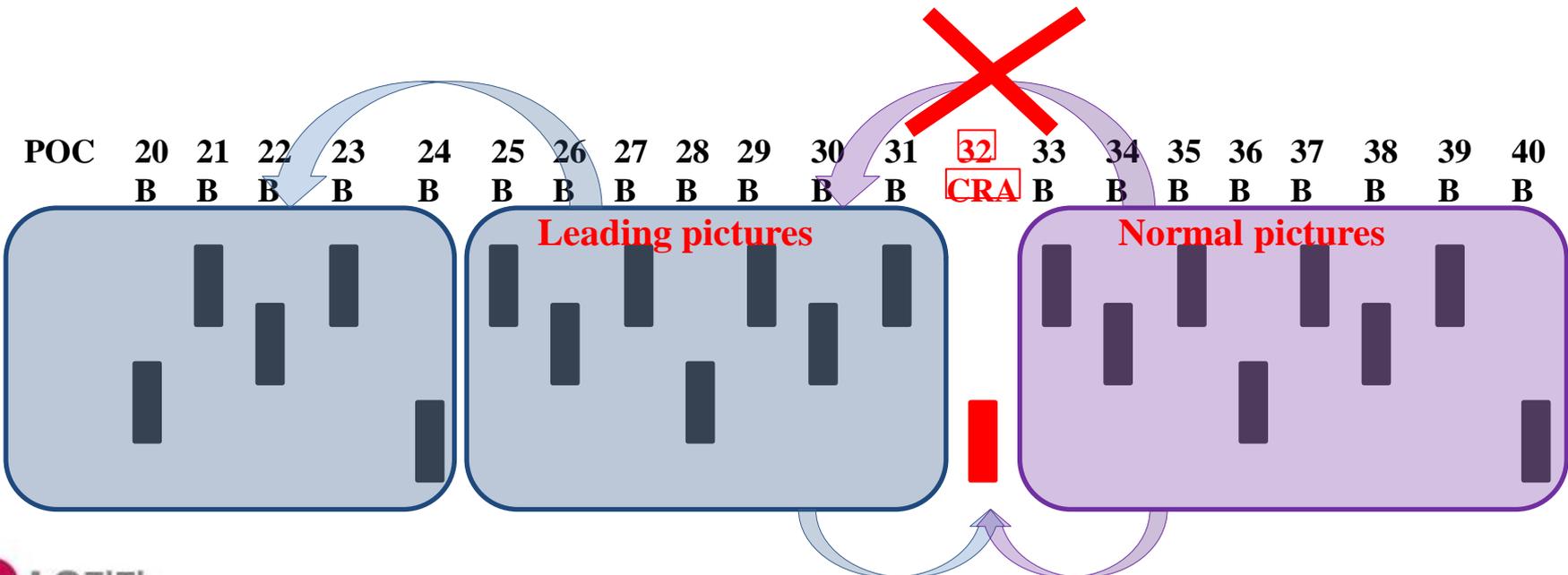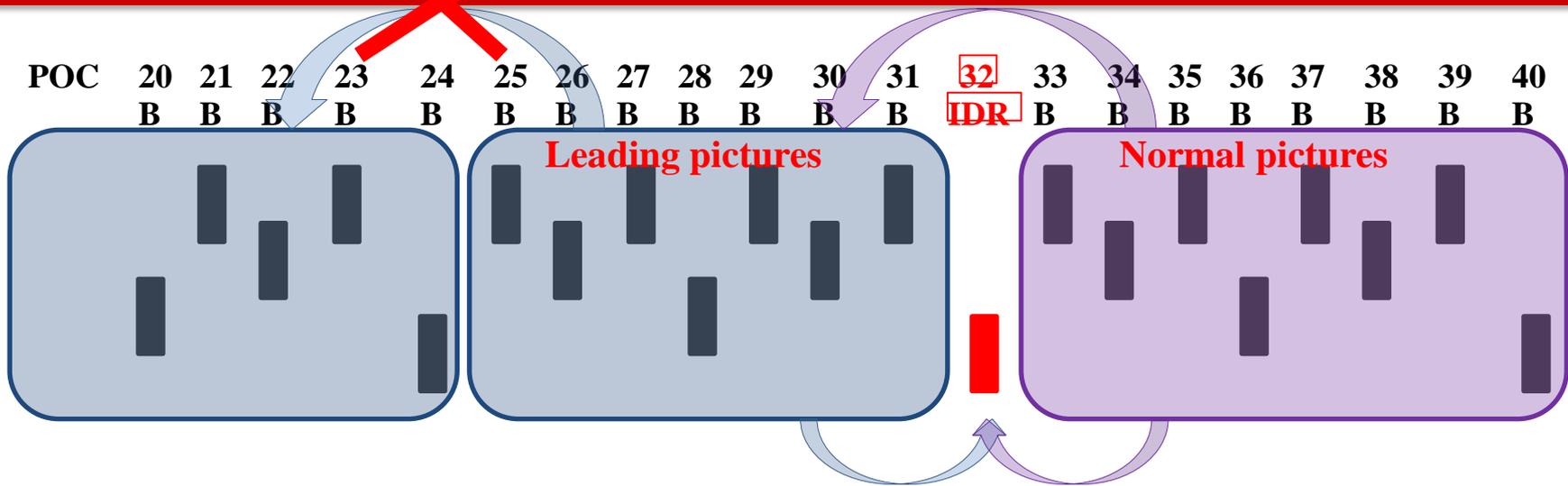# JCTVC-G158
Undiscardable Leading Pictures for CRA

Presented by Hendry

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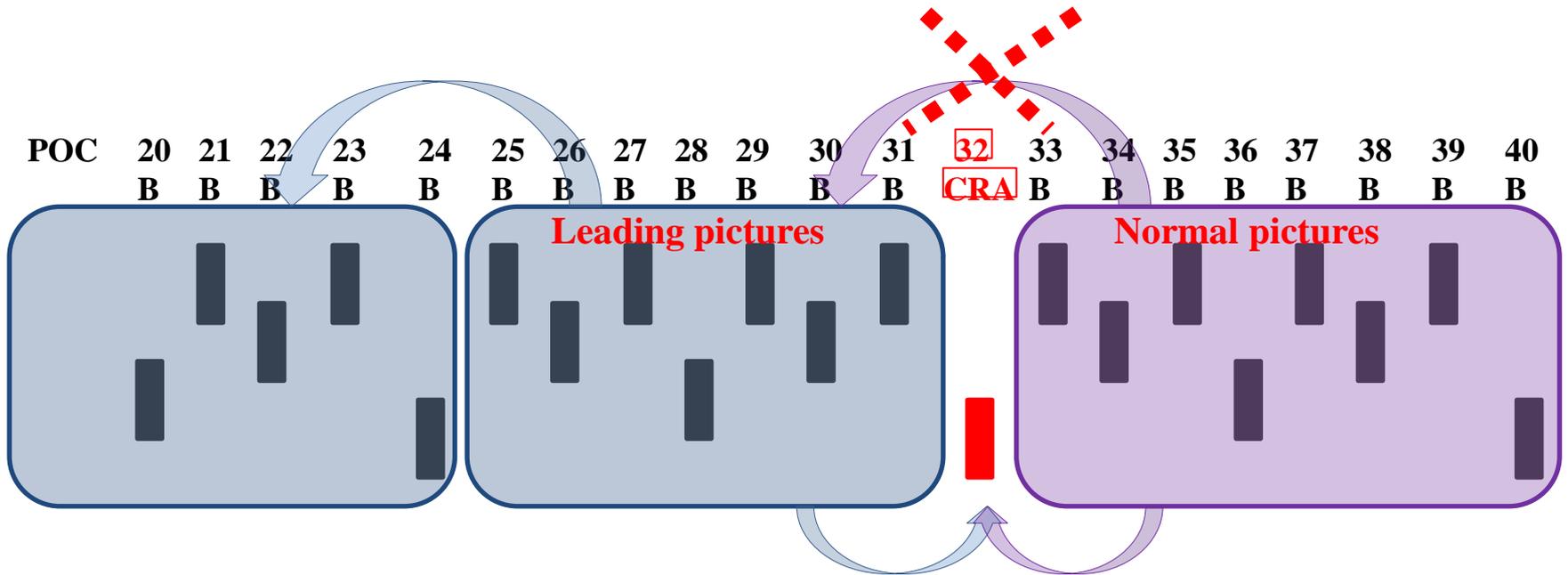
Proposal Item & Motivation

- Currently, to ensure safe random access at CRA picture, decoder shall flush DPB when the first key picture after CRA is received

  - Leading picture can still use pictures that are coded before CRA as reference picture

  - But, leading picture cannot be used as reference by normal pictures that are coded after CRA

- There are some use cases where some leading pictures do not need forward reference

  - No need to flush them out the first key picture after CRA → safe for random access because they do not use forward reference

  - Since they can be kept in DPB, they can be use as reference for normal picture → improve coding performance

- We call such leading pictures: Undiscardable leading pictures (ULPs)

- Proposal: Method for signaling ULPs slice header of CRA

IDR vs. CRA

POC	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	B	B	B	B	B	B	B	B	B	B	B	B	IDR	B	B	B	B	B	B	B	B

Leading pictures **Normal pictures**

POC	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	B	B	B	B	B	B	B	B	B	B	B	B	CRA	B	B	B	B	B	B	B	B

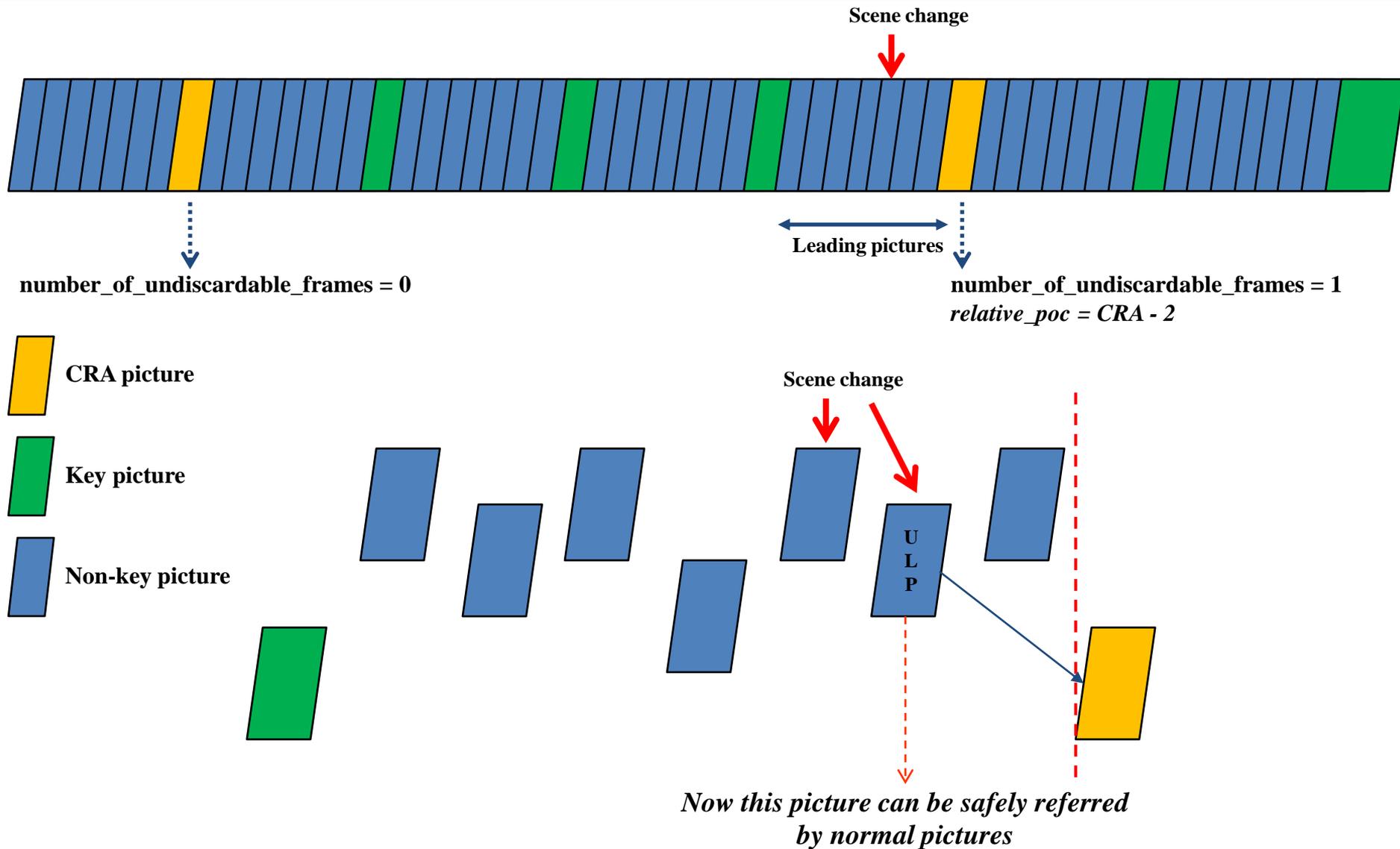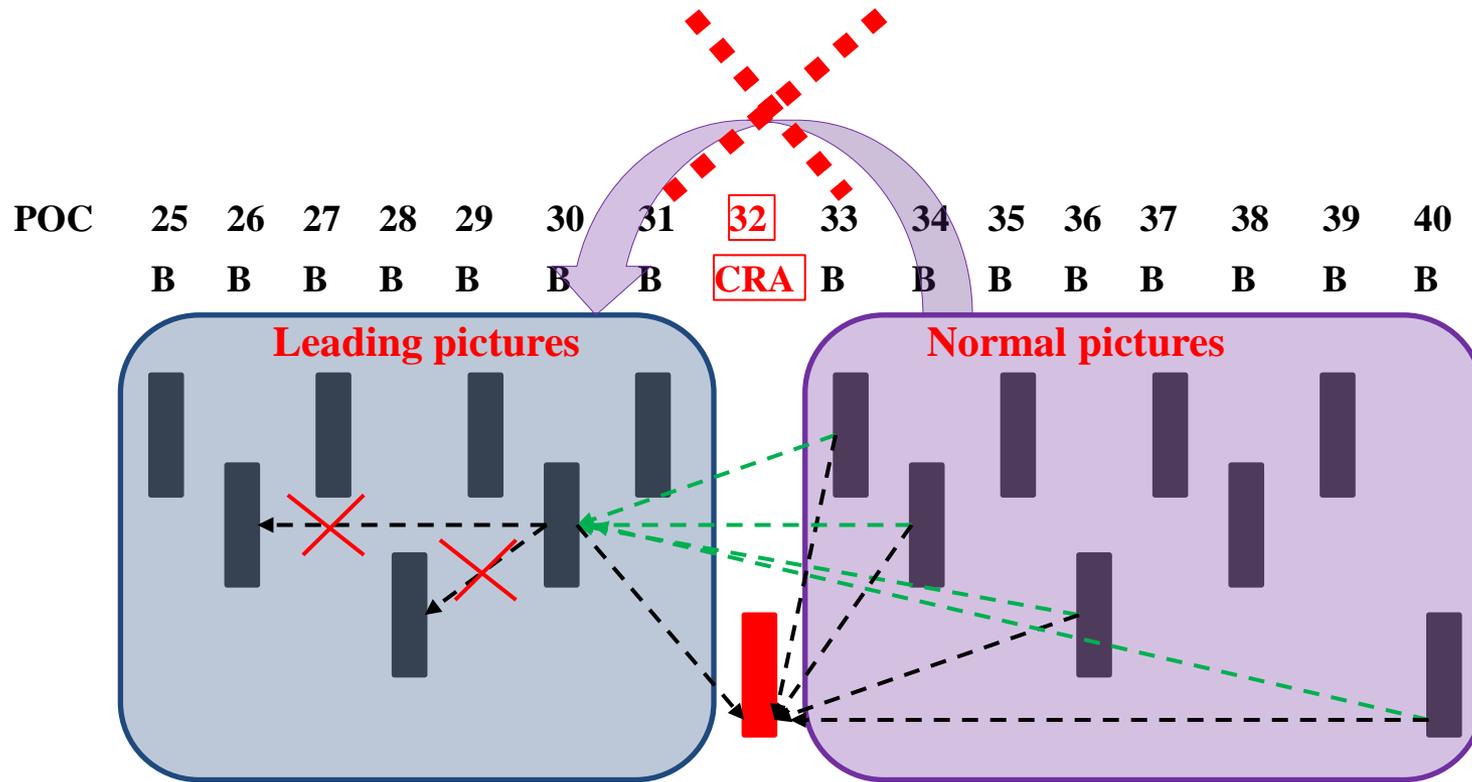**Leading pictures** **Normal pictures**

Proposal

- Define Undiscardable Leading Pictures

- To allow ULPs to be use as reference for normal pictures

- Requirement to be a ULP

  - Only use CRA and other ULPs as reference pictures

POC	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	B	B	B	B	B	B	B	B	B	B	B	B	CRA	B	B	B	B	B	B	B	B

Leading pictures   **Normal pictures**

Use Cases – Scene Change

Scene change

number_of_undiscardable_frames = 0

Leading pictures

number_of_undiscardable_frames = 1
relative_poc = CRA - 2

CRA picture

Key picture

Non-key picture

Scene change

U
L
P

*Now this picture can be safely referred
by normal pictures*

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POC	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	B	B	B	B	B	B	B	CRA	B	B	B	B	B	B	B	B

Leading pictures

Normal pictures

- - - ► Possible reference

- - - ► Additional reference because of ULP

Use Cases – Picture Loss within leading pictures

- Assume there is back channel from decoder to encoder

- When decoder notify encoder that one of picture in leading picture is lost, encoder can take the following actions:

  – Code next leading picture without forward reference

  – Set the leading picture as ULP

- Similar to previous illustration

ULP Signaling

Slice_header( ) {	Desc
…	
If (nal_unit_type == 4) {	
number_of_undiscardable_frames	ue(v)
for(i = 0; i < number_of_undiscardable_frames; i++) {	
relative_poc[i]	ue(v)
}	
}	
…	
}	

number_of_undiscardable_ frames indicates the number of undiscardable leading frames that follow the slice in decoding order.

relative_poc[i] indicates the relative POC of the i-th undiscardable leading frames. POC of the i-th undiscardable leading frames can be computed as follows:

$$PicOrderCnt(i\text{-th ULP}) = PicOrderCnt(CurrPic) - relative\_poc[i]$$

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ULP Signaling – With flag in SPS

seq_parameter_set_rbsp( ) {	Desc
…	
no_ulp_flag	f(1)
…	
}	

Slice_header( ) {	Desc
…	
If (nal_unit_type == 4 && !no_ulp_flag) {	
number_of_undiscardable_frames	ue(v)
for(i = 0; i < number_of_undiscardable_frames; i++) {	
relative_poc[i]	ue(v)
}	
}	
…	
}	

Performance

- Anchor: HM-4.0 with common test configuration for RAHE & RALC

- Input test sequences is modified to have scene change at certain interval near CRA

- E.g., BasketballDrill_PartyScene_CRA_32

  - Frame 0 ~ 29 → from BasketballDrill

  - Frame 30 ~ 61 → from PartyScene

  - Frame 62 ~ 93 → from BasketballDrill

  - So forth

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	-0.1%	-0.2%	-0.2%	-0.4%	0.0%	-0.2%
Class B	-0.2%	-0.2%	-0.3%	-0.3%	-0.2%	-0.2%
Class C	-0.2%	-0.1%	0.0%	-0.2%	-0.1%	-0.1%
Class D	-0.2%	-0.2%	-0.3%	-0.2%	-0.1%	-0.1%
Class E						
Overall	-0.2%	-0.2%	-0.2%	-0.3%	-0.1%	-0.2%
	-0.2%	-0.2%	-0.2%	-0.3%	-0.1%	-0.2%
Enc Time[%]	100%			101%		
Dec Time[%]	100%			101%		

Conclusion

- Propose change to CRA definition
  - Original: flush DPB content when the first key picture after CRA is received
  - Modified: Flush DPB content , *except pictures that are marked as ULPs*, when the first key picture after CRA is received

- Give coding gains in some situation
  - Scene change near CRA
  - Picture loss near CRA

- Recommend JCTVC group to adopt the proposed signaling method