SAMSUNG Research

JVET 11th Meeting

JVET-K0109 – CE1: Partitioning Structure in JVET-J0024 (Tests 1.0.12, 1.0.13, 1.0.14, 1.0.15)

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Introduction

- **4 CE tests based on the partitioning structure (BTT) in JVET-J0024**
  - SubCE1.0.12 (**BTT**)
    - BTT w/ implicit QT split on the top level (to align with the maximum transform size)
  - SubCE1.0.13 (**BTT**)
    - BTT w/o QT split
  - SubCE1.0.14 (**QT+BT+TT**)
    - QT+BT+TT
    - + CU ratio restriction
  - SubCE1.0.15 (**QT+BT+TT**)
    - QT+BT+TT
    - + CU ratio restriction
    - + CU size restriction

Proposed Partitioning Structure (BTT)

- **Binary and triple trees (BTT)**
  - For Quad tree split,
    - Option 1) Implicit QT split on the top level (to align with the maximum transform size)
    - Option 2) No QT split
  - BTT can be enabled by just changing configuration parameters from VTM
    - Minimum QT size: 8 → 128
    - Maximum BT/TT depth: 3 → 10
  - Encoder optimization technique
    - Store RD costs of all the split modes
    - Use them to decide which split modes will be allowed (for next visit)
  - Two restrictions (to reduce search space in codec)
    - 1) CU ratio restriction
      - Define allowed CU ratio
      - e.g.) up to 1:4 or up to 1:8
    - 2) CU size restriction for certain ratio and triple tree split
      - e.g.) If CU size is greater than 32,
        Disallow ratios higher than 1:2
        Disallow triple tree split

Test Results (SubCE1.0.12)

Test description

- BTT (Implicit QT split on the top level)
  - Max BT depth: 8, Max TT depth: 6
- Allowed CU ratio: up to 1:4
- Allowed size for 1:4 CU ratio and TT split: < 64
- ctx # for split info.: 17 → 12

GCC version: 4.8.3
SIMD: AVX

Results

- JVET CTC
- BMS1.0 S/W
- AI (VTM/BMS)
  - -0.9%, 146% EncT
  - -0.7%, 144% EncT
- RA (VTM/BMS)
  - 0.7%, 74% EncT
  - 1.0%, 81% EncT
- LDB (VTM/BMS)
  - 0.4%, 85% EncT
  - 0.7%, 79% EncT

	All Intra Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-1.26%	-2.21%	-2.01%	117%	95%	-1.22%	-3.19%	-3.34%	119%	99%
Class A2	-0.87%	-0.97%	-0.84%	147%	100%	-0.59%	-1.35%	-0.98%	143%	101%
Class B	-0.83%	-1.26%	-1.65%	141%	97%	-0.58%	-1.70%	-2.28%	141%	99%
Class C	-0.66%	-0.91%	-1.01%	196%	98%	-0.46%	-0.99%	-1.11%	186%	101%
Class E	-0.91%	-1.02%	-1.45%	128%	96%	-0.52%	-1.43%	-1.66%	131%	100%
Overall	-0.88%	-1.25%	-1.40%	146%	97%	-0.65%	-1.68%	-1.87%	144%	100%
Class D	-0.72%	-1.04%	-1.18%	212%	97%	-0.51%	-1.02%	-1.23%	200%	102%
Class F (optional)	-2.47%	-3.35%	-3.22%	216%	98%	-2.42%	-3.89%	-4.22%	214%	98%

	Random Access Main 10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	1.88%	1.21%	1.44%	61%	103%	1.84%	1.05%	1.12%	59%	101%
Class A2	1.68%	1.26%	1.38%	70%	101%	2.30%	1.34%	1.50%	78%	99%
Class B	0.26%	0.41%	-0.12%	75%	101%	0.63%	-0.02%	-0.74%	81%	99%
Class C	-0.43%	-0.73%	-0.94%	90%	97%	-0.15%	-0.85%	-1.37%	104%	99%
Class E										
Overall	0.68%	0.43%	0.27%	74%	100%	1.00%	0.25%	-0.09%	81%	99%
Class D	-0.55%	-1.36%	-1.52%	105%	94%	-0.48%	-1.60%	-1.65%	121%	95%
Class F (optional)	-1.52%	-1.80%	-1.71%	100%	99%	-1.32%	-2.53%	-2.53%	120%	100%

Test Results (SubCE1.0.13)

Test description

- BTT (No QT)
  - Max BT depth: 8, Max TT depth: 6
- Allowed CU ratio: up to 1:4
- Allowed size for 1:4 CU ratio and TT split: < 64
- ctx # for split info.: 17 → 12

GCC version: 4.8.3
SIMD: AVX

Results

- JVET CTC
- BMS1.0 S/W
- AI (VTM/BMS)
  - -0.9%, 159% EncT
  - -0.7%, 159% EncT
- RA (VTM/BMS)
  - 0.0%, 85% EncT
  - 0.2%, 91% EncT
- LDB (VTM/BMS)
  - 0.1%, 98% EncT
  - 0.1%, 89% EncT

	All Intra Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-1.24%	-2.28%	-2.15%	126%	97%	-1.21%	-3.35%	-3.56%	129%	101%
Class A2	-0.88%	-1.05%	-0.90%	159%	101%	-0.60%	-1.45%	-1.04%	159%	104%
Class B	-0.82%	-1.27%	-1.67%	155%	98%	-0.58%	-1.85%	-2.43%	158%	100%
Class C	-0.63%	-0.91%	-1.05%	217%	99%	-0.45%	-0.95%	-1.12%	208%	102%
Class E	-0.90%	-1.01%	-1.46%	136%	94%	-0.51%	-1.44%	-1.52%	141%	100%
Overall	-0.87%	-1.28%	-1.45%	159%	98%	-0.65%	-1.76%	-1.94%	159%	102%
Class D	-0.68%	-1.05%	-1.22%	231%	97%	-0.46%	-1.29%	-1.29%	213%	100%
Class F (optional)	-2.46%	-3.33%	-3.15%	242%	98%	-2.39%	-3.90%	-4.30%	237%	99%

	Random Access Main 10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.39%	-0.21%	-0.12%	70%	101%	0.45%	-0.36%	-0.54%	67%	101%
Class A2	0.80%	0.64%	0.77%	81%	101%	0.94%	0.29%	0.45%	89%	101%
Class B	-0.27%	0.08%	-0.57%	86%	99%	-0.14%	-0.67%	-1.29%	92%	100%
Class C	-0.41%	-0.67%	-0.79%	99%	96%	-0.07%	-0.91%	-1.48%	113%	100%
Class E										
Overall	0.04%	-0.06%	-0.27%	85%	99%	0.21%	-0.48%	-0.84%	91%	100%
Class D	-0.46%	-1.15%	-1.35%	113%	93%	-0.24%	-1.99%	-2.11%	131%	98%
Class F (optional)	-1.62%	-1.95%	-1.84%	113%	95%	-1.55%	-2.93%	-2.87%	134%	99%

Test Results (SubCE1.0.14)

Test description

- QT+BT+TT (Same as VTM)
- Allowed CU ratio: up to 1:8

GCC version: 4.8.3
SIMD: AVX

Results

- JVET CTC
- BMS1.0 S/W
- AI (VTM/BMS)
  - No change
  - No change
- RA (VTM/BMS)
  - 0.1%, 88% EncT
  - 0.1%, 93% EncT
- LDB (VTM/BMS)
  - 0.2%, 92% EncT
  - 0.1%, 93% EncT
- Additional Tests 

	All Intra Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.00%	0.00%	0.00%	99%	97%	0.00%	0.00%	0.00%	99%	99%
Class A2	0.00%	0.00%	0.00%	100%	100%	0.00%	0.00%	0.00%	100%	100%
Class B	0.00%	0.00%	0.00%	99%	100%	0.00%	0.00%	0.00%	99%	100%
Class C	0.00%	0.00%	0.00%	99%	96%	0.00%	0.00%	0.00%	100%	100%
Class E	0.00%	0.00%	0.00%	100%	98%	0.00%	0.00%	0.00%	100%	100%
Overall	0.00%	0.00%	0.00%	99%	98%	0.00%	0.00%	0.00%	100%	100%
Class D	0.00%	0.00%	0.00%	99%	96%	0.00%	0.00%	0.00%	100%	100%
Class F (optional)	0.00%	0.00%	0.00%	99%	100%	0.00%	0.00%	0.00%	99%	100%

	Random Access Main 10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.04%	0.06%	0.09%	86%	102%	0.05%	0.06%	0.04%	92%	101%
Class A2	0.24%	0.31%	0.36%	87%	100%	0.29%	0.31%	0.33%	92%	100%
Class B	0.12%	0.32%	0.34%	88%	100%	0.07%	0.22%	0.21%	93%	100%
Class C	0.03%	0.05%	0.04%	91%	98%	0.06%	0.04%	0.05%	94%	99%
Class E										
Overall	0.10%	0.19%	0.22%	88%	100%	0.11%	0.16%	0.16%	93%	100%
Class D	0.02%	0.06%	-0.04%	93%	95%	0.06%	0.00%	0.04%	95%	99%
Class F (optional)	0.13%	0.28%	0.23%	91%	99%	0.13%	0.19%	0.20%	95%	100%

Test Results (SubCE1.0.15)

Test description

- QT+BT+TT (Same as VTM)
- Allowed CU ratio: up to 1:8
- Allowed size for 1:4 CU ratio and TT split: < 64

GCC version: 4.8.3
SIMD: AVX

Results

- JVET CTC
- BMS1.0 S/W
- AI (VTM/BMS)
  - No change
  - No change
- RA (VTM/BMS)
  - 0.4%, 76% EncT
  - 0.5%, 81% EncT
- LDB (VTM/BMS)
  - 0.3%, 80% EncT
  - 0.3%, 80% EncT

	All Intra Main10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.00%	0.00%	0.00%	99%	100%	0.00%	0.00%	0.00%	99%	99%
Class A2	0.00%	0.00%	0.00%	99%	100%	0.00%	0.00%	0.00%	99%	98%
Class B	0.00%	0.00%	0.00%	98%	98%	0.00%	0.00%	0.00%	99%	99%
Class C	0.00%	0.00%	0.00%	98%	95%	0.00%	0.00%	0.00%	100%	101%
Class E	0.00%	0.00%	0.00%	99%	97%	0.00%	0.00%	0.00%	100%	100%
Overall	0.00%	0.00%	0.00%	99%	98%	0.00%	0.00%	0.00%	100%	99%
Class D	0.00%	0.00%	0.00%	99%	97%	0.00%	0.00%	0.00%	100%	101%
Class F (optional)	0.00%	0.00%	0.00%	99%	98%	0.00%	0.00%	0.00%	99%	99%

	Random Access Main 10									
	Over VTM-1.0					Over BMS-1.0				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	0.66%	0.58%	0.66%	71%	102%	0.68%	0.59%	0.88%	74%	100%
Class A2	0.69%	0.67%	0.72%	74%	101%	0.79%	0.67%	0.70%	79%	100%
Class B	0.35%	0.50%	0.41%	76%	101%	0.38%	0.46%	0.42%	81%	100%
Class C	0.07%	0.04%	0.08%	83%	98%	0.17%	0.12%	-0.01%	86%	100%
Class E										
Overall	0.41%	0.43%	0.43%	76%	100%	0.46%	0.44%	0.45%	81%	100%
Class D	0.03%	0.05%	-0.08%	86%	95%	0.09%	0.02%	0.08%	88%	99%
Class F (optional)	0.22%	0.29%	0.25%	80%	98%	0.22%	0.29%	0.29%	85%	99%

Conclusions

- **We proposed BTT partitioning structure and two restriction methods to reduce complexity.**

- **BTT structure can be enabled by just changing parameters**
  - We suggest to enable BTT configuration w/ the encoder optimization technique (**SubCE1.0.13**) on VTM SW for study.

- **CU ratio restriction can be a good solution to control encoder complexity**
  - 0.1% loss with 10% encoding time saving for both VTM and BMS
  - By changing CU ratios to allow, encoder complexity can be adjusted.
  - We suggest to adopt CU ratio restriction (**SubCE1.0.14**) into next VVC WD.

Thanks Canon, HiSilicon, and HHI for crosschecking our proposal

Thank you

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Additional Test for Ratio Restriction

- Results for VTM RA
- Compared to HM16.18

vs. HM	BD-rate(Y)	EncT	DecT
VTM1.0	-8.4%	258%	92%
(1:16)	-8.4%	253%	92%
(1:8) (Test 1.0.14)	-8.3%	232%	92%
(1:4)	-7.7%	191%	92%
(1:2)	-4.2%	80%	92%