**ISO/IEC 14496-15:2022(E)**

ISO/IEC JTC 1/SC 29/WG 03

Date: 2023-07

**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**

CD stage

**Warning for WDs and CDs**

This document is not an ISO International Standard. It is distributed for review and comment. It is subject to change without notice and may not be referred to as an International Standard.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

© ISO 20XX

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO’s member body in the country of the requester.

ISO copyright office

CP 401 • Ch. de Blandonnet 8

CH-1214 Vernier, Geneva

Phone: +41 22 749 01 11

Email: copyright@iso.org

Website: www.iso.org

Published in Switzerland

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

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

*Add the following subclauses 4.16 and 4.17:*

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

**4.16.1 Definition**

The neural-network post-filter characteristics (NNPFC) SEI message is specified in ISO/IEC 23002-7. NNPFC SEI messages may be included in an AVC, SVC, MVC, MVD, HEVC, L-HEVC, or 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 includes the nnpfc\_id syntax element that identifies an applicable post-processing filter associated with the nnpfc\_id value. The SEI payload type value of the NNPFC SEI message is equal to 210, as specified in ISO/IEC 14496-10, ISO/IEC 23008-2, and ISO/IEC 23090-3. 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. The SEI payload type value of the NNPFA SEI message is equal to 211, as specified in ISO/IEC 14496-10, ISO/IEC 23008-2, and ISO/IEC 23090-3.

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.

The applicable post-processing filter is determined by the value of the nnpfa\_target\_base\_flag syntax element in the NNPFA SEI message that activates the post-processing filter. If the nnpfa\_target\_base\_flag is equal to 1, the applicable post-processing filter is the base post-processing filter. Otherwise (the nnpfa\_target\_base\_flag is equal to 0), the applicable post-processing filter is obtained by applying the update provided as an ISO/IEC 15938-17 bitstream or indicated by a URI in an NNPFC SEI message with nnpfc\_base\_flag equal to 0 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 NnpfcSeiSampleGroupEntry in a SampleToGroupBox having filter\_update\_flag equal to 0 and a particular filter\_id, the sample shall not be mapped to an NnpfcSeiSampleGroupEntry in a SampleToGroupBox having filter\_update\_flag equal to 1 and the same filter\_id.

When a track contains an NNPFC sample group, the following applies:

— No NNPFC SEI messages shall be present within the samples of the track.

— One or more of the sample entries may include an SEI NAL unit containing an SEI manifest SEI message having an entry with manifest\_sei\_payload\_type[ i ] equal to 210 and one or more SEI NAL units containing one or more SEI prefix indication SEI messages with prefix\_sei\_payload\_type equal to 210.

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 or within the samples of VVC non-VCL track.

When a track does not contain an NNPFC sample group and NNPFC SEI messages are contained in the samples, the following applies:

— If the processing of NNPFC SEI messages is considered as essential for consuming the content, one or more sample entries shall include an SEI NAL unit containing an SEI manifest SEI message having an entry with manifest\_sei\_payload\_type[ i ] equal to 210 and one or more SEI NAL units containing one or more SEI prefix indication SEI messages with prefix\_sei\_payload\_type equal to 210.

— Otherwise (the processing of NNPFC SEI messages is not considered as essential for consuming the content), one or more sample entries should include an SEI NAL unit containing an SEI manifest SEI message having an entry with manifest\_sei\_payload\_type[ i ] equal to 210 and one or more SEI NAL units containing one or more SEI prefix indication SEI messages with prefix\_sei\_payload\_type equal to 210.

The following applies for the SEI manifest SEI message having an entry with manifest\_sei\_payload\_type[ i ] equal to 210, when present in a sample entry:

— For the i value for which manifest\_sei\_payload\_type[ i ] is equal to 210, the value of manifest\_sei\_description[ i ] shall be set equal to 1 if the processing is considered as essential for consuming the content and 0 otherwise.

— Each of the SEI prefix indication SEI messages with prefix\_sei\_payload\_type equal to 210 shall include at least all bits for the syntax element nnpfc\_purpose.

— It shall have an entry with manifest\_sei\_payload\_type[ i ] equal to 211.

— For the i value for which manifest\_sei\_payload\_type[ i ] is equal to 211, when present, the value of manifest\_sei\_description[ i ] shall be set equal to 1 if the processing is considered as essential for consuming the content and 0 otherwise.

When a reader supports the NNPFC sample group, it shall also support the NNR item (defined in subclause 4.16.4). When a reader supports the NNPFC sample group and is processing a track containing NNPFC sample group(s), it shall perform the following insertion of prefix or suffix SEI NAL units as a part of the bitstream reconstruction:

— When a sample is mapped to at least one NnpfcSeiSampleGroupEntry 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 NnpfcSeiSampleGroupEntry with filter\_update\_flag equal to 0 and a particular filter\_id value filterIdBase,

the sample contains a prefix or suffix SEI NAL unit for each layer contained in the track and each filter\_id value mapped to the sample, and the prefix or suffix SEI NAL unit contains the NNPFC SEI message indicated by the NnpfcSeiSampleGroupEntry with filter\_update\_flag equal to 0, followed by the NNPFC SEI message indicated by the NnpfcSeiSampleGroupEntry 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 NnpfcSeiSampleGroupEntry 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 NnpfcSeiSampleGroupEntry with filter\_update\_flag equal to 0 and filter\_id equal to filterIdUpdate,

the sample contains a prefix or suffix SEI NAL unit for each layer contained in the track and each filter\_id value mapped to the sample, and the prefix or suffix SEI NAL unit contains the NNPFC SEI message indicated by the NnpfcSeiSampleGroupEntry with filter\_update\_flag equal to 1.

An NnpfcSeiSampleGroupEntry is resolved to an NNPFC SEI message as follows:

— If num\_items is equal to 0, the NNPFC SEI message is made of the nnpfc\_sei\_data\_byte[] array.

— Otherwise (num\_items is equal to 1), the NNPFC SEI message is made of the nnpfc\_sei\_data\_byte[] array followed by the item data of the item with item\_ID equal to item\_id[0].

**4.16.2 Syntax**

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

**4.16.3 Semantics**

meta\_box\_handler\_type, num\_items and item\_id[i] have the same semantics as the respective syntax elements in SampleToMetadataItemEntry. num\_items shall be equal to 0 or 1. When num\_items is equal to 1, the item with item\_ID equal to item\_id[0] shall have item\_type equal to 'nnr1' specified in subclause 4.16.4.

nnpfc\_sei\_data\_byte[], when num\_items is equal to 0, is a byte array that shall contain exactly one complete sei\_message( ) syntax structure with payloadType equal to 210. nnpfc\_sei\_data\_byte[], when num\_items is equal to 1, is a byte array that shall contain exactly one complete sei\_message( ) syntax structure with payloadType equal to 210 and nnpfc\_mode\_idc equal to 0, excluding the nnpfc\_payload\_byte[ i ] syntax elements of the nn\_post\_filter\_characteristics( ) syntax structure. The sei\_message( ) syntax structure is specified in ISO/IEC 14496-10 when the sample entry type is an AVC, SVC, MVC, or MVD sample entry type, or in ISO/IEC 23008-2 when the sample entry type is an HEVC or L-HEVC sample entry type, or in ISO/IEC 23090-3 when the sample entry type is a VVC sample entry type, and the nn\_post\_filter\_characteristics( ) syntax structure that is contained in the sei\_payload( ) syntax structure, which is in turn contained in the sei\_message( ) syntax structure, is specified in ISO/IEC 23002-7.

**4.16.4 'nnr1' item**

**4.16.4.1 Definition**

An item of type 'nnr1' consists of the NNR units of an NNR bitstream as defined in ISO/IEC 15938-17 and is called an NNR item. The NNR bitstream in an NNR item may be independently decodable or an incremental update relative to another NNR item. If an NNR item is an incremental update relative to another NNR item, it shall have an item reference of type 'pred' to that other NNR item.

The neural network handler type 'nene' in the HandlerBox of the MetaBox indicates that items defined in the MetaBox represent neural networks.

**4.16.4.2 Syntax**

aligned(8) class NNRItemData  
{  
 unsigned int(8) nnr\_item\_data[item\_size];  
}

**4.16.4.3 Syntax**

In the syntax above, the following applies:

* The value of item\_size is equal to the sum of the extent\_length values of each extent of the item, as specified in the ItemLocationBox.

nnr\_item\_data[item\_size] shall consist of an NNR bitstream as defined in ISO/IEC 15938-17.

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

**4.17.1 Definition**

The neural-network post-filter activation (NNPFA) SEI message is specified in ISO/IEC 23002-7. NNPFA SEI messages may be included in an AVC, SVC, MVC, MVD, HEVC, L-HEVC, or 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, and the nnpfa\_target\_base\_flag syntax element, which indicates whether the applicable post-processing filter is an update to the base post-processing filter or the base post-processing filter itself.

An NNPFA SEI message, when included in a bitstream, indicates that the applicable post-processing filter with nnpfc\_id equal to nnpfa\_target\_id may be used to filter the pictures in the persistency scope of the NNPFA SEI message.

An NNPFA sample group indicates which samples of a track contain NNPFA SEI messages. [Ed. (MH): It is an open question whether an NNPFA sample group may or shall be present when samples contain NNPFA SEI messages.]

The SampleToGroupBox for the NNPFA sample group shall include grouping\_type\_parameter. The grouping\_type\_parameter field is specified for the NNPFA sample group as follows:

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

filter\_id indicates that the sample mapped by this SampleToGroupBox contains an NNPFA SEI message that has nnpfa\_target\_id equal to filter\_id.

When a track contains NNPFA sample group(s), the track shall also contain NNPFC sample group(s).

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.

**4.17.2 Syntax**

aligned(8) class NnpfaSeiSampleGroupEntry() extends SampleToMetadataItemEntry('nfas')  
{  
}

**4.17.3 Semantics**

meta\_box\_handler\_type, num\_items, and item\_id[i] have the same semantics as the respective syntax elements in SampleToMetadataItemEntry. num\_items shall be equal to 0, 1, or 2. When num\_items is equal to 1 or 2, the item with item\_ID equal to item\_id[0] shall have item\_type equal to 'nnr1' specified in subclause 4.16.4 and shall represent the base post-processing filter. When num\_items is equal to 2, the item with item\_ID equal to item\_id[1] shall have item\_type equal to 'nnr1' specified in subclause 4.16.4 and shall represent the filter update applying to the associated NNPFA SEI message.

*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.