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Recommendation

ITU-T J.225 (07/2023)

SERIES J: Cable networks and transmission of television, sound programme and other multimedia signals

Interactive systems for digital television distribution (DOCSIS third to fifth generations)

Fourth-generation transmission systems for interactive cable television services – IP cable modems

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Recommendation ITU-T J.225

Fourth-generation transmission systems for interactive cable television services – IP cable modems

Summary

Recommendation ITU-T J.225 defines the fourth-generation of high-speed data-over-cable systems. The fourth-generation transmission systems introduce a number of new features that build upon what was present in previous Recommendations ITU-T J.112, ITU-T J.122, ITU-T J.222.x-series, and ITU-T J.223.x-series. This Recommendation includes key new features for the physical (PHY) layer and enhancements to the media access control (MAC) layer protocols as well as requirements for upper layer protocols such as Internet protocol (IP), dynamic host configuration protocol (DHCP), etc. The fourth-generation cable modem specifications are incorporated fully in this Recommendation. Informative Supplement 10 to the ITU-T J-series Recommendations contains the correspondence between the data over cable service interface specification (DOCSIS) versions and the ITU-T Recommendations revisions and generations.

NOTE – The structure and content of this Recommendation have been organized for ease of use through direct reference to the original source material, based on the recognition of CableLabs by ITU in accordance with Recommendation ITU-T A.5.

History *

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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Recommendation ITU-T J.225

Fourth-generation transmission systems for interactive cable television services – IP cable modems

1 Scope

This Recommendation defines the fourth-generation of high-speed data-over-cable systems. The fourth-generation transmission systems introduce a number of new features that build upon what was present in previous [ITU-T J.112], [ITU-T J.122], ITU-T J.222.x, and ITU-T J.223.x listed in Annex A. This Recommendation includes key new features for the physical (PHY) layer and enhancements to the media access control (MAC) layer protocols as well as requirements for upper layer protocols such as Internet protocol (IP), dynamic host configuration protocol (DHCP), etc. The fourth-generation cable modem specifications are incorporated fully in this Recommendation. An informative [b-ITU-T J-Sup.10] contains the correspondence between the DOCSIS versions and the ITU-T Recommendations revisions and generations.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[DOCSIS CCAP-OSSIv3.1] Cable Television Laboratories, Inc, CM-SP-CCAP-OSSIv3.1-I25-220819 (2022), *DOCSIS 3.1 CCAP™ OSSI Specification*.

[DOCSIS CM-OSSIv3.1] Cable Television Laboratories, Inc, CM-SP-CM-OSSIv3.1-I23-220819 (2022), *DOCSIS 3.1 Cable Modem OSSI Specification*.

[DOCSIS MULPIv3.1] Cable Television Laboratories, Inc, CMSP-MULPIv3.1-I24-221019 (2022), *MAC and Upper Layer Protocols Interface Specification*.

[DOCSIS PHYv3.1] Cable Television Laboratories Inc, CM-SP-PHYv3.1-I19-211110 (2021), *DOCSIS 3.1, Physical Layer Specification*.

[DOCSIS SECv3.1] Cable Television Laboratories, Inc, CM-SP-SECv3.1-I10-211110 (2021), *DOCSIS 3.1, Security Specification*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DHCP Dynamic Host Configuration Protocol

DOCSIS Data Over Cable Service Interface Specification

IP Internet Protocol

MAC Media Access Control

OFDM Orthogonal Frequency Division Multiplexing

OFDMA Orthogonal Frequency Division Multiple Access

PHY Physical layer

QAM Quadrature Amplitude Modulation

For others, see Section 4 – *Abbreviations and Acronyms* in each of the specifications in clause 2.

5 Conventions

None.

6 Overview of fourth-generation high-speed data-over-cable systems

6.1 Specifications for fourth-generation high-speed data-over-cable systems

With the fourth-generation high-speed data-over-cable systems, a global technical specification has been achieved. As such, it is a general practice of cable operators worldwide to reference the same high quality CableLabs specifications when making purchasing decisions. These specifications have been readily and widely available since late 2013 and cable modem devices have achieved certification since 2016.

The fourth-generation high-speed data-over-cable systems specifications are also known as DOCSIS 3.1 specifications.[2]

The DOCSIS 3.1 specifications introduce a number of features that increase the capability and application of the technology:

1 The use of orthogonal frequency division multiplexing (OFDM) in the downstream and orthogonal frequency division multiple access (OFDMA) in the upstream increases the transmission efficiency (bits/hertz) over single carrier quadrature amplitude modulation (QAM). This enables higher bandwidth capacity over the same amount of spectrum over previous generations of DOCSIS technology with the potential for 10 Gbps service tiers over coax.

2 The specification of multiple modulation profiles enables the cable modems to operate at different modulation orders and to dynamically optimize the transmission capacity for the channel conditions it experiences. This improves the operational efficiency by not constraining all the cable modems to operate at the lowest modulation order supported by the network.

3 The specification of full-band spectrum capture that enables the analysis of the full spectrum as measured from the cable modem enabling sophisticated proactive diagnostics of network issues prior to customer impacting events.

[2] DOCSIS® is a registered trademark of Cable Television Laboratories, Inc. and used in ITU-T Recommendations with permission.

4 The specification of additional security features to enhance the robustness of the DOCSIS network in the face of malicious cyberattacks.

This Recommendation is comprised of the specifications identified in clause 2. Normative references for the specifications in clause 2 are provided in Annex A of this Recommendation. Informative references for the specifications in clause 2 are provided in the Bibliography of this Recommendation.

6.2 CableLabs DOCSIS certification program

In addition to developing DOCSIS specifications, CableLabs also conducts interoperability and compliance testing to validate products that implement the DOCSIS specifications. Details on the CableLabs certification program can be found at: https://www.cablelabs.com/certification.

The DOCSIS specifications are living documents and are updated three to four times per year under a strict engineering change request and document control process. Consequently, it is important that manufacturers of DOCSIS products understand exactly the requirements against which they are being tested for certification. The CableLabs specification and certification process links the engineering change requests with certification testing with sufficient time allowed for manufacturers to implement the required changes. In this way, knowing when a product has been certified, it is possible to know exactly what version of the DOCSIS specifications were used.

Annex A

Normative references for specifications in clause 2

(This annex forms an integral part of this Recommendation.)

The following is the list of normative references for the specifications in clause 2 of this Recommendation.

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[ITU-T J.122] Recommendation ITU-T J.122 (2007), *Second-generation transmission systems for interactive cable television services – IP cable modems*.

[ITU-T J.126] Recommendation ITU-T J.126 (2007), *Embedded Cable Modem device specification*.

[ITU-T J.162] Recommendation ITU-T J.162 (2007), *Network call signalling protocol for the delivery of time-critical services over cable television networks using cable modems*.

[ITU-T J.163] Recommendation ITU-T J.163 (2007), *Dynamic quality of service for the provision of real-time services over cable television networks using cable modems*.

[ITU-T J.179] Recommendation ITU-T J.179 (2005), *IPCablecom support for multimedia*.

[ITU-T J.210] Recommendation ITU-T J.210 (2006), *Downstream RF interface for cable modem termination systems*.

[ITU-T J.211] Recommendation ITU-T J.211 (2006), *Timing interface for cable modem termination systems*.

[ITU-T J.212] Recommendation ITU-T J.212 (2006), *Downstream external Physical layer interface for modular cable modem termination systems*.

[ITU-T J.213] Recommendation ITU-T J.213 (2006), *Layer 2 virtual private networks for IP cable modem systems*.

[ITU-T J.222.1] Recommendation ITU-T J.222.1 (2007), *Third-generation transmission systems for interactive cable television services – IP cable modems: Physical layer specification*.

[ITU-T J.222.2] Recommendation ITU-T J.222.2 (2007), *Third-generation transmission systems for interactive cable television services – IP cable modems: MAC and Upper Layer protocols*.

[ITU-T J.222.3] Recommendation ITU-T J.222.3 (2007), *Third-generation transmission systems for interactive cable television services – IP cable modems: Security services*.

[ITU-T J.223.1] Recommendation ITU-T J.223.1 (2016), *Functional requirements for Cabinet DOCSIS (C-DOCSIS)*.

[ITU-T J.223.2] Recommendation ITU-T J.223.2 (2016), *Cabinet DOCSIS (C-DOCSIS) system specification*.

[ITU-T X.25] Recommendation ITU-T X.25 (1996), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*.

[ITU-T Z.100] Recommendation ITU-T Z.100 (2021), *Specification and Description Language – Overview of SDL-2010*.

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Other references for specifications in clause 2

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[b-ITU-T J-Sup.10] ITU-T J-series Recommendations – Supplement 10 (2023), *Correspondence between CableLabs DOCSIS specifications and ITU-T J-series Recommendations*.

[b-ITU-T J.83.B] Annex B to ITU-T Recommendation J.83 (2007), *Digital multi-program systems for television sound and data services for cable distribution*.

[b-CAN/CSA CISPR 22-10] *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement* (Adopted IEC CISPR 22:2008, sixth edition, 2008-09). <https://webstore.ansi.org/standards/csa/csacispr2210r2019>

[b-C-DOCSIS] *Data-Over-Cable Interface Specifications, C-DOCSIS System Specification*, CM-SP-CDOCSIS-I02-150305, March 5, 2015, Cable Television Laboratories, Inc.

[b-CCAP-CONFIG-YANG] CCAP YANG Configuration Module. <http://www.cablelabs.com/YANG/DOCSIS/3.1>

[b-CCAP-EVENTS-YANG] CCAP YANG Module for Event Messaging, CCAPevents.yang, <http://www.cablelabs.com/YANG/DOCSIS>

[b-CCAP-MIB] Converged Cable Access Platform MIB, CCAP-MIB. <http://www.cablelabs.com/MIBs/DOCSIS>

[b-CLAB-DEF-MIB] CableLabs Definition MIB Specification, CL-SP-MIB-CLABDEF-I12-160325, March 25, 2016, Cable Television Laboratories, Inc.

[b-CLAB-TOPO-MIB] CableLabs Topology MIB, CLAB-TOPO-MIB. <http://www.cablelabs.com/MIBs/common>

[b-DOCS-DIAG-MIB] DOCSIS Diagnostic Log MIB, DOCS-DIAG-MIB. <http://www.cablelabs.com/MIBs/DOCSIS>

[b-DOCS-IF3-MIB] DOCSIS Interface 3 MIB Module, DOCS-IF3-MIB. <http://www.cablelabs.com/MIBs/DOCSIS>

[b-DOCS-IF31-MIB] DOCSIS Interface 3.1 MIB Module, DOCS-IF31-MIB. <http://www.cablelabs.com/MIBs/DOCSIS>

[b-DOCS-IFEXT2-MIB] DOCSIS Interface Extension 2 MIB Module, DOCS-IFEXT2-MIB. <http://www.cablelabs.com/MIBs/DOCSIS>

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