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| *Title:* | **AHG7: on pic\_struct** | | |
| *Status:* | Input document to JCT-VC | | |
| *Purpose:* | Proposal | | |
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# Abstract

This contribution proposes modifications to existing picture timing SEI message syntax and syntax values in HEVC and AVC to enable repetition of an arbitrary number of frames. The existing HEVC and AVC picture timing SEI message syntax element, pic\_struct, is defined to indicate whether a decoded and displayed picture should be repeated, and also whether a picture should be displayed as a frame or as one or more fields. In HEVC and AVC, pic\_struct supports only frame doubling and tripling, which limits its usefulness for display of video on high scan rate displays, such as 120 Hz displays. In this contribution, it is proposed for HEVC and AVC to:

1. add a new pic\_struct value that indicates frame repetition; and
2. add a new syntax element to indicate the number of frames to be repeated.

It is additionally proposed to add HEVC pic\_struct values 9 through 12 to AVC to facilitate transcoding and consistency between HEVC and AVC.

# Introduction

In HEVC and AVC, pic\_struct is used to indicate whether a picture should be displayed as a frame or as one or more fields and whether a decoded picture should be displayed two times, frame doubling, or three times, frame tripling. Frame doubling can be used to facilitate the display, for example, of 25 Hz progressive-scan video on a 50 Hz progressive-scan display or 30 Hz progressive-scan video on a 60 Hz progressive-scan display. Using frame doubling and frame tripling in alternating combination on every other frame can be used to facilitate the display of 24 Hz progressive-scan video on a 60 Hz progressive-scan display. The interpretation of pic\_struct in HEVC is specified in Table D.2, which is copied from the HEVC specification. . The interpretation of pic\_struct in AVC is specified in Table D.1, which is copied from the AVC specification.

The problem is that the current pic\_struct semantics cannot support use cases such as the display of 24 Hz or 30 Hz progressive-scan video on a 120 Hz progressive scan display. Instead of simply adding frame quadrupling, quintupling, sextupling, etc. to support the numerous various combinations of video and display scan rates that can be anticipated, it is proposed that it would be simpler and more flexible to explicitly signal the number of pictures to be repeated.

Table D.2 – Interpretation of pic\_struct (in HEVC)

|  |  |  |
| --- | --- | --- |
| **Value** | **Indicated display of picture** | **Restrictions** |
| 0 | (progressive) Frame | field\_seq\_flag shall be equal to 0 |
| 1 | Top field | field\_seq\_flag shall be equal to 1 |
| 2 | Bottom field | field\_seq\_flag shall be equal to 1 |
| 3 | Top field, bottom field, in that order | field\_seq\_flag shall be equal to 0 |
| 4 | Bottom field, top field, in that order | field\_seq\_flag shall be equal to 0 |
| 5 | Top field, bottom field, top field repeated, in that order | field\_seq\_flag shall be equal to 0 |
| 6 | Bottom field, top field, bottom field repeated, in that order | field\_seq\_flag shall be equal to 0 |
| 7 | Frame doubling | field\_seq\_flag shall be equal to 0 fixed\_pic\_rate\_within\_cvs\_flag shall be equal to 1 |
| 8 | Frame tripling | field\_seq\_flag shall be equal to 0 fixed\_pic\_rate\_within\_cvs\_flag shall be equal to 1 |
| 9 | Top field paired with previous bottom field in output order | field\_seq\_flag shall be equal to 1 |
| 10 | Bottom field paired with previous top field in output order | field\_seq\_flag shall be equal to 1 |
| 11 | Top field paired with next bottom field in output order | field\_seq\_flag shall be equal to 1 |
| 12 | Bottom field paired with next top field in output order | field\_seq\_flag shall be equal to 1 |

**Table D‑1 – Interpretation of pic\_struct (in AVC)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Value** | **Indicated display of picture** | **Restrictions** | **NumClockTS** |
| 0 | frame | field\_pic\_flag shall be 0 | 1 |
| 1 | top field | field\_pic\_flag shall be 1, bottom\_field\_flag shall be 0 | 1 |
| 2 | bottom field | field\_pic\_flag shall be 1, bottom\_field\_flag shall be 1 | 1 |
| 3 | top field, bottom field, in that order | field\_pic\_flag shall be 0 | 2 |
| 4 | bottom field, top field, in that order | field\_pic\_flag shall be 0 | 2 |
| 5 | top field, bottom field, top field repeated, in that order | field\_pic\_flag shall be 0 | 3 |
| 6 | bottom field, top field, bottom field repeated, in that order | field\_pic\_flag shall be 0 | 3 |
| 7 | frame doubling | field\_pic\_flag shall be 0 fixed\_frame\_rate\_flag shall be 1 | 2 |
| 8 | frame tripling | field\_pic\_flag shall be 0 fixed\_frame\_rate\_flag shall be 1 | 3 |
| 9..15 | reserved |  |  |

# Proposal

## HEVC

For HEVC, it is proposed to add a new pic\_struct interpretation value, pic\_struct equal to 13, to Table D.2 in the HEVC specification to indicate frame repetition greater than tripling. It is also proposed to add a new syntax element, **num\_frame\_repetition\_minus3,** to indicate the number of frames to be repeated, as shown in Tables 1 and 2.

Table 1 – Proposed syntax change related to pic\_struct in the picture timing SEI message in HEVC

|  |  |
| --- | --- |
| pic\_timing( payloadSize ) { | **Descriptor** |
| if( frame\_field\_info\_present\_flag ) { |  |
| **pic\_struct** | u(4) |
| if( pic\_struct **== 13)** |  |
| **num\_frame\_repetition\_minus3** | u(4) |
| **source\_scan\_type** | u(2) |
| **duplicate\_flag** | u(1) |
| } |  |

**num\_frame\_repetition\_minus3** plus 4 indicates that when fixed\_pic\_rate\_within\_cvs\_flag is equal to 1, the frame should be displayed num\_frame\_repetition\_minus3 plus 4 times consecutively on displays with a frame refresh interval equal to DpbOutputElementalInterval[ n ] as given by Equation E‑73.

Table 2 – Proposed interpretation of pic\_struct in HEVC

|  |  |  |
| --- | --- | --- |
| **Value** | **Indicated display of picture** | **Restrictions** |
| 0 | (progressive) Frame | field\_seq\_flag shall be equal to 0 |
| 1 | Top field | field\_seq\_flag shall be equal to 1 |
| 2 | Bottom field | field\_seq\_flag shall be equal to 1 |
| 3 | Top field, bottom field, in that order | field\_seq\_flag shall be equal to 0 |
| 4 | Bottom field, top field, in that order | field\_seq\_flag shall be equal to 0 |
| 5 | Top field, bottom field, top field repeated, in that order | field\_seq\_flag shall be equal to 0 |
| 6 | Bottom field, top field, bottom field repeated, in that order | field\_seq\_flag shall be equal to 0 |
| 7 | Frame doubling | field\_seq\_flag shall be equal to 0 fixed\_pic\_rate\_within\_cvs\_flag shall be equal to 1 |
| 8 | Frame tripling | field\_seq\_flag shall be equal to 0 fixed\_pic\_rate\_within\_cvs\_flag shall be equal to 1 |
| 9 | Top field paired with previous bottom field in output order | field\_seq\_flag shall be equal to 1 |
| 10 | Bottom field paired with previous top field in output order | field\_seq\_flag shall be equal to 1 |
| 11 | Top field paired with next bottom field in output order | field\_seq\_flag shall be equal to 1 |
| 12 | Bottom field paired with next top field in output order | field\_seq\_flag shall be equal to 1 |
| 13 | Frame repetition extension | field\_seq\_flag shall be equal to 0 fixed\_pic\_rate\_within\_cvs\_flag shall be equal to 1 |

It is also proposed to add a row corresponding to pic\_struct equal to 13 to Table E.7 of the HEVC specification.

## AVC

For AVC, it is proposed to add a new pic\_struct interpretation value, pic\_struct equal to 13, to Table D.1 in the AVC specification to indicate frame repetition greater than tripling. It is also proposed to add a new syntax element, **num\_frame\_repetition\_minus3,** to indicate the number of frames to be repeated, as shown in Tables 3 and 4.

In addition, it is proposed to copy-and-paste pic\_struct values 9 through 12 from HEVC to AVC.

Table 3 – Proposed syntax change related to pic\_struct in the picture timing SEI message in AVC

|  |  |  |
| --- | --- | --- |
| pic\_timing( payloadSize ) { | **C** | **Descriptor** |
| … |  |  |
| if( pic\_struct\_present\_flag ) { |  |  |
| **pic\_struct** | 5 | u(4) |
| if( pic\_struct **== 13)** |  |  |
| **num\_frame\_repetition\_minus3** | 5 | u(4) |
| … |  |  |
| } |  |  |
| } |  |  |

**num\_frame\_repetition\_minus3** plus 4 indicates that when fixed\_frame\_rate\_flag is equal to 1, the frame should be displayed num\_frame\_repetition\_minus3 plus 4 times consecutively.

Table 4 – Proposed interpretation of pic\_struct in AVC

|  |  |  |  |
| --- | --- | --- | --- |
| **Value** | **Indicated display of picture** | **Restrictions** | **NumClockTS** |
| 0 | frame | field\_pic\_flag shall be 0 | 1 |
| 1 | top field | field\_pic\_flag shall be 1, bottom\_field\_flag shall be 0 | 1 |
| 2 | bottom field | field\_pic\_flag shall be 1, bottom\_field\_flag shall be 1 | 1 |
| 3 | top field, bottom field, in that order | field\_pic\_flag shall be 0 | 2 |
| 4 | bottom field, top field, in that order | field\_pic\_flag shall be 0 | 2 |
| 5 | top field, bottom field, top field repeated, in that order | field\_pic\_flag shall be 0 | 3 |
| 6 | bottom field, top field, bottom field repeated, in that order | field\_pic\_flag shall be 0 | 3 |
| 7 | frame doubling | field\_pic\_flag shall be 0 fixed\_frame\_rate\_flag shall be 1 | 2 |
| 8 | frame tripling | field\_pic\_flag shall be 0 fixed\_frame\_rate\_flag shall be 1 | 3 |
| 9 | Top field paired with previous bottom field in output order | field\_pic\_flag shall be equal to 1 | 1 |
| 10 | Bottom field paired with previous top field in output order | field\_pic\_flag shall be equal to 1 | 1 |
| 11 | Top field paired with next bottom field in output order | field\_pic\_flag shall be equal to 1 | 1 |
| 12 | Bottom field paired with next top field in output order | field\_pic\_flag shall be equal to 1 | 1 |
| 13 | Frame repetition extension | field\_pic\_flag shall be 0 fixed\_frame\_rate\_flag shall be 1 | **num\_frame\_repetition\_minus3** plus 4 |
| 14, 15 | reserved |  |  |

It is also proposed to add rows corresponding to pic\_struct equal to 9 through 13 to Table E.6 of the AVC specification.

# Conclusion

This contribution proposes modifications to existing picture timing SEI message syntax and syntax values in HEVC and AVC to enable repetition of an arbitrary number of frames. The modifications facilitate display of video in cases in which the video and display have different scan rates. The modifications support a wider range of video and display scan rates than are supported currently in HEVC or AVC. The modifications also facilitate consistency and transcoding between HEVC and AVC.

It is recommended that the proposed modifications for HEVC and AVC be adopted.

# References

1. S. McCarthy, F. Pu, T. Lu, P. Yin, W. Husak, T. Chen, “AGH17: on pic\_struct”, JVET-O0435, Gothenburg, SE, Jul. 2019.

# Patent rights declaration(s)

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