

# JCTVC-K0123: AHG9: Reference picture set clean-ups

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# Summary

1. Addition of restrictions such that each LTRP signalled (explicitly or indexed) in the slice header shall be a distinct reference picture
2. Removal of the restriction that POC LSBs for LTRPs are signalled in a non-increasing order

# 1. LTRP should not be repeated in slice header

- Same LTRP may be signalled (either indexed or explicitly) in the slice header
- The `used_by_curr_pic_lt_flag` could be signalled both zero and one for different instances
- **Solution:** Ensure that the LTRP is not signalled in as both used and not used by the current picture. (following slide)

# Changes to decoding process - 1

For each  $i$  in the range of 0 to  $\text{NumPocLtCurr} - 1$ , inclusive, when  $\text{CurrDeltaPocMsbPresentFlag}[i]$  is equal to 1, it is a requirement of bitstream conformance that the following conditions apply:

- There shall be no  $j$  in the range of 0 to  $\text{NumPocStCurrBefore} - 1$ , inclusive, for which  $\text{PocLtCurr}[i]$  is equal to  $\text{PocStCurrBefore}[j]$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocStCurrAfter} - 1$ , inclusive, for which  $\text{PocLtCurr}[i]$  is equal to  $\text{PocStCurrAfter}[j]$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocStFoll} - 1$ , inclusive, for which  $\text{PocLtCurr}[i]$  is equal to  $\text{PocStFoll}[j]$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocLtCurr} - 1$ , inclusive, where  $j$  is not equal to  $i$ , for which  $\text{PocLtCurr}[i]$  is equal to  $\text{PocLtCurr}[j]$ .

For each  $i$  in the range of 0 to  $\text{NumPocLtFoll} - 1$ , inclusive, when  $\text{FollDeltaPocMsbPresentFlag}[i]$  is equal to 1, it is a requirement of bitstream conformance that the following conditions apply:

- There shall be no  $j$  in the range of 0 to  $\text{NumPocStCurrBefore} - 1$ , inclusive, for which  $\text{PocLtFoll}[i]$  is equal to  $\text{PocStCurrBefore}[j]$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocStCurrAfter} - 1$ , inclusive, for which  $\text{PocLtFoll}[i]$  is equal to  $\text{PocStCurrAfter}[j]$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocStFoll} - 1$ , inclusive, for which  $\text{PocLtFoll}[i]$  is equal to  $\text{PocStFoll}[j]$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocLtFoll} - 1$ , inclusive, where  $j$  is not equal to  $i$ , for which  $\text{PocLtFoll}[i]$  is equal to  $\text{PocLtFoll}[j]$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocLtCurr} - 1$ , inclusive, for which  $\text{PocLtFoll}[i]$  is equal to  $\text{PocLtCurr}[j]$ .

# Changes to decoding process - 2

For each  $i$  in the range of 0 to  $\text{NumPocLtCurr} - 1$ , inclusive, when  $\text{CurrDeltaPocMsbPresentFlag}[i]$  is equal to 0, it is a requirement of bitstream conformance that the following conditions apply:

- There shall be no  $j$  in the range of 0 to  $\text{NumPocStCurrBefore} - 1$ , inclusive, for which  $\text{PocLtCurr}[i]$  is equal to  $(\text{PocStCurrBefore}[j] \& (\text{MaxPicOrderCntLsb} - 1))$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocStCurrAfter} - 1$ , inclusive, for which  $\text{PocLtCurr}[i]$  is equal to  $(\text{PocStCurrAfter}[j] \& (\text{MaxPicOrderCntLsb} - 1))$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocStFoll} - 1$ , inclusive, for which  $\text{PocLtCurr}[i]$  is equal to  $(\text{PocStFoll}[j] \& (\text{MaxPicOrderCntLsb} - 1))$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocLtCurr} - 1$ , inclusive, where  $j$  is not equal to  $i$ , for which  $\text{PocLtCurr}[i]$  is equal to  $(\text{PocLtCurr}[j] \& (\text{MaxPicOrderCntLsb} - 1))$ .

For each  $i$  in the range of 0 to  $\text{NumPocLtFoll} - 1$ , inclusive, when  $\text{FollDeltaPocMsbPresentFlag}[i]$  is equal to 0, it is a requirement of bitstream conformance that the following conditions apply:

- There shall be no  $j$  in the range of 0 to  $\text{NumPocStCurrBefore} - 1$ , inclusive, for which  $\text{PocLtFoll}[i]$  is equal to  $(\text{PocStCurrBefore}[j] \& (\text{MaxPicOrderCntLsb} - 1))$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocStCurrAfter} - 1$ , inclusive, for which  $\text{PocLtFoll}[i]$  is equal to  $(\text{PocStCurrAfter}[j] \& (\text{MaxPicOrderCntLsb} - 1))$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocStFoll} - 1$ , inclusive, for which  $\text{PocLtFoll}[i]$  is equal to  $(\text{PocStFoll}[j] \& (\text{MaxPicOrderCntLsb} - 1))$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocLtFoll} - 1$ , inclusive, where  $j$  is not equal to  $i$ , for which  $\text{PocLtFoll}[i]$  is equal to  $(\text{PocLtFoll}[j] \& (\text{MaxPicOrderCntLsb} - 1))$ .
- There shall be no  $j$  in the range of 0 to  $\text{NumPocLtCurr} - 1$ , inclusive, for which  $\text{PocLtFoll}[i]$  is equal to  $(\text{PocLtCurr}[j] \& (\text{MaxPicOrderCntLsb} - 1))$ .

# Remove non-increasing order of POC LSBs

- POC LSBs have non-increasing restriction
  - Useful when LSBs were signalled  $ue(v)$
  - Disallows optimal order that may avoid RPLM signalling
  - Less efficient
- Removal of non-increasing constraint
  - Remove the constraint in semantics of `poc_lsb_lt[i]` and `lt_idx_sps[i]`
  - Remove one condition in derivation of `DeltaPocMsbCycleLt[i]`

# Example – current signalling

POC = 308  
LSB = 20  
MSB cycle = 9

LTRP[0]

POC = 84  
LSB = 20  
MSB cycle = 2

LTRP[1]

POC = 170  
LSB = 10  
MSB cycle = 5

LTRP[2]

POC = 311

current picture

DeltaPocMSBCycleLt[ i ]	1
poc_lsb_lt[ i ]	20
delta_poc_msb_cycle_lt[ i ]	1
# of bits for MSB cycle	3

DeltaPocMSBCycleLt[ i ]	8
poc_lsb_lt[ i ]	20
delta_poc_msb_cycle_lt[ i ]	7
# of bits for MSB cycle	7

DeltaPocMSBCycleLt[ i ]	5
poc_lsb_lt[ i ]	10
delta_poc_msb_cycle_lt[ i ]	5
# of bits for MSB cycle	5

Total bits for  
MSB cycle = 15

**poc\_lsb\_lt[ i ]** specifies the value of the least significant bits of the picture order count value of the i-th long-term reference picture that is included in the long-term reference picture set of the current picture. The length of the poc\_lsb\_lt[ i ] syntax element is  $\log_2 \text{max\_pic\_order\_cnt\_lsb\_minus4} + 4$  bits. For any values of j and k in the range of num\_long\_term\_sps to num\_long\_term\_sps + num\_long\_term\_pics - 1, inclusive, if j is less than k, poc\_lsb\_lt[ j ] shall not be less than poc\_lsb\_lt[ k ].

if( i == 0 || i == num\_long\_term\_sps || PocLsbLt[ i - 1 ] != PocLsbLt[ i ] )

DeltaPocMSBCycleLt[ i ] = delta\_poc\_msb\_cycle\_lt[ i ] (7-37)

else

DeltaPocMSBCycleLt[ i ] = delta\_poc\_msb\_cycle\_lt[ i ] + DeltaPocMSBCycleLt[ i - 1 ]

# Example – proposed signalling

POC = 308  
LSB = 20  
MSB cycle = 9

LTRP[0]

POC = 170  
LSB = 10  
MSB cycle = 5

LTRP[1]

POC = 84  
LSB = 20  
MSB cycle = 2

LTRP[2]

POC = 311

current picture

DeltaPocMSBCycleLt[ i ]	1
poc_lsb_lt[ i ]	20
delta_poc_msb_cycle_lt[ i ]	1
# of bits for MSB cycle	3

DeltaPocMSBCycleLt[ i ]	5
poc_lsb_lt[ i ]	10
delta_poc_msb_cycle_lt[ i ]	4
# of bits for MSB cycle	5

DeltaPocMSBCycleLt[ i ]	8
poc_lsb_lt[ i ]	20
delta_poc_msb_cycle_lt[ i ]	3
# of bits for MSB cycle	5

Total bits for  
MSB cycle = 13

**poc\_lsb\_lt[ i ]** specifies the value of the least significant bits of the picture order count value of the i-th long-term reference picture that is included in the long-term reference picture set of the current picture. The length of the poc\_lsb\_lt[ i ] syntax element is  $\log_2 \text{max\_pic\_order\_cnt\_lsb\_minus4} + 4$  bits. ~~For any values of j and k in the range of num\_long\_term\_sps to num\_long\_term\_sps + num\_long\_term\_pics - 1, inclusive, if j is less than k, poc\_lsb\_lt[ j ] shall not be less than poc\_lsb\_lt[ k ].~~

if( i == 0 || i == num\_long\_term\_sps || ~~PocLsbLt[ i - 1 ] != PocLsbLt[ i ]~~ )

DeltaPocMSBCycleLt[ i ] = delta\_poc\_msb\_cycle\_lt[ i ] (7-37)

else

DeltaPocMSBCycleLt[ i ] = delta\_poc\_msb\_cycle\_lt[ i ] + DeltaPocMSBCycleLt[ i - 1 ]