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Non-CE11: Parallel Context Assignment for Significance Map Coding

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Overall Summary

- Method 1 – a new context formation pattern that removes dependency of three previously decoded bins for 2-level diagonal scan in large TUs

- Method 2 – a new 2-level diagonal-vertical scan with a new context formation pattern for large TUs

- Benefits of the two proposed methods
  - Allow 4-bin parallel context assignment as well
  - Unified pattern for each position in a 4x4 subblock

- Results
  - 0.2% and 0.1% bit rate increases for HE and LC, respectively
  - No run time change

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# Parallel Context Assignment for Sig. Map Coding

- In HM-5.0, pattern-based context formation is adopted for large TUs

- For 2-bin parallel context assignment, two patterns are used for different positions of coefficients

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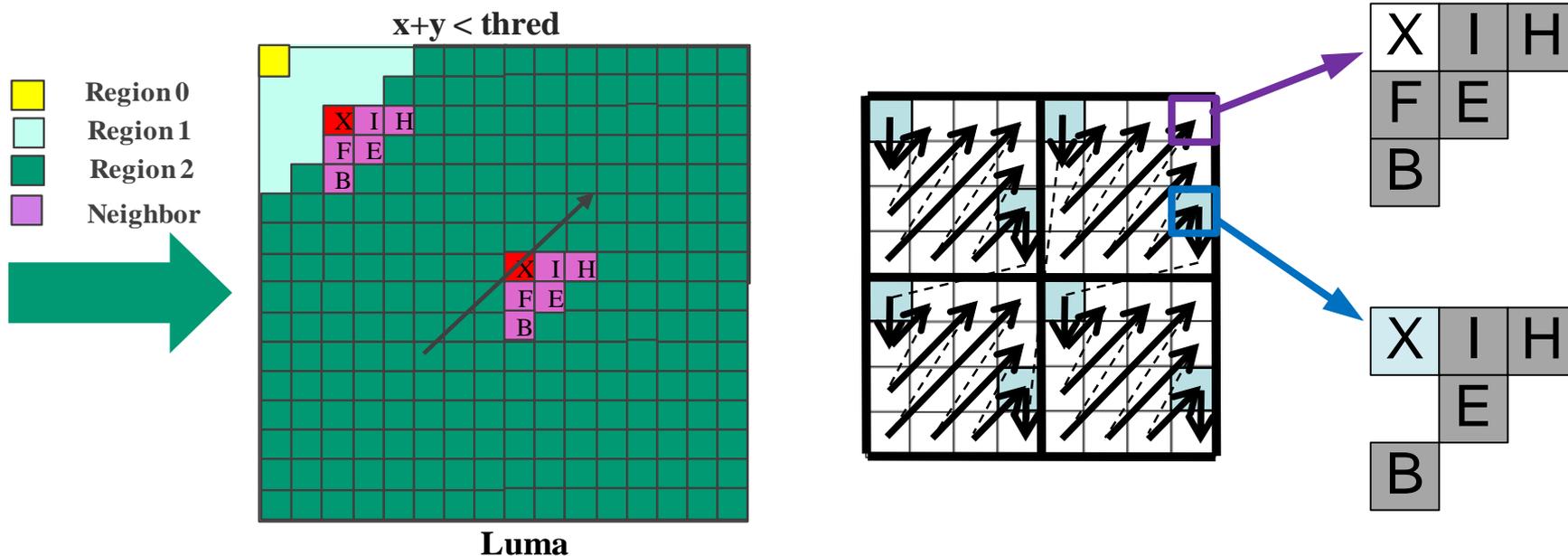
Extend to 3-bin or 4-bin Parallel

- Direct remove the dependency of three previously decoded
  - JCTVC-H0352 (CE11.3.1.4), JCTVC-H0253

- Non-uniform position-based context formation patterns
 - Up to 5 patterns are used, irregular mapping table

JCTVC-H0352

4x4 sub-block
For 4 bins parallel
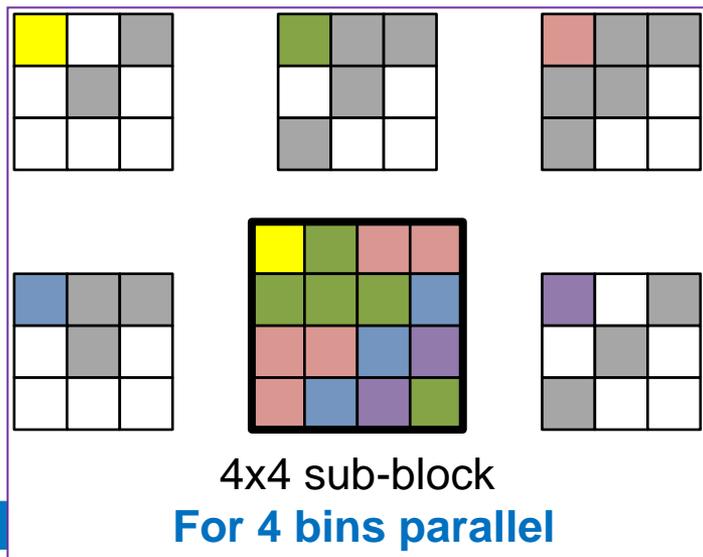
JCTVC-H0253

Reference types

0,4,5,6,8,
9,10,12,13   1,7,11   2   3   15

A   B   C   D   E

3
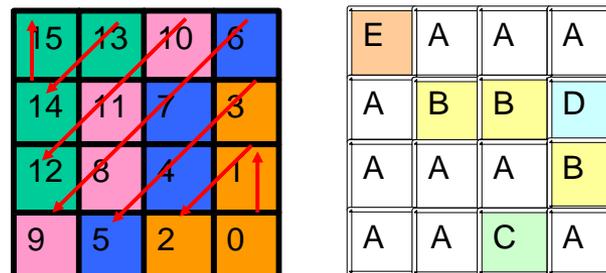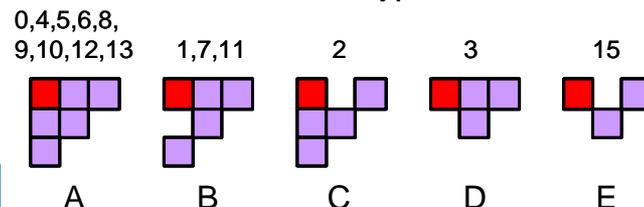
Proposed Context Formation Pattern

- A new context formation pattern that removes dependency of three previously decoded bins
  - Designed for the 2-level diagonal scan in HM-5.0
  - Allow 4-bin parallel context assignment
  - Shift the original context formation pattern to the right by 1 pixel
  - Use the same pattern for the entire subblock
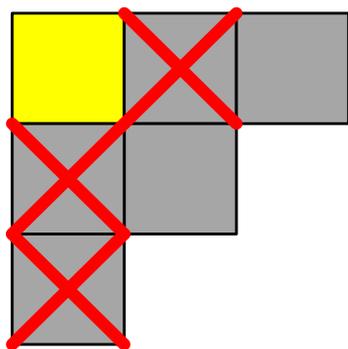
Remove the dependency of three previous bins

Proposed Pattern

4-bin Parallel

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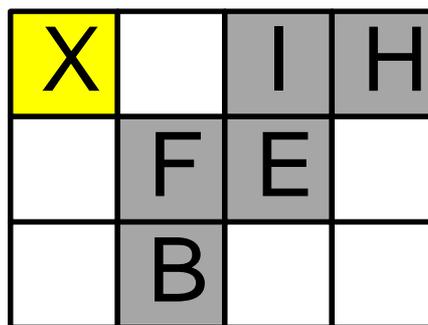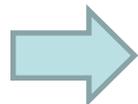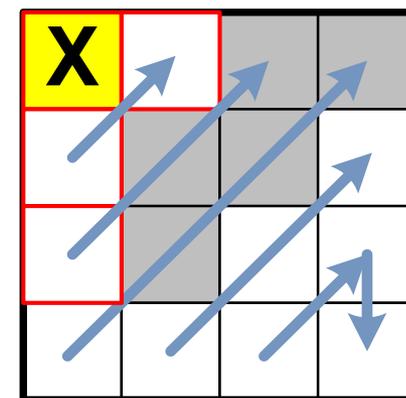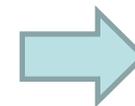
Proposed 2-level Diagonal-Vertical Scan

- To simplify the coefficient coding in subblocks, a new 2-level diagonal-vertical scan is proposed
  - Uses vertical scan within 4x4 subblocks
  - More regular and requires fewer logic gates for address generator in hardware implementation

- Use a new context formation pattern that removes dependency of the same scan line
  - Allow 4-bin parallel context assignment
  - Use the same pattern for the entire subblock
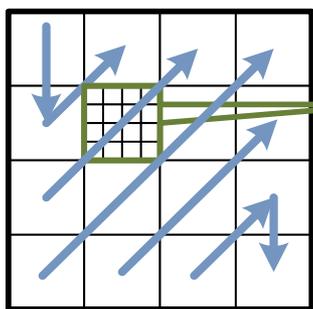
Proposed Scan

Proposed Pattern

4-bin Parallel

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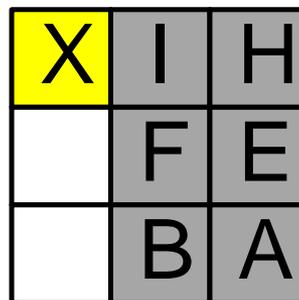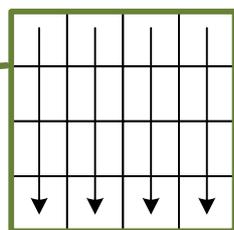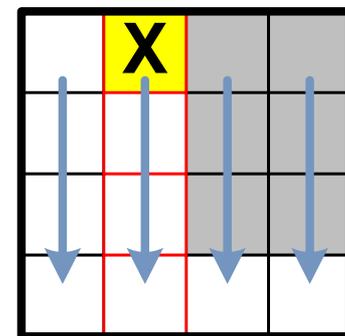
Results

- 0.1-0.2% bit rate increase in QP = 22, 27, 32, 37

- 0.0-0.1% bit rate increase in QP = 12, 17, 22, 27

- No run time increase
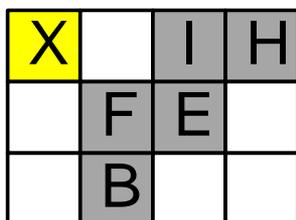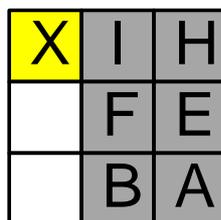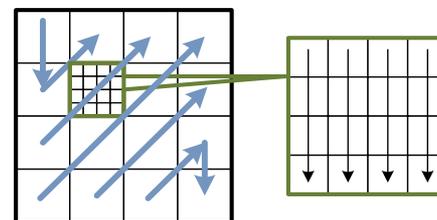
**Pattern 1**　　　　**Pattern 2**　　　　**2-level Diag.-Ver. Scan**

	AI-HE	RA-HE	LB-HE	AI-LC	RA-LC	LB-LC
2-level Diag. scan + Pattern 1	0.2	0.2	0.2	0.1	0.1	0.1
2-level Diag.-Ver. Scan + Pattern 2	0.2	0.2	0.2	0.1	0.1	0.1
2-level Diag. scan + Pattern 1 **(Low QP)**	0.1	0.2	0.2	0.1	0.1	0.1
2-level Diag.-Ver. Scan + Pattern 2 **(Low QP)**	0.2	0.2	0.2	0.1	0.1	0.1

Thanks Qualcomm for cross-checking (JCTVC-H0688)

Comparison with Other Proposals of 4-bin Parallel Context Assignment

- Our proposed methods have similar coding efficiency but with uniform pattern

Normal QP (QP = 22, 27, 32, 37)

	Pattern	AI-HE	RA-HE	LB-HE	AI-LC	RA-LC	LB-LC
JCTVC-H0253	non-uniform	0.1	0.1	0.1	0.1	0.0	0.0
JCTVC-H0352 M2	non-uniform	0.2	0.1	0.1	0.1	0.1	0.1
JCTVC-H0427 M1	non-uniform	0.1	0.1	0.1	0.1	0.1	0.1
JCTVC-H0427 M3	non-uniform	0.2	0.1	0.2	0.1	0.2	0.1
Proposed M1 (diag.-diag.)	**uniform**	0.2	0.2	0.2	0.1	0.1	0.1
Proposed M2 (diag.-ver.)	**uniform**	0.2	0.2	0.2	0.1	0.1	0.1

Low QP (QP = 12, 17, 22, 27, 32)

	Pattern	AI-HE	RA-HE	LB-HE	AI-LC	RA-LC	LB-LC
JCTVC-H0253	non-uniform						
JCTVC-H0352 M2	non-uniform	0.1	0.1	0.1	0.1	0.1	0.0
JCTVC-H0427 M1	non-uniform						
JCTVC-H0427 M3	non-uniform						
Proposed M1 (diag.-diag.)	**uniform**	0.1	0.1	0.1	0.0	0.1	0.0
Proposed M2 (diag.-ver.)	**uniform**	0.1	0.1	0.1	0.0	0.1	0.0

Conclusions

- Proposed method 1: A new context formation pattern that removes dependency of three previously decoded bins for 2-level diagonal scan

- Proposed method 2: A new 2-level diagonal-vertical scan and a new context formation pattern that removes dependency of the same scan line

- Both methods allow 4-bin parallel context assignment and use only one pattern for the entire subblock

- BD-rate=0.2% for HE, BD-rate=0.1% for LC, no run time increase

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