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| *Title:* | **New level and additional SEI messages for VVC (Draft 2)** | | |
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# Abstract

This document contains the draft text for changes to the Versatile Video Coding (VVC) standard (ITU‑T H.266 | ISO/IEC 23090-3), mainly for the addition of Level 6.3 and the SEI manifest and SEI prefix indication SEI messages, but also including SEI payload type values and other interfaces for SEI messages added to the VSEI specification, as well as some technical corrections.

Draft 2 incorporated items:

* Text changes for clarification of 1) the exact meaning of a parameter set being referenced and 2) that the decoding of non-VCL NAL units in a PU after the last VCL NAL unit of the picture in decoder is deferred after all slices of the picture are decoded (JVET-U0073-v3)
* Addition of SEI payload type values 165 (alpha\_channel\_info), 177 (depth\_representation\_info), 179 (multiview\_acquisition\_info), and 205 (scalability\_dimension\_info) (JVET-U0082
* Addition of SEI payload type value 206 (extended\_drap\_indication) and text on the use of the extended dependent random access point (EDRAP) indication SEI message (JVET-U0084)
* Text changes for inclusion of the decoded picture hash SEI message to the list VclAssociatedSeiList, not imposing the same content requirement for repeated user-defined SEI messages, and rules for inclusion of SEI messages in prefix and suffix SEI NAL units (JVET-U0085-v2)
* Fix for ticket [#1448](https://jvet.hhi.fraunhofer.de/trac/vvc/ticket/1448)

Draft 1 incorporated items:

* Addition of SEI manifest and SEI prefix indication SEI messages (JVET-T0056)
* Addition of ExtensionBitsPresentFlag to the sei\_payload( ) syntax and the vui\_payload( ) syntax (JVET-T0048).
* Addition of Level 6.3 (JVET-T0065)
* Addition of payloadType value etc. for the annotated regions SEI message (JVET-T0053)

**Changes to the specification text:**

*Change clause 7.3.2.21 as follows (additions are yellow-highlighted):*

#### 7.3.2.21 General SEI message syntax

|  |  |
| --- | --- |
| vui\_payload( payloadSize ) { | **Descriptor** |
| VuiExtensionBitsPresentFlag = 0 |  | |
| vui\_parameters( payloadSize ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| if( VuiExtensionBitsPresentFlag | | more\_data\_in\_payload( ) ) { |  | |
| if( payload\_extension\_present( ) ) |  | |
| **vui\_reserved\_payload\_extension\_data** | u(v) | |
| **vui\_payload\_bit\_equal\_to\_one** /\* equal to 1 \*/ | f(1) | |
| while( !byte\_aligned( ) ) |  | |
| **vui\_payload\_bit\_equal\_to\_zero** /\* equal to 0 \*/ | f(1) | |
| } |  | |
| } |  |

*In clause 7.4.3.3, replace the following:*

A VPS RBSP shall be available to the decoding process prior to it being referenced, included in at least one AU with TemporalId equal to 0 or provided through external means.

All VPS NAL units with a particular value of vps\_video\_parameter\_set\_id in a CVS shall have the same content.

**vps\_video\_parameter\_set\_id** provides an identifier for the VPS for reference by other syntax elements. The value of vps\_video\_parameter\_set\_id shall be greater than 0.

*with the following:*

A VPS RBSP shall be available to the decoding process, by inclusion in at least one AU with TemporalId equal to 0 or provided through external means, prior to it being referenced by either of the following:

* a PH NAL unit having a ph\_pic\_parameter\_set\_id that refers to a PPS with pps\_seq\_parameter\_set\_id equal to the value of sps\_seq\_parameter\_set\_id in an SPS NAL unit with sps\_video\_parameter\_set\_id equal to the value of vps\_video\_parameter\_set\_id in the VPS RBSP,
* a coded slice NAL unit having sh\_picture\_header\_in\_slice\_header\_flag equal to 1 with a ph\_pic\_parameter\_set\_id that refers to a PPS with pps\_seq\_parameter\_set\_id equal to the value of sps\_seq\_parameter\_set\_id in an SPS NAL unit with sps\_video\_parameter\_set\_id equal to the value of vps\_video\_parameter\_set\_id in the VPS RBSP.

Such a PH NAL unit or coded slice NAL unit references the previous VPS RBSP in decoding order (relative to the position of the PH NAL unit or coded slice NAL unit in decoding order) with that value of vps\_video\_parameter\_set\_id.

All VPS NAL units with a particular value of vps\_video\_parameter\_set\_id in a CVS shall have the same content.

**vps\_video\_parameter\_set\_id** provides an identifier for the VPS for reference by other syntax elements. The value of vps\_video\_parameter\_set\_id shall be greater than 0.

VPS NAL units, regardless of the nuh\_layer\_id values, share the same value space of vps\_video\_parameter\_set\_id.

*In clause 7.4.3.4, replace the following:*

An SPS RBSP shall be available to the decoding process prior to it being referenced, included in at least one AU with TemporalId equal to 0 or provided through external means.

*with the following:*

An SPS RBSP shall be available to the decoding process, by inclusion in at least one AU with TemporalId equal to 0 or provided through external means, prior to it being referenced by either of the following:

* a PH NAL unit having a ph\_pic\_parameter\_set\_id that refers to a PPS with pps\_seq\_parameter\_set\_id equal to the value of sps\_seq\_parameter\_set\_id in the SPS RBSP,
* a coded slice NAL unit having sh\_picture\_header\_in\_slice\_header\_flag equal to 1 with a ph\_pic\_parameter\_set\_id that refers to a PPS with pps\_seq\_parameter\_set\_id equal to the value of sps\_seq\_parameter\_set\_id in the SPS RBSP.

Such a PH NAL unit or coded slice NAL unit references the previous SPS RBSP in decoding order (relative to the position of the PH NAL unit or coded slice NAL unit in decoding order) with that value of sps\_seq\_parameter\_set\_id.

*In clause 7.4.3.5, replace the following:*

A PPS RBSP shall be available to the decoding process prior to it being referenced, included in at least one AU with TemporalId less than or equal to the TemporalId of the PPS NAL unit or provided through external means**.**

*with the following:*

A PPS RBSP shall be available to the decoding process, by inclusion in at least one AU with TemporalId less than or equal to the TemporalId of the PPS NAL unit or provided through external means, prior to it being referenced by either of the following:

* a PH NAL unit having ph\_pic\_parameter\_set\_id equal to the value of pps\_pic\_parameter\_set\_id in the PPS RBSP,
* a coded slice NAL unit having sh\_picture\_header\_in\_slice\_header\_flag equal to 1 with ph\_pic\_parameter\_set\_id equal to the value of pps\_pic\_parameter\_set\_id in the PPS RBSP.

Such a PH NAL unit or coded slice NAL unit references the previous PPS RBSP in decoding order (relative to the position of the PH NAL unit or coded slice NAL unit in decoding order) with that value of pps\_pic\_parameter\_set\_id.

*In clause 7.4.3.6, replace the following:*

Each APS RBSP shall be available to the decoding process prior to it being referenced, included in at least one AU with TemporalId less than or equal to the TemporalId of the coded slice NAL unit that refers it or provided through external means.

All APS NAL units with a particular value of nal\_unit\_type, a particular value of aps\_adaptation\_parameter\_set\_id, and a particular value of aps\_params\_type within a PU shall have the same content.

*with the following and adjust the indices of the NOTEs:*

Each APS RBSP shall be available to the decoding process, by inclusion in at least one AU with TemporalId less than or equal to the TemporalId of the coded slice NAL unit that refers it or provided through external means, prior to it being referenced by any of the following:

* a coded slice NAL unit in a PU with a PH NAL unit having a ph\_alf\_aps\_id\_luma[ i ] or ph\_alf\_aps\_id\_chroma or ph\_alf\_cc\_cb\_aps\_id or ph\_alf\_cc\_cr\_aps\_id syntax element that is present and equal to the aps\_adaptation\_parameter\_set\_id of an APS RBSP with aps\_params\_type equal to ALF\_APS,
* a coded slice NAL unit in a PU having a PH NAL unit with a ph\_lmcs\_aps\_id syntax element that is present and equal to the aps\_adaptation\_parameter\_set\_id of an APS RBSP with aps\_params\_type equal to LMCS\_APS,
* a coded slice NAL unit in a PU having a PH NAL unit with a ph\_scaling\_list\_aps\_id syntax element that is present and equal to the aps\_adaptation\_parameter\_set\_id of an APS RBSP with aps\_params\_type equal to SCALING\_APS,
* a coded slice NAL unit having a sh\_alf\_aps\_id\_luma[ i ] or sh\_alf\_aps\_id\_chroma or sh\_alf\_cc\_cb\_aps\_id or sh\_alf\_cc\_cr\_aps\_id syntax element that is present and equal to the aps\_adaptation\_parameter\_set\_id of an APS RBSP with aps\_params\_type equal to ALF\_APS,
* a coded slice NAL unit having sh\_picture\_header\_in\_slice\_header\_flag equal to 1 with a ph\_alf\_aps\_id\_luma[ i ] or ph\_alf\_aps\_id\_chroma or ph\_alf\_cc\_cb\_aps\_id or ph\_alf\_cc\_cr\_aps\_id syntax element that is present and equal to the aps\_adaptation\_parameter\_set\_id of an APS RBSP with aps\_params\_type equal to ALF\_APS,
* a coded slice NAL unit having sh\_picture\_header\_in\_slice\_header\_flag equal to 1 with a ph\_lmcs\_aps\_id syntax element that is present and equal to the aps\_adaptation\_parameter\_set\_id of an APS RBSP with aps\_params\_type equal to LMCS\_APS,
* a coded slice NAL unit having sh\_picture\_header\_in\_slice\_header\_flag equal to 1 with a ph\_scaling\_list\_aps\_id syntax element that is present and equal to the aps\_adaptation\_parameter\_set\_id of an APS RBSP with aps\_params\_type equal to SCALING\_APS.

Such a coded slice NAL unit references the previous APS RBSP in decoding order (relative to the position of the coded slice NAL unit in decoding order) with the corresponding values of aps\_adaptation\_parameter\_set\_id and aps\_params\_type.

All APS NAL units with a particular value of nal\_unit\_type, a particular value of aps\_adaptation\_parameter\_set\_id, and a particular value of aps\_params\_type within a PU shall have the same content.

NOTE 1 – The content of an APS RBSP in a suffix APS NAL unit and the content of a prefix APS NAL unit with the same values of aps\_adaptation\_parameter\_set\_id (and aps\_params\_type) in the same PU can be different. When a suffix APS NAL unit is present in a PU, its APS RBSP cannot be referenced by the decoding process of that PU, since the suffix APS NAL unit cannot precede the PH NAL unit or any coded slice NAL units of that PU (see clause 7.4.2.4.4). However, the APS RBSP in a suffix APS NAL unit can be referenced by the decoding process of subsequent PUs in the bitstream (if any).

*And replace the following:*

NOTE 4 – A suffix APS NAL unit associated with a particular VCL NAL unit (this VCL NAL unit precedes the suffix APS NAL unit in decoding order) is not for use by the particular VCL NAL unit, but for use by VCL NAL units following the suffix APS NAL unit in decoding order.

*with the following:*

NOTE 4 – A suffix APS NAL unit associated with a particular VCL NAL unit (a VCL NAL unit that precedes the suffix APS NAL unit in decoding order and is the last VCL NAL unit of the PU containing that VCL NAL unit) is not for use in the decoding process of that particular VCL NAL unit or any other VCL NAL unit of the PU containing that particular VCL NAL unit, but rather is for use in the decoding process of VCL NAL units of PUs that follow the suffix APS NAL unit in decoding order (if any).

*In clause 8.1.2, make the following changes (additions are highlighted in yellow):*

1. The processes in clauses 8.4, 8.5, 8.6, 8.7, and 8.8 specify decoding processes using syntax elements in all syntax structure layers. When any NAL units are present in a PU that follow the last VCL NAL unit of the picture in decoding order, their decoding is deferred until after all slices of the current picture have been decoded and the in-loop filter processes of clause 8.8 have been applied. It is a requirement of bitstream conformance that the coded slices of the picture shall contain slice data for every CTU of the picture, such that the division of the picture into slices, and the division of the slices into CTUs each forms a partitioning of the picture.
2. After all slices of the current picture have been decoded, the in-loop filter processes of clause 8.8 have been applied, and all remaining NAL units of the PU have been decoded, the current decoded picture is marked as "used for short-term reference", the picture referred to by each ILRP entry, when present, in RefPicList[ 0 ] or RefPicList[ 1 ] is marked as "used for short-term reference", and the variable PictureOutputFlag of the current picture is derived as follows:

*Change clause A.4.1 as follows (additions are yellow-highlighted):*

### A.4.1 General tier and level limits

...

**Table 135 – General tier and level limits**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Level** | **general\_level\_idc value\*** | **Max luma picture size MaxLumaPs (samples)** | **Max CPB size MaxCPB (CpbVclFactor or CpbNalFactor bits)** | | **Max slices per AU MaxSlicesPerAu** | **Max # of tiles MaxTilesPerAu** | **Max # of tile columns MaxTileCols** |
| **Main tier** | **High tier** |
| **1.0** | 16 | 36 864 | 350 | - | 16 | 1 | 1 |
| **2.0** | 32 | 122 880 | 1 500 | - | 16 | 1 | 1 |
| **2.1** | 35 | 245 760 | 3 000 | - | 20 | 1 | 1 |
| **3.0** | 48 | 552 960 | 6 000 | - | 30 | 4 | 2 |
| **3.1** | 51 | 983 040 | 10 000 | - | 40 | 9 | 3 |
| **4.0** | 64 | 2 228 224 | 12 000 | 30 000 | 75 | 25 | 5 |
| **4.1** | 67 | 2 228 224 | 20 000 | 50 000 | 75 | 25 | 5 |
| **5.0** | 80 | 8 912 896 | 25 000 | 100 000 | 200 | 110 | 10 |
| **5.1** | 83 | 8 912 896 | 40 000 | 160 000 | 200 | 110 | 10 |
| **5.2** | 86 | 8 912 896 | 60 000 | 240 000 | 200 | 110 | 10 |
| **6.0** | 96 | 35 651 584 | 80 000 | 240 000 | 600 | 440 | 20 |
| **6.1** | 99 | 35 651 584 | 120 000 | 480 000 | 600 | 440 | 20 |
| **6.2** | 102 | 35 651 584 | 180 000 | 800 000 | 600 | 440 | 20 |
| **6.3** | 105 | 80 216 064 | 240 000 | 800 000 | 1 000 | 990 | 30 |
| \* The level numbers in this table are in the form of "majorNum.minorNum", and the value of general\_level\_idc for each of the levels is equal to majorNum \* 16 + minorNum \* 3. | | | | | | | |

*Change clause A.4.2 as follows (additions are yellow-highlighted):*

### A.4.2 Profile-specific level limits

...

**Table 136 – Tier and level limits for the video profiles**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Level** | **Max luma sample rate MaxLumaSr (samples/sec)** | **Max bit rate MaxBR (BrVclFactor or BrNalFactor bits/s)** | | **Min compression ratio MinCrBase** | |
| **Main tier** | **High tier** | **Main tier** | **High tier** |
| **1.0** | 552 960 | 128 | - | 2 | 2 |
| **2.0** | 3 686 400 | 1 500 | - | 2 | 2 |
| **2.1** | 7 372 800 | 3 000 | - | 2 | 2 |
| **3.0** | 16 588 800 | 6 000 | - | 2 | 2 |
| **3.1** | 33 177 600 | 10 000 | - | 2 | 2 |
| **4.0** | 66 846 720 | 12 000 | 30 000 | 4 | 4 |
| **4.1** | 133 693 440 | 20 000 | 50 000 | 4 | 4 |
| **5.0** | 267 386 880 | 25 000 | 100 000 | 6 | 4 |
| **5.1** | 534 773 760 | 40 000 | 160 000 | 8 | 4 |
| **5.2** | 1 069 547 520 | 60 000 | 240 000 | 8 | 4 |
| **6.0** | 1 069 547 520 | 60 000 | 240 000 | 8 | 4 |
| **6.1** | 2 139 095 040 | 120 000 | 480 000 | 8 | 4 |
| **6.2** | 4 278 190 080 | 240 000 | 800 000 | 8 | 4 |
| **6.3** | 4 812 963 840 | 320 000 | 800 000 | 8 | 4 |

...

*In clause C.6, step 4, make the following changes (additions are yellow-highlighted):*

– nal\_unit\_type is equal to PREFIX\_APS\_NUT, SUFFIX\_APS\_NUT, TRAIL\_NUT, STSA\_NUT, RADL\_NUT, or RASL\_NUT, or nal\_unit\_type is equal to GDR\_NUT and the associated ph\_recovery\_poc\_cnt is greater than 0.

*Change clause D.2.1 as follows (additions are yellow-highlighted):*

### D.2.1 General SEI message syntax

|  |  |
| --- | --- |
| sei\_payload( payloadType, payloadSize ) { | **Descriptor** |
| SeiExtensionBitsPresentFlag = 0 |  |
| if( nal\_unit\_type = = PREFIX\_SEI\_NUT ) |  |
| ... |  |
| else if( payloadType = = 165 ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| alpha\_channel\_info( payloadSize ) |  |
| else if( payloadType = = 168 ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| frame\_field\_info( payloadSize ) |  |
| else if( payloadType = = 177 ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| depth\_representation\_info( payloadSize ) |  |
| else if( payloadType = = 179 ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| multiview\_acquisition\_info( payloadSize ) |  |
| else if( payloadType = = 200 ) |  |
| sei\_manifest( payloadSize ) |  |
| else if( payloadType = = 201 ) |  |
| sei\_prefix\_indication( payloadSize ) |  |
| else if( payloadType = = 202 ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| annotated\_regions( payloadSize ) |  |
| else if( payloadType = = 203 ) |  |
| subpic\_level\_info( payloadSize ) |  |
| else if( payloadType = = 204 ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| sample\_aspect\_ratio\_info( payloadSize ) |  |
| else if( payloadType = = 205 ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| scalability\_dimension\_info( payloadSize ) |  |
| else if( payloadType = = 206 ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| extended\_drap\_indication( payloadSize ) |  |
| else /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| reserved\_message( payloadSize ) |  |
| ... |  |
| if( SeiExtensionBitsPresentFlag | | more\_data\_in\_payload( ) ) { |  |
| if( payload\_extension\_present( ) ) |  |
| **sei\_reserved\_payload\_extension\_data** | u(v) |
| **sei\_payload\_bit\_equal\_to\_one** /\* equal to 1 \*/ | f(1) |
| while( !byte\_aligned( ) ) |  |
| **sei\_payload\_bit\_equal\_to\_zero** /\* equal to 0 \*/ | f(1) |
| } |  |
| } |  |

*Change clause D.2.2 as follows (additions are yellow-highlighted):*

### D.2.2 General SEI message semantics

...

**Table 142 – Persistence scope of SEI messages (informative)**

|  |  |
| --- | --- |
| **SEI message** | **Persistence scope** |
| Buffering period | The remainder of the bitstream |
| Picture timing | The AU containing the SEI message |
| DU information | The AU containing the SEI message |
| Scalable nesting | Depending on the scalable-nested SEI messages. Each scalable-nested SEI message has the same persistence scope as if the SEI message was not scalable-nested |
| SEI manifest | The CVS containing the SEI message |
| SEI prefix indication | The CVS containing the SEI message |
| Subpicture level information | The CVS containing the SLI SEI message and up to but not including the next CVS, in decoding order, that contains an SLI SEI message with different content |

Only filler payload, decoded picture hash, and scalable nesting SEI messages may be included in a suffix SEI NAL unit; all other SEI messages are not allowed to be included in a suffix SEI NAL unit. When there is a scalable nesting SEI message included in a suffix SEI NAL unit, it is only allowed to contain those SEI messages that are allowed to be included in a suffix NAL unit. When there is a scalable nesting SEI message included in a prefix SEI NAL unit, it is only allowed to contain those SEI messages that are allowed to be included in a prefix NAL unit.

The list VclAssociatedSeiList is set to consist of the payloadType values 3, 19, 45, 129, 132, 137, 144, 145, 147 to 150, inclusive, 153 to 156, inclusive, 165, 168, 177, 179, 200 to 202, inclusive, and 204 to 206, inclusive.

The list PicUnitRepConSeiList is set to consist of the payloadType values 0, 1, 19, 45, 129, 133, 137, 147 to 150, inclusive, 153 to 156, inclusive, 165, 168, 177, 179, and 200 to 206, inclusive.

NOTE 4 – VclAssociatedSeiList consists of the payloadType values of the SEI messages that, when non-scalable-nested, infer constraints on the NAL unit header of the SEI NAL unit on the basis of the NAL unit header of the associated VCL NAL unit. PicUnitRepConSeiList consists of the payloadType values of the SEI messages that are subject to the restriction on 4 repetitions per PU.

...

The following applies on the content of scalable-nested and non-scalable-nested SEI messages applying to the same OLS or layer:

– When there are multiple SEI messages with a particular value of payloadType not equal to 4, 5, or 133 that are associated with a particular AU or DU and apply to a particular OLS or layer, regardless of whether some or all of these SEI messages are scalable-nested, the SEI messages shall have the same SEI payload content.

...

*Renumber clauses D.8 (Use of ITU-T H.274 | ISO/IEC 23002-7 VUI parameters) and D.9 (Use of ITU-T H.274 | ISO/IEC 23002-7 SEI messages) as D.10 and D.11, respectively.*

*Add clauses D.8 and D.9 as follows:*

## D.8 SEI manifest SEI message

### D.8.1 SEI manifest SEI message syntax

|  |  |
| --- | --- |
| sei\_manifest( payloadSize ) { | **Descriptor** |
| **manifest\_num\_sei\_msg\_types** | u(16) |
| for( i = 0; i < manifest\_num\_sei\_msg\_types; i++ ) { |  |
| **manifest\_sei\_payload\_type**[ i ] | u(16) |
| **manifest\_sei\_description**[ i ] | u(8) |
| } |  |
| } |  |

### D.8.2 SEI manifest SEI message semantics

The SEI manifest SEI message conveys information on SEI messages that are indicated as expected (i.e., likely) to be present or not present. Such information may include the following:

– The indication that certain types of SEI messages are expected (i.e., likely) to be present (although not guaranteed to be present) in the CVS.

– For each type of SEI message that is indicated as expected (i.e., likely) to be present in the CVS, the degree of expressed necessity of interpretation of the SEI messages of this type, as follows:

* The degree of necessity of interpretation of an SEI message type may be indicated as "necessary", "unnecessary", or "undetermined".
* An SEI message is indicated by the encoder (i.e., the content producer) as being "necessary" when the information conveyed by the SEI message is considered as necessary for interpretation by the decoder or receiving system in order to properly process the content and enable an adequate user experience; it does not mean that the bitstream is required to contain the SEI message in order to be a conforming bitstream. It is at the discretion of the encoder to determine which SEI messages are to be considered as necessary in a particular CVS. However, it is suggested that some SEI messages, such as the frame packing arrangement, segmented rectangular frame packing arrangement, and omnidirectional projection indication SEI messages, should typically be considered as necessary.

– The indication that certain types of SEI messages are expected (i.e., likely) not to be present (although not guaranteed not to be present) in the CVS.

NOTE – An example of such a usage of an SEI manifest SEI message is to express the expectation that there are no frame packing arrangement SEI messages or omnidirectional projection indication SEI messages in the CVS, and therefore that the rendering of the decoded video pictures for display purposes would not need any of the additional post-processing that is commonly associated with the interpretation of these SEI messages.

The content of an SEI manifest SEI message may, for example, be used by transport-layer or systems-layer processing elements to determine whether the CVS is suitable for delivery to a receiving and decoding system, based on whether the receiving system can properly process the CVS to enable an adequate user experience or whether the CVS satisfies the application needs.

When an SEI manifest SEI message is present in any access unit of a CVS, an SEI manifest SEI message shall be present in the first access unit of the CVS. The SEI manifest SEI message persists in decoding order from the current access unit until the end of the CVS. When there are multiple SEI manifest SEI messages present in a CVS, they shall have the same content.

An SEI NAL unit containing an SEI manifest SEI message shall not contain any other SEI messages other than SEI prefix indication SEI messages. When present in an SEI NAL unit, the SEI manifest SEI message shall be the first SEI message in the SEI NAL unit.

**manifest\_num\_sei\_msg\_types** specifies the number of types of SEI messages for which information is provided in the SEI manifest SEI message.

**manifest\_sei\_payload\_type**[ i ] indicates the payloadType value of the i-th type of SEI message for which information is provided in the SEI manifest SEI message. The values of manifest\_sei\_payload\_type[ m ] and manifest\_sei\_payload\_type[ n ] shall not be identical when m is not equal to n.

**manifest\_sei\_description**[ i ] provides information on SEI messages with payloadType equal to manifest\_sei\_payload\_type[ i ] as specified in Table 143.

**Table 143 – Interpretation of manifest\_sei\_description[ i ]**

|  |  |
| --- | --- |
| **Value** | **Description** |
| 0 | Indicates that there is no SEI message with payloadType equal to manifest\_sei\_payload\_type[ i ] expected to be present in the CVS. |
| 1 | Indicates that there are SEI messages with payloadType equal to manifest\_sei\_payload\_type[ i ] expected to be present in the CVS, and these SEI messages are considered as necessary. |
| 2 | Indicates that there are SEI messages with payloadType equal to manifest\_sei\_payload\_type[ i ] expected to be present in the CVS, and these SEI messages are considered as unnecessary. |
| 3 | Indicates that there are SEI messages with payloadType equal to manifest\_sei\_payload\_type[ i ] expected to be present in the CVS, and the necessity of these SEI messages is undetermined. |
| 4..255 | Reserved |

The value of manifest\_sei\_description[ i ] shall be in the range of 0 to 3, inclusive, in bitstreams conforming to this version of this Specification. Other values for manifest\_sei\_description[ i ] are reserved for future use by ITU-T | ISO/IEC. Decoders shall allow the value of manifest\_sei\_description[ i ] greater than or equal to 4 to appear in the syntax and shall ignore all information for payloadType equal to manifest\_sei\_payload\_type[ i ] signalled in the SEI manifest SEI message and shall ignore all SEI prefix indication SEI messages with prefix\_sei\_payload\_type equal to manifest\_sei\_payload\_type[ i ] when manifest\_sei\_description[ i ] is greater than or equal to 4.

## D.9 SEI prefix indication SEI message

### D.9.2 SEI prefix indication SEI message syntax

|  |  |
| --- | --- |
| sei\_prefix\_indication( payloadSize ) { | **Descriptor** |
| **prefix\_sei\_payload\_type** | u(16) |
| **num\_sei\_prefix\_indications\_minus1** | u(8) |
| for( i = 0; i <= num\_sei\_prefix\_indications\_minus1; i++ ) { |  |
| **num\_bits\_in\_prefix\_indication\_minus1**[ i ] | u(16) |
| for( j = 0; j <= num\_bits\_in\_prefix\_indication\_minus1[ i ]; j++ ) |  |
| **sei\_prefix\_data\_bit**[ i ][ j ] | u(1) |
| while( !byte\_aligned( ) ) |  |
| **byte\_alignment\_bit\_equal\_to\_one** /\* equal to 1 \*/ | f(1) |
| } |  |
| } |  |

### D.9.2 SEI prefix indication SEI message semantics

The SEI prefix indication SEI message carries one or more SEI prefix indications for SEI messages of a particular value of payloadType. Each SEI prefix indication is a bit string that follows the SEI payload syntax of that value of payloadType and contains a number of complete syntax elements starting from the first syntax element in the SEI payload.

Each SEI prefix indication for an SEI message of a particular value of payloadType indicates that one or more SEI messages of this value of payloadType are expected (i.e., likely) to be present in the CVS and to start with the provided bit string. A starting bit string would typically contain only a true subset of an SEI payload of the type of SEI message indicated by the payloadType, may contain a complete SEI payload, and shall not contain more than a complete SEI payload. It is not prohibited for SEI messages of the indicated value of payloadType to be present that do not start with any of the indicated bit strings.

These SEI prefix indications should provide sufficient information for indicating what type of processing is needed or what type of content is included. The former (type of processing) indicates decoder-side processing capability, e.g., whether some type of frame unpacking is needed. The latter (type of content) indicates, for example, whether the bitstream contains subtitle captions in a particular language.

The content of an SEI prefix indication SEI message may, for example, be used by transport-layer or systems-layer processing elements to determine whether the CVS is suitable for delivery to a receiving and decoding system, based on whether the receiving system can properly process the CVS to enable an adequate user experience or whether the CVS satisfies the application needs (as determined in some manner by external means outside the scope of this Specification).

In one example, when the payloadType indicates the frame packing arrangement SEI message, an SEI prefix indication should include up to at least the syntax element frame\_packing\_arrangement\_type; and when the payloadType indicates the omnidirectional projection indication SEI message, an SEI prefix indication should include up to at least the syntax element projection\_type.

In another example, for user data registered SEI messages that are used to carry captioning information, an SEI prefix indication should include up to at least the language code; and for user data unregistered SEI messages extended for private use, an SEI prefix indication should include up to at least the UUID.

When an SEI prefix indication SEI message is present in any access unit of a CVS, an SEI prefix indication SEI message shall be present in the first access unit of the CVS. The SEI prefix indication SEI message persists in decoding order from the current access unit until the end of the CVS. When there are multiple SEI prefix indication SEI messages present in a CVS for a particular value of payloadType, they shall have the same content.

An SEI NAL unit containing an SEI prefix indication SEI message for a particular value of payloadType shall not contain any other SEI messages other than an SEI manifest SEI message and SEI prefix indication SEI messages for other values of payloadType.

**prefix\_sei\_payload\_type** indicates the payloadType value of the SEI messages for which one or more SEI prefix indications are provided in the SEI prefix indication SEI message. When an SEI manifest SEI message is also present for the CVS, the value of prefix\_sei\_payload\_type shall be equal to one of the manifest\_sei\_payload\_type[ m ] values for which manifest\_sei\_description[ m ] is equal to 1 to 3, inclusive, as indicated by an SEI manifest SEI message that applies to the CVS.

**num\_sei\_prefix\_indications\_minus1** plus 1 specifies the number of SEI prefix indications.

**num\_bits\_in\_prefix\_indication\_minus1**[ i ] plus 1 specifies the number of bits in the i-th SEI prefix indication.

**sei\_prefix\_data\_bit**[ i ][ j ] specifies the j-th bit of the i-th SEI prefix indication.

The bits sei\_prefix\_data\_bit[ i ][ j ] for j ranging from 0 to num\_bits\_in\_prefix\_indication\_minus1[ i ], inclusive, follow the syntax of the SEI payload with payloadType equal to prefix\_sei\_payload\_type, and contain a number of complete syntax elements starting from the first syntax element in the SEI payload syntax, and may or may not contain all the syntax elements in the SEI payload syntax. The last bit of these bits (i.e., the bit sei\_prefix\_data\_bit[ i ][ num\_bits\_in\_prefix\_indication\_minus1[ i ] ]) shall be the last bit of a syntax element in the SEI payload syntax, unless it is a bit within an itu\_t\_t35\_payload\_byte or user\_data\_payload\_byte.

NOTE – The exception for itu\_t\_t35\_payload\_byte and user\_data\_payload\_byte is provided because these syntax elements may contain externally-specified syntax elements, and the determination of the boundaries of such externally-specified syntax elements is a matter outside the scope of this Specification.

**byte\_alignment\_bit\_equal\_to\_one** shall be equal to 1.

*Add clauses D.11.7 and D.11.8 as follows:*

### D.11.7 Use of the annotated regions SEI message

For purposes of interpretation of the annotated regions SEI message, the following variables are specified:

– CroppedWidth is set equal to pps\_pic\_width\_in\_luma\_samples − SubWidthC \* ( pps\_conf\_win\_right\_offset + pps\_conf\_win\_left\_offset ).

– CroppedHeight is set equal to pps\_pic\_height\_in\_luma\_samples − SubHeightC \* ( pps\_conf\_win\_bottom\_offset + pps\_conf\_win\_top\_offset ).

– ConfWinLeftOffset is set equal to pps\_conf\_win\_left\_offset.

– ConfWinTopOffset is set equal to pps\_conf\_win\_top\_offset.

### D.11.8 Use of the extended dependent random access point (EDRAP) indication SEI message

A picture that is associated with an EDRAP indication SEI message is referred to as an EDRAP picture.

The following constraints apply to an EDRAP picture:

– The VCL NAL units of the EDRAP picture shall have nal\_unit\_type equal to TRAIL\_NUT.

– The EDRAP picture shall have TemporalId equal to 0.

[Ed. (YK): Check the need for addition of the specifications for use of the alpha channel information SEI message, the depth representation information SEI message, the multiview acquisition information SEI message, and the scalability dimension information SEI message.]