JCTVC-Q0032
Description of Screen Content Coding Technology Proposal by NCTU and ITRI

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Summary

* HM-13.0+RExt-6.0

* IntraBC Extensions
  – Line-based IntraBC
  – Pingpong BV predictor (P0217)

* Palette Coding (based on P0108)
  – Major color merging (P0152)
  – Sub-row copy above mode

* Combined IntraBC and Palette Coding

* Adaptive MV Precision (P0283)

Performance Summary

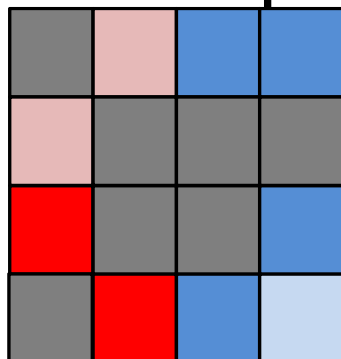|	Lossy			Lossless		
	AI	**RA**	**LB**	**AI**	**RA**	**LB**
RGB, Text & Graphics, 1080p	28.6	17.3	13.7	35.0	34.5	34.6
RGB, Text & Graphics, 720p	14.9	12.3	10.4	15.1	15.4	15.8
RGB, Mixed Content , 1440p	9.5	7.7	10.0	5.5	8.9	9.8
RGB, Mixed Content, 1080p	11.1	8.7	8.0	9.4	11.2	11.4
RGB, Animation, 720p	0.8	1.5	2.3	0.9	7.7	8.2
YUV, Text & Graphics, 1080p	26.3	15.6	10.5	29.3	24.6	22.8
YUV, Text & Graphics, 720p	12.7	10.6	8.2	13.0	10.8	9.9
YUV, Mixed Content , 1440p	9.2	6.6	7.6	4.1	2.4	2.3
YUV, Mixed Content, 1080p	10.5	7.8	6.5	7.8	5.6	5.2
YUV, Animation, 720p	0.6	0.6	0.8	0.5	2.3	2.2
Encoding Time	169%	122%	121%	187%	128%	125%
Decoding Time	103%	86%	115%	99%	111%	114%

Combined IntraBC & Palette Coding

✳ Pixel Classification (based on IntraBC prediction error)

– If |error| < threshold, IntraBC prediction & no residual coding

– Otherwise, palette coding for PCM samples (k=2)

– Threshold: same as the quant. step size for major color mapping

✳ Pixel Indexing

– index = 0: IntraBC predicted samples

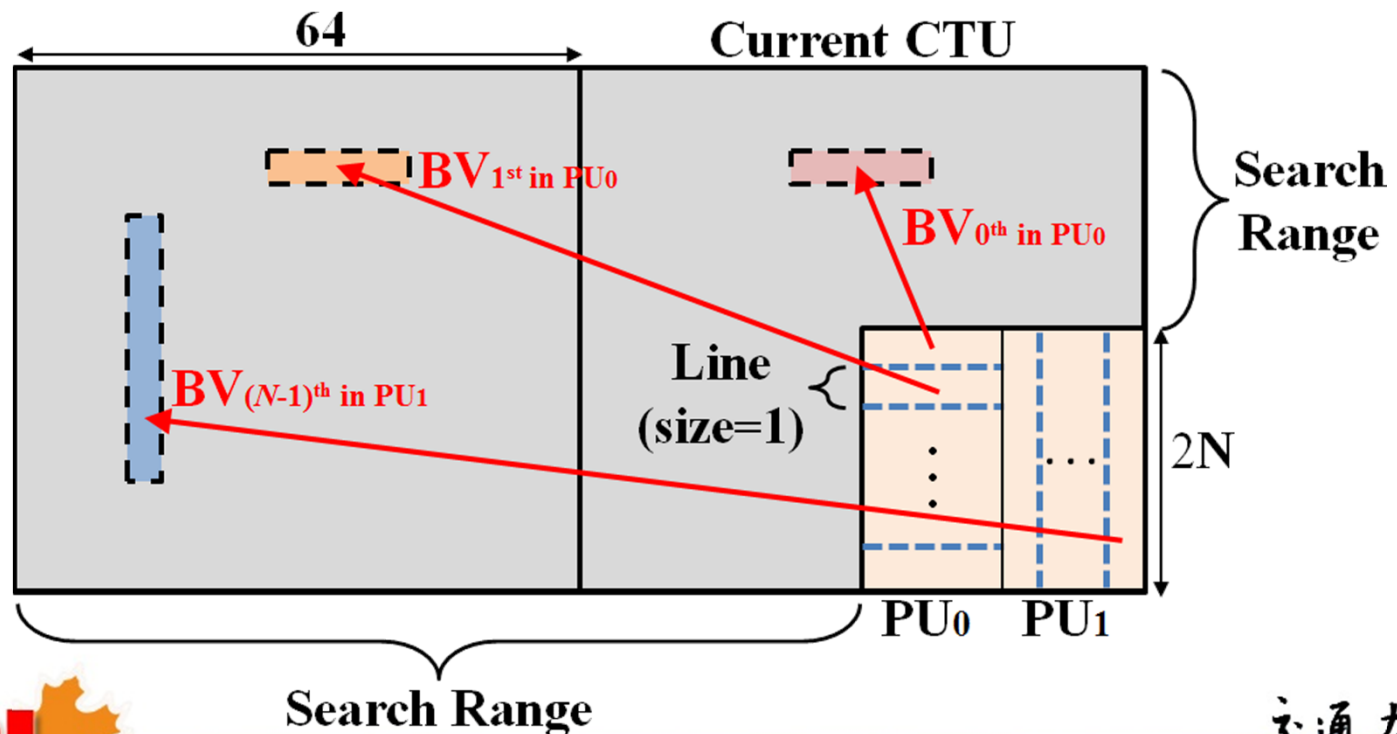– index = 1~N: samples with palette coding (N=1,…,3)

Block Samples

Index Map

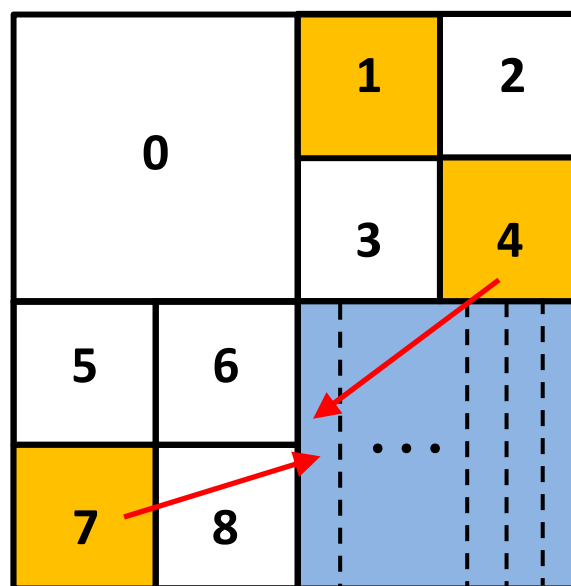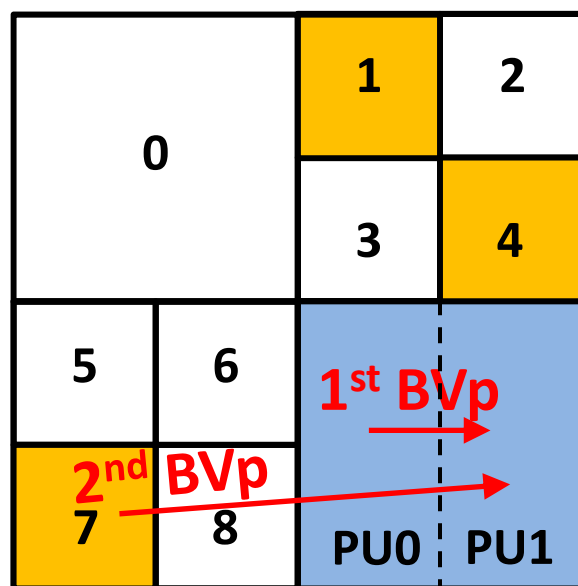| 1 | 0 | 0 | 0 |
0	1	2	3
0	1	2	0
1	0	0	0

Samples with higher prediction errors

Line-based IntraBC

* Divide a PU horizontally or vertically into lines
* Perform 2-D line-based IntraBC, with one BV per line shared across different color components
* Same search area constraint as for HM-13.0+RExt-6.0

Pingpong BV Prediction

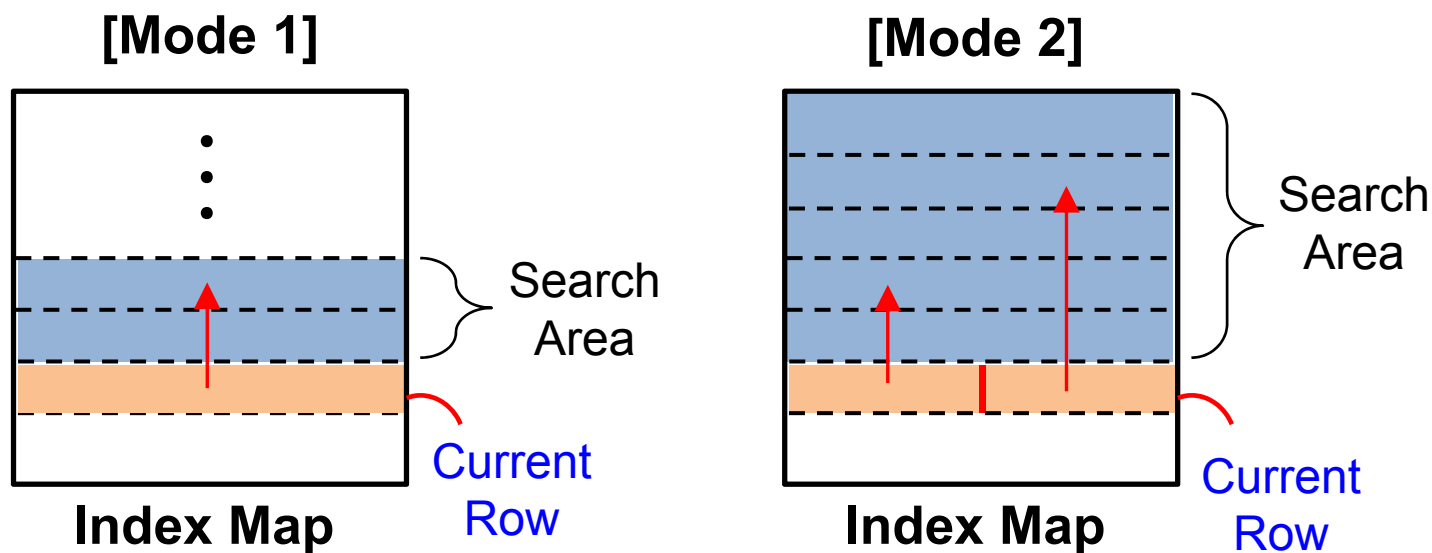＊ Use the last 2 decoded BVs as predictors (P0217)

＊ Initialization process

- Both unavailable: $(-w, 0)$ & $(-2w, 0)$

- Only one available: the other initialized as $(-w, 0)$
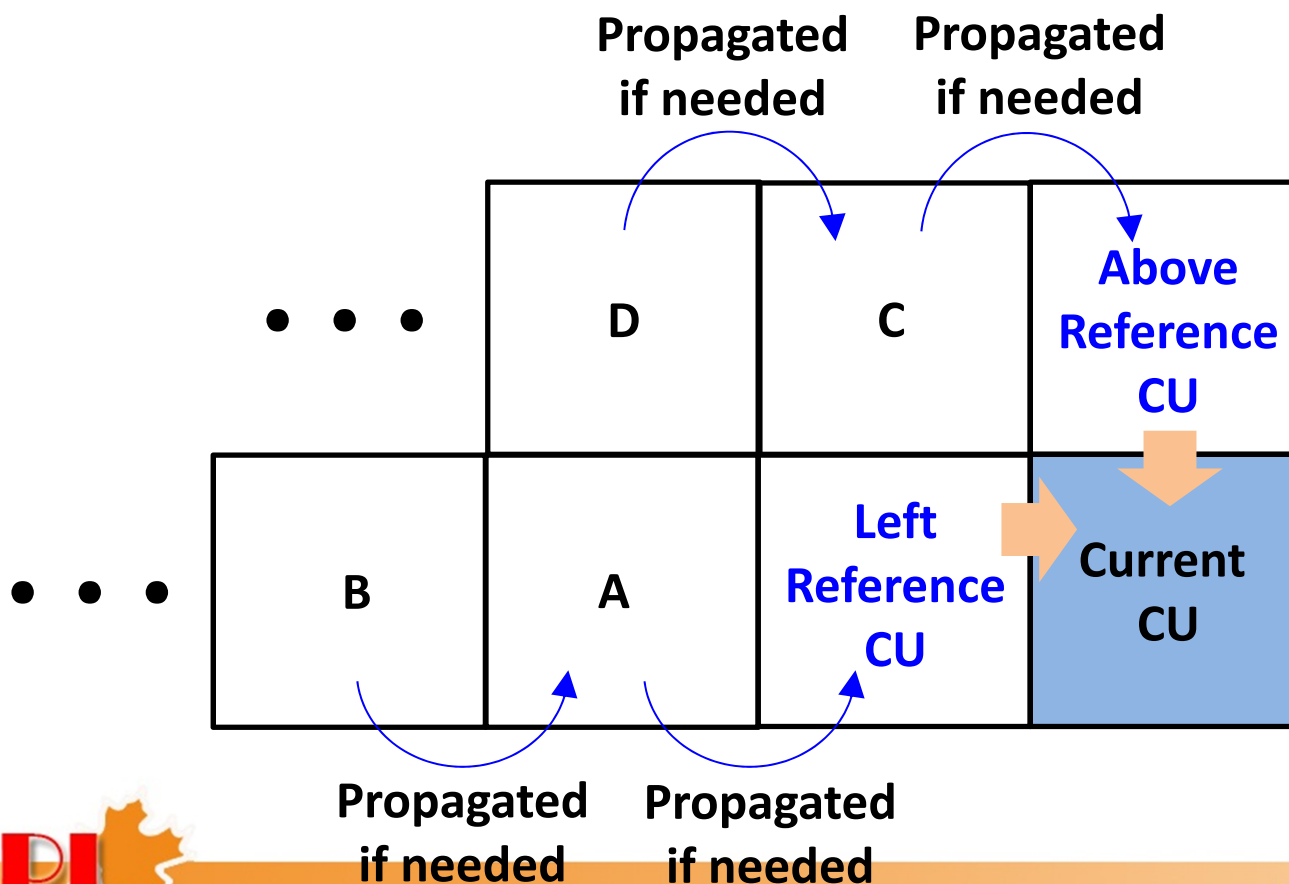
- w is the current CU's width

Current

IBC Block

IntraBC PU

Copy Above Modes for Index Coding

✳ **Mode 1:** Copy from one of the last two above rows

✳ **Mode 2:** Split a row equally into two segments, each coded independently either with normal mode or extended copy above mode which includes all its above rows as candidates for copying

[Mode 1]

[Mode 2]

Search Area

Current Row

Index Map

Search Area

Current Row

Index Map

Major Color Merging & Propagation

* Infer major colors from either left or above CU (P0152)
* When unavailable, propagate major colors from the first available CU to the left of the reference CU (P0096)

Adaptive MV Precision (P0283)

✳ One flag at CU level to indicate its use

✳ Truncate to integer-precision by rounding to zero

- – Both MVp and MVd for MVd coding
- – Merged MVs for merge mode

Additional Results

✳ Enlarge IntraBC search area to cover the entire frame

✳ Only 1-D search in the extended search area

Lossy Results	Without Extension			With Extension		
	AI	RA	LB	AI	RA	LB
RGB, Text & Graphics, 1080p	28.6	17.3	13.7	**39.3**	**25.8**	**21.2**
RGB, Text & Graphics, 720p	14.9	12.3	10.4	**22.1**	**17.8**	**14.9**
RGB, Mixed Content , 1440p	9.5	7.7	10.0	**19.3**	**14.0**	**13.6**
RGB, Mixed Content, 1080p	11.1	8.7	8.0	**17.3**	**13.2**	**10.4**
YUV, Text & Graphics, 1080p	26.3	15.6	10.5	**37.5**	**24.0**	**18.1**
YUV, Text & Graphics, 720p	12.7	10.6	8.2	**20.0**	**16.1**	**11.9**
YUV, Mixed Content , 1440p	9.2	6.6	7.6	**19.9**	**14.1**	**11.6**
YUV, Mixed Content, 1080p	10.5	7.8	6.5	**17.1**	**12.7**	**8.9**
Encoding Time	169%	122%	121%			
Decoding Time	103%	86%	115%			

Concluding Remarks

* Major changes/improvements to HM-13.0+RExt-6.0
  - Line-based IntraBC
  - Palette coding with sub-row copy above mode
  - Combined IntraBC and palette coding
* The first two are conceptually similar to applying 1-D string matching to prediction and index map coding
* The combination of IntraBC and palette coding provides interesting gains
* We recommend further study of these tools in the context of CEs/TEs