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**CODING OF MOVING PICTURES AND AUDIO**

**ISO/IEC JTC 1/SC 29/WG 11 N18117**

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| **Source:** | **Leonardo Chiariglione** |
| **Title:** | **MPEG work plan** |

**MPEG work plan**

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**1. Video Coding**  
  **1.1. Advanced Video Coding**  
    **1.1.1. Additional supplemental enhancement information**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 10 | Additional supplemental enhancement information | A | 1 | *Motivations:* AVC is missing several SEI messages that have been defined in HEVC or are in the process of being defined in HEVC, including high-dynamic range colour related information, omnidirectional video related information, and manifest and prefix messages. *Objectives:* Specification of certain additional SEI messages in the AVC context that have been defined in HEVC or are in the process of being defined in HEVC. |

  **1.2. High Efficiency Video Coding**  
    **1.2.1. 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. |

    **1.2.2. Additional supplemental enhancement information for HEVC**

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

  **1.3. Versatile Video Coding**  
    **1.3.1. 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) |

  **1.4. Usage of video signal type code points**  
    **1.4.1. 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 | 1 | *Motivations:* Industry should be helped to avoid content processing mistakes due to a lack of understanding of the approporiate combinations of video properties that are commonly used, such as colour indication code points. With the increased usage of high-dynamic range and the increased use of look-up tables in television systems, these content processing mistakes could increasingly become magnified. *Objectives:* To provide guidance on combinations of video properties that are widely used in industry production practices. It will document the usage of colour-related code points and description data for video content production. |

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

    **1.5.2. Immersive video - 3DoF+**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 7 | Immersive video - 3DoF+ | Ex | 1 | *Motivations:* Technology 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 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+). |

    **1.5.3. 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 been 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. |

  **1.6. Low Complexity Video Coding Enhancements**  
    **1.6.1. Capability Extension of Existing Video Codec**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 31 | Capability Extension of Existing Video Codec | Ex | 31 | *Motivations:* Expanding service reach and enabling cost/efficient services at higher picture quality (e.g., HD and UHD) while billions of legacy receivers are still in operation is critical for the industry, and would enable acceleration of service and device upgrade. *Objectives:* The main targeted use cases for the new low complexity enhancement codec are those that require low-complexity live encoding, maximum device compatibility and high-quality video: live TV/multimedia streaming (e.g., sports, eSports, news, etc.) under constrained OTT bandwidth, live social network mobile video, live UHD broadcast at viable DTT bandwidth, SD to HD and HD to UHD improvements without the need to change the set-top-box, UHD to 8K improvement while maintaining low complexity and compatibility with UHD devices, live UAV/security video downlinks, live surveillance, etc. |

  **1.7. Essential Video Coding**  
    **1.7.1. 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 |

**2. Audio Coding**  
  **2.1. Audio**  
    **2.1.1. Audio**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 3 | Audio | E | 5 | *Motivations:* ISO requires new edition when there is more than 2 of AMD, COR *Objectives:* Many AMD and COR are rolled up into new edition |

  **2.2. Unified Speech and Audio Coding**  
    **2.2.1. Unified Speech and Audio Coding**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| D | 3 | Unified Speech and Audio Coding | E | 2 | *Motivations:* In general, audio signals can be music, speech or a mix of both. Across applications, the bitrates available in transmission channels can vary greatly. Hence, this work addresses the need to provide high compression for signals that are a mix of music and speech. *Objectives:* To create compression technology that provides high performance over a wide range if bit rates. Specifically, to code mono signals at 12 kb/s, stereo signals from 16 kb/s and 5.1 channel signals at 96 kb/s. |

  **2.3. Dynamic Range Control**  
    **2.3.1. DRC Conformance**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| D | 4 | DRC Conformance | A | 3 | *Motivations:* Test vectors are needed for industry to verify the conformance of implementations *Objectives:* Provide conformance streams and processed waveforms for Dynamic Range Control |

    **2.3.2. Dynamic Range Control Conformance**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| D | 4 | Dynamic Range Control Conformance | A | 4 | *Motivations:* Test vectors are needed for industry to verify the conformance of implementations *Objectives:* Provide conformance streams and processed waveforms for Dynamic Range Control |

  **2.4. Uncompressed Audio in MP4 FF**  
    **2.4.1. Uncompressed Audio in MP4 FF**

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| **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 |

  **2.5. Immersive Audio**  
    **2.5.1. Immersive Audio**

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| **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. Video-based Point Cloud Compression**  
    **3.1.1. Video-based Point Cloud Compression**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 5 | Video-based Point Cloud Compression | E | 1 | *Motivations:* Technologies allow the capure 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**

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| **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. Font Coding**  
  **4.1. Open Font Format**  
    **4.1.1. Colour font technology and other updates**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 22 | Colour font technology and other updates | A | 1 | *Motivations:* Implementation details for SVG-based color font technology is missing *Objectives:* To clarify implementation details for SVG-based color font technology and implement other changes and updates |

**5. Digital Item Coding**  
  **5.1. User Description**  
    **5.1.1. User Description**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 21 | 22 | User Description | E | 2 | *Motivations:* More use cases need to be supported *Objectives:* To support the new use cases, “Visual expression”, “Loudness control” and “Privacy protection”. |

**6. Genome Coding**  
  **6.1. Genomic Information Representation**  
    **6.1.1. Genomic Information Representation**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 2 | Genomic Information Representation | E | 1 | *Motivations:* The development of Next Generation Sequencing (NGS) technologies enable the usage of genomic information as everyday practice in several fields, but the growing volume of data generated becomes a serious obstacle for a wide diffusion. The lack of an appropriate representation and efficient compression of genomic data is widely recognized as a critical element limiting its application potential. ISO/TC 276 and MPEG have combined their respective expertise and missions to develop a compression standard capable of providing new effective solutions for genomic information processing applications *Objectives:* The objectives of the standard are to provide:\r\n- A transport format specification that supports a file format for storage scenarios and a packet format for streaming scenarios that are mutually convertible.\r\n- A compressed representation for sequence reads, quality values and alignment information that enable efficient selective access to genomic regions, data classes and associated information.\r\n- Standard APIs for selective access to the compressed genomic information and the conversion to and from MPEG-G files of commonly used genomic data formats.\r\n- Reference SW for the normative decoding process and informative encoding, conformance methodology. |

**7. Neural Network Coding**  
  **7.1. Compressed representation of neural networks**  
    **7.1.1. Compressed Representation of Neural Networks**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 29 | Compressed Representation of Neural Networks | Ex | 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. |

**8. Systems support**  
  **8.1. Registration Authorities**  
    **8.1.1. Registration Authority for MPEG-4**

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| **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 |

  **8.2. Immersive Media Metrics**  
    **8.2.1. Immersive Media Metrics**

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| --- | --- | --- | --- | --- | --- |
| **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. |

  **8.3. Immersive Media Metadata**  
    **8.3.1. Immersive Media Metadata**

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| --- | --- | --- | --- | --- | --- |
| **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 *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. |

**9. IPMP**  
  **9.1. Common Encryption for ISO Base Media File Format Files**  
    **9.1.1. Multi-Keyed Samples, Content Sensitive Encryption and Item Protection**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| B | 7 | Multi-Keyed Samples, Content Sensitive Encryption and Item Protection | A | 1 | *Motivations:* There are cases where it may be desirable or needed to have multiple keys, with their associated Ivs, for a single sample. For example, when a scalable or tiled media bitstream was represented by multiple tracks in a file, each of the tracks protected with its own keys, multiple keys per sample description is required to re-package the bitstream as a single track in the file. *Objectives:* To support multiple keys per sample using the following tools:\r\n1. extension of the seig sample group\r\n2. extension of the sample auxiliary info data for CENC |

**10. Transport**  
  **10.1. Systems**  
    **10.1.1. Carriage of JPEG XS in MPEG-2 TS**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 2 | 1 | Carriage of JPEG XS in MPEG-2 TS | A | 1 | *Motivations:* MPEG Transport Stream can already carry JPEG 2000 (ISO/IEC 15444-1) for use in broadcast applications. In the meantime, WG1 has specified a new coding scheme, known as JPEG XS (ISO/IEC 21122-1), that is more lightweight in terms of complexity, and focused on low-latency applications compared to JPEG 2000. This new standard is also intended to be used in broadcast applications, mainly for video transport over IP. *Objectives:* To specify the necessary syntax to transport this newly specified WG1 standard ISO/IEC 21122-1. |

    **10.1.2. Carriage of associated CMAF boxes for audio-visual elementary streams in MPEG-2 TS**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 2 | 1 | Carriage of associated CMAF boxes for audio-visual elementary streams in MPEG-2 TS | A | 2 | *Motivations:* The is a need for Structures to carry ISO/IEC 23000-19 CMAF boxes (CMAF Fragments boxes and CMAF initialization header boxes, no mdat box) over MPEG-2 transport stream along with associated audio-visual elementary stream that is designed to be transformed easily to CMAF delivery format. *Objectives:* To specify such structures |

  **10.2. ISO Base Media File Format**  
    **10.2.1. Box relative data addressing**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 12 | Box relative data addressing | A | 2 | *Motivations:* There is a need to have relative addressing as an alternative to offset addressing, which in some environments and workflows can simplify the handling of files. *Objectives:* To specify such relative addressing |

    **10.2.2. Corrected audio handling**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 12 | Corrected audio handling | A | 3 | *Motivations:* Some technical errors on storage of audio data in ISOBMFF has been identified. *Objectives:* - Corrects the derivation of the audio channel count, which otherwise may result in a not recoverable error and prevents any DRC processing.\r\n- Corrects the ChannelLayout box syntax which otherwise uses an incorrect channel count for certain codecs and an unspecified channel ordering in certain cases that can prevent any audio rendering in the worst case.\r\n- Corrects the byte alignment syntax of the DownmixInstructions box which otherwise will result in the decoding of false downmix coefficients in certain cases.\r\n- Adds warning text about the representation of four-character codes in textual contexts, and the need for escaping. |

  **10.3. Carriage of NAL unit structured video in the ISO Base Media File Format**  
    **10.3.1. Carriage of NAL unit structured video in the ISO Base Media File Format**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 15 | Carriage of NAL unit structured video in the ISO Base Media File Format | E | 5 | *Motivations:* Several AMDs and CORs have been produced after publication of 4th edition in 2017 *Objectives:* To integrate ISO/IEC 14496-15:2017/Amd 1:2018, ISO/IEC 14496-15:2017/Amd 2 and ISO/IEC 14496-15:2017/COR 1 into the 4th edition |

  **10.4. Partial File Format**  
    **10.4.1. Partial File Format**

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| --- | --- | --- | --- | --- | --- |
| **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). |

  **10.5. Carriage of Web Resources in ISOBMFF**  
    **10.5.1. Carriage of Web Resource in ISOBMFF**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| B | 15 | Carriage of Web Resource in ISOBMFF | E | 1 | *Motivations:* There is a need to specify the use of ISOBMFF tools for the storage and delivery of web data. *Objectives:* The specified storage is designed to enable enriching audio/video content, as well as audio-only content, with synchronized, animated, interactive web data, including overlays. |

  **10.6. MPEG Media Transport**  
    **10.6.1. MPEG Media Transport CDN support**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 1 | MPEG Media Transport CDN support | A | 3 | *Motivations:* MMT needs to support CDN *Objectives:* To support Virtualized Network Function environment including virtualized MANE |

    **10.6.2. MPEG Media Transport**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 1 | MPEG Media Transport | E | 3 | *Motivations:* There is a need to integrate previously approved AMDs and CORs after 2nd edition. *Objectives:* To execute such integration |

  **10.7. MPEG Media Transport FEC Codes**  
    **10.7.1. Window-based FEC code**

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| --- | --- | --- | --- | --- | --- |
| **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. |

  **10.8. Image File Format**  
    **10.8.1. Image File Format**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 12 | Image File Format | E | 3 | *Motivations:*  *Objectives:* incorporating COR 1. |

  **10.9. MMT Implementation Guidelines**  
    **10.9.1. MPEG Media Transport Implementation Guidelines**

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| --- | --- | --- | --- | --- | --- |
| **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 |

  **10.10. Media presentation description and segment formats**  
    **10.10.1. Device information and other extensions**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| DASH | 1 | Device information and other extensions | A | 5 | *Motivations:* There are a number of technologies in DASH that have been under consideration for some time and the DASH subgroup plans to publish a new amendment to advance some of these technologies. *Objectives:* To include Device information and other extensions in this amendment. |

    **10.10.2. Media presentation description and segment formats/Cor.3**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| DASH | 1 | Media presentation description and segment formats/Cor.3 | C | 3 | *Motivations:* Technical errors have been identified *Objectives:* To correct technical errors such as use of UTCTiming element. |

  **10.11. Format Independent Segment encryption and authentication**  
    **10.11.1. Format Independent Segment encryption and authentication/COR 1**

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| --- | --- | --- | --- | --- | --- |
| **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 |

  **10.12. Delivery of CMAF content with DASH**  
    **10.12.1. Delivery of CMAF content with DASH**

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| --- | --- | --- | --- | --- | --- |
| **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. |

  **10.13. Session based DASH operation**  
    **10.13.1. Session based DASH operations**

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| --- | --- | --- | --- | --- | --- |
| **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. |

  **10.14. Omnidirectional MediA Format**  
    **10.14.1. Omnidirectional MediA Format**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 2 | Omnidirectional MediA Format | E | 2 | *Motivations:* To improve OAMF standards *Objectives:* To add support of 3DoF+ video, interactivity and some other features to OMAF |

  **10.15. Carriage of Point Cloud Data**  
    **10.15.1. Carraige of Point Cloud Data**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 10 | Carraige 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 |

  **10.16. Transport and Storage of Genomic Information**  
    **10.16.1. Transport and Storage of Genomic Information**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 1 | Transport and Storage of Genomic Information | E | 1 | *Motivations:* genomic information as everyday practice in several fields, but the growing volume of data generated becomes a serious obstacle for a wide diffusion. The lack of an appropriate representation and efficient compression of genomic data is widely recognized as a critical element limiting its application potential. ISO/TC 276 and MPEG have combined their respective expertise and missions to develop a compression standard capable of providing new effective solutions for genomic information processing applications. *Objectives:* Transport and storage of genomic sequencing data and associated metadata with the capability of accessing these data sets efficiently, e.g. selective fast browsing, searching and access capabilities directly in compressed form. |

  **10.17. In advance signalling of MPEG containers content**  
    **10.17.1. In-advance signalling of MPEG containers content**

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| --- | --- | --- | --- | --- | --- |
| **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. Application Formats**  
  **11.1. Common Media Application Format**  
    **11.1.1. HEVC Media Profiles update, new CMAF Structural Brand and other improvements**

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| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| A | 19 | HEVC Media Profiles update, new CMAF Structural Brand and other improvements | A | 3 | *Motivations:* The media profiles other SDOs are using are not supported by CMAF *Objectives:* To define profiles aligned with other SDOs are using |

  **11.2. Visual Identity Management Application Format**  
    **11.2.1. Visual Identity Management Application Format**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| A | 21 | Visual Identity Management Application Format | E | 1 | *Motivations:* There are widespread concerns on user privacy arising from sharing pictures in social media services. People can be on a picture taken by someone else, either intentionally or by mistake, and such picture can be posted on a social media service without any permission of the person captured on the picture and possibly without the person even being aware to be on the picture. Social media service operators try to provide some ways to manage such cases but it seems quite limited. Same happens for various video capturing devices such as CCTVs. *Objectives:* To specify a framework for managing privacy of users on the pictures or videos when pictures or videos are shared among users. |

**12. API**  
  **12.1. Network-based Media Processing**  
    **12.1.1. Network-Based Media Processing**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| I | 8 | Network-Based Media Processing | E | 1 | *Motivations:* Recent developments in multimedia have brought significant innovation and disruption to the way multimedia content is consumed. With the emergence of VR and AR/MR applications, users can interact and navigate the consumed content along multiple degrees of freedom. Advanced media processing technologies (e.g., network stitching for VR service, super resolution for enhanced visual quality, transcoding, viewport extraction for 360Â° video) require too much compute power to be executed on modern mobile devices. *Objectives:* Network-based Media Processing (NBMP) will be a framework that allows service providers and end users to describe media processing operations that are to be performed by the network. NBMP describes the composition of network-based media processing services out of a set of network-based media processing functions and makes these network-based media processing services accessible through Application Programming Interfaces (APIs). NBMP framework allows content and service providers to describe, deploy, and control media processing for their content in the network. The NBMP Framework will be interoperable with existing Cloud platforms and is designed to integrate with multiple network environments such as 5G. |

  **12.2. Genomic Information Metadata and Application Programming Interfaces (APIs)**  
    **12.2.1. API and Metadata**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 3 | API and Metadata | E | 1 | *Motivations:* The development of Next Generation Sequencing (NGS) technologies enable the usage of genomic information as everyday practice in several fields, but the growing volume of data generated becomes a serious obstacle for a wide diffusion. The lack of an appropriate representation and efficient compression of genomic data is widely recognized as a critical element limiting its application potential. ISO/TC 276 and MPEG have combined their respective expertise and missions to develop a compression standard capable of providing new effective solutions for genomic information processing applications. *Objectives:* To specify the API to access genomic informatiom to \r\n1. Simplify the usage and manipulation of sequencing data sets for genomic analysis applications\r\n2. Ensure interoperability of transport and storage formats at all levels of the various processing pipelines. |

  **12.3. IoMT Discovery and Communication API**  
    **12.3.1. IoMT Discovery and Communication API**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| IOMT | 2 | IoMT Discovery and Communication API | E | 1 | *Motivations:* Industry considers the Internet of Things (IoT) and SDOs make plans for related standards. \r\nMPEG has defined a specific instance of Thing called Media Thing (MThing), defined as a Thing able to sense and/or act on physical or virtual objects \r\nMThings may be connected to form complex distributed systems called Internet of Media Things (IoMT) where MThings interact between them and humans.\r\nIoMT needs APIs to facilitate discovery other media things in the network *Objectives:* To provide the said API |

  **12.4. IoMT Media Data Formats and API**  
    **12.4.1. IoMT Media Data Formats and API**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| IOMT | 3 | IoMT Media Data Formats and API | E | 1 | *Motivations:* Industry considers the Internet of Things (IoT) and SDOs make plans for related standards. \r\nMPEG has defined a specific instance of Thing called Media Thing (MThing), defined as a Thing able to sense and/or act on physical or virtual objects \r\nMThings may be connected to form complex distributed systems called Internet of Media Things (IoMT) where MThings interact between them and humans.\r\nThese APIs for the media things facilitate connecting and exchanging data between media things. The APIs also provide means for supporting media tokens and its wallet addresses to access functionalities, resources, and data from media things.\r\nThe data for media things consist of user commands (e.g., setup information) from a system designer, (raw or processed) sensed data, actuation information, and information for characteristics and discovery. *Objectives:* To specify data formats of input and output for media sensors, media actuators, media storages, media analyzers, etc.\r\nSensed data or analysed data can be processed further by media analyzers to extract semantic information. The standard does not specify how the process is carried out but only the interfaces. |

**13. Media Systems**  
  **13.1. IoMT Architecture**  
    **13.1.1. IoMT Architecture**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| IOMT | 1 | IoMT Architecture | E | 1 | *Motivations:* Industry considers the Internet of Things (IoT) and SDOs make plans for related standards. \r\nMPEG has defined a specific instance of Thing called Media Thing (MThing), defined as a Thing able to sense and/or act on physical or virtual objects \r\nMThings may be connected to form complex distributed systems ``called Internet of Media Things (IoMT)`` where MThings interact between them and humans. *Objectives:* To describe the architecture of systems for Internet of Media Things. Internet of Media Things (IoMT) is a particular case of IoT (that by definition has the communication capability and it may sense or act on a physical or virtual object), with the specificity that an IoMT has media related multi-sensorial capabilities such as audio, visual, haptics. |

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| 4 | 32 | Reference Software and Conformance for File Format | E | 1 | *Motivations:*  *Objectives:* To provide reference software for ISOBMFF |

  **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**

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

  **14.3. Media orchestration**  
    **14.3.1. Multimedia Orchestration Reference Software**

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

  **14.4. Reference Software and Conformance**  
    **14.4.1. Reference Software and Conformance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| V | 7 | Reference Software and Conformance | E | 4 | *Motivations:*  *Objectives:* |

  **14.5. MMT Reference Software**  
    **14.5.1. MMT Reference Software with Network Capabilities**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 4 | MMT Reference Software with Network Capabilities | A | 1 | *Motivations:*  *Objectives:* |

    **14.5.2. Support for MMTP extensions**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 4 | Support for MMTP extensions | A | 2 | *Motivations:* Extensions to MMTP has been introduced *Objectives:* To implement extensions of MMTP into the reference software |

  **14.6. 3D Audio Reference Software**  
    **14.6.1. 3D audio reference software**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 6 | 3D audio reference software | E | 2 | *Motivations:* The standard is expressed as both text and reference software *Objectives:* Provide reference software implementation of MPEG-H 3D Audio |

  **14.7. Reference software and conformance**  
    **14.7.1. Conformance and reference software regarding SRD, SAND and Server Push**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| DASH | 2 | Conformance and reference software regarding SRD, SAND and Server Push | A | 1 | *Motivations:*  *Objectives:* Conformance vectors and reference software for SRD, SAND and Server Push |

  **14.8. Implementation guidelines**  
    **14.8.1. 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. |

  **14.9. Reference Software**  
    **14.9.1. Reference software and conformance**

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| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 4 | Reference software and conformance | E | 1 | *Motivations:*  *Objectives:* |

  **14.10. IoMT Reference Software and Conformance**  
    **14.10.1. IoMT Reference Software and Conformance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **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 |

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

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

  **15.2. HEVC Conformance testing**  
    **15.2.1. Conformance testing for Screen Content Coding**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| H | 8 | Conformance testing for Screen Content Coding | A | 1 | *Motivations:* Conformance testing is needed for the profiles for screen content coding and high-throughput profiles of the HEVC standard. *Objectives:* Provide conformance testing data and associated descriptions for the screen content coding and high throughput profiles of the HEVC standard. |

  **15.3. Conformance**  
    **15.3.1. Conformance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| G | 5 | Conformance | E | 1 | *Motivations:*  *Objectives:* |

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Std** | **Pt** | **Title** | **Type** | **#** | **Description** |
| Exp | 32 | Data Compression | Ex | 1 | *Motivations:*  *Objectives:* |