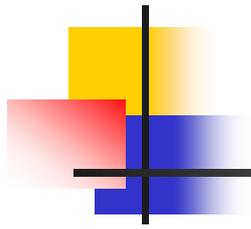


JCTVC-G543

Early SKIP Detection for HEVC

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Summary

- *An early detection of skip mode* to reduce the encoding complexity of HEVC is proposed
- The main concept is that the PU mode in a current CU is determined as *the skip mode at earliest possible stage*
- *This contribution is in the similar concept* with the early skip detection scheme implemented in H.264/AVC MPEG-4 Part 10 reference SW [1]
- It is reported that the contribution reduces *the encoding time by 33% and the decoding time by 2% with BD-bitrate loss of 0.45% on average.*
 - *Verification from JCTVC-G573(ETRI) and JCTVC-G794(Hanyang Univ.)*

[1] B. Jeon and J. Lee, "Fast mode decision for H.264," JVT-J033, Hawaii, USA, December 2003.

Introduction

- In order to decide the PU mode, HM4.0 encoder computes the RD costs of *all the possible PU modes*
- Calculating the costs leads to *high computational complexity*
- A tool for fast mode decision is needed for HEVC

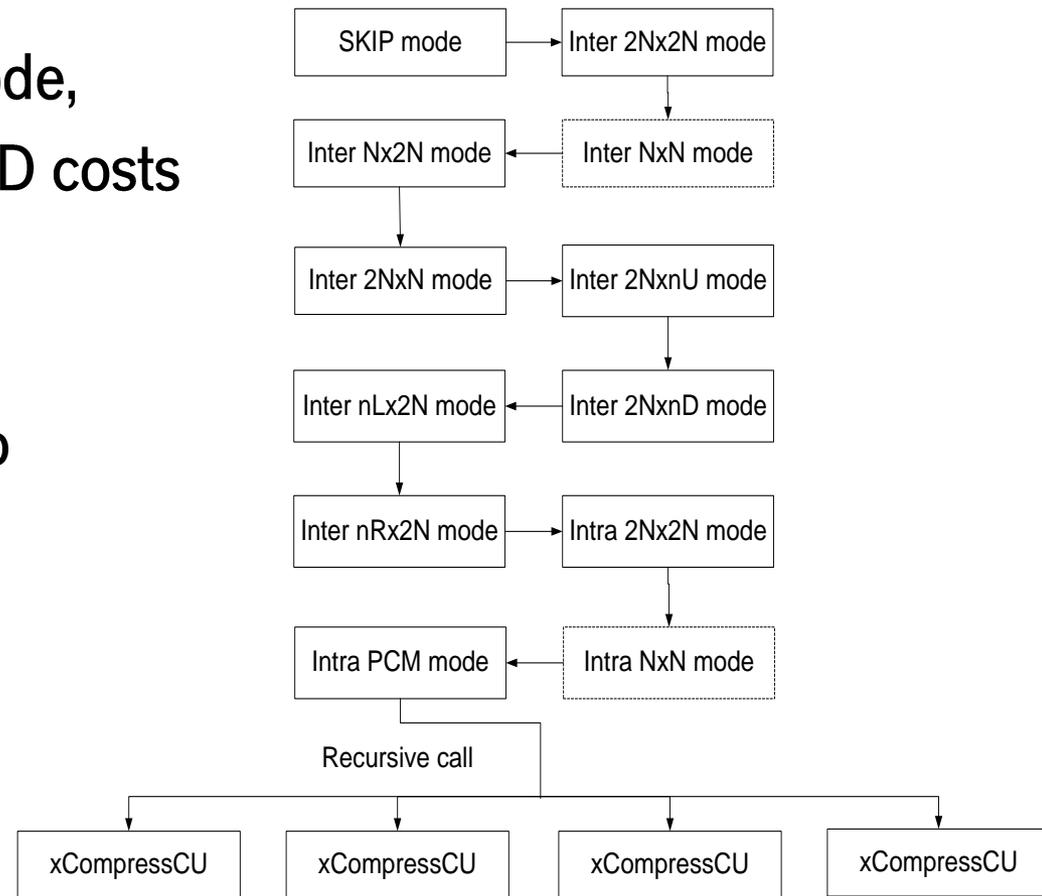


Fig. 1. Encoding process in a current CU(2Nx2N) for *HM4.0*

Remind - Early Skip Detection in JM

- There is a fast mode decision tool in MPEG-4 Part 10 AVC/H.264 reference SW (JM software), namely, an early skip detection [1]
 - In JM software, the partition mode in a current MB is determined as *the skip mode* at earliest possible stage when the encoding results of *16x16 block partition mode* are satisfied with table 1

Table 1. Early skip conditions in JM software

1. Reference picture is just previous one
2. $MVD=(0, 0)$
3. $CBP=0$

[1] B. Jeon and J. Lee, "Fast mode decision for H.264," JVT-J033, Hawaii, USA, December 2003.

Proposed Method

- *Similar to the concept* of the early skip detection in JM software
 - The PU mode in a current CU is determined as *the skip mode* at earliest possible stage when the encoding results of *the best one of two inter 2Nx2N modes (Competition & Merge)* are satisfied with table 2

Table 2. Proposed early skip conditions for HEVC

1. $MVD=(0, 0)$
2. $CBF=0$ for luma and chroma

Proposed Method - Flow Chart

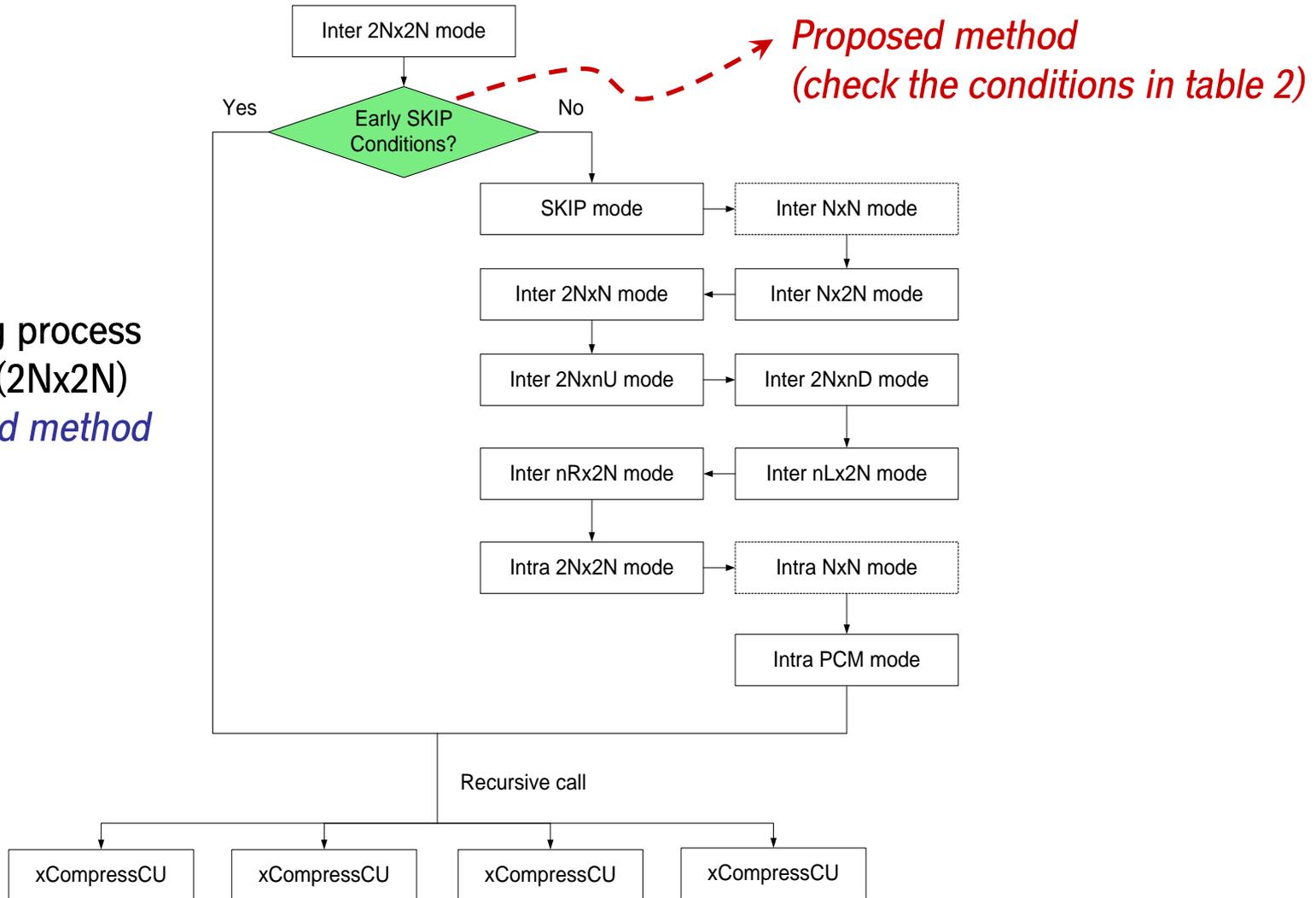


Fig. 2. Encoding process in a current CU(2Nx2N) for *the proposed method*

Combination Method

- A fast mode decision tool was introduced in JCTVC-F092 adopted in the last Torino JCT-VC meeting
 - It is an early detection of *whether a current CU is split or not*
 - CU split process is terminated *if the PU mode in a current CU is skip mode*
- The proposed method can be *easily combined with JCTVC-F092*
 - JCTVC-F092 is for early CU determination
 - This contribution is for fast PU mode decision
- The combination with this contribution and JCTVC-F092 are called as “*combination method*”

Combination Method - Flow Chart

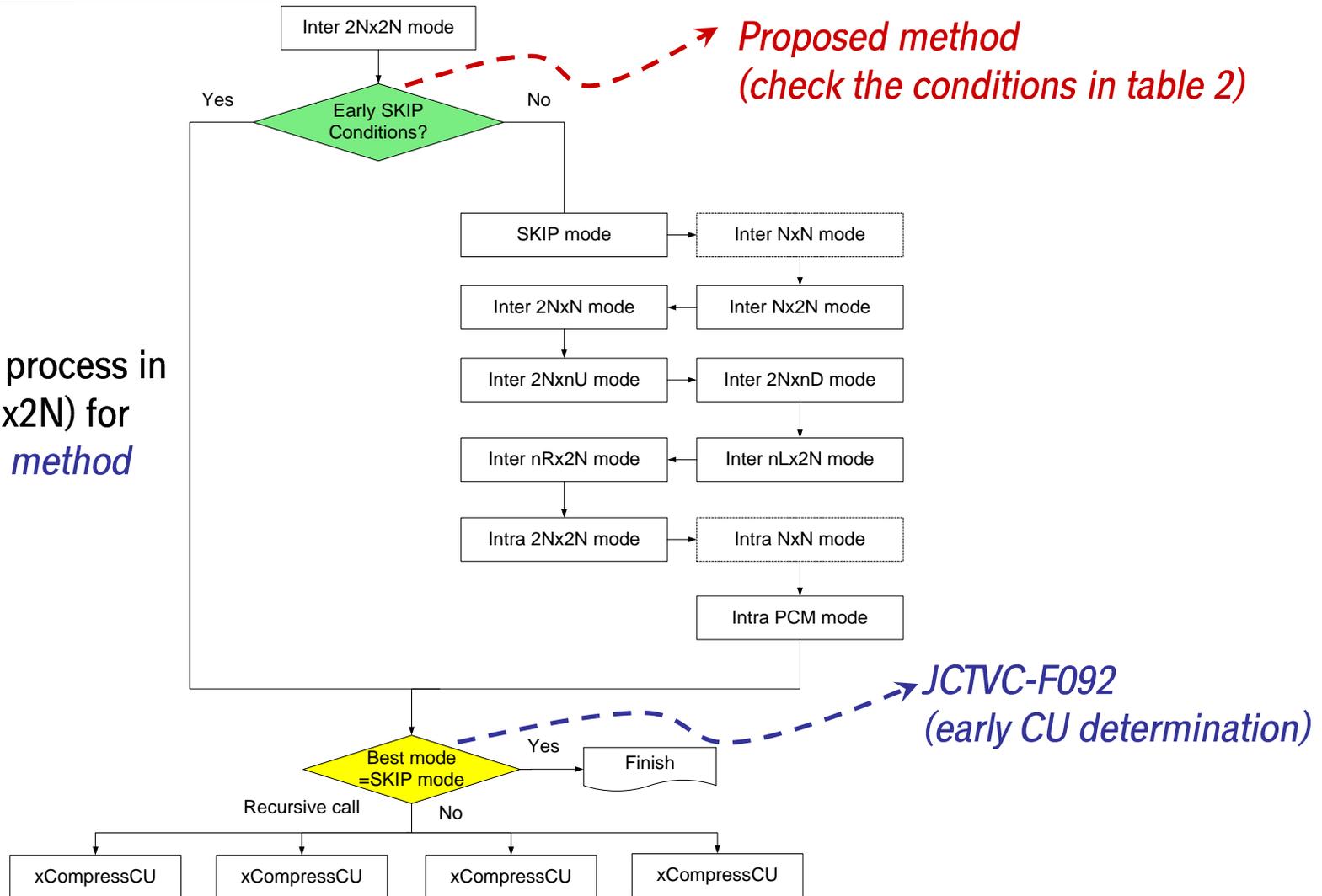


Fig. 3. Encoding process in a current CU(2Nx2N) for the combination method

Experimental Results

- Proposed method
 - **33%** encoding time saving and **2%** decoding time saving with BD-bitrate loss of **0.45%** on average.

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	0.2%	-0.2%	-0.2%	0.2%	-0.1%	-0.1%
Class B	0.3%	-0.1%	-0.2%	0.4%	-0.1%	-0.1%
Class C	0.4%	-0.1%	0.0%	0.4%	-0.1%	0.0%
Class D	0.5%	-0.2%	-0.2%	0.4%	-0.2%	-0.2%
Overall	0.4%	-0.2%	-0.2%	0.3%	-0.1%	-0.1%
	0.4%	-0.1%	-0.1%	0.3%	-0.1%	-0.1%
Enc Time[%]	69%			66%		
Dec Time[%]	98%			100%		

Experimental Results

- Proposed method

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class B	0.4%	-0.1%	-0.1%	0.4%	0.0%	0.1%
Class C	0.4%	0.0%	0.0%	0.3%	0.2%	-0.1%
Class D	0.6%	0.5%	0.2%	0.4%	-0.2%	0.0%
Class E	0.6%	0.2%	1.0%	0.7%	0.6%	-0.1%
Overall	0.5%	0.1%	0.2%	0.4%	0.1%	0.0%
	0.5%	0.1%	0.2%	0.4%	0.1%	0.0%
Enc Time[%]	66%			63%		
Dec Time[%]	99%			97%		

Experimental Results

- Proposed method

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class B	0.5%	-0.1%	0.0%	0.4%	-0.1%	-0.2%
Class C	0.4%	0.0%	-0.1%	0.3%	-0.1%	0.1%
Class D	0.7%	-0.4%	-0.2%	0.4%	-0.2%	-0.2%
Class E	0.8%	0.3%	-0.1%	0.7%	0.0%	-0.4%
Overall	0.6%	-0.1%	-0.1%	0.5%	-0.1%	-0.2%
	0.6%	-0.1%	-0.2%	0.5%	-0.1%	-0.2%
Enc Time[%]	72%			68%		
Dec Time[%]	97%			96%		

Experimental Results

- Combination method (proposed method + JCTVC-F092)
 - **51%** encoding time saving and **5%** decoding time saving with BD-bitrate loss of **1.67%** on average.

	Random Access HE			Random Access LC		
	Y	U	V	Y	U	V
Class A	1.5%	-1.0%	-1.2%	1.7%	-0.8%	-0.7%
Class B	2.1%	-0.9%	-0.9%	2.3%	-0.9%	-0.8%
Class C	2.0%	-0.3%	0.1%	2.2%	-0.3%	0.1%
Class D	2.2%	-0.7%	-0.4%	2.4%	-1.0%	-0.6%
Overall	1.9%	-0.7%	-0.6%	2.2%	-0.7%	-0.5%
	1.9%	-0.7%	-0.6%	2.2%	-0.7%	-0.5%
Enc Time[%]	51%			44%		
Dec Time[%]	96%			98%		

Experimental Results

- Combination method (proposed method + JCTVC-F092)

	Low delay B HE			Low delay B LC		
	Y	U	V	Y	U	V
Class B	1.5%	-0.6%	-0.6%	1.5%	-0.7%	-0.6%
Class C	1.2%	0.1%	0.0%	1.0%	0.2%	0.0%
Class D	1.5%	-0.5%	-0.3%	1.1%	-1.1%	-1.1%
Class E	1.9%	-1.2%	-0.3%	1.8%	-2.1%	-1.3%
Overall	1.5%	-0.5%	-0.3%	1.4%	-0.8%	-0.7%
	1.5%	-0.5%	-0.3%	1.4%	-0.8%	-0.7%
Enc Time[%]	48%			45%		
Dec Time[%]	95%			95%		

Experimental Results

- Combination method (proposed method + JCTVC-F092)

	Low delay P HE			Low delay P LC		
	Y	U	V	Y	U	V
Class B	1.8%	-1.0%	-1.0%	1.7%	-1.0%	-1.1%
Class C	1.3%	-0.3%	-0.4%	1.1%	-0.5%	-0.5%
Class D	1.7%	-1.8%	-1.3%	1.4%	-1.6%	-1.6%
Class E	1.6%	-2.3%	-1.5%	1.4%	-2.5%	-2.4%
Overall	1.6%	-1.3%	-1.0%	1.4%	-1.3%	-1.3%
	1.6%	-1.3%	-1.1%	1.4%	-1.3%	-1.3%
Enc Time[%]	56%			49%		
Dec Time[%]	94%			93%		

Conclusion

- This contribution proposes an early detection of SKIP mode
- The proposed method achieves
 - Reduction of encoding time by 33% and decoding time by 2%
 - Only a negligible loss of luma BD-bitrate 0.45%
- The proposed method can be easily applied in current HM4.0, and combined with JCTVC-F092
 - Modify less than 10 lines in HM 4.0 source code
- We thank ETRI and Hanyang Univ. for crosschecking our proposal
 - JCTVC-G573 , JCTVC-G794