|  |  |
| --- | --- |
| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG 16 WP 3 and ISO/IEC JTC 1/SC 29/WG 11**  28th Meeting: Torino, IT, July 13-21, 2017 | Document: JCTVC-AB0043 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **On internal QP increase for bitrate matching** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Philippe Hanhart, Yuwen He, Yan Ye (InterDigital) Xiang Ma, Huanbang Chen, Haitao Yang, Maxim Sychev (Huawei) | Tel: Email: | [philippe.hanhart@interdigital.com](mailto:philippe.hanhart@interdigital.com)  [yuwen.he@interdigital.com](mailto:yuwen.he@interdigital.com)  [yan.ye@interdigital.com](mailto:yan.ye@interdigital.com)  [maxiang6@huawei.com](mailto:maxiang6@huawei.com)  [chenhuanbang@huawei.com](mailto:chenhuanbang@huawei.com)  [haitao.yang@huawei.com](mailto:haitao.yang@huawei.com) |
| *Source:* | InterDigital Communications Inc.  Huawei Technologies Co., Ltd. | | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Abstract

In the current HM/JEM implementation, the internal QP can be increased by one starting from a specified absolute Picture Order Count (POC) when encoding a sequence to meet a target bitrate. However, the QP increment operation is performed after all other QP adjustments, such as adjustment based on temporal level. This means that it is the frame level QP (calculated from base QP) instead of the base QP that is increased. As a result, depending on the base QP and QP offset model parameters, the resulting QP may be different when compared to increasing the base QP directly. To facilitate the QP tuning for rate matching when using parallel encoding in RA configuration, this contribution proposes to increase the base QP by one instead of increasing the frame QP by one, starting from the QP switching point.

# Problem statement

To find the base QP and switching Picture Order Count (POC), i.e., the POC where internal QP is increased, to match a target bitrate for RA configuration, one strategy may be the following:

First, encode each RAS (Random Access Segment, about 1-second length video segment in current encoder configuration) in parallel using different integer QP values.

Second, based on this first set of results, identify the base QP as well as the RAS where the QP increase has to be applied.

Third, re-encode the identified RAS using different switching POC values to identify the switching POC value that precisely matches the target bitrate. Ideally, when doing bitrate matching, one should be able to put together the final bitstream at the target bitrate by simply concatenating the RASs before the switching POC using results when encoding with QP and the RASs after the switching POC using results when encoding with (QP+1).

However, in the current HM/JEM implementation, the QP value for a non-I slice is computed as:

QP = QPb + QPOffset1 + QPOffset2 + QPOffset3

where, QP is the QP value of current slice, QPb is the base QP, QPOffset1 and QPOffset2 are QP adjustments based on temporal level and derived from a linear model [1], and QPOffset3 is 1 if current POC is greater than or equal to the switching POC, 0 otherwise. Therefore, as the increment operation is performed after all other QP adjustments, for the RASs after the switching POC, the individual frame level QPs may be different between encoding with QP and switching POC and encoding directly with (QP+1). The parameters that impact the frame level QP computations are the base QP and QP offset model parameters [1]. For the JVET CTC [2] and QPs in the range 0 to 51, Table 1 reports the base QPs and POCs for which the frame level QPs differ between encoding with QP and switching POC and encoding directly with (QP+1).

Table 1. Base QPs and POCs for which the frame level QPs differ between encoding with QP and switching POC and encoding directly with (QP+1).

|  |  |
| --- | --- |
| **Base QP** | **POCs** |
| 19 | 1, 3, 5, 7, 9, 11, 13, 15 |
| 22 | 1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15 |
| 23 | 4, 12 |
| 25 | 8 |
| 26 | 1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15 |
| 27 | 4, 12 |
| 29 | 8 |
| 31 | 2, 6, 10, 14 |
| 32 | 4, 12 |
| 34 | 8 |

# Proposed solution

The QP setting process for a non-I slice in the current HM/JEM can be described as:

**Step1:** Get QPb

**Step2:** Calculate QP1 = QPb + QPOffset1

**Step3:** Calculate QP2 = QP1 + QPOffset2, where QPOffset2= a × QP1 + b

**Step4:** Calculate QP3 = QP2 + QPOffset3

To solve the problem described in Section 2, the proposed solution is to modify the frame level QP setting method for a non-I slice as follows:

**Step1:** Get QPb

**Step2:** Calculate QP’1 = QPb + QPOffset3

**Step3:** Calculate QP’2 = QP’1 + QPOffset1

**Step4:** Calculate QP’3 = QP’2 + QPOffset2, where QPOffset2 = a × QP’2 + b

With the proposed change, starting from the QP switching point, the base QP is increased by one instead of increasing the frame level QP by one. And the frame level QPs for the RASs after the switching POC will exactly match the QPs of encoding with (QP+1) directly. The proposed modification is the same as previously proposed in [3].

# Conclusion

In this contribution, a modification to the frame level QP computation in JEM/HM code is proposed to facilitate bitrate matching in RA configuration. It is suggested to accept this modification.

# Reference

1. K. Andersson, P.Wennersten, J.Samuellsson, et.al, “AHG 3 Recommended settings for HM,” JCTVC-X0038, May – June 2016, Geneva, CH.
2. K.Suehring, X.Li, “JVET common test conditions and software reference configurations,” JVET-B1010, February 2016, San Diego, USA.
3. X. Ma, H. Chen, H. Yang, M. Sychev, “Floating point QP support for parallel encoding in RA configuration,” JVET-E0059, January 2017, Geneva, CH.

# Patent rights declaration(s)

**InterDigital Communications Inc. does not have any current or pending patent rights relating to the technology described in this contribution.**

**Huawei Corporation does not have any current or pending patent rights relating to the technology described in this contribution.**