CE6: Low-complexity adaptive coefficient scanning

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Introduction

❖ **Coefficients scanning method in Current HEVC Test Model**

- CABAC condition
  - Context-adaptive scanning method
- LCEC condition
  - Zigzag method
- Coefficients scanning method is not same for CABAC and LCEC entropy coding

❖ **Proposed method**

- A consistent and low complexity coefficients scanning method for both CABAC and LCEC entropy coding
  - 3 simple scanning patterns: default, horizontal and vertical scanning
  - No additional buffer is necessary for horizontal and vertical scanning

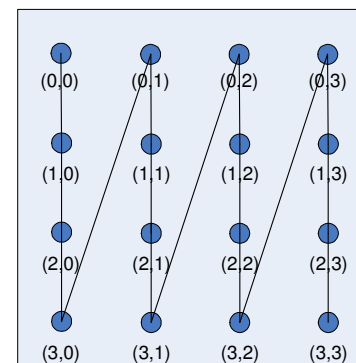# Adaptive Coefficient Scanning with explicit signalling

❖ Adaptive Coefficient Scanning with explicit signalling proposed in JCTVC-C205

  ▪ Three scanning patterns: zigzag, horizontal and vertical scanning
  ▪ Scanning pattern index is explicitly signalled
    • Best scanning index is selected according to RD Cost in RDOQ function
  ▪ Overhead is encoded for the TU in which non-zero AC coefficients exist
  ▪ Chroma signal uses the luma scanning index in the same block
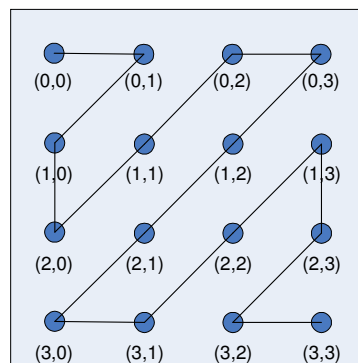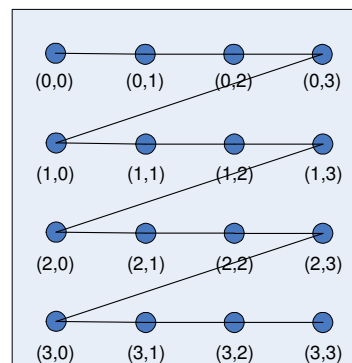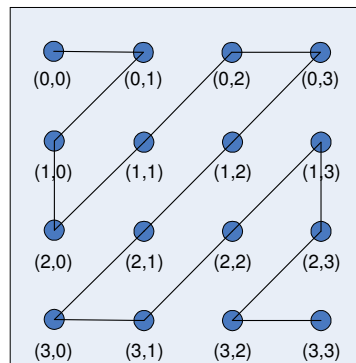

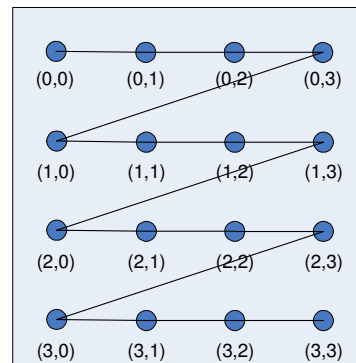Zigzag scan   Horizontal scan   Vertical scan
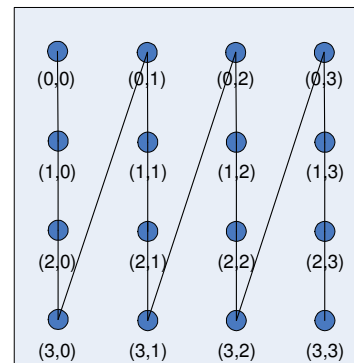
❖ Optimized Adaptive Coefficient Scanning

- Three scanning patterns: zigzag, horizontal and vertical scanning
- Intra CU
  - Mode dependent coefficient scanning method from Qualcomm (JCTVC-D393) to reduce encoding complexity
- Inter CU
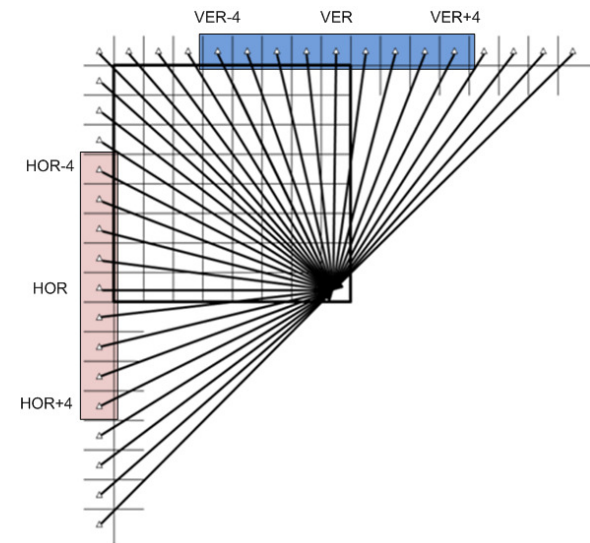 - Best scanning pattern mode is explicitly signalled

Zigzag scan   Horizontal scan   Vertical scan

Experimental results -- 1

❖ Average 0.6% BD-rate gain is achieved by optimised ACS

 ▪ Additional chroma BD-rate gain

❖ Mode dependent coefficient scanning method efficiently reduces encoder complexity

		ACS					Optimised ACS				
		Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Intra	HE	-1.2	-1.6	-1.6	121%	100%	-1.0	-1.2	-1.2	102%	102%
RA	HE	-0.5	-0.9	-0.8	113%	98%	-0.6	-0.8	-0.7	112%	101%
LD	HE	-0.6	-0.9	-0.9	114%	102%	-0.6	-0.9	-0.8	108%	98%
Intra	LoCo	-0.1	-0.7	-0.8	137%	99%	-0.1	-0.3	-0.4	98%	100%
RA	LoCo	-0.1	-0.6	-0.7	111%	100%	-0.2	-0.5	-0.4	113%	104%
LD	LoCo	-1.0	-2.2	-2.2	109%	100%	-1.1	-2.1	-2.3	105%	97%

Experimental results -- 2

❖ **Proportion of significant flags bin of CABAC reduction compare to default scanning method in HE configuration**

- Reduce parsing complexity of CABAC

Configuration	ACS	Optimised ACS
HE Intra	6.2%	2.4%
HE Random access	8.4%	6.5%
HE Low delay	14.0%	14.2%
Total average	**9.5%**	**7.7%**

Conclusion

❖ Propose a consistent coefficients scanning method for both CABAC and LCEC entropy coding in HEVC test model

❖ Average *0.6%* BD-rate gain is achieved by optimized ACS comparing to HM scanning method
  - ▪ Similar decoding time to anchor
    - • Memory access to scanning table buffer is reduced by 40%
  - ▪ Small encoding time increasing

❖ Suggestion
  - ▪ Adopt proposed optimised ACS method as a consistent scanning method for both CABAC and LCEC entropy coding in next version of HM
  - ▪ Set up CE/ad-hop for coefficient scanning topic to find the optimal and identical scanning method for both CABAC and LCEC entropy coding