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JCTVC-B044

TE2: Adaptive scaling for bit depth
compression on IBDI

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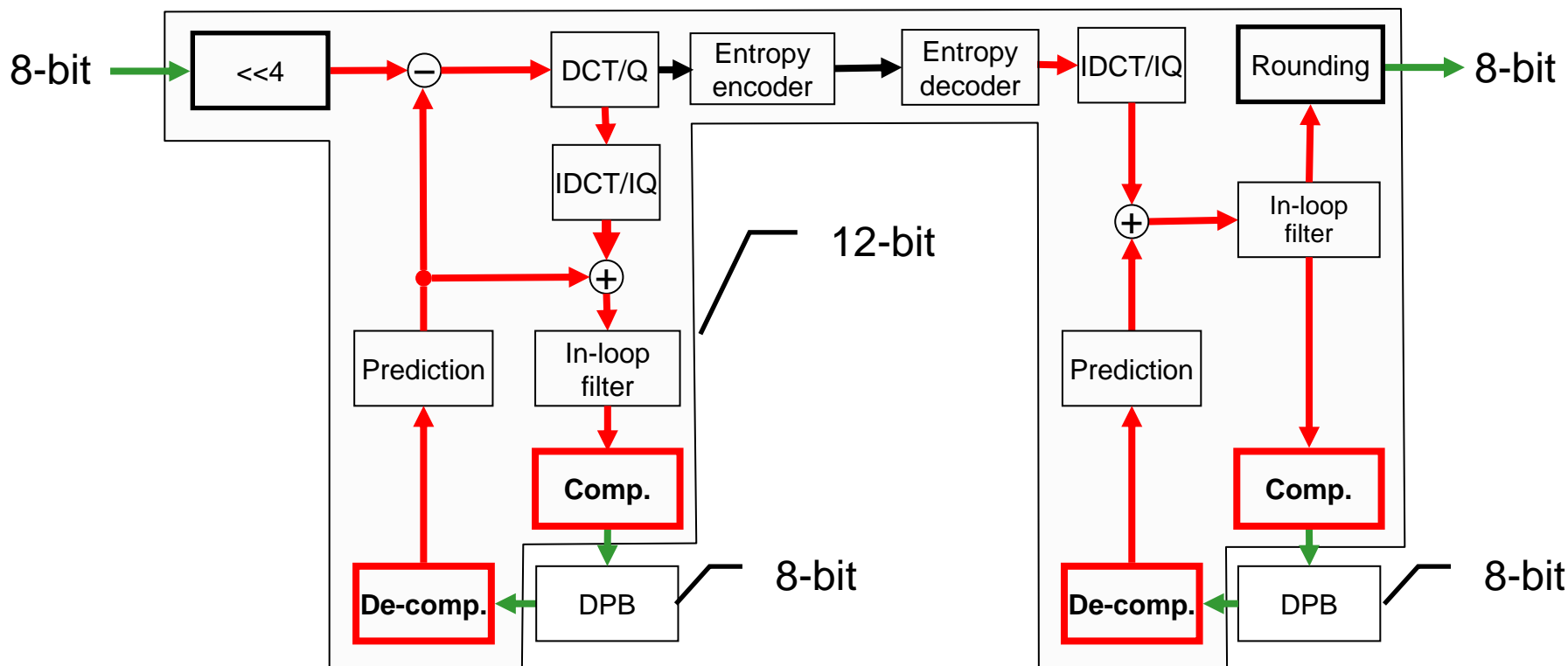
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Summary

- **TE2: IBDI and memory compression**
 - Bit depth compression on IBDI
 - Memory compression on IBDI off
- **Adaptive scaling for bit depth compression on IBDI**
- **Experimental results show the best performance in TE**
 - Loss is 0.13% compared to IBDI
 - Loss of fixed rounding is 0.94%

Bit depth compression on IBDI

- An example of internal 12-bit

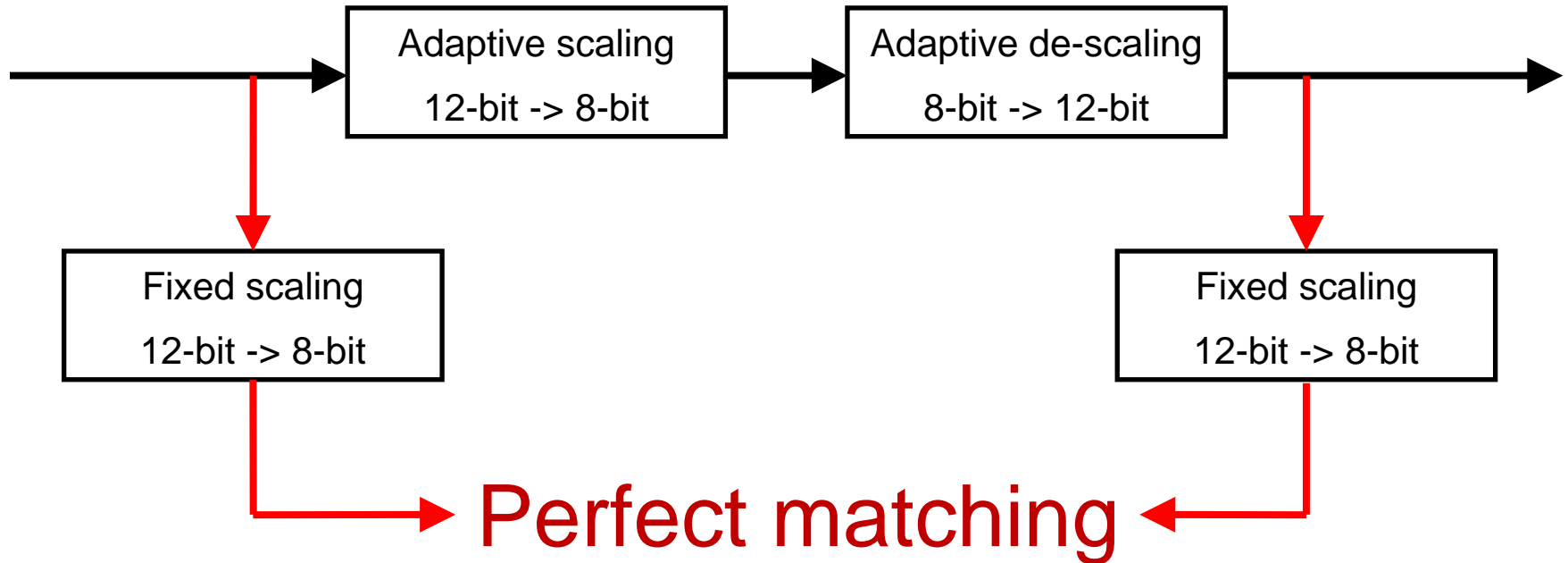


Adaptive scaling

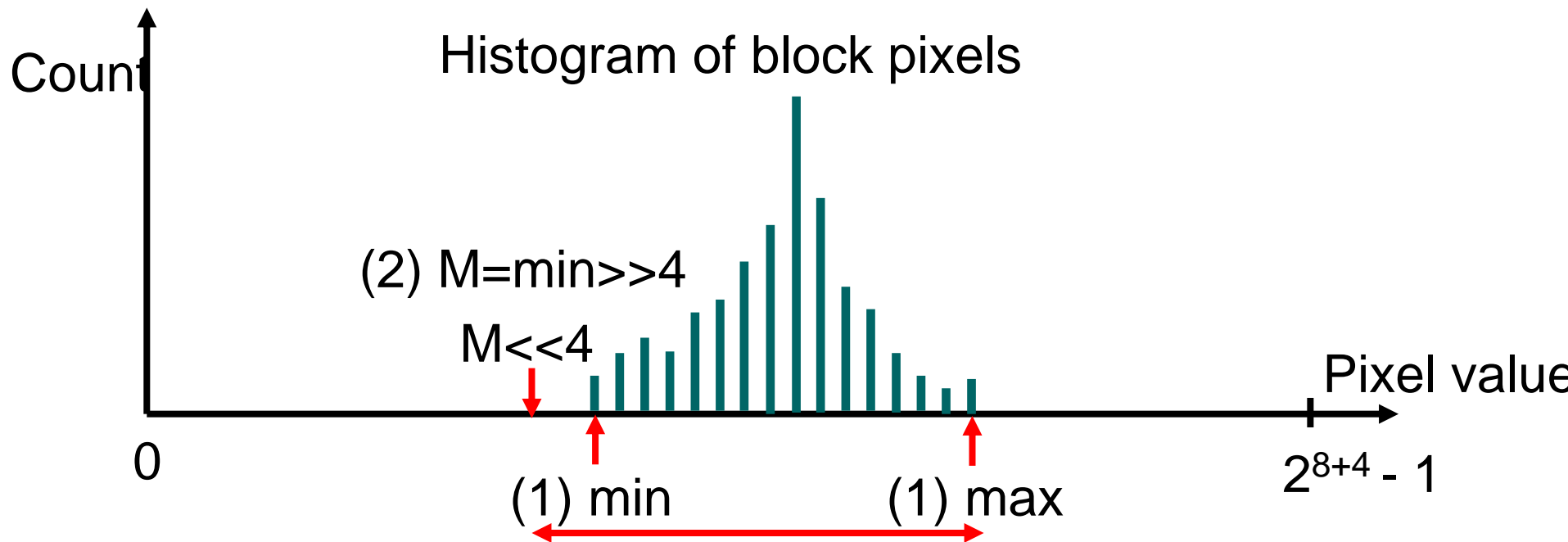
- **Dynamic range adaptive scaling**
- **Scaling process by block and de-scaling process by pixel.**
- **Loss less compression on 8-bit depth level**
 - Results surely better than fixed scaling
- **Complexity is negligible**
- **It is possible to integrate this tool and in-loop filtering process.**

Loss less compression on 8-bit depth level

- The bit value greater than 8-bit depth is not changed



Encoding process



(3) $R = \max - (M \ll 4);$

(4) for ($S=0; R \geq (128 \ll S) \ \&\& \ S < 4; S++$);

(5) if ($S == 4$) $p = (\text{pixel_value} + 8) \gg 4;$

else $p = (\text{pixel_value} - (M \ll 4)) \gg S;$

An example of format (non-nomative)

```
/* An example of compression format */  
f(1);                /* Fixed or Adaptive */  
if (flag) {  
    /* Fixed scaling: 128-bit */  
    for (i=0;i<16;i++) u(8); /* p */  
} else {  
    /* Adaptive scaling: 122-bit*/  
    u(2);              /* S: [0..3] */  
    u(8);              /* M: [0..255] */  
    for (i=0;i<16;i++) u(7); /* p*/  
}
```

Decoding process

- Fixed de-scaling

$$D = P \ll 4;$$

- Adaptive de-scaling

$$D = (P \ll S) + (M \ll 4) + ((S \neq 0) ? (1 \ll (S-1)) : 0);$$

Test condition

- **Configurations are base on JCTVC-A302r1:**
 - Implementation on modified KTA software version 2.6r1
 - HP1 + MVC + MDDT +QALF + IBDI +RDOQ1
- **Evaluation criteria**
 - Measure impact on bitrate/PSNR using provided data. Use 5-point BD-PSNR and BD-Rate.
 - Memory compression ratio.
 - Complexity (encoding and decoding times)
 - Subjective quality (informal comments)

Experimental results

			CS1		CS2	
			Adaptive	Fixed	Adaptive	Fixed
A	S01	Traffic	0.288	1.013	N/A	N/A
	S02	PeopleOnStreet	0.055	0.731	N/A	N/A
B	S03	Kimono	0.000	0.533	0.078	1.346
	S04	ParkScene	0.003	0.504	0.113	1.309
	S05	Cactus	-0.014	0.493	0.243	1.202
	S06	BasketballDrive	0.125	0.592	0.121	1.232
	S07	BQTerrace	0.029	0.926	0.436	1.751
C	S08	BasketballDrill	-0.027	0.201	0.052	1.416
	S09	BQMall	-0.022	0.298	0.038	0.640
	S10	PartyScene	-0.049	0.120	0.291	0.693
	S11	RaceHorses	0.136	0.223	0.141	0.366
D	S12	BasketballPass	-0.075	0.302	0.038	0.551
	S13	BQSquare	0.246	0.432	0.206	0.579
	S14	BlowingBubbles	0.024	0.397	0.046	0.713
	S15	RaceHorses	0.055	0.180	0.159	0.271
E	S16	Vidyo1	N/A	N/A	0.456	4.201
	S17	Vidyo3	N/A	N/A	0.648	3.004
	S18	Vidyo4	N/A	N/A	0.284	3.346

Experimental results (Summary)

	CS1				CS2			
	Adaptive		Fixed		Adaptive		Fixed	
	Loss (%)	Rate (bit)	Loss (%)	Rate (bit)	Loss (%)	Rate (bit)	Loss (%)	Rate (bit)
Class A	0.172	7.71	0.872	8.00	N/A		N/A	8.00
Class B	0.028	7.70	0.610	8.00	0.198	7.70	1.368	8.00
Class C	0.010	7.72	0.210	8.00	0.131	7.72	0.779	8.00
Class D	0.062	7.73	0.328	8.00	0.112	7.73	0.529	8.00
Class E	N/A	N/A	N/A	N/A	0.462	7.70	3.517	8.00
Total	0.052	7.71	0.463	8.00	0.209	7.71	1.414	8.00

Loss: Adaptive < Fixed

Complexity

- **Encoding and decoding time**
 - Increase rate (%) of average encoding and decoding times on IBDI

	Adaptive		Fixed	
Condition	CS1	CS2	CS1	CS2
Encoding Time	0.39	1.88	0.85	4.85
Decoding Time	5.94	6.67	5.66	7.78

Not significantly different

Conclusion

- **Adaptive scaling for bit depth compression on IBDI**
 - That loss is always smaller than loss of fixed rounding
 - Increase of complexity is negligible
- **This is one of the best solution of bit-depth compression of DPB on IBDI**
- **It is possible to integrate this process and in-loop filtering.**

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