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| *Title:* | **Handling for exception cases regarding to code-word larger than 32bit in CAVLC** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Chanyul Kim Youngo Park Kwang Pyo Choi | Email: [dionism@samsung.com](mailto:dionism@samsung.com)  [youngo.park@samsung.com](mailto:youngo.park@samsung.com)  [kp5.choi@samsung.com](mailto:kp5.choi@samsung.com) |  |
| *Source:* | Samsung Electronics Co., Ltd. | | |

# Abstract

In this contribution, a scheme is proposed to handle exception cases for code-word larger than 32 bit in CAVLC which leads to an error. The modified VLC tables are mixed with fixed-length code which eliminates the need for any loop in bit-stream writing and errors. It does not generate any side effect such as performance change but cover the maximum level of quantized coefficients in CAVLC.

# Introduction

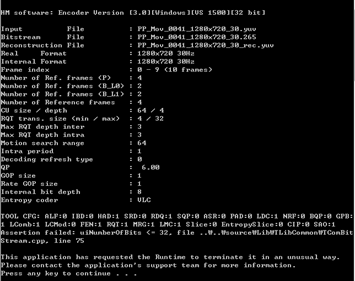
In HM3.0 CAVLC coding, the quantized coefficient level is represented as

Where N is block size, offset is 26214. The maximum level of quantized coefficient would be 15-bit (14-bit level +sign). In the CAVLC coefficient coding, the required bit (RB) for code-word corresponding to the maximum level of quantized coefficients can be obtained as Equation. (2).

Where n is VLC table number and k is the leading zeroes in the Exp-golomb. The possible maximum level (PML) of quantized coefficient represented with a 32bit does not cover the maximum range of level denoted in Equation. (3). Moreover, there is error if the code word is larger than 32-bit due to current VLC tables do not fully support for maximum *RB* of quantized coefficients. For example, in the case of last position- level coding in the extreme case such as shown in Figure 1, the code-word is larger than 32-bits for maximum quantized coefficient with VLC table 0, which caused an error in the bit-stream writer. Therefore, modified VLC tables are to be needed for covering full range of quantized coefficient.

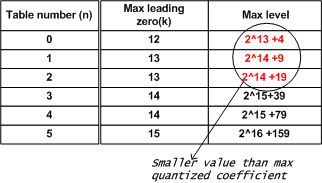
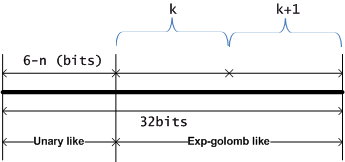
# Proposal

Modified VLC tables for supporting maximum *RB* of quantized coefficient are proposed. The current HM uses the concatenated unary and Exp- golomb like code. The modified them do not effect on coding performance but cover the exception case for code-word larger than 32-bit. Not more than five of VLC table number is only considered in this proposal.

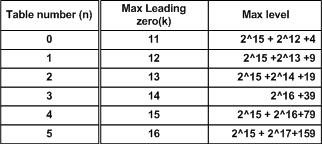
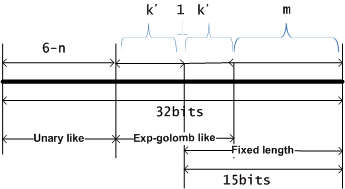


**Figure 1. Error case in larger than 33bit code word in synthetic image (***PP\_Mov\_0041\_1280x720\_30.yuv)*

The VLC tables are combined with unary and Exp-golomb like code as shown in Figure 2. The maximum representable coefficients are smaller than maximum quantized coefficient in case of less than VLC table number 2, where more than 32-bit code words are generated. Therefore, the proposed VLC tables could cover the full range of maximum quantized coefficients within 32-bits code word, while does not effect on coding performance. The VLC tables based on unary, Exp-golomb mixed with fixed length code are presented as shown in Figure 3. The leading zeros of Exp-golomb are quite similar with HM3.0 as shown in Table 2.

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**Figure 2. VLC Table structure and the maximum coverage quantized coefficient in HM3.0**

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**Figure 3. Modified VLC Table structure and the maximum coverage of quantized coefficient**

# Test Condition

First we check the coding performance variation under the common test condition. The error is occurred in the current HM with the sequence *PP\_Mov\_0041\_1280x720\_30.yuv* as shown in Figure 1. The sequence has black and white region where maximum quantized coefficient is occurred at specific point such as DC due to worst prediction.

# Experimental Results

No coding performance drop (identical same performance) and no additional complexity are observed as shown in Table 1. The propose scheme successfully encode and decode using *PP\_Mov\_0041\_1280x720\_30.yuv* sequence, whereas the current HM generates error and no further encoding is proceeded.

**Table 1 Common condition test using modified VLC tables**

# Conclusion

This proposal is to handle for exception or error cases regarding to code-word larger than 32-bit in CAVLC. The current VLC tables do not fully support for coding maximum quantized coefficients. The propose scheme is to handle exception case of larger than 32-bit code word in CAVLC without any performance changing.

# References

[1] M. Karczewicz, X.Wang, W.-J. Chien, “CE5: Improved coefficient coding with LCEC”, JCTVC-E385, Geneva, CH, 16-23 March, 2011.

# Specification

JCTVC-E603\_d8.doc Section 9.2.1

Depending on the value of vlcNum, the value of codeNum is assigned as follows.

* If vlcNum is equal to 0,
* If leadingZeroBits is less than or equal to 6,

codeNum = leadingZeroBits (9‑5)

* ~~Otherwise~~ ~~(leadingZeroBits is greater than 6),~~

~~numBits = leadingZeroBits – 6 (9‑6)  
 codeNum = 5 + (1<< numBits) + read\_bits( numBits )~~

* Else If (leadingZeroBits is greater than 6 and less than 17)

numBits = leadingZeroBits – 6 (9‑6)  
 codeNum = 5 + (1<< numBits) + read\_bits( numBits )

* Else(leadingZeroBits is equal 17)

numBits = 17

codeNum = 4 + (1<<11) + read\_bits(numBits)

* Otherwise, if vlcNum is less than 5,
* If leadingZeroBits is less than or equal to 6,

codeNum = (leadingZeroBits << vlcNum) + read\_bits( vlcNum ) (9‑7)

* ~~Otherwise (leadingZeroBits is greater than 6),~~

~~numBits = leadingZeroBits – 6 + vlcNum (9‑8)  
 codeNum = 5\*(1<<vlcNum) + (1<< numBits) + read\_bits( numBits)~~

* Else If (leadingZeroBits is greater than 6 and less than 17)

numBits = leadingZeroBits -6 (9‑8)  
 codeNum = 5+(1<<numBits) +read\_bits(numBits)

* Else(leadingZeroBits is equal 17)

numBits = 17

codeNum = 5\*(1<<vlcNum) + (1<<(11+vlcNum)) -1 + read\_bits(numBits)

# Patent rights declaration(s)

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