

JVET-E0030

JEM BUG FIX FOR ALF CROSS-PICTURE PREDICTION

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# ALF CROSS-PICTURE PREDICTION



- › ALF cross-picture prediction was introduced in February 2015
  - Document SG16-C-0806
- › It enables ALF coefficient values used for a previous picture to be re-used for the current picture
- › For each picture, there are three ALF options:
  1. Do not use ALF
  2. Use ALF and signal the ALF coefficient values explicitly for the current slice
  3. Use ALF by copying the ALF coefficient values from a previous picture

|  | Descriptor |
|--|------------|
| slice_segment_header( ) {                  |            |
| ...  |            |
| <b>alf_flag</b>                            | u(1)       |
| if( slice_type == P    slice_type == B ) { |            |
| <b>temporal_alf_flag</b>                   | u(1)       |
| if( temporal_alf_flag == 1 ) {             |            |
| <b>alf_uvlc</b>                            | ue(v)      |
| }  |            |
| }  |            |
| ...  |            |

# ALF CROSS-PICTURE PREDICTION



- › The **alf\_uvlc** codeword is used with an array `m_acStoredAlfPara` to select which previous ALF parameters to copy
- › The following pseudo-code illustrates how it works:

```
define COM16_C806_ALF_TEMPPRED_NUM    6                               ///< 0: no temporal prediction
ALFParam m_acStoredAlfPara[COM16_C806_ALF_TEMPPRED_NUM];

foreach (picture P that is decoded)
    if (picture P is IRAP)
        index = 0
    if (temporal ALF is used)
        ALF_parameters_to_use = m_acStoredAlfPara[alf_uvlc]
    else if (ALF is used and ALF parameters are signaled explicitly in the slice header)
        ALF_parameters_to_use = DecodeALFParameters()
    m_acStoredAlfPara[index++] = ALF_parameters_to_use
    if (index == COM16_C806_ALF_TEMPPRED_NUM)
        index = 0;
```

# PROBLEMS WITH ALF CROSS-PICTURE PREDICTION IN JEM 4.0



- › Temporal layer decoding is broken
  - The JEM 4.0 encoder uses ALF data from previous pictures of higher temporal layers
  - This breaks decoding of temporal sub-layers (using the `-t` decoder parameter)
    - › The primary reason is that array management does not take temporal layers into account
    - › Thus the state of the array will differ depending on what temporal layers are decoded
- › ALF parameters of pictures that are not in RPS may be referenced
  - This breaks the robustness mechanism of RPS

# PROPOSAL



- › We propose to use a reference picture list and let `alf_uvlc` be an index to this list
- › The list is proposed to contain all pictures in the RPS with `used_by_curr_pic_flag` equal to 1
  - The list starts with the reference pictures with lower POC than the current picture in decreasing POC order
  - Then reference pictures with higher POC than the current picture in increasing POC order follow

# RESULTS



|                      | Random Access Main 10                 |        |        |      |      |
|----------------------|---------------------------------------|--------|--------|------|------|
|                      | Over JEM4.0 ALF CPP with proposed fix |        |        |      |      |
|                      | Y                                     | U      | V      | EncT | DecT |
| Class A1             | 0.04%                                 | 0.01%  | 0.09%  | 101% | 102% |
| Class A2             | 0.04%                                 | 0.04%  | 0.06%  | 100% | 101% |
| Class B              | 0.03%                                 | 0.02%  | 0.05%  | 101% | 103% |
| Class C              | 0.07%                                 | 0.06%  | 0.05%  | 99%  | 99%  |
| Class D              | 0.11%                                 | -0.12% | -0.10% | 99%  | 102% |
| Class E              |                                       |        |        |      |      |
| <b>Overall (Ref)</b> | 0.06%                                 | 0.00%  | 0.03%  | 100% | 101% |
| Class F (optional)   | 0.02%                                 | 0.06%  | 0.04%  | 102% | 101% |

|                      | Low delay B Main 10                   |        |        |      |      |
|----------------------|---------------------------------------|--------|--------|------|------|
|                      | Over JEM4.0 ALF CPP with proposed fix |        |        |      |      |
|                      | Y                                     | U      | V      | EncT | DecT |
| Class A1             |                                       |        |        |      |      |
| Class A2             |                                       |        |        |      |      |
| Class B              | 0.09%                                 | -0.03% | 0.03%  | 103% | 102% |
| Class C              | 0.16%                                 | 0.02%  | -0.13% | 100% | 102% |
| Class D              | 0.14%                                 | 0.19%  | 0.25%  | 100% | 99%  |
| Class E              | 0.13%                                 | -0.18% | -0.92% | 97%  | 97%  |
| <b>Overall (Ref)</b> | 0.13%                                 | 0.01%  | -0.13% | 101% | 100% |
| Class F (optional)   | 0.09%                                 | 0.37%  | -0.02% | 99%  | 98%  |

|                      | Low delay P Main10                    |        |        |      |      |
|----------------------|---------------------------------------|--------|--------|------|------|
|                      | Over JEM4.0 ALF CPP with proposed fix |        |        |      |      |
|                      | Y                                     | U      | V      | EncT | DecT |
| Class A1             |                                       |        |        |      |      |
| Class A2             |                                       |        |        |      |      |
| Class B              | 0.08%                                 | -0.48% | -0.09% | 101% | 100% |
| Class C              | 0.13%                                 | -0.04% | -0.27% | 100% | 100% |
| Class D              | 0.10%                                 | -0.03% | 0.10%  | 99%  | 97%  |
| Class E              | 0.36%                                 | -0.54% | -0.74% | 104% | 103% |
| <b>Overall (Ref)</b> | 0.15%                                 | -0.27% | -0.21% | 101% | 100% |
| Class F (optional)   | 0.03%                                 | 0.21%  | -0.28% | 102% | 100% |

|                      | Random Access Main 10                 |         |         |       |       |
|----------------------|---------------------------------------|---------|---------|-------|-------|
|                      | Over JEM4.0 ALF CPP with proposed fix |         |         |       |       |
|                      | Y                                     | U       | V       | EncT  | DecT  |
| Class A1             | #VALUE!                               | #VALUE! | #VALUE! | #NUM! | #NUM! |
| Class A2             | #VALUE!                               | #VALUE! | #VALUE! | #NUM! | #NUM! |
| Class B              | 0.03%                                 | 0.03%   | 0.05%   | 100%  | 104%  |
| Class C              | 0.07%                                 | 0.06%   | 0.06%   | 99%   | 101%  |
| Class D              | 0.11%                                 | -0.11%  | -0.09%  | 99%   | 100%  |
| Class E              |                                       |         |         |       |       |
| <b>Overall (Ref)</b> | #VALUE!                               | #VALUE! | #VALUE! | #NUM! | #NUM! |
| Class F (optional)   | 0.02%                                 | 0.06%   | 0.04%   | 101%  | 102%  |

|                      | Low delay B Main 10                   |         |         |       |       |
|----------------------|---------------------------------------|---------|---------|-------|-------|
|                      | Over JEM4.0 ALF CPP with proposed fix |         |         |       |       |
|                      | Y                                     | U       | V       | EncT  | DecT  |
| Class A1             |                                       |         |         |       |       |
| Class A2             |                                       |         |         |       |       |
| Class B              | #VALUE!                               | #VALUE! | #VALUE! | #NUM! | #NUM! |
| Class C              | 0.16%                                 | 0.01%   | -0.09%  | 97%   | 98%   |
| Class D              | 0.13%                                 | 0.55%   | 0.01%   | 94%   | 95%   |
| Class E              | 0.20%                                 | 0.02%   | 0.03%   | 98%   | 97%   |
| <b>Overall (Ref)</b> | #VALUE!                               | #VALUE! | #VALUE! | #NUM! | #NUM! |
| Class F (optional)   | 0.10%                                 | 0.12%   | 0.29%   | 97%   | 97%   |

|                      | Low delay P Main10                    |         |         |       |       |
|----------------------|---------------------------------------|---------|---------|-------|-------|
|                      | Over JEM4.0 ALF CPP with proposed fix |         |         |       |       |
|                      | Y                                     | U       | V       | EncT  | DecT  |
| Class A1             |                                       |         |         |       |       |
| Class A2             |                                       |         |         |       |       |
| Class B              | #VALUE!                               | #VALUE! | #VALUE! | #NUM! | #NUM! |
| Class C              | 0.12%                                 | -0.07%  | -0.21%  | 98%   | 99%   |
| Class D              | 0.06%                                 | 0.48%   | 0.13%   | 96%   | 95%   |
| Class E              | 0.38%                                 | -1.26%  | -0.92%  | 103%  | 102%  |
| <b>Overall (Ref)</b> | #VALUE!                               | #VALUE! | #VALUE! | #NUM! | #NUM! |
| Class F (optional)   | 0.01%                                 | 0.19%   | -0.18%  | 97%   | 97%   |

# CONCLUSION



- › The proposal solves the problem of temporal layer decoding
- › Re-uses the RPS mechanism
  - Clean design in line with reference picture handling
  - Decoder aware of missing data and what picture that is missing
  - All RPS constraints applies automatically
    - › e.g. temporal layers and sub-layer non-reference (SLNR) pictures
    - › Constraints for random access and leading pictures
- › Average BDR of 0.06%, 0.13%, 0.15% for RA, LDB, LDP respectively



**ERICSSON**