|  |  |
| --- | --- |
| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**  10th Meeting: Stockholm, Sweden, July 11-20, 2012 | Document: JCTVC-J0370  M25702 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **Cross-verification of JCTVC-J0138 on NSQT simplification** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Information | | |
| *Author(s) or Contact(s):* | Minhua Zhou Texas Instruments Inc., USA | Tel: Email:  : | +1-214-480-3816 [zhou@ti.com](mailto:zhou@ti.com) |
| *Source:* | Texas Instruments Inc; | | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Abstract

This contribution reports cross-check results of JCTVC-J0138 on NSQT simplifications. For 32x32 and 16x16 CU size, JCTVC-J0138 removes 4x4 transform for non-square partition modes (i.e. PART\_Nx2N, or PART\_nLx2U, PART\_nRx2N, PART\_Nx2N, or PART\_nLx2U and PART\_nRx2N), which avoids splitting non-square partitions into square transforms, and unifies the luma and chroma NSQT TU quad-trees. For CU size of 64x64 and 8x8, no change has been introduced. The experiment results reported in this document match those provided by the proponents in JCTVC-J0138, the source code has been also checked to verify its consistency with the proposal description.

# Introduction

JCTVC-J0138 proposes simplification of NSQT, the key change is to remove 4x4 transform for non-square partition modes from 32x32 and 16x16 CUs when NSQT is enabled. Table 1 shows an example of changes relative to HM7.0 for non-square prediction modes of PART\_2NxN, or PART\_2NxnU, or PART\_2NxnD (the changes relative to HM7.0 are highlighted in yellow).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 64x64 CU | | 32x32 CU | | 16x16 CU | | 8x8 CU | |
|  | Luma | Chroma | Luma | Chroma | Luma | Chroma | Luma | Chroma |
| trafoDepth=0 | - | - | 32x32 | 16x16 | 16x16 | 8x8 | 8x8 | 4x4 |
| trafoDepth=1 | 32x32 | 16x16 | 32x8 | 16x4 | 16x4 | ~~4x4~~ | 4x4 | - |
| trafoDepth=2 | 32x8 | 16x4 | 16x4 | ~~4x4~~ | ~~4x4~~ | - | - | - |

Table 1: The transform block size when partition mode is PART\_2NxN, or PART\_2NxnU, or PART\_2NxnD after JCTVC-J0138 simplification.

The proponents asserted that the proposed changes simplified the design in the following aspects

1. The luma and chroma NSQT quad-trees are unified which helps simplify the NSQT TU splitting decision logic
2. Square transform (i.e. 4x4 transform) for non-square partitions is avoided at transform depth larger than 0

.

# Test Settings and Conditions

The simulations of this document have used HM7.0 software, the simulation platform is LSF equipped with Intel(R) Xeon(R) CPU X5570 64 bits Linux machines of different frequencies, the common test conditions and reference configurations specified in [1] are followed. Additional tests were run to create anchor data for Main configurations with NSQT on and for HE10 configurations with NSQT off.

# Experimental results

The experimental results are summarized in Table 1 and table 2. The results match the ones reported in JCTVC-J0138. Please be advised the run time reported in Table 1 and Table 2 might not be accurate.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | | |  | | |
|  | **Random Access Main** | | | **Random Access HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | -0.07% | -0.29% | -0.20% | 0.00% | 0.03% | 0.04% |
| Class B | 0.02% | -0.03% | -0.17% | 0.00% | -0.07% | -0.15% |
| Class C | 0.01% | 0.18% | 0.17% | 0.03% | 0.23% | 0.06% |
| Class D | 0.06% | 0.27% | 0.22% | 0.05% | 0.39% | 0.18% |
| Class E |  |  |  |  |  |  |
| **Overall** | 0.01% | 0.03% | 0.00% | 0.02% | 0.14% | 0.02% |
|  | 0.00% | 0.04% | 0.00% | 0.02% | 0.15% | 0.02% |
| Class F | 0.13% | 0.17% | 0.22% | 0.10% | 0.22% | 0.30% |
| Enc Time[%] | 96% | | | 94% | | |
| Dec Time[%] | 97% | | | 96% | | |
|  |  | | |  | | |
|  | **Low delay B Main** | | | **Low delay B HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A |  | | |  | | |
| Class B | -0.03% | 0.30% | 0.34% | -0.05% | 0.28% | 0.16% |
| Class C | -0.04% | 0.59% | 0.41% | -0.01% | 0.37% | 0.44% |
| Class D | 0.04% | 0.64% | 0.65% | 0.05% | 0.54% | 0.34% |
| Class E | -0.20% | -0.04% | 0.16% | -0.04% | -0.82% | -0.10% |
| **Overall** | -0.04% | 0.39% | 0.40% | -0.01% | 0.16% | 0.23% |
|  | -0.04% | 0.38% | 0.41% | -0.01% | 0.21% | 0.35% |
| Class F | -0.04% | -0.26% | -0.41% | 0.08% | 0.14% | 1.69% |
| Enc Time[%] | 101% | | | 97% | | |
| Dec Time[%] | 103% | | | 99% | | |

**Table 1. BD-rate difference (%) of the simplified NSQT relative to HM7.0 anchor w/ NSQT on**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | | |  | | |
|  | **Random Access Main** | | | **Random Access HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A | -0.3% | -1.0% | -0.9% | -0.4% | -0.5% | -0.7% |
| Class B | -0.5% | -1.5% | -1.5% | -0.4% | -1.4% | -1.2% |
| Class C | -0.5% | -0.4% | -0.4% | -0.4% | -0.3% | -0.4% |
| Class D | -0.3% | -0.1% | 0.0% | -0.3% | 0.0% | 0.0% |
| Class E |  |  |  |  |  |  |
| **Overall** | -0.4% | -0.8% | -0.7% | -0.4% | -0.6% | -0.6% |
|  | -0.4% | -0.8% | -0.7% | -0.4% | -0.6% | -0.6% |
| Class F | -0.1% | -0.2% | 0.0% | -0.3% | -0.2% | -0.1% |
| Enc Time[%] | 102% | | | 95% | | |
| Dec Time[%] | 102% | | | 94% | | |
|  |  | | |  | | |
|  | **Low delay B Main** | | | **Low delay B HE10** | | |
|  | Y | U | V | Y | U | V |
| Class A |  | | |  | | |
| Class B | -1.0% | -3.3% | -3.3% | -0.9% | -3.0% | -3.1% |
| Class C | -1.0% | -1.5% | -1.4% | -0.8% | -1.4% | -1.1% |
| Class D | -0.7% | -0.8% | -0.2% | -0.7% | -1.3% | -0.8% |
| Class E | -1.5% | -3.0% | -2.3% | -1.3% | -3.7% | -2.8% |
| **Overall** | -1.0% | -2.2% | -1.9% | -0.9% | -2.3% | -2.0% |
|  | -1.0% | -2.2% | -1.8% | -0.9% | -2.3% | -1.9% |
| Class F | -1.0% | -1.5% | -1.5% | -0.9% | -1.5% | 0.3% |
| Enc Time[%] | 100% | | | 96% | | |
| Dec Time[%] | 97% | | | 94% | | |

**Table 2. BD-rate gain (%) of the simplified NSQT relative HM7.0 anchor w/ NSQT off**

# References

[1] F. Bossen, “Common test conditions and software reference configurations,” JCT-VC Document, JCTVC-I1100, 9th Meeting: Geneva, Switzerland, 27 April – 07 May, 2012

[2] [B. Bross](mailto:benjamin.bross@hhi.fraunhofer.de), [W.-J. Han](mailto:wjhan.han@samsung.com), [J.-R. Ohm](mailto:ohm@ient.rwth-aachen.de), [G. J. Sullivan](mailto:garysull@microsoft.com), [T. Wiegand](mailto:thomas.wiegand@hhi.fraunhofer.de) “High Efficiency Video Coding (HEVC) text specification draft 7,” JCT-VC Document, JCTVC-I1003, 9th Meeting: Geneva, Switzerland, 27 April – 07 May, 2012.

[3] X. Zheng, Y. Yuan, H. Yu and Y. He, “NSQT simplification,” JCT-VC Document, JCTVC-J0138, 10th Meeting: Stockholm, SE, 11–20 July 2012