

# **Handling for exception cases regarding to code-word larger than 32bit in CAVLC**

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**(JCTVC-F466)**

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# Summary

- ❖ There are exception cases for code-word larger than 32bits due to its lack of supporting maximum quantized coefficient in CAVLC.
- ❖ It leads to generate error, no further encoding is proceeded.
- ❖ Change:
  - Modified VLC tables less than number five
  - Unary + Exp-golomb + fixed code
- ❖ Modified VLC tables do not affect coding performance
  - 0.0 / 0.0 / 0.0 : exactly the same bit
- ❖ Cross-check
  - F622 by Qualcomm

# Long code word larger than 32bit

❖ Quantized coefficient level is

$$\text{level} = ((\pm(2^{15}-1) * \text{offset}) \gg (21 + \frac{QP}{6} - \log_2(N)))$$

1. Maximum level of quantized coefficients → 15 bits (14bits +sign).
2. Long Code-word (>32bits) happens when max level is coded using VLC tables (< 3).
3. Error is occurred in the bit-stream writer
4. Need to modify VLC tables to cover full range of quantized coefficients.

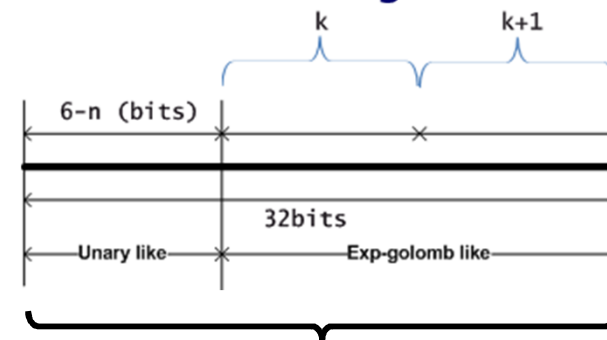


Table number (n)	Max leading zero(k)	Max level
0	12	$2^{13} + 4$
1	13	$2^{14} + 9$
2	13	$2^{14} + 19$
3	14	$2^{15} + 39$
4	14	$2^{15} + 79$
5	15	$2^{16} + 159$

smaller than  $2^{15}$

# Modified VLC tables

❖ Unary + Exp-golomb + fixed code

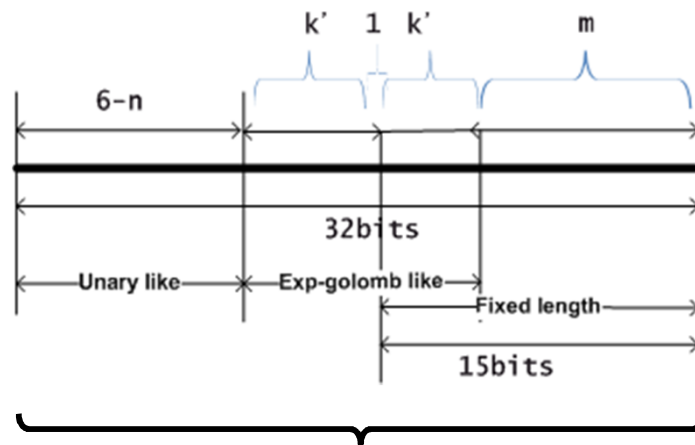


Table number (n)	Max Leading zero(k)	Max level
0	11	$2^{15} + 2^{12} + 4$
1	12	$2^{15} + 2^{13} + 9$
2	13	$2^{15} + 2^{14} + 19$
3	14	$2^{15} + 2^{15} + 39$
4	15	$2^{15} + 2^{16} + 79$
5	16	$2^{15} + 2^{17} + 159$

Cover maximum level of quantized coefficient

$$(6 - n) + 2k' + 1 + m \leq 32 \quad \text{--- (1)}$$

$$k' + m = 15 \quad \text{--- (2)}$$

Satisfied two conditions

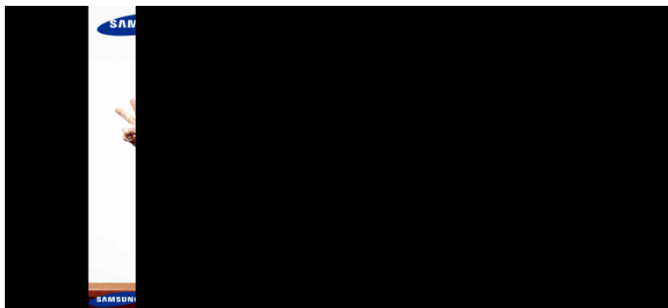
# Experimental results

## ❖ Common condition test

- Exactly the same bits (no difference with HM3.0)
- No complexity increase

	All Intra LC			Random Access LC			Low delay B LC		
	Y	U	V	Y	U	V	Y	U	V
Class A	0.0	0.0	0.0	0.0	0.0	0.0			
Class B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Class C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Class D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Class E	0.0	0.0	0.0				0.0	0.0	0.0
<b>Overall</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
Enc Time[%]	100%			100%			100%		
Dec Time[%]	100%			98%			99%		

## ❖ Error is occurred , when encode *PP\_Mov\_0041\_1280x720\_30.yuv* in HM3.0.



Error & no encoding  
when QP <=6



```

HM software: Encoder Version [3.0](Windows)[VC 1500][32 bit]
Input File : PP_Mov_0041_1280x720_30.yuv
Bitstream File : PP_Mov_0041_1280x720_30.265
Reconstruction File : PP_Mov_0041_1280x720_30_rec.yuv
Real Format : 1280x720 30Hz
Internal Format : 1280x720 30Hz
Frame Index : 0 - 9 (10 frames)
Number of Ref. frames (P) : 4
Number of Ref. frames (B_L0) : 2
Number of Ref. frames (B_L1) : 2
Number of Reference frames : 8
CU size / depth : 64 / 4
RQT trans. size (min / max) : 4 / 32
Max RQT depth inter : 3
Max RQT depth intra : 3
Motion search range : 64
Intra period : 1
Decoding refresh type : 0
QP : 6.00
GOP size : 1
Rate GOP size : 1
Internal bit depth : 8
Entropy coder : VLC

Tool Cfg: ALP:0 ID:0 HAD:1 SH:0 RD:1 SQP:0 AER:0 PBD:0 LDC:1 NRP:0 RPP:0 CPB:
1 LComb:1 LComb:1 PFI:1 RFI:1 BRG:1 LRC:1 Elice:1 Intep:1 Lb:1 CIP:0 SRO:1
Assertion failed: uiNumberOfBits <= 32, file ..\..\Source\WMF\LibCommon\WTComBit
Stream.cpp, line 75

This application has requested the Runtime to terminate it in an unusual way.
Please contact the application's support team for more information.
Press any key to continue . . .
    
```

# Conclusions

- ❖ Support the maximum quantized coefficient
  - Mixture codes with unary + Exp-goloum + fixed code
  - The length of code-words is limited by 32 bits.
- ❖ Need to support the exception case for code-word larger than 32 bit.  
(There is more possibility to appear under low QP, worse prediction)
- ❖ Coding efficiency impact:
  - No change performance in the common test
  - No complexity increase.
- ❖ We recommend the proposed scheme to be adopted into HM for handling exception cases in CAVLC.