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**Information technology — Coding of audio-visual objects — Part 15: Carriage of network abstraction layer (NAL) unit structured video in the ISO base media file format — Amendment 3: Support for neural-network post-filter supplemental enhancement information and other improvements**

WD stage

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Information technology — Coding of audio-visual objects — Part 15: Carriage of network abstraction layer (NAL) unit structured video in the ISO base media file format — Amendment 3: Support for neural-network post-filter supplemental enhancement information and other improvements

*Add the following to the normative references in Clause 2:*

ISO/IEC 23002-7, *Information technology — MPEG video technologies — Part 7: Versatile supplemental enhancement information messages for coded video bitstreams*

*Add the following subclauses 11.4.22 and 11.4.23:*

**11.4.22 Neural-network post-filter characteristics sample group**

**11.4.22.1 Definition**

The neural-network post-filter characteristics (NNPFC) SEI message is specified in ISO/IEC 23002-7. NNPFC SEI messages may be included in a VVC bitstream.

An NNPFC SEI message contains the nnpfc\_id syntax element, which is an identifying number that may be used to identify the post-processing filter that the NNPFC SEI message concerns.

An NNPFC SEI message identifies an applicable post-processing filter associated with the nnpfc\_id value. The use of applicable post-processing filters with different values of nnpfc\_id for specific pictures is indicated with neural-network post-filter activation (NNPFA) SEI messages.

An NNPFC SEI message either specifies a base post-processing filter or contains a neural network update. A base post-processing filter is identified by the first NNPFC SEI message, in decoding order, that has a particular nnpfc\_id value within a CLVS. If there is no subsequent NNPFC SEI message that has the same nnpfc\_id value as the base post-processing filter, the applicable post-processing filter is the same as the base post-processing filter. Otherwise, the applicable post-processing filter is obtained by applying the update provided as an ISO/IEC 15938-17 bitstream in a subsequent NNPFC SEI message on top of the base post-processing filter.

All instances of the SampleToGroupBox for the NNPFC sample group shall include grouping\_type\_parameter. The grouping\_type\_parameter field is specified for the NNPFC sample group as follows:

{  
 unsigned int(1) filter\_update\_flag;  
 unsigned int(31) filter\_id;  
}

filter\_update\_flag equal to 1 indicates that all the sample group description entries referenced by this SampleToGroupBox contain an NNPFC SEI message that provides an update on top of a base post-processing filter. filter\_update\_flag equal to 0 indicates that all the sample group description entries referenced by this SampleToGroupBox contain an NNPFC SEI message that specifies a base post-processing filter.

filter\_id indicates that all the sample group description entries referenced by this SampleToGroupBox contain an NNPFC SEI message that has nnpfc\_id equal to filter\_id.

NOTE As a consequence of the grouping\_type\_parameter definition, the post-processing filters for different nnpfc\_id values are specified in different instances of the SampleToGroupBox. Furthermore, one SampleToGroupBox specifies the base post-processing filter(s) for a particular nnpfc\_id value, while another SampleToGroupBox, if any, specifies the filter updates for the same nnpfc\_id value. It is therefore possible to indicate that the base post-processing filter persists over a longer period than any of the filter updates.

When a sample is not mapped to NnpfcSeiEntry in a SampleToGroupBox having filter\_update\_flag equal to 0 and a particular filter\_id, the sample shall not be mapped to an NnpfcSeiEntry in a SampleToGroupBox having filter\_update\_flag equal to 1 and the same filter\_id.

When a track contains an NNPFC sample group, no NNPFC SEI messages shall be present within the samples of the track. When a VVC track has an associated VVC non-VCL track that contains an NNPFC sample group, no NNPFC SEI messages shall be present within the samples of the VVC track.

When a reader supports the NNPFC sample group, it shall perform the following implicit insertion of prefix SEI NAL units as a part of the bitstream reconstruction:

— When a sample is mapped to at least one NnpfcSeiEntry with filter\_update\_flag equal to 0 and the sample is

— a sync sample, or

— the first sample of a sequence of samples associated with the same sample entry, or

— the first sample of a sequence of samples mapped to the same NnpfcSeiEntry with filter\_update\_flag equal to 0 and a particular filter\_id value filterIdBase,

then the sample implicitly contains a prefix SEI NAL unit for each layer contained in the track and each filter\_id value mapped to the sample, and the prefix SEI NAL unit contains the NNPFC SEI message from the NnpfcSeiEntry with filter\_update\_flag equal to 0, followed by the NNPFC SEI message from the NnpfcSeiEntry with filter\_update\_flag equal to 1 and filter\_id equal to filterIdBase that is mapped to the sample, if any.

— When a sample is the first sample in a sequence of samples mapped to the same NnpfcSeiEntry with filter\_update\_flag equal to 1 and a particular filter\_id value filterIdUpdate and the sample is

— not a sync sample, and

— not the first sample of a sequence of samples associated with the same sample entry, and

— not the first sample in a sequence of samples mapped to the same NnpfcSeiEntry with filter\_update\_flag equal to 0 and filter\_id equal to filterIdUpdate,

then the sample implicitly contains a prefix SEI NAL unit for each layer contained in the track and each filter\_id value mapped to the sample, and the prefix SEI NAL unit contains the NNPFC SEI message from the NnpfcSeiEntry with filter\_update\_flag equal to 1.

**11.4.22.2 Syntax**

aligned(8) class NnpfcSeiEntry() extends VisualSampleGroupEntry('nfcs')  
{  
 unsigned int(8) nnpfc\_sei\_data\_byte[];  
}

**11.4.22.3 Semantics**

nnpfc\_sei\_data\_byte[] is a byte array that shall contain exactly one complete NNPFC SEI message as specified in ISO/IEC 23002-7.

[Ed. In MPEG#142, further study was encouraged if it is desirable for the NnpfcSeiEntry design to contain a complete NNPFC SEI message or just some parameters, such as those that could help applications to decide whether to use or to skip the post-filter (such as identification, purpose, complexity), excluding the ISO/IEC 15938-17 bitstream, if any, and parameters for post-filter operation. In the latter case, there is an open question how to avoid repetition of the ISO/IEC 15938-17 bitstream.]

**11.4.23 Neural-network post-filter activation sample group**

**11.4.23.1 Definition**

The neural-network post-filter activation (NNPFA) SEI message is specified in ISO/IEC 23002-7. NNPFA SEI messages may be included in a VVC bitstream.

An NNPFA SEI message contains the nnpfa\_target\_id syntax element, which is an identifying number that may be used to identify the post-processing filter that the NNPFA SEI message concerns.

An NNPFA SEI message indicates that the applicable post-processing filter with nnpfc\_id equal to nnpfa\_target\_id may be used to filter the picture containing the NNPFA SEI message.

Instances of the SampleToGroupBox for the NNPFA sample group shall not include grouping\_type\_parameter.

When a track contains an NNPFA sample group, no NNPFA SEI messages shall be present within the samples of the track.

When a reader supports the NNPFA sample group, it shall perform the following implicit insertion of prefix SEI NAL units as a part of the bitstream reconstruction:

— When a sample is mapped to at least one NnpfaSeiEntry, the sample implicitly contains a prefix SEI NAL unit for each layer contained in the track, and the prefix SEI NAL unit contains the NNPFA SEI message from the NnpfaSeiEntry.

When a reader processes an NNPFA sample group, it shall also process the NNPFC sample groups of the same track. When a VVC track has an associated VVC non-VCL track that contains an NNPFA sample group, no NNPFA SEI messages shall be present within the samples of the VVC track.

When an NNPFC sample group is an essential sample group and an NNPFA sample group is present in the same track, the NNPFA sample group shall be an essential sample group and the 'esgh' sample group shall list 'nfcs' and 'nfas' in subsequent entries of the sample\_group\_description\_type array.

**11.4.23.2 Syntax**

aligned(8) class NnpfaSeiEntry() extends VisualSampleGroupEntry('nfas')  
{  
 do {  
 unsigned int(8) nnpfa\_sei\_len;  
 if (nnpfa\_sei\_len > 0)  
 unsigned int(8) nnpfa\_sei\_data\_byte[nnpfa\_sei\_len];

} while (nnpfa\_sei\_len > 0)  
}

**11.4.23.3 Semantics**

nnpfa\_sei\_len greater than 0 is the number of bytes in the following byte array nnpfa\_sei\_data\_byte[nnpfa\_sei\_len]. At least the first instance of nnpfa\_sei\_len shall be greater than 0. nnpfa\_sei\_len equal to 0 specifies that no further byte arrays follow in this NnpfaSeiEntry.

nnpfa\_sei\_data\_byte[nnpfa\_sei\_len] is a byte array that shall contain exactly one complete NNPFA SEI message as specified in ISO/IEC 23002-7.

*In subclause 11.6.2, add the following paragraph just before the paragraph starting with "A time-aligned sample":*

When an essential sample group is present in a VVC non-VCL track and the reader does not recognize the sample group, the reader shall ignore and skip the VVC non-VCL track in the process of reconstructing an access unit.

*Add the following to Bibliography:*

ISO/IEC 15938-17, *Information technology — Multimedia content description interface — Part 17: Compression of neural networks for multimedia content description and analysis*