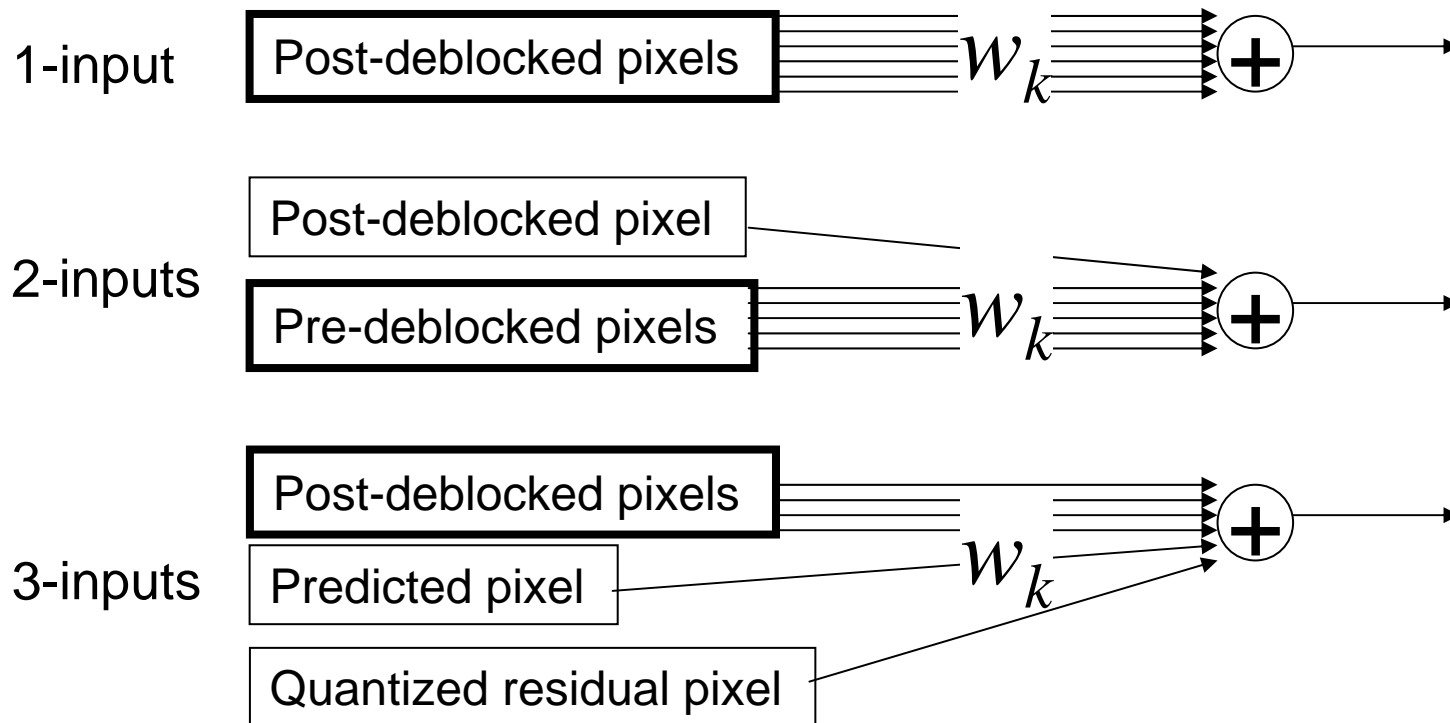**TOSHIBA**

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JCTVC-D192: Analysis on the interaction between deblocking filtering and in-loop filtering

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TOSHIBA

Background

- **Mandate 3 of In-loop and post-processing filtering**
  - Discuss relationships and evaluation procedures for the filtering techniques

- **In CE8.2, 1/2/3-inputs Wiener-based in-loop filters are proposed**

1-input — Post-deblocked pixels — w_k — ⊕

2-inputs — Post-deblocked pixel / Pre-deblocked pixels — w_k — ⊕

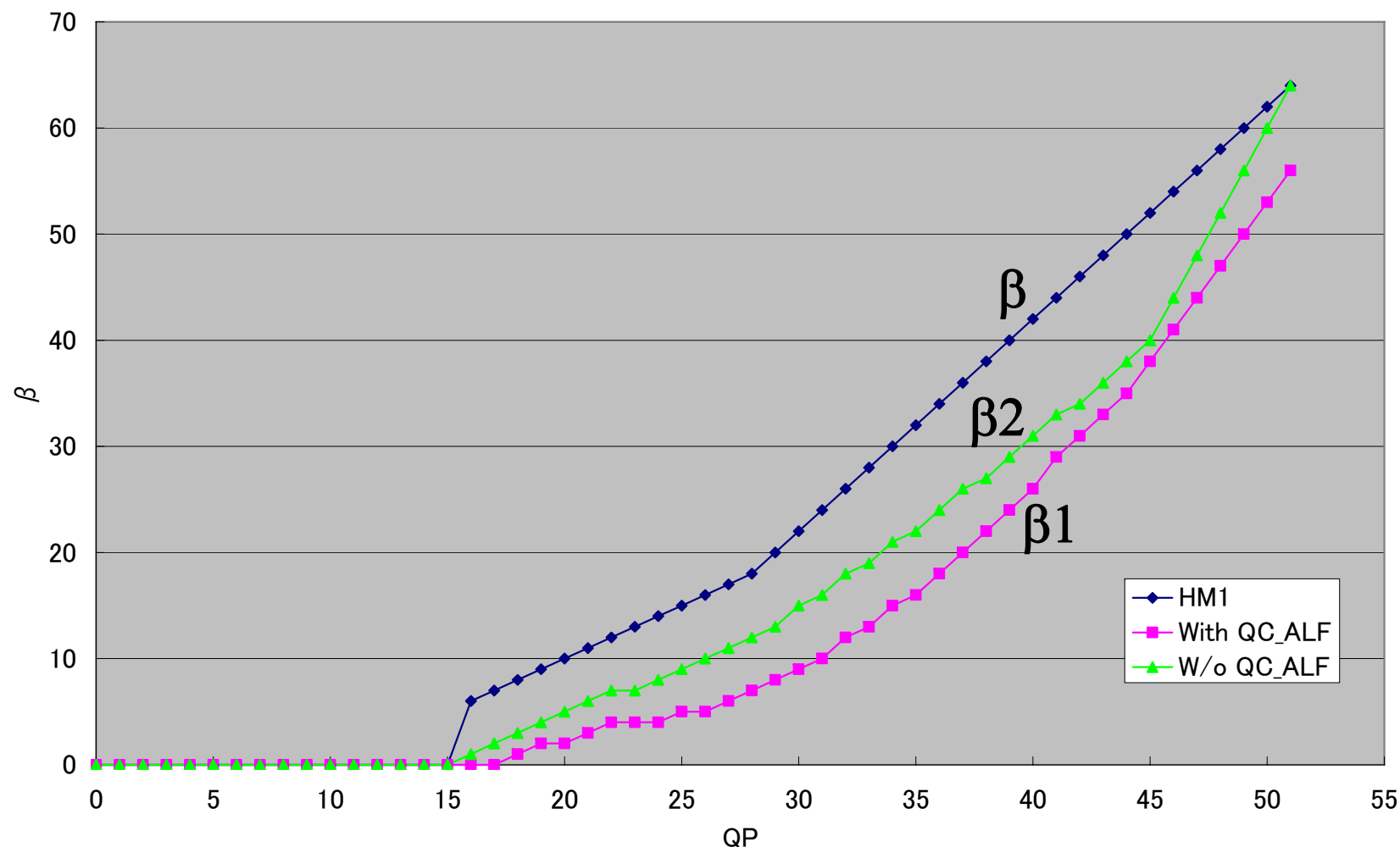3-inputs — Post-deblocked pixels / Predicted pixel / Quantized residual pixel — w_k — ⊕

Summary

- **Analysis on the interaction between deblocking filtering and in-loop filtering by adjusting parameter β of deblocking filter**
  - In High Efficiency conditions, parameter β is modified to improve the coding gain for with and without QC_ALF cases
    - Additional bitrate reduction of 0.7% for I Only case, 0.5% for Random Access case and 0.7% for Low Delay case when comparing the modified β for each cases.
  - The modified parameter is applied to MQT_ALF (JCTVC-D119)
    - Bitrate reduction of 0.7% for I Only case, 1.0% for Random Access case and 3.1% for Low Delay case compared to the High Efficiency HM1 anchor.

- **Cross-checked by MediaTek for QC_ALF cases (JCTVC-D293)**

- **Recommend to use different default β values for deblocking filtering according to the usage of ALF so that the default value can provide the best performance.**

Modification of β values

Offsetting Qp is applied when referring to the β values in HM1.
Six High Efficiency cases are tested; (IO, RA, LD) x (with QC_ALF, w/o QC_ALF)

Experimental Results – Interaction Analysis –

High Efficiency			With QC_ALF (β vs β1)			W/o QC_ALF (β vs β2)		
			IO	RA	LD	IO	RA	LD
A	S01	Traffic	**-1.2**	**-1.7**		-0.1	-0.6	
	S02	PeopleOnStreet	**-1.3**	**-0.3**		0.0	0.8	
B	S03	Kimono	**-0.6**	**-0.3**	**-0.4**	0.0	0.1	0.1
	S04	ParkScene	**-1.2**	**-1.1**	**-1.5**	-0.2	-0.3	-0.3
	S05	Cactus	**-0.9**	**-1.0**	**-1.4**	-0.2	-0.2	-0.5
	S06	BasketballDrive	**-0.9**	**-0.1**	**-0.5**	-0.3	0.2	0.0
	S07	BQTerrace	**-0.7**	**-0.7**	**-1.1**	-0.2	0.1	-0.2
C	S08	BasketballDrill	**-0.9**	**-1.1**	**-1.4**	-0.4	-0.6	-0.9
	S09	BQMall	**-0.7**	**-0.3**	**-0.5**	-0.1	0.0	0.0
	S10	PartyScene	**-0.4**	**-0.2**	**-0.3**	-0.1	-0.1	0.0
	S11	RaceHorses	**-0.6**	**0.0**	**-0.2**	-0.1	0.4	0.2
D	S12	BasketballPass	**-0.7**	**0.0**	**-0.2**	-0.2	0.2	0.3
	S13	BQSquare	**-0.2**	**-0.5**	**-0.3**	-0.1	-0.3	0.2
	S14	BlowingBubbles	**-0.4**	**-0.4**	**-0.7**	-0.2	-0.4	-0.3
	S15	RaceHorses	**-0.9**	**-0.1**	**-0.6**	-0.2	0.4	-0.1
E	S16	Vidyo1	**-0.8**		**-2.4**	0.0		-0.9
	S17	Vidyo3	**-0.9**		**-2.7**	-0.2		-0.8
	S18	Vidyo4	**-0.9**		**-2.5**	-0.1		-1.1
Class A			**-1.2**	**-1.0**		0.0	0.1	
Class B			**-0.9**	**-0.7**	**-1.0**	-0.2	0.0	-0.2
Class C			**-0.6**	**-0.4**	**-0.6**	-0.2	-0.1	-0.2
Class D			**-0.6**	**-0.3**	**-0.4**	-0.2	0.0	0.0
Class E			**-0.9**		**-2.5**	-0.1		-0.9
Total			**-0.8**	**-0.5**	**-1.0**	-0.1	0.0	-0.3

JCTVC-D192 loop filtering

0.7%, 0.5% and 0.7% additional gain are observed for IO, RA and LD. 5

Experimental Results – Combination with MQT_ALF –

High Efficiency			MQT_ALF (β)			MQT_ALF (β1)		
			IO	RA	LD	IO	RA	LD
A	S01	Traffic	0.1	-0.1		**-1.0**	**-1.8**	
A	S02	PeopleOnStreet	0.0	0.0		**-1.3**	**-0.2**	
B	S03	Kimono	0.3	0.2	-0.4	**-0.2**	**-0.1**	**-0.9**
B	S04	ParkScene	0.0	-0.3	-2.1	**-1.3**	**-1.4**	**-4.0**
B	S05	Cactus	-0.2	-0.3	-2.1	**-0.7**	**-1.3**	**-3.6**
B	S06	BasketballDrive	0.2	-0.1	-0.6	**-0.7**	**-0.3**	**-1.1**
B	S07	BQTerrace	0.1	-0.8	-1.3	**-0.6**	**-1.8**	**-2.8**
C	S08	BasketballDrill	0.1	-1.5	-3.0	**-0.7**	**-2.7**	**-4.9**
C	S09	BQMall	0.2	-0.6	-2.3	**-0.4**	**-1.0**	**-3.1**
C	S10	PartyScene	0.0	-0.4	-1.6	**-0.3**	**-0.6**	**-2.1**
C	S11	RaceHorses	0.2	0.0	-0.5	**-0.4**	**0.0**	**-0.7**
D	S12	BasketballPass	0.0	-0.2	-0.5	**-0.7**	**-0.2**	**-0.8**
D	S13	BQSquare	-0.5	-1.6	-2.6	**-0.7**	**-2.0**	**-3.4**
D	S14	BlowingBubbles	0.0	-0.4	-1.1	**-0.4**	**-1.0**	**-1.9**
D	S15	RaceHorses	0.3	-0.3	-1.1	**-0.5**	**-0.4**	**-1.6**
E	S16	Vidyo1	0.4		-2.7	**-0.4**		**-4.6**
E	S17	Vidyo3	0.3		-5.6	**-0.7**		**-8.7**
E	S18	Vidyo4	0.3		-2.1	**-0.6**		**-4.7**
		Class A	0.1	0.0		**-1.1**	**-1.0**	
		Class B	0.1	-0.3	-1.3	**-0.7**	**-1.0**	**-2.5**
		Class C	0.2	-0.6	-1.9	**-0.5**	**-1.1**	**-2.7**
		Class D	-0.1	-0.6	-1.3	**-0.6**	**-0.9**	**-1.9**
		Class E	0.3		-3.5	**-0.7**		**-6.0**
		Total	0.1	-0.4	-1.9	**-0.7**	**-1.0**	**-3.1**

MQT_ALF with β1 achieved 0.7%, 1.0% and 3.1% gain compared to HM1.

Conclusion

- **Parameter β that controls filter on/off and affects strength of filtering for deblocking is adjusted for both with and w/o QC_ALF cases.**

- **QC_ALF shows additional bitrate reduction of 0.7%, 0.5% and 0.7% for HE IO, RA and LD cases.**

  – Some interaction between deblocking filter and QC_ALF is observed.

- **Coding efficiency is also improved for MQT_ALF.**

- **It is recommended to use different default β values for deblocking filtering according to the usage of ALF so that the default value can provide the best performance.**

  – When comparing ALF schemes, it is suggested to take into account for the reported results.