Encoding complexity reduction by Removal of NxN Partition

JCTVC-D087

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Introduction

- In HM, a PU may split into several partitions

  - Intra PU
    - 2Nx2N
    - NxN

  - Inter PU
    - 2Nx2N
    - 2NxN
    - Nx2N
    - NxN

2Nx2N   NxN

<Partition types for Intra PU>
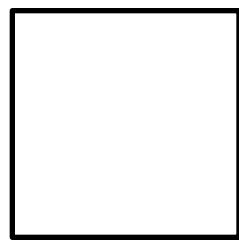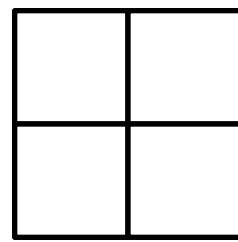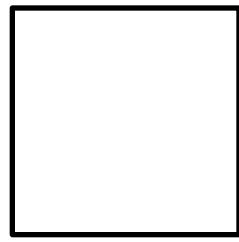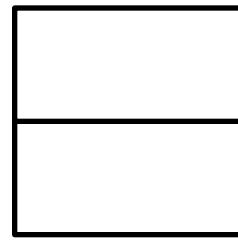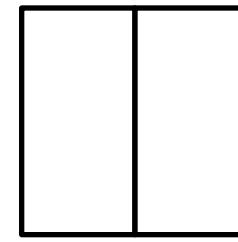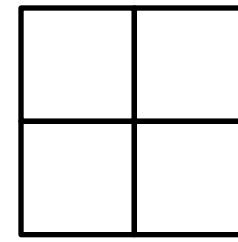
2Nx2N   2NxN   Nx2N   NxN

<Partition types for Inter PU>

Proposed Method

- We propose to
  - For inter prediction
    - Remove NxN partition
    - Allow NxN partition for minimum CU
  - For intra prediction
    - Remove NxN partition
    - Allow NxN partition for minimum CU

Decided to remove NxN partition except for minimum CU

JCTVC-D432 in detail

Proposed Method

2Nx2N partition   Depth level : D

NxN partition   Depth level : D

2Nx2N partition   Depth level : D+1

NxN partition   Depth level : D+1

2Nx2N partition   Depth level : Max

NxN partition   Depth level : Max
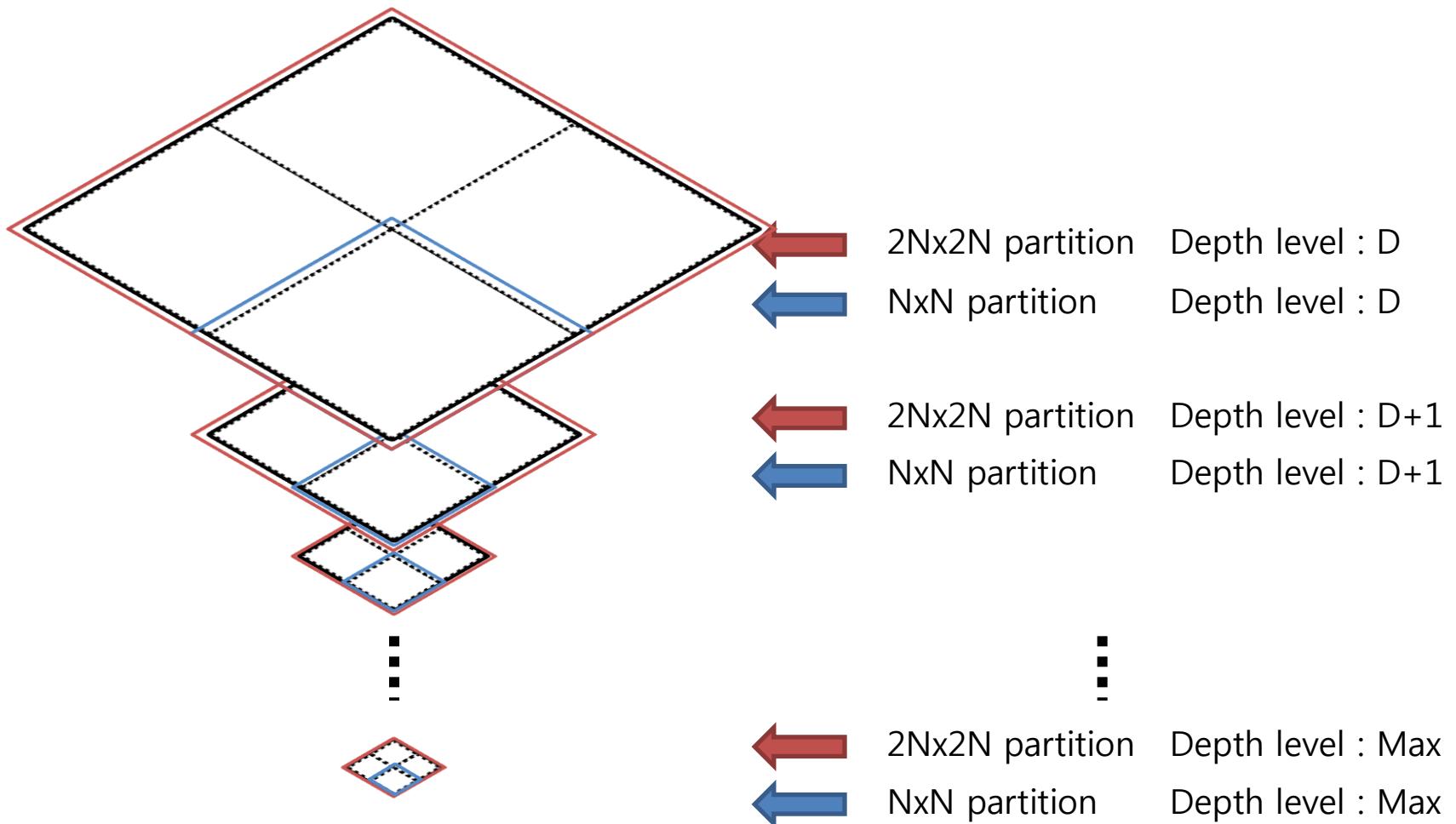
Proposed Method

- In summary,
  - Available partition types are as follow

Previous		Intra prediction	Inter prediction
		2Nx2N, NxN	2Nx2N, 2NxN, Nx2N, NxN

Proposed	CU size	Intra prediction	Inter prediction
	CU size > minimum	2Nx2N	2Nx2N, 2NxN, Nx2N
	CU size = minimum	2Nx2N, NxN	2Nx2N, 2NxN, Nx2N, NxN

Proposed Method

- Codewords assigned to prediction mode and partition type are changed as follow

Slice Type	CU Type	Partition Type	HM	Decided		Proposed	
				CU > minimum	CU = minimum	CU > minimum	CU = minimum
Intra slice	Intra CU	2Nx2N	1	1		-	1
		NxN	0	0		Not exist	0
Inter slice	Intra CU	2Nx2N	00000	0000	00000	000	00000
		NxN	00001	0001	00001	Not exist	00001
	Inter CU	2Nx2N	1	1	1	1	1
		2NxN	01	01	01	01	01
		Nx2N	001	001	001	001	001
		NxN	0001	Not exist	0001	Not exist	0001

Simulation Results

- Test Condition
  - Intra : High efficiency, Low complexity
  - Random access : High efficiency, Low complexity
  - Low delay : High efficiency, Low complexity

- Comparison
  - Anchor : TMuC 0.9

Simulation Results (I)

	Intra			Intra LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.3	0.5	0.7	1.1	-0.3	-0.4
Class B	0.2	0.3	0.4	1.1	-0.3	-0.3
Class C	0.2	0.2	0.3	0.6	-0.1	-0.1
Class D	0.1	0.1	0.1	0.4	-0.2	-0.1
Class E	0.3	0.7	0.7	1.8	-1.1	-0.6
All	0.2	0.3	0.4	0.9	-0.4	-0.3
Enc Time[%]	71%			66%		
Dec Time[%]	100%			100%		

	Random access			Random access LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.3	0.3	0.4	0.9	-0.8	-1.0
Class B	0.2	0.2	0.1	0.8	-0.4	-0.2
Class C	0.3	0.3	0.3	0.8	0.2	0.2
Class D	0.3	0.4	0.5	0.6	-0.1	0.4
Class E						
All	0.3	0.3	0.3	0.8	-0.2	-0.1
Enc Time[%]	82%			77%		
Dec Time[%]	100%			99%		

	Low delay			Low delay LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.1	0.2	0.3	0.3	-0.1	0.0
Class C	0.3	0.2	0.2	0.5	0.0	0.2
Class D	0.3	-0.2	0.7	0.4	0.4	0.2
Class E	0.0	0.6	0.7	0.3	-0.8	-1.1
All	0.2	0.2	0.4	0.4	-0.1	-0.1
Enc Time[%]	79%			75%		
Dec Time[%]	100%			99%		

\<Both inter and intra NxN partition disabled except for minimum CU\>

Simulation Results (II)

	Intra			Intra LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	2.2	1.4	1.5	4.6	-0.9	-1.0
Class B	1.5	0.9	0.9	4.5	-1.1	-1.4
Class C	3.8	1.7	1.8	9.8	0.3	0.2
Class D	4.5	2.2	2.2	10.9	0.4	0.5
Class E	2.3	1.5	1.7	5.7	-1.2	-1.0
All	2.9	1.5	1.6	7.3	-0.4	-0.5
Enc Time[%]	39%			31%		
Dec Time[%]	99%			91%		

<Intra NxN partition disabled for every CU>

	Intra			Intra LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.3	0.5	0.7	1.1	-0.3	-0.4
Class B	0.2	0.3	0.4	1.1	-0.3	-0.3
Class C	0.2	0.2	0.3	0.6	-0.1	-0.1
Class D	0.1	0.1	0.1	0.4	-0.2	-0.1
Class E	0.3	0.7	0.7	1.8	-1.1	-0.6
All	0.2	0.3	0.4	0.9	-0.4	-0.3
Enc Time[%]	71%			66%		
Dec Time[%]	100%			100%		

<Intra NxN partition disabled except for minimum CU>

Conclusions

- We propose to disable NxN partition type except when a CU has minimum size
  - For inter prediction
    - Already decide to remove the type
  - For intra prediction
- It reduces encoding complexity considerably with negligible loss
- We recommend restricting use of NxN partition type for both intra and inter prediction to reduce encoding complexity

Appendix

- Applying the proposed method only to intra CU

	Random access			Random access LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.3	0.3	0.4	0.9	-0.8	-1.0
Class B	0.2	0.2	0.1	0.8	-0.4	-0.2
Class C	0.3	0.3	0.3	0.8	0.2	0.2
Class D	0.3	0.4	0.5	0.6	-0.1	0.4
Class E						
All	0.3	0.3	0.3	0.8	-0.2	-0.1
Enc Time[%]	82%			77%		
Dec Time[%]	100%			99%		

	Random access			Random access LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A	0.2	0.1	0.2	0.7	-1.0	-1.1
Class B	0.1	0.2	0.2	0.7	-0.5	-0.3
Class C	0.2	0.2	0.2	0.6	0.0	0.1
Class D	0.1	-0.1	0.3	0.4	-0.4	-0.2
Class E						
All	0.1	0.1	0.2	0.6	-0.4	-0.3
Enc Time[%]	97%			98%		
Dec Time[%]	100%			101%		

	Low delay			Low delay LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.1	0.2	0.3	0.3	-0.1	0.0
Class C	0.3	0.2	0.2	0.5	0.0	0.2
Class D	0.3	-0.2	0.7	0.4	0.4	0.2
Class E	0.0	0.6	0.7	0.3	-0.8	-1.1
All	0.2	0.2	0.4	0.4	-0.1	-0.1
Enc Time[%]	79%			75%		
Dec Time[%]	100%			99%		

	Low delay			Low delay LoCo		
	Y BD-rate	U BD-rate	V BD-rate	Y BD-rate	U BD-rate	V BD-rate
Class A						
Class B	0.1	0.0	0.3	0.2	-0.1	0.0
Class C	0.2	0.1	0.1	0.3	0.0	0.1
Class D	0.1	-0.4	0.2	0.1	0.3	0.1
Class E	0.1	0.5	-0.2	0.3	-0.5	-0.9
All	0.1	0.0	0.1	0.2	0.0	-0.1
Enc Time[%]	96%			98%		
Dec Time[%]	100%			99%		

\<Both inter and intra NxN partition disabled except for minimum CU\>

\<Intra NxN partition disabled except for minimum CU\>