

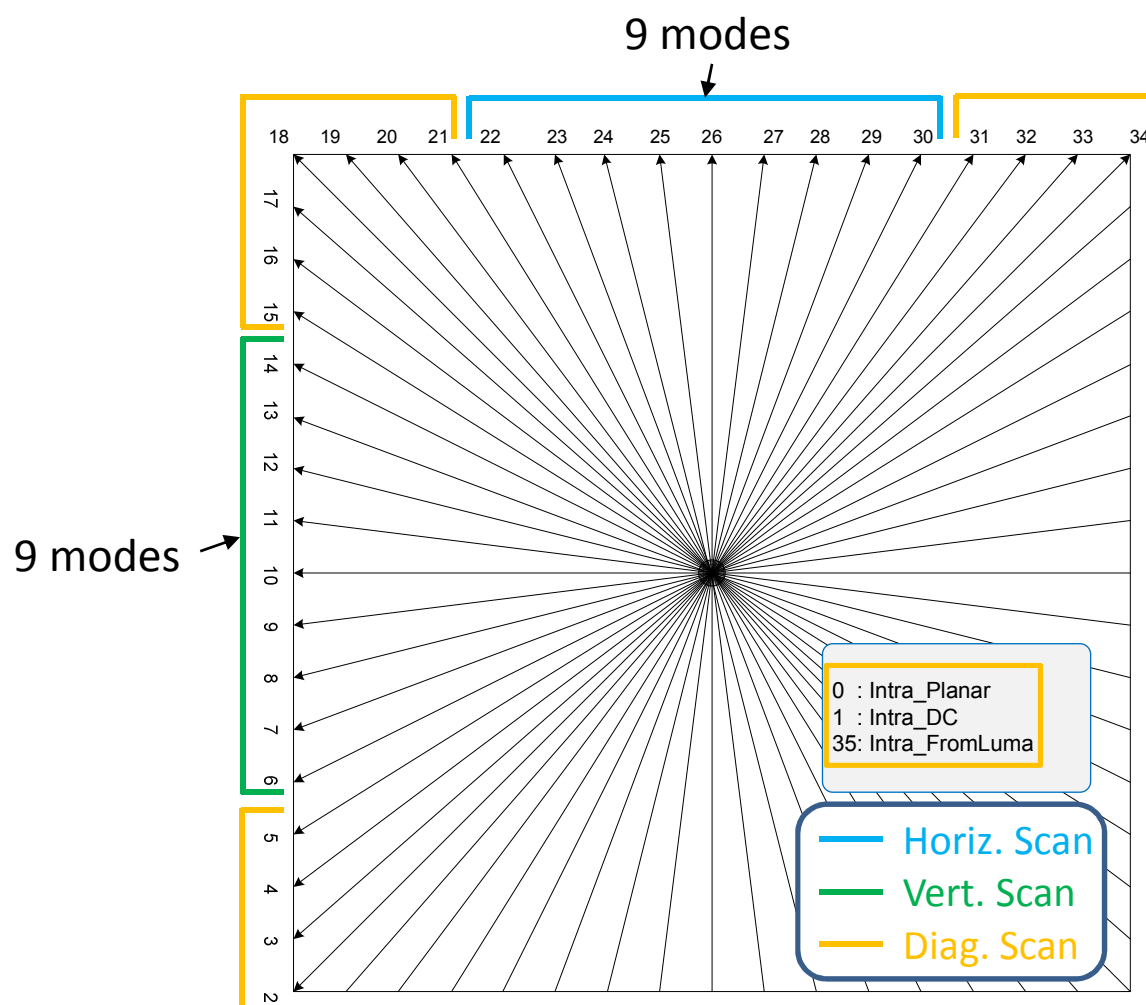
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JCTVC-J0105
Simplification of coefficient scanning order

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Scan types for Intra transform blocks

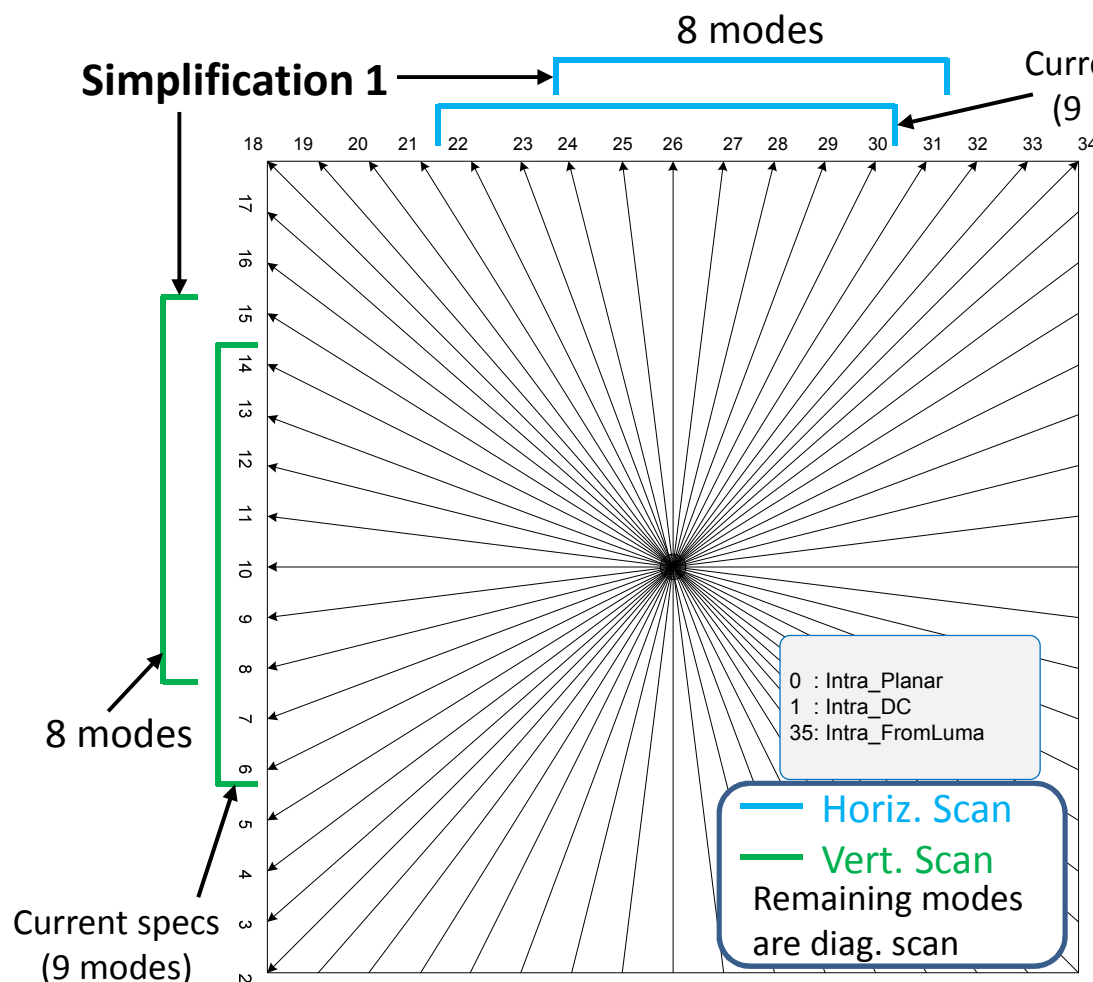


- Current HEVC specs:
 - Intra prediction mode is mapped to scan order
 - 9 modes (6 – 14) mapped to vertical scan
 - 9 modes (22 – 30) mapped to horizontal scan

Simplification of mapping

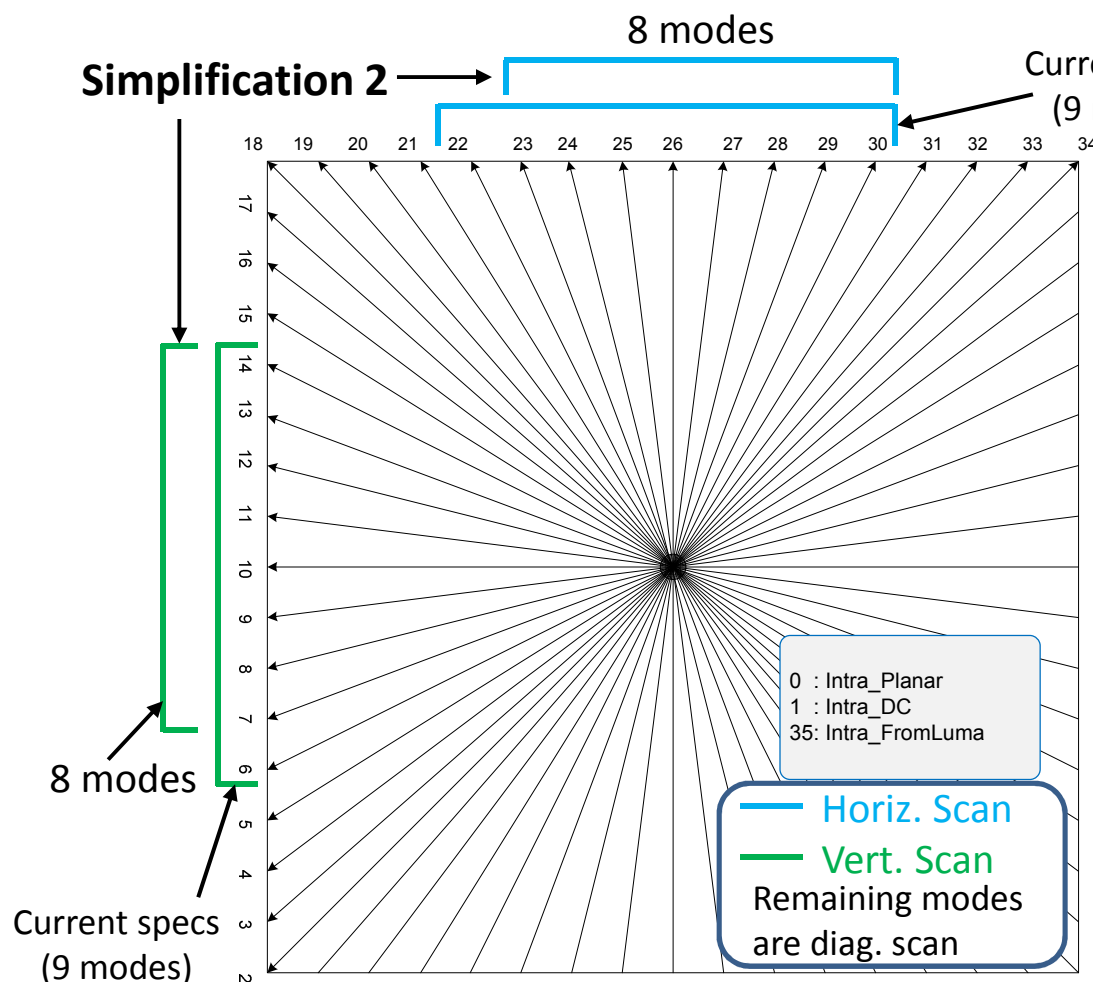
- **Current specs: Must see if mode is within those sets of 9 values (6 – 14 and 22 – 30)**
- **Proposal: Reduce range to 8 values**
 - Enables mapping to be done using simple Boolean logic
 - Optionally align ranges to start at mode value that is a multiple of 8, for further simplification
- **Three simplification methods are proposed**

Simplification 1



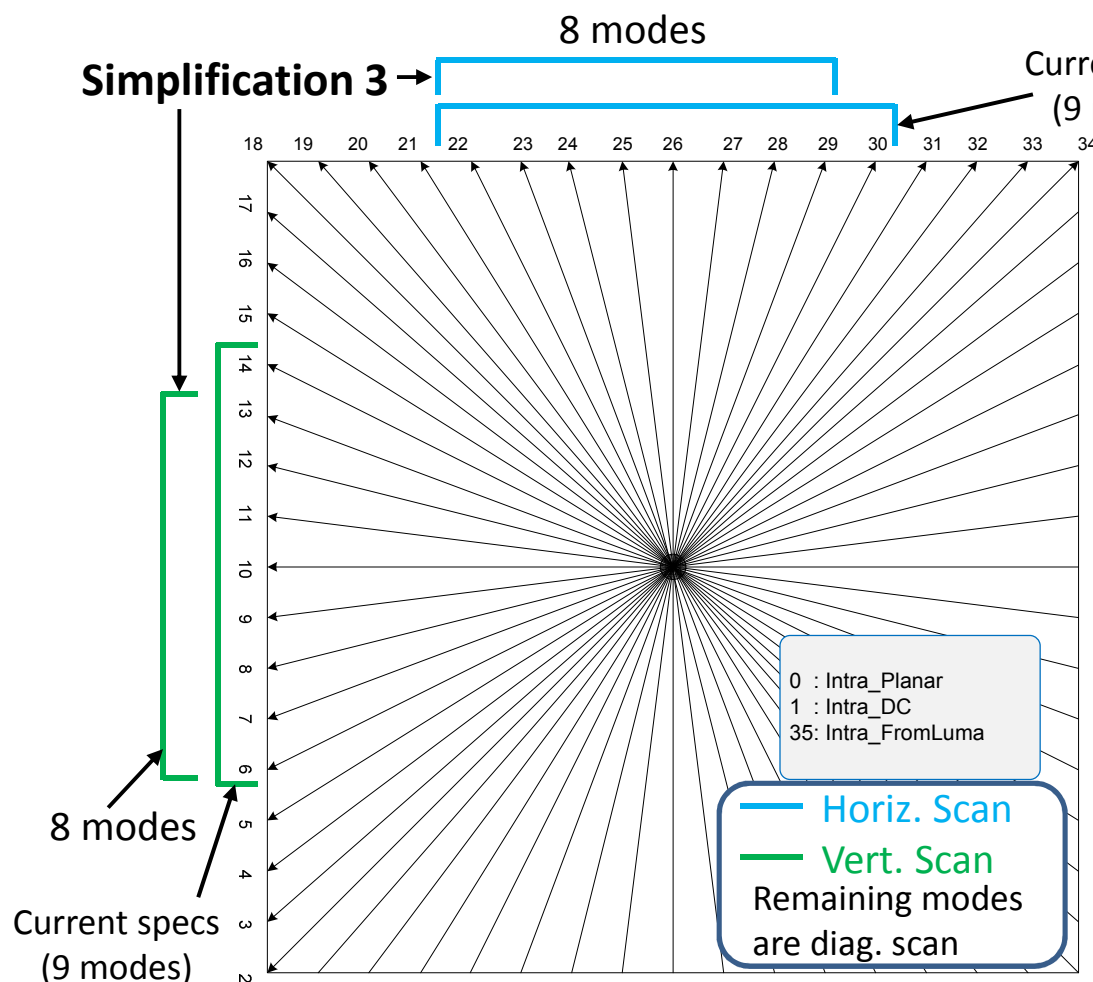
- Reduces range from 9 to 8
- Align to multiple of 8
- Vertical scan used for modes 8 - 15:
 - Examine 3 bits of mode: $\underline{x} \underline{x} \underline{x} _ _ _$
(IntraPredMode >> 3) ^ 0x01 is 0
- Horiz. scan used for modes 24 - 31:
 - Examine 3 bits of mode: $\underline{x} \underline{x} \underline{x} _ _ _$
(IntraPredMode >> 3) ^ 0x03 is 0

Simplification 2



- Reduces range from 9 to 8
- Upper subset of current range
- Vertical scan used for modes 8 - 15:
 - Examine 3 bits of mode offset by 1:
 $((\text{IntraPredMode} + 1) \gg 3) \wedge 0x01$ is 0
- Horiz. scan used for modes 24 - 31:
 - Examine 3 bits of mode offset by 1:
 $((\text{IntraPredMode} + 1) \gg 3) \wedge 0x03$ is 0

Simplification 3



- Reduces range from 9 to 8
- Lower subset of current range
- Vertical scan used for modes 8 - 15:
 - Examine 3 bits of mode offset by 2:
 $((\text{IntraPredMode} + 2) \gg 3) \wedge 0x01$ is 0
- Horiz. scan used for modes 24 - 31:
 - Examine 3 bits of mode offset by 2:
 $((\text{IntraPredMode} + 2) \gg 3) \wedge 0x03$ is 0

Changes to text specifications

Table 7 12 – Specification of ScanType[log2TrafoSize – 2][IntraPredMode]

Simplification 1

IntraPredMode	log2TrafoSize – 2	
	0	1
0	0	0
1	0	0
2 – 57	0	0
68 – 1415	2	2
1516 – 2123	0	0
2224 – 3031	1	1
3132 – 35	0	0

Simplification 2

IntraPredMode	log2TrafoSize – 2	
	0	1
0	0	0
1	0	0
2 – 56	0	0
67 – 14	2	2
15 – 2122	0	0
2223 – 30	1	1
31 – 35	0	0

Simplification 3

IntraPredMode	log2TrafoSize – 2	
	0	1
0	0	0
1	0	0
2 – 5	0	0
6 – 1413	2	2
1514 – 21	0	0
22 – 3029	1	1
3130 – 35	0	0

BD-Rate performance for Simplification 1

	All Intra Main			All Intra HE10		
	Y	U	V	Y	U	V
Class A	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%
Class B	0.1%	0.2%	0.2%	0.1%	0.2%	0.1%
Class C	0.2%	0.3%	0.3%	0.2%	0.2%	0.2%
Class D	0.1%	0.2%	0.2%	0.1%	0.2%	0.2%
Class E	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%
Overall	0.1%	0.2%	0.2%	0.1%	0.1%	0.1%
	0.1%	0.2%	0.2%	0.1%	0.1%	0.1%
Class F	0.2%	0.3%	0.3%	0.1%	0.0%	0.3%
Enc Time[%]	100%			100%		
Dec Time[%]	97%			98%		

	Random Access Main			Random Access HE10		
	Y	U	V	Y	U	V
Class A	0.1%	-0.3%	0.0%	0.0%	0.1%	-0.1%
Class B	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%
Class C	0.1%	0.2%	0.0%	0.0%	-0.1%	0.0%
Class D	0.1%	0.1%	0.2%	0.1%	0.0%	-0.2%
Class E						
Overall	0.1%	0.0%	0.0%	0.0%	0.0%	-0.1%
	0.1%	0.0%	0.0%	0.0%	0.0%	-0.1%
Class F	0.1%	0.1%	0.1%	0.0%	0.1%	-0.1%
Enc Time[%]	100%			99%		
Dec Time[%]	100%			100%		

	Low delay B Main			Low delay B HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.2%	0.0%	0.0%	0.2%	0.2%
Class C	0.0%	0.0%	0.2%	0.0%	-0.1%	0.3%
Class D	0.0%	0.3%	0.3%	0.0%	0.3%	-0.2%
Class E	-0.1%	0.6%	-0.3%	0.1%	-0.5%	-0.5%
Overall	0.0%	0.3%	0.0%	0.0%	0.1%	0.0%
	0.0%	0.3%	0.0%	0.0%	0.1%	0.0%
Class F	0.0%	0.3%	0.2%	0.1%	1.2%	0.3%
Enc Time[%]	100%			100%		
Dec Time[%]	100%			102%		

BD-Rate performance for Simplification 2

	All Intra Main			All Intra HE10		
	Y	U	V	Y	U	V
Class A	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Class B	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%
Class C	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Class D	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Class E	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%
Overall	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%
	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%
Class F	0.1%	0.2%	0.1%	0.0%	0.0%	0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	98%			99%		

	Random Access Main			Random Access HE10		
	Y	U	V	Y	U	V
Class A	0.0%	-0.3%	-0.1%	0.0%	0.2%	-0.1%
Class B	0.0%	0.2%	0.0%	0.0%	0.1%	0.0%
Class C	0.0%	0.1%	0.0%	0.0%	0.1%	-0.2%
Class D	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%
Class E						
Overall	0.0%	0.0%	0.0%	0.0%	0.1%	-0.1%
	0.0%	0.0%	0.0%	0.0%	0.1%	-0.1%
Class F	0.1%	0.1%	0.1%	0.0%	0.1%	-0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	99%			100%		

	Low delay B Main			Low delay B HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.1%	0.1%	0.0%	0.2%	0.1%
Class C	0.0%	-0.1%	0.0%	0.0%	0.0%	0.3%
Class D	0.0%	-0.1%	0.2%	0.0%	0.5%	-0.2%
Class E	-0.1%	0.5%	-0.3%	0.0%	-0.4%	0.3%
Overall	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%
	0.0%	0.1%	0.0%	0.0%	0.1%	0.2%
Class F	0.0%	0.2%	0.2%	0.1%	0.9%	0.7%
Enc Time[%]	101%			100%		
Dec Time[%]	90%			92%		

BD-Rate performance for Simplification 3

	All Intra Main			All Intra HE10		
	Y	U	V	Y	U	V
Class A	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Class C	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%
Class D	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%
Class E	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Class F	0.0%	0.1%	0.1%	0.0%	-0.3%	0.0%
Enc Time[%]	100%			100%		
Dec Time[%]	99%			99%		

	Random Access Main			Random Access HE10		
	Y	U	V	Y	U	V
Class A	0.0%	-0.4%	-0.1%	0.0%	0.0%	0.0%
Class B	0.0%	0.0%	-0.2%	0.0%	0.0%	0.0%
Class C	0.0%	0.2%	0.1%	0.0%	0.1%	-0.1%
Class D	0.0%	0.1%	0.1%	0.0%	0.0%	-0.2%
Class E						
Overall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%
Class F	0.1%	0.2%	0.0%	0.0%	0.2%	0.1%
Enc Time[%]	100%			100%		
Dec Time[%]	99%			99%		

	Low delay B Main			Low delay B HE10		
	Y	U	V	Y	U	V
Class A						
Class B	0.0%	0.3%	0.2%	0.0%	0.2%	-0.1%
Class C	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Class D	0.0%	0.0%	0.0%	-0.1%	0.2%	-0.3%
Class E	-0.1%	0.2%	-0.2%	0.1%	0.0%	-0.3%
Overall	0.0%	0.1%	0.0%	0.0%	0.1%	-0.1%
	0.0%	0.1%	-0.1%	0.0%	0.2%	-0.1%
Class F	0.0%	0.6%	0.5%	0.1%	0.8%	0.9%
Enc Time[%]	100%			100%		
Dec Time[%]	98%			93%		

Summary and conclusions

- **Reduces range of modes for horiz. or vertical scan from 9 to 8**
- **Enables simple Boolean operations to determine ScanType**
- **Simplification 1**
 - Aligned to multiples of 8
 - Avg. change in BD-Rate for Intra: 0.1% to 0.2%
- **Simplifications 2/3**
 - Upper/lower subset of existing range
 - Avg. change in BD-Rate for Intra: 0.0% to 0.1%
- **Cross-verified in JCTVC-J0135 (BBC) – adoption desired**
- **Proponent also asks for adoption of this simplification into DIS**