Video Services Forum (VSF)
Technical Recommendation TR-08

Transport of JPEG XS
Video in ST 2110-22

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TR-08:2026

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Executive Summary

This VSF Technical Recommendation (TR), in addition to defining profiles for streaming of JPEG XS video over SMPTE ST 2110-22, adds information for the interoperable transport of audio and ancillary data over other relevant SMPTE ST 2110 standards. The JPEG XS compression method is used in low latency transmission applications for cost-effective, high quality, real-time transport of television video signals over IP networks. The term "XS" is meant to convey the "extra small", "extra speed" nature of the compression method.

The VSF has published a previous version of this TR known as *VSF TR-08:2022 Transport of JPEG XS Video in ST 2110-22* This document, *VSF TR-08:2026* adds the following capabilities and clarifications to the original version.

1. **Capability Set and Interop Points for JPEG XS Temporal Differential Coding (TDC).** TDC can optimize quality at a given rate or allow reduced bit rates for some content.

2. **Addition of Interop Points** for some non broadcast frame rates.

3. **Addition of 1Gb Capability Set,** including lowering to 2Bpp rates in order to keep streams under 1Gbps bandwidth

4. **Reference to the new RFC** which will replace RFC-9134 and supports JPEG XS Temporal Differential Coding (TDC)

5. **Clarifications, Examples, References and Constraints,** including specific supported functionality in order to improve interoperability

6. **Updated normative references** to current versions

7. Consolidation of Rows to provide a more concise Appendix B Capability Set and Interop Points table

Recipients of this document are invited to submit technical comments. The VSF also requests that recipients notify us of any relevant patent claims or other intellectual property rights of which they may be aware, that might be infringed by any implementation of the Recommendation set forth in this document, and to provide supporting documentation.

Table of Contents

1. Introduction

This document describes an encapsulation of JPEG XS codestream(s) into SMPTE ST 2110-22 for transmission over Internet Protocol-based networks. It also addresses potential system interoperability issues with other media components within the ST 2110 system.

As a follow up to the revision work started in February of 2020 and concluding with the publication of TR-08 in April 2022, this activity group was formed to expand and improve this VSF Technical Recommendation. The main focus is on adding the JPEG-XS TDC profile in this revision.

1.1 Contributors

Contributors to this document include:

- John Dale, Activity Group Chairman, Media Links, Inc.
- Alain Champenois, Matrox
- Christian Kellner, Imagine
- Eben Jenkins, Leader
- Grant McGilvray, NBC
- John Mailhot, Imagine Communications
- Tim Bruylants, intoPIX SA

1.2 About the Video Services Forum

The Video Services Forum, Inc. (www.videoservicesforum.org) is an international association dedicated to video transport technologies, interoperability, quality metrics and education. The VSF is composed of service providers, users and manufacturers. The organization's activities include:

- providing forums to identify issues involving the development, engineering, installation, testing and maintenance of audio and video services;
- exchanging non-proprietary information to promote the development of video transport service technology and to foster resolution of issues common to the video services industry;
- identification of video services applications and educational services utilizing video transport services;
- promoting interoperability and encouraging technical standards for national and international standards bodies.

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For more information on the Video Services Forum, contact the Operations Manager (opsmgr@vsf.tv

2. Conformance Notation

Normative text is text that describes elements of the design that are indispensable or that contain the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative", or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to

the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

3. Normative References

AES: AES3:2009 (r2019): “Digital input-output interfacing — Serial transmission format for two-channel linearly-represented digital audio data”

AMWA BCP-002-01: Natural Grouping of NMOS Resources v1.0.0

AMWA BCP-003-01: Secure Communication in NMOS Systems v1.0.0

AMWA BCP-003-02: Authorization in NMOS Systems v1.0.0

AMWA BCP-003-03: Certificate provisioning in NMOS Systems v1.0.0

AMWA BCP-006-01: NMOS with JPEG XS v1.0.0 (Work In Progress)

AMWA IS-04 NMOS Discovery and Registration Specification (Stable) v1.31

AMWA IS-05 NMOS Device Connection Management Specification (Stable) v1.1.1

ANSI/CTA 861-H:2021 “A DTV Profile for Uncompressed High-Speed Digital Interfaces”

IEEE 1588-2008: “IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems” (PTP)

IETF RFC 9134 “RTP Payload Format for ISO/IEC 21122 (JPEG XS)”[1]

IETF RFC 7273 “RTP Clock Source Signaling”

IETF RFC 8866 “SDP: Session Description Protocol”

ISO/IEC 21122-1:2024: “Information technology — JPEG XS low-latency lightweight image coding system — Part 1: Core coding system”

ISO/IEC 21122-2:2024: “Information technology — JPEG XS low-latency lightweight image coding system — Part 2: Profiles and buffer models”

ISO/IEC 21122-3:2024: “Information technology — JPEG XS low-latency lightweight image coding system — Part 3: Transport and container formats”

JT-NM TR-1001_2020v1.1 System Environment and Device Behaviors for ST 2110 Media Nodes in Engineered Networks –Networks, Registration, and Connection Management

Rec. ITU-R BT.2020-2: “Parameter values for ultra-high definition television systems for production and international programme exchange”

Rec. ITU-R BT.2100-2: “Image parameter values for high dynamic range television for use in production and international programme exchange”

Rec. ITU-T H.273 (2021) | ISO/IEC 23091-2:2019: "Information Technology - Coding-independent code points - Part 2: Video"

SMPTE ST 2022-7:2019: “Seamless Protection Switching of RTP Datagrams”

SMPTE ST 2086:2018 “Mastering Display Color Volume Metadata Supporting High Luminance and Wide Color Gamut Images”

[1] An update for RFC 9134 is in progress at IETF and will be published in 2026 as a new RFC with a new number. It will contain clarifications regarding interlace video, add support for the TDC profile, and integrate the errata of RFC 9134, while it maintains backward compatibility for XS High. Once published, RFC 9134 will point to this new RFC, and all references to RFC 9134 in this TR-08 should be seen as references to the new RFC.

SMPTE ST 2108-1:2018 “HDR/WCG Metadata Packing and Signaling in the Vertical Ancillary Data Space”

SMPTE ST 2108-2:2019 “Vertical Ancillary Data Mapping of KLV Formatted HDR/WCG Metadata”

SMPTE ST 2110-10:2017: “Professional Media over Managed IP Networks: System Timing and Definitions”
SMPTE ST 2110-21:2017: “Professional Media over Managed IP Networks: Traffic Shaping and Delivery Timing for Uncompressed Active Video”

SMPTE ST 2110-22:2019: “Professional Media over Managed IP Networks: Constant Bit-Rate Compressed Video”

SMPTE ST 2110-30:2017: “Professional Media over Managed IP Networks: PCM Digital Audio”

SMPTE ST 2110-31:2018: “Professional Media over Managed IP Networks: AES3 Transparent Transport”

SMPTE ST 2110-40:2018: “Professional Media over Managed IP Networks: SMPTE ST 291-1 Ancillary Data”

VSF Technical Recommendation TR-10-1:2022: “Internet Protocol Media Experience (IPMX): System Timing and Definitions”

Note: Joint ITU and ISO/IEC documents refer to exactly the same standard text, and may share the same title, however in some cases they do not.

4. Acronyms

ACL	Audio Conformance Level
AES	Audio Engineering Society
ANC	Ancillary Data
API	Application Programming Interface
Bpp	Bits per pixel
ETSI	European Telecommunications Standards Institute
FBB	Frame Buffer Bandwidth (relevant with JPEG XS TDC)
FEC	Forward Error Correction
FHD	Full High Definition
HD	High Definition
HDR	High Dynamic Range
HLG	Hybrid-Log Gamma
IEC	International Electrotechnical Commission
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPMX	Internet Protocol Media Experience
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JPEG	Joint Photographic Experts Group
JPEG XS	Joint Photographic Experts Group 21122 Coding Standard
LAN	Local Area Network
PCM	Pulse Code Modulation
PQ	Perceptual Quantize
RGB	Red Green Blue
RTP	Real-Time Protocol
SDP	Session Description Protocol
SDR	Standard Dynamic Range
SDI	Serial Digital Interface
SMPTE	Society of Motion Picture and Television Engineers
TDC	Temporal Differential Coding (JPEG XS coding mode and profile)
TR[2]	Video Services Forum Technical Recommendation[2]
UHD	Ultra High Definition
UHD1	Ultra high resolution with a resolution of 3840 × 2160, which is found in ITU-R BT 2020
UHD2	Ultra high resolution with a resolution of 7680 × 4320, which is found in ITU-R BT 2020
VSF	Video Services Forum
VS	Video Support Super Box
YCbCr	Luminance Component, Blue-Difference and Red-Difference Chroma Components
WAN	Wide Area Network

[2] Note that the term Technical Recommendation is also used by other organizations such as ETSI.

5. Definitions

Device	"Device" as defined in SMPTE ST 2110-10.
Media Node	"Media Node" as defined in JT-NM TR-1001.
Receiver	"Receiver" as defined in SMPTE ST 2110-10.
Sender	"Sender" as defined in SMPTE ST 2110-10.

6. System Overview/Use Cases (Informative)

An end-user or service provider of broadcast transmission services can utilize devices that implement this Technical Recommendation (TR) for the unidirectional transport of real time television signals over an IP network within a facility or between facilities. The signals may include video, audio, and SMPTE 291 formatted Ancillary Data packets.

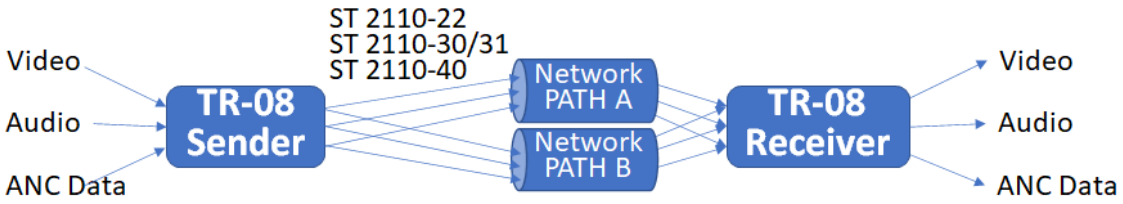

Figure 1: Example system for transmission of real time television signal over IP

As shown in figure 1 above, the Sender has video, audio, and Ancillary Data inputs. These inputs are presumed to be time-aligned at their presentation to the Sender. The video is compressed using a JPEG XS compression algorithm. The JPEG XS codestream is converted into a Real-Time Protocol (RTP) stream in accordance with RFC 9134 and meeting the requirements of SMPTE ST 2110-22. Audio signals are converted into SMPTE ST 2110-30 or SMPTE ST 2110-31 streams, and ANC Data is packaged into SMPTE ST 2110-40 streams.

The system defined in this TR supports linear PCM audio using SMPTE ST 2110-30, and non-PCM audio (and non-audio signals represented in AES3 wrappers) using SMPTE ST 2110-31.

The Sender transmits the RTP streams over the network in accordance with SMPTE ST 2110-10, including optional support of the SMPTE ST 2022-7 redundancy model and separate network paths. The Receiver de-encapsulates the RTP/IP streams, recovering the Audio, ANC Data, and the JPEG XS codestream. The JPEG XS codestream is further decoded to video essence in accordance with provisions of this recommendation. The reconstructed video, audio, and ANC Data signals are time-aligned using the RTP timestamps (correcting for different RTP Clock rates) before presentation.

The target end to end transmission latency, (less network and transit delay, and not including buffering for delay path differential), for the real time transmission of all essence components including audio and ancillary data is approximately one tenth of a video frame.

This TR specifies the syntax and semantics of the signals between the Sender and the Receiver, and in doing so, places constraints on the behavior of the Sender. It also specifies some minimum requirements for the Receiver. These constraints and requirements are needed for interoperability.

Receivers under this TR-08 must make the relevant video signal metadata (colorimetry, transfer characteristic, frame rate, sampling structure, image dimensions, etc) available to downstream

devices using the technical standards appropriate to the internal or external interfaces provided.

A number of different “Capability Sets”, each with several “Conformance Levels”, are specified in section 10 of this recommendation. These capability sets include interoperation of Senders and Receivers within a facility under a common clock domain, and also interoperation of Senders and Receivers in different facilities, perhaps separated by some distance, and operating on potentially different clock domains.

7. Organization and Signaling of a VSF TR-08 Package

Streams compliant with this Technical Recommendation shall be organized into a “TR-08 Package” consisting of one SMPTE ST 2110-22 video stream(s), zero or more SMPTE ST 2110-30, zero or more ST 2110-31 audio stream(s), and zero or more SMPTE ST 2110-40 ANC Data streams.

Media Nodes should comply with the requirements and behaviors specified in Section 11 of JT-NM TR-1001-1 except when overridden by provisions of this Technical Recommendation.

Media Nodes shall register their Senders and Receivers using the Registration API defined in the AMWA NMOS IS-04 Discovery and Registration Specification.

Receivers shall be capable of connecting to Senders’ streams when directed as per the AMWA NMOS IS-05 Device Connection Management Specification.

Compliant senders and receivers shall implement the recommendations of AMWA BCP-006-01.

Media Nodes shall indicate appropriate grouping of Senders and Receivers as per AMWA BCP-002-01 Natural Grouping of NMOS Resources Specification. (Example: a video and associated audio stream from a field camera.)

Optionally Media Nodes may implement security on the NMOS APIs. If a media note implements security, the implementation shall comply with AMWA NMOS BCP-003 specifications.

Video signals shall be compressed using a JPEG XS codec that conforms to ISO/IEC 21122-1, ISO/IEC 21122-2, and ISO/IEC 21122-3 as described in Section 8.1 of this TR.

The JPEG XS codestream shall be encapsulated into RTP using the payload format described in RFC 9134.

The RTP Stream shall meet all of the requirements of SMPTE ST 2110-22, and by extension, shall meet all of the requirements of SMPTE ST 2110-10.

Details of the required elements of the IS-05 “transport-tile” (an RFC 4566 SDP object) shall be as described in RFC 9134 and shall meet the requirements of SMPTE ST 2110-10.

PCM Audio signals shall be organized into SMPTE ST 2110-30 streams or SMPTE ST 2110-31 streams, depending on application requirements.

Non-PCM audio signals and any AES3-encapsulated non-audio signals shall be encapsulated into SMPTE ST 2110-31 streams.

Ancillary Data signals shall be encapsulated into SMPTE ST 2110-40 streams.

Each essence component shall be synchronous to the clock source declared in the *ts-refclk* element of the Sender's Session Description Protocol (SDP) object in compliance with RFC 7273 RTP Clock Source Signaling.

8. Essence Service Components

This section establishes specific restrictions for JPEG XS video, audio and metadata in order to improve interoperability between Senders and Receivers from different implementers.

8.1 JPEG XS Video

8.1.1 JPEG XS Codestream Restrictions

JPEG XS Codestreams emitted by Senders that are compliant with this TR shall be compliant with ISO/IEC 21122-1, ISO/IEC 21122-2, and ISO/IEC 21122-3, with the following parameters, settings and changes:

- **Number of components, chroma sampling format and alpha channel**: If there is an alpha channel, it shall be transported in its own codestream.

  Codestream parameters and the JPEG XS Video Information box parameters shall be set according to one of the allowed configurations shown in Table 1. below.

Allowed Configurations	N_c value (= number of components)	$s_x[c]$ and $s_y[c]$ values (= horizontal and vertical sampling factors)	Profile	Ppih	Cpih	SCHAR
3 color components 4:2:0 YCbCr sampling	$N_c = 3$	$s_x[0] = s_y[0] = 1$ $s_x[1] = s_x[2] = 2$ $s_y[1] = s_y[2] = 2$	High 420.12	0x4240	0	3
			TDC 444.12	0x4a45		
3 color components 4:2:2 YCbCr sampling	$N_c = 3$	$s_x[0] = 1$ $s_x[1] = s_x[2] = 2$ $s_y[0] = s_y[1] = s_y[2] = 1$	High 444.12	0x4a40	0	0
			TDC 444.12	0x4a45		
3 color components 4:4:4 YCbCr sampling	$N_c = 3$	$s_x[0] = s_x[1] = s_x[2] = 1$ $s_y[0] = s_y[1] = s_y[2] = 1$	High 444.12	0x4a40	0 (No RCT)	1
			TDC 444.12	0x4a45		

3 color components 4:4:4 RGB sampling	$N_c = 3$	$s_x[0] = s_x[1] = s_x[2] = 1$ $s_y[0] = s_y[1] = s_y[2] = 1$	High 444.12	0x4a40	1 (RCT)	2
			TDC 444.12	0x4a45		
alpha channel only 4:0:0 sampling	$N_c = 1$	$s_x[0] = s_y[0] = 1$	High 444.12	0x4a40	0	0[3]

Table 1. Number of components and chroma sampling

- **Color transformation**:
  If the three components of the image use the YCbCR digital representation, Cpih shall be set to 0 (no color transformation).

  Senders shall use the following order of components in the JPEG XS codestream, and the component index shall be set as follows: Y (component index shall be set to 0), Cb (component index shall be set to 1), Cr (component index shall be set to 2).

  In the case of RGB color components with 4:4:4 sampling, Cpih shall be set to 1. This indicates that the three color components of the image can be reversibly transformed to YCbCr digital representation by JPEG XS.

  Senders shall use the following order of components in the JPEG XS codestream, and the component index shall be set as follows: R (component index shall be set to 0), G (component index shall be set to 1), B (component index shall be set to 2).

- **Input bit depth**: B[c] shall be set to 8, 10, or 12 for all values of c (i.e. all components) based on the Conformance Level and selected Capability Set shown in Table 5 in Section 10.

- **Number of horizontal wavelet transformations**: $N_{L,x}$ shall be set to 5

- **Number of vertical wavelet transformations**: $N_{L,y}$ shall be set to 2

- **Quantizer type**: Qpih shall be set to 1 (uniform quantizer)

- **Level**: shall be set to either 1k-1, 2k-1, 4k-2, or 8k-2, depending on the targeted capability set based on the Conformance Level and selected Capability Set shown in Table 5 in Section 10. Implementers shall select the lowest level possible given the width, height and frame rate of the image.

  Note: The selected level defines constraints on the maximum dimensions and framerate of the images in the uncompressed domain, and as such, sets a lower bound on the

[3] Note that no value is specified in ISO/IEC 21122-3 for 4:0:0 sampling, however, TR-08 includes the value of '0' for alpha channel 4:0:0 sampling, as well as for 4:2:2 YCbCr sampling.

throughput in the decoded domain.

- **Sublevel**: encoders shall set Sublevel to Sublev2bpp, Sublev3bpp or Sublev4bpp as applicable by capability set. For sets other than E/F, when the bpp is less than or equal to 3bpp, Sublev3bpp shall be used. When the bpp is above 3bpp up to 4bpp, Sublev4bpp shall be used. Implementations compliant with this TR shall not set Sublevel to any other values.

  Compression bit rate shall be constrained to a maximum of 4 bpp (see capability sets defined in Section 10).

  Note: Level, Sublevel, and Fbblevel shall be signaled in the Plev field in accordance with ISO/IEC 21122-2. There have been (backward compatible) changes since the original publication of both TR-08 and ISO/IEC 21122-2.

  Note: The selected sublevel defines constraints on the maximum number of bits per pixel for an encoded image and as such, sets a lower bound on the throughput in the compressed domain that a conforming decoder implementation supports. Implementers are encouraged to support new sublevels (new Sublev2bpp), which is mandatory in capability sets E/F.

- **FBB level**: when employing the TDC 444.12 profile, encoders shall set FBB level to either Fbblev12bpp or Fbblev8bpp for levels 1k-1, 2k-1, and 4k-2, and shall set FBB level to Fbblev8bpp for 8k-2 levels.

  Note: The selected FBB level defines a constraint to provide a lower bound on the throughput that a conforming decoder implementation shall support for accessing its frame buffer.

8.1.2 JPEG XS Stream

The JPEG XS Stream shall be mapped into IP packets in accordance with RFC 9134 with the following constraints:

The *pacKetization mode (K)* bit shall be set to “0” in the RTP Payload Header. This sets the codestream packetization mode to ‘codestream’.

The number of bytes of *Payload Data* in a packet shall be a multiple of 8 bytes except for the last packet of the field or frame. Note: last packets have the ‘M’ bit set to ‘1’ as specified in RFC 9134.

8.1.2.1 Bit rate coding

The value of the *brat* field shall be set to the actual maximum bit rate of the specific transmitted stream (not the theoretical maximum bit rate defined by the sublevel).

8.1.2.2 Field coding and frame rate

Field coding and frame rate shall be set by the *frat* field, whose semantics are defined in ISO/IEC 21122-3.

Senders shall set the *frat* field in the JPEG XS Stream as follows:

For interlaced signals, the Interlace_Mode of the *frat* field of all JPEG XS picture segments shall be set to '1' (note: indicating that the first picture of a frame is the first video field, and the second picture of a frame is the second video field). For progressive signals, the Interlace_Mode of the *frat* field shall be set to '0'.

The *frat* field shall always be set to signal the frame rate and shall not indicate an unknown frame rate.

In addition, the frame rate can be signaled as described in RFC 9134 as part of the SDP. If there is conflict between the frame rate indicated in the SDP file and the frame rate signaled in the JPEG XS Video Information box, the values in the JPEG XS Video Information box shall prevail.

Sender implementations compliant with this document shall ensure that the information signaled as described in RFC 9134 shall always match the information contained in the SDP file.

8.1.2.3 RTP Timestamps

The RTP timestamps of the transmitted packets shall comply with ST 2110-10. In interlace mode, each field shall have a unique timestamp.

8.1.2.4 Color Specification & Dynamic Range

Color information shall be specified in the JPEG XS stream using the Color Specification box as defined in ISO/IEC 21122-3 and in RFC 9134. In the Color Specification box, the seven (7) CICP_RESERVED bits of the METHDAT field shall all be set to '0'.

Color information shall be signaled in the SDP file as described in RFC 9134. If there is conflict between the information in the SDP file and the JPEG XS stream, or if the SDP indicates a colorimetry value of "UNSPECIFIED", the values in the JPEG XS stream shall prevail.

Sender implementations compliant with this document shall ensure that the information signaled as described in RFC 9134 shall always match the information contained in the SDP file.

Note: Table 2. below summarizes the signaling code values a sender might employ for commonly used color spaces. This information may be found in ISO/IEC 21122-3 and in Rec. ITU-T H.273 and is provided here for the convenience of implementers.

Color space	**Color primaries code**	**Transfer characteristics code**	**Matrix coefficients code**	**Video full range flag**	**Notes**
Rec. ITU-R BT.709-6	1	1	1	0	gBT 709 SDR
Rec. ITU-R BT.2020-2	9	14 (10 bit)	9 (non-constant luminance)	0	Wide Color Gamut SDR

Rec. ITU-R BT.2020-2	9	15 (12 bit)	9 (non-constant luminance)	0	Wide Color Gamut SDR
Rec. ITU-R BT.2020-2	9	14 (10 bit)	10 (constant luminance)	0	Wide Color Gamut SDR
Rec. ITU-R BT.2020-2	9	15 (12 bit)	10 (constant luminance)	0	Wide Color Gamut SDR
Rec. ITU-R BT.2100-2	9	16	9 (Y'CbCr)	0	Wide Color Gamut PQ HDR
Rec. ITU-R BT.2100-2	9	18	9 (Y'CbCr)	0	Wide Color Gamut HLG/HDR

Table 2. (Informative) – Selected examples of color space specification

8.1.2.5 Video Support and Color Specification Box

Video Support box and color specification box shall be carried as noted in RFC 9134 as defined in ISO/IEC 21122-3. Mastering Display Metadata box is optional.

Note: The *tcod* field is not used for SMPTE time code, it is not mandatory for the Receiver to use values of the *tcod* field (i.e. Senders are allowed to set it to all 0's).

8.1.2.6 Mastering Display Metadata

Mastering Display Metadata is defined in SMPTE ST 2108-1 and ST 2108-2. This information may be carried as specified in RFC 9134, in the Mastering Display Metadata box within the JPEG XS Video Support box, or it may be transported in a ST 2110-40 stream.

In the case where the Mastering Display Metadata is present at a decoder in multiple locations, the information in the Mastering Display Metadata box shall take priority.

If a Sender does not have access to the Mastering Display Metadata at the time the stream is generated, then the Mastering Display Metadata box shall not be included in the VS box.

Mastering Display Metadata shall be specified using the following fields:

- *X_c0, Y_c0, X_c1, Y_c1, X_c2, Y_c2, X_wp, Y_wp, L_max* and *L_min*, as defined in

SMPTE ST 2086:2018 “Mastering Display Color Volume Metadata Supporting High Luminance and Wide Color Gamut Images”

- *MaxFALL* and *MaxCLL*, as defined in ANSI/CTA 861-H:2021 “A DTV Profile for Uncompressed High-Speed Digital Interfaces”

8.2 Audio Transport (PCM and Non-PCM signals)

Audio signals shall be sampled at a rate of 48 kHz, using a sampling clock which is synchronous to the signaled ts-refclk clock source in the SDP.

PCM Audio signals shall be organized into SMPTE ST 2110-30 streams or SMPTE ST-2110-31 streams or a combination thereof. Any non-PCM audio signals, and/or AES3-formatted non-audio signals, shall be packaged into SMPTE ST 2110-31 streams.

Senders and Receivers that are compliant with this TR shall support the Audio Conformance Level specified in Section 10 of this document for the specified use case, referring to the requirements enumerated in Table 3 below.

Audio Conformance Level	**Bit Depth, Sampling, PIDs and AES Channel Pairs per PID**
A	24 bits, 48 kHz sampling Up to four (4) audio streams each stream may be SMPTE 2110-30 (Level A) or 2110-31 (Level A) Up to 16 total channels (or channel-equivalents)
B	24 bits, 48 kHz sampling Up to eight (8) audio streams each stream may be SMPTE 2110-30 (Level A) or 2110-31 (Level A) Up to 32 total channels (or channel-equivalents)
C	24 bits, 48 kHz sampling Up to eight (8) audio streams each stream may be SMPTE 2110-30 (Level C) or 2110-31 (Level C) Up to 64 total channels (or channel-equivalents)

Table 3. Audio Conformance Level

Receivers should incorporate a selection mechanism that allows the user to choose the mapping of audio channels from JPEG XS codestreams to subsequent devices or processes. If Receivers implement a re-mapping capability, then AMWA NMOS IS-08 shall be used for controlling this mapping.

8.3 Ancillary Data

Most SDI signals include Horizontal Ancillary (HANC) and Vertical Ancillary (VANC) data packets formatted in accordance with SMPTE ST 291-1. Senders compliant with this recommendation shall transport the ANC data packets (subject to the restrictions below) using

SMPTE ST 2110-40. Receivers shall recover the ANC data and present it to the downstream application.

Since RFC 9134 includes a box structure for video specific metadata as a prefix to the JPEG XS codestream, it may be possible that a contradiction could occur between this ancillary metadata, metadata included within the SDP parameters and a potential SMPTE 2110-40 stream. Implementers shall follow best practices as indicated in this document to avoid duplication of metadata. If duplication is unavoidable, then metadata shall be consistent in each location with no difference. In regard to video metadata specifically, if a receiver detects a conflict, then JPEG XS stream metadata shall prevail.

8.3.1 HANC and VANC data which are excluded from transport

Although embedded audio is formatted as HANC data, Senders shall use the method identified in section 8.2 for the transport of all audio signals.

Senders shall not use the methods in this section for audio.

The Embedded Audio Control Packet defined in SMPTE ST 299-1 should not be transmitted by Senders, and shall be ignored by Receivers if present in the ST 2110-40 stream. Receivers shall generate a locally correct Embedded Audio Control Packet based on their specific configuration if they are creating an SDI output.

EDH, CRC, and Line Number information, while present in the ancillary data spaces of SDI, are not formatted as ANC packets under SMPTE ST 291-1 and therefore shall not appear in SMPTE ST 2110-40 streams.

9. IP Encapsulation, Forward Error Correction, and Receiver Timing

Senders and Receivers compliant with this recommendation shall be able to create and process, respectively, IP streams that are compliant with SMPTE ST 2110-22.

If SMPTE ST 2022-5 FEC is implemented in a Sender, that Sender shall construct the FEC stream in accordance with SMPTE ST 2022-5, and signal that FEC is being used, as specified in SMPTE ST 2110-10.

If SMPTE ST 2022-5 FEC is implemented in a Receiver, that Receiver shall be able to process FEC streams constructed in accordance with SMPTE ST 2022-5 and shall make use of the signaling specified in 2110-10.

If SMPTE ST 2022-7 redundant streams are implemented in a Sender, then that Sender shall construct the redundant streams as described in SMPTE ST 2022-7 and shall signal them as specified in SMPTE ST 2110-10.

If SMPTE ST 2022-7 redundant streams are implemented in a Receiver, then that Receiver shall process the redundant streams which have been constructed in accordance with SMPTE ST 2022-7, and shall make use of the signaling specified in ST 2110-10.

Note: other FEC approaches may be used and if so, will be signaled in accordance with their defining documents; in particular the VSF IPMX activity FEC approach may be used.

Receivers shall implement one or more of the Timing Recovery Modes defined in Table 4 below.

Timing Recovery Mode	Definition (normative)
SYNC	Receivers shall be able to consume streams where the Sender's *ts-refclk* is equivalent to the Receiver's time source. Video Senders and Receivers shall conform to type W in SMPTE ST 2110-21. Note: Senders that implement the 2110TPNL traffic shape meet the requirements of 2110TPW.
ASYNC	Receivers shall be able to consume streams where the Sender's ts-refclk differs from the Receiver's time source. Video Senders shall conform to type W in SMPTE ST 2110-21, while video Receivers shall be of type A in SMPTE ST 2110-21.
IPMX	Video Senders shall conform to type W in SMPTE ST 2110-21, while Receivers shall implement the timing model defined in VSF TR-10-1.

Table 4. Enumerated Names for the Timing Recovery Modes

10. Capability Sets and Interoperability Points

Senders and Receivers which claim conformance with this recommendation shall support one or more configuration(s). A configuration is defined by the intersection of a Conformance Level and a Capability Set, as specified in Table 5 below.

Senders and Receivers supporting a specific configuration in Table 5 below shall support all interoperability points listed for that configuration in Appendix B of this document.

Note: Appendix B contains a table of capability sets indexed by conformance level. The table provides reasonable coverage of common formats and features used in professional video applications at the time of the publication of this recommendation.

Capability Set / Conformance Level		**A/B**	**A/B (TDC)**	**C**	**C (TDC)**	**D**	**D (TDC)**	**E/F**	**E/F (TDC)**
		A, Intra-facility Use B, Interfacility Use		Intra-campus with Multimedia extensions		Intra-campus with Multimedia extensions		2Bpp Over 1Gbps Transport	
ALL	Timing	A, SYNC B, ASYNC		ASYNC and IPMX		IPMX		IPMX	
FHD	Video	JPEG XS High only	JPEG XS High and TDC	JPEG XS High only	JPEG XS High and TDC	JPEG XS High only	JPEG XS High and TDC	JPEG XS High only	JPEG XS High and TDC
		YCbCr 4:2:2 only bit depth = 10 maximum rate = 4bpp frame rate <= 60Hz image width <= 1920 image height <= 1080		YCbCr 4:2:2, YCbCr 4:4:4, RGB 4:4:4 bit depth <= 10 maximum rate = 4bpp frame rate <= 60Hz image width <= 2048 image height <= 1200		YCbCr 4:2:0, YCbCr 4:2:2, YCbCr 4:4:4, RGB 4:4:4 bit depth <= 12 maximum rate = 4bpp frame rate <= 60Hz image width <= 2048 image height <= 1200		YCbCr 4:2:0, YCbCr 4:2:2, YCbCr 4:4:4, RGB 4:4:4 bit depth <= 12 maximum rate = 2bpp frame rate <= 60Hz image width <= 2048 image height <= 1200	
	Audio	ACL-A,B,C		ACL-A		ACL-A		ACL-A	
UHD1 (4K)	Video	JPEG XS High only	JPEG XS High and TDC	JPEG XS High only		JPEG XS High only	JPEG High and TDC	JPEG XS High only	JPEG High and TDC
		YCbCr 4:2:2 only bit depth = 10 maximum rate = 4bpp frame rate <= 60Hz image width <= 3840 image height <= 2160		YCbCr 4:2:2, YCbCr 4:4:4, RGB 4:4:4 bit depth <= 10 maximum rate 4bpp frame rate <= 60Hz image width <= 4096 image height <= 2160		YCbCr 4:2:0, YCbCr 4:2:2, YCbCr 4:4:4, RGB 4:4:4 bit depth <= 12 maximum rate = 4bpp frame rate <= 60Hz image width <= 4096 image height <= 2160		YCbCr 4:2:0, YCbCr 4:2:2, YCbCr 4:4:4, RGB 4:4:4 bit depth <= 12 maximum rate = 2bpp frame rate <= 60Hz image width <= 4096 image height <= 2160	
	Audio	ACL-B,C		ACL-A		ACL-A		ACL-A	
UHD2 (8K)	Video	JPEG XS High only	JPEG XS High and TDC	JPEG XS High only		JPEG XS High only	JPEG XS High and TDC	N/A	JPEG XS High and TDC
		YCbCr 4:2:2 only bit depth = 10 maximum rate = 4bpp frame rate <= 60Hz image width <= 7680 image height <= 4320		YCbCr 4:2:2, YCbCr 4:4:4, RGB 4:4:4 bit depth <= 10 maximum rate = 4bpp frame rate <= 60Hz image width <= 8192 image height <= 4320		YCbCr 4:2:0, YCbCr 4:2:2, YCbCr 4:4:4, RGB 4:4:4 bit depth <= 12 maximum rate = 4bpp frame rate <= 60Hz image width <= 8192 image height <= 4320		YCbCr 4:2:0, YCbCr 4:2:2, YCbCr 4:4:4, RGB 4:4:4 bit depth <= 12 maximum rate = 2bpp frame rate <= 60Hz image width <= 8192 image height <= 4320	
	Audio	ACL-B,C		ACL-B		ACL-B		N/A	

Table 5. Capability Sets

Appendix A (Informative) Session Description and NMOS Examples

The following Session Description Protocol (SDP) object describes a SMPTE ST2110-22 JPEG XS stream containing 720p@59.94Hz video, sent in duplicate using ST 2022-7.

Note the media subtype “jxsv” and the kilobits-per-second indication b=AS:116000 (116 megabits per second, or about 2 bpp plus overheads). The b=AS:<rate> is defined in SMPTE ST 2110-22. The optional level and sublevel terms are also shown

```
v=0
o=- 101202 53 IN IP4 10.0.81.54
s=237.0.0.50:22000
i=Nmos Testing 237.0.0.50:22000
t=0 0
a=recvonly
a=group:DUP PRIMARY SECONDARY
m=video 22000 RTP/AVP 98
c=IN IP4 237.0.0.50/32
a=source-filter: incl IN IP4 237.0.0.50 10.0.81.54
a=rtpmap:98 jxsv/90000
a=fmtp:98 sampling=YCbCr-
4:2:2;width=1280;height=720;packetmode=0;exactframerate=60000/1001;dept
h=10;TCS=SDR;colorimetry=BT709;SSN=ST2110-22:2019;TP=2110TPN;level=1k-
1;sublevel=Sublev3bpp
b=AS:116000
a=ssrc:0 cname:nmos@nmos.tv
a=ts-refclk:ptp=IEEE1588-2008:08-00-11-FF-FE-22-91-3C:127
a=mediaclk:direct=0
a=mid:PRIMARY
m=video 22000 RTP/AVP 98
c=IN IP4 237.64.0.50/32
a=source-filter: incl IN IP4 237.64.0.50 10.0.81.154
a=rtpmap:98 jxsv/90000
a=fmtp:98 sampling=YCbCr-
4:2:2;width=1280;height=720;packetmode=0;exactframerate=60000/1001;dept
h=10;TCS=SDR;colorimetry=BT709;SSN=ST2110-22:2019;TP=2110TPN;level=1k-
1;sublevel=Sublev3bpp
b=AS:116000
a=ssrc:0 cname:nmos@nmos.tv
a=ts-refclk:ptp=IEEE1588-2008:08-00-11-FF-FE-22-91-3C:127
a=mediaclk:direct=0
a=mid:SECONDARY
```

In particular, each JPEG XS capable video receiver must indicate subtype jxsv in its “caps” parameter (within the receiver object). An example of this is shown below.

```
{
    "device_id": "a2e5d793-b20c-31b2-baf5-0215a8f92bbd",
    "transport": "urn:x-nmos:transport:rtp.mcast",
    "format": "urn:x-nmos:format:video",
    "subscription": { "sender_id": null, "active": true },
    "caps": {"media_types": [ "video/jxsv" ] },
    "interface_bindings": [ "eth0", "eth1" ],
    "description": "JPEG XS Test Receiver - video",
```

```
    "tags": { "urn:x-nmos:tag:grouphint/v1.0": [ "X:v1" ] },
    "id": "6aafb9e8-cb9f-3a15-9e25-6f50971ac7a2",
    "version": "1643643942:666000",
    "label": "JPEG XS Test Receiver - video"
}
```

In registering senders and receivers using AMWA IS-04, the JPEG XS capable receiver must indicate so using the same subtype in its “caps” parameter (part of the receiver object):

```
    "caps": { "media_types": [ "video/raw", "video/jxsv" ] }
```

In the NMOS Flow object, again the media_type must indicate video/jxsv. Additional parameters may be added to the NMOS Flow schema for the average rate per frame in a future NMOS version.

Appendix B (Informative) Capability Sets and Interoperability Points

Interoperability Points Capability Set A & B

Interop Points	Capability Set (F3)	Timing (F3)	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp	Bit Depth	Color Sampling	Color Space	Audio Conformance Level	JPEG XS Profile			Reference Uncompressed Video BitRate, in Mbps
															Profile	Level	Sublevel (F2)	
1	A/B		FHD	720px1280/59	921,600	55,240,759	83	1.5	221	4.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	High 444.12	1K-1	Sublev4bpp	1,105
2	A/B		FHD	720px1280/50	921,600	46,080,000	69	1.5	184	4.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	High 444.12	1K-1	Sublev4bpp	922
3	A/B		FHD	1080ix1920/29	2,073,600	62,145,854	93	1.5	249	4.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	High 444.12	2K-1	Sublev4bpp	1,243
4	A/B		FHD	1080ix1920/25	2,073,600	51,840,000	78	1.5	207	4.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	High 444.12	2K-1	Sublev4bpp	1,037
5a,b,c	A/B		FHD	1080px1920/59	2,073,600	124,291,708	186	1.5	497	4.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	2,486
6a,b,c	A/B		FHD	1080px1920/50	2,073,600	103,680,000	156	1.5	415	4.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	2,074
11a.b.c	A/B		FHD	1080px1920/23.98	2,073,600	49,716,683	75	1.5	199	4.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	994
12a.b.c	A/B		FHD	1080px1920/24	2,073,600	49,766,400	75	1.5	199	4.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	995
13a.b.c	A/B		FHD	1080px1920/29.97	2,073,600	62,145,854	93	1.5	249	4.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	1,243
14a.b.c	A/B		FHD	1080px1920/30	2,073,600	62,208,000	93	1.5	249	4.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	1,244
15a.b.c	A/B		FHD	1080px1920/60	2,073,600	124,416,000	187	1.5	498	4.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	2,488
7a.b.c	A/B		UHD1	2160px3840/59	8,294,400	497,166,833	746	1.5	1989	4.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev4bpp	9,943
8a.b.c	A/B		UHD1	2160px3840/50	8,294,400	414,720,000	622	1.5	1,659	4.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev4bpp	8,294
16a.b.c	A/B		UHD1	2160px3840/23.98	8,294,400	198,866,733	298	1.5	795	4.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev4bpp	9,943
17a.b.c	A/B		UHD1	2160px3840/24	8,294,400	199,065,600	299	1.5	796	4.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev4bpp	8,294
18a.b.c	A/B		UHD1	2160px3840/29.97	8,294,400	248,583,417	373	1.5	994	4.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev4bpp	8,294
19a.b.c	A/B		UHD1	2160px3840/30	8,294,400	248,832,000	373	1.5	995	4.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev4bpp	8,294
20a.b.c	A/B		UHD1	2160px3840/60	8,294,400	497,664,000	746	1.5	1991	4.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev4bpp	8,294
9a.b.c	A/B		UHD2	4320px7680/59	33,177,600	1,988,667,333	2983	1.5	7955	4.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	8K-2	Sublev4bpp	39,773
10a.b.c	A/B		UHD2	4320px7680/50	33,177,600	1,658,880,000	2488	1.5	6,636	4.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	8K-2	Sublev4bpp	33,178

Notes:

F1 "Video format is given as active lines, scanning (interlaced or progressive) and frame rate (—59.9 is equivalent to —60/1.001 while —29.97 is equivalent to —30/1.001, 23.98 is equivalent to 24/1001".

F2 Sublevel: shall be set to Sublev3bpp or Sublev4bpp when the bpp is less than or equal to 3bpp, and shall be set to Sublev4bpp when the bpp exceeds 3bpp. Implementations compliant with this TR shall not set Sublevel to any other values.

F3 Capability set A with Timing set to "Sync" and Capability Set B with Timing set to "Async".

F4 Color Space: a=BT.709-6, b=BT.2100-2 (PQ), c=BT.2100-2 (HLG).

Interoperability Points Capability Set AT & BT

Interop Points	Capability Set (F3)	Timing (F3)	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp	Bit Depth	Color Sampling	Color Space	Audio Conformance Level	JPEG XS Profile			Decoder Minimum FBB Level	Reference Uncompressed Video BitRate, in Mbps
															Profile	Level	Sublevel (F2)	(F5)	
1	AT/BT		FHD	720px1280/59	921,600	55,240,759	55	1.0	221	4.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	TDC 444.12 High 444.12	1K-1	Sublev4bpp	Fbblev12bpp	1,105
2	AT/BT		FHD	720px1280/50	921,600	46,080,000	46	1.0	184	4.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	TDC 444.12 High 444.12	1K-1	Sublev4bpp	Fbblev12bpp	922
3	AT/BT		FHD	1080ix1920/29	2,073,600	62,145,854	62	1.0	249	4.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	1,243
4	AT/BT		FHD	1080ix1920/25	2,073,600	51,840,000	52	1.0	207	4.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	1,037
5a,b,c	AT/BT		FHD	1080px1920/59	2,073,600	124,291,708	124	1.0	497	4.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	2,486
6a,b,c	AT/BT		FHD	1080px1920/50	2,073,600	103,680,000	104	1.0	415	4.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	2,074
11a.b.c	AT/BT		FHD	1080px1920/23.98	2,073,600	49,716,683	50	1.0	199	4.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	994
12a.b.c	AT/BT		FHD	1080px1920/24	2,073,600	49,766,400	50	1.0	199	4.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	995
13a.b.c	AT/BT		FHD	1080px1920/29.97	2,073,600	62,145,854	62	1.0	249	4.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	1,243
14a.b.c	AT/BT		FHD	1080px1920/30	2,073,600	62,208,000	62	1.0	249	4.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	1,244
15a.b.c	AT/BT		FHD	1080px1920/60	2,073,600	124,416,000	124	1.0	498	4.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	2,488
7a.b.c	AT/BT		UHD1	2160px3840/59	8,294,400	497,166,833	497	1.0	1989	4.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	9,943
8a.b.c	AT/BT		UHD1	2160px3840/50	8,294,400	414,720,000	415	1.0	1,659	4.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	8,294
16a.b.c	AT/BT		UHD1	2160px3840/23.98	8,294,400	198,866,733	199	1.0	795	4.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	9,943
17a.b.c	AT/BT		UHD1	2160px3840/24	8,294,400	199,065,600	199	1.0	796	4.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	8,294

Interop Points	Capability Set (F3)	Timing (F3)	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp	Bit Depth	Color Sampling	Color Space	Audio Conformance Level	JPEG XS Profile			Decoder Minimum FBB Level	Reference Uncompressed Video BitRate, in Mbps
															Profile	Level	Sublevel (F2)	(F5)	
18a.b.c	AT/BT		UHD1	2160px3840/29.97	8,294,400	248,583,417	249	1.0	994	4.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	8,294
19a.b.c	AT/BT		UHD1	2160px3840/30	8,294,400	248,832,000	249	1.0	995	4.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	8,294
20a.b.c	AT/BT		UHD1	2160px3840/60	8,294,400	497,664,000	498	1.0	1991	4.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	8,294
9a.b.c	AT/BT		UHD2	4320px7680/59	33,177,600	1,988,667,333	1989	1.0	7955	4.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	8K-2	Sublev4bpp	Fbblev8bpp	39,773
10a.b.c	AT/BT		UHD2	4320px7680/50	33,177,600	1,658,880,000	1659	1.0	6,636	4.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	8K-2	Sublev4bpp	Fbblev8bpp	33,178

Notes:

F1 "Video format is given as active lines, scanning (interlaced or progressive) and frame rate (—59.9 is equivalent to —60/1.001while —29.97 is equivalent to —30/1.001, 23.98 is equivalent to 24/1001".

F2 Sublevel: shall be set to Sublev3bpp or Sublev4bpp when the bpp is less than or equal to 3bpp, and shall be set to Sublev4bpp when the bpp exceeds 3bpp. Implementations compliant with this TR shall not set Sublevel to any other values.

F3 Capability set A with Timing set to "Sync" and Capability Set B with Timing set to "Async".

F4 Color Space: a=BT.709-6, b=BT.2100-2 (PQ), c=BT.2100-2 (HLG).

F5 Decoder mandatory minimum supported frame buffer level.

Interoperability Points Capability Set C

Interop Points	Capability Set	Timing	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp (F4)	Bit Depth	Color Sampling (F3)	Color Space	Audio Conformance Level	JPEG XS Profile			Reference Uncompressed Video BitRate, in Mbps
															Profile	Level	Sublevel (F2)	
Capability set C includes all items 1-10c in Capability Set B, below are only the additional interop points																		
1a	C	ASYNC	FHD	1080px1920/59*	2,073,600	124,291,708	186	1.5	497	4.0	8bit	RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	2,983
1b	C	ASYNC	FHD	1080px1920/50	2,073,600	103,680,000	156	1.5	415	4.0	8bit	RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	2,488
1c	C	ASYNC	FHD	1080px1920/60	2,073,600	124,416,000	187	1.5	498	4.0	10bit	RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	3,732
1d	C	ASYNC	FHD	1080px1920/59*	2,073,600	124,291,708	186	1.5	497	4.0	8bit	YCbCr 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	High 444.12	2K-1	Sublev4bpp	2,983
2a	C	ASYNC	FHD	1200px1920/60	2,304,000	138,101,898	207	1.5	552	4.0	8bit	Full Range RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	High 444.12	4K-1	Sublev4bpp	3,318
2b	C	ASYNC	FHD	1200px1920/50	2,304,000	115,200,000	173	1.5	461	4.0	8bit	Full Range RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	High 444.12	4K-1	Sublev4bpp	2,765
3a	C	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	746	1.5	1,991	4.0	8bit	RGB 4:4:4	Rec. ITU-R BT.2020-2	ACL-B,C	High 444.12	4K-2	Sublev4bpp	11,932
3b	C	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	746	1.5	1,991	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2	ACL-B,C	High 444.12	4K-2	Sublev4bpp	14,915
3c	C	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	746	1.5	1,991	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2 (PQ)	ACL-B,C	High 444.12	4K-2	Sublev4bpp	14,915
3d	C	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	746	1.5	1,991	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2 (HLG)	ACL-B,C	High 444.12	4K-2	Sublev4bpp	14,915
3e	C	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	746	1.5	1,991	4.0	8bit	RGB 4:4:4	Rec. ITU-R BT.2020-2	ACL-B,C	High 444.12	4K-2	Sublev4bpp	11,932
4a	C	ASYNC	UHD2	4320px7680/60	33,177,600	1,990,656,000	2,986.0	1.5	7,963	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2	ACL-B,C	High 444.12	8K-2	Sublev4bpp	59,660
4b	C	ASYNC	UHD2	4320px7680/60	33,177,600	1,990,656,000	2,986.0	1.5	7,963	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2 (PQ)	ACL-B,C	High 444.12	8K-2	Sublev4bpp	59,660
4c	C	ASYNC	UHD2	4320px7680/60	33,177,600	1,990,656,000	2,986.0	1.5	7,963	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2 (HLG)	ACL-B,C	High 444.12	8K-2	Sublev4bpp	59,660

Notes:

F1 "Video format is given as active lines, scanning (interlaced or progressive) and frame rate (—59.9 is equivalent to —60/1.001 while —29.97 is equivalent to —30/1.001, 23.98 is equivalent to 24/1001".

F2 Sublevel: shall be set to Sublev3bpp or Sublev4bpp when the bpp is less than or equal to 3bpp, and shall be set to Sublev4bpp when the bpp exceeds 3bpp. Implementations compliant with this TR shall not set Sublevel to any other values.

F3 Full Range is indicated, on 2a and 2b. Whenever not indicated the limited range applies (RGB or YCbCr).

F4 1Gb Network Interface may limit some video formats to 2Bpp.

Interoperability Points Capability Set CT

Interop Points	Capability Set	Timing	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp (F4)	Bit Depth	Color Sampling (F3)	Color Space	Audio Conformance Level	JPEG XS Profile			Decoder Minimum FBB Level	Reference Uncompressed Video BitRate, in Mbps
															Profile	Level	Sublevel (F2)	(F5)	
Capability set C includes all items 1-10c in Capability Set B (TDC), below are only the additional interop points																			
1a	CT	ASYNC	FHD	1080px1920/59	2,073,600	124,291,708	124	1.0	497	4.0	8bit	RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	2,983
1b	CT	ASYNC	FHD	1080px1920/50	2,073,600	103,680,000	104	1.0	415	4.0	8bit	RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	2,488
1c	CT	ASYNC	FHD	1080px1920/60	2,073,600	124,416,000	124	1.0	498	4.0	10bit	RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	3,732
1d	CT	ASYNC	FHD	1080px1920/59*	2,073,600	124,291,708	124	1.0	497	4.0	8bit	YCbCr 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev4bpp	Fbblev12bpp	2,983
2a	CT	ASYNC	FHD	1200px1920/60	2,304,000	138,101,898	138	1.0	552	4.0	8bit	Full Range RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	TDC 444.12 High 444.12	4K-1	Sublev4bpp	Fbblev12bpp	3,318
2b	CT	ASYNC	FHD	1200px1920/50	2,304,000	115,200,000	115	1.0	461	4.0	8bit	Full Range RGB 4:4:4	Rec. ITU-R BT.709-6	ACL-A,B,C	TDC 444.12 High 444.12	4K-1	Sublev4bpp	Fbblev12bpp	2,765
3a	CT	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	498	1.0	1,991	4.0	8bit	RGB 4:4:4	Rec. ITU-R BT.2020-2	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev6bpp	Fbblev12bpp	11,932
3b	CT	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	498	1.0	1,991	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	14,915
3c	CT	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	498	1.0	1,991	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2 (PQ)	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	14,915
3d	CT	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	498	1.0	1,991	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2 (HLG)	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	14,915
3e	CT	ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	498	1.0	1,991	4.0	8bit	RGB 4:4:4	Rec. ITU-R BT.2020-2	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	11,932
4a	CT	ASYNC	UHD2	4320px7680/60	33,177,600	1,990,656,000	1,991	1.0	7963	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2	ACL-B,C	TDC 444.12 High 444.12	8K-2	Sublev4bpp	Fbblev8bpp	59,660
4b	CT	ASYNC	UHD2	4320px7680/60	33,177,600	1,990,656,000	1,991	1.0	7963	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2 (PQ)	ACL-B,C	TDC 444.12 High 444.12	8K-2	Sublev4bpp	Fbblev8bpp	59,660
4c	CT	ASYNC	UHD2	4320px7680/60	33,177,600	1,990,656,000	1,991	1.0	7,963	4.0	10bit	YCbCr 4:4:4	Rec. ITU-R BT.2100-2 (HLG)	ACL-B,C	TDC 444.12 High 444.12	8K-2	Sublev4bpp	Fbblev8bpp	59,660

Notes:

F1 "Video format is given as active lines, scanning (interlaced or progressive) and frame rate (—59.9 is equivalent to —60/1.001 while —29.97 is equivalent to —30/1.001, 23.98 is equivalent to 24/1001"

F2 Sublevel: shall be set to Sublev3bpp or Sublev4bpp when the bpp is less than or equal to 3bpp, and shall be set to Sublev4bpp when the bpp exceeds 3bpp. Implementations compliant with this TR shall not set Sublevel to any other values.

F3 Full Range is indicated, on 2a and 2b, where not indicated all others are limited range (RGB or YCbCr)

F4 1Gb Network Interface may limit some video formats to 2Bpp

F5 Decoder mandatory minimum supported frame buffer level

Interoperability Points Capability Set D

Interop Points	Capability Set	Timing	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp (F4)	Bit Depth	Color Sampling (F3)	Color Space	Audio Conformance Level	JPEG XS Profile			Reference Uncompressed Video BiRate, in Mbps
															Profile	Level	Sublevel (F2)	
Capability set D includes all items 1-10c in Capability Set B, all items in Capability Set C 1a-4c. Below are only the additional interop points																		
1a	D	ASYNC	UHD1	2160px3840/59*	8,294,400	497,166,833	746	1.5	1,989	4.0	8bit	YCbCr 4:2:0	Rec. ITU-R BT. 2020-2	ACL-B,C	High 420.12	4K-2	Sublev4bpp	5,966
1b	D	ASYNC	UHD1	2160px3840/50	8,294,400	414,720,000	622	1.5	1,659	4.0	8bit	YCbCr 4:2:0	Rec. ITU-R BT. 2020-2	ACL-B,C	High 420.12	4K-2	Sublev4bpp	4,977
1c	D	ASYNC	UHD1	2160px3840/59	8,294,400	497,166,833	746	1.5	1,989	4.0	10bit	YCbCr 4:2:0	Rec. ITU-R BT. 2020-2	ACL-B,C	High 420.12	4K-2	Sublev4bpp	7,458
1d	D	ASYNC	UHD1	2160px3840/59	8,294,400	497,166,833	746	1.5	1,989	4.0	12bit	YCbCr 4:2:0	Rec. ITU-R BT. 2020-2	ACL-B,C	High 444.12	4K-2	Sublev4bpp	8,949
2a	D	ASYNC	UHD2	4320px7680/59	33,177,600	1,988,667,333	2,983	1.5	7,955	4.0	10bit	YCbCr 4:2:0	Rec. ITU-R BT.2100-2	ACL-B,C	High 444.12	8K-2	Sublev4bpp	29,830
2b	D	ASYNC	UHD2	4320px7680/59	33,177,600	1,988,667,333	2,983	1.5	7,955	4.0	10bit	YCbCr 4:2:0	Rec. ITU-R BT.2100-2 (PQ)	ACL-B,C	High 444.12	8K-2	Sublev4bpp	29,830
2c	D	ASYNC	UHD2	4320px7680/59	33,177,600	1,988,667,333	2,983	1.5	7,955	4.0	10bit	YCbCr 4:2:0	Rec. ITU-R BT.2100-2 (HLG)	ACL-B,C	High 444.12	8K-2	Sublev4bpp	29,830

Notes:

F1 "Video format is given as active lines, scanning (interlaced or progressive) and frame rate (—59.9 is equivalent to —60/1.001 while —29.97 is equivalent to —30/1.001, 23.98 is equivalent to 24/1001"

F2 Sublevel: shall be set to Sublev3bpp or Sublev4bpp when the bpp is less than or equal to 3bpp, and shall be set to Sublev4bpp when the bpp exceeds 3bpp. Implementations compliant with this TR shall not set Sublevel to any other values.

F3 Full Range is indicated, on 2a and 2b, where not indicated all others are limited range (RGB or YCbCr)

F4 1Gb Network Interface may limit some video formats to 2Bpp

Interoperability Points Capability Set DT

Interop Points	Capability Set	Timing	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp (F4)	Bit Depth	Color Sampling (F3)	Color Space	Audio Conformance Level	JPEG XS Profile			Decoder Minimum FBB Level	Reference Uncompressed Video BiRate, in Mbps
															Profile	Level	Sublevel (F2)	(F5)	
Capability set D includes all items 1-10c in Capability Set B TDC, all items in Capability Set C TDC 1a-4c. Below are only the additional interop points																			
1a	DT	ASYNC	UHD1	2160px3840/59	8,294,400	497,166,833	497	1.0	1,989	4.0	8bit	YCbCr 4:2:0	Rec. ITU-R BT. 2020-2	ACL-B,C	TDC 444.12 High 420.12	4K-2	Sublev4bpp	Fbblev12bpp	5,966
1b	DT	ASYNC	UHD1	2160px3840/50	8,294,400	414,720,000	415	1.0	1,659	4.0	8bit	YCbCr 4:2:0	Rec. ITU-R BT. 2020-2	ACL-B,C	TDC 444.12 High 420.12	4K-2	Sublev4bpp	Fbblev12bpp	4,977
1c	DT	ASYNC	UHD1	2160px3840/59	8,294,400	497,166,833	497	1.0	1,989	4.0	10bit	YCbCr 4:2:0	Rec. ITU-R BT. 2020-2	ACL-B,C	TDC 444.12 High 420.12	4K-2	Sublev4bpp	Fbblev12bpp	7,458
1d	DT	ASYNC	UHD1	2160px3840/59	8,294,400	497,166,833	497	1.0	1,989	4.0	12bit	YCbCr 4:2:0	Rec. ITU-R BT. 2020-2	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev4bpp	Fbblev12bpp	8,949
2a	DT	ASYNC	UHD2	4320px7680/59	33,177,600	1,988,667,333	1989	1.0	7955	4.0	10bit	YCbCr 4:2:0	Rec. ITU-R BT.2100-2	ACL-B,C	TDC 444.12 High 444.12	8K-2	Sublev4bpp	Fbblev8bpp	29,830
2b	DT	ASYNC	UHD2	4320px7680/59	33,177,600	1,988,667,333	1989	1.0	7955	4.0	10bit	YCbCr 4:2:0	Rec. ITU-R BT.2100-2 (PQ)	ACL-B,C	TDC 444.12 High 444.12	8K-2	Sublev4bpp	Fbblev8bpp	29,830
2c	DT	ASYNC	UHD2	4320px7680/59	33,177,600	1,988,667,333	1,989	1.0	7,955	4.0	10bit	YCbCr 4:2:0	Rec. ITU-R BT.2100-2 (HLG)	ACL-B,C	TDC 444.12 High 444.12	8K-2	Sublev4bpp	Fbblev8bpp	29,830

Notes:

F1 "Video format is given as active lines, scanning (interlaced or progressive) and frame rate (—59.9 is equivalent to —60/1.001 while —29.97 is equivalent to —30/1.001, 23.98 is equivalent to 24/1001"

F2 Sublevel: shall be set to Sublev3bpp or Sublev4bpp when the bpp is less than or equal to 3bpp, and shall be set to Sublev4bpp when the bpp exceeds 3bpp. Implementations compliant with this TR shall not set Sublevel to any other values.

F3 Full Range is indicated, on 2a and 2b, where not indicated all others are limited range (RGB or YCbCr)

F4 1Gb Network Interface may limit some video formats to 2Bpp

F5 Decoder mandatory minimum supported frame buffer level

Interoperability Points Capability Set E/F

	Capability Set	Timing (F3)	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp	Bit Depth	Color Sampling	Color Space	Audio Conformance Level	JPEG XS Profile			Reference Uncompressed Video BitRate, in Mbps
															Profile	Level	Sublevel (F2)	
1	E/F	SYNC /ASYNC	FHD	720px1280/59	921,600	55,240,759	83	1.5	110	2.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	High 444.12	1K-1	Sublev2bpp	1,105
2	E/F	SYNC /ASYNC	FHD	720px1280/50	921,600	46,080,000	69	1.5	92	2.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	High 444.12	1K-1	Sublev2bpp	922
3	E/F	SYNC /ASYNC	FHD	1080ix1920/29	2,073,600	62,145,854	93	1.5	124	2.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	High 444.12	2K-1	Sublev2bpp	1,243
4	E/F	SYNC /ASYNC	FHD	1080ix1920/25	2,073,600	51,840,000	78	1.5	104	2.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	High 444.12	2K-1	Sublev2bpp	1,037
5a	E/F	SYNC /ASYNC	FHD	1080px1920/59	2,073,600	124,291,708	186	1.5	249	2.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev2bpp	2,486
6a	E/F	SYNC /ASYNC	FHD	1080px1920/50	2,073,600	103,680,000	156	1.5	207	2.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev2bpp	2,074
11a	E/F	SYNC /ASYNC	FHD	1080px1920/23.98	2,073,600	49,716,683	75	1.5	99	2.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev2bpp	994
12a	E/F	SYNC /ASYNC	FHD	1080px1920/24	2,073,600	49,766,400	75	1.5	100	2.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev2bpp	995
13a	E/F	SYNC /ASYNC	FHD	1080px1920/29.97	2,073,600	62,145,854	93	1.5	124	2.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev2bpp	1,243
14a	E/F	SYNC /ASYNC	FHD	1080px1920/30	2,073,600	62,208,000	93	1.5	124	2.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev2bpp	1,244
15a	E/F	SYNC /ASYNC	FHD	1080px1920/60	2,073,600	124,416,000	187	1.5	249	2.0	10bit	4:2:2	F4	ACL-A,B,C	High 444.12	2K-1	Sublev2bpp	2,488
7a	E/F	SYNC /ASYNC	UHD1	2160px3840/59	8,294,400	497,166,833	746	1.5	994	2.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev2bpp	9,943
8a	E/F	SYNC /ASYNC	UHD1	2160px3840/50	8,294,400	414,720,000	622	1.5	829	2.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev2bpp	8,294
16a	E/F	SYNC /ASYNC	UHD1	2160px3840/23.98	8,294,400	198,866,733	298	1.5	398	2.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev2bpp	9,943
17a	E/F	SYNC /ASYNC	UHD1	2160px3840/24	8,294,400	199,065,600	299	1.5	398	2.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev2bpp	8,294

	Capability Set	Timing (F3)	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp	Bit Depth	Color Sampling	Color Space	Audio Conformance Level	JPEG XS Profile			Reference Uncompressed Video BitRate, in Mbps
															Profile	Level	Sublevel (F2)	
18a	E/F	SYNC /ASYNC	UHD1	2160px3840/29.97	8,294,400	248,583,417	373	1.5	497	2.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev2bpp	8,294
19a	E/F	SYNC /ASYNC	UHD1	2160px3840/30	8,294,400	248,832,000	373	1.5	498	2.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev2bpp	8,294
20a	E/F	SYNC /ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	746	1.5	995	2.0	10bit	4:2:2	F4	ACL-B,C	High 444.12	4K-2	Sublev2bpp	8,294

Notes:

F1 "Video format is given as active lines, scanning (interlaced or progressive) and frame rate (—59.9 is equivalent to —60/1.001 while —29.97 is equivalent to —30/1.001, 23.98 is equivalent to 24/1001"

F2 Sublevel: shall only be set to Sublev2bpp.

F3 Capability set E with Timing set to "Sync" and Capability Set F with Timing set to "Async"

F4 Color Space, a=BT.709-6, b=BT.2100-2 (PQ), c=BT.2100-2 (HLG)

Interoperability Points Capability Set ET/FT

Interop Points	Capability Set (F3)	Timing (F3)	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp	Bit Depth	Color Sampling	Color Space	Audio Conformance Level	JPEG XS Profile			Decoder Minimum FBB Level	Reference Uncompressed Video BitRate, in Mbps
															Profile	Level	Sublevel (F2)	(F5)	
1	ET/FT	SYNC /ASYNC	FHD	720px1280/59	921,600	55,240,759	55	1.0	110	2.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	TDC 444.12 High 444.12	1K-1	Sublev2bpp	Fbblev12bpp	1,105
2	ET/FT	SYNC /ASYNC	FHD	720px1280/50	921,600	46,080,000	46	1.0	92	2.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	TDC 444.12 High 444.12	1K-1	Sublev2bpp	Fbblev12bpp	922
3	ET/FT	SYNC /ASYNC	FHD	1080ix1920/29	2,073,600	62,145,854	62	1.0	124	2.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	TDC 444.12 High 444.12	2K-1	Sublev2bpp	Fbblev12bpp	1,243
4	ET/FT	SYNC /ASYNC	FHD	1080ix1920/25	2,073,600	51,840,000	52	1.0	104	2.0	10bit	4:2:2	Rec. ITU-R BT.709-6	ACL-A	TDC 444.12 High 444.12	2K-1	Sublev3bpp	Fbblev12bpp	1,037
5a	ET/FT	SYNC /ASYNC	FHD	1080px1920/59	2,073,600	124,291,708	124	1.0	249	2.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev2bpp	Fbblev12bpp	2,486
6a	ET/FT	SYNC /ASYNC	FHD	1080px1920/50	2,073,600	103,680,000	104	1.0	207	2.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev2bpp	Fbblev12bpp	2,074
11a	ET/FT	SYNC /ASYNC	FHD	1080px1920/23.98	2,073,600	49,716,683	50	1.0	99	2.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev2bpp	Fbblev12bpp	994
12a	ET/FT	SYNC /ASYNC	FHD	1080px1920/24	2,073,600	49,766,400	50	1.0	100	2.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev2bpp	Fbblev12bpp	995
13a	ET/FT	SYNC /ASYNC	FHD	1080px1920/29.97	2,073,600	62,145,854	62	1.0	124	2.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev2bpp	Fbblev12bpp	1,243
14a	ET/FT	SYNC /ASYNC	FHD	1080px1920/30	2,073,600	62,208,000	62	1.0	124	2.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev2bpp	Fbblev12bpp	1,244
15a	ET/FT	SYNC /ASYNC	FHD	1080px1920/60	2,073,600	124,416,000	124	1.0	249	2.0	10bit	4:2:2	F4	ACL-A,B,C	TDC 444.12 High 444.12	2K-1	Sublev2bpp	Fbblev12bpp	2,488
7a	ET/FT	SYNC /ASYNC	UHD1	2160px3840/59	8,294,400	497,166,833	497	1.0	994	2.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev2bpp	Fbblev12bpp	9,943
8a	ET/FT	SYNC /ASYNC	UHD1	2160px3840/50	8,294,400	414,720,000	415	1.0	829	2.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev2bpp	Fbblev12bpp	8,294

Interop Points	Capability Set (F3)	Timing (F3)	Conformance Level	Format & Frame Rate (F1)	Sampling Points	Pixels per Second	Min rate (Mbps)	Min Bpp	Max Rate (Mbps)	Max Bpp	Bit Depth	Color Sampling	Color Space	Audio Conformance Level	JPEG XS Profile			Decoder Minimum FBB Level	Reference Uncompressed Video BitRate, in Mbps
															Profile	Level	Sublevel (F2)	(F5)	
16a	ET/FT	SYNC /ASYNC	UHD1	2160px3840/23.98	8,294,400	198,866,733	199	1.0	398	2.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev2bpp	Fbblev12bpp	9,943
17a	ET/FT	SYNC /ASYNC	UHD1	2160px3840/24	8,294,400	199,065,600	199	1.0	398	2.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev2bpp	Fbblev12bpp	8,294
18a	ET/FT	SYNC /ASYNC	UHD1	2160px3840/29.97	8,294,400	248,583,417	249	1.0	497	2.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev2bpp	Fbblev12bpp	8,294
19a	ET/FT	SYNC /ASYNC	UHD1	2160px3840/30	8,294,400	248,832,000	249	1.0	498	2.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev2bpp	Fbblev12bpp	8,294
20a	ET/FT	SYNC /ASYNC	UHD1	2160px3840/60	8,294,400	497,664,000	498	1.0	995	2.0	10bit	4:2:2	F4	ACL-B,C	TDC 444.12 High 444.12	4K-2	Sublev2bpp	Fbblev12bpp	8,294

Notes:

F1 "Video format is given as active lines, scanning (interlaced or progressive) and frame rate (—59.9 is equivalent to —60/1.001 while —29.97 is equivalent to —30/1.001, 23.98 is equivalent to 24/1001"

F2 Sublevel: shall only be set to Sublev2bpp.

F3 Capability set ET with Timing set to "Sync" and Capability Set FT with Timing set to "Async"

F4 Color Space, a=BT.709-6, b=BT.2100-2 (PQ), c=BT.2100-2 (HLG)

F5 Decoder mandatory minimum supported frame buffer level