Information technology — Generic coding of moving pictures and associated audio information: Part 1: Systems

TECHNICAL CORRIGENDUM 2: STD buffer sizes for HEVC and miscellaneous editorial issues

Technologies de l'information — Codage générique des images animées et du son associé: Partie 1: Systèmes

RECTIFICATIF TECHNIQUE 2

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INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

Information technology – Generic coding of moving pictures and associated audio information: Systems

Technical Corrigendum 2

STD buffer sizes for HEVC and miscellaneous editorial issues

1) Clause 2.4.2.3, Extensions for single layer HEVC

In clause 2.4.2.3, replace:

NOTE 2 – In the following equations, unit conversion should be implicitly performed as appropriate.

With:

NOTE 2 – In the following equations, unit conversion should be implicitly performed as appropriate. Values expressed in bits are implicitly converted into values expressed in bytes by: number_of_bytes = (number_of_bits + 7) / 8.

2) Clause 2.17.2, Extensions for single layer HEVC

In clause 2.17.2, replace:

• There is exactly one multiplexing buffer MBn for the HEVC video stream or HEVC temporal video sub-bitstream, where the size MBSn of the multiplexing buffer MB is constrained as follows:

\[ MBS_n = BS_{mux} + BS_{oh} + CpbNalFactor \times MaxCPB[tier, level] - cpb_size \]

where BSoh, packet overhead buffering, is defined as:

\[ BS_{oh} = \left(\frac{1}{750}\right) \text{seconds} \times \max\{ CpbNalFactor \times MaxBR[tier, level], 2000000 \text{ bit/s} \} \]

and BSmux, additional multiplex buffering, is defined as:

\[ BS_{mux} = 0.004 \text{ seconds} \times \max\{ CpbNalFactor \times MaxBR[tier, level], 2000000 \text{ bit/s} \} \]

MaxCPB[tier, level] and MaxBR[tier, level] are taken from Annex A of Recommendation ITU-T H.265 | ISO/IEC 23008-2 for the tier and level of the HEVC video stream or HEVC temporal video sub-bitstream. Cpb_size is taken from the HRD parameters, as specified in Annex E of Recommendation ITU-T H.265 | ISO/IEC 23008-2, included in the HEVC video stream or HEVC temporal video sub-bitstream.

• There is exactly one elementary stream buffer EBn for all the elementary streams in the set of received elementary streams associated by hierarchy descriptors, with a total size EBSn

\[ EBS_n = cpb_size \text{ (measured in bytes)} \]

where cpb_size is taken from the HRD parameters, as specified in Annex E of Recommendation ITU-T H.265 | ISO/IEC 23008-2, included in the HEVC video stream or the HEVC temporal video sub-bitstream.

With:

• There is exactly one multiplexing buffer MBn for the HEVC video stream or HEVC temporal video sub-bitstream, where the size MBSn of the multiplexing buffer MB is constrained as follows:

\[ MBS_n = BS_{mux} + BS_{oh} + CpbNalFactor \times MaxCPB[tier, level] - cpb_size \]

where BSoh, packet overhead buffering, is defined as:

\[ BS_{oh} = \left(\frac{1}{750}\right) \text{seconds} \times \max\{ BrNalFactor \times MaxBR[tier, level], 2000000 \text{ bit/s} \} \]

and BSmux, additional multiplex buffering, is defined as:

\[ BS_{mux} = 0.004 \text{ seconds} \times \max\{ BrNalFactor \times MaxBR[tier, level], 2000000 \text{ bit/s} \} \]

MaxCPB[tier, level] and MaxBR[tier, level] are taken from Annex A of Rec. ITU-T H.265 | ISO/IEC 23008-2 for the tier and level of the HEVC video stream or HEVC temporal video sub-bitstream, where rates are expressed in bit/s. Cpb_size is taken from the HRD parameters, as specified in Annex E of Rec. ITU-T H.265 | ISO/IEC 23008-2, included in the HEVC video stream or HEVC temporal video sub-bitstream, where the size is expressed in bits. Implicit conversion is carried out according to Note 2 in 2.4.2.3.

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There is exactly one elementary stream buffer EBₙ for all the elementary streams in the set of received elementary streams associated by hierarchy descriptors, with a total size EBSₙ

$$EBS_n = cpb\_size$$

where cpb_size is taken from the HRD parameters, as specified in Annex E of Rec. ITU-T H.265 | ISO/IEC 23008-2, included in the HEVC video stream or the HEVC temporal video sub-bitstream, where the size is expressed in bits. Implicit conversion is carried out according to Note 2 in 2.4.2.3.

Further, replace:

When there is no data in TBₙ then Rxₙ is equal to zero. Otherwise:

$$Rx_n = bit\_rate$$

where bit_rate is CpbBrNalFactor/CpbBrVclFactor x BitRate[ SchedSelIdx ] of data flow into the CPB for the byte stream format and BitRate[ SchedSelIdx ] is as defined in Annex E of Rec. ITU-T H.265 | ISO/IEC 23008-2 when NAL hrd_parameters() is present in the VUI parameters of the HEVC video stream.

With:

When there is no data in TBₙ then Rxₙ is equal to zero. Otherwise:

$$Rx_n = bit\_rate$$

where bit_rate is BrNalFactor/BrVclFactor x BitRate[ SchedSelIdx ] of data flow into the CPB for the byte stream format and BitRate[ SchedSelIdx ] is as defined in Annex E of Rec. ITU-T H.265 | ISO/IEC 23008-2 when NAL hrd_parameters() is present in the VUI parameters of the HEVC video stream.

Further, replace:

Otherwise, the leak method shall be used to transfer data from MBₙ to EBₙ as follows:

$$Rbx_n = CpbBrNalFactor \times MaxBR[tier, level]$$

with:

Otherwise, the leak method shall be used to transfer data from MBₙ to EBₙ as follows:

$$Rbx_n = BrNalFactor \times MaxBR[tier, level]$$

3) Clause 2.17.3, Extensions for layered transport of HEVC temporal video subsets

In clause 2.17.3, replace:

- There is one multiplex buffer MBₙₖ for each received elementary stream ESₙₖ, where the size MBSₙₖ of the multiplex buffer MBₙₖ is constrained as follows:

$$MBS_{n,k} = BS_{mux} + BS_{oh} + CpbBrNalFactor \times MaxCPB[tier, level] - cpb\_size$$

where cpb_size is taken from the HRD parameters, as specified in Annex E of Recommendation. ITU-T H.265 | ISO/IEC 23008-2, included in the HEVC highest temporal sub-layer representation associated with ESₙₖ.

with:

- There is one multiplex buffer MBₙₖ for each received elementary stream ESₙₖ, where the size MBSₙₖ of the multiplex buffer MBₙₖ is constrained as follows:

$$MBS_{n,k} = BS_{mux} + BS_{oh} + CpbNalFactor \times MaxCPB[tier, level] - cpb\_size$$

where cpb_size is taken from the HRD parameters, as specified in Annex E of Rec. ITU-T H.265 | ISO/IEC 23008-2, included in the HEVC highest temporal sub-layer representation associated with ESₙₖ. In the HRD parameters, cpb_size is expressed in bits, and its value is implicitly converted into a value expressed in bytes according to Note 2 in 2.4.2.3.

Further, replace

- There is exactly one elementary stream buffer EBₙ for the H + 1 elementary streams in the set of received elementary streams ESₙ₀ to ESₙₜ, with a total size EBSₙ

$$EBS_n = cpb\_size$$

where cpb_size is taken from the HRD parameters, as specified in Annex E of Recommendation. ITU-T H.265 | ISO/IEC 23008-2, included in the HEVC highest temporal sub-layer representation associated with ESₙₜ.
There is exactly one elementary stream buffer $EB_n$ for the $H + 1$ elementary streams in the set of received elementary streams $ES_{n,0}$ to $ES_{n,H}$, with a total size $EBS_n$

$$EBS_n = \text{cpb\_size}$$

where $\text{cpb\_size}$ is taken from the HRD parameters, as specified in Annex E of Rec. ITU-T H.265 | ISO/IEC 23008-2, included in the HEVC highest temporal sub-layer representation associated with $ES_{n,H}$. In the HRD parameters, $\text{cpb\_size}$ is expressed in bits, and its value is implicitly converted into a value expressed in bytes according to Note 2 in 2.4.2.3.

Further, replace

Otherwise, the leak method shall be used to transfer data from $MB_{n,k}$ to $EB_n$ as follows:

$$Rbx_{n,k} = \text{CpbBrNalFactor} \times \text{MaxBR[tier, level]}$$

with

Otherwise, the leak method shall be used to transfer data from $MB_{n,k}$ to $EB_n$ as follows:

$$Rbx_{n,k} = \text{BrNalFactor} \times \text{MaxBR[tier, level]}$$

4) Clause 2.17.4, Extensions for layered transport of HEVC sub-partitions with bitstream-partition-specific CPB operation

In clause 2.17.4, replace:

- There is one multiplex buffer $MB_{l,k}$ for each received elementary stream $ES_{l,k}$, where the size $MBS_{l,k}$ of the multiplex buffer $MB_{l,k}$ is constrained as follows:

$$MBS_{l,k} = \text{BS\_mux} + \text{BS\_oh} + \text{CpbBrNalFactor} \times \text{MaxCPB[tier, level]} - \text{cpb\_size}$$

where $\text{BS\_oh}$, packet overhead buffering, and $\text{BS\_mux}$, additional multiplex buffering, are as specified in clause 2.17.2; $\text{MaxCPB[tier, level]}$ and $\text{MaxBR[tier, level]}$ are taken from the tier and level specification of HEVC for the tier and level of $ES_{l,k}$ the HEVC operation point associated with $ES_{l,k}$; $\text{cpb\_size}$ is taken from the sub-layer HRD parameters within the applicable $\text{hrd\_parameters( )}$, as specified in Annex F of Recommendation. ITU-T H.265 | ISO/IEC 23008-2, for the HEVC operation point associated with $ES_{l,k}$.

There is one elementary stream buffer $EB_{l}$ for the $H_{l} + 1$ elementary streams in the set of received elementary streams $ES_{l,0}$ to $ES_{l,H_{l}}$ with a total size $EBS_{l}$

$$EBS_{l} = \text{cpb\_size}$$

where $\text{cpb\_size}$ is taken from the sub-layer HRD parameters within the applicable $\text{hrd\_parameters( )}$, as specified in Annex F of Recommendation. ITU-T H.265 | ISO/IEC 23008-2, for the HEVC operation point associated with $ES_{l,H_{l}}$.

with

- There is one multiplex buffer $MB_{l,k}$ for each received elementary stream $ES_{l,k}$, where the size $MBS_{l,k}$ of the multiplex buffer $MB_{l,k}$ is constrained as follows:

$$MBS_{l,k} = \text{BS\_mux} + \text{BS\_oh} + \text{CpbNalFactor} \times \text{MaxCPB[tier, level]} - \text{cpb\_size}$$

where $\text{BS\_oh}$, packet overhead buffering, and $\text{BS\_mux}$, additional multiplex buffering, are as specified in 2.17.2; $\text{MaxCPB[tier, level]}$ and $\text{MaxBR[tier, level]}$ are taken from the tier and level specification of HEVC for the tier and level of $ES_{l,k}$ the HEVC operation point associated with $ES_{l,k}$; $\text{cpb\_size}$ is taken from the sub-layer HRD parameters within the applicable $\text{hrd\_parameters( )}$, as specified in Annex F of Rec. ITU-T H.265 | ISO/IEC 23008-2, for the HEVC operation point associated with $ES_{l,k}$.

In the HRD parameters, $\text{cpb\_size}$ is expressed in bits, and its value is implicitly converted into a value expressed in bytes according to Note 2 in 2.4.2.3.

There is one elementary stream buffer $EB_{l}$ for the $H_{l} + 1$ elementary streams in the set of received elementary streams $ES_{l,0}$ to $ES_{l,H_{l}}$ with a total size $EBS_{l}$

$$EBS_{l} = \text{cpb\_size}$$
where cpb_size is taken from the sub-layer HRD parameters within the applicable hrd_parameters( ), as specified in Annex F of Rec. ITU-T H.265 | ISO/IEC 23008-2, for the HEVC operation point associated with \( E_{1,1} \). In the HRD parameters, cpb_size is expressed in bits, and its value is implicitly converted into a value expressed in bytes according to Note 2 in 2.4.2.3.

Further, replace

- Otherwise, the leak method shall be used to transfer data from \( MB_{l,k} \) to \( EB_l \) as follows:

\[
R_{bx_{l,k}} = \text{CpbBrNalFactor} \times \text{MaxBR[tier, level]}
\]

with

- Otherwise, the leak method shall be used to transfer data from \( MB_{l,k} \) to \( EB_l \) as follows:

\[
R_{bx_{l,k}} = \text{BrNalFactor} \times \text{MaxBR[tier, level]}
\]