

JVET-AHxxxx: AHG9 Quality metric SEI

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Quality metric SEI

- Post-processing filter gain SEI in the TuC for VSEI (JVET-AG2032) provides signalling of the quality gain achieved by applying an indicated post-processing filter (PPF) or an indicated PPF group
- Propose to rename to Quality metric SEI and extend functionality to add signalling of absolute quality metrics per CLVS and/or individual output picture and support additional quality metrics, including user-specified metrics
- Proposed SEI normatively references quality metrics defined in:
 - ISO/IEC 23001-10 Carriage of timed metadata metrics of media in ISO base media file format
 - ISO/IEC 23001-11 Energy-Efficient Media Consumption (Green Metadata)
- Use cases examples include:
 - A high complexity post-processing operation, e.g., an AI task such as facial recognition, may select the highest quality frames of a video to operate on
 - A decoder may choose not to display pictures with quality below a target quality level, or to not decode CLVSs below a target quality level
 - A receiver/decoder may decide whether or not to apply post-processing filtering

Metric types

- Multiple pre-defined metric types described
- User-defined metrics support signaling of:
 - Flag to indicate if higher values mean better quality
 - Some metrics represent error rather than quality
 - Academic papers often have tables with multiple metrics, with up ↑ or down ↓ arrows to indicate better quality
 - Flag to indicate if metric is full reference
 - If not full reference, may be non-reference or may represent other uses, such as measuring the degree of realism of generative AI images or video, rather than measuring the impact of video compression
 - Optional text description of metric type
 - Enables identification of new metrics
- Metric definitions only need to be signalled once per CLVS

t	Description	IncreasingFlag[t]	FullReferenceFlag[t]	NumBytes[t]
0	User-defined			
1	PSNR [2]	1	1	2
2	PSNR-YUV [2]	1	1	2
3	SSIM [2]	1	1	2
4	MS-SSIM [1]	1	1	2
5	MOS [1]	1	0	1
6	wPSNR [2]	1	1	2
7	WS-PSNR [2]	1	1	2
8	MSE	0	1	2
9..127	Reserved			
128..255	Unspecified			

[1] ISO/IEC 23001-10 Carriage of timed metadata metrics of media in ISO base media file format

[2] ISO/IEC 23001-11 Energy-Efficient Media Consumption (Green Metadata)

Metric scope

- Metric values can be signaled per CLVS and/or per picture
- Metric values can represent absolute quality or relative quality
 - Absolute quality compares output picture(s) to encoder input picture(s)
 - Relative quality, for use with post-processing filters, compares the post-processing output with either cropped decoded picture(s) or input of the current post-processing filter

Summary of proposed features

1. Signal quality metrics per CLVS and/or cropped decoded picture
2. Signal quality metrics as absolute or as relative gains for PPFs/PPFGs, relative to the cropped decoded picture or relative to the input of the current PPF of the PPFG
3. User-specified quality metrics with
 - Text description of the metric
 - Flag to indicate whether higher or lower values of the metric correspond to increased quality
 - Flag to indicate if the quality metric is a full reference metric
 - Signalling of number of bytes signalled for the metric values
4. Quality metrics can be signaled for a single colour component, or for 3 components individually, or for some metric types a combination of all colour components.

Proposed syntax

quality_metric(payloadSize) {	Descriptor
<u>qm_metric_definitions_present_flag</u>	u(1)
<u>qm_clvs_values_present_flag</u>	u(1)
<u>qm_pic_values_present_flag</u>	u(1)
<u>qm_num_metrics_minus1</u>	u(4)
if (<u>qm_metric_definitions_present_flag</u>) {	
<u>qm_gain_enabled_flag</u>	u(1)
for(i = 0; i <= <u>qm_num_metrics_minus1</u> ; i++) {	
if (<u>qm_gain_enabled_flag</u>)	
<u>qm_gain_flag</u> [i]	u(1)
if (<u>qm_gain_flag</u> [i])	
<u>qm_gain_reference_flag</u> [i]	u(1)
<u>qm_metric_type</u> [i]	u(8)
<u>qm_three_component_flag</u> [i]	u(1)
if (<u>qm_metric_type</u> [i] == 0 <u>qm_metric_type</u> [i] >= 128) {	
<u>qm_metric_increasing_flag</u> [i]	u(1)
<u>qm_full_reference_flag</u> [i]	u(1)
<u>qm_value_len_minus1_in_bytes</u> [i]	u(2)
<u>qm_metric_description_present_flag</u> [i]	u(1)
}	
}	
}	
while(!byte_aligned())	
<u>qm_bit_equal_to_zero</u> /* equal to 0 */	f(1)
for(i = 0; i <= <u>qm_num_metrics_minus1</u> ; i++) {	
if (<u>qm_metric_description_present_flag</u> [i])	
<u>qm_metric_description</u> [i]	st(v)
if(<u>qm_clvs_values_present_flag</u>)	
for(i = 0; i <= <u>qm_num_metrics_minus1</u> ; i++)	
for(c = 0; c < (<u>qm_three_component_flag</u> ? 3 : 1); c++)	
<u>qm_clvs_metric_value</u> [i][c]	u(v)
if(<u>qm_pic_values_present_flag</u>)	
for(i = 0; i <= <u>qm_num_metrics_minus1</u> ; i++)	
for(c = 0; c < (<u>qm_three_component_flag</u> ? 3 : 1); c++)	
<u>qm_pic_metric_value</u> [i][c]	u(v)
}	

Discussion

- Green Metadata SEI provides the capability to signal absolute quality metrics for each coded picture or subpicture but does not provide the full set of capabilities provided in the proposed SEI message
 - Proposed SEI normatively references Green Metadata SEI for definitions of several metrics
- Additional functionality vs. Green Metadata SEI:
 - Additional metric types, including user-defined metric types with definitions and descriptions
 - Relative quality gain for post-processing filters
 - Per CLVS metric values
- Additional functionality vs Post-processing filter gain SEI:
 - Additional metric types, including user-defined metric types with definitions and descriptions
 - Absolute quality metric values
 - Indication of reference used for relative gain
- Recommend to adopt Quality Metric SEI into TMuC for VSEI, replacing Post-processing filter gain SEI

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