SMPTVE Standards Various

ST 2051-1-2015  -  Generation and Alignment of Interface Signals to the SMPTE Epoch  
-  Provided parameter and required calculation for source encoding, timebase resampling and frame format alignment

ST 2050-2015 (E2050-2018)  -  SMPTE Profile for use of E105 Precision Time Protocol (PTP) in Broadband IP Applications  
-  Define profile, clocks, transport and performance for both unicast and multicast  
-  Enable any slave introduced into a network to become synchronized and maintain network-based time accuracy

SMPTE 2050-12 (2018)  -  Title “the SMPTE” is no longer officially referred to original matrix dimensions, Units of the International System of Units (SI) are the preferred units of measurement in all current SMPTE Engineering Documents.
-  HD SDI defines the mapping of various source images onto a single link, dual-link and quad-link serial digital interface operating at a sampling rate of 1.485 Gbps.
-  SMPTE 2050 defines a 10-bit serial digital interface operating at 1437 Mbps.
-  SMPTE 2148 defines the 1080- HD video format including 1080i-25 and 1080p-30.
-  SMPTE 2151-1 2015  -  Ancillary data placed and Space Formatting.
-  SMPTE 230-1 2009  -  512 data channels.
-  SMPTE 230-8 2016  -  1024 data channels.
-  SMPTE 311M-2009 defines camera to CCU Cable and connects to SMPTE 304M connector.
-  SMPTE 304M defines LEMO Hybrid Fiber connector standard (3K.93C connector).
-  Multicast audio is always on UDP port 4321. Unicast audio ports come from a range: 14336 - 14600.
-  Audio; 5.1 channel audio or immersive audio. Audio Codec AC-3, EAC-3, HE-ACC, AAC-LC.
-  Bit depth of 10-bits per sample; frame rate of up to 60 fps (integer frame rates preferred).
-  Dual-layer HDR (Dolby Vision);

IETF Standards (Internet Engineering Task Force)

RFC 3560 Real-time Transport Protocol (RTP)  
-  Provides RTP and RTCP delivery services for multimedia, including interactive audio and video. Those services identify payload type, sequence numbering, timestamping, timebase correction

RFC 4719 Payload Format for Uncompressed Video  
-  Defines a scheme to package uncompressed, studio-quality video streams for transport using RTP. It supports a range of standard and high-definition video, including 3G-SDI, and AV/8 SDI.

RFC 4959 Session Description (SDP)  
-  The SDP (RFC-4566) tells the receiver what it needs to know. Senders expose an SDP on every stream they make. The control system (out of scope) carries the SDP information to the receiver.

RFC 8331: 2018 Ancillary Data (RTP Payload Format for SMPTE 291-1)  
-  RTP Payload for SMPTE 291-1 Ancillary Data (Cell Timers, Closed Captions and Active Format Description) (RTP/AVC Annex)
-  SMPTE Ancillary Data is generally used for professional video formats to carry ancillary video data, including timecodes, captions, and the Active Format Description (AFD).

AES67 (Audio Engineering Society) AES67-2015  
-  Is a standard published in 2015, to enable interoperable streaming of high-performance audio-over-IP between various IP based audio networking protocols currently in existence such as Dante, EtherSound and CobraNet. Protocol is based on a common IP audio-over-IP payload format with the same payload layout.

DANTE (Digital Audio Network Through Ethernet)  
-  Owned by Audinate. Licensed to Shure, Allen & Heath and Yamaha. 
-  Proprietary system improves on audio-over-Ethernet technologies such as CobraNet and EtherSound. 

Dynamic Toning (Dolby Laboratories)  
-  Is an HDR format from Dolby Laboratories that can be optionally supported by Ultra HD Blu-ray discs and streaming video services. Dolby Vision is a proprietary format and Dolby’s IP business unit (Del) has stated that it will only pay for Dolby Vision to the consumer for content that is delivered to the consumer. When Dolby Vision is streamed it is done through the International Telecommunication Union (ITU) online website on July 4, 2016. Dolby Vision video streaming has a dynamic range of more than 100:1, compared to 60,000:1 for a normal display. Dolby Vision uses a separate gamma curve for HDR video, when utilizing a conventional gamma curve and a bit depth of 10-bits per sample, it has a dynamic range of 350:1 or 8.3 dynamic range, a range not offered by the majority of current displays.

Perceptual Quantizer (PQ), SMPTE ST 2084  
-  Is a transfer function that allows for the display of high dynamic range (HDR) video with a luminance level of up to 10,000 cd/m2 and can be used with the Rec. 2020 color space. PQ is a nonlinear electro-optical transfer function (OTF). On April 12, 2016, the Ultra HD Forum announced industry guidelines for HDR Video Phase A which uses Hybrid Log-Gammas (HLG) and PQ transfer functions with a bit depth of 10-bits and the Rec. 2020 color space. On July 1, 2016, the SMPTE-TR 2084, which uses PQ or HLG, displays video content for the SMPTE 2084 color space.

DRC Media Profile  
-  More commonly known as HDR10, was announced on August 27, 2015, by the Consumer Technology Association and which uses the wide-gamut Rec. 2020 color space. It carries a range of 10-bits per channel and has a dynamic range of 3,000:1 or 10.2 dynamic range. DCR media profile of 10-bits allows for more accurate adjustment brightness levels on a scene-by-scene or frame-by-frame basis. HDR10+ is an open standard supported by a wide variety of companies, which includes monitor and TV manufacturers such as Dell, LG, Samsung, Sharp and Sony, as well as Microsoft and Sony Interactive Entertainment, which support HDR10+ on their PlayStation 4 and Xbox One video game consoles and PCs.

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SL HDR-1  
-  Is an HDR standard that was jointly developed by the IBC and NHK. NHK defined a reference static and dynamic transfer function (TFT) in which the lower half of the signal values use a single curve and the upper half of the signal values use a logarithmic curve. The HDR standard is now required in equipment and consumer devices (HDMI 2.1) supports this new standard, and displays which are compliant are those that are HDMI 2.1 certified. SL HDR-1 is a standard which can be delivered using SHD distribution networks and services already in place. SL HDR-1 allows for HDR devices and SHD rendering on HDR devices using a single layer video stream.

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H.265 / HEVC
High efficiency video coding, also known as H.265, is a new video compression standard, developed by the Joint Collaborative Team on Video Coding (JCT-VC). The JCT-V is a single standard that is approved by two standards bodies, ISO/IEC and ITU-T.


The initial version of the H.265/HEVC video codec standard was released in 2013. In January 2015, HEVC was developed with the goal of providing better compression efficiency for the previous standard, H.264 / AVC. HEVC includes a number of improvements over H.264, mainly concerning encoder complexity and operation at high bit rates.

H.266 / HEVC Part 10, Advanced Video Coding (H.266-AVC)
This is the standard currently being used for most HEVC encoders. The future version of H.266, H.266 Part 11, is expected to be released in late 2020.

- 3D video
- Better support for dynamic range
- Higher resolution 4K120p & 8K60p
- Game mode VPR features (variable refresh rate/3D graphics
- HDR and wide color gamut
- Higher video resolution 4K120p & 8K60p
- Improved compression efficiency
- Mathematically lossless compression
- Graceful degradation
- Scalability
- License-free

AV1
- Alpha Media Video 1
- An open, royalty-free video coding format designed for video transmissions over the Internet. It is being developed by the Alliance for Open Media (AIMedia) for video streaming and video-on-demand services.
- Provides high-quality video at a lower bit rate than HEVC.
- AV1 is backward-compatible with HEVC, meaning that HEVC decoders can decode AV1 streams.
- AV1 is expected to be released in late 2020.
IP Connectivity • “25 is the new 10, 100 is the new 40”

40 GbE and 100 GbE Optics

The IEEE introduced the 802.3ba Ethernet standard in June 2010 in response to the increasing bandwidth demands facing data centers, paving the way for the introduction of 40 GbE and 100 GbE Ethernet operations. A just a few years later, many of these technologies are already being introduced to new deployments, and it is likely that 40 GbE and 100 GbE will be used in just about every new data center deployment.

Module Types

AOC (active optical cables)

Plug into standard optical module sockets. They have the optical electronics already connected eliminating the connections between the cable and the optical module. They are lower than other optical solutions because the manufacturer can match the electronics to the required length and type of cable.

SFP “Small Form-factor Pluggable”

A compact hot-pluggable optical module transceiver supporting communication over optical cabling up to 4.25Gb/s (depending on model).

SFP+ Enhanced version of the SFP that supports data rates up to 10Gb/s.

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Tone Mapping
A reference reproduction using a luminance range constrained by Recommendation ITU-R BT.2035 § 3.2 for video applications, or SMPTE RP 431 Scene-Referred
A function that maps scene luminance to displayed luminance.

A function that maps scene luminance to digital code value (see also EOTF).

nit video to represent a quantity which may more precisely be referred to as “luma”. 1 lx = 1 lm/m² = 1 cd·sr/m²

System specified and designed for capturing, processing, and reproducing a scene, conveying the full range of perceptible shadow and highlight

High Dynamic Range System (HDR System)
A function that maps digital code value to displayed luminance (see also OETF).

Electro-Optical Transfer Function (EOTF)
Metadata that can vary dynamically throughout the source content.

Also referred as Color Model is a specific organization and representation of colors. The Color Model is an abstract mathematical model which simply
describes the range of colors and represents them as tuples of number or color components (e.g. RGB).

Contest-Dependent Metadata
Metadatas that can vary dynamically throughout the source content.

Electro-Optical Transfer Function (EOTF)
A function that maps digital code value to displayed luminance (see also OETF).

High Dynamic Range System (HDR System)
System specified and designed for capturing, processing, and reproducing a scene, conveying the full range of perceptible shadow and highlight regions, with sufficient precision and acceptable artifacts, with sufficient separation of off-white and special highlights.

Luminance
Luminance intensity of a surface is a view dependent, the projected area of the surface element as viewed from that direction. A unit is candela per square meter (cd/m²).

Electro-Optical Transfer Function (EOTF)
A function that maps scene luminance to digital code value (see also EOTF).

Optical-Optical Transfer Function (OBTF)
A function that maps scene luminance to displayed luminance.

Peak Display Luminance
The highest luminance that a display can produce.

Scene-Referenced
An attribute including that the image data represents the colorimetry of the elements in a scene.

Standard Dynamic Range (SDR)
A reference reproduction using a luminance range recommended by RecommendaTIon ITU-R BT.870.305:2.3 for video applications, or SMPTE RP 431 for cinema applications.

Tone Mapping
The mapping luminance values in one color volume to luminance values in another color volume.

Transfer Function
A single variable, monotonic, mathematical function applied individually to one or more color channels of a color space.

White Color-Gamut (WCG)
Chromatically gamut significantly larger than the chromaticity gamut defined by Recommendation ITU-R BT.709.

Color Volume
Includes all colors throughout the entire luminance range - not just at one specifically defined level of luminance. It is represented by a three-dimensional object sometimes referred to as a “3D Color Gamut”.

Color Depth
Also known as bit-depth, is the number of total bits used to indicate the color of a single pixel (bpp), in a bit-mapped image or the number of bits used for each of the red, green, and blue color components that make up a single pixel.

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