APPS005-Codensity TM T408 Weighted Prediction Application Note

V2.0

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1 Table of Abbreviations

Abbreviation:	Full Form:
ABR	Average bitrate
CQP	Constant QP
NVMe	Non-volatile Memory express (Transport protocol)
CQ	Constant Quality
AI	Artificial Intelligence
API	Application Programming Interface
AUD	Access Unit Delimiters
AV	Audio Video
AV1	Alliance Open Media Video 1 Codec
CABAC	Context Adaptive Binary Arithmetic Coding
CBR	Constant Bit Rate
CPU	Central Processing Unit
CRF	Constant Rate Factor
DSP	Digital Signal Processing
EOF	End Of File
FIXQB	Fixed Quantization Parameter
FF	Form Factor
FPS	Frames Per Second
GOP	Group of pictures
HDR	High Dynamic Range
HHHL	Half Height, Half Length
HHFL	Half Height, Full Length
HLG	Hybrid Log Gamma
HRD	Hypothetical Reference Decoder
IE	Inference Engine
Mbps	Mega Bit per second
MBps	Mega Byte per second
NLP	Natural Language Processing
NPU	Neural Processing Unit
NVMe	Non-Volatile Memory express
PCIe	Peripheral Component Interconnect express
PPS	Picture Parameter Set
QP	Quoted Printable
RGB	Red Green Blue

RGBA	Red Green Blue Alpha
RDO	Optimization
ROI	Region of interest
SDK	Software Development Kit
SEI	Supplemental Enhancement Information
SRIOV	Single Root I/O Virtualization
SPS	Sequence Parameter Set
VBR	Variable Bit Rat
VCL	Video Coding Layer
VPS	Video Parameter Set
VUI	Video Usability Information

2 Background

This document talks about the weighted prediction feature, how to enable this feature in T408 and the test result.

2.1 Intended Audience

This document is intended to help engineers/technicians/developers operating NETINT transcoders troubleshoot common problems.

2.2 Compatibility

Software Compatibility

This guide is intended to be used with NETINT Codensity T408 Video Transcoder software Release 2.0.0.

Hardware Compatibility

Supports NETINT Codensity T408 Video Transcoder hardware.

Operation system

Ubuntu 18.04, kernel, ffmpeg version, libxcoder version and etc.

3 Weighted Prediction

3.1 Theory of weighted Prediction

To achieve high coding efficiency, hybrid video coding consisting of block-based motion compensation (MC) and block-based transform is widely used in many video coding standards such as MPEG-4 and H.264 Advanced Video Coding (AVC). Since temporally successive video images are highly correlated, redundant data in successive frames can be reduced by using MC. However, MC does not work well when temporal illumination variations such as fading and dissolving are present because MC relies on motion estimation based on a block matching technique.

To resolve this issue, Toshiba has developed a weighted prediction (WP) technology with a view to its adoption as part of the H.265 High Efficiency Video Coding (HEVC) standard. H.265/HEVC dramatically improves coding efficiency for such images by performing linear pixel value prediction using a multiplicative weighting factor and an additive offset after MC. In order to determine the optimal WP parameters for an encoder, we have proposed a WP parameter derivation method using image characteristics between the target and reference pictures.

This method is incorporated into the H.265/HEVC reference software. H.265/HEVC using the WP technology provides much higher coding efficiency than H.264/AVC and is expected to realize the distribution of high-quality video contents to various audiovisual devices including tablets, TV sets, and PCs.

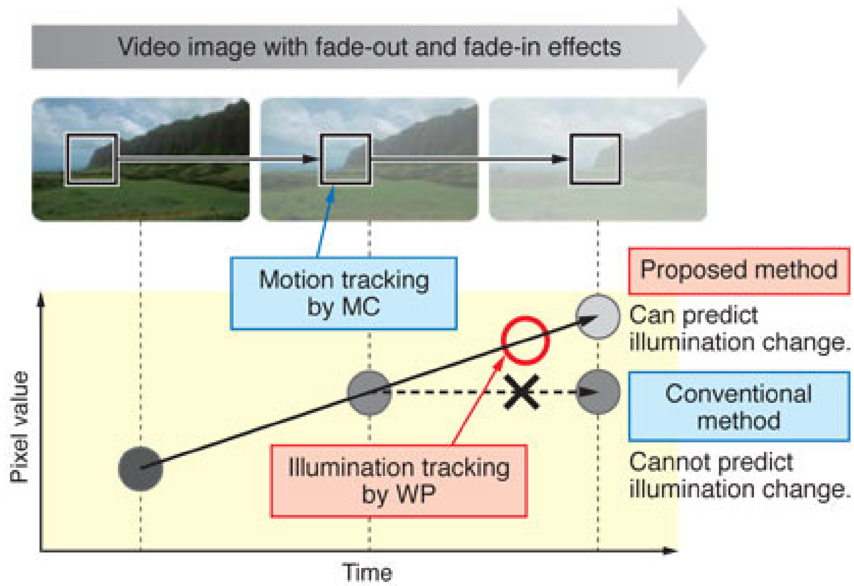

Figure 1 weighted prediction (WP) from Toshiba (https://www.toshiba.co.jp/rdc/rd/fields/13_e03_e.htm)

3.2 Weighted Prediction in H265 spec.

Three types

P slice with 'explicit' weighted prediction

B slice with 'explicit' weighted prediction

B slice with 'implicit weighted prediction

'Explicit' prediction:

The weighted factors are determined by the encoder.

'Implicit' prediction:

The weighted factors are calculated based on the relative temporal positions of the reference pictures.

3.3 Test with brightness gradual change video

Here is the same frame encoded with libx265 preset fast, T408 without weighted prediction and with prediction.

Figure 2 Libx265_fast, 2.75Mbps

Figure 3 ni265, weightPredEnable=0, 2.75Mbps:

Figure 4 Ni265, weightPredEnable=1:

without weighted prediction:

with weighted prediction:

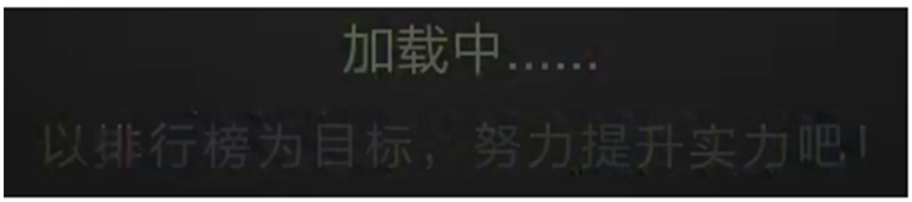

Figure 5 chinese characters are greatly improved with weighted prediction feature.

3.4 How to enable weighted prediction feature in T408

weightPredEnable = 0: disabled.

weightPredEnable = 1: enabled, but values not calculated.

weightPredEnable = 2: enabled, values calculated.

Example:

sudo ffmpeg -y -hide_banner -i ./basketballvbr2.264 -c:v h265_ni_enc -xcoder-params "RcEnable=1:weightPredEnable=1:bitrate=100000" output.265

3.5 Effect to performance and VQ

3.5.1 Test change to performance

Test a transcoding case with/without weightedPrediction.

Test 3 times for each case and take the average time from ffmpeg start to the end.

This test tests the signle instance speed.

test times	weightedPrediction=1,start	weightedPrediction=1,end	time(s)	weightedPrediction=0, start	weightedPrediction=0,end	time(s)
1	20200103-14:46:34.273069	20200103-14:47:20.172873	45.8998	20200103-15:36:53.975304	20200103-15:37:40.282689	46.30739
2	20200103-14:48:06.629663	20200103-14:48:52.958709	46.32905	20200103-15:37:58.511279	20200103-15:38:44.533822	46.02254
3	20200103-14:49:33.950196	20200103-14:50:20.330581	46.38039	20200103-15:39:00.537105	20200103-15:39:47.548292	47.01119
average:			46.20308			46.44704

with weightedPrediction, i.e. weightedPrediction=1, the time is 46.20 seconds.

without weightedPrediction, i.e. weightedPrediction=0, the time is 46.45 seconds.

Conclusion: set weightedPrediction=1 won't introduce side effect to performance under single instance case.

3.5.2 Test change to Video Quality

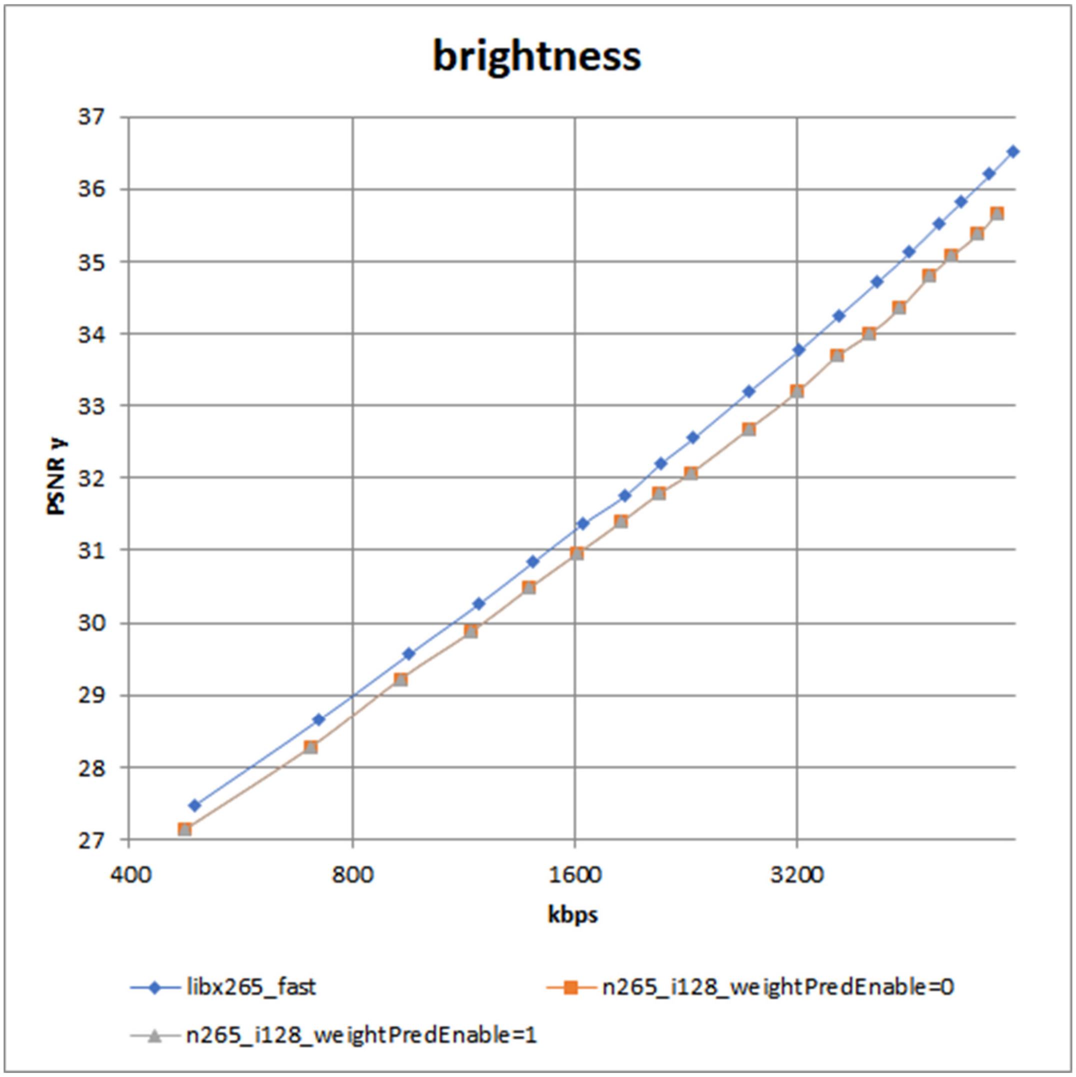

Figure 6 BD-rate comparison with libx265 fast, Netint265 with/without weightPrediction

From this test, we can find enable weightedPrediction won't affect the VQ of the whole stream. It only helps on some frames with brightness gradual change.

4 Reference

Efficient weighted prediction parameter signaling using parameter prediction and direct derivation.

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Abstract:

Weighted prediction (WP) is an efficient motion compensation technique to predict temporal illumination variation. It has been introduced in H.264/MPEG-4 AVC (Advanced Video Coding, H.264) and consists of two modes: an explicit WP (EWP) and an implicit WP (IWP). Since in EWP, a weighting factor and an offset for each reference picture are explicitly transmitted to the decoder, an overhead of these parameters affects the coding efficiency. Since in H.264-based EWP, these parameters are directly encoded without prediction, it is difficult to apply WP for low bitrate applications. In order to reduce the overhead of them, this paper presents an efficient weighted prediction parameter signaling method towards High Efficiency Video Coding (HEVC) standard by introducing a WP parameter prediction and a direct WP parameter derivation. A weighting factor and an offset are predicted using the characteristics of WP parameters and entropy-coded. Moreover, when there are the same entries in reference pictures for prediction list 0 and 1 in the case of B-slices, a set of WP parameters for prediction list 1 is directly derived from that for prediction list 0. The experimental results show that our method can achieve up to 66% overhead bitrate reduction and up to 7% overall bitrate reduction compared to the conventional H.264-based EWP.

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5 Revision History

Version	Change	Create Date	Author
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2.0	Updated to latest template	November 29, 2021	Balwinder Sidhu

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