 ISO/IEC JTC 1/SC 29/WG 5 N0020

**ISO/IEC JTC 1/SC 29/WG 5**

**MPEG Joint Video Coding Team(s) with ITU-T SG 16**

**Convenorship: DE**

**Document type:** General

**Title:** Working Draft 1 of ISO/IEC 23090-3 Amd.1 Operation range extensions

**Status:** Approved

**Date of document:** 2020-10-16

**Source:** ISO/IEC JTC 1/SC 29/WG 5

**Expected action:** Info

**Action due date:** None

**No. of pages:** 8 (without cover page)

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**Committee URL:** https://isotc.iso.org/livelink/livelink/open/jtc1sc29wg5

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| **Joint Video Experts Team (JVET)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29**  20th Meeting, by teleconference, 7 – 16 Oct. 2020 | Document: JVET-T2019-v2 |

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| --- | --- | --- | --- |
| *Title:* | **New level and additional SEI messages for VVC (Draft 1)** | | |
| *Status:* | Output document approved by JVET | | |
| *Purpose:* | Draft text | | |
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| *Source:* | Editors | | |

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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.

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) | |
| } |  | |
| } |  |

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

### A.4.1 General tier and level limits

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**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

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**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 |

...

*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 = = 168 ) /\* Specified in Rec. ITU-T H.274 | ISO/IEC 23002-7 \*/ |  |
| frame\_field\_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 ) |  |
| ... |  |
| 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 |

The list VclAssociatedSeiList is set to consist of the payloadType values 3, 19, 45, 129, 137, 144, 145, 147 to 150, inclusive, 153 to 156, inclusive, 168, 200, 201, 202, and 204.

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, 168, 200, 201, 202, 203, and 204.

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.

...

*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 clause D.11.7 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.