

# Non-CE11: Context reduction for coefficient level

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## Motivation

- ✓ Reduce context size for coefficient levels

In current HMv4

- ✓ `coeff_abs_level_greater1_flag`
  - ✓ Each 6 context set has 5 contexts (each luma, chroma) = 60 contexts
- ✓ `coeff_abs_level_greater2_flag`
  - ✓ Each 6 context set has 5 contexts (each luma, chroma) = 60 contexts

## Approach

- ✓ The context can be reduced by following approaches.
  - I. Sharing context set between Luma / Chroma
  - II. Reducing the number of contexts in context set

## Approach I (Luma/Chroma context set sharing)

If many high level context is exist in neighbour ( ctxSet = 1,2,4,5 )

probability of “level\_greater1/2\_flag =1” is consistently high for both luma and chroma

→ luma and chroma can use the same context sets

Context set for coeff\_abs\_level\_greater1/2\_flag

variable ctxSet (in WD)	0		1		2		3		4		5	
Y:Luma / C:Chroma	Y	C	Y	C	Y	C	Y	C	Y	C	Y	C
current HEVC	Y0	C0	Y1	C1	Y2	C2	Y3	C3	Y4	C4	Y5	C5
proposal	Y0	C0	S1		S2		Y3	C3	S4		S5	

Yn : luma context for ctxSet(n)

Cn : chroma context for ctxSet(n)

Sn : luma chroma sharing context for ctxSet(n)

coeff\_abs\_level\_greater1\_flag

→ Context Size : 60 → 40

coeff\_abs\_level\_greater2\_flag

→ Context Size : 60 → 40

→ **Total context size : 120 → 80**

**40 contexts reduction**

## Approach II (for coeff\_abs\_level\_greater1\_flag)

-> Changing maximum number from 4 to 2 (5 contexts to **3** contexts)

This change is only applied to CtxSet = {1,2,4,5}

### HMv4 (example)

	coefficient scan pos within the current 16 coefficient subset															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
greater 1 Ctx	1	2	3	4	4	4	4	0	0	0	0	0	0	0	0	0
coeff_abs_level_greater1_flag	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1



### Proposal (example)

	coefficient scan pos within the current 16 coefficient subset															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
greater 1 Ctx	1	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0
coeff_abs_level_greater1_flag	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

Approach II Context Size : 60 → 44

Approach I&II Context Size : 60 → 32

## Approach II *(for coeff\_abs\_level\_greater2\_flag)*

-> Changing maximum number from 4 to 1 (5 contexts to **2** contexts)

This change is only applied to CtxSet = {1,2,4,5}

### HMv4 (example)

	coefficient scan pos within the current 16 coefficient subset															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
greater 2Ctx	0	1	2	3	4	4	4	4	4	4	4	4	4	4	4	4
coeff_abs_level_greater_2_flag	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1



### Proposal (example)

	coefficient scan pos within the current 16 coefficient subset															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
greater 2Ctx	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
coeff_abs_level_greater_2_flag	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Approach II Context Size : 60 → 36

Approach I&II Context Size : 60 → 28

➔ *20 additional contexts reduction by G1&G2*

Number of context

ctxSet		0		1		2		3		4		5		Total
Y:Luma / C:Chroma		Y	C	Y	C	Y	C	Y	C	Y	C	Y	C	
Current HEVC	abs_level_greater1_flag	5	5	5	5	5	5	5	5	5	5	5	5	60
	abs_level_greater2_flag	5	5	5	5	5	5	5	5	5	5	5	5	60
Proposal Solution	abs_level_greater1_flag	5	5	3	3	3	3	5	5	3	3	3	3	32
	abs_level_greater2_flag	5	5	2	2	2	2	5	5	2	2	2	2	28

→ The number of context for abs\_level\_greater1/2\_flag is reduced by 50% (120 → 60)

	Intra			Random access			Low delay			Reduced Context Num	
	Y	U	V	Y	U	V	Y	U	V		
All average	0.02	0.04	0.06	0.02	0.01	-0.07	0.05	-0.13	-0.02	60	50%

**Our proposal can reduce the memory size for coefficient level contexts without major impact on coding efficiency.**

context for coeff\_abs\_level\_greater1/2\_flag could reduced from 120 to 60.

## **Recommendation**

**It is suggested to consider the inclusion of this proposal in the HM/WD of HEVC.**

BD BR for each proposal technique

Proposal Technique	ctxSet	Intra			Random access			Low delay			Reduced Context Num	
		Y	U	V	Y	U	V	Y	U	V		
Approach I & II	1, 2, 4, 5	0.02	0.04	0.06	0.02	0.01	-0.07	0.05	-0.13	-0.02	60	50%
Approach I (L/C share)		0.00	0.00	0.01	-0.01	0.04	-0.02	0.01	-0.07	0.01	40	33%
Approach II (Ctx Reduction)		0.02	0.04	0.04	0.02	0.04	-0.01	0.05	-0.08	-0.02	40	33%
Approach I & II	2, 5	0.01	0.00	0.01	0.01	0.15	-0.08	0.02	0.10	-0.16	30	25%
Approach I (L/C share)		0.00	0.00	0.00	0.00	-0.03	0.04	0.01	-0.07	0.03	20	17%
Approach II (Ctx Reduction)		0.01	0.01	0.01	0.01	0.09	-0.17	0.02	0.15	-0.14	20	17%

**NOTE :** initial context is no changed for this test. → cross checked by TI (JCTVC-G126)  
For Luma/Chroma sharing, Luma initial context is used for this test.

Combination of G522 & G121

In addition, the combination of CE11 context reduction (G121) is also tested.

→ This result shows further context reduction (120 → 48) can be done by our proposal

BD BR for proposed solution with JCTVC-G121

	Intra			Random access			Low delay		
	Y	U	V	Y	U	V	Y	U	V
All average	0.06	0.08	0.09	0.05	0.06	0.01	0.01	-0.04	-0.24

		Number of context												Total
ctxSet		0		1		2		3		4		5		
Y:Luma / C:Chroma		Y	C	Y	C	Y	C	Y	C	Y	C	Y	C	
Current HEVC	abs_level_greater1_flag	5	5	5	5	5	5	5	5	5	5	5	5	60
	abs_level_greater2_flag	5	5	5	5	5	5	5	5	5	5	5	5	60
Proposal Solution	abs_level_greater1_flag	5	5	3	3	5	5	3	3	3	3	3	3	32
	abs_level_greater2_flag	5	5	2	2	5	5	2	2	2	2	2	2	28
Proposal + G121	abs_level_greater1_flag	4	4	3	3	4	4	3	3	3	3	3	3	28
	abs_level_greater2_flag	3	3	2	2	3	3	2	2	2	2	2	2	20

→ This result shows further context reduction (120 → 48) can be done by our proposal