



**JCTVC-G243**

**CE6b: Intra mode coding with 4 MPMs  
and mode ranking**

Canon, LG, MediaTek, Qualcomm, Sony

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# Proposal overview

## ■ Combination of several proposals

- F062 (MediaTek) and F459 (Qualcomm) : use of additional MPMs
- F091 (Sony), F106 (LG) and F269 (Canon) : use of mode ranking for remaining mode coding

## ■ Content of the proposal

- 4 MPMs (2 usual MPMs + 2 MPRMs)
  - 2 closest adjacent modes of 2 1<sup>st</sup> MPMs
- Remaining mode coding
  - Unified use of mode ranking for CABAC and CAVLC, applied to all modes
  - Unified VLC and binarization tables for LC and HE configurations
  - In HE, bypass coding for MPRMs and remaining modes bins
- Modified Chroma mode coding
  - 6 modes, DM, LM, DM angular neighbors + perpendicular mode
- Addition of a 19th mode for 4x4 PUs

# Addition of 2 MPRMs

## ■ Derive 2 closest adjacent modes of MPM1 ( $M1[x]$ ) and MPM2 ( $M2[x]$ )

- Based on 4 look-up tables  $MPM\_Minus\_1[x]$  and  $MPM\_Plus\_1[x]$

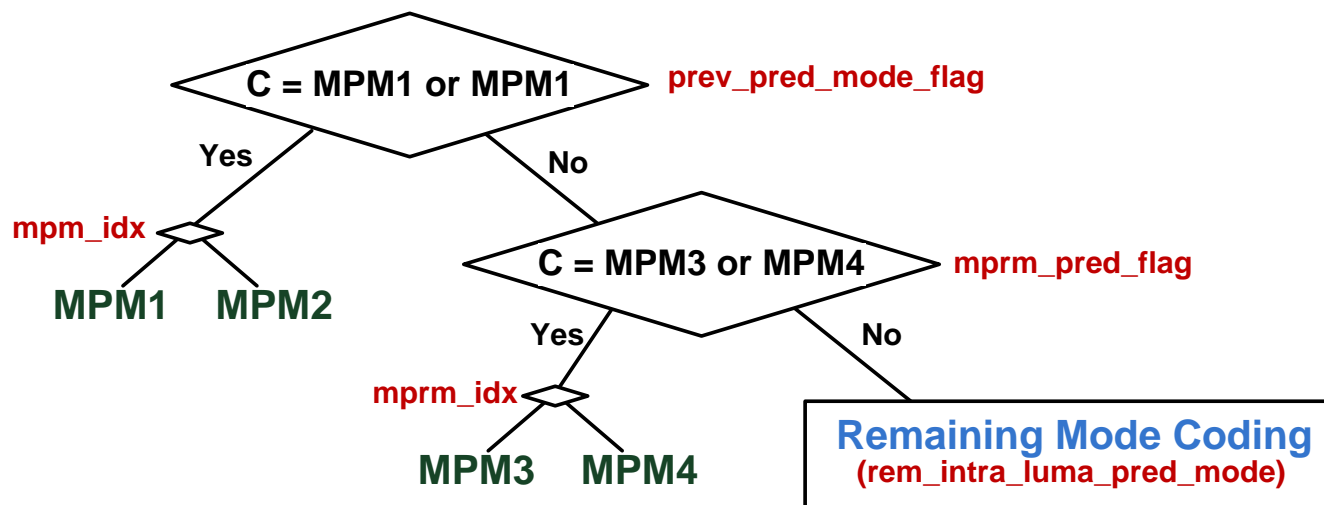
### 3<sup>rd</sup> MPM (MPM3):

- If  $MPM1 == Planar$   $MPM3 = M2[1]$
- Else  $MPM3 = Planar$

### 4<sup>th</sup> MPM (MPM4):

- If  $MPM1 == Planar$   $MPM4 = M2[0]$
- Else if  $MPM1 \neq M2[1]$   $MPM4 = M2[1]$
- Else  $MPM4 = M1[1]$

- Encoding process modified to favour more MPMs/MPRMs in full RDO test
  - But without adding more modes tested by full RDO

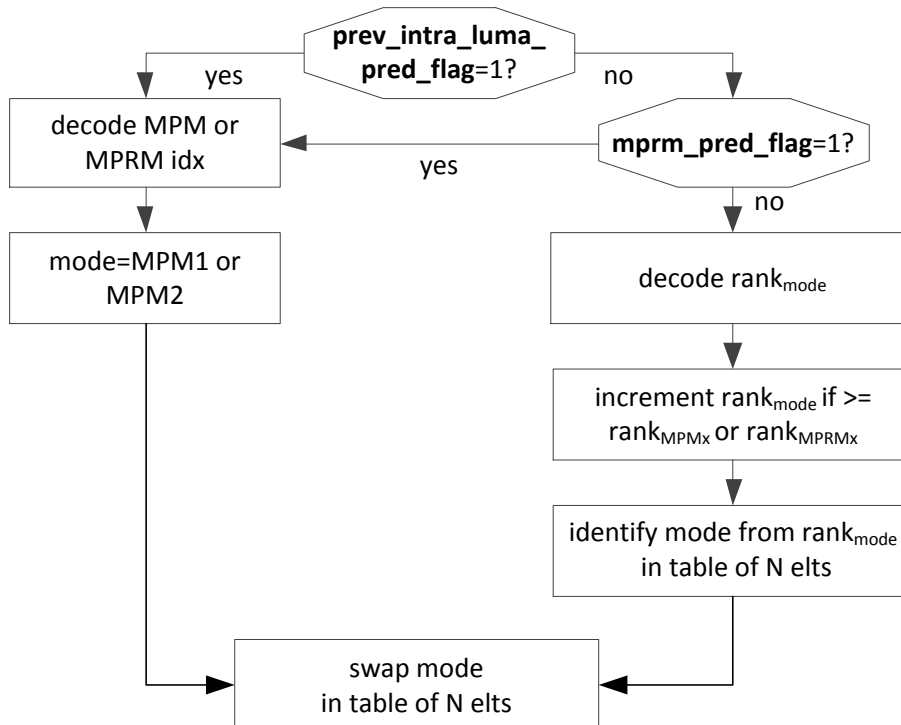


Bypass coding for  
mprm\_idx

# Remaining mode coding

## ■ Mode ranking of all intra modes, for CAVLC and CABAC

- 2 rank tables of size 19 (4x4 PUs) and 35 (8x8 to 32x32 PUs)
- Unified VLC and binarization tables for LC and HE configurations
- In HE, bypass coding for MPRMs and remaining modes bins



4x4 PU

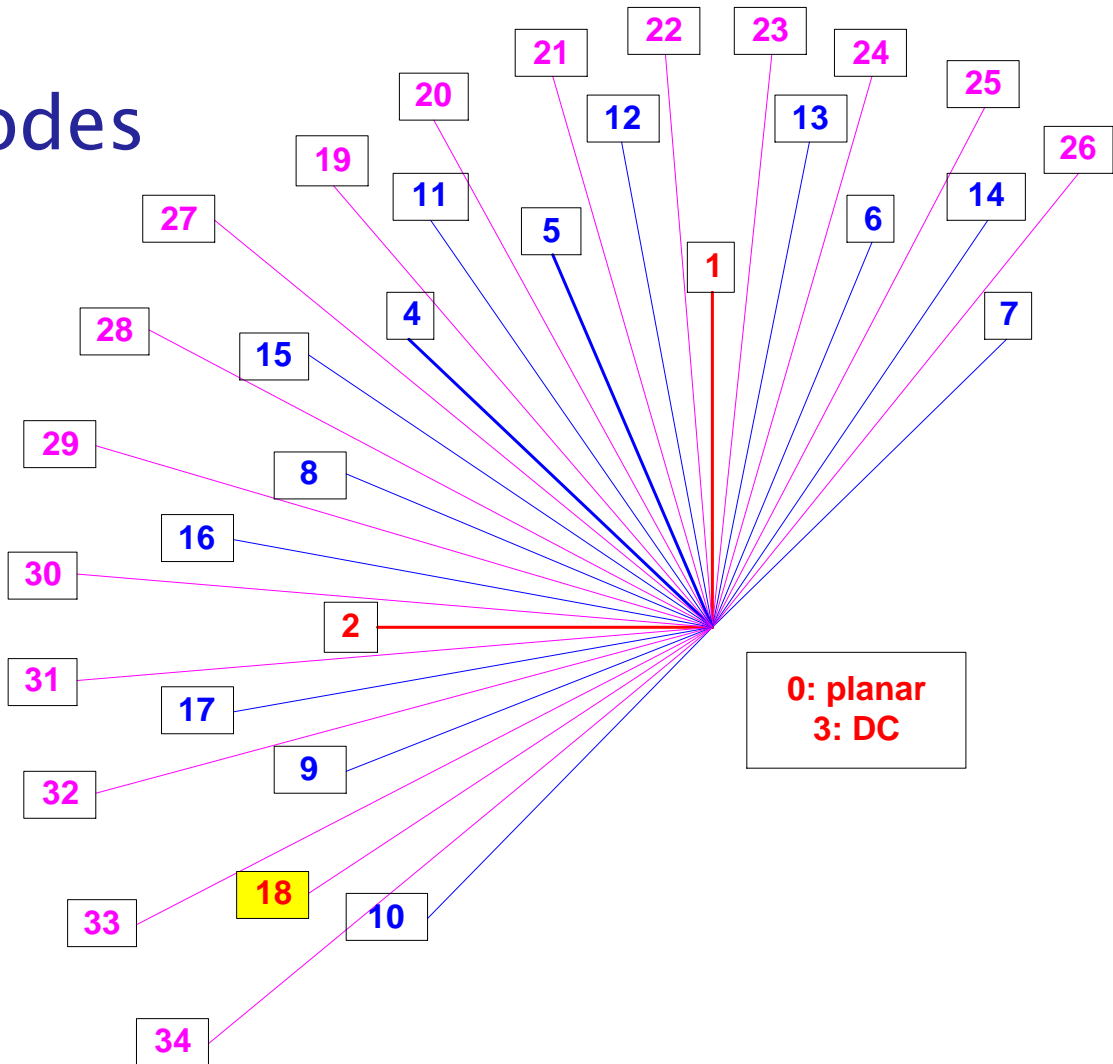
Rank range	prefix	suffix
0-3	0	xx
4-7	10	xx
8-14	11	xxx

8x8 to  
32x32 PU

Rank range	prefix	suffix
0-1	00	x
2-5	01	xx
6-13	10	xxx
14-28	11	xxxx
29	11	11110
30	11	11111

# 19 modes for 4X4 PUs

- Mode 18 added into set of 4x4 modes



# Intra Chroma mode coding

## ■ 6 chroma modes

- $\text{ChrMode}[0] = \text{DM}$
  - $\text{ChrMode}[1] = \text{LM}$
  - $\text{ChrMode}[2] = \text{Planar}$
  - $\text{ChrMode}[3] = \text{MPM\_Minus\_1} [ \text{LumaMode} ]$
  - $\text{ChrMode}[4] = \text{MPM\_Plus\_1} [ \text{LumaMode} ]$
  - $\text{ChrMode}[5] = \text{Perpendicular} [ \text{LumaMode} ]$
- 
- 2 look-up tables for  $\text{Perpendicular} [ x ]$

# Results

## ■ Reference: HM4.0 with LM bug fix

	All Intra HE			All Intra LC		
	Y	U	V	Y	U	V
Class A	-0.5%	0.0%	-0.1%	-0.3%	-0.3%	-0.3%
Class B	-0.4%	-0.5%	-0.5%	-0.4%	-0.7%	-0.8%
Class C	-0.5%	-0.8%	-0.8%	-0.5%	-1.0%	-0.9%
Class D	-0.4%	-0.5%	-0.6%	-0.3%	-0.6%	-0.7%
Class E	-0.6%	-0.3%	-0.5%	-0.6%	-0.8%	-0.8%
<b>Overall</b>	<b>-0.5%</b>	<b>-0.4%</b>	<b>-0.5%</b>	<b>-0.4%</b>	<b>-0.7%</b>	<b>-0.7%</b>
	-0.5%	-0.4%	-0.5%	-0.4%	-0.7%	-0.7%
Enc Time[%]	100%			101%		
Dec Time[%]	101%			101%		

	HE			LC		
	Y	U	V	Y	U	V
<b>AI</b>	-0.5%	-0.4%	-0.5%	-0.4%	-0.7%	-0.7%
<b>RA</b>	-0.2%	-0.3%	-0.5%	-0.1%	-0.3%	-0.2%
<b>LD</b>	-0.1%	-0.1%	-0.2%	0.0%	0.0%	0.0%

Cross-check: G311 (Sharp)

# Conclusion

## ■ Unified solution combining 2 tools for intra mode coding

- Add 2 MPRMs in addition to the 2 MPMs
- Use mode ranking for Remaining mode coding

## ■ Performance

- Gain Y 0.5% AIHE / 0.4% AILC / 0.2% RAHE / 0.1% RALC / 0.1% LDHE / 0% LDLC
- Chroma also improved
- Limited impact on encoding/decoding run time

## ■ Not fully but mostly additive benefit from the combination

- Adding 2 MPRMs only → ~ 0.3% Y gain AI
- Using mode ranking only → ~ 0.2% Y gain AI
- Combination → ~ 0.5% Y gain AI
- Chroma coding improvement is orthogonal
- 19<sup>th</sup> mode for 4x4 block brings minor gain, but enables a more coherent design

## ■ Recommend adoption of the unified intra mode coding solution