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| *Title:* | **CE5: Summary report on CAVLC entropy coding improvements** | | |
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| *Author(s) or Contact(s):* | Xianglin Wang  Ping Wu  Chanyul Kim | Tel: Email: | 1-858-651-5135 [xianglin@qualcomm.com](mailto:xianglin@qualcomm.com)  [ping.wu@zte.com.cn](mailto:ping.wu@zte.com.cn)  [dionism@samsung.com](mailto:dionism@samsung.com) |
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# Introduction

This document summarizes the activities in the Core Experiment CE5 on CAVLC entropy coding improvements. A group of 17 companies and universities registered for participation in CE5.

# Related documents

There are seven proposals in the CE. Except proposal G389, all proposals were made available on time (i.e. on or before Sep. 10, 2011). Proposal G389 was made available on Oct. 26, 2011.

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| **Proposal** | **Title** | **Cross-check** |
| JCTVC-G532 (Samsung) | Improvement of CAVLC run- coding by prediction mode | JCTVC-G367 (Sony) |
| JCTVC-G674 (Qualcomm) | Sub-block coding of transform coefficients with CAVLC | JCTVC-G340 (Sharp) |
| [JCTVC-G360](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=2317) (Sony) | Redundancy removal for Run-mode in CAVLC | [JCTVC-G786](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=2252) (Samsung) |
| [JCTVC-G389](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=2249) (Yonsei, Samsung) | CAVLC coding table modification | [JCTVC-G851](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=2174) (Qualcomm) |
| JCTVC-G677 (Qualcomm) | Limitation on VLC codeword length | JCTVC-G924 (Samsung) |
| JCTVC-G563 (Samsung, Qualcomm) | Handling for exception cases longer than 32bit code-word in CAVLC | JCTVC-G841 (MediaTek) |
| [JCTVC-G310](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=2317) (Sharp) | CAVLC Adaptation using Difference Counter | [JCTVC-G402](http://phenix.int-evry.fr/jct/doc_end_user/current_document.php?id=2252) (Microsoft) |

# Summary of proposals

## Coefficient coding

### JCTVC-G532 (JCTVC-F458)

In JCTVC-G532, it is proposed that intra chroma coefficients are coded using intra-block run-level index mapping instead of inter-block run-level index mapping. Currently in HM4.0 all chroma coefficients are coded using inter-block run-level index mapping. It is asserted that such a change may increase the cashe hit-ratio. It is reported by doing so coding efficiency has a loss in chroma. More specifically, BD-rate changes on Y, U, and V are -0.1%/0.5%/0.3% for all intra, 0.0%/0.7%/0.7% for random access and 0.0%/0.2%/0.1% for low delay configuration.

### JCTVC-G674 (JCTVC-F612)

In JCTVC-G674, a coefficient coding improvement scheme is proposed for 16x16 and 32x32 blocks. According to this proposal, transform blocks of 16x16 and 32x32 are divided into 4x4 sub-blocks in run-level coding. For each sub-block, information is sent indicating whether it has any non-zero coefficients. Simulation results show that BD-rate changes are -0.6%/0.1%/0.2% for all intra, -0.2%/-0.1/0.2% for random access and -0.1%/-0.1%/-0.1% for low delay configuration.

## VLC table modification

### JCTVC-G360 (JCTVC-F286)

In JCTVC-G360, several truncated unary code tables (with different sizes) are introduced to remove the redundancy in run-mode coding. Simulation results show BD-rate changes on Y, U, V are -0.1%/-0.1%/-0.1% for all intra, -0.1%/-0.1%/0.1% for random access and -0.1%/0.0%/0.0% for low delay configuration.

### JCTVC-G389 (JCTVC-F408)

According to JCTVC-G389, VLC tables changes include: i) similar changes as proposed in JCTVC-G360 regarding unary truncated codes; ii) other VLC tables are re-structured into a concatenation of Golomb code and exp-Golomb code, with concatenation point controlled by a parameter k; iii) in run mode coding, k is controlled by three thresholds based on transform size, trailing ones, intra or inter and luma or chroma; iv) in level mode coding, k is determined from tables, based on VLC table number, and luma or chroma.

Simulation results show BD-rate changes on Y, U, V are -0.1%/-0.2%/-0.2% for all intra, -0.1%/0.0%/-0.1% for random access and -0.1%/0.1%/0.% for low delay configuration.

### JCTVC-G677 (JCTVC-F608)

Currently coefficient coding for large chroma blocks may generate codeword longer than 32 bits when a run value is large enough. To solve the issue, in JCTVC-G677 it is proposed to modify a VLC table through a concatenation of Golomb codes with two different parameters. Simulation results show that there is no performance change with the proposed solution.

### JCTVC-G563 (JCTVC-F608, JCTVC-F466)

In JCTVC-F466, it was reported that when coding an extremely high level coefficient, the codeword can also be larger than 32 bit. A solution was proposed by appending fixed-length codeword above certain code number for five VLC tables. Simulation showed that it does not affect performance either.

In JCTVC-G563, the proposed changes from both JCTVC-F608 and JCTVC-F466 are integrated together and tested. Simulation results show that there is virtually no change on coding performance.

## Codeword adaptation

### JCTVC-G310 (JCTVC-F395)

In JCTVC-G310, it is proposed to use difference counter in CAVLC codeword mapping adaptation. In the proposed method, the difference of the occurrences of two successive code numbers is stored in a difference counter. Decoding table is swapped when the value of the associated counter equals to zero. It is asserted that the proposed scheme can simplify CAVLC adaptation by removing normalization process and sum counters. The changes have little impact on coding performance.

Comments: cross-checker expressed concerns that in some cases the codeword adaptation based on the proposed scheme is not as accurate as the current one in HM.

# Conclusion

There is not enough feedback from CE participants on adoption recommendation for the above proposals. Suggest having further discussion during the meeting.

# References

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