



**Integrated broadband cable
telecommunication networks (CABLE);
Fourth Generation Transmission Systems for Interactive Cable
Television Services - IP Cable Modems;
Part 2: Physical Layer;
DOCSIS[®] 3.1**

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Integrated broadband cable telecommunication networks (CABLE).

The present document is part 2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [21].

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Modal verbs terminology

In the present document "**shall**", "**shall not**", "**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).

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1 Scope

The present document is part of a series of specifications that defines the fourth generation of high-speed data-over-cable systems, commonly referred to as the DOCSIS 3.1 specifications. The present document was developed for the benefit of the cable industry, and includes contributions by operators and vendors from North and South America, Europe and Asia.

This generation of the DOCSIS specifications builds upon the previous generations of DOCSIS specifications (commonly referred to as the DOCSIS 3.0 and earlier specifications), leveraging the existing Media Access Control (MAC) and Physical (PHY) layers, but with the addition of a new PHY layer designed to improve spectral efficiency and provide better scaling for larger bandwidths (and appropriate updates to the MAC and management layers to support the new PHY layer). It includes backward compatibility for the existing PHY layers in order to enable a seamless migration to the new technology.

There are differences in the cable spectrum planning practices adopted for different networks in the world. For the new PHY layer defined in the present document, there is flexibility to deploy the technology in any spectrum plan; therefore, no special accommodation for different regions of the world is required for this new PHY layer.

However, due to the inclusion of the DOCSIS 3.0 PHY layers for backward compatibility purposes, there is still a need for different region-specific physical layer technologies. Therefore, three options for physical layer technologies are included in the present document, which have equal priority and are not required to be interoperable. One technology option is based on the downstream channel identification plan that is deployed in North America using 6 MHz spacing. The second technology option is based on the corresponding European multi-program television distribution. The third technology option is based on the corresponding Chinese multi-program television distribution. All three 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 5 and 6, whereas the second is defined by replacing the content of those sections with the content of Annex C. The third is defined by replacing the content of those sections with the content of Annex D. Correspondingly, [18] and [2] apply only to the first option, and [8] apply to the second and third. Compliance with the present document requires compliance with one of these implementations, but not with all three. It is not required that equipment built to one option shall interoperate with equipment built to the other.

Compliance with frequency planning and EMC requirements is not covered by the present document and remains the operators' responsibility. In this respect, [14] and [15] are relevant to the USA; [1] and [i.5] to Canada; [7], [9], [10], [11], [12] and [13] are relevant to the European Union; [16] and [i.4] are relevant to China.

The present document defines the interface for the physical layer, and corresponds to the CableLabs specification [i.8].

2 References

2.1 Normative 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.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://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.

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

- [1] IEC CISPR 22:2008 (2008): "Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement".
- [2] CEA-542-D (2013): "CEA Standard: Cable Television Channel Identification Plan".

- [3] ETSI EN 302 878-3: "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".
- [4] ETSI TS 103 311-3: "Integrated broadband cable telecommunication networks (CABLE); Fourth Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems Part 3: MAC and Upper Layer Protocols Interface; DOCSIS® 3.1".
- [5] ETSI EN 302 878-2: "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".
- [6] ETSI EN 302 769 (V1.2.1): "Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital transmission system for cable systems (DVB-C2)".
- [7] ETSI EG 201 212 (V1.2.1): "Electrical safety; Classification of interfaces for equipment to be connected to telecommunication networks".
- [8] ETSI EN 300 429 (V1.2.1): "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems".
- [9] CENELEC EN 50083-1 (2002): "Cabled distribution systems for television, sound and interactive multimedia signals - Part 1: Safety requirements".
- [10] CENELEC EN 50083-2 (2005): "Cable networks for television signals, sound signals and interactive services -- Part 2: Electromagnetic compatibility for equipment".
- [11] CENELEC EN 50083-7 (1996): "Cable networks for television signals, sound signals and interactive services -- Part 7: System performance".
- [12] CENELEC EN 61000-6-4 (2001): "Electromagnetic compatibility (EMC) -- Part 6-4: Generic standards - Emission standard for industrial environments".
- [13] CENELEC EN 61000-6-3 (2003): "Electromagnetic compatibility (EMC) -- Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments".
- [14] Code of Federal Regulations, Title 47, Part 15 (October 2005).
- [15] Code of Federal Regulations, Title 47, Part 76 (October 2005).
- [16] Standardization Administration of People's republic of China (SAC): "Audio, video and similar electronic apparatus-Safety requirements".

NOTE: Available at www.sac.gov.cn.

- [17] ISO/IEC-61169-24 (2001): "Radio-frequency connectors - Part 24: Sectional specification - Radio frequency coaxial connectors with screw coupling, typically for use in 75 ohm cable distribution systems (type F)".
- [18] Annex B to Recommendation ITU-T J.83 (2007): "Digital multi-program systems for television sound and data services for cable distribution".
- [19] ANSI/SCTE 02, Specification for "F" Port, Female Indoor.
- [20] SCTE Measurement Recommended Practices for Cable Systems, Fourth Edition (March 2012).
- [21] ETSI TS 103 311-1: "Integrated broadband cable telecommunication networks (CABLE); Fourth Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems; Part 1: General; DOCSIS® 3.1".

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] G. Castagnoli, S. Bräuer, and M. Herrmann: "Optimization of Cyclic Redundancy-Check Codes with 24 and 32 Parity Bits", IEEE Transactions on Communications, vol. 41, No. 6, pp. 883-892, June 1993.
- [i.2] Cable Television Laboratories, Inc.: "DOCSIS 3.1 CCAP Operations Support System Interface Specification", CM-SP-CCAP-OSSIV3.1-I01-140808, August 8, 2014.
- [i.3] Cable Television Laboratories, Inc.: "DOCSIS 3.1 Cable Modem Operations Support System Interface Specification", CM-SP-CM-OSSIV3.1-I01-140619, June 19, 2014.
- [i.4] China Zhijian Publish House SAC: "Equipments and components used in cabled distribution systems primarily intended for television and sound signals--Part 1: Generic specifications".
- [i.5] Information Technology Equipment (ITE): "Limits and methods of measurement".
- [i.6] Cable Television Laboratories, Inc.: "Number and size of codewords versus grant sizes", CM-PHYv3.1-CODECHECK-131029.

NOTE: Available at <https://community.cablelabs.com/wiki/plugins/servlet/cablelabs/alfresco/download?id=f039b211-b5dc-4b0d-81b7-bbf1dd782a64;1.0>.

- [i.7] PHYv3.1QAM Mapping, bit to constellation symbol mapping for DOCSIS 3.1, April 2014.

NOTE: Available at <https://community.cablelabs.com/wiki/plugins/servlet/cablelabs/alfresco/download?id=794df4ae-500c-49dc-bfd9-1ddace26c235;1.0>.

- [i.8] Cable Television Laboratories, Inc.: "DOCSIS 3.1 Physical Layer Specification", CM-SP-PHYv3.1-I03-140610, June 10, 2014.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

active channel: any channel which has been assigned to a cable modem's transmit channel set either in a registration response message or a dynamic bonding request message, and prior to registration

NOTE: After registration, the set of active channels also is called the transmit channel set. If the CMTS needs to add, remove, or replace channels in the cable modem's transmit channel set, it uses the dynamic bonding request message with transmit channel configuration encodings to define the desired new transmit channel set. Note that the set of channels actually bursting upstream from a cable modem is a subset of that cable modem's active channels. In many instances one or all of a cable modem's active channels will not be bursting, but such quiet channels are still considered active channels for that cable modem.

active subcarrier:

- 1) In a downstream OFDM channel, any subcarrier other than an excluded subcarrier.