

**ISO/IEC JTC 1/SC 29/WG 11**

**Coding of moving pictures and audio**

**Convenorship: UNI (Italy)**

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**ISO/IEC JTC 1/SC 29/WG 11**

**CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC 1/SC 29/WG 11 N19177**

**Alpbach, AT – April 2020**

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| **Source:** | **Convenor** |
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**WG 11 work plan**

1. Video Coding  
  1.1. Advanced Video Coding  
    1.1.1. [Items for future corrections of spec](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#809)  
  1.2. Supplemental enhancement information messages for coded video bitstreams  
    1.2.1. [Supplemental enhancement information messages for coded video bitstreams](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#797)  
  1.3. High Efficiency Video Coding  
    1.3.1. [High Efficiency Video Coding](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#571)  
    1.3.2. [Additional supplemental enhancement information](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#729)  
    1.3.3. [Shutter interval supplemental enhancement information](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#813)  
    1.3.4. [Items for future modifications of spec](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#810)  
  1.4. Versatile Video Coding  
    1.4.1. [Versatile Video Coding](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#702)  
  1.5. Immersive Video  
    1.5.1. [Immersive Video](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#786)  
  1.6. Video  
    1.6.1. [Chroma location and corrections](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#811)  
  1.7. Usage of video signal type code points  
    1.7.1. [Usage of video signal type code points](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#778)  
  1.8. Immersive Video  
    1.8.1. [Immersive video - 6DoF](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#686)  
    1.8.2. [Compression of dense representation of light fields](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#687)  
  1.9. Video Coding for Machines  
    1.9.1. [Video Coding for Machines](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#796)  
  1.10. Essential Video Coding  
    1.10.1. [Essential Video Coding](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#740)  
  1.11. Low Complexity Enhancement Video Coding  
    1.11.1. [Low Complexity Enhancement Video Coding](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#752)  
2. Audio Coding  
  2.1. Audio-System interaction  
    2.1.1. [Second Edition](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#812)  
  2.2. Uncompressed Audio in MP4 FF  
    2.2.1. [Uncompressed Audio in MP4 FF](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#749)  
  2.3. 3D Audio  
    2.3.1. [Corrections and Improvements on 3D Audio](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#801)  
  2.4. Immersive Audio  
    2.4.1. [Immersive Audio](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#692)  
3. 3D Graphics Coding  
  3.1. Visual Volumetric Video-based Coding (V3C) and Video-based Point Cloud Compression (V-PCC)  
    3.1.1. [Video-based Point Cloud Compression](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#694)  
  3.2. Geometry-based Point Cloud Compression  
    3.2.1. [Geometry-based Point Cloud Compression](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#758)  
4. Digital Item Coding  
  4.1. MPEG-21 Based Smart Contracts  
    4.1.1. [MPEG-21 Based Smart Contracts](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#771)  
5. Genome Coding  
  5.1. Transport and Storage of Genomic Information  
    5.1.1. [Transport and storage of genomic information](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#807)  
  5.2. Genomic Information Representation  
    5.2.1. [Genomic Information Representation](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#808)  
  5.3. Genomic Annotation Representation  
    5.3.1. [Genomic Annotation Representation](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#770)  
6. Neural Network Coding  
  6.1. Compression of neural networks for multimedia content description and analysis  
    6.1.1. [Compressed Representation of Neural Networks](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#698)  
7. Media Description  
  7.1. User Description  
    7.1.1. [User Description [3rd]](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#816)  
  7.2. Immersive Media Metadata  
    7.2.1. [Immersive Media Metadata](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#693)  
    7.2.2. [Immersive Video Metadata](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#783)  
    7.2.3. [Immersive Audio Metadata](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#784)  
8. Media Composition  
  8.1. Scene Description for MPEG Media  
    8.1.1. [Extensions to Scene Descriptions for Real-time Media](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#806)  
9. Systems support  
  9.1. Registration Authorities  
    9.1.1. [Registration Authority for MPEG-4](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#757)  
  9.2. MPEG Media Transport FEC Codes  
    9.2.1. [Window-based FEC code](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#663)  
  9.3. Immersive Media Metrics  
    9.3.1. [Immersive Media Metrics](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#699)  
10. IPMP  
  10.1. Format Independent Segment encryption and authentication  
    10.1.1. [Format Independent Segment encryption and authentication/COR 1](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#761)  
11. Transport  
  11.1. Systems  
    11.1.1. [Carriage of VVC in MPEG-2 TS](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#759)  
    11.1.2. [Corrigendum](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#788)  
    11.1.3. [Carriage of EVC in MPEG-2 TS and update of the MPEG-H 3D Audio descriptor](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#825)  
  11.2. ISO Base Media File Format  
    11.2.1. [Compact movie fragments](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#772)  
    11.2.2. [EventMessage Track Format](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#803)  
  11.3. Carriage of NAL unit structured video in the ISO Base Media File Format  
    11.3.1. [HEVC Carriage Improvements](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#789)  
    11.3.2. [Carriage of VVC in ISOBMFF](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#790)  
  11.4. Carriage of Timed Metadata Metrics of Media in ISO Base Media File Format  
    11.4.1. [Support for guided transcoding and spatial relationships](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#821)  
  11.5. Partial File Format  
    11.5.1. [Partial File Format](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#746)  
    11.5.2. [Support for HTTP entities, enhanced file type and byte-range priority](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#822)  
  11.6. Derived Visual Tracks in ISOBMFF  
    11.6.1. [Derived Visual Tracks in ISOBMFF](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#792)  
  11.7. MPEG Media Transport  
    11.7.1. [Support of FCAST](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#779)  
  11.8. Image File Format  
    11.8.1. [support for predictive image coding, bursts, bracketing, and other improvements](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#774)  
    11.8.2. [Support for slideshows and other improvements](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#827)  
  11.9. MMT Implementation Guidelines  
    11.9.1. [MPEG Media Transport Implementation Guidelines](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#747)  
  11.10. Media presentation description and segment formats  
    11.10.1. [CMAF support, events processing model and other extensions](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#781)  
  11.11. Delivery of CMAF content with DASH  
    11.11.1. [Delivery of CMAF content with DASH](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#738)  
  11.12. Session based DASH operations  
    11.12.1. [Session based DASH operations](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#767)  
  11.13. Omnidirectional MediA Format  
    11.13.1. [Omnidirectional MediA Format](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#658)  
  11.14. Carriage of Visual Volumetric Video-based Coding Data  
    11.14.1. [Carriage of Point Cloud Data](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#763)  
  11.15. Carriage of Geometry-based Point Cloud Compression Data  
    11.15.1. [Carriage of Geometry-based Point Cloud Compression Data](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#819)  
  11.16. In advance signalling of MPEG containers content  
    11.16.1. [In-advance signalling of MPEG containers content](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#708)  
  11.17. 5G Opportunities  
    11.17.1. [5G Opportunities](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#802)  
  11.18. Carriage of Essential Video Coding  
    11.18.1. [Carriage of EVC in MPEG Systems](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#820)  
12. Application Formats  
  12.1. Common Media Application Format  
    12.1.1. [Additional CMAF HEVC media profiles](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#804)  
  12.2. Multi-Image Application Format  
    12.2.1. [Harmonization of MIAF brands, profiles and processing models](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#824)  
    12.2.2. [MIAF HEVC Advanced HDR profile and other clarifications](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#826)  
13. API  
  13.1. Network-based Media Processing  
    13.1.1. [NBMP Function Templates](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#818)  
  13.2. Implementation Guidelines for Network-based Media Processing  
    13.2.1. [Implementation Guidelines for Network-based Media Processing](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#782)  
  13.3. Video Decoding Interface for Immersive Media  
    13.3.1. [Multi-Decoder Video Interface for Immersive Media](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#805)  
14. Reference implementation  
  14.1. Reference software and conformance for file formats  
    14.1.1. [Reference Software and Conformance for File Format](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#798)  
  14.2. Conformance and Reference Software for Compact Descriptors for Video Analysis  
    14.2.1. [Conformance and Reference Software for Compact Descriptors for Video Analysis](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#722)  
  14.3. Visual Identity Management Application Format  
    14.3.1. [Reference Software and Conformance for Visual Identity Management Application Format](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#777)  
  14.4. Multi-Image Application Format  
    14.4.1. [Reference Software and Conformance for Multi Image Application Format](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#787)  
  14.5. Media orchestration  
    14.5.1. [Multimedia Orchestration Reference Software](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#723)  
  14.6. MMT Reference Software  
    14.6.1. [Support for MMTP extensions](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#764)  
  14.7. Implementation guidelines  
    14.7.1. [MPEG-DASH Implementation Guidelines](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#660)  
  14.8. Reference Software for Versatile Video Coding  
    14.8.1. [VVC Reference Software](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#815)  
  14.9. Reference Software and Conformance for Omnidirectional MediA Format  
    14.9.1. [Reference Software and Conformance for OMAF](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#817)  
  14.10. Reference Software for V-PCC  
    14.10.1. [Reference Software for V-PCC](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#828)  
  14.11. Reference Software  
    14.11.1. [Reference software and conformance](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#641)  
  14.12. IoMT Reference Software and Conformance  
    14.12.1. [IoMT Reference Software and Conformance](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#760)  
  14.13. Conformance and Reference Software of Essential Video Coding  
    14.13.1. [Conformance and Reference Software of Essential Video Coding](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#823)  
15. Conformance  
  15.1. MMT Conformance testing  
    15.1.1. [MMT Conformance Testing](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#725)  
  15.2. Conformance Testing for Versatile Video Coding  
    15.2.1. [VVC Conformance](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#814)  
  15.3. Conformance for V-PCC  
    15.3.1. [Conformance for V-PCC](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#829)  
  15.4. Conformance  
    15.4.1. [Conformance](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#642)  
16. Data compression  
  16.1. Data Compression  
    16.1.1. [Data Compression](http://wg11.sc29.org/projects/generateWorkPlan.php?selectedMeeting=182#765)  
  
  
**1. Video Coding**  
  **1.1. Advanced Video Coding**  
    **1.1.1. Items for future corrections of spec**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 10 | Items for future corrections of spec | E | 10 | *Motivations:* There are several items to be corrected in AVC. It is to be determined if this would better be done by corrigendum or new edition *Objectives:* Correction of specification text |

  **1.2. Supplemental enhancement information messages for coded video bitstreams**  
    **1.2.1. Supplemental enhancement information messages for coded video bitstreams**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| C | 7 | Supplemental enhancement information messages for coded video bitstreams | E | 1 | *Motivations:* Supplemental enhancement information contained in this standard is valuable for applications but not mandatory to decode the video bitstream itself. *Objectives:* It is targeted to make the supplemental enhancement information contained in this standard shall be usable in combination with various video coding standards, including Versatile Video Coding. |

  **1.3. High Efficiency Video Coding**  
    **1.3.1. High Efficiency Video Coding**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 2 | High Efficiency Video Coding | E | 4 | *Motivations:* A new edition of the standard is needed to integrate the prior amendments to the previous edition. Also, a new profile of HEVC with encoding of a single (i.e. monochrome) colour plane and restricted to a maximum of 10 bits per sample to complement other 10 bit profiles, such as the Main 10, Main 10 Still Picture, and Main 4:4:4 10 profiles is needed in a variety of applications that may require signalling of 10 bit monochrome auxiliary information, such as depth information and alpha planes, and additional supplemental enhancement information, e.g. fisheye video, SEI manifest, and SEI prefix messages. *Objectives:* Specification of a profile of HEVC that that will have an encoding of a single (i.e. monochrome) colour plane and will be restricted to a maximum of 10 bits per sample, in a manner otherwise consistent with the prior specified “range extensions” profiles of HEVC.\r\n\r\nThe specification of additional supplemental enhancement information will also be included, including fisheye video, SEI manifest, and SEI prefix messages. |

    **1.3.2. Additional supplemental enhancement information**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 2 | Additional supplemental enhancement information | A | 1 | *Motivations:* Thiere is a need for additional supplemental enhancement information, including an annotated regions SEI message and a fisheye video information SEI message *Objectives:* To provide syntax and semantics for the annotated regions and fisheye video information SEI messages |

    **1.3.3. Shutter interval supplemental enhancement information**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 2 | Shutter interval supplemental enhancement information | A | 2 | *Motivations:* It is valuable for decoding systems to receive information regarding how the source pictures were generated - particularly including the exposure time of the capturing process for the pictures in the bitstreams *Objectives:* Representing information that indicates the shutter interval exposure time for pictures in video bitstreams |

    **1.3.4. Items for future modifications of spec**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 2 | Items for future modifications of spec | E | 5 | *Motivations:* There are several items to be corrected or amended in HEVC. It is to be determined if this would better be done by amendment, corrigendum or new edition *Objectives:* Improvement of specification |

  **1.4. Versatile Video Coding**  
    **1.4.1. Versatile Video Coding**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 3 | Versatile Video Coding | E | 1 | *Motivations:* Industry needs a standard providing more video compression and new features *Objectives:* 1. Develop 2D video coding technology which could improve the compression performance or give new functionality, as compared to HEVC including the development of test cases and evaluation methodologies for assessment of such benefits are investigated.\r\n2. Develop video compression that can be applied to 360ᵒ Video (3DoF) |

  **1.5. Immersive Video**  
    **1.5.1. Immersive Video**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 12 | Immersive Video | E | 1 | *Motivations:* Enable immersive video viewing experience of real-world and virtual 3D scenes. *Objectives:* Develop coding technology of multiple texture and depth views representing immersive video, enabling user viewing with 6 Degree of Freedom (6DoF) at any position and orientation within a constrained range, utilizing legacy 2D video coding standards. |

  **1.6. Video**  
    **1.6.1. Chroma location and corrections**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| CICP | 2 | Chroma location and corrections | E | 2 | *Motivations:* Chroma sample location identification is desired to be added. There are also several items to be corrected. *Objectives:* Add chroma location type information and correct errors |

  **1.7. Usage of video signal type code points**  
    **1.7.1. Usage of video signal type code points**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| CICP | 4 | Usage of video signal type code points | T | 2 | *Motivations:* The second edition will include additional combinations of code points commonly used in industry, and will also include baseband signalling *Objectives:* To keep the report up to date with market needs |

  **1.8. Immersive Video**  
    **1.8.1. Immersive video - 6DoF**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 7 | Immersive video - 6DoF | Ex | 2 | *Motivations:* Computational imaging technology offers users ways for immersive experiences with six degrees-of-freedom in limited volume free navigation, providing more freedom of user movement than in 3DoF+. Eventually, full-6DoF will be achieved (any translation and rotation in space), synthesizing virtual viewpoints from multiple, fixed cameras set up in various arrangements (planar arrangement, cameras in an arc, 360 divergent, etc). *Objectives:* To provide normative improvements on compression of 6DoF content on top of the state of the art anchor. The improvements are evaluated simultaneously on decoded views and synthesized views. |

    **1.8.2. Compression of dense representation of light fields**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 7 | Compression of dense representation of light fields | Ex | 3 | *Motivations:* Recently, camera technology has evolved and new capturing devices are emerging. Such capturing devices can simultaneously acquire dense spatial and angular light information. Having such information we can extract dense multiviews, perform refocusing and estimate depth information. Such cameras are expected to be replaced with current cameras to acquire 3-D real-world visual data. *Objectives:* New capturing devices can capture light field in one shot, having both spatial and angular light information. Due to higher dimension of such data, i.e. 4-D, the size of capture data is not only larger but also different from traditional camera images. Therefore, a new and compatible compression for such formats would be essential so that new services can be provided. |

  **1.9. Video Coding for Machines**  
    **1.9.1. Video Coding for Machines**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 34 | Video Coding for Machines | Ex | 1 | *Motivations:* Traditional video coding standards are optimized for human consumption of video. Since today most video is analyzed by machines and human consumption is mostly related to verification of machine analysis results - if at all - a new standard might enable lower bitrates without lowering the performance of machine analysis. *Objectives:* The MPEG activity on Video Coding for Machines (VCM) aims to standardize a bitstream format generated by compressing both a video stream and previously extracted features. The bitstream should enable multiple machine vision tasks |

  **1.10. Essential Video Coding**  
    **1.10.1. Essential Video Coding**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 5 | 1 | Essential Video Coding | E | 1 | *Motivations:* To provide an ISO video coding standard to address business and technology needs in some use cases that are not well served by existing ISO standards, such as HEVC. *Objectives:* To develop a new video coding standard that meets a combination of business and technology requirements:\r\n• a Baseline profile containing technologies which are over 20 years old or which are accompanied only by Type 1 declarations\r\n• a Main profile containing a small number of additional tools, each of which is capable of being cleanly switched off or switched over to Baseline tools on an individual basis\r\n• encouragement of the timely publication of licensing terms\r\n• coding efficiency at least as good as that of HEVC\r\n• complexity suitable for real time encoding and decoding |

  **1.11. Low Complexity Enhancement Video Coding**  
    **1.11.1. Low Complexity Enhancement Video Coding**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 5 | 2 | Low Complexity Enhancement Video Coding | E | 1 | *Motivations:* There is a commercial need for a lightweight video codec that has better coding performance while also being low complexity. Such a coding technology would fit a niche where an existing video decoder with the addition of a small amount of additional technology could provide substantial improvements. *Objectives:* The objective of this project is to develop a standard that leverages existing deployed MPEG video codecs in a manner that improves video compression efficiency while keeping the incremental technology complexity impact low. Target platforms for deployment would be a software codec or existing hardware codec with extra processing capability. Examples could be Set Top Boxes (STB), mobile devices and PC-based decoders. An additional benefit is the reduction in implementation complexity or a corresponding expansion in spatial resolution. |

**2. Audio Coding**  
  **2.1. Audio-System interaction**  
    **2.1.1. Second Edition**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 24 | Second Edition | T | 1 | *Motivations:* MPEG audio can have complex interactions with Systems, e.g. File Format. *Objectives:* Show what interactions can occur and demonstrate how they should be handled. |

  **2.2. Uncompressed Audio in MP4 FF**  
    **2.2.1. Uncompressed Audio in MP4 FF**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| D | 5 | Uncompressed Audio in MP4 FF | E | 1 | *Motivations:* It is not possible to carry uncompressed audio (e.g. PCM) in MP4 FF *Objectives:* Specifies carriage of uncompressed audio (e.g. PCM) in MP4 FF |

  **2.3. 3D Audio**  
    **2.3.1. Corrections and Improvements on 3D Audio**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 3 | Corrections and Improvements on 3D Audio | A | 2 | *Motivations:* This Amendment provides various technical corrections and improvements to the specification. *Objectives:* For example, it defines the exact use of MHAS packet labels and marker packets, which are essential for a reliable interoperability across implementations. The amendment further adds necessary technical specification text that is required for successful deployment of the standard. It also corrects or improves several other minor or editorial aspects of the specification. The subdivision is within the scope of the original project, which is about immersive audio coding. |

  **2.4. Immersive Audio**  
    **2.4.1. Immersive Audio**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 4 | Immersive Audio | E | 1 | *Motivations:* MPEG-H 3D Audio supports a 3DoF (yaw, pitch, roll) user experience at the movie \"sweet spot,\" but it is desired to extend this to 6 DoF (adding x, y, z). *Objectives:* MPEG-I Audio builds upon MPEG-H 3D Audio to provide an immersive audio VR experience with 6 DoF. MPEG-I Audio standardizes additional metadata and rendering technology that delivers a compelling user experience with full 6DoF freedom of navigation. |

**3. 3D Graphics Coding**  
  **3.1. Visual Volumetric Video-based Coding (V3C) and Video-based Point Cloud Compression (V-PCC)**  
    **3.1.1. Video-based Point Cloud Compression**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 5 | Video-based Point Cloud Compression | E | 1 | *Motivations:* Technologies allow the capture of 3D point clouds typically with multiple cameras and depth sensors in various setups producing thousands up to billions of points when realistically reconstructed scenes are represented. Point clouds can have attributes such as colors, material properties and/or other attributes and are useful for real-time communications, for GIS, CAD and cultural heritage applications. *Objectives:* To specify lossy compression of 3D point clouds employing efficient geometry and attributes compression, scalable/progressive coding, and coding of point clouds sequence captured over time with support of random access to subsets of the point cloud. |

  **3.2. Geometry-based Point Cloud Compression**  
    **3.2.1. Geometry-based Point Cloud Compression**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 9 | Geometry-based Point Cloud Compression | E | 1 | *Motivations:* Due to the increased popularity of augmented and virtual reality experiences, the interest in capturing the real world in multiple dimensions and in presenting it to users in an immersible fashion has never been higher. Distributing such representations enables users to freely navigate in multi-sensory 3D media experiences. Such representations require a large amount of data, not feasible for transmission on today’s networks. Efficient compression technologies well adopted *Objectives:* This standard completes the second approach proposed (the Geometry-based PCC) by compressing efficiently sparse point clouds |

**4. Digital Item Coding**  
  **4.1. MPEG-21 Based Smart Contracts**  
    **4.1.1. MPEG-21 Based Smart Contracts**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 33 | MPEG-21 Based Smart Contracts | E | 1 | *Motivations:* MPEG-21 provides an extensive set of standard functionalities for commerce of digital media. However, there is no standard interface with transaction systems. *Objectives:* To develop standard interfaces to convert CEL contracts to code that can be executed as a smart contract on the Virtual Machine of a Blockchain |

**5. Genome Coding**  
  **5.1. Transport and Storage of Genomic Information**  
    **5.1.1. Transport and storage of genomic information**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 1 | Transport and storage of genomic information | E | 2 | *Motivations:* Fix editorial errors in the first edition *Objectives:* Create a second edition of the standard. |

  **5.2. Genomic Information Representation**  
    **5.2.1. Genomic Information Representation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 2 | Genomic Information Representation | E | 2 | *Motivations:* Errors in the first edition were identified. *Objectives:* Provide a clean second edition. |

  **5.3. Genomic Annotation Representation**  
    **5.3.1. Genomic Annotation Representation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 6 | Genomic Annotation Representation | E | 1 | *Motivations:* The output of most biological studies based on sequencing protocols is usually represented as different types of annotations (meta-information) all associated to one or more intervals on the reference genome. *Objectives:* A standard for representing genomic annotations compatible with existing parts of MPEG-G. |

**6. Neural Network Coding**  
  **6.1. Compression of neural networks for multimedia content description and analysis**  
    **6.1.1. Compressed Representation of Neural Networks**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 7 | 17 | Compressed Representation of Neural Networks | E | 1 | *Motivations:* Recently (deep) neural networks (NNs) have become a widely applied method in many application areas, including signal processing and multimedia. Classification methods, feature extractors and encoding methods based on NNs often outperform hand-crafted approaches. In many applications the trained NNs (which may contain large amounts of data) need to be transmitted to other systems or terminal devices (with possibly limited computing capabilities), where they are used for inference and/or are updated with local data. Thus efficient representations for exchanging NNs are required. *Objectives:* To study existing representations of NNs, the state of the art of NN compression methods, and the processing flows of training and deploying NNs to a range of (generic or dedicated) hardware platforms, to identify interfaces where a standard compressed NN representation is needed and the define the requirements for such a representation. |

**7. Media Description**  
  **7.1. User Description**  
    **7.1.1. User Description [3rd]**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 21 | 22 | User Description [3rd] | E | 3 | *Motivations:*  *Objectives:* |

  **7.2. Immersive Media Metadata**  
    **7.2.1. Immersive Media Metadata**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 7 | Immersive Media Metadata | E | 1 | *Motivations:* In MPEG-I several standards will require similar information such as description about a projection. So, instead of having duplicated information in many standards, this standard will provide a single consolidated reference of information.\r\nTechnology is making available different ways of offering a user an\\r\\nimmersive experience surrounding him/her with a large field of view\\r\\nvideo (up to 360 degrees) through Virtual Reality goggles or large 3D\\r\\nvideo walls. *Objectives:* To define common immersive media metadata focusing on immersive video (including 360° video), images, audio, and timed text. This metadata can be referenced by various other standards.\r\nTo study immersive video where different viewpoints are presented to\\r\\nthe user`s surroundings, corresponding to rotational head movements\\r\\nonly (so-called Three Degrees of Freedom, 3DoF), possibly augmented\\r\\nwith a virtual or physical translational body/head movement in a\\r\\nlimited volume around a central position (referred to as 3DoF+). |

    **7.2.2. Immersive Video Metadata**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 7 | Immersive Video Metadata | E | 1 | *Motivations:*  *Objectives:* |

    **7.2.3. Immersive Audio Metadata**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 7 | Immersive Audio Metadata | E | 1 | *Motivations:*  *Objectives:* |

**8. Media Composition**  
  **8.1. Scene Description for MPEG Media**  
    **8.1.1. Extensions to Scene Descriptions for Real-time Media**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 14 | Extensions to Scene Descriptions for Real-time Media | E | 1 | *Motivations:* Immersive media providing 6DoF experience is composed of multiple individual component objects. Description providing spatio-temporal relationship among component objects for efficient delivery and processing is required. *Objectives:* To provide integration of audio-visual media to the scene description widely used by the industries such as glTF. |

**9. Systems support**  
  **9.1. Registration Authorities**  
    **9.1.1. Registration Authority for MPEG-4**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 34 | Registration Authority for MPEG-4 | E | 1 | *Motivations:* MPEG-4 Systems and ISOBMFF requires continuous and frequent registration of new ObjectTypes and 4CC characters *Objectives:* To establish registration authorities |

  **9.2. MPEG Media Transport FEC Codes**  
    **9.2.1. Window-based FEC code**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 10 | Window-based FEC code | A | 1 | *Motivations:* Effective use of FEC requires entities on the delivery path *Objectives:* To describe the two-stage FEC scheme implementation as one stage FEC or two stage FEC by one entity, and may be cascaded and added by two or more (if more than two stages). \r\nTo enable layer aware FEC implementation as one layer FEC or two layer FEC by one entity, and may be cascaded and added by two or more (if more than two layers) entities. |

  **9.3. Immersive Media Metrics**  
    **9.3.1. Immersive Media Metrics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 6 | Immersive Media Metrics | E | 1 | *Motivations:* A consistent method to capture, measure and analyse such impact is essential to quantify and assess the VR product and application performance and effectiveness, maximize feelings of presence and enjoyment, and further optimize the product and experience design. While it is challenging to quantify the super accurate immersive level or emotional impact from the aggregate data, it is critically important to identify the basic objective metrics needed for a quality VR experience for MPEG-I use cases. *Objectives:* To specify the metrics and measurement framework to enhance the immersive media quality and experiences. It also includes a client reference model with observation and measurement points to define the interfaces for the collection of the metrics. |

**10. IPMP**  
  **10.1. Format Independent Segment encryption and authentication**  
    **10.1.1. Format Independent Segment encryption and authentication/COR 1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| DASH | 4 | Format Independent Segment encryption and authentication/COR 1 | C | 1 | *Motivations:* Errors in XML schema has been found *Objectives:* To correct errors in XML schema |

**11. Transport**  
  **11.1. Systems**  
    **11.1.1. Carriage of VVC in MPEG-2 TS**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 2 | 1 | Carriage of VVC in MPEG-2 TS | A | 2 | *Motivations:* Carriage of VVC over MPEG-2 TS needs to be defined. *Objectives:* To specify carriage of VVC over MPEG-2 TS |

    **11.1.2. Corrigendum**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 2 | 1 | Corrigendum | C | 1 | *Motivations:*  *Objectives:* |

    **11.1.3. Carriage of EVC in MPEG-2 TS and update of the MPEG-H 3D Audio descriptor**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 2 | 1 | Carriage of EVC in MPEG-2 TS and update of the MPEG-H 3D Audio descriptor | A | 3 | *Motivations:*  *Objectives:* |

  **11.2. ISO Base Media File Format**  
    **11.2.1. Compact movie fragments**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 12 | Compact movie fragments | A | 4 | *Motivations:* Metadata boxes contains lots of information and are getting larger in size. In a delay sensitive application download time of such boxes needs to be reduced. *Objectives:* To support for a more compact version of the TrackRunBox, particularly for use in delay-sensitive applications. |

    **11.2.2. EventMessage Track Format**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 12 | EventMessage Track Format | A | 5 | *Motivations:* The DASHEventMessageBox, defined in ISO/IEC 23009-1, is a box structure that may arise in streaming applications. However it is tricky to work with this box in ISOBMFF formatted media files, such as those based on the Common Media Track Format (CMAF). For instance, identifying active events at any point in the media track may require scanning of a large sub part of that track. In addition, it is not clear what happens to DashEventMessageBoxes when tracks are de-fragmented. Further, DashEventMessageBoxes cannot be de-multiplexed from track files based on ISO/IEC 23009-1 or ISO/IEC 23000-19. *Objectives:* This AMD specifies alternative methods for carriage of DashEventMessageBox structures using ISOBMFF Timed metadata track format. This event message track format associates the timeline of the DashEventMessageBox to the ISOBMFF track timeline. The specified track format enables all common ISOBMFF processing such as multiplexing and de-fragmentation. |

  **11.3. Carriage of NAL unit structured video in the ISO Base Media File Format**  
    **11.3.1. HEVC Carriage Improvements**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 15 | HEVC Carriage Improvements | A | 1 | *Motivations:* Additional features of HEVC needs to be supported *Objectives:* To supports additional features of HEVC such as SliceSegmentHeaderInfo |

    **11.3.2. Carriage of VVC in ISOBMFF**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 15 | Carriage of VVC in ISOBMFF | A | 2 | *Motivations:* New video codec, VVC is under development *Objectives:* To support storage of VVC in ISOBMFF |

  **11.4. Carriage of Timed Metadata Metrics of Media in ISO Base Media File Format**  
    **11.4.1. Support for guided transcoding and spatial relationships**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| B | 10 | Support for guided transcoding and spatial relationships | A | 1 | *Motivations:*  *Objectives:* |

  **11.5. Partial File Format**  
    **11.5.1. Partial File Format**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| B | 14 | Partial File Format | E | 2 | *Motivations:* Some broadcast mechanism (FLUTE, HbbTV) may deliver files in broadcast, usually for cache population. This is done by assigning to the broadcasted resource an HTTP URL. There are however use cases where some entity headers are also carried in the broadcast, such as cache directive, CORS or other meta-data. We currently lack a way of storing both these entities and the partial file, for later cache population (eg for cases when the receiver is not the process/device in charge of cache population). Both ISOBMFF and Partial File Format could benefit from a way of storing HTTP entities.\r\n\r\nIn addition, we have identified two use cases benefiting from degradation priority signaling *Objectives:* This standard will enable storing both these entities and the partial file, for later cache population (eg for cases when the receiver is not the process/device in charge of cache population). |

    **11.5.2. Support for HTTP entities, enhanced file type and byte-range priority**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| B | 14 | Support for HTTP entities, enhanced file type and byte-range priority | A | 1 | *Motivations:*  *Objectives:* |

  **11.6. Derived Visual Tracks in ISOBMFF**  
    **11.6.1. Derived Visual Tracks in ISOBMFF**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| B | 16 | Derived Visual Tracks in ISOBMFF | E | 1 | *Motivations:* To support new visual contents by specifying derivation process instead of processed visual content *Objectives:* To define derivation operation and derivation tracks |

  **11.7. MPEG Media Transport**  
    **11.7.1. Support of FCAST**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 1 | Support of FCAST | A | 1 | *Motivations:* FCAST is widely used object download protocol. *Objectives:* This Amendment adds support for the FCAST protocol to MMT in 2 different ways. The first option is to enable cross-referencing of assets between FCAST and MMT. The second option is to define a new payload mode for MMT to operate FCAST over MMTP instead of FCAST of LCT. |

  **11.8. Image File Format**  
    **11.8.1. support for predictive image coding, bursts, bracketing, and other improvements**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 12 | support for predictive image coding, bursts, bracketing, and other improvements | A | 1 | *Motivations:* More interesting features for applications have been identified *Objectives:* To add new features like burst, pictures with very small time, panoramas, favorites and albums and so on. |

    **11.8.2. Support for slideshows and other improvements**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 12 | Support for slideshows and other improvements | A | 3 | *Motivations:*  *Objectives:* |

  **11.9. MMT Implementation Guidelines**  
    **11.9.1. MPEG Media Transport Implementation Guidelines**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 13 | MPEG Media Transport Implementation Guidelines | T | 4 | *Motivations:* There is a need to add a use case of flexible and separable AL-FEC scheme *Objectives:* To develop such a use case |

  **11.10. Media presentation description and segment formats**  
    **11.10.1. CMAF support, events processing model and other extensions**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| DASH | 1 | CMAF support, events processing model and other extensions | A | 1 | *Motivations:* CMAF defines fragmented ISOBMFF formats for adaptive bitrate delivery over HTTP. Delivery of CMAF contents with DASH needs to be defined *Objectives:* This Amendment \r\n- Adds a DASH profile for CMAF content\r\n- Event and timed metadata processing model\r\n- Signalling random access points within segments\r\n- MPD Patch fixes |

  **11.11. Delivery of CMAF content with DASH**  
    **11.11.1. Delivery of CMAF content with DASH**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| DASH | 7 | Delivery of CMAF content with DASH | T | 1 | *Motivations:* The CMAF specification defines an encoding format for the content. Each media component of the content may be encoded in multiple tracks, grouped in one or more CMAF Switching Sets. However there is no description of how these tracks are related, and how various media components should be delivered and played.\r\nThe DASH specification defines segment formats for media content. But it also defines a manifest, Media Presentation Description (MPD) which expresses the relationship of tracks and segments as well as how they are identified as URI resources. \r\nWhile CMAF delivery entities can be identical to DASH segments, there are multiple ways to package them and/or identified them as resources and described by a MPD. *Objectives:* This Standard defines guidelines for delivering content generated based on the CMAF specification (ISO/IEC 23000-19) using DASH specification (ISO/IEC 23009-1).\r\n These guidelines recommend some of the most popular delivery schemes for such mapping and delivery. |

  **11.12. Session based DASH operations**  
    **11.12.1. Session based DASH operations**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| DASH | 8 | Session based DASH operations | E | 1 | *Motivations:* Some operation needs to be applied to the client operation during for some period of time. *Objectives:* To define a method for MPD to manage DASH session for the server to instruct the client some operation continuously applied during the session. |

  **11.13. Omnidirectional MediA Format**  
    **11.13.1. Omnidirectional MediA Format**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 2 | Omnidirectional MediA Format | E | 2 | *Motivations:* 1st edition of OMAF only supports 3DoF experience with a single camera position. We need support for enhanced user experience of 3DoF+ with more than one single camera position by OMAF so that the user can interactively navigate the virtual space. *Objectives:* To add support of 3DoF+ video, interactivity and some other features to OMAF |

  **11.14. Carriage of Visual Volumetric Video-based Coding Data**  
    **11.14.1. Carriage of Point Cloud Data**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 10 | Carriage of Point Cloud Data | E | 1 | *Motivations:* As new type of media, PCC, is introduced carriage of such media needs to be specified. *Objectives:* To define storage of PCC data in ISOBMFF and transport of it with DASH, MMT and so on |

  **11.15. Carriage of Geometry-based Point Cloud Compression Data**  
    **11.15.1. Carriage of Geometry-based Point Cloud Compression Data**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 18 | Carriage of Geometry-based Point Cloud Compression Data | E | 1 | *Motivations:*  *Objectives:* |

  **11.16. In advance signalling of MPEG containers content**  
    **11.16.1. In-advance signalling of MPEG containers content**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 28 | In-advance signalling of MPEG containers content | Ex | 1 | *Motivations:* MPEG defines several container formats, in particular ISOBMFF and MPEG-2 TS. Files conformant to these formats may contain multiple media streams, each of which may conform to different media formats, with different profiles and levels. There are several file consumption scenarios under which the full content of the file is not available to a player but under which the player has nevertheless to take a decision to retrieve the file or not. These scenarios include progressive file download, adaptive streaming, etc. In such scenarios, the player needs to have sufficient information to determine if it has or not the capabilities of playing the entire content or only a part of the container content, and when multiple container files are provided, to enable a player to choose the most appropriate file(s) to process. The practice to send information about the container content, together with URL(s) to the content and prior to its retrieval, is called hereafter \"in-advance signaling\". *Objectives:* To investigate what action should MPEG take |

  **11.17. 5G Opportunities**  
    **11.17.1. 5G Opportunities**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 35 | 5G Opportunities | Ex | 1 | *Motivations:* With the advent of the 5G network, the promised latencies and data rates might enable new applications. *Objectives:* Investigate standardization activities related to 5G networks. Identify areas relevant to MPEG that require standards given the new network features of 5G and the applications enabled by them. |

  **11.18. Carriage of Essential Video Coding**  
    **11.18.1. Carriage of EVC in MPEG Systems**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 5 | 3 | Carriage of EVC in MPEG Systems | E | 1 | *Motivations:*  *Objectives:* |

**12. Application Formats**  
  **12.1. Common Media Application Format**  
    **12.1.1. Additional CMAF HEVC media profiles**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| A | 19 | Additional CMAF HEVC media profiles | A | 1 | *Motivations:* Need to support media profiles used by other SDOs *Objectives:* To add additional media profiles defined by other SDOs |

  **12.2. Multi-Image Application Format**  
    **12.2.1. Harmonization of MIAF brands, profiles and processing models**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| A | 22 | Harmonization of MIAF brands, profiles and processing models | A | 2 | *Motivations:*  *Objectives:* |

    **12.2.2. MIAF HEVC Advanced HDR profile and other clarifications**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| A | 22 | MIAF HEVC Advanced HDR profile and other clarifications | A | 2 | *Motivations:*  *Objectives:* |

**13. API**  
  **13.1. Network-based Media Processing**  
    **13.1.1. NBMP Function Templates**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 8 | NBMP Function Templates | A | 1 | *Motivations:*  *Objectives:* |

  **13.2. Implementation Guidelines for Network-based Media Processing**  
    **13.2.1. Implementation Guidelines for Network-based Media Processing**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 11 | Implementation Guidelines for Network-based Media Processing | T | 1 | *Motivations:*  *Objectives:* |

  **13.3. Video Decoding Interface for Immersive Media**  
    **13.3.1. Multi-Decoder Video Interface for Immersive Media**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 13 | Multi-Decoder Video Interface for Immersive Media | E | 1 | *Motivations:* Flexible use of media decoder, for example decoding only a subset of a single elementary stream, is required for the processing of immersive media composed of large number of elementary stream. *Objectives:* To provide interface and operation of video engine where one-to-one relationship between an elementary stream and a decoder is not required. |

**14. Reference implementation**  
  **14.1. Reference software and conformance for file formats**  
    **14.1.1. Reference Software and Conformance for File Format**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 32 | Reference Software and Conformance for File Format | E | 2 | *Motivations:*  *Objectives:* |

  **14.2. Conformance and Reference Software for Compact Descriptors for Video Analysis**  
    **14.2.1. Conformance and Reference Software for Compact Descriptors for Video Analysis**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 7 | 16 | Conformance and Reference Software for Compact Descriptors for Video Analysis | E | 1 | *Motivations:*  *Objectives:* |

  **14.3. Visual Identity Management Application Format**  
    **14.3.1. Reference Software and Conformance for Visual Identity Management Application Format**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| A | 21 | Reference Software and Conformance for Visual Identity Management Application Format | A | 1 | *Motivations:* To provide reference software and conformance of VIMAF *Objectives:* To provide reference software and conformance of VIMAF |

  **14.4. Multi-Image Application Format**  
    **14.4.1. Reference Software and Conformance for Multi Image Application Format**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| A | 22 | Reference Software and Conformance for Multi Image Application Format | A | 1 | *Motivations:* To provide reference software and conformance of MIAF *Objectives:* To provide reference software and conformance of MIAF |

  **14.5. Media orchestration**  
    **14.5.1. Multimedia Orchestration Reference Software**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| B | 13 | Multimedia Orchestration Reference Software | A | 1 | *Motivations:*  *Objectives:* To provide reference software and conformance. |

  **14.6. MMT Reference Software**  
    **14.6.1. Support for MMTP extensions**

|  |  |  |  |  |  |
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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 4 | Support for MMTP extensions | A | 1 | *Motivations:* Extensions to MMTP has been introduced *Objectives:* To implement extensions of MMTP into the reference software |

  **14.7. Implementation guidelines**  
    **14.7.1. MPEG-DASH Implementation Guidelines**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| DASH | 3 | MPEG-DASH Implementation Guidelines | T | 2 | *Motivations:* Design and deployment of streaming media delivery systems using MMT needs guidelines *Objectives:* To provide guidelines for design and deployment of streaming media delivery systems including content generation, client implementation, and examples of deployment scenarios. |

  **14.8. Reference Software for Versatile Video Coding**  
    **14.8.1. VVC Reference Software**

|  |  |  |  |  |  |
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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 16 | VVC Reference Software | E | 1 | *Motivations:* This part of MPEG-I provides reference software for the Versatile Video Coding standard, to provide an example of how the standard can be implemented and enable experimentation with its capabilities. *Objectives:* To provide an example encoder and decoder for the Versatile Video Coding standard, including examples of effective encoding practices. |

  **14.9. Reference Software and Conformance for Omnidirectional MediA Format**  
    **14.9.1. Reference Software and Conformance for OMAF**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 17 | Reference Software and Conformance for OMAF | E | 1 | *Motivations:*  *Objectives:* |

  **14.10. Reference Software for V-PCC**  
    **14.10.1. Reference Software for V-PCC**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 19 | Reference Software for V-PCC | E | 1 | *Motivations:*  *Objectives:* |

  **14.11. Reference Software**  
    **14.11.1. Reference software and conformance**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 4 | Reference software and conformance | E | 1 | *Motivations:* Provide an implementation of the specification *Objectives:* Reference software allows to decode conforming bitstreams |

  **14.12. IoMT Reference Software and Conformance**  
    **14.12.1. IoMT Reference Software and Conformance**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| IOMT | 4 | IoMT Reference Software and Conformance | E | 1 | *Motivations:* This part implements the IoMT APIs *Objectives:* This part implements the IoMT APIs |

  **14.13. Conformance and Reference Software of Essential Video Coding**  
    **14.13.1. Conformance and Reference Software of Essential Video Coding**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 5 | 4 | Conformance and Reference Software of Essential Video Coding | E | 1 | *Motivations:*  *Objectives:* |

**15. Conformance**  
  **15.1. MMT Conformance testing**  
    **15.1.1. MMT Conformance Testing**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 7 | MMT Conformance Testing | E | 1 | *Motivations:*  *Objectives:* |

  **15.2. Conformance Testing for Versatile Video Coding**  
    **15.2.1. VVC Conformance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 15 | VVC Conformance | E | 1 | *Motivations:* This Part of MPEG-I provides conformance testing specifications and bitstream data for verifying conformance to the Versatile Video Coding standard. *Objectives:* To provide procedures and data for extensive (though non-exhaustive) testing of implementations of the VVC standard. |

  **15.3. Conformance for V-PCC**  
    **15.3.1. Conformance for V-PCC**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 20 | Conformance for V-PCC | E | 1 | *Motivations:*  *Objectives:* |

  **15.4. Conformance**  
    **15.4.1. Conformance**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 5 | Conformance | E | 1 | *Motivations:* Valid MPEG-G bitstreams are required for testing MPEG-G decoders *Objectives:* Provide bitstreams that exercise all parts of the specification. |

**16. Data compression**  
  **16.1. Data Compression**  
    **16.1.1. Data Compression**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 32 | Data Compression | Ex | 1 | *Motivations:* Digitalisation in all areas of society creates a data stórage problem *Objectives:* Define application specific data coding algorithms for areas like UAVs, automotive, geographic information, biotechnology, industry 4.0, etc. |