

On cu_qp_delta range constraint (JCTVC-F663/ M21116)

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Summay

- HM3.0 cu_qp_delta range constraint
- Straightforward cu_qp_delta range constraint
 - No modulo operation
 - Finite codes
 - No cyclic QP reconstruction
- Recommendation
 - JCTVC experts discuss the appropriate cu_qp_delta range constraint in the HM design

Current cu_qp_delta range constraint

7.4.9 Transform coefficient semantics says that:

“The decoded value of cu_qp_delta shall be in the range of $-(26 + QpBdOffset_Y / 2)$ to $+(25 + QpBdOffset_Y / 2)$, inclusive. cu_qp_delta shall be inferred to be equal to 0 when it is not present for any quantization group of coding units.

The value of QP_Y is derived as

$$QP_Y = (((Q_{PY,PREV} + cu_qp_delta + 52 + 2 * QpBdOffset_Y) \% (52 + QpBdOffset_Y)) - QpBdOffset_Y) \quad (7-32)$$

where $Q_{PY,PREV}$ is the luma quantization parameter, ... ”

In short, for $QpBdOffset_Y = 0$ case, the above sentences say that:

“Don't send syntax values outside the specified range although cyclic QP reconstruction rule yield the identical results for $dQP = X + 52 * n$, where $X \in [-26, 25]$ and $n \in \mathbb{Z}$. (Decoders are not able to parse infinite-length codes...) “

Why do we have such a constraint?

Straightforward cu_qp_delta range constraint

“The decoded value of cu_qp_delta shall be in the range of $-(|0 - QP_{Y,PREV}|)$ to $+(51 - QP_{Y,PREV})$, inclusive. cu_qp_delta shall be inferred to be equal to 0 when it is not present for any quantization group of coding units.

The value of QP_Y is derived as

$$QP_Y = Q_{PY,PREV} + cu_qp_delta + QpBdOffset_Y \quad (7-32)$$

where $QP_{Y,PREV}$ is the luma quantization parameter, ... ”

In short, the above sentences say that:

“Don't send a syntax value that yield a reconstruct QP value outside the specified range $[QpBdOffset_Y, 51 + QpBdOffset_Y]$. “

Pros. and cons. of the above constraint

- No modulo operation (Pros.)
- Finite codes (Pros.)
- No cyclic QP reconstruction (Cons.?)

Conclusions and recommendation

- HM3.0 cu_qp_delta range constraint
- Straightforward cu_qp_delta range constraint
 - No modulo operation
 - Finite codes
 - No cyclic QP reconstruction
- Recommendation
 - JCTVC experts review this contribution and discuss the appropriate cu_qp_delta range constraint in the HM design

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Code number mapping issue

- Mapping from a signed value (cu_qp_delta) to the unsigned value (code number) is unconscious with asymmetric distribution.

➤ For example, if $-6 \leq \text{cu_qp_delta} \leq 2$, then mapping becomes redundant.

| cu_qp_delta | Code number |
|--------------------------------|-------------|
| 0 | 0 |
| 1 | 1 |
| -1 | 2 |
| 2 | 3 |
| -2 | 4 |
| 3 | 5 |
| -3 | 6 |
| 4 | 7 |
| -4 | 8 |
| 5 | 9 |
| -5 | 10 |
| ... | |
| $(-1)^{k+1} \lceil k/2 \rceil$ | k |

Redundant mapping

| cu_qp_delta | Code number |
|-------------|-------------|
| 0 | 0 |
| 1 | 1 |
| -1 | 2 |
| 2 | 3 |
| -2 | 4 |
| na | 5 |
| -3 | 6 |
| na | 7 |
| -4 | 8 |
| na | 9 |
| -5 | 10 |
| na | 11 |
| -6 | 12 |

Solutions: JVTVC-F174

JCTVC-F174 assigns smaller code number to available smaller absolute cu_qp_delta value.

Redundant mapping

| cu_qp_delta | Code number |
|-------------|-------------|
| 0 | 0 |
| 1 | 1 |
| -1 | 2 |
| 2 | 3 |
| -2 | 4 |
| na | 5 |
| -3 | 6 |
| na | 7 |
| -4 | 8 |
| na | 9 |
| -5 | 10 |
| na | 11 |
| -6 | 12 |

JCTVC-F174 mapping

| cu_qp_delta | Code number |
|-------------|-------------|
| 0 | 0 |
| 1 | 1 |
| -1 | 2 |
| 2 | 3 |
| -2 | 4 |
| na | |
| -3 | 5 |
| na | |
| -4 | 6 |
| na | |
| -5 | 7 |
| na | |
| -6 | 8 |

Solutions: JVTVC-F046

JCTVC-F046 directly maps `cu_qp_delta` to bin string in a sign-conscious way.

Redundant mapping

| cu_qp_delta | Bin string | | | | | | | | |
|---------------|------------|-----|-----|-----|-----|------|------|------|------|
| | 1st | 2nd | 3rd | 4th | ... | 10th | 11th | 12th | 13th |
| 0 | 0 | | | | | | | | |
| 1 | 1 | 0 | | | | | | | |
| -1 | 1 | 1 | 0 | | | | | | |
| 2 | 1 | 1 | 1 | 0 | | | | | |
| -2 | 1 | 1 | 1 | 1 | ... | | | | |
| -3 | 1 | 1 | 1 | 1 | ... | | | | |
| -4 | 1 | 1 | 1 | 1 | ... | | | | |
| -5 | 1 | 1 | 1 | 1 | ... | 1 | 0 | | |
| -6 | 1 | 1 | 1 | 1 | ... | 1 | 1 | 1 | 0 |
| Context index | 0 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

JCTVC-F046 mapping

| cu_qp_delta | Bin string | | | | | | | |
|---------------|------------|-----|-----|-----|-----|-----|-----|-----|
| | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th |
| 0 | 0 | | | | | | | |
| 1 | 1 | 0 | 0 | | | | | |
| -1 | 1 | 1 | 0 | | | | | |
| 2 | 1 | 0 | 1 | | | | | |
| -2 | 1 | 1 | 1 | 0 | | | | |
| -3 | 1 | 1 | 1 | 1 | 0 | | | |
| -4 | 1 | 1 | 1 | 1 | 1 | 0 | | |
| -5 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | |
| -6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Context index | 0 | na | 2 | 3 | 3 | 3 | 3 | 3 |