JCTVC-C075
TE2: Adaptive scaling for bit depth compression on IBDI

Takeshi Chujoh
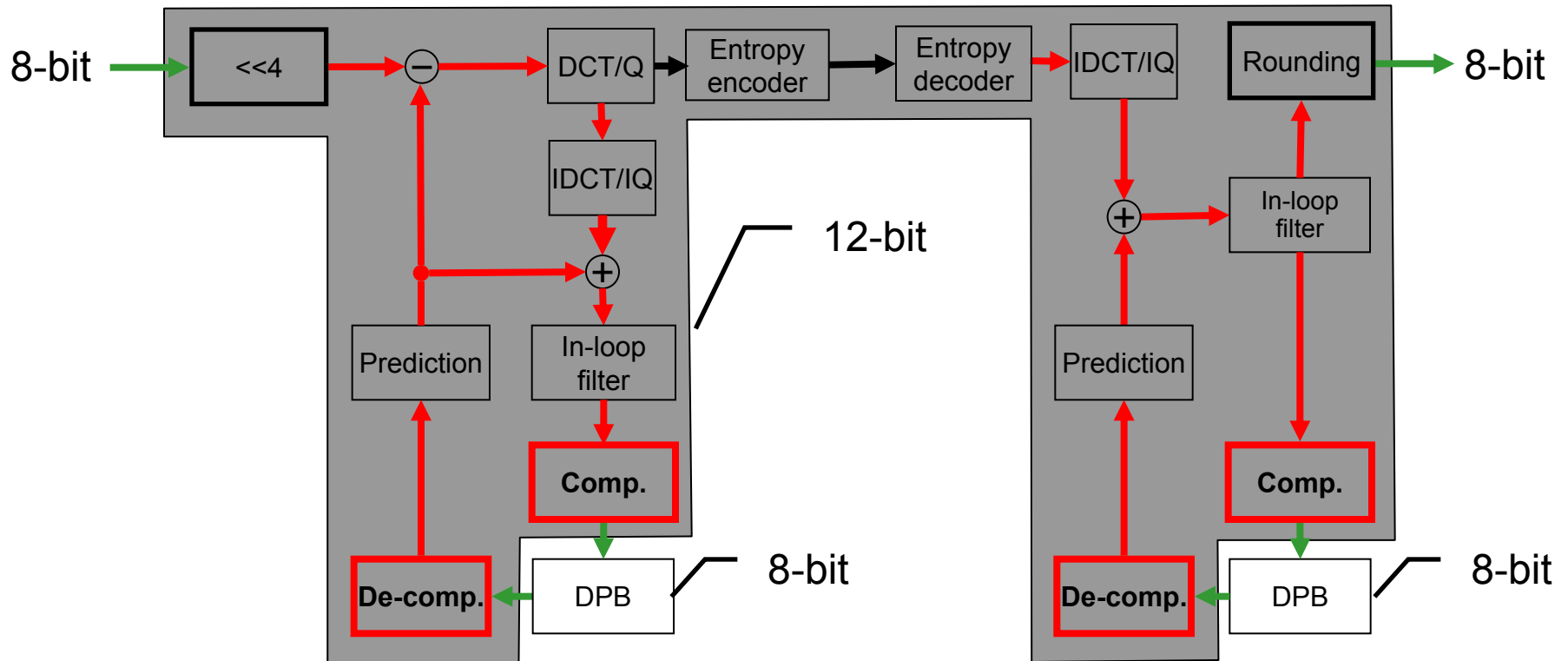Tomoo Yamakage

TOSHIBA CORPORATION

October 8, 2010

Summary

- **TE2: IBDI and memory compression**
  - Experiments on TMuC Software

- **Adaptive scaling for bit depth compression on IBDI**

- **Experimental results show the best performance in TE**
  - Loss is 0.78% compared to IBDI

Bit depth compression on IBDI
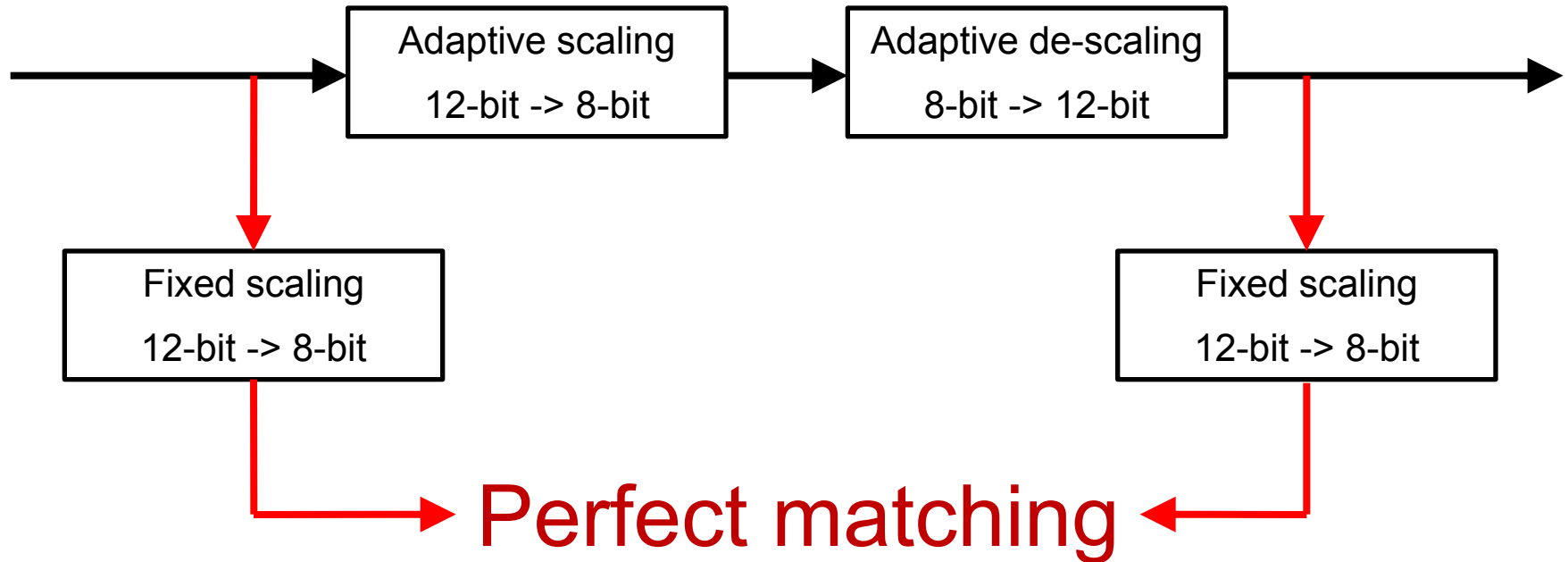
- **An example of internal 12-bit**
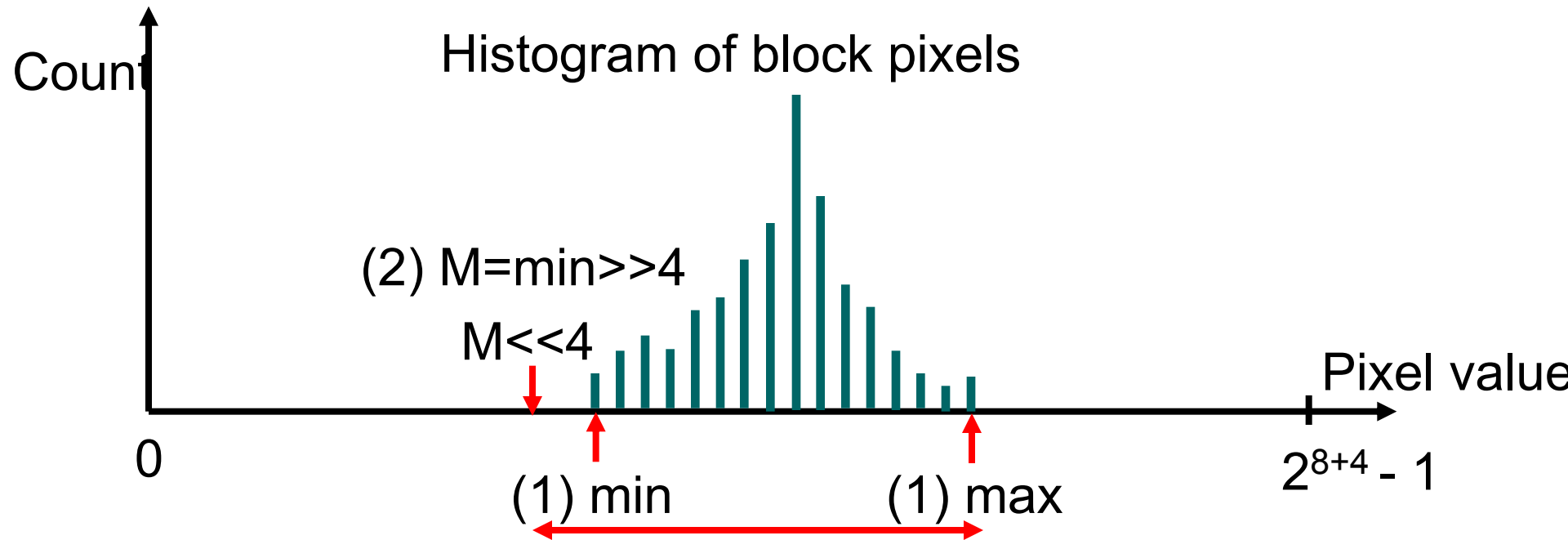
Adaptive scaling

- **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 grater than 8-bit depth is not changed**

Encoding process

Histogram of block pixels

Count

(2) M=min>>4

M<<4

Pixel value

0

2^{8+4} - 1

(1) min   (1) max

(3) R=max – (M<<4);

(4) for (S=0; R>=(128<<S) && S<4; S++);

(5) if (S==4) p = (pixel_value+8)>>4;

else p = (pixel_value – (M<<4))>>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

    $D = P << 4;$

- Adaptive de-scaling

    $D = (P << S) + (M<<4) + ((S!=0)? (1<<(S-1)):0);$

Test condition

- **Configurations are base on JCTVC-B302r1:**
  - Implementation on TMuC 0.7 with BUGFIX50TMP
  - Depth compression ratio 1: 12-bit to N-bit (Anchor including IBDI)
    - High coding efficiency, random access configuration
    - High coding efficiency, low delay configuration
  - Common test condition is specified in JCTVC-B300

- **Evaluation criteria**
  - Measure impact on bitrate/PSNR using provided data. Use 4-point BD-PSNR and BD-Rate.
  - Memory compression ratio.
  - Memory access measures
  - Complexity (encoding and decoding times)
  - Subjective quality (informal comments)

Experimental results

			Random access		Low delay	
			Adaptive	Fixed	Adaptive	Fixed
A	S01	Traffic	0.233	2.028	N/A	N/A
	S02	PeopleOnStreet	0.096	0.528	N/A	N/A
B	S03	Kimono	0.108	1.184	0.128	2.526
	S04	ParkScene	0.095	1.199	0.384	3.061
	S05	Cactus	0.262	2.795	1.522	9.295
	S06	BasketballDrive	0.039	0.857	0.155	2.321
	S07	BQTerrace	0.312	1.751	0.730	3.158
C	S08	BasketballDrill	0.156	1.584	0.732	3.864
	S09	BQMall	0.160	1.438	0.666	3.636
	S10	PartyScene	0.178	0.665	0.280	1.279
	S11	RaceHorses	0.047	0.319	0.069	0.679
D	S12	BasketballPass	0.092	0.647	0.262	1.507
	S13	BQSquare	0.273	1.078	0.581	1.972
	S14	BlowingBubbles	0.154	0.719	0.493	1.903
	S15	RaceHorses	0.001	0.378	0.089	0.971
E	S16	Vidyo1	N/A	N/A	5.463	27.428
	S17	Vidyo3	N/A	N/A	5.597	23.834
	S18	Vidyo4	N/A	N/A	5.355	25.010

Experimental results (Summary)

	Random access				Low delay			
	Adaptive		Fixed		Adaptive		Fixed	
	Loss (%)	Rate (bit)	Loss (%)	Rate (bit)	Loss (%)	Rate (bit)	Loss (%)	Rate (bit)
Class A	0.165	7.71	1.278	8.00	N/A	N/A	N/A	N/A
Class B	0.163	7.70	1.557	8.00	0.584	7.70	4.072	8.00
Class C	0.135	7.72	1.001	8.00	0.437	7.73	2.365	8.00
Class D	0.130	7.73	0.705	8.00	0.356	7.73	1.588	8.00
Class E	N/A	N/A	N/A	N/A	5.472	7.70	25.424	8.00
Total	0.147	7.72	1.145	8.00	1.407	7.71	7.028	8.00

Loss: Adaptive < Fixed

Complexity

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

Condition	Adaptive		Fixed	
	Random access	Low delay	Random access	Low delay
Encoding Time	0.316	0.472	5.277	7.310
Decoding Time	1.319	1.512	-0.899	2.888

Not significantly different

Memory access

- **Average motion compensation memory bandwidth saving rate (%)**
  - Both Luma and Chroma block size define 4x4
  - Rate defines 0.667

Alignment size/burst size	Random access	Low delay
32bit/64bit	-26.90	-27.40
64bit/128bit	-34.70	-35.50
128bit/128bit	-39.80	-40.90
256bit/256bit	-48.30	-49.50

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.**

TOSHIBA

Leading Innovation ❯❯❯