

CE7-related: Modified subblock coding passes for coding TS residual (JVET-00295)

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Overall Summary

- In VVC Draft 5, each subblock needs to go through six subblock coding passes for entropy coding the associated coefficient levels
- Proposal
 - Modified subblock processing flow with the number of subblock coding passes reduced by 2 (from 6 to 4)
 - Modified context modeling based on the proposed subblock processing flow
- Summary of average luma BD bitrate results

CTCs	All Intra (AI)					Random Access (RA)					Low Delay B (LB)				
	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec
Class F	-0.23%	-0.15%	0.00%	100%	98%	-0.16%	-0.02%	0.15%	99%	101%	-0.10%	-0.05%	-0.46%	99%	97%
TGM	-0.45%	-0.37%	-0.36%	101%	100%	-0.31%	-0.16%	-0.23%	100%	98%	-0.20%	-0.19%	-0.18%	99%	95%

TS Residual Coding in VVC Draft 5

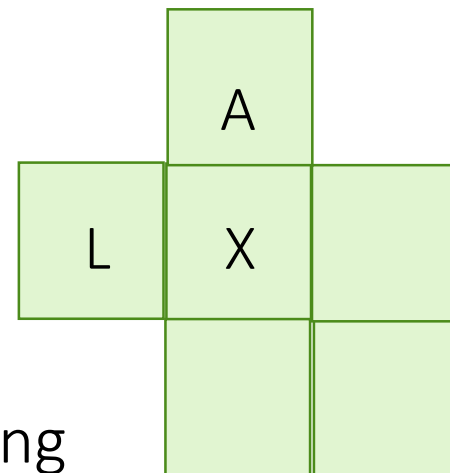
- Transform subblock processing flow in VVC Draft 5
 - Pass 1: Signal `sig_coeff_flag[n]`, `coeff_sign_flag[n]`, `abs_level_gtX_flag[ n ][ 0]`, `par_level_flag[n]` for each `n` if present
 - Pass 2: Signal `abs_level_gtX_flg1g[ n ][1 ]` for each `n` if present
 - Pass 3: Signal `abs_level_gtX_flg1g[ n ][2 ]` for each `n` if present
 - Pass 4: Signal `abs_level_gtX_flg1g[ n ][3 ]` for each `n` if present
 - Pass 5: Signal `abs_level_gtX_flg1g[ n ][4]` for each `n` if present
 - Pass 6: Signal `abs_remainder[n]` for each `n` if present
- The syntax elements `par_level_flag[n]` and `abs_level_gtX_flg1g[n][j]`, $j = 0..4$, are each coded by single contexts

Proposed Transform Subblock Processing Flow

- $\text{abs_level_gtX_flag}[n][j]$, $j = 1..4$, are signaled in one pass
- A dedicated pass for $\text{par_level_flag}[n]$ after $\text{abs_level_gtX_flag}[n][j]$
- Proposed transform subblock processing flow
 - Pass 1: Signal $\text{sig_coeff_flag}[n]$, $\text{coeff_sign_flag}[n]$, $\text{abs_level_gtX_flag}[n][0]$ for each n if present
 - Pass 2: Signal $\text{abs_level_gtX_flag}[n][j]$, $j = 1..4$ for each n if present
 - Pass 3: Signal $\text{par_level_flag}[n]$ for each n if present
 - Pass 4: Signal $\text{abs_remainder}[n]$ for each n if present

Proposed Context Modeling

- The context increment, ctxInc, for entropy coding `abs_level_gtx_flag[n][j]` is derived by

$$\text{ctxInc} = ((\text{absLevelPartA} \geq ((j+1) \ll 1)) \mid \mid \\ (\text{absLevelPartL} \geq ((j+1) \ll 1))) ? 1 : 0$$


- The context increment, ctxInc, for entropy coding `par_level_flag` is derived by

$$\text{ctxInc} = ((\text{AbsLevelPassX} \gg 1) == 1) ? 0 : \\ (((\text{AbsLevelPassX} \gg 2) == 1) ? 1 : 2),$$

where $\text{AbsLevelPassX} = \text{sig_coeff_flag}[n] + \text{abs_level_gtX}[n][0] + 2 * \\ (\text{abs_level_gtX}[n][1] + \text{abs_level_gtX}[n][2] + \text{abs_level_gtX}[n][3] + \\ \text{abs_level_gtX}[n][4])$

- Use 7 additional context variables

Experimental Results Over Standard QPs

- Anchor: VTM-5.0 under the SCC CTCs
- Test A (top): Anchor + proposed subblock processing flow
- Test B (bottom): Test A + proposed context modeling
- Thank LGE for cross check

	All Intra (AI)					Random Access (RA)					Low Delay B (LB)				
	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec
Class F	-0.05%	-0.03%	-0.02%	100%	101%	-0.08%	-0.10%	0.03%	98%	102%	-0.01%	0.04%	0.07%	98%	98%
TGM	-0.05%	-0.06%	-0.05%	99%	101%	-0.11%	-0.09%	-0.13%	99%	99%	-0.08%	-0.20%	-0.11%	98%	95%

	All Intra (AI)					Random Access (RA)					Low Delay B (LB)				
	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec
Class F	-0.23%	-0.15%	0.00%	100%	98%	-0.16%	-0.02%	0.15%	102%	104%	-0.10%	-0.05%	-0.46%	99%	101%
TGM	-0.45%	-0.37%	-0.36%	101%	100%	-0.31%	-0.16%	-0.23%	100%	100%	-0.20%	-0.19%	-0.18%	100%	98%

Experimental Results Over Low QPs

- Anchor: VTM-5.0 under the SCC CTCs over QPs = 2, 7, 12, 17
- Test A (top): Anchor + proposed subblock processing flow
- Test B (bottom): Test A + proposed context modeling
- Thank LGE for cross check

	All Intra (AI)					Random Access (RA)					Low Delay B (LB)				
	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec
Class F	-0.10%	-0.13%	-0.12%	100%	100%	0.03%	-0.09%	-0.05%	99%	104%	-0.05%	0.01%	0.00%	101%	104%
TGM	-0.41%	-0.31%	-0.32%	100%	100%	3.30%	-0.25%	-0.24%	100%	100%	-0.73%	-0.29%	-0.33%	100%	100%

	All Intra (AI)					Random Access (RA)					Low Delay B (LB)				
	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec
Class F	-0.23%	-0.15%	-0.17%	101%	99%	-0.41%	-0.15%	-0.21%	99%	95%	-0.15%	0.06%	0.07%	100%	98%
TGM	-0.54%	-0.39%	-0.39%	101%	100%	3.61%	-0.50%	-0.46%	101%	100%	-0.81%	-0.35%	-0.44%	100%	102%

Conclusions

- Proposed subblock processing flow reduces the number of subblock coding passes by 2 while providing slight BD bitrate improvements
- Further combined with the proposed context modeling for `abs_level_gtx_flag[n][j]` and `par_level_flag` using 7 additional context variables, the proposed method achieves luma BD bitrates as follows:

CTCs	All Intra (AI)					Random Access (RA)					Low Delay B (LB)				
	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec	Y	Cb	Cr	Enc	Dec
Class F	-0.23%	-0.15%	0.00%	100%	98%	-0.16%	-0.02%	0.15%	99%	101%	-0.10%	-0.05%	-0.46%	99%	97%
TGM	-0.45%	-0.37%	-0.36%	101%	100%	-0.31%	-0.16%	-0.23%	100%	98%	-0.20%	-0.19%	-0.18%	99%	95%