Title:	**Independent intra-period coding in 3D-HTM**
Status:	Input Document
Purpose:	Proposal
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1 Introduction

This document presents a proposal of 3D-HTM encoder software modification which aims at enhancement of experimentation. Some interesting benefits which can be acquired for the group are: parallel intra-periods coding and fast debugging functionality. No normative change to the future standard is imposed.

2 The idea

Our idea is to attain the following benefits:

1. **Allow parallelization of 3D sequence encoding by splitting into multiple runs, each for different IntraPeriod.** Each IntraPeriod would be encoded independently (in parallel) and then the results would be merged into a single concatenated bitstream. The resultant bitstream should be binary identical to the one produced with a single-pass of the encoder (without parallelization).

2. **Provide an approach for verification of deterministic operation of the encoder.** If after future integration of some new tool, there is a mismatch between single-pass encoding and parallel encoding, there might be an issue with deterministic operation of the software.

3. **Allow stand-alone encoding of a selected IntraPeriod for debugging.** Currently, if an error occurs in e.g. 249th frame, the whole sequence has to be traced in order to find an exact location of the bug in the source code. More feasible way would be to encode only the last IntraPeriod in which the error occurs.

Such idea has been successfully implemented and exploited in Poznan University of Technology proposal for the CfP [2] ("EncodeSelectedGOP") [3] and proved its usefulness.
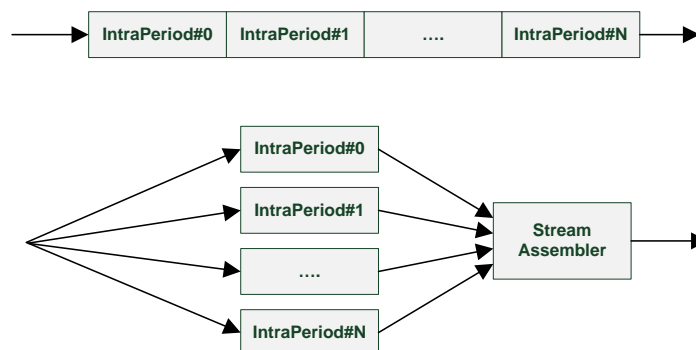

Fig. 1. Single-pass versus proposed parallel IntraPeriod encoding.

3 Implementation issues

The idea can be implemented by simple modification of the encoder software, which would allow encoding of the selected IntraPeriod only, instead of the whole sequence. This requires that the encoding of each IntraPeriod is independent from others. In 3D-HTM it is true in general with two exceptions:

1. 3D-HTM uses open-GOP encoding structure in which CDR frames (Clean Decoder Refresh) are used for prediction that breaks IntraPeriod boundaries. This is further described in Subsection 3.1.

2. The main problem is context derivation of "`cabac_init_flag`" [1] in the slice header. This is further described in Subsection 3.2.

3.1   CDR frames

To allow independent IntraPeriod coding, all IDR/CDR frames that are used as a source for prediction inside selected IntraPeriod must be encoded. Typically this requires processing of an additional CDR frame which is encoded but not written to the output bitstream (Fig. 2).
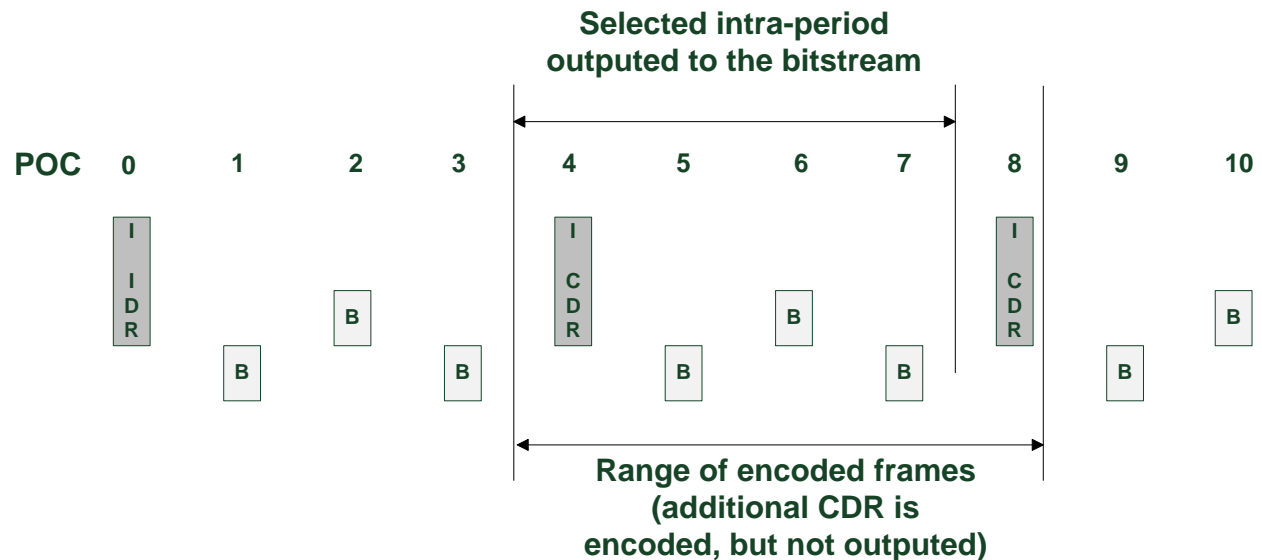
Fig 2. Additional redundant encoding of CDR frame (POC 8) is required in order to produce bitstream for selected intra period..

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3.2 Context derivation of " cabac_init_flag " in 3D-HTM versus 2D generic HEVC.

In 2D generic HEVC, context of "`cabac_init_flag`" is cleared at the beginning of each IntraPeriod (with I frame) and thus there is no problem with intra-periods dependences (Fig. 3).
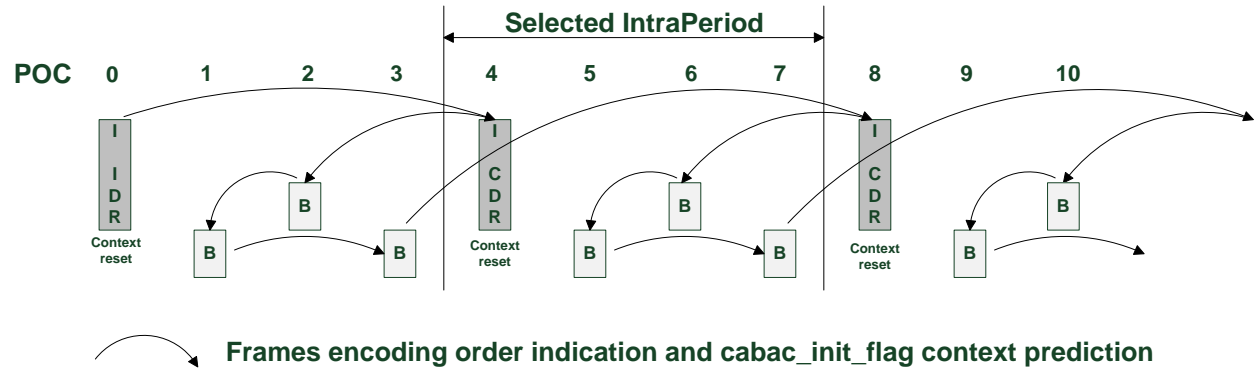
Fig. 3. HEVC coding order and "`cabac_init_flag`" context transition schematic.

In 3D-HTM the context of the flag is also cleared with I frame, but unfortunately in the dependent views there are no I frames. Therefore, in case of dependent views this flag is continuously derived across intra-period boundaries (independently in each view) as showed in Fig. 4.
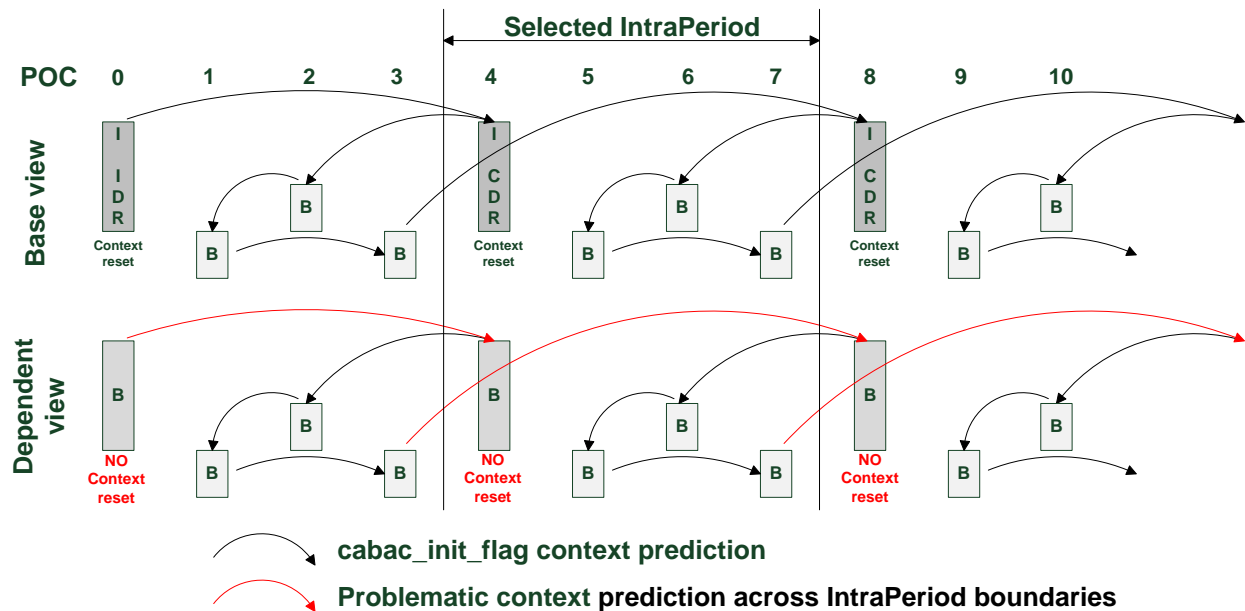
Fig. 4. 3D-HTM coding order and "`cabac_init_flag`" context transition schematic.

We propose to reset the context of "`cabac_init_flag`" across IntraPeriod boundaries in all views. Currently, each I frame reset the context only of a its view which causes the problem. **It can be solved simply by extending "cabac_init_flag" flag context reset to all views.** This would have minor impact of encoding efficiency, while fulfilling requirement of IntraPeriods independency.

4 Summary and recommendations.

Proposed encoder modification involves no normative change to the future standard. Independent intra-period coding eases debugging and parallel computing. We recommend to:

- fix the bug with "cabac_init_flag" context prediction across IntraPeriod boundaries,

- adopt independent intra-period coding in 3D-HTM.

5 Patent rights declaration(s)

Poznan University of Technology does not have current or pending patent rights related to the technology described in this contribution.

6 References

[1] ISO/IEC JTC1/SC29/WG 11 JCTVC-H0540: "CE1 subtest B4 – On CABAC Init IDC," Feb. 2012, San Jose, USA.

[2] " Call for Proposals on 3D Video Coding Technology ", ISO/IEC JTC1/SC29/WG11 MPEG2011/N12036, Geneva, Switzerland, March 2011.

[3] M. Domański, T. Grajek, D. Karwowski, K. Klimaszewski , J. Konieczny, M. Kurc, Adam Łuczak, R. Ratajczak, J. Siast, O. Stankiewicz, J. Stankowski, K, Wegner, "Technical Description of Poznan University of Technology proposal for Call on 3D Video Coding Technology", ISO/IEC JTC1/SC29/WG11 document M22697, Geneva, Switzerland, November 2011.