JCTVC-L0177:
Hook on TMVP derivation for MV-HEVC

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Summary

- **Hook on TMVP derivation for MV-HEVC in case of collocated picture being an inter-view reference picture**

- **Modification to HEVC**
  - **#1 modification to the collocated MV selection**
  - **#2 modification to the collocated picture selection**

- **Coding efficiency for 3-view coding in MV-HEVC**
  - **Average -0.7% bitrate saving for all 3 views with #1 modification**
  - **Average -1.8% bitrate saving for all 3 views, and up to -4.3% for single dependent view, with #1+#2 modifications**
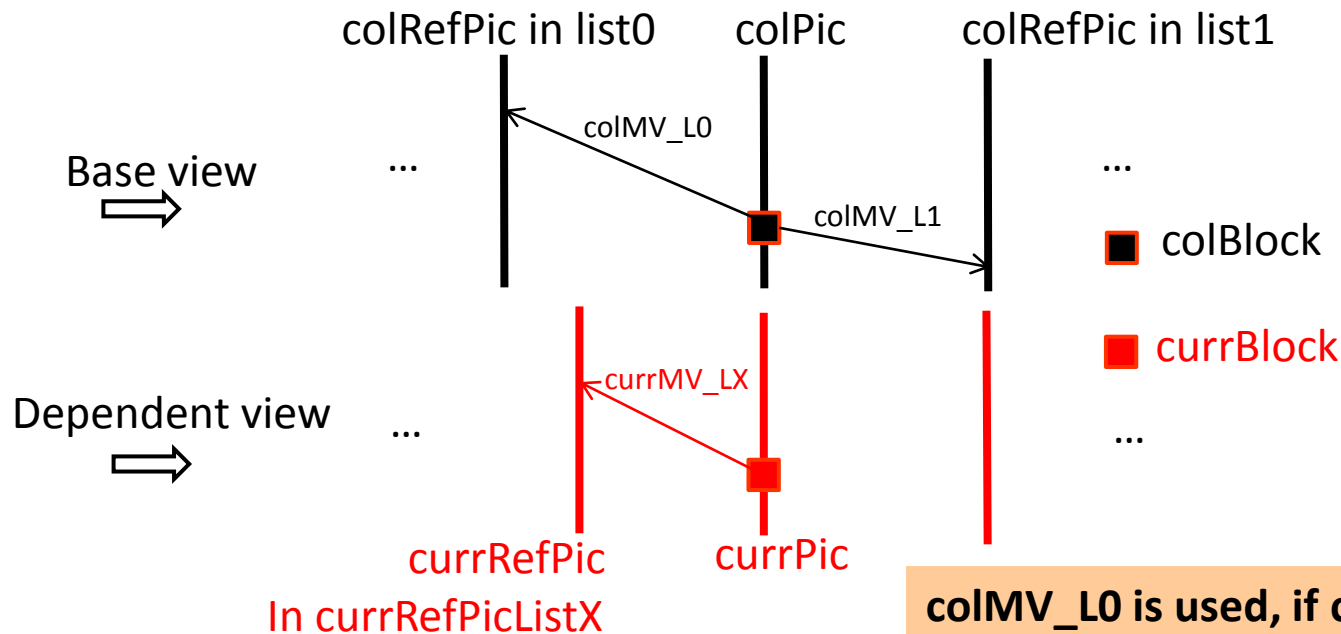
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Motivation

- **Reference picture type: short-term or long-term**
- **Constrain on TMVP derivation in HEVC**
  - **TMVP candidate unavailable in case of picture type mismatch between the reference pictures of current block and its collocated block.**
- **MV-HEVC**
  - **inter-view reference picture is regarded as long-term**
  - **Temporal reference picture is usually short-term picture**
  - **large possibility of unavailable TMVP candidate due to the above constrain , affecting coding efficiency of MV-HEVC**

- **Proposed a hook for MV-HEVC on TMVP derivation to avoid the case of picture type mismatch**
- **Basic idea is to select** collocated picture and collocated MV depending on POC values of the current picture and its reference picture

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#1 modification: collocated MV selection

If colPic is a long-term picture (which indicates colPic is an inter-view reference picture), then

- **HEVC:**   colRefPicList = collocated_from_l0_flag
- **Proposal:**   colRefPicList = currRefPicListX
- where,
- colRefPicList denotes reference picture list used for collocated block
- currRefPicListX denotes reference picture list specified for current block

colMV_L0 is used, if currRefPicLisX = LIST0
colMV_L1 is used, if currRefPicLisX = LIST1

Coding efficiency with respect to MV-HEVC anchor

* 3-view coding, MV-HEVC configuration based on HTM5.1
* Cross-checked by Qualcomm in JCTVC-L0400

	video0	video1	video2	video PSNR / video bitrate	video PSNR / total bitrate
#1 Modification	0.0%	-1.8%	-0.4%	-0.7%	-0.7%

Noted that the first case(#1 modification) combined with an encoder issue, i.e. signalling an inter-view reference as colPic if available.
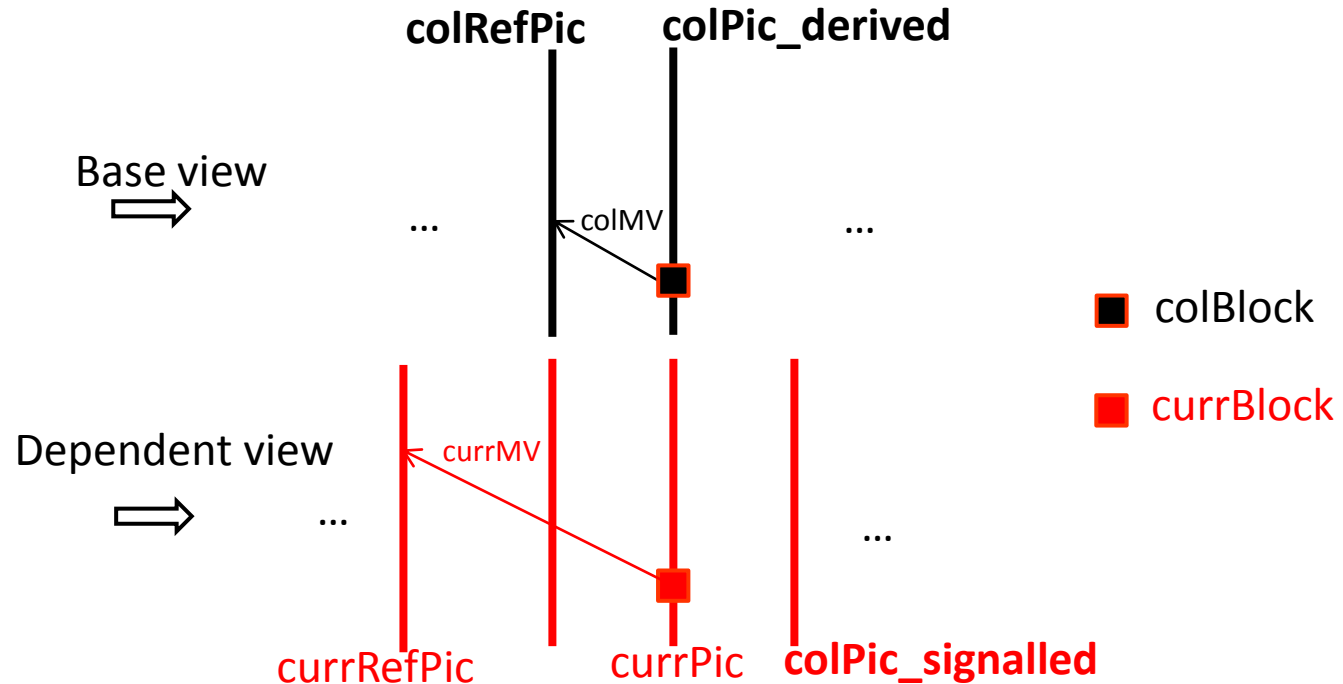
#2 modification: collocated picture selection

Collocated picture used in TMVP derivation

- **HEVC: colPic is signaled at slice level**
- **Proposal:**
  - **Besides the signaled colPic, an additional colPic is derived such that the additional colPic and the signaled colPic are located in different view.**
  - **If both the signaled colPic and current reference picture do or do not from the same view, the additional colPic instead of the signaled colPic is used for TMVP derivation**

  - **The additional colPic can also be derived at slice level.**
  - **The additional colPic is not available for base view but can be exploited for dependent view.**

Example of 2-view coding:

when the signaled colPic and currRefPic are short-term,
an additional colPic is derived and used for TMVP derivation

colRefPic   **colPic_derived**

Base view ⇨

... ←colMV ...

■ colBlock

■ currBlock

Dependent view ⇨

... ←currMV ...

currRefPic   currPic   **colPic_signalled**

As a result, same reference picture type for both currRefPic and colRefPic:
a.   **currRefPic is short-term**
b.   **colRefPic is also short-term , since the derived colPic from base view**

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Coding efficiency with respect to MV-HEVC anchor

* 3-view coding, MV-HEVC configuration based on HTM5.1
* Cross-checked by Qualcomm in JCTVC-L0400

	video0	video1	video2	video PSNR / video bitrate	video PSNR / total bitrate
#1 Modification	0.0%	-1.8%	-0.4%	-0.7%	-0.7%
#1 + #2 Modifications	0.0%	-4.3%	-3.1%	-1.8%	-1.8%

Noted that the first case(#1 modification) combined with an encoder issue, i.e. inter-view reference colPic signaled if available.

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Coding efficiency with respect to MV-HEVC anchor

* 3-view coding, MV-HEVC configuration based on HTM5.1

	Video0	video1	video2	video PSNR / video bitrate	video PSNR / total bitrate
#1 Modification	0.0%	-1.8%	-0.4%	-0.7%	-0.7%
#1 + #2 Modification	0.0%	-4.3%	-3.1%	-1.8%	-1.8%
#2 Modification	0.0%	-3.0%	-2.1%	-1.2%	-1.2%
Inter-view colPic signaled (encoder issue)	0.0%	-0.4%	0.6%	-0.1%	-0.1%

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Recommendation

- **The proposal**
  - #1: reference picture list direction for colBlock depends on that of currBlock
  - #2: an additional colPic only for dependent view coding
  - significant gain for dependent view coding
  - similar performance can be expected for HLS only framework of SHVC
  - minor text changes to HEVC text
- **Recommend to adopt**
  - #1 modification, with minimum text changes
  - #1+#2 modifications, with best performance

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Thank you!

Coding efficiency of #1+#2 modification

* 3-view coding, MV-HEVC configuration based on HTM5.1

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	enc time	dec time
Balloons	0.0%	-7.9%	-6.1%	-3.6%	-3.6%	100.3%	98.5%
Kendo	0.0%	-6.0%	-4.7%	-2.7%	-2.7%	100.0%	91.0%
Newspaper_CC	0.0%	-2.0%	0.2%	-0.4%	-0.4%	99.8%	93.5%
GT_Fly	0.0%	-4.1%	-4.2%	-2.0%	-2.0%	92.5%	103.4%
Poznan_Hall2	0.0%	-5.2%	-2.7%	-1.9%	-1.8%	99.7%	98.4%
Poznan_Street	0.0%	-2.1%	-1.7%	-0.8%	-0.8%	98.4%	99.4%
Undo_Dancer	0.0%	-2.7%	-2.1%	-1.0%	-1.0%	99.9%	102.4%
1024x768	0.0%	-5.3%	-3.5%	-2.2%	-2.2%	100.0%	94.3%
1920x1088	0.0%	-3.5%	-2.7%	-1.4%	-1.4%	97.6%	100.9%
average	0.0%	-4.3%	-3.1%	-1.8%	-1.8%	98.6%	98.0%

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Coding efficiency of #2 modification

* 3-view coding, MV-HEVC configuration based on HTM5.1

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	enc time	dec time
Balloons	0.0%	-4.4%	-3.4%	-2.0%	-2.0%	101.5%	99.7%
Kendo	0.0%	-3.4%	-2.5%	-1.5%	-1.5%	100.1%	90.2%
Newspaper_CC	0.0%	-1.1%	0.5%	-0.1%	-0.1%	100.7%	96.2%
GT_Fly	0.0%	-3.4%	-3.5%	-1.7%	-1.7%	93.0%	102.8%
Poznan_Hall2	0.0%	-4.2%	-2.2%	-1.5%	-1.4%	100.4%	97.6%
Poznan_Street	0.0%	-1.7%	-1.3%	-0.7%	-0.7%	99.3%	96.9%
Undo_Dancer	0.0%	-2.6%	-2.1%	-1.0%	-1.0%	100.5%	102.1%
1024x768	0.0%	-3.0%	-1.8%	-1.2%	-1.2%	100.7%	95.3%
1920x1088	0.0%	-3.0%	-2.3%	-1.2%	-1.2%	98.2%	99.8%
average	0.0%	-3.0%	-2.1%	-1.2%	-1.2%	99.3%	97.9%

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Coding efficiency of #1 modification

* 3-view coding, MV-HEVC configuration based on HTM5.1
* Cross-checked by Qualcomm in JCTVC-L0400

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	enc time	dec time
Balloons	0.0%	-5.7%	-4.0%	-2.5%	-2.5%	102.2%	97.1%
Kendo	0.0%	-3.2%	-2.1%	-1.4%	-1.4%	101.8%	89.6%
Newspaper_CC	0.0%	-0.3%	1.8%	0.4%	0.4%	102.6%	91.8%
GT_Fly	0.0%	0.1%	0.5%	-0.5%	-0.5%	94.5%	104.0%
Poznan_Hall2	0.0%	-3.2%	-0.1%	-0.7%	-0.6%	100.6%	97.5%
Poznan_Street	0.0%	0.1%	0.7%	0.1%	0.1%	100.1%	93.8%
Undo_Dancer	0.0%	-0.6%	0.4%	-0.1%	-0.1%	102.0%	101.1%
1024x768	0.0%	-3.1%	-1.4%	-1.2%	-1.2%	102.2%	92.8%
1920x1088	0.0%	-0.9%	0.4%	-0.3%	-0.3%	99.2%	99.0%
average	0.0%	-1.8%	-0.4%	-0.7%	-0.7%	100.5%	96.3%

Noted that #1 modification is combined with an encoder issue, i.e. using an inter-view reference as colPic if available.

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Coding efficiency of inter-view colPic signaled (encoder issue)

* 3-view coding, MV-HEVC configuration based on HTM5.1

	video 0	video 1	video 2	video PSNR / video bitrate	video PSNR / total bitrate	enc time	dec time
Balloons	0.0%	-1.9%	-1.2%	-0.9%	-0.9%	102.6%	98.2%
Kendo	0.0%	-0.6%	0.3%	-0.1%	-0.1%	102.2%	88.7%
Newspaper_CC	0.0%	0.7%	2.1%	0.7%	0.6%	103.4%	94.2%
GT_Fly	0.0%	0.8%	1.1%	-0.2%	-0.2%	94.9%	104.2%
Poznan_Hall2	0.0%	-2.1%	0.5%	-0.2%	-0.2%	101.4%	97.4%
Poznan_Street	0.0%	0.6%	1.1%	0.2%	0.2%	101.0%	94.4%
Undo_Dancer	0.0%	-0.4%	0.5%	0.0%	0.0%	102.8%	99.3%
1024x768	0.0%	-0.6%	0.4%	-0.1%	-0.1%	102.7%	93.6%
1920x1088	0.0%	-0.3%	0.8%	0.0%	0.0%	99.9%	98.8%
average	0.0%	-0.4%	0.6%	-0.1%	-0.1%	101.1%	96.5%