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OF TELEVISION, SOUND PROGRAMME AND OTHER
MULTIMEDIA SIGNALS

Cable set-top box

Requirements and functional specification of cable set-top boxes for 4K ultra-high definition television

Recommendation ITU-T J.297

ITU-T

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Summary

Recommendation ITU-T J.297 specifies requirements and functional specifications for 4K cable set top boxes (STBs) that enable 4K ultra-high definition television (UHDTV) service reception over cable networks, and considers the compatibility and differences with the existing 2K cable STB.

The Recommendation was revised in 2018 mainly to add the multiplex method for type length value (TLV) and channel bonding in the functional specification section, as well as a new high dynamic range (HDR) function for 4K ultra-high definition services.

History

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Table of Contents

		Page
1	Scope.....	1
2	References.....	1
3	Definitions	3
3.1	Terms defined elsewhere	3
3.2	Terms defined in this Recommendation.....	3
4	Abbreviations and acronyms	3
5	Conventions	4
6	Overview.....	5
6.1	4K cable system.....	5
6.2	Block diagram of 4K cable STB functions.....	5
7	Requirements	6
7.1	QAM-based 4K linear video service	6
7.2	IP-based 4K linear video service	7
7.3	4K IP-VOD service	7
7.4	Backward compatibility for 2K cable STB	10
8	Functional specifications	10
8.1	Specifications common to QAM-based and IP-based 4K cable STB for linear video services	10
8.2	Specifications particular to QAM-based and IP-based 4K cable STBs for linear video service.....	13
8.3	Specifications of 4K IP-VOD STB	15
Appendix I – Broadcasting standards (Region A)		18
I.1	ETSI/DVB	18
I.2	IEC/CENELEC.....	19
I.3	CENELEC	19
I.4	ISO/IEC	19
Appendix II – Broadcasting standards (Region B)		20
II.1	ATSC	20
II.2	IEEE	21
II.3	SCTE	21
Appendix III – Broadcasting standards (Region C).....		22
III.1	Broadcasting related specifications for Region C (see clause 8.2.1)	22
III.2	Tuner (see clause 8.2.1.2).....	24
III.3	External interface (see clauses 8.1.5 and 8.3.5)	24
III.4	Software management (see clause 8.2.1.5)	24
III.5	Content protection (see clause 8.1.4)	24
III.6	Decoder for broadcasting type service (see clauses 8.1.1 and 8.1.2)	25
III.7	Forward error correction (see clause 8.2.2.1).....	26

Bibliography.....	27
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Recommendation ITU-T J.297

Requirements and functional specification of cable set-top boxes for 4K ultra-high definition television

1 Scope

This Recommendation specifies the requirements and functional specification of cable set-top boxes (STBs) for 4K ultra-high definition television (UHDTV).

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.

- [ITU-T H.222.0] Recommendation ITU-T H.222.0 (2017) | ISO/IEC 13818-1:2018, *Information technology – Generic coding of moving pictures and associated audio information: Systems.*
- [ITU-T H.262] Recommendation ITU-T H.262 (2012) | ISO/IEC 13818-2: 2013, *Information technology – Generic coding of moving pictures and associated audio information: Video.*
- [ITU-T H.264] Recommendation ITU-T H.264 (2016), *Advanced video coding for generic audiovisual services.*
ISO/IEC 14496-10: 2014, *Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding.*
- [ITU-T H.265] Recommendation ITU-T H.265 (2015), *High efficiency video coding.*
ISO/IEC 23008-2: 2015, *Information technology – High efficiency coding and media delivery in heterogeneous environments – Part 2: High efficiency video coding.*
- [ITU-T H.701] Recommendation ITU-T H.701 (2009), *Content delivery error recovery for IPTV services.*
- [ITU-T H.721] Recommendation ITU-T H.721 (2015), *IPTV terminal devices: Basic model.*
- [ITU-T H.750] Recommendation ITU-T H.750 (2008), *High-level specification of metadata for IPTV services.*
- [ITU-T J.83] Recommendation ITU-T J.83 (2007), *Digital multi-programme systems for television, sound and data services for cable distribution.*
- [ITU-T J.94] Recommendation ITU-T J.94 (2016), *Service information for digital broadcasting in cable television systems.*
- [ITU-T J.112] Recommendation ITU-T J.112 (1998), *Transmission systems for interactive cable television services.*
- [ITU-T J.183] Recommendation ITU-T J.183 (2016), *Time-division multiplexing of multiple MPEG-2 transport streams and generic formats of transport streams over cable television systems.*

- [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.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.288] Recommendation ITU-T J.288 (2016), *Encapsulation of type-length-value (TLV) packet for cable transmission systems.*
- [ITU-T J.295] Recommendation ITU-T J.295 (2012), *Functional requirements for a cable set-top box.*
- [ITU-T J.296] Recommendation ITU-T J.296 (2012), *Specifications for a hybrid cable set-top box.*
- [ITU-T J.1005] Recommendation ITU-T J.1005 (2015), *Architecture and requirements of digital rights management (DRM) for cable television multiscreen.*
- [ITU-T J.1006] Recommendation ITU-T J.1006 (2016), *Specification of IP-VoD DRM for cable television multiscreen system in multi-DRM environment.*
- [ITU-T Y.1910] Recommendation ITU-T Y.1910 (2008), *IPTV functional architecture.*
- [ITU-R BT.709] Recommendation ITU-R BT.709-6 (2015), *Parameter values for the HDTV standards for production and international programme exchange.*
- [ITU-R BT.1869] Recommendation ITU-R BT.1869-0 (2010), *Multiplexing scheme for variable-length packets in digital multimedia broadcasting systems.*
- [ITU-R BT.2100] Recommendation ITU-R BT.2100-1 (2017), *Image parameter values for high dynamic range television for use in production and international programme exchange.*
- [ITU-R BT.2020] Recommendation ITU-R BT.2020-2 (2015), *Parameter values for ultra-high definition television systems for production and international programme exchange.*
- [ISO/IEC 14496-3] ISO/IEC 14496-3:2009, *Information technology – Coding of audio-visual objects – Part 3: Audio.*
- [ISO/IEC 14496-12] ISO/IEC 14496-12:2015, *Information technology – Coding of audio-visual objects – Part 12: ISO base media file format.*
- [ISO/IEC 13818-7] ISO/IEC 13818-7:2006, *Information technology – Generic coding of moving pictures and associated audio information – Part 7: Advanced Audio Coding (AAC).*
- [ISO/IEC 23001-7] ISO/IEC 23001-7:2016, *Information technology – MPEG systems technologies – Part 7: Common encryption in ISO base media file format files.*
- [ISO/IEC 23008-1] ISO/IEC 23008-1:2017, *Information technology – High efficiency coding and media delivery in heterogeneous environments – Part 1: MPEG media transport (MMT).*

- [ISO/IEC 23009-1] ISO/IEC 23009-1:2014, *Information technology – Dynamic adaptive streaming over HTTP (DASH) – Part 1: Media presentation description and segment formats*.
- [BBF TR069] Broadband Forum (2018), *CPE WAN Management Protocol Version 1.4*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 ultra-high definition television (UHDTV) [ITU-R BT.2020]: UHDTV provides viewers with an enhanced visual experience primarily by a wider field of view that covers a considerable part of the human natural visual field with appropriate screen sizes relevant to usage at home and in public places. Signal formats contributing to increasing the compression efficiency are desirable for UHDTV systems as they have a larger number of pixels than HDTV systems.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 4K UHDTV: This supports $3,840 \times 2,160$ resolution and 60p frame frequency specified in [ITU-R BT.2020].

3.2.2 remote control unit (RCU): The piece of equipment used to operate a set-top box remotely.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

API	Application Program Interface
AVC	Advanced Video Coding
BS	Broadcast Satellite television
CAS	Conditional Access System
CDN	Content delivery Network
CENC	Common Encryption
CP	Content Provider
DOCSIS	Data Over Cable Service Interface Specifications
DRM	Digital Rights Management
ECM	Entitlement Control Message
EME	Encrypted Media Extensions
EMM	Entitlement Management Message
FEC	Forward Error Correction
FTTH	Fibre To The Home
GUI	Graphical User Interface
HEVC	High Efficiency Video Coding
H/E	cable television Head-End
HFC	Hybrid of Fibre-Coaxial
HDCP	High-bandwidth Digital Content Protection system

HDMI	High-Definition Multimedia Interface
HDR	High Dynamic Range
HTML	Hypertext Markup Language
IP	Internet Protocol
IPTV	Internet Protocol Television
LAN	Local Area Network
MPEG	Moving Picture Experts Group
MMT	MPEG Media Transport
MSE	Media Source Extensions
PON	Passive Optical Network
PSI	Program Specific Information
QAM	Quadrature Amplitude Modulation
RCU	Remote Control Unit
RF	Radio Frequency
SI	Service Information
STB	Set-Top Box
TLV	Type Length Value
TS	Transport Stream
TTS	Timestamped TS
UHDTV	Ultra-high Definition Television
UI	User Interface
VOD	Video On Demand

5 Conventions

The keywords "**is required to**" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The keywords "**is recommended**" indicate a requirement which is recommended but which is not absolutely required. Thus this requirement need not be present to claim conformance.

The keywords "**is prohibited from**" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The keywords "**can optionally**" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

In the body of this document and its annexes, the words *shall*, *shall not*, *should* and *may* sometimes appear, in which case they are to be interpreted, respectively as, *is required to*, *is prohibited from*, *is recommended* and *can optionally*. The appearance of such phrases or keywords in an appendix or in material explicitly marked as *informative* are to be interpreted as having no normative intent.

6 Overview

6.1 4K cable system

See Figure 6-1 as an example of a 4K cable system. 4K cable content can be obtained from 4K programmes broadcasted via satellite stations. Cable operators may also capture 4K video content by themselves. In addition, some providers offer 4K video.

4K video content encoded by HEVC [ITU-T H.265] is transmitted over RF/QAM-based or IP-based systems through the cable network and received at a 4K cable STB. 4K video content can be transmitted via existing HFC transport network which handles 64QAM and/or 256QAM as RF transmission. 4K video content can also be transmitted via DOCSIS or FTTH as IP transmission.

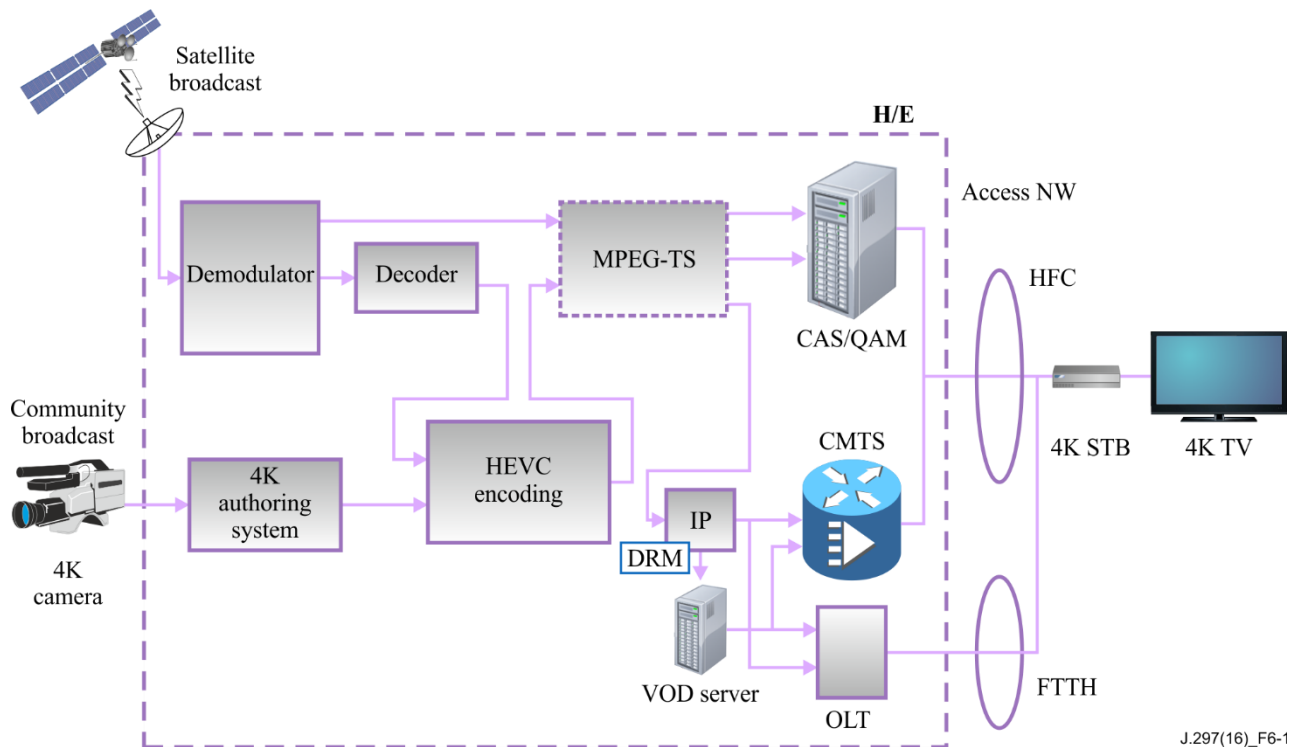


Figure 6-1 – Example of 4K cable system

6.2 Block diagram of 4K cable STB functions

Figure 6-2 shows an example of a block diagram of a 4K cable STB. Functions of major components of 4K cable STBs are explained as follows:

- type of input signal is assumed to be RF or IP.
NOTE – Implementation of QAM-based 4K service reception and IP-based 4K service reception in a 4K cable STB is not always necessary and may be left to the cable operator to decide.
- For content protection CAS or DRM should be adopted.

Figure 6-2 shows a model of an STB with a DOCSIS modem. For other models connected to an external DOCSIS modem or an external ONU, it is also possible to receive IP signals over Ethernet.

In Figure 6-2, QAM Demod (or QAM demodulator) is the function of decoding QAM-based transport stream received from the H/E. DeScrambler is the function that decodes the content-encrypted by the CAS or DRM algorithms. DeMux is the function of de-multiplexing video, audio and service information. Video decoder and audio decoder are used to decode the compressed video and audio content, respectively. HDMI2.0 or above is used to interface with the television system as an output interface.

HEVC [ITU-T H.265] has high coding efficiency and should be adopted to decode 4K content.

In the case of IP transmission, an HTML5 based browser for the user interface (UI) should be used.

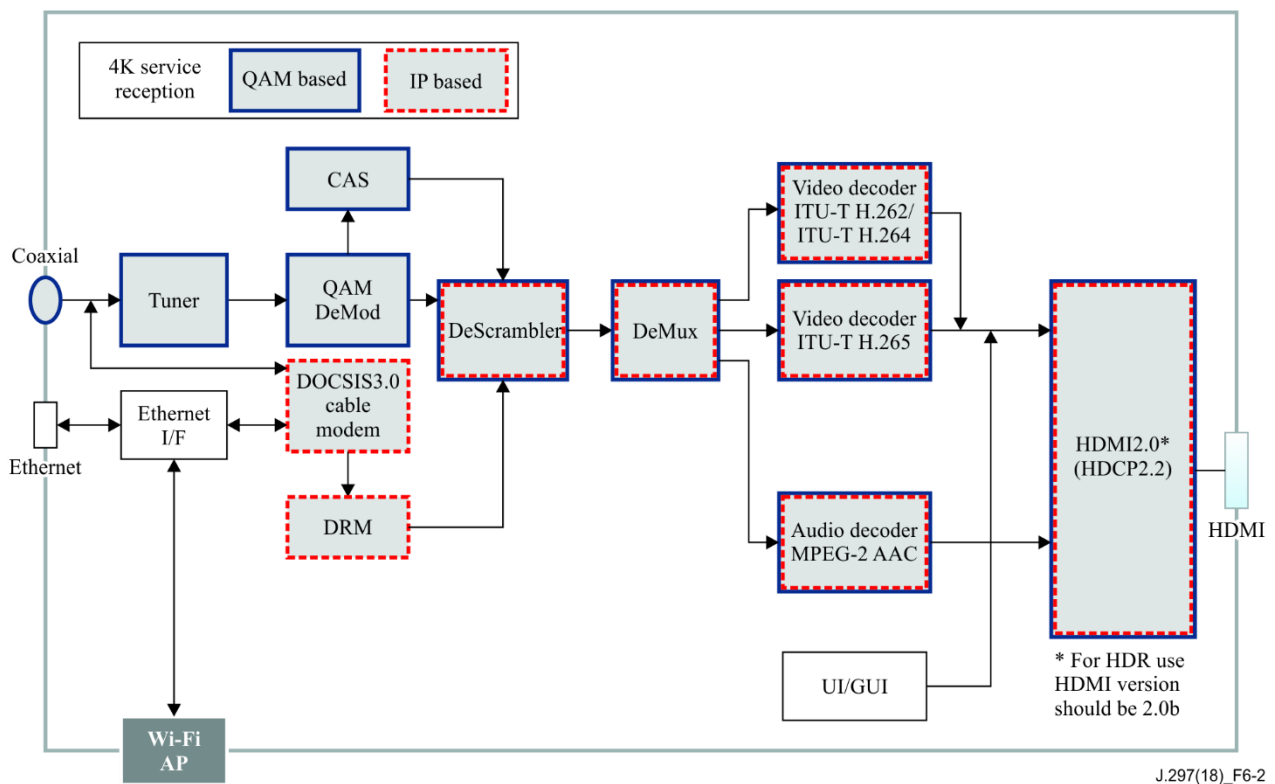


Figure 6-2 – Example of 4K cable STB block diagram

7 Requirements

This clause describes the requirements for 4K cable STBs in QAM-based 4K linear video services, IP-based 4K linear video services and IP VOD services, respectively. In addition, the requirements for backward compatibility of 2K video services is also described.

NOTE – The choice of QAM-based 4K linear video services, IP-based 4K linear video services and IP VOD services is left to the cable operators.

7.1 QAM-based 4K linear video service

[QLR-001]: A 4K cable STB is required to receive 4K content broadcasted by a cable H/E.

NOTE – Downlink is essentially used and uplink is not necessarily used for this requirement.

[QLR-002]: A 4K cable STB is required to equip a function of tuner that selects broadcasting channels.

[QLR-003]: A 4K cable STB is required to equip the QAM decoding (demodulation) function.

[QLR-004]: A 4K cable STB is required to equip the CAS decoding (descrambling) function used for content protection.

[QLR-005]: A 4K cable STB is required to equip the de-multiplexing function for video, audio and service information (SI/PSI).

[QLR-006]: A 4K cable STB can optionally support the synchronization of plural media transported between different streams such as RF transmission and IP transmission.

[QLR-007]: A 4K cable STB is required to equip a function of decoding 4K video.

[QLR-008]: A 4K cable STB is required to equip decoding advanced audio of 5.1 channels.