

CE11: Summary report on coefficient scanning and coding (JCTVC-E031/m19568)

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Sub Experiments in CE11

- **CE.A: Context Modeling/Selection and Binarization for Transform Coefficient related syntax elements**
 - D336/E253: "Coding of transform coefficient levels with Golomb-Rice codes" (HHI)
 - D185/E227: "Context size reduction for the significance map" (Panasonic)
 - D262/E338: "Parallel Context Processing for the significance map in high coding efficiency" (Qualcomm)
- **CE.B: Coefficient Scanning Methods**
 - D311/E296: "Adaptive coefficients scanning for inter-frame coding" (Huawei)
 - D374/E392: "Adaptive Coefficient Scanning for LCEC" (Qualcomm)

Summary of Modifications in CE11 Proposals

- **D336/E253 (HE)**
 - Modify binarization of coefficient levels
 - Change number of context-coded binary symbols
- **D185/E227 (HE)**
 - Change number of contexts for `significant_coeff_flag` and `last_significant_coeff_flag`
- **D262/E338 (HE)**
 - Modify method of signaling last significant coefficient information: Transmit location (X,Y) of last significant coefficient (instead of `last_significant_coeff_flag`) before all `significant_coeff_flag`
 - Modify context selection of first 10 `significant_coeff_flag`
- **D311/E296 (HE)**
 - For Inter CU, select one of three transform coefficient scanning method (zig-zag, vertical, horizontal) based on pixel texture for each block
 - New zig-zag scan proposed
- **D374/E392 (LC)**
 - For Intra CU in LCEC, change transform coefficient scanning for each coefficient position based on statistics (counter adaptation)

Cross-Verification

Proponent	Document	Tool description	Configurations/ Versions	Cross-checker
HHI	D336/E253	Coding of transform coefficient levels with Golomb-Rice codes	Ver.1 (sent 2/23/11)	RIM, TI
			Ver.2 (sent 3/7/11)	TI
Panasonic	D185/E227	Simplified Context modeling for Transform Coefficient Coding	N1	Qualcomm
			N2	Qualcomm
			N1N2	Qualcomm
Qualcomm	D262/E338	Context size reduction for the significance map		Panasonic, Sony
Huawei	D311/E296	Adaptive coefficients scanning for inter-frame coding	Proposal 1	HHI
			Proposal 2	HHI
			Proposal 3 (sent 3/11/11)	
Qualcomm	D374/E392	Adaptive Coefficient Scanning for LCEC	Ver.1 (sent 2/28/11)	Motorola, Sharp
			Ver.2 (sent 3/6/11)	Motorola, Sharp

Performance Measurement Criteria

- **Coding Performance Measurements**

- Coding Efficiency Results (BD-Rate) for High Efficiency
- HM-2.0 under common conditions

- **Complexity Measurements**

- The total number of bins and bin reduction/increase due to proposed technique
- A breakdown of the number of bins coded in regular and bypass mode for CABAC
- A breakdown of the number of bins for sig flag, last flag and absolute coefficient level
- Core experiment participants who investigate parallelization aspects are requested to provide a description showing how the parallelization is improved and which architecture(s) would see the benefit of the parallelization. Average and worst case throughput gain from parallelized methods should be considered.
- For Sub Experiment B:
 - Scheme of selecting the scan pattern during encoding needs to be described.
 - Scheme of updating the scan pattern during parsing needs to be described.

Reported Results (Coding Efficiency)

Proposal Document #		Configuration	Intra	Random Access	Low Delay
D336/E253	(ver. 1)	HE	0.02	0.03	-0.02
	(ver. 2)	HE	-0.05	-0.01	-0.05
D185/E227	(N1)	HE	-0.04	-0.08	-0.22
	(N2)	HE	0.08	0.08	0.02
	(N1N2)	HE	0.03	0.00	-0.14
D262/E338		HE	-0.03	0.01	-0.10
D311/E296	(proposal 1)	HE	N/A	-0.3	-1.0
	(proposal 2)	HE	N/A	-0.3	-0.8
D374/E392	(ver. 1)	LC	-1.0	-0.4	0.0
	(ver. 2)	LC	-1.0	-0.4	0.0

D374/E392 is for low complexity configuration (no bin distribution reported)

Reported Results (Syntax Element)

Proposal Document #	Intra			Random Access			Low Delay		
	% sig	% last	% coeff	% sig	% last	% coeff	% sig	% last	% coeff
ANCHOR	29%	14%	24%	26%	10%	16%	27%	9%	12%
D336/E253 (ver. 1)	29%	14%	23%	26%	10%	15%	27%	9%	12%
D336/E253 (ver. 2)	29%	14%	23%	26%	10%	15%	27%	9%	12%
D185/E227 (N1)	29%	14%	24%	26%	10%	16%	27%	9%	12%
D185/E227 (N2)	29%	14%	24%	26%	10%	16%	27%	9%	12%
D185/E227(N1N2)	29%	14%	24%	26%	10%	16%	27%	9%	12%
D262/E338	29%	11%	25%	26%	9%	16%	26%	10%	11%
D311/E296 (proposal 1)	N/A	N/A	N/A	24%	10%	10%	25%	9%	9%
D311/E296(proposal 2)	N/A	N/A	N/A	23%	10%	10%	23%	9%	9%

D374/E392 is for low complexity configuration (no bin distribution reported)

Reported Results (Total Bin Count)

Proposal Document #	Intra	Random Access	Low Delay
D336/E253 (ver. 1)	-1	0	0
D336/E253 (ver. 2)	-1	0	0
D185/E227 (N1)	0	0	0
D185/E227 (N2)	0	0	0
D185/E227(N1N2)	0	0	0
D262/E338	-5	-2	0
D311/E296 (proposal 1)	N/A	0%	-2%
D311/E296(proposal 2)	N/A	-1%	-3%

D374/E392 is for low complexity configuration (no bin distribution reported)

Reported Results (Coding Method)

Proposal Document #	Intra		Random Access		Low Delay	
	% reg	% bypass	% reg	% bypass	% reg	% bypass
ANCHOR	86%	14%	86%	13%	88%	11%
D336/E253 (ver. 1)	81%	19%	84%	15%	87%	12%
D336/E253 (ver. 2)	81%	19%	84%	15%	87%	12%
D185/E227 (N1)	86%	14%	86%	13%	88%	11%
D185/E227 (N2)	86%	14%	86%	13%	88%	11%
D185/E227(N1N2)	86%	14%	86%	13%	88%	11%
D262/E338	85%	15%	86%	13%	88%	11%
D311/E296 (proposal 1)	N/A	N/A	86%	13%	88%	12%
D311/E296(proposal 2)	N/A	N/A	86%	13%	87%	12%

D374/E392 is for low complexity configuration (no bin distribution reported)

Reported Results (Context Count)

JCTVC-D185 (N1)	Increase number of context	sig %	last %	coeff %	total %
	Intra only	-22.4%	0.0%	0.0%	-6.6%
	Random access	-22.4%	0.0%	0.0%	-5.9%
	Low Delay	-22.4%	0.0%	0.0%	-5.9%
JCTVC-D185 (N2)	Increase number of context	sig %	last %	coeff %	total %
	Intra only	0.0%	-73.1%	0.0%	-20.8%
	Random access	0.0%	-73.1%	0.0%	-18.6%
	Low Delay	0.0%	-73.1%	0.0%	-18.6%
JCTVC-D185 (N1N2)	Increase number of context	sig %	last %	coeff %	total %
	Intra only	-22.4%	-73.1%	0.0%	-27.3%
	Random access	-22.4%	-73.1%	0.0%	-24.4%
	Low Delay	-22.4%	-73.1%	0.0%	-24.4%
JCTVC-D262	Increase number of context	sig %	last %	coeff %	total %
	Intra only	58.9%	15.4%	0.0%	21.6%
	Random access	58.9%	15.4%	0.0%	19.3%
	Low Delay	58.9%	15.4%	0.0%	19.3%

Reported Results (Enc/Dec Time)

Proposal Document #	Intra		Random Access		Low Delay	
	Enc	Dec	Enc	Dec	Enc	Dec
D336/E253 (ver. 1)	104%	103%	103%	106%	103%	109%
D336/E253 (ver. 2)	99%	98%	100%	97%	99%	100%
D185/E227 (N1)	100%	100%	101%	99%	101%	98%
D185/E227 (N2)	100%	99%	100%	99%	100%	99%
D185/E227(N1N2)	100%	99%	100%	98%	100%	97%
D262/E338	100%	101%	100%	99%	98%	102%
D311/E296 (proposal 1)	N/A	N/A	102%	103%	102%	102%
D311/E296(proposal 2)	N/A	N/A	106%	101%	106%	101%
D336/E253 (ver. 1)	102%	102%	101%	99%	98%	99%
D336/E253 (ver. 2)	101%	101%	101%	99%	96%	101%