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JCTVC-D128
Slice Boundary Processing and Picture Layer Raw Byte Sequence Payload

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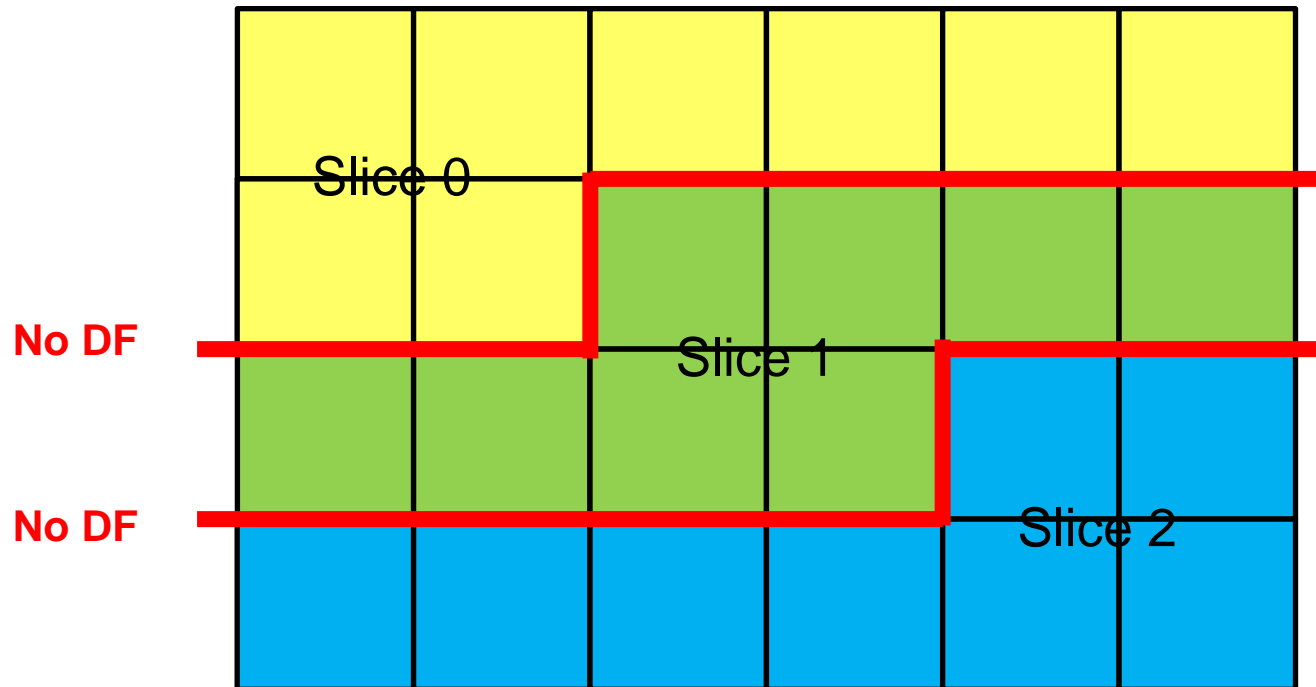20-28 January, 2011

Overall Summary

- In slice AHG software, one picture can be divided into multiple slices
  - DF and ALF are still processed across slice boundaries

- We proposed slice-independent DF and ALF to better support parallel encoding and decoding

- We proposed slice boundary filter to reduce possible slice boundary artifacts
  - Two possible schemes: in-loop and post-loop
  - Obvious subjective quality improvement at slice boundaries

- We proposed picture-layer RBSP as an option for sharing common information among slice headers in a picture
  - Better gain is expected when the number of slices per picture increases

Outline

- Slice-independent DF

- Slice-independent ALF

- Slice boundary filter (SBF)

- Picture-layer RBSP

- Experimental results

- Conclusion

Slice Independent DF

- Not across slice boundaries
  - Only edges inside the slice region will be filtered

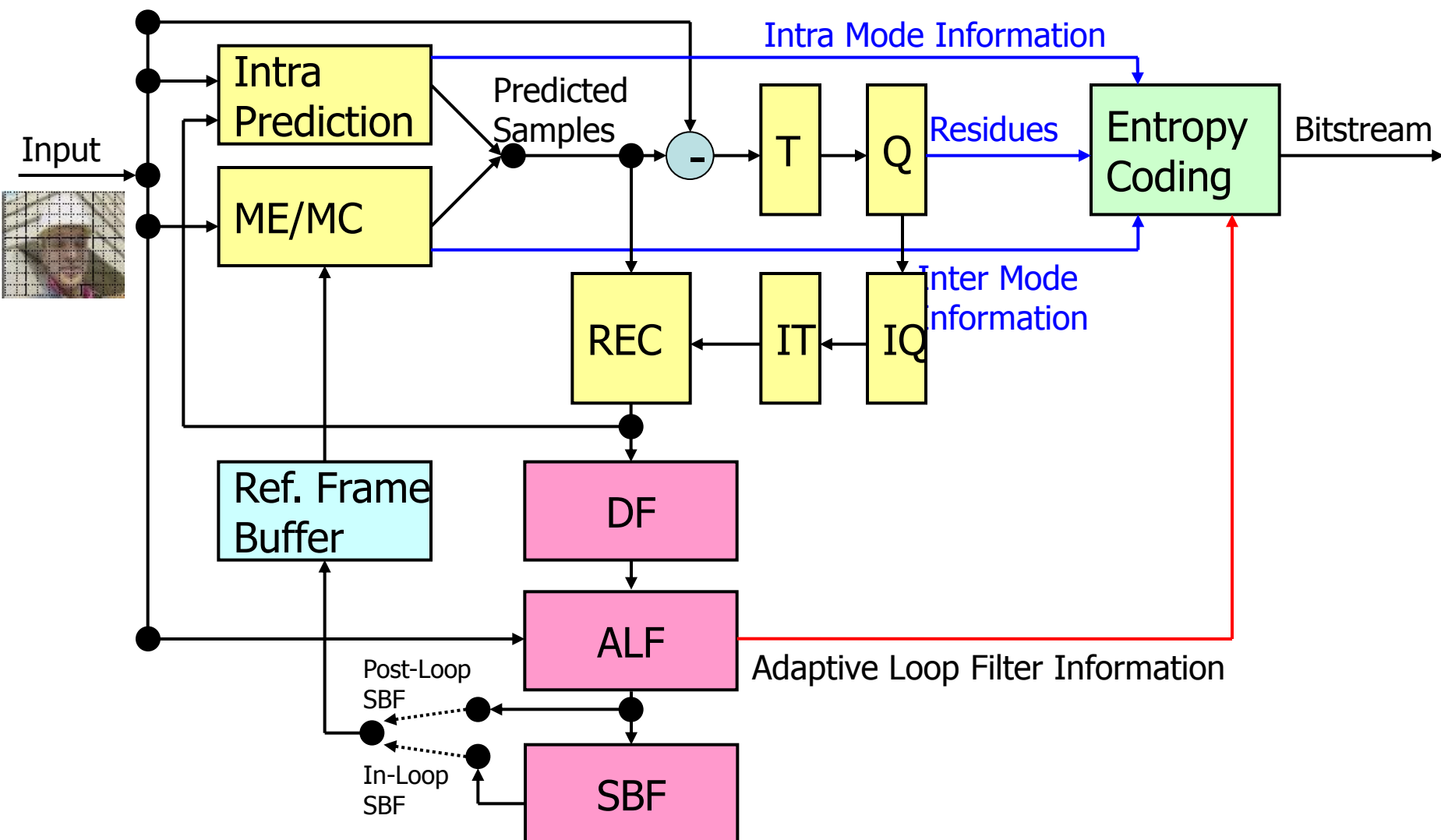- Provide flexibility for parallel encoding and decoding

Slice-independent ALF

- ALF coefficients are derived from slice region instead of the entire picture

- ALF process is not across slice boundaries

- Slice boundary padding
  - Similar to the image boundary repetitive extension in Unrestricted Motion Compensation (UMC)

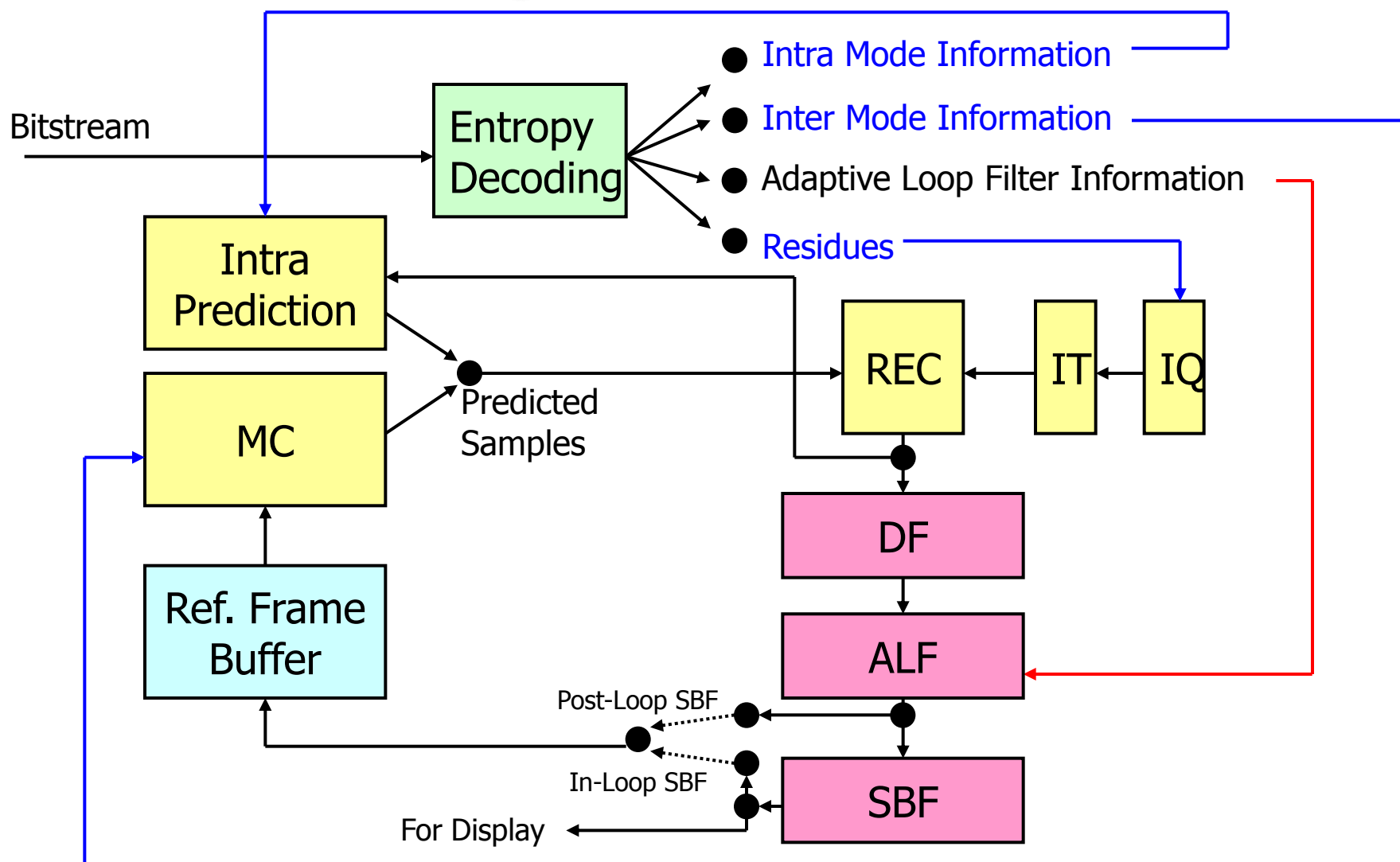- Provide flexibility for parallel encoding and decoding

Slice Boundary Filter (SBF)

- Motivation
  - Slice-independent DF and ALF may introduce artifacts at slice boundaries

- Similar to deblocking techniques

- Only operate at slice boundaries

- In-loop SBF
  - Conceptually provide better coding efficiency than post-loop
  - Almost the same result as DF cross slice boundaries

- Post-loop SBF
  - Provide more flexibility at decoder than in-loop

Encoder Diagram with SBF

Decoder Diagram with SBF

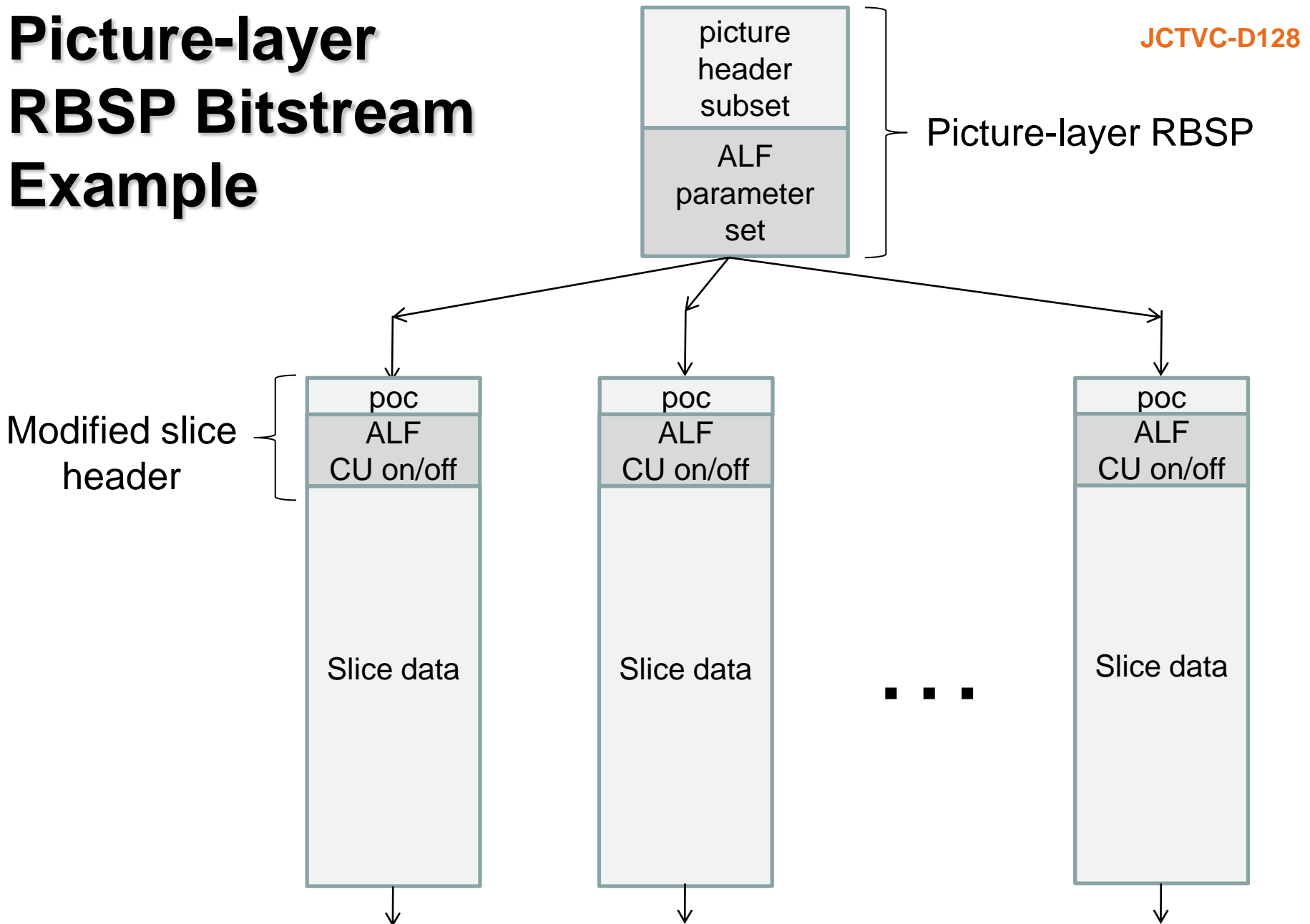# Picture-layer RBSP

- Motivation
  - Provide an option for picture-level information sharing among multiple slices in the same picture

- Shared information in picture-layer RBSP
  - Slice-layer QP
  - Entropy coding method
  - ALF parameter set (e.g. ALF Coefficients)
  - …etc. (roughly 20 syntax elements)

- Slice dependent information still in slice header
  - ALF CU on/off control information

Picture-layer RBSP Bitstream Example

Picture-layer RBSP

Modified slice header

Experiment 1:Slice-independent DF&ALF

- Anchor: JCTVC-C500

- Common slice settings:
  - 2 slices per picture
  - LCU-aligned slices

- Different slice settings:
  - MediaTek software
    - Slice-independent DF & ALF (SBF off)
    - One ALF parameter set per picture (using picture-layer RBSP)
  - Slice AHG software
    - DF and ALF processes are across slice boundaries
    - One ALF parameter set per picture
      (sending an ALF parameter set only in the slice header of the first slice)

MediaTek software vs. Slice AHG software

- 0.1%-0.5% BD-rate loss due to slice-independent processing

	HE-AI	HE-RA	HE-LD	LC-AI	LC-RA	LC-LD
Slice AHG	0.5	1.2	1.3	0.6	1.1	1.0
MediaTek	0.6	1.4	1.8	0.6	1.2	1.1

Experiment 2: Slice Boundary Filter

- Anchor: JCTVC-C500

- Software
  - **MediaTek** software based on TMuC0.9

- Common slice settings:
  - 2 slices per picture
  - LCU-aligned slices
  - Slice-independent DF & ALF
  - One ALF parameter set per picture (using picture-layer RBSP)

- Compared slice settings
  - SBF off vs. In-loop SBF vs. post-loop SBF

SBF off vs. In-loop vs. post-loop SBF

- The BD-rate performance is essentially the same

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	HE-AI	HE-RA	HE-LD	LC-AI	LC-RA	LC-LD
No SBF	0.6	1.4	1.8	0.6	1.2	1.1
In-loop	0.6	1.4	1.7	0.6	1.2	1.1
Post-loop	0.6	1.4	1.7	0.6	1.2	1.0

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	HE-AI	HE-RA	HE-LD	LC-AI	LC-RA	LC-LD
No SBF	0.6	1.6	1.6	0.7	0.9	0.6
In-loop	0.5	1.4	1.8	0.5	0.9	0.6
Post-loop	0.5	1.6	1.6	0.5	0.9	0.6

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	HE-AI	HE-RA	HE-LD	LC-AI	LC-RA	LC-LD
No SBF	0.6	1.7	1.7	0.8	1.0	0.6
In-loop	0.5	1.6	1.7	0.6	0.9	0.6
Post-loop	0.5	1.7	1.7	0.6	0.9	0.6

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Subjective Quality Improvement by SBF

- BlowingBubble, 416x240, QP=37, HE-AI, 7th frame

- 2 slices per picture

- No SBF v.s. In-loop SBF

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Summary for Experiment 2

- Either in-loop or post-loop SBF affects luma BD-rate performance slightly

- 0.1%- 0.2% BD-rate improvement on chroma components

- Obvious subjective quality improvement at slice boundaries

Experiment 3:Picture-layer RBSP

- Anchor: JCTVC-C500

- Software
  - **MediaTek** software based on TMuC0.9

- Common slice settings:
  - 4 slices per picture
  - LCU-aligned slices
  - Slice-independent DF & ALF (SBF off)

- Compared slice settings
  - Not use v.s. use picture-layer RBSP
  (one ALF parameter set per slice v.s. per picture)

Use v.s. Not use Picture-layer RBSP

- The BD-rate improvement is up to 0.4% in 4 slices per picture case
  - Better gain is expected as the number of slices in a picture increases

	HE-AI	HE-RA	HE-LD	LC-AI	LC-RA	LC-LD
Not use	2.0	3.9	4.0	1.7	3.1	2.6
Use	1.6	3.5	3.9	1.7	2.9	2.4

Conclusions

- Slice independent DF & ALF are proposed to better support parallel encoding and decoding

- Slice boundary filter can significantly improve subjective quality at slice boundaries

- Picture-layer RBSP provides an option for sharing common information among slice headers in a picture

- It is proposed to adopt these three slice tools in HM

Thank you