

**Title:** Cross-check of JCTVC-I0147 – Parallel Processing Entry Point Indication  
**Status:** Input Document to JCT-VC  
**Purpose:** Cross-check  
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## Abstract

This cross-check reviews the proposal JCTVC-I0147[1]. The proposal can be split into two separate concerns. Firstly, a modification to the signalling of tile and wavefront entry point indicators to replace the current two methods with a single method as a compromise between the current cost of low-latency scheme and the high-delay of the low-cost scheme. This cross-check confirms the results presented in I0147 to be reproducible. The code supplied was examined and appears to match the description.

Secondly, a set of additional constraints are proposed that allow the removal of `num_substreams_minus1` and `tile_idx_minus1`. These constraints are partially orthogonal to the entry point signalling.

Comparisons are made between the I0147 proposal and the related proposals JCTVC-I0080[2] and JCTVC-I0159[3].

## Results

Table 1: Results of I0147 vs HM-6.0 with WPP (–WaveFrontSubstreams=Num CTB rows)

	Y' BD-rate	U BD-rate	V BD-rate		Y' BD-rate	U BD-rate	V BD-rate
<b>Class A</b>	0.0%	0.0%	0.0%	<b>Class A</b>	0.1%	0.1%	0.1%
<b>Class B</b>	0.0%	0.0%	0.0%	<b>Class B</b>	0.1%	0.1%	0.1%
<b>Class C</b>	0.0%	0.0%	0.0%	<b>Class C</b>	0.2%	0.2%	0.2%
<b>Class D</b>	0.0%	0.0%	0.0%	<b>Class D</b>	0.3%	0.3%	0.3%
<b>Class E</b>	0.0%	0.0%	0.0%	<b>Class E</b>			
<b>Class F</b>	0.0%	0.0%	0.0%	<b>Class F</b>	0.2%	0.1%	0.1%
<b>All (A-E)</b>	0.0%	0.0%	0.0%	<b>All (A-E)</b>	0.2%	0.2%	0.2%
<b>Enc Time</b>	101%			<b>Enc Time</b>	100%		
<b>Dec Time</b>	97%			<b>Dec Time</b>	98%		

(a) All Intra (Main Profile) (b) Random Access (Main Profile)

	Y' BD-rate	U BD-rate	V BD-rate
<b>Class A</b>			
<b>Class B</b>	0.1%	0.1%	0.1%
<b>Class C</b>	0.2%	0.1%	0.1%
<b>Class D</b>	0.3%	0.2%	0.2%
<b>Class E</b>	1.1%	0.9%	0.9%
<b>Class F</b>	0.3%	0.2%	0.2%
<b>All (A-E)</b>	0.4%	0.4%	0.4%
<b>Enc Time</b>	100%		
<b>Dec Time</b>	100%		

(c) Low Delay (B) (Main Profile)

## Tile/WPP Substream constraints

The proposal suggests two constraints on the design that permit the removal of two syntax elements:

- There shall be one wavefront substream per CTB row. The syntax element `num_substreams_minus1` may be inferred from the picture dimensions and is no longer required.

- All tiles shall have an entry point. As the decoder can now identify the tile index by the entry point number, the syntax element `tile_idx_minus1` is no longer required.

## Comparison with JCTVC-I0080 and JCTVC-I0159

Considering only the changes to entry point signalling, contributions[2, 3] provide alternative attempts to address similar concerns.

Contribution I0080 proposes:

- extending the `entry_point_marker_two_3bytes` to wavefront substreams.
- prohibiting simultaneous use of `entry_point_marker_two_3bytes` and slice header `entry_point_offset` table.
- requiring an `entry_point_offset` value signalling length of the substream to following each `entry_point_marker_two_3bytes`. (two methods of signalling are proposed).

Contribution I0159 proposes:

- removing the slice header `entry_point_offset` table.
- all substreams excluding the last, commence with an `entry_point_offset` value signalling the length of the substream.

In contrast, I0147 is summarised thus:

- removing the slice header `entry_point_offset` table.
- requiring the second substream to be identified using `entry_point_marker_two_3bytes`.
- all substreams excluding the first, commence with an `entry_point_offset` value signalling the length of the substream.

## Remarks

Regarding I0080, it is not immediately obvious why it is desirable to force the signalling of `entry_point_offset` following `entry_point_marker_two_3bytes`. It is expected that the `entry_point_offset` is far more beneficial to a decoder, and the original reasoning behind the entry point marker was to permit low delay encoder operation. The proposal serves to only increase the overhead of the low-delay option.

The I0159 proposal is very similar to I0147.

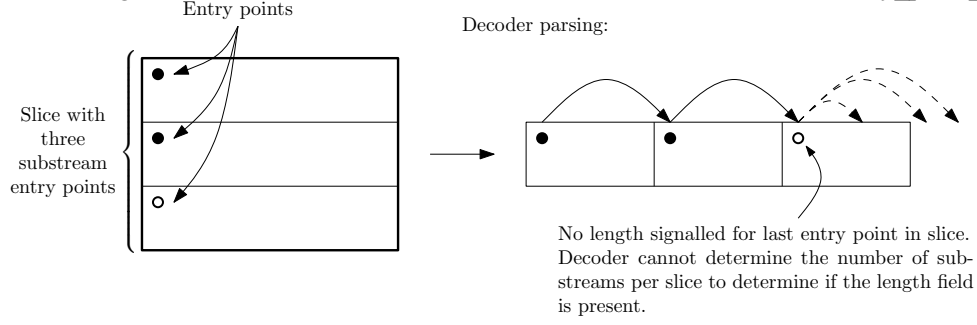
- I0159 encodes the entry point offset in a way that permits prefixing the substream with an integral number of bytes. This property is not provided by I0147, allowing finer grained signalling which is marginally more efficient. However, the penalty of having to re-align the entire substream is not worth the cost.
- I0159 has no BD-Rate change when compared to the same anchor as used in Table 1.
- I0147 incurs a 1–2 byte per frame<sup>1</sup> penalty for signalling the entry point marker for the second substream. However, this removes the requirement for an encoder to buffer the first substream in order to indicate the length.
- I0147 incurs a ~1 byte per frame penalty for signalling the entry point for the last substream in a slice with a zero offset. However, this obviates the need for signalling `num_substreams_minus1`.
- I0159 does not signal the length of, or mark the last substream in a slice. This raises a concern in correctly handling the last substream of a slice when there is more than one slice per picture, since the decoder cannot determine the number of substreams present in a slice. This condition occurs if there is more than one slice per picture. See Figure 1.
- I0159 has rewritten and simplified the CD semantics text for entry point offsets.

Compared to I0159, I0147 has 0.1% (`ra_main`) and 0.3% (`ldB_main`) BD-rate losses.

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<sup>1</sup> 1 byte/frame @ 30 fps = 0.24kbit/sec ≈ 0.1% BD-Rate for class D

Figure 1: Parsing issue when the last substream in a slice does not contain an entry\_point\_offset



An evaluation of I0147 using the entry\_point\_offset coding scheme of I0159 is currently being investigated. The preliminary results in Table 2 show that there is a minor coding advantage over I0147 with the new coding method (which also avoids the need to re-align the substream).

Table 2: Results of I0147 with I0159 entry\_point\_offset coding vs HM-6.0 with WPP (–WaveFrontSubstreams=Num CTB rows)

	Y' BD-rate	U BD-rate	V BD-rate		Y' BD-rate	U BD-rate	V BD-rate
<b>Class A</b>	0.0%	0.0%	0.0%	<b>Class A</b>	%	%	%
<b>Class B</b>	0.0%	0.0%	0.0%	<b>Class B</b>	0.1%	0.1%	0.1%
<b>Class C</b>	0.0%	0.0%	0.0%	<b>Class C</b>	0.1%	0.1%	0.1%
<b>Class D</b>	0.0%	0.0%	0.0%	<b>Class D</b>	0.2%	0.2%	0.2%
<b>Class E</b>	0.0%	0.0%	0.0%	<b>Class E</b>			
<b>Class F</b>	0.0%	0.0%	0.0%	<b>Class F</b>	0.1%	0.1%	0.1%
<b>All (A-E)</b>	0.0%	0.0%	0.0%	<b>All (A-E)</b>	%	%	%
<b>Enc Time</b>	101%			<b>Enc Time</b>	%		
<b>Dec Time</b>	99%			<b>Dec Time</b>	%		

(a) All Intra (Main Profile)
(b) Random Access (Main Profile)

	Y' BD-rate	U BD-rate	V BD-rate
<b>Class A</b>			
<b>Class B</b>	%	%	%
<b>Class C</b>	0.1%	0.1%	0.1%
<b>Class D</b>	0.2%	0.2%	0.2%
<b>Class E</b>	0.6%	0.5%	0.5%
<b>Class F</b>	0.2%	0.2%	0.2%
<b>All (A-E)</b>	%	%	%
<b>Enc Time</b>	%		
<b>Dec Time</b>	%		

(c) Low Delay (B) (Main Profile)

## References

- [1] S. Worrall, “AHG4: Parallel Processing Entry Point Indication For Low Delay Applications.” JCTVC-I0147, Apr. 2012.
- [2] Hendry and B. Jeon, “AHG4: Unified marker for Tiles’ and WPP’s entry points.” JCTVC-I0080, Apr. 2012.
- [3] G. Clare, F. Henry, and S. Pateux, “AHG4: Proposals on entry points signalling.” JCTVC-I0159, Apr. 2012.