

SCTE • ISBE[®]

S T A N D A R D S

Digital Video Subcommittee

SCTE STANDARD

SCTE 247 2018

**High Dynamic Range (HDR) Video:
System Requirements for Cable
Phase 1 – Initial Deployment**

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1. Introduction

1.1. Executive Summary

The consensus of the drafting group members is that HDR10 is appropriate for use in the cable industry for a “first pass” HDR video distribution option against the time constraints larger operators desire to meet. Other existing HDR formats used for content or advertising *production* have appropriately defined conversion methods that allow other options to be used but translated for cable *distribution*. HDR10 is used by both Blu-ray and Internet streaming providers, which ensures the availability of high-quality content in the format and the availability of technical systems products that will meet the needs of the cable industry. HDR10 processing and display is supported across the widest variety of currently available and next-generation television, computer, tablet, and phone devices. Its performance may be improved in the future with the optional inclusion of dynamic metadata, as the ability to create and deliver it becomes a practical possibility in the content production and distribution ecosystem. SCTE should proceed expeditiously to document HDR10 for cable systems to address initial industry launch demands while continuing work to consider other HDR options for use in cable where appropriate. The HLG HDR system, which operates simply without HDR metadata of any kind to complicate the various cable system workflow and processing systems, is also a potentially valid solution to some of the issues identified in this document, and should be evaluated along with other HDR systems and metadata based enhancements to HDR10 in future phases of HDR standardization.

A non-consensus opinion is noted in section 9.3

1.2. Background

From origins using an ‘amplified pipe’ for the distribution of off-air television signals, the cable industry has successfully adopted, evolved and innovated distribution technologies used to provide information and entertainment services to consumers. Like the change from analog to digital audio and video formats, the nature of cable technology has been to *embrace* potentially disruptive and different technologies – but deploy those technologies to consumers in what is actually a more measured *evolution*.

Next-generation video services and related consumer product offerings are disruptive and quite varied in their technical nature. In the context of this document -- and requirements within -- the reader should use care to understand the context of the advanced services – high dynamic range (HDR) video services are potentially only one component of a next-generation consumer offering, perhaps combined with wide color gamut (WCG), and possibly higher-resolution ultra-high definition video (UHD) and higher frame rate (HFR) video.

The objective of this requirements document is to define the technical elements of next-generation video systems that are necessary for the cable industry. These technical details will enable proponents and designers to specify a system necessary to support a product offering that can be standardized and deployed via cable systems to consumers.

Use of the singular ‘system’ in the preceding paragraph is further detailed in the document – additional features and evolution of next-generation technologies *may* occur over time, however, the intent of this document is to provide a narrow and succinct choice of parameters that will enable an initial launch to consumers with a stable platform and provide future-proof evolutionary paths toward enhancements. Generally, and colloquially, that evolution could be referred to as ‘crawl, walk, run.’

1.3. Scope

This document represents a collaborative collection of use cases and requirements that the SCTE•ISBE Digital Video Subcommittee (DVS) members believe will be a first step for a comprehensive set of Standards, Recommended Practices and other documents that define a next-generation system of high dynamic range video for cable operators.

It is important to note that next-generation video and audio systems are part of an entire ecosystem from capture to production through distribution to consumer consumption. There are several trade organizations and standards development organizations (SDO) that are actively working on, and have oversight over, aspects of those technical details. Notably:

- High dynamic range video system parameters for production have been developed internationally and are documented in ITU-R Recommendation BT.2100 “Image parameter values for high dynamic range television for use in production and international programme exchange.” Two different high dynamic range systems are included: a display-referred perceptual quantization (PQ) system and a scene-referred hybrid log gamma (HLG) system. ,
- The next-generation ATSC 3.0 terrestrial broadcast standard [4] allows multiple HDR Video representations [ref A/341].
- The parameters for delivery of HDR video across the uncompressed consumer electronics interface are specified in CTA 861-G. [29]

The use of these standards by cable operators’ ecosystem partners necessitates considerations about interoperability and technical interfaces among content creators, programmers, broadcasters and cable operators of varying size and technical infrastructure. Cable content *shall* interoperate smoothly with consumer electronics devices. These format discussions have both technical and business ramifications. This document does not intend to codify those specifications. However, for clarity and information, those ecosystem components *may* be described herein.

1.4. Benefits

Generally, these requirements are in tabular form. The requirements describe the functional and technical needs for the successful design and selection of a next-generation video system.

1.5. Intended Audience

This document is intended for system proponents, design and development engineers as well as cable operators. Product feature and, potentially, marketing groups may use this document to ensure overall needs are addressed.

1.6. Areas for Further Investigation or to be Added in Future Versions

This requirements document, while initially static, tries to take a snapshot of a dynamic area of technology. Next-generation technologies described herein will lead to standards, specifications and/or recommended practices for an end-to-end cable infrastructure. They will determine interfaces and points of interconnect with other system elements such as program providers and consumer electronic devices used by consumers – some or all of which may evolve over time.

2. Normative References

The following documents contain provisions, which, through reference in this text, constitute provisions of this document. At the time of Subcommittee approval, the editions indicated were valid. All documents are subject to revision; and while parties to any agreement based on this document are encouraged to investigate the possibility of applying the most recent editions of the documents listed below, they are reminded that newer editions of those documents might not be compatible with the referenced version.

2.1. SCTE References

- No normative references are applicable.

2.2. Standards from Other Organizations

- No normative references are applicable.

2.3. Published Materials

- No normative references are applicable.

3. Informative References

The following documents might provide valuable information to the reader but are not required when complying with this document.

3.1. SCTE References

- [1] ANSI/SCTE 215-1 2015, HEVC Coding Constraints for Cable Television Part 1-Coding **[HDR UPDATE IN PROCESS]**
- [2] ANSI/SCTE 215-2 2015, HEVC Video Constraints for Cable Television Part 2-Transport **[HDR UPDATE IN PROCESS]**
- [3] ANSI/SCTE 172 2017, Constraints On AVC and HEVC Structured Video Coding for Digital Program Insertion

3.2. Standards from Other Organizations

- [4] SMPTE ST 2086:2014: Mastering Display Color Volume Metadata Supporting High Luminance and Wide Color Gamut Images.
- [5] ITU-R BT.2100-1:2017 Image parameter values for high dynamic range television for use in production and international programme exchange.
- [6] ITU: Report ITU-R BT.2390, “High dynamic range television for production and international programme exchange,” International Telecommunications Union, Geneva.
- [7] ATSC: “ATSC 3.0 System” (A/300),” Doc. A/200:2017, Advanced Television Systems Committee, Washington, D.C., 19 October, 2017
- [8] IEEE: “Use of the International Systems of Units (SI): The Modern Metric System,” Doc. SI 10, Institute of Electrical and Electronics Engineers, New York, N.Y.

- [9] ISO/IEC: “Information technology – High efficiency coding and media delivery in heterogeneous environments – Part 2: High efficiency video coding,” Doc. ISO/IEC 23008-2:2015¹. Note that this version of the HEVC specification does not include all items referenced by this document. JCTVC-Y1003, which is available at http://phenix.intevry.fr/jct/doc_end_user/documents/25_Chengdu/wg11/JCTVC-Y1003-v1.zip defines these additional items.
- [10] ITU: ITU-R Recommendation BT.601-6 (2007), “Encoding Parameters of Digital Television for Studios,” International Telecommunications Union, Geneva.
- [11] ITU: ITU-R Recommendation BT.709-5 (2002), “Parameter values for the HDTV standards for production and international programme exchange,” International Telecommunications Union, Geneva.
- [12] ITU: ITU-R Recommendation BT.2020-1 (2014), “Parameter values for ultra-high definition television systems for production and international programme exchange,” International Telecommunications Union, Geneva.
- [13] SMPTE: “Format for Active Format Description and Bar Data,” Doc. SMPTE ST 2016-1 (2009), Society of Motion Picture and Television Engineers, White Plains, N.Y.
- [14] SCTE: “AVC Video Constraints for Cable Television, Part 1 – Coding,” Doc. ANSI/SCTE 128-1 2013, Society of Cable Telecommunications Engineers, Exton, PA.
- [15] CTA: “Digital Television (DTV) Closed Captioning,” Doc. ANSI/CTA-708-E, Consumer Technology Association, Arlington, VA, August 2013.
- [16] SMPTE: “Electro-Optical Transfer Function for High Dynamic Range Reference Display” Doc. ST 2084 (2014), Society of Motion Picture and Television Engineers, White Plains, NY.
- [17] ATSC: “ATSC Proposed Standard: Signaling, Delivery, Synchronization, and Error Protection (A/331),” Doc. S33-174r6, Advanced Television Systems Committee, Washington, D.C., 4 May 2017. (*work in process*)
- [18] SMPTE: “Ultra High Definition Television — Image Parameter Values for Program Production,” Doc. SMPTE ST 2036-1 (2013), Society of Motion Picture and Television Engineers, White Plains, N.Y.
- [19] SMPTE: “Standard for Television—1920 x 1080 Scanning and Analog and Parallel Digital Interfaces for Multiple Picture Rates,” Doc. SMPTE ST 274 (2008), Society of Motion Picture and Television Engineers, White Plains, N.Y.
- [20] SMPTE: “Standard for Television—1280 x 720 Progressive Image Sample Structure, Analog and Digital Representation and Analog Interface,” Doc. SMPTE ST 296 (2012), Society of Motion Picture and Television Engineers, White Plains, N.Y.
- [21] SMPTE: “SDTV Component Video Signal Coding 4:4:4 and 4:2:2, for 13.5 MHz and 18 MHz Systems,” Doc. SMPTE ST 125 (2013), Society of Motion Picture and Television Engineers, White Plains, N.Y.

- [22] SMPTE: “Standard for Television—3 Gb/s SDI Signal/Data Serial Interface,” Doc. SMPTE ST 424 (2012), Society of Motion Picture and Television Engineers, White Plains, N.Y.
- [23] SMPTE: “Standard for Television— Professional Media Over Managed IP Networks” Doc. Suite SMPTE ST 2110-x (2017), Society of Motion Picture and Television Engineers, White Plains, N.Y.
- [24] ETSI: “Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream,” Doc. ETSI TS 101 154 V2.1.1 (2015-03), European Telecommunications Standards Institute, Sophia Antipolis Cedex – FRANCE.
- [25] CTA: “Active Format Description (AFD) and Bar Data Recommended Practice,” Doc. CTA-CEB16-A, Consumer Technology Association, Arlington, VA, July 2012.
- [26] DTG: “Digital Receiver Implementation Guidelines and Recommended Receiver Reaction to Aspect Ratio Signaling in Digital Video Broadcasting, v2.0.0”, January 2012. Digital TV Group, London, England.
- [27] ATSC: “Video - HEVC” Doc. A/341:2017, Advanced Television Systems Committee, Washington, D.C., 19 May 2017. *(and associated amendments)*
- [28] ATSC: “Audio Common Elements,” Doc. A/342 Part 1:2017, Advanced Television Systems Committee, Washington, D.C., 24 January 2017.
- [29] CTA: “A DTV Profile for Uncompressed High Speed Digital Interfaces,” Doc. ANSI/CTA-861-G, Consumer Technology Association, Arlington, VA, November 2016.
- [30] ISO/IEC 13818-1, (2013), “Information Technology—Generic coding of moving pictures and associated audio—Part1: Systems.”

3.3. Published Materials

- [31] ITU: Report ITU-R BT.2408-2017 “Operational Practices in HDR Television Production,” International Telecommunications Union, Geneva Compliance Notation
- [32] UltraHD Forum "UltraHD Forum: Phase A Guidelines Rev. 1.4", Aug 25, 2017, Fremont, CA

4. Compliance Notation

<i>shall</i>	This word or the adjective “ required ” means that the item is an absolute requirement of this document.
<i>shall not</i>	This phrase means that the item is an absolute prohibition of this document.
<i>forbidden</i>	This word means the value specified shall never be used.
<i>should</i>	This word or the adjective “ recommended ” 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 weighted before choosing a different course.
<i>should not</i>	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
<i>may</i>	This word or the adjective “ optional ” 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.
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5. Abbreviations and Definitions

5.1. Abbreviations

4G	Generally, advanced commercial mobile radio services (licensed wireless carriers)
ATSC	Advanced Television Systems Committee
CEA / CTA	Consumer Technology Association
COAM	customer owned and managed (e.g. not supplied by the cable provider)
DASH	dynamic adaptive streaming over HTTP
DOCSIS	Data Over Cable Service Interface Specification, used herein as a generic reference to current cable modem service
DVR	digital video recorder; also cDVR (cloud-based DVR)
DVS	SCTE•ISBE Digital Video Subcommittee
EOTF	electro-optical transfer function
HD	high definition; generally 1920x1080 or 1280x720
HDCP	High-Bandwidth Digital Content Protection
HDMI	high definition multimedia interface
HDR	High-dynamic range (generic reference, document context is important); generally ITU definition.[5]
HFC	hybrid fiber-coax
HLG	hybrid log gamma
HLS	HTTP live streaming
IP	Internet protocol
ISBE	International Society of Broadband Experts