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| **Source** | Samsung Electronics, Nokia Technologies, Apple Inc. |
| **Status** | Input contribution |
| **Title** | Essential enhancement information messages |
| **Authors** | Rajan Joshi, Madhukar Budagavi (Samsung), Lukasz Kondrad (Nokia), Alexis Michael Tourapis, Khaled Mammou (Apple) |

# Introduction

The current V-PCC specification [1] defines two conformance points. The first conformance point (point A) covers the decoded attributes, geometry, and occupancy video streams, plus the decoded atlas information and decoded block to patch information, without any 3D point cloud reconstruction or smoothing. The second conformance point (point B) covers a fully reconstructed point cloud. This conformance point may include geometry and attribute smoothing, based on the values of certain syntax elements.

The current V-PCC specification places geometry and attribute smoothing parameters in SEI messages. A V-PCC decoder using Rec. 1 reconstruction to conform to point B should be required to decode and consider such SEI messages in the 3D point cloud reconstruction. In practice, HEVC and AVC decoders sometimes discard SEI messages. Although, V-PCC SEI messages are distinct from HEVC and AVC SEI messages, we would like to avoid a situation where V-PCC SEI messages that are needed to achieve conformance point A or B are sometimes discarded.

# Proposal

It is proposed to create two categories of SEI message, namely, essential and non-essential. Unlike non-essential SEI messages, essential SEI messages are an integral part of the V-PCC bitstream and should not be removed from the bitstream. Different NAL unit types are used to carry the essential and non-essential SEI messages. It is envisaged that there would be two types of essential SEI messages:

1. Type-A essential SEI messages: These SEIs contain information required to check bitstream conformance and for output timing decoder conformance. Every V-PCC decoder conforming to conformance point A shall decode Type-A essential SEI messages.
2. Type-B essential SEI messages: V-PCC decoders using Rec1 reconstruction to conform to point B should decode and consider Type-B essential SEI messages for 3D point cloud reconstruction.

As an example, the smoothing parameters SEI message proposed in [2] would instead be a Type-B essential SEI message.

# Specification Text

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#### NAL unit header semantics

**nal\_forbidden\_zero\_bit** shall be equal to 0.

**nal\_unit\_type** specifies the type of RBSP data structure contained in the NAL unit as specified in Table 7-1.

NAL units that have nal\_unit\_type in the range of NAL\_UNSPEC\_48..NAL\_UNSPEC\_63, inclusive, for which semantics are not specified, shall not affect the decoding process specified in this Specification.

NOTE 1 – NAL unit types in the range of NAL\_UNSPEC\_48..NAL\_UNSPEC\_63 may be used as determined by the application. No decoding process for these values of nal\_unit\_type is specified in this Specification. Since different applications might use these NAL unit types for different purposes, particular care must be exercised in the design of encoders that generate NAL units with these nal\_unit\_type values, and in the design of decoders that interpret the content of NAL units with these nal\_unit\_type values. This Specification does not define any management for these values. These nal\_unit\_type values might only be suitable for use in contexts in which "collisions" of usage (i.e., different definitions of the meaning of the NAL unit content for the same nal\_unit\_type value) are unimportant, or not possible, or are managed – e.g., defined or managed in the controlling application or transport specification, or by controlling the environment in which bitstreams are distributed.

For purposes other than determining the amount of data in the decoding units of the bitstream (as specified in Annex C), decoders shall ignore (remove from the bitstream and discard) the contents of all NAL units that use reserved values of nal\_unit\_type.

NOTE 2 – This requirement allows future definition of compatible extensions to this Specification.

**Table 3‑1 – NAL unit type codes and NAL unit type classes**

|  |  |  |  |
| --- | --- | --- | --- |
| **nal\_unit\_type** | **Name of nal\_unit\_type** | **Content of NAL unit and RBSP syntax structure** | **NAL unit type class** |
| 0 | NAL\_TRAIL | Coded tile group of a non-TSA, non STSA trailing atlas frame  atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 1 | NAL\_TSA | Coded tile group of a TSA atlas frame  atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 2 | NAL\_STSA | Coded tile group of a STSA atlas frame  atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 3 | NAL\_RADL | Coded tile group of a RADL atlas frame  atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 4 | NAL\_RASL | Coded tile group of a RASL atlas frame  atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 5 | NAL\_SKIP | Coded tile group of a skipped atlas frame  atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 6..9 | NAL\_RSV\_ACL\_6.. NAL\_RSV\_ACL\_9 | Reserved non-IRAP ACL NAL unit types | ACL |
| 10 11 12 | NAL\_BLA\_W\_LP NAL\_BLA\_W\_RADL NAL\_BLA\_N\_LP | Coded tile group of a BLA atlas frame atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 13 14 15 | NAL\_GBLA\_W\_LP NAL\_GBLA\_W\_RADL NAL\_GBLA\_N\_LP | Coded tile group of a GBLA atlas frame atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 16 17 | NAL\_IDR\_W\_RADL NAL\_IDR\_N\_LP | Coded tile group of an IDR atlas frame  atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 18 19 | NAL\_GIDR\_W\_RADL NAL\_GIDR\_N\_LP | Coded tile group of a GIDR atlas frame  atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 20 | NAL\_CRA | Coded tile group of a CRA atlas frame atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 21 | NAL\_GCRA | Coded tile group of a GCRA atlas frame atlas\_tile\_group\_layer\_rbsp( ) | ACL |
| 22 23 | NAL\_IRAP\_ACL\_22 NAL\_IRAP\_ACL\_23 | Reserved IRAP ACL NAL unit types | ACL |
| 24..31 | NAL\_RSV\_ACL\_24.. NAL\_RSV\_ACL\_31 | Reserved non-IRAP ACL NAL unit types | ACL |
| 32 | NAL\_ASPS | Atlas sequence parameter set atlas\_sequence\_parameter\_set\_rbsp( ) | non-ACL |
| 33 | NAL\_AFPS | Atlas frame parameter set atlas\_frame\_parameter\_set\_rbsp( ) | non-ACL |
| 34 | NAL\_AUD | Access unit delimiter access\_unit\_delimiter\_rbsp( ) | non-ACL |
| 35 | NAL\_VPCC\_AUD | V-PCC access unit delimiter access\_unit\_delimiter\_rbsp( ) | non-ACL |
| 36 | NAL\_EOS | End of sequence end\_of\_seq\_rbsp( ) | non-ACL |
| 37 | NAL\_EOB | End of bitstream end\_of\_atlas\_substream\_rbsp( ) | non-ACL |
| 38 | NAL\_FD | Filler filler\_data\_rbsp( ) | non-ACL |
| 39 40 | NAL\_PREFIX\_SEI  NAL\_SUFFIX\_SEI | Non-essential supplemental enhancement information sei\_rbsp( ) | non-ACL |
| 41 42 | NAL\_PREFIX\_ESEI NAL\_SUFFIX\_ESEI | Essential supplemental enhancement information sei\_rbsp( ) | non-ACL |
| 43..47 | NAL\_RSV\_NACL\_43 NAL\_RSV\_NACL\_47 | Reserved non-ACL NAL unit types | non-ACL |
| 48..63 | NAL\_UNSPEC\_48.. NAL\_UNSPEC\_63 | Unspecified non-ACL NAL unit types | non-ACL |

NOTE 3 – A clean random access (CRA) and a global clean random access atlas frame may have associated random access skipped leading (RASL) or random access decodable leading (RADL) atlas frames present in the bitstream.

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D1. **General**

This annex specifies syntax and semantics for SEI message payloads.

SEI messages assist in processes related to decoding, reconstruction, display, or other purposes. This annex defines two types of SEI messages, namely essential and non-essential.

Non-essential SEI messages are not required by the decoding process. Conforming decoders are not required to process this information for output order conformance to this Specification (see Annex A for the specification of conformance).

In clause C.5.2 including its subclauses, specification for presence of non-essential SEI messages is also satisfied when those messages (or some subset of them) are conveyed to decoders (or to the HRD) by other means not specified in this Specification. When present in the bitstream, non-essential SEI messages shall obey the syntax and semantics specified in clause 7.3.8 and this annex. When the content of a non-essential SEI message is conveyed for the application by some means other than presence within the bitstream, the representation of the content of the SEI message is not required to use the same syntax specified in this annex. For the purpose of counting bits, only the appropriate bits that are actually present in the bitstream are counted.

Essential SEI messages are an integral part of the V-PCC bitstream and should not be removed from the bitstream. The essential SEI messages categorized into two types:

1. Type-A essential SEI messages: These SEIs contain information required to check bitstream conformance and for output timing decoder conformance. Every V-PCC decoder conforming to point A should not discard any relevant Type-A essential SEI messages and shall consider them bitstream conformance and for output timing decoder conformance.
2. Type-B essential SEI messages: V-PCC decoders that wish to conform to a particular reconstruction profile as specified in Annex A should not discard any relevant Type-B essential SEI messages and shall consider them for 3D point cloud reconstruction and conformance purposes.

Table XXX lists the essential and non-essential SEI messages. In case of essential SEI messages, the type is also specified.

[insert table here]

### Supplemental enhancement information message semantics

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Reference

[1] “Text of ISO/IEC DIS 23090-5 Video-based Point Cloud Compression”, ISO/IEC JTC1/SC29/WG11 output document N18670, July 2019, Gothenburg, Sweden

[2] Lukasz Kondrad, Lauri Ilola, Kimmo Roimela, and Sebastian Schwarz, “Splitting SEI messages”, ISO/IEC JTC1/SC29/WG11 m50827, October 2019, Geneva, CH