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| --- | --- | --- | --- | --- |
| *Title:* | **Prediction and partition mode binarization for Low Delay P** | | | |
| *Status:* | Input Document to JCT-VC | | | |
| *Purpose:* | Proposal | | | |
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# Abstract

This contribution reports a bug fix and a method for binarizing prediction and partition modes for Low Delay P configuration. Firstly, a mismatch was found between WD and HM with regard to the prediction and partition mode binarization for Low Delay P. With the bug fix in HM software, negligible (0.0%) impact is reported on both BD-rate and encoding and decoding runtime. Secondly, it is proposed to unify the prediction and partition mode binarization for Low Delay P and B, which simplifies both WD and HM. Again, experimental results report negligible (0.0%) impact on both BD-rate and encoding and decoding runtime.

1. Introduction

The current HEVC (High Efficiency Video Coding) defines coding unit (CU) and prediction unit (PU), where a CU may consist of one or multiple PUs. There are various types of PUs (or partition types). For example, an Intra 2Nx2N CU should consist of one 2Nx2N PU if it is greater than smallest coding unit (SCU); or it may consist of either one 2Nx2N PU or four NxN PUs if it is an SCU. An Inter 2Nx2N CU may consist of one 2Nx2N PU, two rectangular shape PUs (e.g. 2NxN, Nx2N, 2NxnU, 2NxnD, nLx2N, nRx2N), or four NxN PUs if it is an SCU. In WD4 [1], the prediction and partition mode binarization are defined as shown in Table 1.

Table 1 Prediction and partition mode binarization in WD4.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Slice type** | **Value of pred\_type** | **PredMode** | **PartMode** | **Bin string** | | |
| cLog2CUSize >  Log2MinCUSize | cLog2CUSize = = Log2MinCUSize | |
| cLog2CUSize = = 3 &&  !inter\_4x4\_enabled\_flag | cLog2CUSize > 3 | |  inter\_4x4\_enabled\_flag |
| I | 0 | MODE\_INTRA | PART\_2Nx2N | - | 1 | 1 |
| 1 | MODE\_INTRA | PART\_NxN | - | 0 | 0 |
| P | 0 | MODE\_INTER | PART\_2Nx2N | 0 1 | 0 1 | 0 1 |
| 1 | MODE\_INTER | PART\_2NxN | 0 011 | 0 01 | 0 01 |
| 2 | MODE\_INTER | PART\_Nx2N | 0 001 | 0 00 | 0 001 |
| 4 | MODE\_INTER | PART\_2NxnU | 0 0100 | - | - |
| 5 | MODE\_INTER | PART\_2NxnD | 0 0101 | - | - |
| 6 | MODE\_INTER | PART\_nLx2N | 0 0000 | - | - |
| 7 | MODE\_INTER | PART\_nRx2N | 0 0001 | - | - |
| 3 | MODE\_INTER | PART\_NxN | - | - | 0 000 |
| 4 | MODE\_INTRA | PART\_2Nx2N | 1 | 11 | 11 |
| 5 | MODE\_INTRA | PART\_NxN | - | 10 | 10 |
| B | 0 | MODE\_INTER | PART\_2Nx2N | 1 | 1 | 1 |
| 1 | MODE\_INTER | PART\_2NxN | 011 | 01 | 01 |
| 2 | MODE\_INTER | PART\_Nx2N | 001 | 001 | 001 |
| 4 | MODE\_INTER | PART\_2NxnU | 0100 | - | - |
| 5 | MODE\_INTER | PART\_2NxnD | 0101 | - | - |
| 6 | MODE\_INTER | PART\_nLx2N | 0000 | - | - |
| 7 | MODE\_INTER | PART\_nRx2N | 0001 | - | - |
| 3 | MODE\_INTER | PART\_NxN | - | - | 0001 |
| 4 | MODE\_INTRA | PART\_2Nx2N | 000 | 000 0 | 0000 0 |
| 5 | MODE\_INTRA | PART\_NxN | - | 000 1 | 0000 1 |

# Proposed Bug Fix

In this contribution, we report a bug fix, which is regard to a mismatch between the WD [1] and HM4.0 software [2]. In WD, when the “PredMode” is MODE\_INTER and the “PartMode” is PART\_Nx2N in situations when “cLog2CUSize = = 3 && !inter\_4x4\_enabled\_flag” or AMP (Asymmetric Motion Partitioning) is not used, the binarization is “000”. However in HM4.0, the binarization is found to be “0001”. We fixed this bug in HM4.0 to match WD. Results are reported in Table 3.

# Proposed unification for prediction and partition mode binarization for Low Delay P and B

In this contribution, we propose to unify the binarization for prediction and partition mode for Low Delay P and B. That is, to use the binarization described in current WD to both Low Delay P and B, as shown in Table 2. Hence, both WD and HM (encoding and decoding procedures) can be simplified with negligible effect on coding efficiency. Results are reported in Table 4.

Table 2 Proposed prediction and partition mode binarization.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Slice type** | **Value of pred\_type** | **PredMode** | **PartMode** | **Bin string** | | |
| cLog2CUSize >  Log2MinCUSize | cLog2CUSize = = Log2MinCUSize | |
| cLog2CUSize = = 3 &&  !inter\_4x4\_enabled\_flag | cLog2CUSize > 3 | |  inter\_4x4\_enabled\_flag |
| I | 0 | MODE\_INTRA | PART\_2Nx2N | - | 1 | 1 |
| 1 | MODE\_INTRA | PART\_NxN | - | 0 | 0 |
| P/B | 0 | MODE\_INTER | PART\_2Nx2N | 1 | 1 | 1 |
| 1 | MODE\_INTER | PART\_2NxN | 011 | 01 | 01 |
| 2 | MODE\_INTER | PART\_Nx2N | 001 | 001 | 001 |
| 4 | MODE\_INTER | PART\_2NxnU | 0100 | - | - |
| 5 | MODE\_INTER | PART\_2NxnD | 0101 | - | - |
| 6 | MODE\_INTER | PART\_nLx2N | 0000 | - | - |
| 7 | MODE\_INTER | PART\_nRx2N | 0001 | - | - |
| 3 | MODE\_INTER | PART\_NxN | - | - | 0001 |
| 4 | MODE\_INTRA | PART\_2Nx2N | 000 | 000 0 | 0000 0 |
| 5 | MODE\_INTRA | PART\_NxN | - | 000 1 | 0000 1 |

# Experimental Results

Simulations were conducted following common test conditions defined in JCTVC-F900 [3]. Anchor data was generated using HM4.0 software [2]. Results for bug fix described in Section 2 and the proposed unification method described in Section 3 are reported in Table 3 and Table 4, respectively.

Table 3 Results for fixing WD-HM mismatch.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Low delay P HE** | | |
|  | Y | U | V |
| Class A |  |  |  |
| Class B | 0.0% | 0.0% | 0.1% |
| Class C | 0.0% | 0.0% | -0.1% |
| Class D | 0.0% | -0.3% | 0.0% |
| Class E | 0.0% | 0.1% | 0.4% |
| **Overall** | 0.0% | -0.1% | 0.1% |
|  | 0.0% | -0.1% | 0.1% |
| Enc Time[%] | 100% | | |
| Dec Time[%] | 100% | | |

Table 4 Results for the proposed unification for Low Delay P and B.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Low delay P HE** | | |
|  | Y | U | V |
| Class A |  |  |  |
| Class B | 0.0% | 0.2% | 0.3% |
| Class C | 0.0% | 0.1% | -0.1% |
| Class D | 0.0% | -0.1% | -0.1% |
| Class E | 0.0% | 0.0% | 0.1% |
| **Overall** | 0.0% | 0.0% | 0.0% |
|  | 0.0% | 0.0% | -0.1% |
| Enc Time[%] | 100% | | |
| Dec Time[%] | 100% | | |

# Conclusions

This contribution first reports a mismatch between WD and HM with regard to the prediction and partition mode binarization for Low Delay P. With the bug fix in HM software, negligible (0.0%) impact is reported on both BD-rate and encoding and decoding runtime. Secondly, it is proposed to unify the prediction and partition mode binarization for Low Delay P and B, which simplifies both WD and HM. Again, experimental results report negligible (0.0%) impact on both BD-rate and encoding and decoding runtime. It is recommended to include the proposed unification in next version WD and HM.

# References

1. Benjamin Bross, Woo-Jin Han, Jens-Rainer Ohm, Gary J. Sullivan and Thomas Wiegand, “WD4: Working Draft 4 of High-Efficiency Video Coding”, JCTVC-F803, Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T VCEG and ISO/IEC MPEG, Torino, Italy, July 2011.
2. HM 4.0 Software, <http://hevc.kw.bbc.co.uk/trac/browser/tags/HM-4.0>.
3. Frank Bossen, “Common test conditions and software reference configurations”, JCTVC-F900, Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T VCEG and ISO/IEC MPEG, Torino, Italy, July 2011.

# Patent rights declaration(s)

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