex B: "Digital multi-programme systems for television, sound and data services for cable distribution".
- [18] ETSI EN 302 878-4 (V1.1.0): "Access, Terminals, Transmission and Multiplexing (ATTM); Third Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems; Part 4: MAC and Upper Layer Protocols; DOCSIS 3.0".
- [19] Cable Television Laboratories, Inc., CM-SP-OSSIV3.0-I13-101008 (October 2010): "Data-Over-Cable Service Interface Specifications - DOCSIS 3.0 - Operations Support System Interface Specification".
- [20] ANSI/SCTE 02 (2006): "Specification for "F" Port, Female, Indoor".
- [21] Cable Television Laboratories, Inc., CM-SP-TEI-I06-100611 (2010): "Data-Over-Cable Service Interface Specifications - Business Services over DOCSIS - TDM Emulation Interface Specification".

## 2.2 Informative references

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] ETSI EG 201 212 (V1.2.1): "Electrical safety; Classification of interfaces for equipment to be connected to telecommunication networks".
  - [i.2] Cable Television Laboratories, Inc. (November 1994): "Digital Transmission Characterization of Cable Television Systems".
- NOTE: Available at [http://www.cablelabs.com/downloads/digital\\_transmission.pdf](http://www.cablelabs.com/downloads/digital_transmission.pdf).  
<https://standards.iteh.ai/catalog/standards/sist/2b461974-9186-4c1e-8062-29a3a87c>
- [i.3] NCTA Recommended Practices for measurements on Cable Television Systems - National Cable Television Association, Washington DC, 2nd Edition, revised October 1993.
  - [i.4] ETSI EN 302 878-1: "Access, Terminals, Transmission and Multiplexing (ATTM); Third Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems; Part 1: General; DOCSIS 3.0".
  - [i.5] IETF RFC 791: "Internet Protocol".
  - [i.6] IETF RFC 2460: "Internet Protocol, Version 6 (IPv6) Specification".

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## 3 Definitions and abbreviations

### 3.1 Definitions

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

**active codes:** set of spreading codes which carry information in an S-CDMA upstream. The complementary set, the unused codes, are idle and are not transmitted. Reducing the number of active codes below the maximum value of 128 may provide advantages including more robust operation in the presence of coloured noise.

**allocation:** group of contiguous mini-slots in a MAP which constitutes a single transmit opportunity

**availability:** in cable television systems, availability is the long-term ratio of the actual RF channel operation time to scheduled RF channel operation time (expressed as a percent value) and is based on a Bit Error Rate (BER) assumption

**Bandwidth Allocation Map (MAP):** MAC Management Message that the CMTS uses to allocate transmission opportunities to cable modems (MAP)

**Bit Error Rate (BER):** percentage of bits that have errors relative to the total number of bits received in a transmission, usually expressed as ten to a negative power

**burst:** single continuous RF signal from the upstream transmitter, from transmitter on to transmitter off

**Cable Modem (CM):** modulator-demodulator at subscriber locations intended for use in conveying data communications on a cable television system

**Cable Modem Termination System (CMTS):** Cable modem termination system, located at the cable television system head-end or distribution hub, which provides complementary functionality to the cable modems to enable data connectivity to a wide-area network

**Capture Bandwidth (CBW):** sum of the Tuning Bands in the TB List in MHz

**carrier hum modulation:** peak-to-peak magnitude of the amplitude distortion relative to the RF carrier signal level due to the fundamental and low-order harmonics of the power-supply frequency

**Carrier-to-Noise Ratio (C/N) (CNR):** ratio of signal power to noise power in the defined measurement bandwidth. For digital modulation,  $C/N = E_s/N_0$ , the energy-per-symbol to noise-density ratio; the signal power is measured in the occupied bandwidth and the noise power is normalized to the modulation-rate bandwidth. For video, the measurement bandwidth is 4 MHz (C/N).

**channel:** See RF Channel.

**channel bonding:** logical process that combines the data packets received on multiple independent channels into one higher-speed data stream. Channel bonding can be implemented independently on upstream channels or downstream channels.

**chip:** each of the 128 bits comprising the S-CDMA spreading codes

**chip rate:** rate at which individual chips of the S-CDMA spreading codes are transmitted (1 280 kHz to 5 120 kHz),  $E_s/N_0$

**codeword:** element of an error-correcting code used to detect and correct transmission errors

**codeword error rate:** ratio of the number of uncorrectable code words to the total number of code words sent without errors, with corrected errors and with uncorrectable errors

**Composite Second Order beat (CSO):** peak of the average level of distortion products due to second order nonlinearities in cable system equipment

**Composite Triple Beat (CTB):** peak of the average level of distortion components due to third-order nonlinearities in cable system equipment

**cross-modulation:** form of television signal distortion where modulation from one or more television channels is imposed on another channel or channels

**Customer Premises Equipment (CPE):** equipment at the end user's premises; may be provided by the end user or the service provider

**Decibel-Millivolt (dBmV):** dB measurement system wherein 0 dBmV is defined as 1 millivolt over 75  $\Omega$

**Decibels (dB):** unit to measure the relative levels of current, voltage or power. An increase of 3 dB indicates a doubling of power, an increase of 10 dB indicates a 10x increase in power and an increase of 20 dB indicates a 100x increase in power.

**demodulator module:** physical entity in the CM that demodulates a block of one or more contiguous channels of a single bandwidth (6 MHz or 8 MHz) within the output from a single tuner

**distribution hub:** location in a cable television network which performs the functions of a head-end for customers in its immediate area and which receives some or all of its television program material from a Master Head-end in the same metropolitan or regional area