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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 1: Support for neural-network post-filter supplemental enhancement information and other improvements

Technologies de l'information — Codage des objets audiovisuels —

Partie 15: Transport de vidéo structurée en unités NAL sur la couche réseau au format ISO de base pour les fichiers médias

AMENDEMENT 1: Prise en charge des informations supplémentaires d'amélioration post-filtre du réseau neuronal et autres améliorations

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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 1: Support for neural-network post-filter supplemental enhancement information and other improvements

Clause 2

Add the following normative references:

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*

4.10

Replace the content with the following:

4.10 SEI information box

4.10.1 Definition

Box Type: `'seii'`

Container: `SchemeInformationBox` (`'schi'`) or `VisualSampleEntry`

Mandatory: Yes (in the `SchemeInformationBox`), no (in a `VisualSampleEntry`)

Quantity: One (in the `SchemeInformationBox`), zero or one (in a `VisualSampleEntry`)

The `SeiInformationBox` documents SEI messages in a bitstream. When contained in a `VisualSampleEntry`, `numRequiredSEIs` shall be 0. By inspecting the `SeiInformationBox` a player will know which SEI messages it can assume to be present, and which are deemed necessary by the file author for correct playback. There might be other SEI messages present in the bitstream that are not documented by this box.

NOTE Writers can list non-required SEI messages in the `SeiInformationBox` included directly in the sample entry and required SEI messages in the `SeiInformationBox` in the `SceheneInformationBox` of the same track.

The SEI messages listed in the `SeiInformationBox` should be stored either in the bitstream or in the configuration record within the untransformed sample entry. The `SeiInformationBox` does not contain the actual SEI messages, it only lists those that occur in the bitstream.

4.10.2 Syntax

```
aligned(8) class SeiInformationBox extends Box('seii') {
   unsigned int(16) numRequiredSEIs;
```

```
    for (i = 0; i < numRequiredSEIs; i++) {
        unsigned int(16) requiredSEI_ID;
    }
    unsigned int(16) numNotRequiredSEIs;
    for (i = 0; i < numNotRequiredSEIs; i++) {
        unsigned int(16) notrequiredSEI_ID;
    }
}
```

4.10.3 Semantics

`requiredSEI_ID` takes on the value "payloadType" of an SEI message present in the bitstream that is deemed necessary by the file author for correct playback.

`notrequiredSEI_ID` takes on the value "payloadType" of an SEI message present in the bitstream that is not deemed necessary by the file author for correct playback.

4.11

Replace the content with the following:

4.11 Post-decoder requirements scheme for signalling of SEI

4.11.1 General

In order to handle situations where the file author requires certain actions on the player or renderer, the ISO base media file format specifies the restricted-video mechanism where untransformed sample entries are hidden behind the sample entry type `'resv'`. Subclause 4.11.2 uses the restricted-video mechanism to specify a scheme for post-decoder requirements for handling SEI messages that is identified by the `'aSEI'` scheme type. The mechanism specified in subclause 4.11.2 applies to all coding systems identified in this document. For the case of signalling of SEI messages, a file author can list occurring SEI message payload type values and classify them into two categories: those that are deemed required by the file author for correct playback, and others. The occurrence of either type of SEI messages can be signalled in the `SeiInformationBox`.

Many of the applicable video coding standards define an SEI manifest SEI message, which can be used to indicate SEI message payload types that are considered necessary. When the processing of a particular SEI message payload type is considered as essential for consuming the content of a track, the following applies:

— When the untransformed sample entry type does not impose a player to process SEI manifest SEI messages, the file writer shall use a restricted video track with the `'aSEI'` scheme type and include that particular SEI message payload type as `requiredSEI_ID` in `SeiInformationBox`.

— When the untransformed sample entry type imposes a player to process SEI manifest SEI messages, the file writer shall include, in the sample entry, an SEI manifest SEI message where that particular SEI message payload type is indicated to be necessary.

— It is allowed to include both an SEI manifest SEI message in the sample entry and an `SeiInformationBox` for the same sample entry, provided that both declare the same SEI message payload types consistently.

4.11.2 Definition

The restricted video scheme for signalling of SEI messages categorized to those requiring certain actions on the player or renderer and those whose processing by the player or renderer is not required is defined in this subclause.

The `scheme_type` equal to '`aSEI`' is used.

The `SeiInformationBox` is mandatory in the `SchemeInformationBox` under the `'aSEI'` scheme. In this case, it contains information about the SEI messages present in the bitstream. Although the SEI messages are not required for decoding, the file author may require certain actions for rendering or other purposes. The

box distinguishes between SEI messages that are required to be understood for correct playback and SEI messages that are not required for correct playback (but may enhance playback).

4.16

Add the following paragraph at the end of subclause 4.16:

When an SEI manifest SEI message declares one or more SEI messages to be present and necessary and these SEI messages require certain actions on the player or renderer, a file writer may use the `'resv'` sample entry type with the `'aSEI'` scheme type as specified in subclause 4.11 to ensure that the player or renderer performs the actions related to these SEI messages. In this case, the `requiredSEI_ID` fields in the `SeiInformationBox` should include all the SEI message payload type values that are indicated to be present and necessary in the SEI manifest SEI message.

4.19 and 4.20

Add the following subclauses after subclause 4.18:

4.19 Neural-network post-filter characteristics sample group

4.19.1 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 bitstream conforming to ISO/IEC 14496-10, ISO/IEC 23008-2, or ISO/IEC 23090-3.

An NNPFC SEI message contains the nnpfc_id syntax element, which is an identifying number for a post-processing filter.

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. The constants NNPFC_PAYLOAD_TYPE and NNPFA_PAYLOAD_TYPE are derived as follows:

— NNPFC_PAYLOAD_TYPE is set equal to 210.

— NNPFA_PAYLOAD_TYPE is set equal to 211.

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 an NNPFC SEI message with nnpfc_base_flag equal to 1.

The applicable post-processing filter is determined by the values of the nnpfa_target_id and nnpfa_target_base_flag syntax elements 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 with nnpfc_id equal to nnpfa_target_id. 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_id equal to nnpfa_target_id and nnpfc_base_flag equal to 0 on top of the base post-processing filter having the same nnpfc_id value.

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, no NNPFC SEI messages shall be present within the samples or sample entries 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 or sample entries of the VVC track or within the samples or sample entries of the VVC non-VCL track.

When a reader supports the NNPFC sample group, it shall also support the NNR item (defined in subclause 4.19.4).

4.19.2 Syntax

```
aligned(8) class NnpfcSeiSampleGroupEntry() extends SampleToMetadataItemEntry('nfcs')
{
   unsigned int(8) nnpfc_sei_data_byte[];
}
```

4.19.3 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 0, `meta_box_handler_type` has no impact in readers and may be set equal to `'nnet'`. 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 4.19.4.

`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 NNPFC_PAYLOAD_TYPE, which shall include the nn_post_filter_characteristics( ) syntax structure specified in ISO/IEC 23002-7. `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 NNPFC_PAYLOAD_TYPE and nnpfc_mode_idc equal to 0, excluding the nnpfc_payload_byte[i] syntax elements of the nn_post_filter_characteristics( ) syntax structure. These nnpfc_payload_byte[i] syntax elements shall be stored as an `'nnr1'` item. The sei_message( ) syntax structure is specified in ISO/IEC 14496-10 when the sample entry type is an AVC 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.

4.19.4 'nnr1' item

4.19.4.1 Definition

An item of type `'nnr1'` includes NNR units of an NNR bitstream as defined in ISO/IEC 15938-17 and is called an NNR item.

An NNR item may be associated with an NNR configuration item property (`'nnrC'`) specified in subclause 4.19.5.

If an NNR item is associated with an NNR configuration item property, the following applies:

— The NNR bitstream shall be constructed by including first the NNR units from the NNR configuration item property in their appearance order, followed by the NNR units from the item data.

— It is a requirement for file conformance that the constructed NNR bitstream conforms to ISO/IEC 15938-17.

— The item data of the NNR item shall not contain any NNR units with nnr_unit_type equal to any `nnr_unit_type[j]` value of the associated NNR configuration item property.

Otherwise (an NNR item is not associated with an NNR configuration item property), the item data of the NNR item shall be a conforming NNR bitstream.

The NNR bitstream 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 `'nnet'` in the `HandlerBox` of the `MetaBox` indicates that items defined in the `MetaBox` represent neural networks. An NNR item may be present in a `MetaBox` with `HandlerBox` containing some other handler type than `'nnet'`, in which case `HandlerProperty` with `handler_type` equal to `'nnet'` may be associated with the NNR item.

4.19.4.2 Syntax

```
aligned(8) class NNRItemData
{
   unsigned int(8) nnr_item_data[item_size];
}
```

4.19.4.3 Semantics

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 include a sequence of NNR units as defined in ISO/IEC 15938-17.

4.19.5 'nnrC' item property

4.19.5.1 Definition

Box Type: `'nnrC'`

Property Type: Descriptive item property

Container: `ItemPropertyContainerBox`

Mandatory: No

Quantity: Zero or one for an `'nnr1'` item

An item property of type `'nnrC'` includes one or more NNR units for the associated NNR item. The NNR units included in the `'nnrC'` item property may have the NNR unit type of NNR start (NNR_STR), NNR model parameter set (NNR_MPS), NNR layer parameter set (NNR_LPS), NNR topology, (NNR_TPL), or NNR quantization (NNR_QNT), and shall not have any other NNR unit type.

4.19.5.2 Syntax

```
aligned(8) class NNRDecoderConfigurationRecord {
   unsigned int(8) num_of_arrays;
   for (j=0; j < num_of_arrays; j++) {
```

```
      bit(2) reserved = 0;
      unsigned int(6) nnr_unit_type[j];
      unsigned int(8) num_nnr_units[j];
   }
   for (j=0; j < num_of_arrays; j++)
      for (i=0; i < num_nnr_units[j]; i++)
         NNRUnit nnr_unit[j][i];
}

aligned(8) class NNRConfigurationItemProperty extends ItemFullProperty('nnrC', version=0,
flags=0) {
   NNRDecoderConfigurationRecord nnr_config;
}
```

4.19.5.3 Semantics

`num_of_arrays` indicates the number of arrays of NNR units of the indicated type(s). `num_arrays` shall be greater than 0.

`nnr_unit_type[j]` indicates the type of the NNR units in the following array (which shall be all of that type); it takes a value of nnr_unit_type as defined in ISO/IEC 15938-17; it is restricted to take one of the values NNR_STR, NNR_MPS, NNR_LPS, NNR_TPL, or NNR_QNT.

`num_nnr_units[j]` indicates the number of NNR units of the indicated type included in the configuration record.

`NNRUnit` is defined in this document as an alias of the nnr_unit syntax structure specified in ISO/IEC 15938-17.

`nnr_unit[j][i]` is the `i`-th NNR unit of NNR unit type equal to `nnr_unit_type[j]`.

`nnr_config` is an NNR decoder configuration record that contains NNR units for the associated NNR item.

4.19.6 Declaration of required or recommended processing of NNPFC SEI messages

When a track contains an NNPFC sample group, 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 NNPFC_PAYLOAD_TYPE and one or more SEI NAL units containing one or more SEI prefix indication SEI messages with prefix_sei_payload_type equal to NNPFC_PAYLOAD_TYPE.

Let avcHevcVvcSampleEntryList be a list of the following sample entry types: `'avc1'`, `'avc2'`, `'avc3'`, `'avc4'`, `'hvc1'`, `'hev1'`, `'hvc2'`, `'hev2'`, `'hvc3'`, `'hev3'`, `'lhv1'`, `'lhe1'`, `'vvc1'`, `'vvi1'`.

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, the following applies:

  — A file writer shall mark the track to be an `'aSEI'` restricted video track (specified in subclause 4.11) and include `requiredSEI_ID` equal to NNPFC_PAYLOAD_TYPE in the `SeiInformationBox` of the track.

  — When the untransformed sample entry type of the track is present in avcHevcVvcSampleEntryList, the file writer may include an SEI NAL unit containing an SEI manifest SEI message having an entry with manifest_sei_payload_type[i] equal to NNPFC_PAYLOAD_TYPE in the sample entry.

  — When the untransformed sample entry type of the track is present in avcHevcVvcSampleEntryList, the file writer shall include one or more SEI NAL units containing one or more SEI prefix indication SEI messages with prefix_sei_payload_type equal to NNPFC_PAYLOAD_TYPE in the sample entry.

— Otherwise, if the processing of NNPFC SEI messages is not considered as essential for consuming the content and the sample entry type is present in avcHevcVvcSampleEntryList, 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 NNPFC_PAYLOAD_TYPE and one or more SEI NAL units containing one or more SEI prefix indication SEI messages with prefix_sei_payload_type equal to NNPFC_PAYLOAD_TYPE.

The following applies for the SEI manifest SEI message having an entry with manifest_sei_payload_type[i] equal to NNPFC_PAYLOAD_TYPE, when present in a sample entry:

— For the i value for which manifest_sei_payload_type[i] is equal to NNPFC_PAYLOAD_TYPE, 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 NNPFC_PAYLOAD_TYPE 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 NNPFA_PAYLOAD_TYPE.

— For the i value for which manifest_sei_payload_type[i] is equal to NNPFA_PAYLOAD_TYPE, 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.

4.19.7 Insertion of SEI NAL units based on the NNPFC sample group

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 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 following applies:

  — If the track is an HEVC, L-HEVC, or a VVC track, a prefix or suffix SEI NAL unit is inserted in the sample for each layer contained in the track and each `filter_id` value mapped to the sample.

  — Otherwise (the track is an AVC track), an SEI NAL unit is inserted in the sample for each `filter_id` value mapped to the sample.

  — The following NNPFC SEI messages are inserted in each inserted SEI NAL unit: 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 following applies:

  — If the track is an HEVC, L-HEVC, or a VVC track, a prefix or suffix SEI NAL unit is inserted in the sample for each layer contained in the track and each `filter_id` value mapped to the sample.

  — Otherwise (the track is an AVC track), an SEI NAL unit is inserted in the sample for each `filter_id` value mapped to the sample.

  — The NNPFC SEI message indicated by the `NnpfcSeiSampleGroupEntry` with `filter_update_flag` equal to 1 is inserted in the inserted SEI NAL unit.