Description of video coding technology proposal by Renesas (JCTVC-A126)

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Summary

- **Coding tools**
  - **Intra repetitive pixel replenishment (Intra RPR) using block matching**
  - **2D adaptive interpolation filter (2D-AIF)**
  - **Motion vector competition**
  - **Extended block sizes (ExtMB): 32x32, 32x16, 16x32**

- **Experimental results**
  - **Set 1: BD-Bitrate -20.67 %, BD-PSNR 0.85 dB**
  - **Set 2: BD-Bitrate -11.79 %, BD-PSNR 0.49 dB**

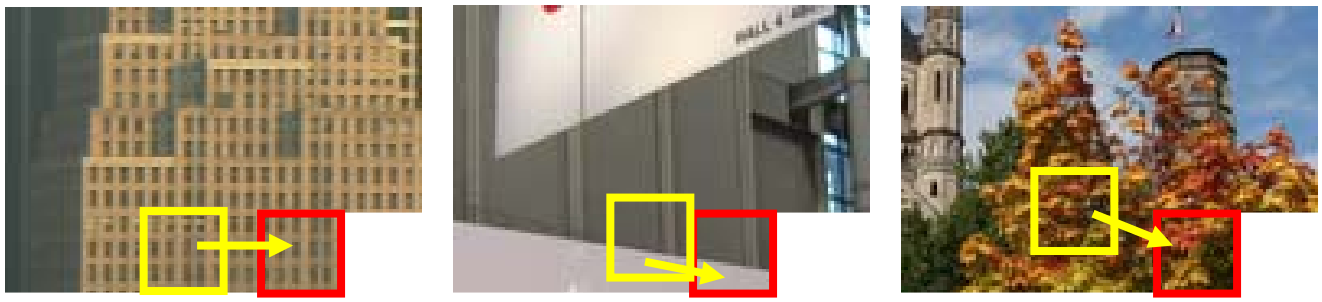
Improvement of intra coding efficiency

Motivation

- 26% of total bits is derived from Intra picture, which is the average of alpha anchor. (53% at the maximum case of alpha anchor)
- Improvement of Intra picture quality effects coding efficiency of following inter predicted picture.
- On the other hand,
  - AVC intra predicted image does NOT have enough quality.
  - AVC intra prediction uses only neighboring pixels of target MB.

Basic idea

- Intra vector prediction by block matching
- Prediction from more pixels improves predicted image quality.

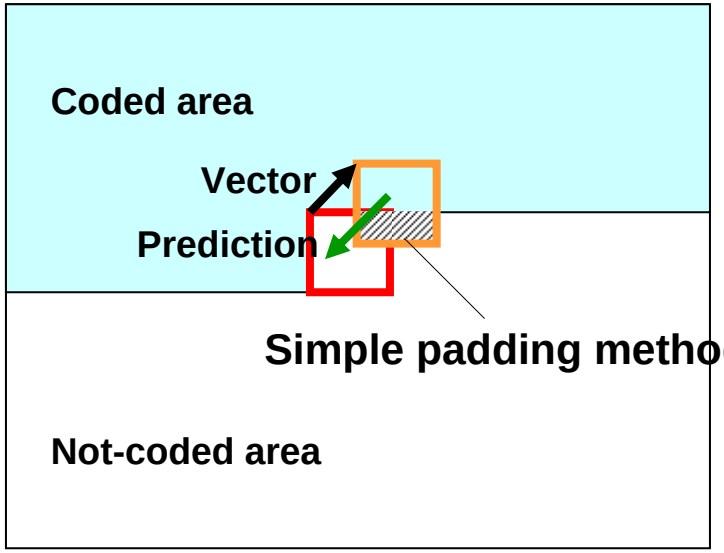


Examples fit for block matching and unfit for AVC intra prediction

Intra vector prediction

Problem of intra vector prediction

- **Prediction from closer pixels must derive better quality, but neighboring area is not coded yet.**



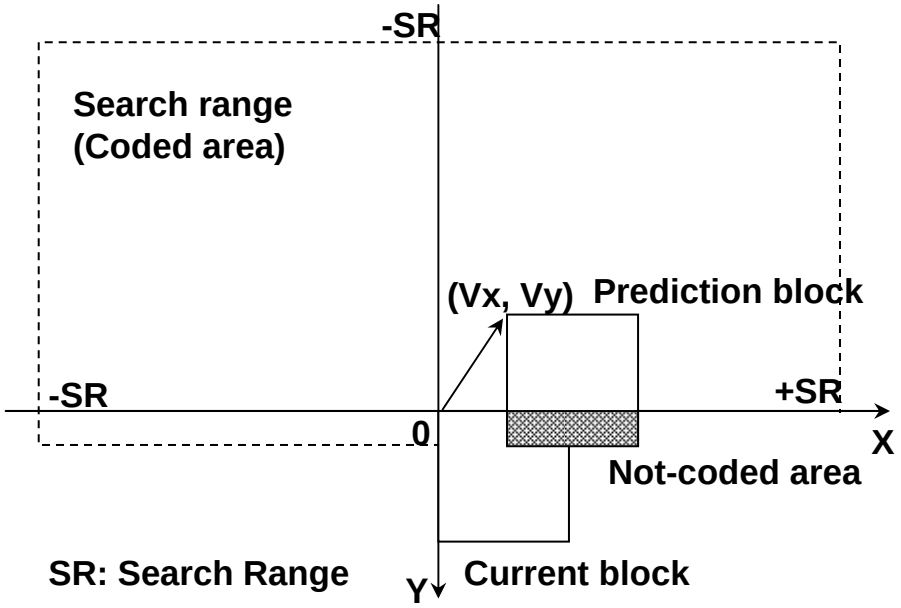
Simple padding method degrades predicted image quality.

Proposal

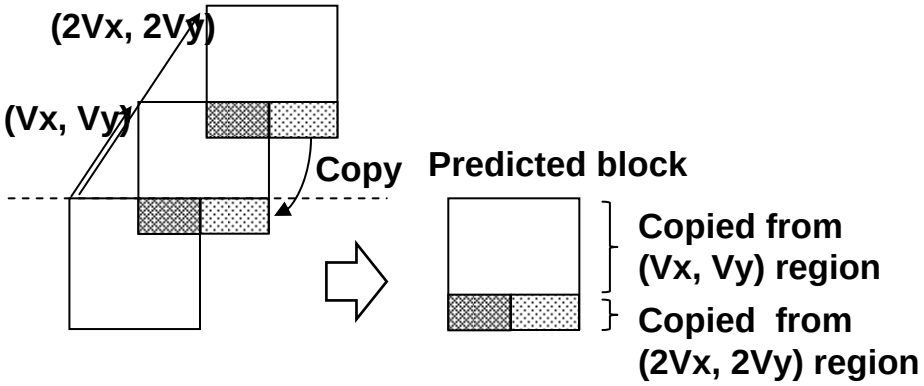
- **Pixel replenishment based on repetitive characteristics of objects**

Intra repetitive pixel replenishment (Intra RPR)

- If reference block includes a not-coded area, intra vector is multiplied as (2Vx, 2Vy), and adaptively padding such region by using new reference pixel as shown in Fig. (b).
- This scheme is especially effective to predict the cyclic patterns.



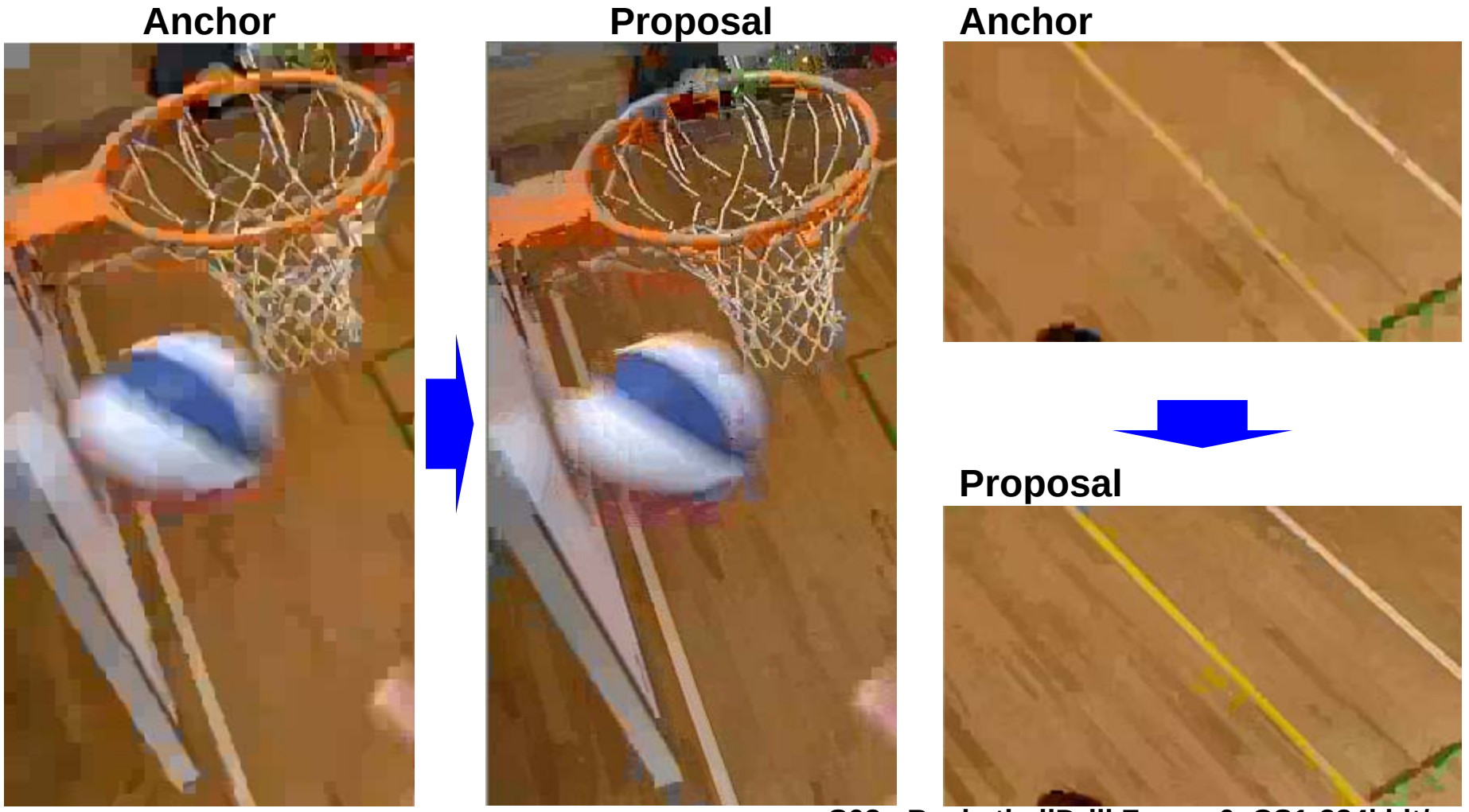
(a) Intra vector prediction



(b) Adaptive padding

Effect of Intra RPR

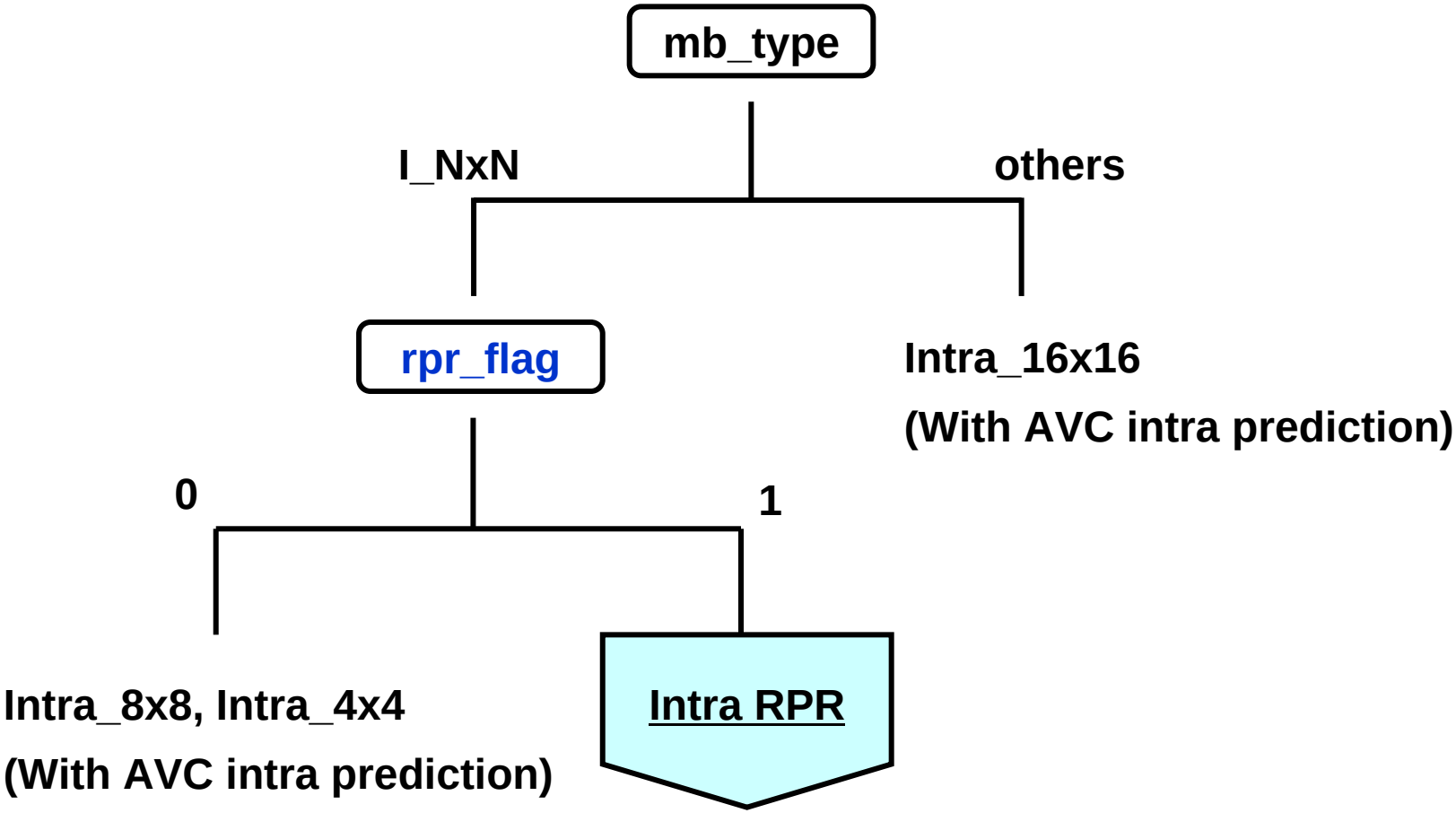
- **Predicted image quality was improved significantly.**



S08 : BasketballDrill Frame 0, CS1-384kbit/s

Representation on Syntax

- Additional 1-bit flag “rpr_flag”



Complexity study for Intra RPR

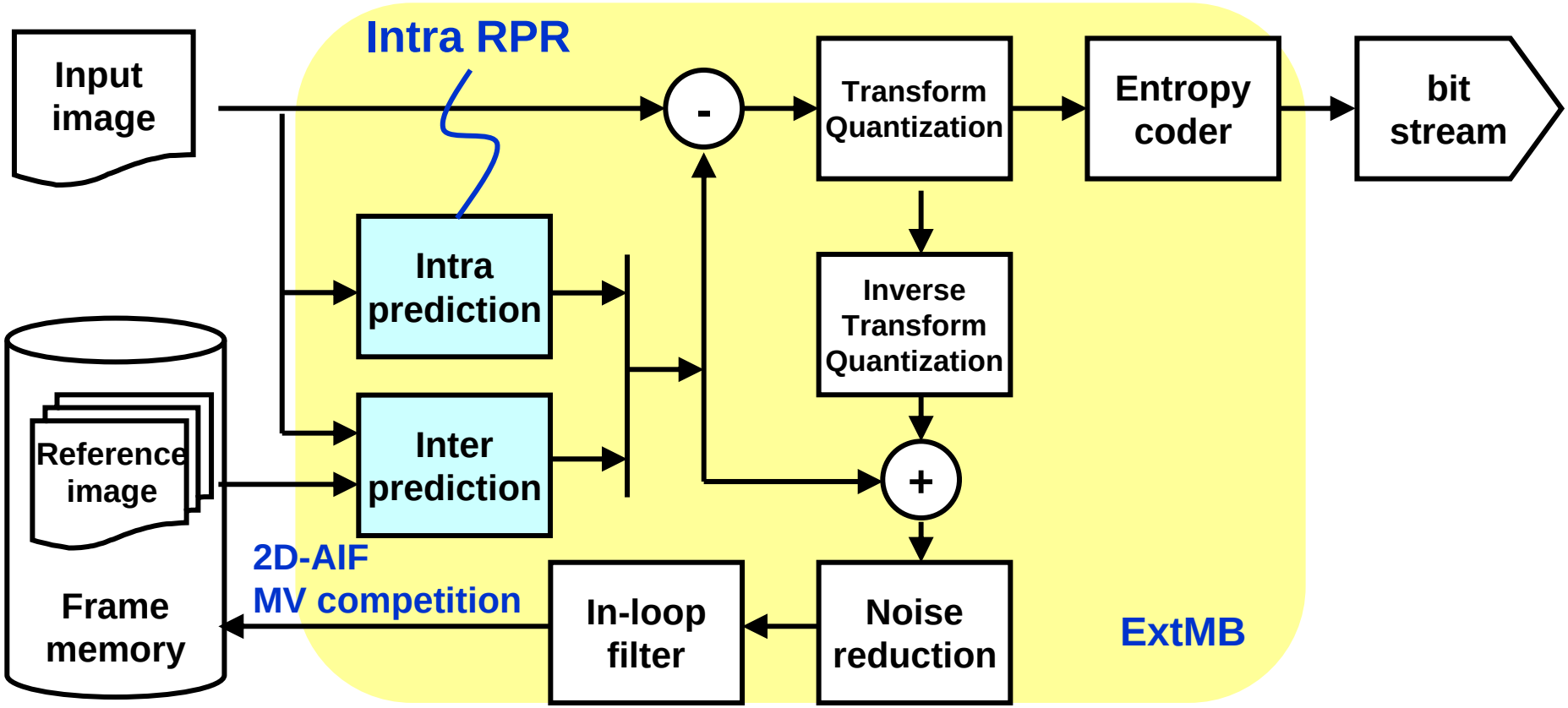
- Block matching for intra vector prediction is quite low complexity compared to the inter prediction.
- Hardware implements ALUs for required maximum performance, i.e. inter-frame prediction.

Comparison with inter-frame prediction

	Search area	Block size	No. of points
This method	544 (16x33+16)	8x8	2,176
Inter-frame prediction (P-frame)	16,384 (128x128)	16x16, 16x8, 8x16, 8x8	147,456

Coding tools

- **Intra RPR**
- **2D-AIF, MV competition , ExtMB are also introduced.**



Experimental results - Performance

Constraint set 1

Test Class	BD-Value	
	BD-Bitrate (%)	BD-PSNR (dB)
Class A	-16.92	0.77
Class B	-21.77	0.70
Class C	-23.07	1.06
Class D	-18.76	0.88
Total	-20.67	0.85

Constraint set 2

Test Class	BD-Value	
	BD-Bitrate (%)	BD-PSNR (dB)
Class B	-18.96	0.67
Class C	-10.10	0.45
Class D	1.06	0.05
Class E	-19.24	0.82
Total	-11.79	0.49

Experimental results - Complexity

- **Condition**
  - Including YUV output, reference input
  - Linux SLES9 64bit , Xeon quad-core CPU 3.0 GHz, 8GB RAM
- **Encoding time**
- **Decoding time**

Class	Encoding time (hour)	
	Set 1	Set 2
Class A	41.52	-
Class B	60.88	51.35
Class C	13.96	12.47
Class D	4.99	4.52
Class E	-	39.30

Constraint set 1

Class	Decoding time (sec)		Ratio
	Alpha anchor	Proposal	(proposal/anch
Class A	31.17	250.94	8.05
Class B	43.36	393.84	9.08
Class C	8.83	60.03	6.80
Class D	2.61	19.87	7.60

Ave. 7.88

Constraint set 2

Class	Decoding time (sec)		Ratio
	Beta anchor	Proposal	(proposal/anch
Class B	32.91	385.65	11.72
Class C	7.32	70.31	9.61
Class D	2.27	19.76	8.72
Class E	15.81	123.56	7.81

Ave. 9.47

Conclusion

- **Renesas presented a response to the CfP featuring a novel intra-frame prediction based on repetitive pixel replenishment (Intra RPR).**

- **Experimental results**
  - **Set 1: BD-Bitrate -20.67 %, BD-PSNR 0.85 dB**
  - **Set 2: BD-Bitrate -11.79 %, BD-PSNR 0.49 dB**

- **Further examination in core experiments**
  - **Half/Quarter pixel vector with AIF**
  - **Apply to P/B frames**
  - **Further reduction in vector representation**

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