JVET-V0097

AHG12: UNSYMMETRIC PARTITIONING METHODS IN VIDEO CODING

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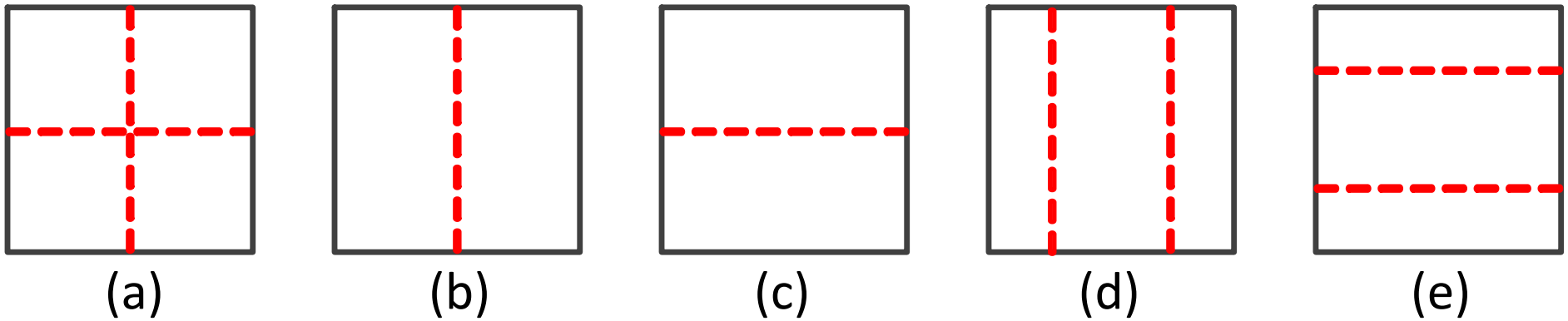
Background

- In VVC, three kinds of partitioning methods, can be selectively applied to split a CU
  - *quad-tree (QT), binary-tree (BT) and ternary-tree (TT)*
- All the partitioning methods supported in VVC are symmetric



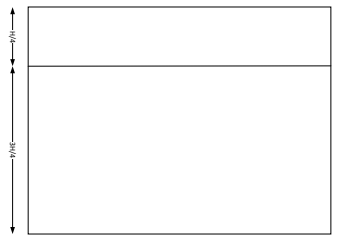
- Symmetric partitioning methods may not always be efficient
  - *Several unsymmetric partitioning methods have been proposed (JVET-K0197, JVET-N0421)*

Proposed: Unsymmetric partitioning

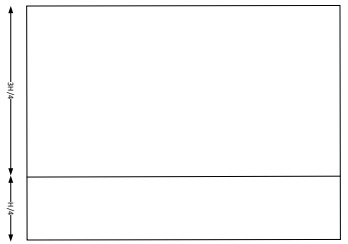
- Two unsymmetric partitioning methods are proposed, as additional partitioning choices together with QT, BT and TT
  - *unsymmetric binary-tree (UBT) partitioning*
  - *unsymmetric quad-tree (UQT) partitioning*
- Constraints on UBT and UQT
  - *QT is not allowed for a CU if any of its ancestor CUs is split from UBT or UQT*
  - *UBT and UQT can only be applied to CUs no greater than 64×64*
  - *The width and height on luma component must be in a form of 4N after any partitioning*
  - *UBT and UQT are not used on chroma components for dual-tree coding structure*
  - *Local dual-tree is disabled when UBT and UQT are used*
  - *For a CU with dimension W×H:*
    - If W is a non-dyadic number (not in a form of 2^N), no vertical partitioning is allowed on the CU
    - If H is a non-dyadic number (not in a form of 2^N), no horizontal partitioning is allowed on the CU

Proposed: UBT

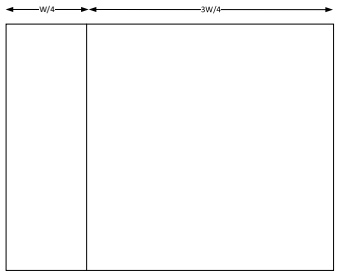
- UBT-H1 and UBT-H2 split a CU with dimension W×H into two child-CUs with dimensions {W×H/4, W×3H/4} and {W×3H/4, W×H/4}
- UBT-V1 and UBT-V2 split a CU with dimension W×H into two child-CUs with dimensions {W/4×H, 3W/4×H} and {3W/4×H, W/4×H}
- With UBT, the width or height of a CU or TU may be a non-dyadic number (not in a form of 2^N)
  - *6-point, 12-point, 24-point, and 48-point transforms/inverse-transforms are introduced*
  - *Some coding tools like ISP, MIP and SBT are disabled in those CUs*



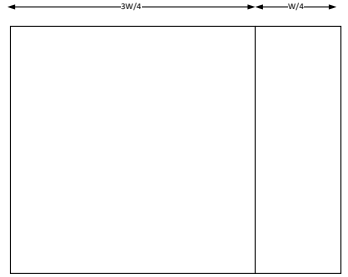
UBT-H1



UBT-H2



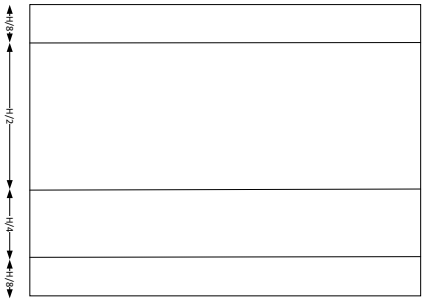
UBT-V1



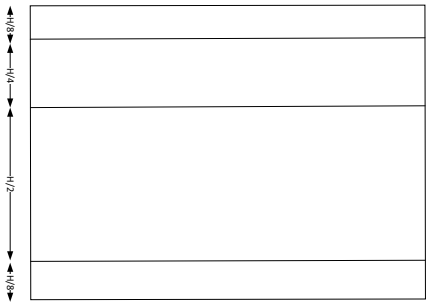
UBT-V2

Proposed: UQT

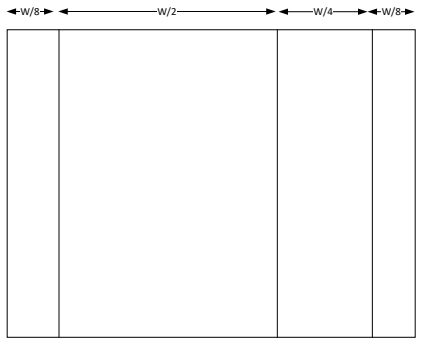
- UQT-H1 and UQT-H2 split a CU with dimension W×H into four child-CUs with dimensions {W×H/8, W×H/2, W×H/4, W×H/8} and {W×H/8, W×H/4, W×H/2, W×H/8}
- UQT-V1 and UQT-V2 split a CU with dimension W×H into four child-CUs with dimensions {W/8×H, W/2×H, W/4×H, W/8×H} and {W/8×H, W/4×H, W/2×H, W/8×H}



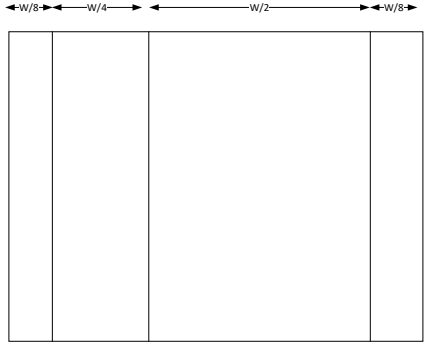
UQT-H1



UQT-H2



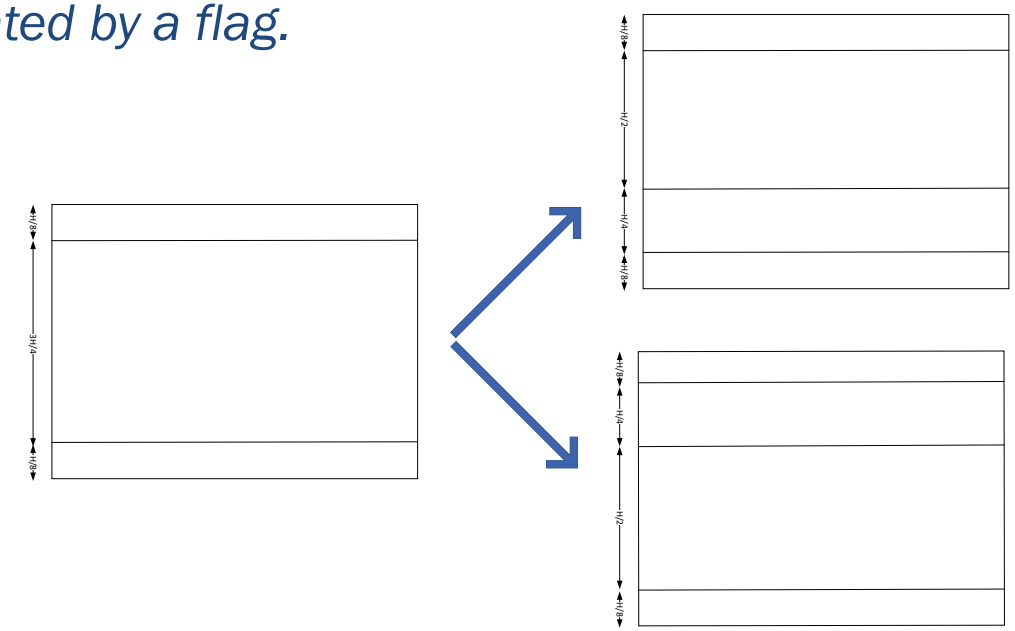
UQT-V1



UQT-V2

Proposed: Signaling of UBT/UQT

- Whether to apply vertical or horizontal UBT/UQT partitioning is indicated by mtt_split_cu_vertical_flag
- An mtt_split_cu_ubt_flag is signaled before mtt_split_cu_binary_flag to indicate whether UBT is applied. If UBT is applied, type-1 or type-2 UBT is indicated by a second flag
- UQT is signaled in a two-step manner to avoid redundancy
  - *First, an mtt_split_cu_uqt_flag is signaled to indicate whether regular TT is applied, or the CU is firstly split into three parts as {1/8, 3/4, 1/8}*
  - *Under the latter case, the central part can only be further split into to two parts as {2/3, 1/3} or {1/3, 2/3}, indicated by a flag.*



Simulation results (tool-on)

- Tool-on test (VTM-11 as the anchor):
- AI: -0.68%, 190%, 104%; RA: -1.48%, 204%, 102%;

	AI					RA				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-0.51%	-0.55%	-0.33%	181%	102%	-1.24%	-1.53%	-1.78%	193%	103%
Class A2	-0.68%	-0.73%	-0.76%	189%	104%	-1.45%	-1.88%	-1.90%	198%	103%
Class B	-0.69%	-0.63%	-0.83%	198%	103%	-1.44%	-1.86%	-1.82%	201%	102%
Class C	-0.69%	-0.96%	-0.97%	190%	105%	-1.74%	-1.86%	-1.93%	223%	102%
Class E	-0.83%	-0.51%	-0.47%	191%	104%					
Overall	-0.68%	-0.69%	-0.71%	190%	104%	-1.48%	-1.80%	-1.86%	204%	102%
Class D	-0.56%	-1.12%	-0.98%	186%	107%	-1.69%	-2.57%	-2.39%	219%	94%

Simulation results (tool-off)

- Tool-off test (JVET-U0100 EE code as the anchor):
- AI: -0.61%, 187%, 103%; RA: -1.23%, 201%, 101%

	AI					RA				
	Y	U	V	EncT	DecT	Y	U	V	EncT	DecT
Class A1	-0.49%	-0.26%	-0.23%	181%	102%	-1.11%	-1.27%	-1.46%	186%	100%
Class A2	-0.57%	-0.27%	-0.29%	191%	105%	-1.19%	-1.43%	-1.29%	197%	100%
Class B	-0.62%	-0.38%	-0.30%	197%	102%	-1.27%	-1.53%	-1.70%	203%	100%
Class C	-0.58%	-0.30%	-0.37%	180%	104%	-1.29%	-1.57%	-1.71%	213%	102%
Class E	-0.77%	-0.31%	-0.53%	184%	101%					
Overall	-0.61%	-0.31%	-0.34%	187%	103%	-1.23%	-1.47%	-1.57%	201%	101%
Class D	-0.45%	-0.26%	-0.33%	179%	98%	-1.07%	-1.41%	-1.58%	207%	104%

Conclusion

- This contribution presents two unsymmetric partitioning methods: UBT and UQT.
- The proposed methods contribute promising coding gains
- It is suggested to further study the proposed methods on a platform beyond VVC