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Information technology — Generic coding of moving pictures and associated audio information —

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Foreword

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Amendment 3 to ISO/IEC 13818-1:2015 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*, in collaboration with ITU-T. The identical text is published as ITU-T H.222.0 (12/2015).

INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

Information technology – Generic coding of moving pictures and associated audio information: Systems

Amendment 2

Carriage of layered HEVC

1)   Clause 1.2.2

Replace:

–   Recommendation ITU-T H.264 (2013), *Advanced video coding for generic audiovisual services*.

ISO/IEC 14496-10:2013, *Information technology – Coding of audio-visual objects – Part 10: Advanced video coding*.

–   Recommendation ITU-T H.265 (2013), *High efficiency video coding*.

ISO/IEC 23008-2:2013, *Information technology – High efficiency coding and media delivery in heterogeneous environments – Part 2: High efficiency video coding*.

with:

–   Recommendation ITU-T H.264 (2014), *Advanced video coding for generic audiovisual services*.

ISO/IEC 14496-10:2014, *Information technology – Coding of audio-visual objects – Part 10: Advanced video coding*.

–   Recommendation ITU-T H.265 (2015), *High efficiency video coding*.

ISO/IEC 23008-2:2015, *Information technology – High efficiency coding and media delivery in heterogeneous environments – Part 2: High efficiency video coding*.

2)   Clauses 2.1.95, 2.1.96, 2.1.106 and 2.1.107

Replace clause 2.1.95 with:

2.1.95   HEVC video stream: Byte stream as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2 Annex B.

NOTE – This term represents either a byte stream as specified in Annex B of the first version of Rec. ITU-T H.265 | ISO/IEC 23008-2 or an HEVC layered video sub-bitstream.

Replace clause 2.1.96 with:

2.1.96   HEVC access unit: An access unit as defined in Annex F of Rec. ITU-T H.265 | ISO/IEC 23008-2 with the constraints specified in 2.17.1.

Replace clause 2.1.106 with:

2.1.106   HEVC temporal video sub-bitstream: An HEVC video sub-bitstream that contains all VCL NAL units and associated non-VCL NAL units of the temporal sub-layer of the same layer, as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2, associated with TemporalId equal to 0 and which may additionally contain all VCL NAL units and associated non-VCL NAL units of all temporal sub-layers of the same layer associated with a contiguous range of TemporalId from 1 to a value equal to or smaller than sps_max_sub_layers_minus1 included in the active sequence parameter set, as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2.

Replace clause 2.1.107 with:

2.1.107   HEVC temporal video subset: An HEVC video sub-bitstream that contains all VCL NAL units and the associated non-VCL NAL units of one or more temporal sub-layers of the same layer, as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2, with each temporal sub-layer not being present in the corresponding HEVC temporal video sub-bitstream and TemporalId associated with each temporal sub-layer forming a contiguous range of values that is equal to

or smaller than sps_max_sub_layers_minus1 included in the active sequence parameter set, as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2.

> NOTE – According to the constraints for the transport of HEVC specified in 2.17.1, each temporal sub-layer of an HEVC video stream is present either in the HEVC temporal video sub-bitstream or in exactly one HEVC temporal video subset which is carried in a set of elementary streams that are associated by hierarchy descriptors or HEVC hierarchy extension descriptors. This prevents multiple inclusions of the same temporal sub-layer and allows aggregation of the HEVC temporal video sub-bitstream with associated HEVC temporal video subsets according to the hierarchy descriptors, as specified in 2.17.3 and according to the hierarchy descriptors or HEVC hierarchy extension descriptors, as specified in 2.17.4.

3)   Clauses 2.1.116 to 2.1.127

Add the following definitions after clause 2.1.115:

2.1.116   HEVC base layer: HEVC layer with nuh_layer_id equal to 0.

2.1.117   HEVC base sub-partition: HEVC video sub-bitstream that is also a conforming bitstream as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2, which contains all VCL NAL units and the associated non-VCL NAL units of an HEVC base layer up to a target highest TemporalId identified by a target HEVC operation point.

2.1.118   HEVC enhancement sub-partition: One HEVC layer with a particular value of nuh_layer_id greater than 0 in the NAL unit header syntax element or an HEVC temporal video sub-bitstream or HEVC temporal video subset thereof, of which the HEVC layer aggregation with an HEVC base sub-partition and zero or more other HEVC sub-partitions, according to HEVC layer list, results in a valid HEVC layered video stream.

2.1.119   HEVC layer: HEVC video sub-bitstream that contains all VCL NAL units with a particular value of nuh_layer_id in the NAL unit header syntax element and associated non-VCL NAL units, as defined in Annex F of Rec. ITU-T H.265 | ISO/IEC 23008-2.

2.1.120   HEVC layer aggregation: Successive HEVC layer component aggregation of all HEVC layer components in an HEVC video sequence.

2.1.121   HEVC layer component: VCL NAL units and the associated non-VCL NAL units of an HEVC access unit which belong to an HEVC sub-partition.

2.1.122   HEVC layer component aggregation: Concatenation of all HEVC layer components with the same output time from all HEVC sub-partitions indicated in an HEVC layer list in the order indicated by the HEVC layer list, resulting in a valid HEVC access unit as defined in Annex F of Rec. ITU-T H.265 | ISO/IEC 23008-2.

2.1.123   HEVC layer list: Ordered list of HEVC sub-partitions for a target HEVC operation point of which the HEVC layer aggregation results in a valid HEVC layered video stream.

> NOTE – An HEVC layer list is signalled for each target HEVC operation point using the HEVC operation point descriptor.

2.1.124   HEVC layered video stream: HEVC video stream that contains all VCL NAL units and associated non-VCL NAL units conforming to one or more profiles defined in Annex G or Annex H of Rec. ITU-T H.265 | ISO/IEC 23008-2.

2.1.125   HEVC operation point: Operation point based on a target highest TemporalId, and a target layer identifier list as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2.

> NOTE – Rec. ITU-T H.265 | ISO/IEC 23008-2 specifies the sub-bitstream extraction process for an operation point according to which the operation point is a conforming bitstream. An operation point is associated with an HEVC layered video stream or HEVC base layer.

2.1.126   HEVC sub-partition: Either an HEVC base sub-partition or an HEVC enhancement sub-partition.

> NOTE – An HEVC sub-partition can either be an HEVC temporal video sub-bitstream if it includes VCL NAL units with the minimum value of TemporalId (i.e., including TemporalId equal to 0), or it can be an HEVC temporal video subset, if it complements an HEVC base sub-partition or HEVC enhancement sub-partition with the same target layer identifier.

2.1.127   HEVC temporal enhancement sub-partition: An HEVC temporal video subset of the same HEVC layer as another HEVC enhancement sub-partition of the same HEVC video stream which contains one or more complementary temporal sub-layers, as specified in Rec. ITU-T H.265 | ISO/IEC 23008-2.

4)   Clause 2.4.2.13

Add the following new clause immediately after 2.4.2.12:

2.4.2.13   T-STD extensions for carriage of MV HEVC and SHVC

T-STD extensions and T-STD parameters for decoding of HEVC layered video streams are defined in 2.17.4. Program stream support including P-STD extensions and P-STD parameters are not specified for HEVC extension video streams.

5)   Clause 2.4.3.7

In the section specifying the PTS (presentation time stamp), replace:

For HEVC video streams, HEVC temporal video sub-bitstreams and HEVC temporal video subsets, if a PTS is present in the PES packet header, it shall refer to the first HEVC access unit that commences in this PES packet. To achieve consistency between the STD model and the HRD model defined in Annex C of Rec. ITU-T H.265 | ISO/IEC 23008-2, for each HEVC access unit the PTS value in the STD shall, within the accuracy of their respective clocks, indicate the same instant in time as the nominal DPB output time in the HRD, as defined in Annex C of Rec. ITU-T H.265 | ISO/IEC 23008-2.

with:

For HEVC video streams, HEVC temporal video sub-bitstreams and HEVC temporal video subsets, if a PTS is present in the PES packet header, it shall refer to the first HEVC access unit that commences in this PES packet. For HEVC video sub-partitions, if a PTS is present in the PES packet header, it shall refer to the first HEVC layer component that commences in this PES packet. An HEVC layer component commences in a PES packet if the first byte of the HEVC layer component is present in the PES packet. To achieve consistency between the STD model and the HRD model defined in Annex C of Rec. ITU-T H.265 | ISO/IEC 23008-2, for each HEVC access unit the PTS value in the STD shall, within the accuracy of their respective clocks, indicate the same instant in time as the nominal DPB output time in the HRD, as defined in Annex C of Rec. ITU-T H.265 | ISO/IEC 23008-2.

In the section specifying the DTS (decoding time stamp), replace:

For HEVC video streams, HEVC temporal video sub-bitstreams and HEVC temporal video subsets, if a DTS is present in the PES packet header, it shall refer to the first HEVC access unit that commences in this PES packet. To achieve consistency between the STD model and the HRD model defined in Annex C of Rec. ITU-T H.265 | ISO/IEC 230082, for each HEVC access unit the DTS value in the STD shall, within the accuracy of their respective clocks, indicate the same instant in time as the nominal CPB removal time in the HRD, as defined in Annex C of Rec. ITU-T H.265 | ISO/IEC 230082.

with:

For HEVC video streams, HEVC temporal video sub-bitstreams and HEVC temporal video subsets, if a DTS is present in the PES packet header, it shall refer to the first HEVC access unit that commences in this PES packet. For HEVC video sub-partitions, if a DTS is present in the PES packet header, it shall refer to the first HEVC layer component that commences in this PES packet. An HEVC layer component commences in a PES packet if the first byte of the HEVC layer component is present in the PES packet. To achieve consistency between the STD model and the HRD model defined in Annex C of Rec. ITU-T H.265 | ISO/IEC 23008-2, for each HEVC access unit the DTS value in the STD shall, within the accuracy of their respective clocks, indicate the same instant in time as the nominal CPB removal time t_r in the HRD, as defined in Annex C of Rec. ITU-T H.265 | ISO/IEC 23008-2.

6)   Clause 2.4.4.9

In Table 2-34 – Stream type assignments, replace the following lines:

0x1B	AVC video stream conforming to one or more profiles defined in Annex A of Rec. ITU-T H.264	ISO/IEC 14496-10 or AVC video sub-bitstream of SVC as defined in 2.1.78 or MVC base view sub-bitstream, as defined in 2.1.85, or AVC video sub-bitstream of MVC, as defined in 2.1.88 or MVCD base view sub-bitstream, as defined in 2.1.97, or AVC video sub-bitstream of MVCD, as defined in 2.1.100

0x28-0x7E	Rec. ITU-T H.222.0	ISO/IEC 13818-1 Reserved

with:

0x1B	AVC video stream conforming to one or more profiles defined in Annex A of Rec. ITU-T H.264 | ISO/IEC 14496-10 or AVC video sub-bitstream of SVC as defined in 2.1.78 or MVC base view sub-bitstream, as defined in 2.1.85, or AVC video sub-bitstream of MVC, as defined in 2.1.88 or MVCD base view sub-bitstream, as defined in 2.1.97, or AVC video sub-bitstream of MVCD, as defined in 2.1.100, or AVC base layer of an HEVC video stream conforming to one or more profiles defined in Annex G or Annex H of Rec. ITU-T H.265 | ISO/IEC 23008-2

0x28	HEVC enhancement sub-partition which includes TemporalId 0 of an HEVC video stream where all NALs units contained in the stream conform to one or more profiles defined in Annex G of Rec. ITU-T H.265 | ISO/IEC 23008-2
0x29	HEVC temporal enhancement sub-partition of an HEVC video stream where all NAL units contained in the stream conform to one or more profiles defined in Annex G of Rec. ITU-T H.265 | ISO/IEC 23008-2
0x2A	HEVC enhancement sub-partition which includes TemporalId 0 of an HEVC video stream where all NAL units contained in the stream conform to one or more profiles defined in Annex H of Rec. ITU-T H.265 | ISO/IEC 23008-2
0x2B	HEVC temporal enhancement sub-partition of an HEVC video stream where all NAL units contained in the stream conform to one or more profiles defined in Annex H of Rec. ITU-T H.265 | ISO/IEC 23008-2
0x2C-0x7E	Rec. ITU-T H.222.0 | ISO/IEC 13818-1 Reserved

7)   Clause 2.6.6

Replace Table 2-49 with:

Table 2-49 – Hierarchy descriptor

Syntax	No. of bits	Mnemonic
hierarchy_descriptor ( ) {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
no_view_scalability_flag	1	bslbf
no_temporal_scalability_flag	1	bslbf
no_spatial_scalability_flag	1	bslbf
no_quality_scalability_flag	1	bslbf
hierarchy_type	4	uimsbf
reserved	2	bslbf
hierarchy_layer_index	6	uimsbf
tref_present_flag	1	bslbf
reserved	1	bslbf
hierarchy_embedded_layer_index	6	uimsbf
reserved	2	bslbf
hierarchy_channel	6	uimsbf
}		

8)   Clause 2.6.7

Replace:

temporal_scalability_flag – A 1-bit flag, which when set to '0' indicates that the associated program element enhances the frame rate of the bit-stream resulting from the program element referenced by the hierarchy_embedded_layer_index. The value of '1' for this flag is reserved.

spatial_scalability_flag – A 1-bit flag, which when set to '0' indicates that the associated program element enhances the spatial resolution of the bit-stream resulting from the program element referenced by the hierarchy_embedded_layer_index. The value of '1' for this flag is reserved.

quality_scalability_flag – A 1-bit flag, which when set to '0' indicates that the associated program element enhances the SNR quality or fidelity of the bit-stream resulting from the program element referenced by the hierarchy_embedded_layer_index. The value of '1' for this flag is reserved.

hierarchy_type – The hierarchical relation between the associated hierarchy layer and its hierarchy embedded layer is defined in Table 2-50. If scalability applies in more than one dimension, this field shall be set to the value of '8' ("Combined Scalability"), and the flags temporal_scalability_flag, spatial_scalability_flag and quality_scalability_flag shall be set accordingly. For MVC video sub-bitstreams, this field shall be set to the value '9' ("MVC video sub-bitstream") and the flags temporal_scalability_flag, spatial_scalability_flag and quality_scalability_flag shall be set to '1'. For MVC base view sub-bitstreams, this field shall be set to the value of '15' and the flags temporal_scalability_flag, spatial_scalability_flag and quality_scalability_flag shall be set to '1'. For MVCD video sub-bitstreams, this field shall be set to the value of '9' ("MVCD video sub-bitstream") and the flags temporal_scalability_flag, spatial_scalability_flag and quality_scalability_flag shall be set to '1'. For MVCD base view sub-bitstreams, this field shall be set to the value of '15' and the flags temporal_scalability_flag, spatial_scalability_flag and quality_scalability_flag shall be set to '1'.

with:

no_view_scalability_flag – A 1-bit flag, which when set to '0' indicates that the associated program element enhances the number of views of the bit-stream resulting from the program element referenced by the hierarchy_embedded_layer_index. The value of '1' for this flag is reserved.

no_temporal_scalability_flag – A 1-bit flag, which when set to '0' indicates that the associated program element enhances the frame rate of the bit-stream resulting from the program element referenced by the hierarchy_embedded_layer_index. The value of '1' for this flag is reserved.

no_spatial_scalability_flag – A 1-bit flag, which when set to '0' indicates that the associated program element enhances the spatial resolution of the bit-stream resulting from the program element referenced by the hierarchy_embedded_layer_index. The value of '1' for this flag is reserved.

no_quality_scalability_flag – A 1-bit flag, which when set to '0' indicates that the associated program element enhances the SNR quality or fidelity of the bit-stream resulting from the program element referenced by the hierarchy_embedded_layer_index. The value of '1' for this flag is reserved.

hierarchy_type – The hierarchical relation between the associated hierarchy layer and its hierarchy embedded layer is defined in Table 2-50. If scalability applies in more than one dimension, this field shall be set to the value of '8' ("Combined Scalability"), and the flags no_view_scalability_flag, no_temporal_scalability_flag, no_spatial_scalability_flag and no_quality_scalability_flag shall be set accordingly. For MVC video sub-bitstreams, this field shall be set to the value of '9' ("MVC video sub-bitstream") and the flags no_view_scalability_flag, no_temporal_scalability_flag, no_spatial_scalability_flag and no_quality_scalability_flag shall be set to '1'. For MVC base view sub-bitstreams, this field shall be set to the value of '15' and the flags no_view_scalability_flag, no_temporal_scalability_flag, no_spatial_scalability_flag and no_quality_scalability_flag shall be set to '1'. For MVCD video sub-bitstreams, this field shall be set to the value of '9' ("MVCD video sub-bitstream") and the flags no_view_scalability_flag, no_temporal_scalability_flag, no_spatial_scalability_flag and no_quality_scalability_flag shall be set to '1'. For MVCD base view sub-bitstreams, this field shall be set to the value of '15' and the flags no_view_scalability_flag, no_temporal_scalability_flag, no_spatial_scalability_flag and no_quality_scalability_flag shall be set to '1'.

Replace in Table 2-50 the description for values 8, 10 and 15, and redefine the reserved range as follows:

Table 2-50 – Hierarchy_type field values

Value	Description
8	Combined Scalability or MV-HEVC sub-partition.
10	Auxiliary picture layer as defined in Annex F of Rec. ITU-T H.265 | ISO/IEC 23008-2.
11-14	Reserved
15	Base layer or MVC base view sub-bitstream or AVC video sub-bitstream of MVC or HEVC temporal video sub-bitstream or HEVC base sub-partition.

9)   Clause 2.6.90

Replace Table 2-105 with:

Table 2-105 – Extension descriptor

Syntax	No. of bits	Mnemonic
Extension_descriptor ( ) {		
descriptor_tag	**8**	**uimsbf**
descriptor_length	**8**	**uimsbf**
extension_descriptor_tag	**8**	**uimsbf**
if (extension_descriptor_tag == 0x02) {		
ObjectDescriptorUpdate( )		
}		
else if (extension_descriptor_tag == 0x03) {		
HEVC_timing_and_HRD_descriptor( )		
}		
else if (extension_descriptor_tag == 0x04) {		
af_extension_descriptor( )		
}		
else if (extension_descriptor_tag == 0x05) {		
HEVC_operation_point_descriptor( )		
}		
else if (extension_descriptor_tag == 0x06) {		
HEVC_hierarchy_extension_descriptor( )		
}		
else {		
for (i=0; i<N; i++) {		
reserved	**8**	**bslbf**
}		
}		
}		

10)   Clause 2.6.91

Add the following immediately before Table 2-106:

HEVC_operation_point_descriptor( ) – This structure is defined in 2.6.100 and 2.6.101.

HEVC_hierarchy_extension_descriptor( ) – This structure is defined in 2.6.102 and 2.6.103.

Replace in Table 2-106 the description for values 5 to 255 as follows:

Table 2-106 – Extension descriptor tag values

Extension_descriptor_tag	TS	PS	Identification
5	X	n/a	HEVC_operation_point_descriptor( )
6	X	n/a	HEVC_hierarchy_extension_descriptor( )
7-255	n/a	n/a	Rec. ITU-T H.222.0	ISO/IEC 13818-1 Reserved