

JVET-P0157

CE5-related: Align ALF padding processes at picture and subpicture boundaries

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Overall Summary

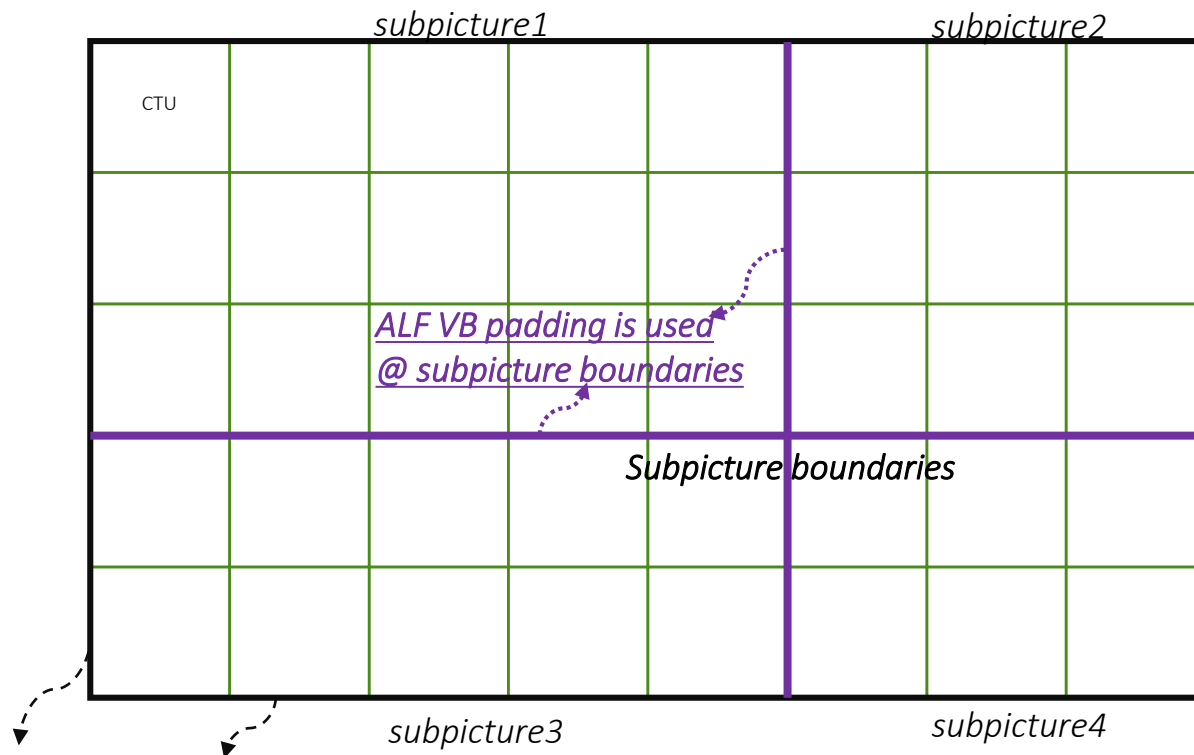
- One mismatch occurs when one picture consists of multiple independent decodable subpictures
 - Different ALF padding processes at picture and subpicture boundaries, when neighbouring samples are unavailable
 - Apply the repetitive padding at picture boundaries
 - Apply ALF virtual boundary (VB) padding at subpicture boundaries
- Proposed to unify the ALF padding processes at picture and subpicture boundaries to solve this issue

Introduction to ALF Padding Process

- The neighbouring samples become unavailable, because
 - The neighbouring samples are outside the picture
 - The neighbouring samples are not located at the same segment (slice/brick/360 face/subpicture), and the loop filter cannot reference the samples located at other segments
- Current design of ALF padding process in VVC Draft 6, when neighbouring samples are unavailable
 - Apply the repetitive padding at picture boundaries
 - Apply ALF-VB padding at subpicture boundaries

One Picture with Multiple Independent Decodable Subpictures

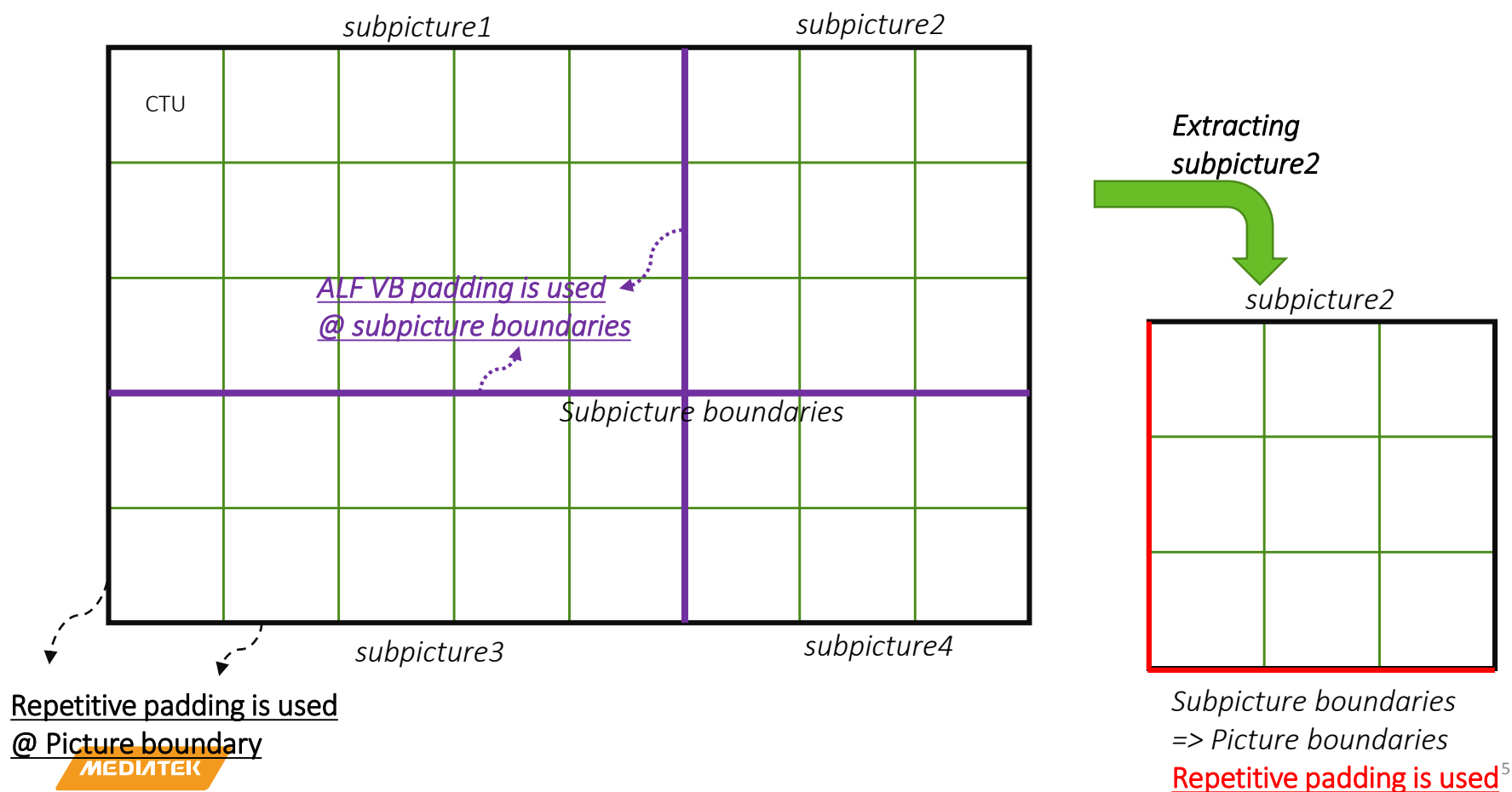
- When `subpic_treated_as_pic_flag` is equal to 1, the subpicture should be decodable independently



Repetitive padding is used
@ Picture boundary

Mismatch Occurs When Decoding One Independent Subpicture

- Decoding subpicture2 only



Unify ALF Padding Processes at Picture and Subpicture Boundaries

- Method 1
 - If the slice/brick/360 faces/subpicture/picture boundary is aligned with CTU boundaries, apply ALF-VB padding to handle the unavailable neighbouring samples
 - Otherwise (the slice/brick/360 faces/subpicture/picture boundary is not aligned with CTU boundaries), the repetitive padding is applied to generate the unavailable neighbouring samples

Unify ALF Padding Processes at Picture and Subpicture Boundaries

- Method 2: conditionally selecting an ALF padding method at subpicture boundaries
 - if independent subpicture decoding of one subpicture is enabled (`subpic_treated_as_pic_flag[i]=1`), the repetitive padding is used;
 - Otherwise, if the loop filter cannot reference samples located at other subpictures (`loop_filter_across_subpic_enabled_flag[i]=0`), the ALF-VB padding is used.

Unify ALF Padding Processes at Picture and Subpicture Boundaries

- Method3
 - Apply the repetitive padding at subpicture boundaries instead of ALF-VB padding, when neighbouring samples are unavailable
- Method4: Extension of Method3
 - Apply the repetitive padding at slice/brick/360 faces/subpicture/picture boundaries, when neighbouring samples are unavailable

Summary

Method	Picture Boundaries	Subpicture Boundaries	360 Virtual Boundaries	Slice/Brick Boundaries
VVC Draft 6	repetitive padding	CTU aligned: ALF-VB padding	CTU aligned: ALF-VB padding Not CTU-aligned: repetitive padding	CTU aligned: ALF-VB padding
Method 1	If the boundary is aligned with CTU boundaries, use ALF-VB padding Otherwise, (the boundary is not aligned with CTU boundaries), use repetitive padding			
Method 2	repetitive padding	Independently decoding: repetitive padding Not independently decoding: ALF-VB padding	CTU aligned: ALF-VB padding Not CTU-aligned: repetitive padding	CTU aligned: ALF-VB padding
Method 3	repetitive padding	repetitive padding	CTU aligned: ALF-VB padding Not CTU-aligned: repetitive padding	CTU aligned: ALF-VB padding
Method 4	repetitive padding	repetitive padding	repetitive padding	repetitive padding

Conclusion

- One mismatch occurs when one picture consists of multiple independent decodable subpictures
 - Different ALF padding processes at picture and subpicture boundaries, when neighbouring samples are unavailable
- Proposed to unify the ALF padding processes at picture and subpicture boundaries to solve this issue

