**ISO/IEC 23001-11:2024/AMD 2:202X(E)**

ISO/IEC JTC1/SC 29

Secretariat: JISC

**Information technology — MPEG systems technologies — Part 11: Energy-efficient media consumption (green metadata) — Amendment 2: Energy-efficient media consumption (green metadata) for new display power reduction metadata**

Potential improvement of DAM stage

**Copyright notice**

This ISO document is a DAM draft and is copyright-protected by ISO. While the reproduction of DAM drafts in any form for use by participants in the ISO standards development process is permitted without prior permission from ISO, neither this document nor any extract from it may be reproduced, stored or transmitted in any form for any other purpose without prior written permission from ISO.

Requests for permission to reproduce this document for the purpose of selling it should be addressed as shown below or to ISO's member body in the country of the requester:

ISO copyright office

Case postale 56 • CH-1211 Geneva 20

Tel. + 41 22 749 01 11

Fax + 41 22 749 09 47

E-mail copyright@iso.org

Web www.iso.org

Reproduction for sales purposes may be subject to royalty payments or a licensing agreement.

Violators may be prosecuted.

**Information technology — MPEG systems technologies — Part 11: Energy-efficient media consumption (green metadata) — Amendment 2: Energy-efficient media consumption (green metadata) for new display power reduction metadata**

*Foreword*

*Replace the following*

The main changes are as follows:

— The clause 6.2 related to complexity metrics for decoder-power reduction is amended by the specification of a new VVC SEI message carrying complexity metrics for decoder-power reduction.

— The clause 9 related to metrics for quality recovery after low-power encoding is amended by the specification of additional metrics for quality recovery after low-power encoding in the newly added VVC SEI message.

*with*

The main changes are as follows:

— The clause 6.2 related to complexity metrics for decoder-power reduction is amended by the specification of a new VVC SEI message carrying complexity metrics for decoder-power reduction.

— The clause 9 related to metrics for quality recovery after low-power encoding is amended by the specification of additional metrics for quality recovery after low-power encoding in the newly added VVC SEI message.

— The clause 6.3 related to interactive signalling for remote decoder-power reduction is amended by adding new syntax elements allowing requests of cancellation of previous decoding operation reduction requests from the decoder and allowing a response from the encoder to acknowledge decoder power reduction requests

— The clause 7 related to display power reduction using display adaptation is amended by extending Green SEI metadata. These metadata rely on the use of Attenuation Maps transmitted thanks to auxiliary pictures conveyed along with the base video pictures. In addition, the clause 7 is amended by adding new syntax elements allowing interactive signalling for remote display-power reduction.

*Introduction*

*Replace the following*

The metadata for energy-efficient decoding specifies two sets of information: complexity metrics (CM) metadata and decoding operation reduction request (DOR-Req) metadata. A decoder uses CM metadata to vary operating frequency and thus reduce decoder power consumption. In a point-to-point video conferencing application, the remote encoder uses the DOR-Req metadata to modify the decoding complexity of the bitstream and thus reduce local decoder power consumption.

The metadata for energy-efficient encoding specifies quality metrics that are used by a decoder to reduce the quality loss from low-power encoding.

The metadata for energy-efficient presentation specifies RGB-component statistics and quality levels. A presentation subsystem uses this metadata to reduce power by adjusting display parameters, based on the statistics, to provide a desired quality level from those provided in the metadata.

*with*

The metadata for energy-efficient decoding specifies two sets of information: complexity metrics (CM) metadata and decoding operation reduction request (DOR-Req) and response (DOR-Resp) metadata. A decoder uses CM metadata to vary operating frequency and thus reduce decoder power consumption. In a point-to-point video conferencing application, the remote encoder uses the DOR-Req metadata to modify the decoding complexity of the bitstream and thus reduce local decoder power consumption. The remote encoder uses the DOR-Resp metadata to acknowledge for the request and indicate how it has decided to answer.

The metadata for energy-efficient encoding specifies quality metrics that are used by a decoder to reduce the quality loss from low-power encoding.

The metadata for energy-efficient presentation specifies Attenuation Map Information (AMI) metadata, RGB-component statistics and quality levels. A presentation subsystem uses this metadata to reduce power by modifying the content based on Attenuation Map and/or adjusting display parameters, based on the statistics, to provide a desired quality level from those provided in the metadata.

In a point-to-point video conferencing application, a decoder can use the Display Attenuation Map Power Reduction Request (DAMPR-Req) message to reduce the energy consumption of the display. The remote encoder uses the Display Attenuation Map Power Reduction Response (DAMPR-Resp) message to adapt the amount of light emitted by the display, and thus reduce the display energy consumption.

*3.2*

*Add the following in alphabetical order in subclause 3.2 (“Symbols and abbreviated terms”)*

|  |  |
| --- | --- |
| AMI | attenuation map information |
| DA | display adaptation |
| DAMPR-Req | display attenuation map power reduction request |
| DAMPR-Resp | display attenuation map power reduction response |
| DPRAV-Req | display power reduction attenuated video request |
| DPRAV-Resp | display power reduction attenuated video response |
| picAMI | Attenuation Map sample values coded in auxiliary pictures of type AUX\_ALPHA |

*6.3.2*

*Replace the Table 11 in subclause 6.3.2 (“Syntax”)*

Table 11 – syntax for interactive signalling for remote decoder-power reduction

|  |  |
| --- | --- |
|  | **Descriptor** |
| **dec\_pow\_reduction\_type** | u(2) |
| if (dec\_pow\_reduction\_type = = 0) { |  |
| **dec\_ops\_reduction\_req** | s(6) |
| else if (dec\_pow\_reduction\_type = = 1) { |  |
| **disable\_loop\_filters** | u(1) |
| **disable\_bi\_prediction** | u(1) |
| **disable\_intra\_in\_B** | u(1) |
| **disable\_fracpel\_filtering** | u(1) |
| **user\_defined\_req** | u(2) |
| } |  |
| else if (dec\_pow\_reduction\_type = = 2) { |  |
| **pic\_width\_in\_luma\_samples** | u(14) |
| **pic\_height\_in\_luma\_samples** | u(14) |
| **frames\_per\_second** | u(10) |
| } |  |

*with*

Table 11 – syntax for interactive signalling for remote decoder-power reduction

|  |  |
| --- | --- |
|  | **Descriptor** |
| **dec\_pow\_reduction\_type** | u(2) |
| if (dec\_pow\_reduction\_type = = 0) { |  |
| **dec\_ops\_reduction\_req** | s(6) |
| else if (dec\_pow\_reduction\_type = = 1) { |  |
| **disable\_loop\_filters** | u(1) |
| **disable\_bi\_prediction** | u(1) |
| **disable\_intra\_in\_B** | u(1) |
| **disable\_fracpel\_filtering** | u(1) |
| **user\_defined\_req** | u(2) |
| } |  |
| else if (dec\_pow\_reduction\_type = = 2) { |  |
| **pic\_width\_in\_luma\_samples** | u(14) |
| **pic\_height\_in\_luma\_samples** | u(14) |
| **frames\_per\_second** | u(10) |
| } |  |
| else if (dec\_pow\_reduction\_type = = 3) { |  |
| **dec\_pow\_reduction\_extension\_type** | u(2) |
| if (dec\_pow\_reduction\_extension\_type == 0) { |  |
| **nb\_dec\_pow\_reduction\_type\_req** | u(2) |
| for (i = 0 ; i < nb\_dec\_pow\_reduction\_type\_req; i++){ |  |
| **dec\_pow\_reduction\_type\_req\_id[ i ]** | u(2) |
| } |  |
| } |  |
| } |  |

*Add the following at the end of subclause 6.3.2 (“Syntax”)*

The transmitter then uses the message format described in Table X.1 to acknowledge the request of the decoding operation reduction from the receiver:

**Table X.1 – syntax for interactive signalling from the transmitter to acknowledge remote decoder-power reduction**

|  |  |
| --- | --- |
|  | **Descriptor** |
| **dec\_pow\_reduction\_type\_resp** | u(2) |
| if (dec\_pow\_reduction\_type\_resp = = 0) { |  |
| **dec\_ops\_reduction\_resp** | s(6) |
| else if (dec\_pow\_reduction\_type\_resp = = 1) { |  |
| **disabled\_loop\_filters\_resp** | u(1) |
| **disabled\_bi\_prediction\_resp** | u(1) |
| **disabled\_intra\_in\_B\_resp** | u(1) |
| **disabled\_fracpel\_filtering\_resp** | u(1) |
| **user\_defined\_resp** | u(2) |
| } |  |
| else if (dec\_pow\_reduction\_type\_resp = = 2) { |  |
| **pic\_width\_in\_luma\_samples\_resp** | u(14) |
| **pic\_height\_in\_luma\_samples\_resp** | u(14) |
| **frames\_per\_second\_resp** | u(10) |
| } |  |
| else if (dec\_pow\_reduction\_type\_resp = = 3) { |  |
| **dec\_pow\_reduction\_extension\_type\_resp** | u(2) |
| if (dec\_pow\_reduction\_extension\_type\_resp == 0) { |  |
| **nb\_dec\_pow\_reduction\_type\_resp** | u(2) |
| if (nb\_dec\_pow\_reduction\_type\_resp == 0) { |  |
| **pic\_width\_in\_luma\_samples\_resp** |  |
| **pic\_height\_in\_luma\_samples\_resp** |  |
| **frames\_per\_second\_resp** |  |
| } |  |
| else { |  |
| for (i = 0 ; i < nb\_dec\_pow\_reduction\_type\_resp; i++){ |  |
| **dec\_pow\_reduction\_type\_resp\_id[ i ]** | u(2) |
| } |  |
| } |  |
| } |  |
| } |  |

*6.3.3*

*Replace in subclause 6.3.3 (“Signalling”)*

The transmitter in each device sends a decoding operation reduction request (DOR-Req) message to the attention of the remote encoder. In a first mode (dec\_pow\_reduction\_type equal to 0), this message requests the remote encoder to adjust its encoding parameters so that ideally, when the local decoder decodes the bitstream, the power saving of the local decoder matches the power saving implied by the DOR-Req message. In a second mode (dec\_pow\_reduction\_type equal to 1), this message requests the remote encoder to disable coding tools so that, when the local decoder decodes the bitstream, the power consumption of the local decoder is decreased. In a third mode (dec\_pow\_reduction\_type equal to 2), this message requests the remote encoder to adjust the picture resolution and video frame rate so that, when the local decoder decodes the bitstream, the power consumption of the local decoder is decreased.

*with*

The transmitter in each device sends a decoding operation reduction request (DOR-Req) message to the attention of the remote encoder. In a first mode (dec\_pow\_reduction\_type equal to 0), this message requests the remote encoder to adjust its encoding parameters so that ideally, when the local decoder decodes the bitstream, the power saving of the local decoder matches the power saving implied by the DOR-Req message. In a second mode (dec\_pow\_reduction\_type equal to 1), this message requests the remote encoder to disable coding tools so that, when the local decoder decodes the bitstream, the power consumption of the local decoder is decreased. In a third mode (dec\_pow\_reduction\_type equal to 2), this message requests the remote encoder to adjust the picture resolution and video frame rate so that, when the local decoder decodes the bitstream, the power consumption of the local decoder is decreased. In a fourth mode (dec\_pow\_reduction\_type equal to 3), this message indicates that some other extended decoding operation reduction types are requested by the remote encoder.

*Add the following at the end of subclause 6.3.3 (“Signalling”)*

In a first extension of the decoding operation reduction types, the message requests a global or partial cancellation of the last decoding operation reduction requests of specific types at the transmitter side. In this case, the encoder stops the corresponding changes previously enabled in its coding process. In case a global cancellation is requested, the transmitter goes back to the nominal mode, where no change in local decoding operations compared to the start of the video session is applied.

In response to a decoding operation reduction request (DOR-Req), the remote encoder sends a decoding operation reduction response (DOR-Resp) message to the remote decoder. In a first mode (dec\_pow\_reduction\_type\_resp equal to 0), it acknowledges that it has proceeded to an adjustment of its encoding parameters to save power while decoding. In a second mode (dec\_pow\_reduction\_type\_resp equal to 1), this message acknowledges that the encoder has disabled some coding tools. The list of coding tools it has accepted to disable is then sent in the message. In a third mode (dec\_pow\_reduction\_type\_resp equal to 2), it acknowledges that it has adjusted the picture resolution and video frame rate. In a fourth mode (dec\_pow\_reduction\_type\_resp equal to 3), this message indicates that some other extended decoding operation reduction types were acknowledged.

In a first extension of the decoding operation reduction types, the remote encoder acknowledges the list of types of decoding operation reduction requests it has accepted to cancel.

*6.3.4*

*Add a new subclause title right at the beginning of subclause 6.3.4 (“Semantics”)*

#### Decoding operation reduction request semantics

*Replace the Table 13 in subclause 6.3.4 (“Semantics”)*

Table 13 - definition of dec\_pow\_reduction\_type

|  |  |
| --- | --- |
| dec\_pow\_reduction\_type | Definition |
| 0 | Decoder operations reduction |
| 1 | Coding tool configuration |
| 2 | Spatial and temporal scaling |

*with*

Table 13 – definition of dec\_pow\_reduction\_type

|  |  |
| --- | --- |
| dec\_pow\_reduction\_type | Definition |
| 0 | Decoder operations reduction |
| 1 | Coding tool configuration |
| 2 | Spatial and temporal scaling |
| 3 | Extension of the request types |

*Add the following at the end of subclause 6.3.4 (“Semantics”)*

**dec\_pow\_reduction\_extension\_type** indicates other types of requests for decoding operation reduction from the remote decoder.

When dec\_pow\_reduction\_extension\_type equals 0, it indicates that a global or partial cancellation of the last decoding operation reduction requests of specific types at the transmitter side is requested. In this case, the encoder is requested to stop the corresponding changes previously enabled in its coding process. In case a global cancellation is requested, the transmitter is requested to go back to the nominal mode, where no change in local decoding operations compared to the start of the video session is applied.

**nb\_dec\_pow\_reduction\_type\_req** indicates the number of requested types of request the decoder requests to cancel. nb\_dec\_pow\_reduction\_type\_req shall not be larger than 3.

**dec\_pow\_reduction\_type\_req\_id[ i ]** indicates that the decoder requests to cancel the last request of corresponding type. dec\_pow\_reduction\_type\_req\_id[ i ] shall not be equal to dec\_pow\_reduction\_type\_req\_id[ j ], for any j in 0..nb\_dec\_pow\_reduction\_type\_req not equal to i.

#### Decoding operation reduction response semantics

**dec\_pow\_reduction\_type\_resp** indicates the type of the decoder power reduction method the encoder acknowledges to have received and accepts to apply. The type is indicated by an unsigned integer. The types are explained in Table X.2.

Table X.2 - definition of dec\_pow\_reduction\_type\_resp

|  |  |
| --- | --- |
| dec\_pow\_reduction\_type\_resp | Definition |
| 0 | Decoder operations reduction |
| 1 | Coding tool configuration |
| 2 | Spatial and temporal scaling |
| 3 | **Extension of the response types** |

**dec\_ops\_reduction\_resp** indicates the variation of local decoding operations relative to the local decoding operations since the last dec\_ops\_reduction\_req was sent to the transmitter, or since the start of the video session, if no earlier dec\_ops\_reduction\_req was sent, the encoder accepts to set in place. dec\_ops\_reduction\_resp is an integer in the interval [-31, 32]. When not present, dec\_ops\_reduction\_resp is set equal to 0.

*P*DecOpsReductionReq is derived by dec\_ops\_reduction\_resp and indicates the requested percentage change of local decoding operations by

PDecOpsReductionReq=2∗dresp

(6108)

where *d*resp is set equal to dec\_ops\_reduction\_resp.

A negative percentage means a decrease of decoding operations. *P*DecOpsReductionReq is an integer in the interval [-62, 64] in steps of two.

**disabled\_loop filters\_resp** equal to 1 indicates that loop filters were disabled, disabled\_loop\_filters\_resp equal to 0 specifies that the encoder does not accept to disable loop filters. Loop filters include, upon availability, the deblocking filter, sample Adaptive offset, and the adaptive loop filter.

**disabled\_bi\_prediction\_resp** equal to 1 indicates bi-prediction is disabled in B slices. disabled\_bi\_prediction\_resp equal to 0 indicates that the encoder does not accept to disable bi-prediction in B slices.

**disabled\_intra\_in\_B\_resp** equal to 1 indicates intra prediction is disabled in B slices. disable\_intra\_in\_B\_resp equal to 0 indicates that the encoder does not accept to disable intra prediction in B slices.

**disabled\_fracpel\_filtering\_resp** equal to 1 indicates fractional pel filtering is disabled in P slices or B slices. disabled\_fracpel\_filtering\_resp equal to 0 indicates that the encoder does not accept to disable fractional pel filtering in P slices or B slices.

**user\_defined\_resp** indicates whether or not the encoder accepts to enable or disable user-defined coding tools.

**pic\_width\_in\_luma\_samples\_resp** indicates the picture width in the units of luma samples that the encoder accepts to encode.

**pic\_height\_in\_luma\_samples\_resp** indicates the picture height in the units of luma samples samples that the encoder accepts to encode.

**frames\_per\_second\_resp** indicates the frame rate samples that the encoder accepts to produce.

**dec\_pow\_reduction\_extension\_type\_resp** indicates other types of requests for decoding operation reduction acknowledged by the remote encoder.

When dec\_pow\_reduction\_extension\_type\_resp equals 0, it indicates that a global or partial cancellation of the last decoding operation reduction requests of specific types was accepted at the transmitter side. In this case, the encoder stops the corresponding changes previously enabled in its coding process. In case a global cancellation was accepted, the transmitter goes back to the nominal mode, where no change in local decoding operations compared to the start of the video session is applied.

**nb\_dec\_pow\_reduction\_type\_resp** indicates the number of requested types the encoder accepts to cancel. When nb\_dec\_pow\_reduction\_type\_respequal to 0, it indicates that a global cancellation of all previous decoding operation reductions was accepted by the encoder. nb\_dec\_pow\_reduction\_type\_resp shall not be larger than 3.

**dec\_pow\_reduction\_type\_resp\_id[ i ]** indicates that the encoder accepts to cancel the last request of corresponding type. dec\_pow\_reduction\_type\_resp\_id[ i ] shall not be equal to dec\_pow\_reduction\_type\_resp\_id[ j ], for any j in 0..nb\_dec\_pow\_reduction\_type\_resp not equal to i.

*7.1*

*Replace the following in subclause 7.1 (“General”)*

With respect to the functional architecture, display adaptation (DA) provides green metadata comprised of RGB-component statistics and quality indicators. The statistics are used to set display controls in the presentation subsystem so that desired quality levels and corresponding display power reductions are attained.

*with*

With respect to the functional architecture, display adaptation (DA) provides green metadata comprised of Attenuation Map Information (AMI), RGB-component statistics and quality indicators. The Attenuation Map Information (AMI) metadata indicate how to use Attenuation Maps carried as auxiliary pictures of type AUX\_ALPHA for display adaptation. The Attenuation Maps and their related Attenuation Map Information as well as RGB-component statistics are used to set display controls in the presentation subsystem so that desired quality levels and corresponding display power reductions are attained.

In interactive signalling, two modes of use of Attenuation Maps can be distinguished. Upon requests from the receiver, either some Attenuation Maps and Attenuation Map Information are transmitted and applied in the presentation subsystem, or the transmitter generates a requested Attenuation Map and applies it on the base video to generate a Display Attenuation Attenuated Video, that is transmitted, together with Attenuation Map Information.

In a point-to-point video conferencing application, the display adaptation can be performed with or without an SEI message.

*7.2.1*

*Add a new subclause right at the beginning of subclause 7.2.1 (“Systems without a signalling mechanism from the receiver to the transmitter”)*

#### Systems using SEI messages to transmit DA green metadata

The syntax for the AMI metadata is described in Table X.3. This syntax is the same for AVC, HEVC and VVC.

Table X.3– syntax for the AMI metadata

|  |  |
| --- | --- |
|  | **Descriptor** |
| **ami\_flags** | u(8) |
| if (**ami\_flags && 0x01 != 0x01**) { |  |
| **ami\_display\_model** | u(4) |
| **if ( ami\_flags && 0x04 == 0x04 ) {** |  |
| **ami\_map\_approximation\_model** | u(4) |
| } |  |
| **ami\_map\_number** | u(3) |
| for ( i=0;i<ami\_map\_number;i++ ) { |  |
| **ami\_layer\_id**[ i ] | u(8) |
| **ami\_ols\_number**[ i ] | u(4) |
| for ( j=0;j<ami\_ols\_number[i];j++){ |  |
| **ami\_ols\_id**[ i ][ j ] | u(8) |
| } |  |
| **ami\_energy\_reduction\_rate**[ i ] | u(5) |
| **if ( ami\_flags && 0x20== 0x20 ){** |  |
| **ami\_video\_quality\_metric[ i ]** | u(8) |
| **ami\_video\_quality\_level[ i ]** | u(16) |
| } |  |
| **ami\_max\_value**[ i ] | u(8) |
| if **( ami\_flags && 0x02 != 0x02 ) or ( i == 0 ) {** |  |
| **ami\_attenuation\_use\_idc**[ i ] | u(4) |
| **ami\_attenuation\_comp\_idc**[ i ] | u(4) |
| **if ( ami\_flags && 0x08 == 0x08 ){** |  |
| **ami\_preprocessing\_flag**[ i ] | u(1) |
| if( **ami\_preprocessing\_flag**[ i ] ){ |  |
| **ami\_preprocessing\_type\_idc**[ i ] | u(2) |
| } |  |
| **ami\_preprocessing\_scale\_idc** [ i ] | u(8) |
| } |  |
| **if ( ami\_flags && 0x10 == 0x10 ){** |  |
| **ami\_backlight\_scaling\_idc**[ i ] | u(4) |
| } |  |
| } |  |
| } |  |
| **if (ami\_map\_number == 0){** |  |
| **ami\_energy\_reduction\_rate[ 0 ]** | u(5) |
| **if(ami\_flags && 0x20== 0x20){** |  |
| **ami\_video\_quality\_metric[ 0 ]** | u(8) |
| **ami\_video\_quality\_reduction[ 0 ]** | u(16) |
| **}** |  |
| **}** |  |
| } |  |

*Add a new subclause title right after the insertion of the above subclause in subclause 7.2.1 (“Systems without a signalling mechanism from the receiver to the transmitter”)*

#### Systems not using SEI message to transmit DA green metadata

*7.2.2*

*Add a new subclause right at the beginning of subclause 7.2.2 (“Systems with a signalling mechanism from the receiver to the transmitter”)*

#### Systems using SEI messages to transmit DA green metadata

##### First mode of use: Application of Attenuation Maps at the receiver

The receiver first uses the message format to signal information related to Display Adaptation through the use of Attenuation Maps described in Table X.4:

Table X.4 - syntax from receiver for display adaptation through the use of Attenuation Maps (DAMPR-Req)

|  |  |
| --- | --- |
|  | **Descriptor** |
| **ami\_cancel\_flag\_req** | **u(1)** |
| **if ( ! ami\_cancel\_flag\_req ) {** |  |
| **ami\_display\_model\_cap** | **u(4)** |
| **ami\_attenuation\_use\_cap** | **u(8)** |
| **ami\_attenuation\_comp\_cap** | **u(8)** |
| **ami\_preprocessing\_type\_cap** | **u(8)** |
| **ami\_map\_approximation\_model\_cap** | **u(8)** |
| **}** |  |
| **ami\_map\_number\_req** | **u(3)** |
| **for (i = 1; i <= ami\_map\_number\_req; i++) {** |  |
| **ami\_energy\_reduction\_rate\_req [ i ]** | **u(5)** |
| **}** |  |

The transmitter then uses the message format to signal metadata to the receiver described in Table X.5:

Table X.5 - syntax from transmitter to receiver for display adaption through the use of Attenuation Maps (DAMPR-Resp)

|  |  |
| --- | --- |
|  | **Descriptor** |
| **ami\_map\_number\_resp** | **u(3)** |
| **for (i = 1; i <= ami\_map\_number\_resp; i++) {** |  |
| **ami\_energy\_reduction\_rate\_resp[ i ]** | **u(5)** |
| **}** |  |

##### Second mode of use: Transmission of an Attenuated Video

The receiver first uses the message format to signal information related to Display Adaptation through the use of Attenuation Maps described in Table X.6.

Table X.6 - syntax for the Display Power Reduction Attenuated Video Request (DPRAV-Req) message from the receiver

|  |  |
| --- | --- |
|  | **Descriptor** |
| ami\_cancel\_flag | u(1) |
| ami\_display\_model\_cap | u(4) |
| ami\_attenuation\_comp\_cap | u(8) |
| ami\_energy\_reduction\_rate\_req | u(5) |

The transmitter then uses the message format to signal metadata to the receiver as described in Table X.7.

Table X.7 - syntax for the Display Power Reduction Attenuated Video Reduction Response (DPRAV-Resp) message from the transmitter.

|  |  |
| --- | --- |
|  | Descriptor |
| ami\_energy\_reduction\_rate\_resp | u(5) |

*Add a new subclause title right after the insertion of the above subclause in subclause 7.2.2 (“Systems with a signalling mechanism from the receiver to the transmitter”)*

#### Systems not using SEI message to transmit DA green metadata

*7.3.1*

*Add a new subclause right at the beginning of subclause 7.3.1 (“Systems without a signalling mechanism from the receiver to the transmitter”)*

#### Systems using SEI messages to transmit DA green metadata

SEI messages can be used to signal green metadata in an AVC, HEVC or VVC stream.

The green metadata SEI message payload type is specified in ISO/IEC 14496-10, ISO/IEC 23008-2, and ISO/IEC 23090-3.

Attenuation Map Information (AMI) metadata describing how to use Attenuation Maps are carried through SEI message from the transmitter to the receiver. The Attenuation Maps are carried as auxiliary pictures of type AUX\_ALPHA for display adaptation, with the flag alpha\_channel\_use\_idc equal to 3.

The complete syntax of the green metadata SEI message payload, including the Attenuation Map Information, is specified in Annex A.

The SEI message containing the AMI metadata is transmitted at the start of an upcoming period. The next message containing AMI metadata is transmitted at the start of the next upcoming period. Therefore, when the upcoming period is a picture or the interval up to the next I-slice, a message is transmitted for each picture or interval, respectively. However, when the upcoming period is a specified time interval or a specified number of pictures, the associated message is transmitted with the first picture in the time interval or with the first picture in the specified number of pictures.

*Add a new subclause title right after the insertion of the above subclause in subclause 7.3.1 (“Systems without a signalling mechanism from the receiver to the transmitter”)*

#### Systems not using SEI messages to transmit DA green metadata

*Replace the following in subclause 7.3.1 (“Systems without a signalling mechanism from the receiver to the transmitter*

Green metadata can be carried as specified in ISO/IEC 13818-1 or it can be carried in metadata tracks within the ISO base media file format (ISO/IEC 14496-12), as specified in ISO/IEC 23001-10. Using the format in 7.2.1, the transmitter sends a message to the receiver. The DA metadata is applicable to the presentation subsystem until the next message containing DA metadata arrives.

*with*

Green metadata can be carried as specified in ISO/IEC 13818-1 or it can be carried in metadata tracks within the ISO base media file format (ISO/IEC 14496-12), as specified in ISO/IEC 23001-10. Using the format in 7.2.1.2, the transmitter sends a message to the receiver. The DA metadata is applicable to the presentation subsystem until the next message containing DA metadata arrives.

*7.3.2*

*Add a new subclause right at the beginning of subclause 7.3.2 (“Systems with a signalling mechanism from the receiver to the transmitter”)*

#### Systems using SEI messages to transmit DA green metadata

##### First mode of use: Application of Attenuation Maps at the receiver

The receiver in each device sends a Display Attenuation Map Power Reduction Request (DAMPR-Req) message to the attention of the transmitter. This message allows the receiver to request some Attenuation Maps with some specific energy reduction rates to the transmitter, and to specify the transmitter with specific information on its capacities to apply Attenuation Maps, e.g., its display type, supported processings to apply on the requested Attenuation Maps and supported types of Attenuation Maps.

In response to the DAMPR-Req from the receiver, the transmitter sends a Display Attenuation Map Power Reduction Response (DAMPR-Resp) message. In a first mode, this message indicates the number of Attenuation Maps it accepts to produce and the information of energy reduction rate expected when applying them on the original video. In a second mode, when this message is used to acknowledge a DAMPR-Req with a cancel flag:

1 it is empty or the parameter ami\_map\_resp\_number is set to 0 for a global cancellation of the attenuation maps

1. it contains the list of the remaining attenuation maps with their related energy reduction rate.

##### 7.3.2.1.2 Second mode of use: Transmission of an Attenuated Video

The receiver sends a Display Power Reduction Attenuated Video Request (DPRAV-Req) message to request the transmitter to apply a given Display Attenuation Map corresponding to some energy and quality criteria, on the original video before encoding and transmitting it in order to reduce its energy consumption while rendering the video on its display.

The transmitter sends a Display Power Reduction Attenuated Video Response (DPRAV-Resp) message to indicate the expected display energy reduction rate and the corresponding reduction of the video quality metric selected by the receiver when the attenuated video is rendered on the receiver display.

When this message is used to acknowledge a request with a cancel flag, it is empty.

*Add a new subclause title right after the insertion of the above subclause in subclause 7.3.2 (“Systems with a signalling mechanism from the receiver to the transmitter”)*

#### Systems not using SEI messages to transmit DA green metadata

*7.4*

*Add a new subclause right at the beginning of subclause 7.4 (“Semantics”)*

### Systems without a signalling mechanism from the receiver to the transmitter

#### Semantics using SEI messages to transmit DA green metadata

The semantics of various terms are defined below.

Note: In a preferred mode, the Attenuation Map shall be applied on the sample values of the decoded primary picture(s), i.e., just after the decoding process.

The Attenuation Map Information (AMI) metadata provide information about the interpretation of the Attenuation Map sample values coded in auxiliary pictures of type AUX\_ALPHA (in the following picAMI) and the post-processing intended to be applied to the one or more associated primary pictures of the CVS.

Note: the association of auxiliary pictures to primary pictures are specified in the SDI SEI message (see ISO/IEC 23002-7).

When a CVS does not contain an SDI SEI message with sdi\_aux\_id[ i ] equal to 1 for at least one value of i, no picture in the CVS shall be associated with a Green metadata SEI message.

When an access unit (AU) contains both an SDI SEI message with sdi\_aux\_id[ i ] equal to 1 for at least one value of i and a Green metadata SEI message, the SDI SEI message shall precede the Green metadata SEI message in decoding order.

When an AU contains a picAMI in a layer, with nuh\_layer\_id equal to nuhLayerIdAMI, that is indicated as an Alpha Map auxiliary layer by an SDI SEI message, the Attenuation Map sample values of picAMI persist in output order until one or more of the following conditions are true:

– The next picture, in output order, with nuh\_layer\_id equal to nuhLayerIdAMI is output.

– A CLVS containing the auxiliary picture picAMI ends.

– The bitstream ends.

– A CLVS of any associated primary layer of the auxiliary picture layer with nuh\_layer\_id equal to nuhLayerIdAMI ends.

The following semantics apply separately to each nuh\_layer\_id targetLayerId among the nuh\_layer\_id values to which the Green metadata SEI message applies.

ami\_flags is a bit field mask which groups several flags, that allow to reduce the size of the AMI metadata when some parameters are not needed to apply the Attenuation Maps. These flags are described in Table X.8.

bit 0: when not present, indicates that the SEI message cancels the persistence of any previous Attenuation Map Information SEI message in output order. When present, indicates that Attenuation Map Information follows. Corresponds to an ami\_cancel\_flag.

bit 1: indicates whether the following Attenuation Map Information is defined globally for all the listed maps. When not present, indicates that ami\_attenuation\_use\_idc[ i ], ami\_attenuation\_comp\_idc[ i ], ami\_preprocessing\_flag[ i ], ami\_preprocessing\_type\_idc[ i ], ami\_preprocessing\_scale\_idc[ i ], ami\_backlight\_scaling\_idc[ i ] for i=0.. ami\_map\_number, shall be present. When present, indicates that only ami\_attenuation\_use\_idc[ 0 ], ami\_attenuation\_comp\_idc[ 0 ], ami\_preprocessing\_flag[ 0 ], ami\_preprocessing\_type\_idc[ 0 ], ami\_preprocessing\_scale\_idc[ 0 ], ami\_backlight\_scaling\_idc[ 0 ] shall be present. Corresponds to an ami\_global\_flag.

bit 2: indicates whether the listed Attenuation Maps can be used to approximate other Attenuation Maps for other reduction rates. Corresponds to an ami\_approximate\_flag.

bit 3: indicates whether some preprocessing is required to use the listed Attenuation Maps. Corresponds to an ami\_preprocessing\_global\_flag.

bit 4: indicates whether backlight scaling is required and, in this case, the field ami\_backlight\_scaling\_idc specifies the process to compute the scaling factor of the backlight of transmissive pixel displays, derived from the Attenuation Map sample values of the decoded auxiliary picture of index i. Corresponds to an ami\_backlightscaling\_flag.

Bits 1-4: set to 0 when the SEI is distributed with a Display Attenuation Attenuated Video within the CLVS.

bit 5**:** indicates whether the Video Quality information is present in the message. Corresponds to an ami\_video\_quality\_flag.

Bits 6-7: bit reserved for future use.

Table X.8 - Description of ami\_flags

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| bit 6-7 | bit 5 | bit 4 | bit 3 | bit 2 | bit 1 | bit 0 |
| Future use | ami\_video\_quality\_flag | ami\_backlightscaling\_flag | ami\_preprocessing\_global\_flag | ami\_approximate\_flag | ami\_global\_flag | ami\_cancel\_flag |

ami\_map\_number specifies the number of auxiliary pictures of type AUX\_ALPHA in the CVS. This field is set to 0 when the SEI is distributed with a Display Attenuation Attenuated Video within the CLVS.

ami\_display\_model is a bit field mask which indicates the display models on which the Attenuation Map sample values of the auxiliary picture picAMI may be used.

Table X.9 - Interpretation of the bits of ami\_display\_model

|  |  |
| --- | --- |
| **Bit number** | **Display model** |
| 0 | Backlit pixel |
| 1 | Emissive pixel |
| 2..3 | Reserved for future types |

For example, ami\_display\_model=11 means the Attenuation Map Information can be used for both “Backlit” and “Emissive” display models.

ami\_map\_approximation\_model specifies the model used to extrapolate a set of received Attenuation Map sample values(s) from a set of decoded auxiliary picture(s) with individual energy reduction rate(s) to another set of Attenuation Map sample values with a different energy reduction rate.

ami\_map\_approximation\_model equal to 0 specifies that a linear scaling of the Attenuation Map sample values of the provided auxiliary picture given its respective ami\_energy\_reduction\_rate should be considered to obtain corresponding Attenuation Map sample values for another energy reduction rate. In case several auxiliary pictures picAMI are provided, the auxiliary picture with the lowest ami\_energy\_reduction\_rate is used for the linear scaling. This is the preferred type.

ami\_map\_approximation\_model equal to 1 specifies that a bilinear interpolation between the Attenuation Map sample values of the provided auxiliary picture(s) given their respective ami\_energy\_reduction\_rate should be considered to obtain corresponding Attenuation Map sample values for another energy reduction rate.

ami\_map\_approximation\_model equal to 2 specifies that an interpolation of type Lanczos between the Attenuation Map sample values of the provided auxiliary picture(s) given their respective ami\_energy\_reduction\_rate should be considered to obtain corresponding Attenuation Map sample values for another energy reduction rate.

ami\_map\_approximation\_model equal to 3 specifies that an interpolation of type bicubic between the Attenuation Map sample values of the provided auxiliary picture(s) given their respective ami\_energy\_reduction\_rate should be considered to obtain corresponding Attenuation Map sample values for another energy reduction rate.

ami\_map\_approximation\_model equal to 4 specifies that a proprietary user defined process should be used to infer corresponding Attenuation Map sample values for another energy reduction rate from the Attenuation Map sample values of the provided auxiliary picture(s) given their respective ami\_energy\_reduction\_rate.

Table X.10 - Interpretation of ami\_map\_approximation\_model

|  |  |
| --- | --- |
| **ami\_map\_approximation\_model** | **Attenuation Map interpolation process** |
| 0 | Linear scaling |
| 1 | Bilinear interpolation |
| 2 | Lanczos interpolation |
| 3 | Bicubic interpolation |
| 4 | User defined |
| 5..15 | Reserved for future uses |

ami\_attenuation\_use\_idc[ i ] specifies the use of the Attenuation Map sample values of the decoded auxiliary picture of index i.

ami\_attenuation\_use\_idc[ i ] equal to 0 specifies that the Attenuation Map sample values of the decoded auxiliary picture should be subtracted from one or more associated primary picture decoded sample(s) before displayed on screen. This is the preferred type.

ami\_attenuation\_use\_idc[ i ] equal to 1 specifies that the Attenuation Map sample values of the decoded auxiliary picture should be multiplied by one or more associated primary picture decoded sample(s) before displayed on screen.

ami\_attenuation\_use\_idc[ i ] equal to 2 specifies that the Attenuation Map sample values of the decoded auxiliary picture should be used according to a proprietary user defined process to modify the one or more associated primary picture decoded sample(s) before displayed on screen.

Table X.11 - Interpretation of ami\_attenuation\_use\_idc[ i ]

|  |  |
| --- | --- |
| **ami\_attenuation\_use\_idc[ i ]** | **Process to apply on associated primary picture decoded samples** |
| 0 | Subtraction |
| 1 | Multiplication |
| 2 | User defined |
| 3..15 | Reserved for future uses |

ami\_attenuation\_comp\_idc[ i ] specifies on which colour component(s) of the associated primary picture(s) decoded samples the decoded auxiliary picture of type AUX\_ALPHA of index i should be applied using the process defined by ami\_attenuation\_use\_idc[ i ].

ami\_attenuation\_comp\_idc[ i ] equal to 0 specifies that the luma component of the decoded auxiliary picture of type AUX\_ALPHA of index i should be applied to the luma component of the associated primary picture(s) decoded samples. This is the preferred type.

ami\_attenuation\_comp\_idc[ i ] equal to 1 specifies that the luma component of the decoded auxiliary picture of type AUX\_ALPHA of index i should be applied to the luma component and the chroma components of the associated primary picture(s) decoded samples.

ami\_attenuation\_comp\_idc[ i ] equal to 2 specifies that the luma component of the decoded auxiliary picture of type AUX\_ALPHA of index i should be applied to the RGB components (after YUV to RGB conversion) of the associated primary picture(s) decoded samples.

ami\_attenuation\_comp\_idc[ i ] equal to 3 specifies that the luma component of the decoded auxiliary picture of type AUX\_ALPHA of index i should be applied to the first component of the associated primary picture(s) decoded samples.

ami\_attenuation\_comp\_idc[ i ] equal to 4 specifies that the luma component of the decoded auxiliary picture of type AUX\_ALPHA of index i should be applied to the second component of the associated primary picture(s) decoded samples.

ami\_attenuation\_comp\_idc[ i ] equal to 5 specifies that the luma component of the decoded auxiliary picture of type AUX\_ALPHA of index i should be applied to the third component of the associated primary picture(s) decoded samples.

ami\_attenuation\_comp\_idc[ i ] equal to 6 specifies that the mapping between the luma component of the decoded auxiliary picture of type AUX\_ALPHA of index i and the components of which to apply the decoded auxiliary picture of type AUX\_ALPHA of index i corresponds to some proprietary user-defined process.

Table X.12 - Interpretation of ami\_attenuation\_comp\_idc[ i ]

|  |  |
| --- | --- |
| **ami\_attenuation\_comp\_idc[ i ]** | **Mapping between components of the Attenuation Map and primary picture components on which to apply the Attenuation Map** |
| 0 | Luma component in the picAMI applied to the luma component of the associated primary picture |
| 1 | Luma component in the picAMI applied to the luma and chroma components of the associated primary picture |
| 2 | Luma component in the picAMI applied to the three RGB components of the associated primary picture |
| 3 | Luma component in the picAMI applied to the first component of the associated primary picture |
| 4 | Luma component in the picAMI applied to the second component of the associated primary picture |
| 5 | Luma component in the picAMI applied to the third component of the associated primary picture |
| 6 | User defined |
| 7..15 | Reserved for future uses |

ami\_backlight\_scaling\_idc[ i ] specifies the process to compute the scaling factor of the backlight of transmissive pixel displays, derived from the Attenuation Map sample values of the decoded auxiliary picture of index i.

ami\_backlight\_scaling\_idc[ i ] equal to 0 specifies that the scaling to apply to the backlight of the display is computed as the ratio between the maximal values of the associated primary picture decoded samples after and before applying the Attenuation Map sample values of the decoded auxiliary picture of index i. The associated primary picture decoded sample(s) on which the Attenuation Map sample values of the decoded auxiliary picture of index i are applied are further rescaled to their maximal value before the application of the Attenuation Map sample values of the decoded auxiliary picture of index i. This is the preferred type.

ami\_backlight\_scaling\_idc[ i ] equal to 1 specifies that the scaling to apply to the backlight of the display is determined according to a proprietary user defined process derived from the Attenuation Map sample values of the decoded auxiliary picture of index i.

Table X.13 - Interpretation of ami\_backlight\_scaling\_idc[ i ]

|  |  |
| --- | --- |
| **ami\_backlight\_scaling\_idc[ i ]** | **Backlight scaling processing type** |
| 0 | Scaling by the ratio between maximum values before and after the use of the Attenuation Map |
| 1 | User defined |
| 2..15 | Reserved for future uses |

ami\_preprocessing\_flag[ i ] specifies whether some pre-upsampling is to be used on the Attenuation Map sample values of the decoded auxiliary picture of index i. In that case it is supposed that the auxiliary coded picture(s) and the primary coded picture have different sizes.

ami\_preprocessing\_type\_idc[ i ] specifies the recommended type of the interpolation (e.g., bicubic) used to resample the Attenuation Map sample values of the decoded auxiliary picture of index i at the same resolution as the associated decoded picture.

ami\_preprocessing\_type\_idc[ i ] equal to 0 specifies that an interpolation of type bicubic between the Attenuation Map sample values of the provided auxiliary picture of index i should be considered to obtain the Attenuation Map sample values to apply to the sample values of the decoded picture. This is the preferred type.

ami\_preprocessing\_type\_idc[ i ] equal to 1 specifies that a bilinear interpolation between the Attenuation Map sample values of the provided auxiliary picture of index i should be considered to obtain the Attenuation Map sample values to apply to the sample values of the decoded picture.

ami\_preprocessing\_type\_idc[ i ] equal to 2 specifies that an interpolation of type Lanczos between the Attenuation Map sample values of the provided auxiliary picture of index i should be considered to obtain the Attenuation Map sample values to apply to the sample values of the decoded picture.

ami\_preprocessing\_type\_idc[ i ] equal to 3 specifies that a proprietary user defined process should be used to pre-upsample the Attenuation Map sample values of the provided auxiliary picture of index i to obtain the Attenuation Map sample values to apply to the sample values of the decoded picture.

Table X.14- Interpretation of ami\_preprocessing\_type\_idc[ i ]

|  |  |
| --- | --- |
| **ami\_preprocessing\_type\_idc[ i ]** | **Attenuation Map preprocessing type** |
| 0 | Bicubic interpolation |
| 1 | Bilinear interpolation |
| 2 | Lanczos interpolation |
| 3 | User defined |
| 4..15 | Reserved for future uses |

ami\_preprocessing\_scale\_idc[ i ] specifies which scaling should be applied to the Attenuation Map of index i to obtain the Attenuation Map sample values before applying them on the sample values of the decoded picture.

ami\_preprocessing\_scale\_idc[ i ] equal 0 specifies that a scaling of should be applied to the Attenuation Map of index i to obtain the Attenuation Map sample values before applying them on the sample values of the decoded picture. This is the preferred type.

ami\_preprocessing\_scale\_idc[ i ] equal 1 specifies that a proprietary user defined scaling should be applied to the Attenuation Map of index i to obtain the Attenuation Map sample values before applying them on the sample values of the decoded picture.

Table X.15 - Interpretation of ami\_preprocessing\_scale\_idc[ i ]

|  |  |
| --- | --- |
| **ami\_preprocessing\_scale\_idc[ i ]** | **Attenuation Map scaling preprocess** |
| 0 | Scaling of |
| 1 | User defined |
| 2..15 | Reserved for future uses |

ami\_layer\_id[ i ] specifies the identifier of the decoded layer for the Attenuation Map of index i.

ami\_ols\_number[ i ] specifies the number of Output Layer Sets to which the Attenuation Map of index i belongs.

ami\_ols\_id[ i ][ j ] specifies the identifier of the Output Layer Set of index j for the Attenuation Map of index i. This identifier shall be used to select the OLS to output both the primary decoded picture and the Attenuation Map of index i.

ami\_energy\_reduction\_rate[ i ] indicates the expected energy saving rate when the video is displayed after applying the Attenuation Map sample values of the decoded auxiliary picture of index i on the sample values of the decoded picture.

In the case where the transmitter directly transmits an Attenuated Video, no Attenuation Maps are transmitted. ami\_map\_number is equal to 0 and ami\_energy\_reduction\_rate[ 0 ] corresponds to the expected energy saving rate when the decoded transmitted Attenuated Video is displayed.

ami\_max\_value[ i ] indicates the maximum value of the attenuation map of index i. Such a maximal value can be optionally used to further adjust the dynamic of the encoded attenuation map in the scaling process.

**ami\_video\_quality\_metric**[ i ] indicates the quality metric which was considered by the transmitter to inform the receiver of the reduction of the video quality.

Table X.16: Interpretation of ami\_video\_quality\_metric[ i ]

|  |  |
| --- | --- |
| **ami\_video\_quality\_metric[ i ]** | **Metric to assess the video quality of the Video after applying the Attenuation Map** |
| 0x00 | PSNR |
| 0x01 | SSIM |
| 0x02 | wPSNR |
| 0x03 | WS-PSNR |
| 0x04..0x07 | Reserved for future metrics |

**ami\_video\_quality\_level**[ i ] is a 16-bit unsigned integer interpreted as a floating-point VMetric value as follows, with m set equal to ami\_video\_quality\_level[ i ]:

which indicates the expected video quality when the decoded picture is rendered on the receiver display after application of the Attenuation Map either at the transmitter (in this case, ami\_map\_number is equal to 0) or at the receiver.

*Add a new subclause title right after the insertion of the above subclauses in subclause 7.4 (“Semantics”)*

#### Semantics not using SEI message for DA green metadata

*Add new subclauses at the end of subclause 7.4 (“Semantics”)*

### Systems with a signalling mechanism from the receiver to the transmitter

#### Systems using SEI messages to transmit DA green metadata

##### Semantics of Display Attenuation Map Power Reduction Request (DAMPR-Req) message

**ami\_cancel\_flag\_req** equal to 1 indicates that the receiver requests to cancel the transmission of the Attenuation Maps of energy reduction rates listed in the message and the related information in the Green Metadata SEI message.

**ami\_display\_model\_cap** is a bit field mask which indicates the display models of the receiver on which the Attenuation Map sample values may be used.

Table X.17 - Interpretation of the bits of ami\_display\_model\_cap

|  |  |
| --- | --- |
| **Bit number** | **Display model** |
| 0 | Transmissive pixel |
| 1 | Emissive pixel |
| 2..3 | Reserved for future types |

**ami\_attenuation\_use\_cap** is a bit field mask which specifies the different processes supported by the receiver to apply the Attenuation Map sample values.

bit 0 set to 1 indicates that subtraction is supported.

bit 1 set to 1 indicates that multiplication is supported.

bits 2..7 are reserved for future processes.

Table X.18 - Interpretation of ami\_attenuation\_use\_cap

|  |  |
| --- | --- |
| Bit number | Process to apply on associated primary picture decoded samples |
| 0 | Subtraction |
| 1 | Multiplication |
| 2..7 | User defined |

**ami\_attenuation\_comp\_cap** is a bit field mask which indicates on which pixel component(s) the receiver accepts to apply an Attenuation Map.

bit 0 set to 1 indicates that the receiver supports to apply the luma component of the Attenuation Map to the luma component of the primary picture.

bit 1 set to 1 indicates that the receiver supports to apply the luma component of the Attenuation Map to the luma component and the chroma components of the primary picture.

bit 2 set to 1 indicates that the receiver supports to apply the luma component of the Attenuation Map to the RGB components (after YUV to RGB conversion) of the primary picture.

bit 3 set to 1 indicates that the receiver supports to apply the luma component of the Attenuation Map to the first component of the primary picture.

bit 4 set to 1 indicates that the receiver supports to apply the luma component of the Attenuation Map to the second component of the primary picture.

bit 5 set to 1 indicates that the receiver supports to apply the luma component of the Attenuation Map to the third component of the primary picture.

bits 6-7 are reserved for future uses.

Table X.19 - Interpretation of ami\_attenuation\_comp\_cap

|  |  |
| --- | --- |
| **Bit number** | **Mapping between the luma component of the Attenuation Map and primary picture components on which to apply the Attenuation Map supported by the receiver** |
| 0 | Luma component of the map applied to the luma component of the primary picture |
| 1 | Luma component of the map applied to the luma and chroma components of the primary picture |
| 2 | Luma component of the map applied to the three RGB components of the primary picture |
| 3 | Luma component of the map applied to the first component of the primary picture |
| 4 | Luma component of the map applied to the second component of the primary picture |
| 5 | Luma component of the map applied to third component of the primary picture |
| 6..7 | Future uses |

**ami\_preprocessing\_type\_cap** is a bit field mask which indicates which pre-processings of the Attenuation Map are supported by the receiver.

bit 0 set to 1 indicates that the receiver supports scaling.

bit 1 set to 1 indicates that the receiver supports a pre-upsampling of type bicubic.

bit 2 set to 1 indicates that the receiver supports a pre-upsampling of type bilinear interpolation.

bit 3 set to 1 indicates that the receiver supports a pre-upsampling of type Lanczos interpolation.

bits 4..7 are reserved for future pre-processing types

Table X.20 - Interpretation of ami\_preprocessing\_type\_cap

|  |  |
| --- | --- |
| **Bit number** | **Attenuation Map preprocessing type** |
| 0 | Scaling pre-processing |
| 1 | Bicubic pre-upsampling |
| 2 | Bilinear pre-upsampling |
| 3 | Lanczos pre-upsampling |
| 4..7 | Reserved for future pre-processing types |

**ami\_map\_approximation\_model\_cap** is a bit field mask specifying the models supported by the receiver to extrapolate the set of sample values of the requested Attenuation Maps with individual energy reduction rate(s) to another set of Attenuation Map sample values with a different energy reduction rate.

bit 0 set to 1 indicates that linear scaling is supported.

bit 1 set to 1 indicates that bilinear interpolation is supported.

bit 2 set to 1 indicates that Lanczos interpolation is supported.

bit 3 set to 1 indicates that bicubic interpolation is supported.

bits 4..7 are reserved for future approximation models

Table X.21 - Interpretation of ami\_map\_approximation\_model\_cap

|  |  |
| --- | --- |
| **Bit number** | **Attenuation Map interpolation process** |
| 0 | Linear scaling |
| 1 | Bilinear interpolation |
| 2 | Lanczos interpolation |
| 3 | Bicubic interpolation |
| 4..7 | Reserved for future uses |

**ami\_map\_number\_req** indicates the number of Attenuation Maps that are requested by the receiver.

**ami\_energy\_reduction\_rate\_req**[ i ] indicates the energy reduction rate the receiver expects when the Attenuation Map of index i is applied on the primary picture. An example unit for the ami\_energy\_reduction\_rate is a percentage or a value in Watts.

##### Semantics of Display Attenuation Map Power Reduction Response (DAMPR-Resp) message

**ami\_map\_number\_resp** indicates the number of transmitted Attenuation Maps. When set to 0, it indicates that the transmitter acknowledge reception of a global cancellation request of all Attenuation Maps from the receiver.

**ami\_energy\_reduction\_rate\_resp[ i ]** indicates the energy reduction rate the receiver can expect when the Attenuation map of index i is applied on the primary picture. An example unit for the ami\_energy\_reduction\_rate is a percentage or a value in Watts.

##### Semantics of Display Power Reduction Attenuated Video Request (DPRAV-Req) message

**ami\_cancel\_flag** equal to 1 indicates that the receiver requests to cancel the transmission of the Attenuated Video content and the related information in the Green Metadata SEI message.

**ami\_display\_model\_cap** is a bit field mask which indicates the display models of the receiver on which the Attenuated Video content will be rendered.

Table X.22 - Interpretation of the display model

|  |  |
| --- | --- |
| **Bit number** | **Display model** |
| 0 | Transmissive pixel |
| 1 | Emissive pixel |
| 2..3 | Reserved for future types |

**ami\_attenuation\_comp\_cap** is a bit field which allows the receiver to indicate both which component(s) of the Attenuation Map exists, and the component(s) of the original video on which it accepts that the transmitter applies the components of the Attenuation Map.

bit 0 set to 1 indicates that the receiver accepts that the transmitter builds an Attenuation Map of one only component and that it applies this component on the luma component of the primary picture.

bit 1 set to 1 indicates that the receiver accepts that the transmitter builds an Attenuation Map of one only component and that it applies this component to the luma component and the chroma components of the primary picture.

bit 2 set to 1 indicates that the receiver accepts that the transmitter builds an Attenuation Map of one only component and that it applies this component to the RGB components (after YUV to RGB conversion) of the primary picture.

bit 3 set to 1 indicates that the receiver accepts that the transmitter builds an Attenuation Map of two components and that it applies the first component to the luma component and the second component to both chroma components of the primary picture.

bit 4 set to 1 indicates that the receiver accepts that the transmitter applies a per component Attenuation Map respectively to the luma and chroma components of the primary picture.

bit 5 set to 1 indicates that the receiver accepts that the transmitter applies a per component Attenuation Map to the RGB components (after YUV to RGB conversion) of the primary picture.

bit 6-7 are reserved for future uses.

Table X.23 - Interpretation of the mapping between components of the Attenuation Map and primary picture components on which to apply the Attenuation Map by the transmitter

|  |  |
| --- | --- |
| **bit number** | **Mapping between components of the Attenuation Map and primary picture components on which to apply the Attenuation Map by the transmitter** |
| 0 | One component of the map applied to the luma component of the primary picture |
| 1 | One component of the map applied to the luma and chroma components of the primary picture |
| 2 | One component in the map applied to the three RGB components of the primary picture |
| 3 | Two components of the map applied as:   * First component to luma component * Second component to the chroma components   of the primary picture |
| 4 | Three components of the map applied to resp.  luma and chroma components of the associated primary picture |
| 5 | Three components of the map applied to resp.  the RGB components of the associated primary picture |
| 6..7 | Future uses |

**ami\_energy\_reduction\_rate\_req** indicates the energy reduction rate the receiver expects when the Attenuation Map is applied on the primary picture. The unit of the ami\_energy\_reduction\_rate is a percentage.

##### Semantics of Display Power Reduction Attenuated Video Response (DPRAV-Resp) message

**ami\_energy\_reduction\_rate\_resp** indicates the energy reduction rate in percentage, the receiver can expect when the Attenuated Video is rendered on its display.

#### Systems not using SEI messages to transmit DA green metadata

The semantics is the same as the one described in section 7.4.1.2.

*A.1.1*

*Replace the following in subclause A.1.1 (“Syntax”)*

|  |  |
| --- | --- |
| green\_metadata(payload\_size) { | **Descriptor** |
| **green\_metadata\_type** | u(8) |
| switch (green\_metadata\_type) { |  |
| case 0: |  |
| **period\_type** | u(8) |
| if ( period\_type = = 2 ) || ( period\_type = = 7 ) { |  |
| **num\_seconds** | u(16) |
| } |  |
| else if ( period\_type = = 3 ) || ( period\_type = = 8 ) { |  |
| **num\_pictures** | u(16) |
| } |  |
| if ( period\_type = = 8 ) { |  |
| **temporal\_map** | u(8) |
| for ( t=0; t<8; t++ ) { |  |
| if ( (temporal\_map>>t)%2 = = 1) |  |
| **num\_pictures\_in\_temporal\_layers[ t ]** | u(16) |
| } |  |
| } |  |
| if (period\_type<= 3) { |  |
| **portion\_non\_zero\_8x8\_blocks** | u(8) |
| **portion\_intra\_predicted\_macroblocks** | u(8) |
| **portion\_six\_tap\_filterings** | u(8) |
| **portion\_alpha\_point\_deblocking\_instances** | u(8) |
| } |  |
| else if (period\_type= = 4) { |  |
| for ( i=0; i<= num\_slice\_groups\_minus1; i++ ) { |  |
| **num\_slices\_minus1[ i ]** | u(16) |
| } |  |
| for ( i=0; i<= num\_slice\_groups\_minus1; i++ ) { |  |
| for ( j=0; j<=num\_slices\_minus1[ i ]; j++ ) { |  |
| **first\_mb\_in\_slice[ i ][ j ]** | u(16) |
| **portion\_non\_zero\_8x8\_blocks[ i ][ j ]** | u(8) |
| **portion\_intra\_predicted\_macroblocks[ i ][ j ]** | u(8) |
| **portion\_six\_tap\_filterings[ i ][ j ]** | u(8) |
| **portion\_alpha\_point\_deblocking\_instances[ i ][ j ]** | u(8) |
| } |  |
| } |  |
| } |  |
| else if ( period\_type >= 5) && ( period\_type <= 8) { |  |
| **num\_layers\_minus1** | u(16) |
| for (l=0; l<= num\_layers\_minus1; l++ ) { |  |
| **picture\_parameter\_set\_id[ l ]** | u(8) |
| **priority\_id[ l ]** | u(6) |
| **dependency\_id[ l ]** | u(3) |
| **quality\_id[ l ]** | u(4) |
| **temporal\_id[ l ]** | u(3) |
| **portion\_non\_zero\_8x8\_blocks[ l ]** | u(8) |
| **portion\_intra\_predicted\_macroblocks[ l ]** | u(8) |
| **portion\_six\_tap\_filterings[ l ]** | u(8) |
| **portion\_alpha\_point\_deblocking\_instances[ l ]** | u(8) |
| } |  |
| } |  |
| break; |  |
| case 1: |  |
| **xsd\_metric\_type** | u(8) |
| **xsd\_metric\_value** | u(16) |
| break; |  |
| break; |  |
| default: |  |
| } |  |
| } |  |

|  |  |
| --- | --- |
| green\_metadata(payload\_size) { | **Descriptor** |
| **green\_metadata\_type** | u(8) |
| switch (green\_metadata\_type) { |  |
| case 0: |  |
| **period\_type** | u(8) |
| if ( period\_type = = 2 ) || ( period\_type = = 7 ) { |  |
| **num\_seconds** | u(16) |
| } |  |
| else if ( period\_type = = 3 ) || ( period\_type = = 8 ) { |  |
| **num\_pictures** | u(16) |
| } |  |
| if ( period\_type = = 8 ) { |  |
| **temporal\_map** | u(8) |
| for ( t=0; t<8; t++ ) { |  |
| if ( (temporal\_map>>t)%2 = = 1) |  |
| **num\_pictures\_in\_temporal\_layers[ t ]** | u(16) |
| } |  |
| } |  |
| if (period\_type<= 3) { |  |
| **portion\_non\_zero\_8x8\_blocks** | u(8) |
| **portion\_intra\_predicted\_macroblocks** | u(8) |
| **portion\_six\_tap\_filterings** | u(8) |
| **portion\_alpha\_point\_deblocking\_instances** | u(8) |
| } |  |
| else if (period\_type= = 4) { |  |
| for ( i=0; i<= num\_slice\_groups\_minus1; i++ ) { |  |
| **num\_slices\_minus1[ i ]** | u(16) |
| } |  |
| for ( i=0; i<= num\_slice\_groups\_minus1; i++ ) { |  |
| for ( j=0; j<=num\_slices\_minus1[ i ]; j++ ) { |  |
| **first\_mb\_in\_slice[ i ][ j ]** | u(16) |
| **portion\_non\_zero\_8x8\_blocks[ i ][ j ]** | u(8) |
| **portion\_intra\_predicted\_macroblocks[ i ][ j ]** | u(8) |
| **portion\_six\_tap\_filterings[ i ][ j ]** | u(8) |
| **portion\_alpha\_point\_deblocking\_instances[ i ][ j ]** | u(8) |
| } |  |
| } |  |
| } |  |
| else if ( period\_type >= 5) && ( period\_type <= 8) { |  |
| **num\_layers\_minus1** | u(16) |
| for (l=0; l<= num\_layers\_minus1; l++ ) { |  |
| **picture\_parameter\_set\_id[ l ]** | u(8) |
| **priority\_id[ l ]** | u(6) |
| **dependency\_id[ l ]** | u(3) |
| **quality\_id[ l ]** | u(4) |
| **temporal\_id[ l ]** | u(3) |
| **portion\_non\_zero\_8x8\_blocks[ l ]** | u(8) |
| **portion\_intra\_predicted\_macroblocks[ l ]** | u(8) |
| **portion\_six\_tap\_filterings[ l ]** | u(8) |
| **portion\_alpha\_point\_deblocking\_instances[ l ]** | u(8) |
| } |  |
| } |  |
| break; |  |
| case 1: |  |
| **xsd\_metric\_type** | u(8) |
| **xsd\_metric\_value** | u(16) |
| break; |  |
| case 2: |  |
| **ami\_flags** | u(8) |
| if ( **ami\_flags && 0x01 != 0x01** ) { |  |
| **ami\_display\_model** | u(4) |
| **if ( ami\_flags && 0x04 == 0x04 ) {** |  |
| **ami\_map\_approximation\_model** | u(4) |
| } |  |
| **ami\_map\_number** | u(3) |
| for ( i=0;i<ami\_map\_number;i++ ) { |  |
| **ami\_layer\_id**[ i ] | u(8) |
| **ami\_ols\_number**[ i ] | u(4) |
| for ( j=0;j<ami\_ols\_number[ i ];j++){ |  |
| **ami\_ols\_id**[ i ][ j ] | u(8) |
| } |  |
| **ami\_energy\_reduction\_rate**[ i ] | u(5) |
| **if ( ami\_flags && 0x20== 0x20 ){** |  |
| **ami\_video\_quality\_metric[ i ]** | u(8) |
| **ami\_video\_quality\_level[ i ]** | u(16) |
| } |  |
| **ami\_max\_value**[ i ] | u(8) |
| **if ( ami\_flags && 0x02 != 0x02 ) or ( i == 0 ) {** |  |
| **ami\_attenuation\_use\_idc**[ i ] | u(4) |
| **ami\_attenuation\_comp\_idc**[ i ] | u(4) |
| **if ( ami\_flags && 0x08 == 0x08 ){** |  |
| **ami\_preprocessing\_flag**[ i ] | u(1) |
| if( **ami\_preprocessing\_flag**[ i ] ){ |  |
| **ami\_preprocessing\_type\_idc**[ i ] | u(2) |
| } |  |
| **ami\_preprocessing\_scale\_idc**[ i ] | u(8) |
| } |  |
| **if ( ami\_flags && 0x10 == 0x10 ){** |  |
| **ami\_backlight\_scaling\_idc**[ i ] | u(4) |
| } |  |
| } |  |
| } |  |
| **if (ami\_map\_number == 0){** |  |
| **ami\_energy\_reduction\_rate[ 0 ]** | u(5) |
| **if(ami\_flags && 0x20 == 0x20){** |  |
| **ami\_video\_quality\_metric[ 0 ]** | u(8) |
| **ami\_video\_quality\_reduction[ 0 ]** | u(16) |
| **}** |  |
| **}** |  |
| } |  |
| break; |  |
| default: |  |
| } |  |
| } |  |

*A.1.2*

*Replace the following in subclause A.1.2 (“Semantics”)*

green\_metadata\_type specifies the type of metadata that is present in the SEI message. If green\_metadata\_type is 0, then complexity metrics are present. Otherwise, if green\_metadata\_type is 1, then metadata enabling quality recovery after low-power encoding is present. Other values of green\_metadata\_type are reserved for future use by ISO/IEC.

*with*

green\_metadata\_type specifies the type of metadata that is present in the SEI message. If green\_metadata\_type is 0, then complexity metrics are present. If green\_metadata\_type is 1, then metadata enabling quality recovery after low-power encoding is present. If green\_metadata\_type is 2, then metadata enabling the use of Attenuation Maps for Display Adaptation is present. Other values of green\_metadata\_type are reserved for future use by ISO/IEC.

*A.2.1*

*Replace the following in subclause A.2.1 (“Syntax”)*

|  |  |
| --- | --- |
| green\_metadata( payload\_size ) { | **Descriptor** |
| **green\_metadata\_type** | u(8) |
| switch ( green\_metadata\_type) { |  |
| case 0: |  |
| **period\_type** | u(8) |
| if ( period\_type = = 2 ) { |  |
| **num\_seconds** | u(16) |
| } |  |
| else if ( period\_type = = 3 ) { |  |
| **num\_pictures** | u(16) |
| } |  |
| if ( period\_type <= 3 ) { |  |
| **portion\_non\_zero\_blocks\_area** | u(8) |
| if ( portion\_non\_zero\_blocks\_area != 0 ) { |  |
| **portion\_8x8\_blocks\_in\_non\_zero\_area** | u(8) |
| **portion\_16x16\_blocks\_in\_non\_zero\_area** | u(8) |
| **portion\_32x32\_blocks\_in\_non\_zero\_area** | u(8) |
| } |  |
| **portion\_intra\_predicted\_blocks\_area** | u(8) |
| if ( portion\_intra\_predicted\_blocks\_area = = 255) { |  |
| **portion\_planar\_blocks\_in\_intra\_area** | u(8) |
| **portion\_dc\_blocks\_in\_intra\_area** | u(8) |
| **portion\_angular\_hv\_blocks\_in\_intra\_area** | u(8) |
| } |  |
| else { |  |
| **portion\_blocks\_a\_c\_d\_n\_filterings** | u(8) |
| **portion\_blocks\_h\_b\_filterings** | u(8) |
| **portion\_blocks\_f\_i\_k\_q\_filterings** | u(8) |
| **portion\_blocks\_j\_filterings** | u(8) |
| **portion\_blocks\_e\_g\_p\_r\_filterings** | u(8) |
| } |  |
| **portion\_deblocking\_instances** | u(8) |
| } |  |
| else if( period\_type = = 4 ) { |  |
| **max\_num\_slices\_tiles\_minus1** | u(16) |
| for ( t=0; t<=max\_num\_slices\_tiles\_minus1; t++ ) { |  |
| **first\_ctb\_in\_slice\_or\_tile[ t ]** | u(16) |
| **portion\_non\_zero\_blocks\_area[ t ]** | u(8) |
| if (portion\_non\_zero\_blocks\_area[ t ] != 0 ) { |  |
| **portion\_8x8\_blocks\_in\_non\_zero\_area[ t ]** | u(8) |
| **portion\_16x16\_blocks\_in\_non\_zero\_area[ t ]** | u(8) |
| **portion\_32x32\_blocks\_in\_non\_zero\_area[ t ]** | u(8) |
| } |  |
| **portion\_intra\_predicted\_blocks\_area[ t ]** | u(8) |
| if ( portion\_intra\_predicted\_blocks\_area[ t ] = = 255 ) { |  |
| **portion\_planar\_blocks\_in\_intra\_area[ t ]** | u(8) |
| **portion\_dc\_blocks\_in\_intra\_area[ t ]** | u(8) |
| **portion\_angular\_hv\_blocks\_in\_intra\_area[ t ]** | u(8) |
| } |  |
| else { |  |
| **portion\_blocks\_a\_c\_d\_n\_filterings[ t ]** | u(8) |
| **portion\_blocks\_h\_b\_filterings[ t ]** | u(8) |
| **portion\_blocks\_f\_i\_k\_q\_filterings[ t ]** | u(8) |
| **portion\_blocks\_j\_filterings[ t ]** | u(8) |
| **portion\_blocks\_e\_g\_p\_r\_filterings[ t ]** | u(8) |
| } |  |
| **portion\_deblocking\_instances[ t ]** | u(8) |
| } |  |
| } |  |
| break; |  |
| case 1: |  |
| **xsd\_metric\_type** | u(8) |
| **xsd\_metric\_value** | u(16) |
| break; |  |
| break; |  |
| default: |  |
| } |  |
| } |  |

*with*

|  |  |
| --- | --- |
| green\_metadata( payload\_size ) { | **Descriptor** |
| **green\_metadata\_type** | u(8) |
| switch ( green\_metadata\_type) { |  |
| case 0: |  |
| **period\_type** | u(8) |
| if ( period\_type = = 2 ) { |  |
| **num\_seconds** | u(16) |
| } |  |
| else if ( period\_type = = 3 ) { |  |
| **num\_pictures** | u(16) |
| } |  |
| if ( period\_type <= 3 ) { |  |
| **portion\_non\_zero\_blocks\_area** | u(8) |
| if ( portion\_non\_zero\_blocks\_area != 0 ) { |  |
| **portion\_8x8\_blocks\_in\_non\_zero\_area** | u(8) |
| **portion\_16x16\_blocks\_in\_non\_zero\_area** | u(8) |
| **portion\_32x32\_blocks\_in\_non\_zero\_area** | u(8) |
| } |  |
| **portion\_intra\_predicted\_blocks\_area** | u(8) |
| if ( portion\_intra\_predicted\_blocks\_area = = 255) { |  |
| **portion\_planar\_blocks\_in\_intra\_area** | u(8) |
| **portion\_dc\_blocks\_in\_intra\_area** | u(8) |
| **portion\_angular\_hv\_blocks\_in\_intra\_area** | u(8) |
| } |  |
| else { |  |
| **portion\_blocks\_a\_c\_d\_n\_filterings** | u(8) |
| **portion\_blocks\_h\_b\_filterings** | u(8) |
| **portion\_blocks\_f\_i\_k\_q\_filterings** | u(8) |
| **portion\_blocks\_j\_filterings** | u(8) |
| **portion\_blocks\_e\_g\_p\_r\_filterings** | u(8) |
| } |  |
| **portion\_deblocking\_instances** | u(8) |
| } |  |
| else if( period\_type = = 4 ) { |  |
| **max\_num\_slices\_tiles\_minus1** | u(16) |
| for ( t=0; t<=max\_num\_slices\_tiles\_minus1; t++ ) { |  |
| **first\_ctb\_in\_slice\_or\_tile[ t ]** | u(16) |
| **portion\_non\_zero\_blocks\_area[ t ]** | u(8) |
| if (portion\_non\_zero\_blocks\_area[ t ] != 0 ) { |  |
| **portion\_8x8\_blocks\_in\_non\_zero\_area[ t ]** | u(8) |
| **portion\_16x16\_blocks\_in\_non\_zero\_area[ t ]** | u(8) |
| **portion\_32x32\_blocks\_in\_non\_zero\_area[ t ]** | u(8) |
| } |  |
| **portion\_intra\_predicted\_blocks\_area[ t ]** | u(8) |
| if ( portion\_intra\_predicted\_blocks\_area[ t ] = = 255 ) { |  |
| **portion\_planar\_blocks\_in\_intra\_area[ t ]** | u(8) |
| **portion\_dc\_blocks\_in\_intra\_area[ t ]** | u(8) |
| **portion\_angular\_hv\_blocks\_in\_intra\_area[ t ]** | u(8) |
| } |  |
| else { |  |
| **portion\_blocks\_a\_c\_d\_n\_filterings[ t ]** | u(8) |
| **portion\_blocks\_h\_b\_filterings[ t ]** | u(8) |
| **portion\_blocks\_f\_i\_k\_q\_filterings[ t ]** | u(8) |
| **portion\_blocks\_j\_filterings[ t ]** | u(8) |
| **portion\_blocks\_e\_g\_p\_r\_filterings[ t ]** | u(8) |
| } |  |
| **portion\_deblocking\_instances[ t ]** | u(8) |
| } |  |
| } |  |
| break; |  |
| case 1: |  |
| **xsd\_metric\_type** | u(8) |
| **xsd\_metric\_value** | u(16) |
| break; |  |
| case 2: |  |
| **ami\_flags** | u(8) |
| if ( **ami\_flags && 0x01 != 0x01** ) { |  |
| **ami\_display\_model** | u(4) |
| **if ( ami\_flags && 0x04 == 0x04 ) {** |  |
| **ami\_map\_approximation\_model** | u(4) |
| } |  |
| **ami\_map\_number** | u(3) |
| for ( i=0;i<ami\_map\_number;i++ ) { |  |
| **ami\_layer\_id**[ i ] | u(8) |
| **ami\_ols\_number**[ i ] | u(4) |
| for ( j=0;j<ami\_ols\_number[ i ];j++){ |  |
| **ami\_ols\_id**[ i ][ j ] | u(8) |
| } |  |
| **ami\_energy\_reduction\_rate**[ i ] | u(5) |
| **if ( ami\_flags && 0x20== 0x20 ){** |  |
| **ami\_video\_quality\_metric[ i ]** | u(8) |
| **ami\_video\_quality\_level[ i ]** | u(16) |
| } |  |
| **ami\_max\_value**[ i ] | u(8) |
| **if ( ami\_flags && 0x02 != 0x02 ) or ( i == 0 ) {** |  |
| **ami\_attenuation\_use\_idc**[ i ] | u(4) |
| **ami\_attenuation\_comp\_idc**[ i ] | u(4) |
| **if ( ami\_flags && 0x08 == 0x08 ){** |  |
| **ami\_preprocessing\_flag**[ i ] | u(1) |
| if( **ami\_preprocessing\_flag**[ i ] ){ |  |
| **ami\_preprocessing\_type\_idc**[ i ] | u(2) |
| } |  |
| **ami\_preprocessing\_scale\_idc**[ i ] | u(8) |
| } |  |
| **if ( ami\_flags && 0x10 == 0x10 ){** |  |
| **ami\_backlight\_scaling\_idc**[ i ] | u(4) |
| } |  |
| } |  |
| } |  |
| **if (ami\_map\_number == 0){** |  |
| **ami\_energy\_reduction\_rate[ 0 ]** | u(5) |
| **if(ami\_flags && 0x20 == 0x20){** |  |
| **ami\_video\_quality\_metric[ 0 ]** | u(8) |
| **ami\_video\_quality\_reduction[ 0 ]** | u(16) |
| **}** |  |
| **}** |  |
| } |  |
| break; |  |
| default: |  |
| } |  |
| } |  |

*A.2.2*

*Replace the following in subclause A.2.2 (“Semantics”)*

green\_metadata\_type specifies the type of metadata that is present in the SEI message. If green\_metadata\_type is 0, then complexity metrics are present. Otherwise, if green\_metadata\_type is 1, then metadata enabling quality recovery after low-power encoding is present. Other values of green\_metadata\_type are reserved for future use by ISO/IEC.

*with*

green\_metadata\_type specifies the type of metadata that is present in the SEI message. If green\_metadata\_type is 0, then complexity metrics are present. If green\_metadata\_type is 1, then metadata enabling quality recovery after low-power encoding is present. If green\_metadata\_type is 2, then metadata enabling the use of Attenuation Maps for Display Adaptation is present. Other values of green\_metadata\_type are reserved for future use by ISO/IEC.

*A.3.1*

*Replace the following in subclause A.3.1 (“Syntax”)*

|  |  |
| --- | --- |
| green\_metadata( payload\_size ) { | **Descriptor** |
| **green\_metadata\_type** | u(8) |
| switch ( green\_metadata\_type) { |  |
| case 0: |  |
| **period\_type** | u(4) |
| **granularity\_type** | u(3) |
| **extended\_representation\_flag** | u(1) |
| if ( period\_type = = 2 ) { |  |
| **num\_seconds** | u(16) |
| } |  |
| else if ( period\_type = = 3 ) { |  |
| **num\_pictures** | u(16) |
| } |  |
| if ( granularity\_type = = 0 ) { |  |
| **portion\_non\_zero\_blocks\_area** | u(8) |
| **portion\_non\_zero\_transform\_coefficients\_area** | u(8) |
| **portion\_intra\_predicted\_blocks\_area** | u(8) |
| **portion\_deblocking\_instances** | u(8) |
| **portion\_alf\_instances** | u(8) |
| if ( extended\_representation\_flag ) { |  |
| if ( portion\_non\_zero\_blocks\_area != 0 ) { |  |
| **portion\_non\_zero\_4\_8\_16\_blocks\_area** | u(8) |
| **portion\_non\_zero\_32\_64\_128\_blocks\_area** | u(8) |
| **portion\_non\_zero\_256\_512\_1024\_blocks\_area** | u(8) |
| **portion\_non\_zero\_2048\_4096\_blocks\_area** | u(8) |
| } |  |
| if ( portion\_intra\_predicted\_blocks\_area < 255 ) { |  |
| **portion\_bi\_and\_gpm\_predicted\_blocks\_area** | u(8) |
| **portion\_bdof\_blocks\_area** | u(8) |
| } |  |
| **portion\_sao\_instances** | u(8) |
| } |  |
| } |  |
| else if( granularity\_type <= 3 ) { |  |
| **max\_num\_segments\_minus1** | u(16) |
| for ( t=0; t<= max\_num\_segments\_minus1; t++ ) { |  |
| **segment\_address[ t ]** | u(16) |
| **portion\_non\_zero\_blocks\_area[ t ]** | u(8) |
| **portion\_non\_zero\_transform\_coefficients\_area[ t ]** | u(8) |
| **portion\_intra\_predicted\_blocks\_area[ t ]** | u(8) |
| **portion\_deblocking\_instances[ t ]** | u(8) |
| **portion\_alf\_filtered\_blocks[ t ]** | u(8) |
| if ( extended\_representation\_flag ) { |  |
| if ( portion\_non\_zero\_blocks\_area[ t ] != 0 ) { |  |
| **portion\_non\_zero\_4\_8\_16\_blocks\_area[ t ]** | u(8) |
| **portion\_non\_zero\_32\_64\_128\_blocks\_area[ t ]** | u(8) |
| **portion\_non\_zero\_256\_512\_1024\_blocks\_area[ t ]** | u(8) |
| **portion\_non\_zero\_2048\_4096\_blocks\_area[ t ]** | u(8) |
| } |  |
| if ( portion\_intra\_predicted\_blocks\_area[ t ] < 255 ) { |  |
| **portion\_bi\_predicted\_blocks\_area[ t ]** | u(8) |
| **portion\_bdof\_block\_area[ t ]** | u(8) |
| } |  |
| **portion\_sao\_filtered\_blocks[ t ]** | u(8) |
| } |  |
| } |  |
| } |  |
| break; |  |
| case 1: |  |
| **xsd\_subpic\_number\_minus1** | u(16) |
| for ( i=0; i<= xsd\_subpic\_number\_minus1; i++ ) { |  |
| **xsd\_subpic\_idc[ i ]**\_ | u(16) |
| **xsd\_metric\_number\_minus1[ i ]** | u(8) |
| for ( j=0; j<= xsd\_metric\_number\_minus1[ i ]; j++ ) { |  |
| **xsd\_metric\_type[ i ][ j ]** | u(8) |
| **xsd\_metric\_value[ i ][ j ]** | u(16) |
| } |  |
| } |  |
| break; |  |
| break; |  |
| default: |  |
| } |  |
| } |  |

*with*

|  |  |
| --- | --- |
| green\_metadata( payload\_size ) { | **Descriptor** |
| **green\_metadata\_type** | u(8) |
| switch ( green\_metadata\_type) { |  |
| case 0: |  |
| **period\_type** | u(4) |
| **granularity\_type** | u(3) |
| **extended\_representation\_flag** | u(1) |
| if ( period\_type = = 2 ) { |  |
| **num\_seconds** | u(16) |
| } |  |
| else if ( period\_type = = 3 ) { |  |
| **num\_pictures** | u(16) |
| } |  |
| if ( granularity\_type = = 0 ) { |  |
| **portion\_non\_zero\_blocks\_area** | u(8) |
| **portion\_non\_zero\_transform\_coefficients\_area** | u(8) |
| **portion\_intra\_predicted\_blocks\_area** | u(8) |
| **portion\_deblocking\_instances** | u(8) |
| **portion\_alf\_instances** | u(8) |
| if ( extended\_representation\_flag ) { |  |
| if ( portion\_non\_zero\_blocks\_area != 0 ) { |  |
| **portion\_non\_zero\_4\_8\_16\_blocks\_area** | u(8) |
| **portion\_non\_zero\_32\_64\_128\_blocks\_area** | u(8) |
| **portion\_non\_zero\_256\_512\_1024\_blocks\_area** | u(8) |
| **portion\_non\_zero\_2048\_4096\_blocks\_area** | u(8) |
| } |  |
| if ( portion\_intra\_predicted\_blocks\_area < 255 ) { |  |
| **portion\_bi\_and\_gpm\_predicted\_blocks\_area** | u(8) |
| **portion\_bdof\_blocks\_area** | u(8) |
| } |  |
| **portion\_sao\_instances** | u(8) |
| } |  |
| } |  |
| else if( granularity\_type <= 3 ) { |  |
| **max\_num\_segments\_minus1** | u(16) |
| for ( t=0; t<= max\_num\_segments\_minus1; t++ ) { |  |
| **segment\_address[ t ]** | u(16) |
| **portion\_non\_zero\_blocks\_area[ t ]** | u(8) |
| **portion\_non\_zero\_transform\_coefficients\_area[ t ]** | u(8) |
| **portion\_intra\_predicted\_blocks\_area[ t ]** | u(8) |
| **portion\_deblocking\_instances[ t ]** | u(8) |
| **portion\_alf\_filtered\_blocks[ t ]** | u(8) |
| if ( extended\_representation\_flag ) { |  |
| if ( portion\_non\_zero\_blocks\_area[ t ] != 0 ) { |  |
| **portion\_non\_zero\_4\_8\_16\_blocks\_area[ t ]** | u(8) |
| **portion\_non\_zero\_32\_64\_128\_blocks\_area[ t ]** | u(8) |
| **portion\_non\_zero\_256\_512\_1024\_blocks\_area[ t ]** | u(8) |
| **portion\_non\_zero\_2048\_4096\_blocks\_area[ t ]** | u(8) |
| } |  |
| if ( portion\_intra\_predicted\_blocks\_area[ t ] < 255 ) { |  |
| **portion\_bi\_predicted\_blocks\_area[ t ]** | u(8) |
| **portion\_bdof\_block\_area[ t ]** | u(8) |
| } |  |
| **portion\_sao\_filtered\_blocks[ t ]** | u(8) |
| } |  |
| } |  |
| } |  |
| break; |  |
| case 1: |  |
| **xsd\_subpic\_number\_minus1** | u(16) |
| for ( i=0; i<= xsd\_subpic\_number\_minus1; i++ ) { |  |
| **xsd\_subpic\_idc[ i ]**\_ | u(16) |
| **xsd\_metric\_number\_minus1[ i ]** | u(8) |
| for ( j=0; j<= xsd\_metric\_number\_minus1[ i ]; j++ ) { |  |
| **xsd\_metric\_type[ i ][ j ]** | u(8) |
| **xsd\_metric\_value[ i ][ j ]** | u(16) |
| } |  |
| } |  |
| break; |  |
| case 2: |  |
| **ami\_flags** | u(8) |
| if ( **ami\_flags && 0x01 != 0x01** ) { |  |
| **ami\_display\_model** | u(4) |
| **if ( ami\_flags && 0x04 == 0x04 ) {** |  |
| **ami\_map\_approximation\_model** | u(4) |
| } |  |
| **ami\_map\_number** | u(3) |
| for ( i=0;i<ami\_map\_number;i++ ) { |  |
| **ami\_layer\_id**[ i ] | u(8) |
| **ami\_ols\_number**[ i ] | u(4) |
| for ( j=0;j<ami\_ols\_number[ i ];j++){ |  |
| **ami\_ols\_id**[ i ][ j ] | u(8) |
| } |  |
| **ami\_energy\_reduction\_rate**[ i ] | u(5) |
| **if ( ami\_flags && 0x20== 0x20 ){** |  |
| **ami\_video\_quality\_metric[ i ]** | u(8) |
| **ami\_video\_quality\_level[ i ]** | u(16) |
| } |  |
| **ami\_max\_value**[ i ] | u(8) |
| **if ( ami\_flags && 0x02 != 0x02 ) or ( i == 0 ) {** |  |
| **ami\_attenuation\_use\_idc**[ i ] | u(4) |
| **ami\_attenuation\_comp\_idc**[ i ] | u(4) |
| **if ( ami\_flags && 0x08 == 0x08 ){** |  |
| **ami\_preprocessing\_flag**[ i ] | u(1) |
| if( **ami\_preprocessing\_flag**[ i ] ){ |  |
| **ami\_preprocessing\_type\_idc**[ i ] | u(2) |
| } |  |
| **ami\_preprocessing\_scale\_idc**[ i ] | u(8) |
| } |  |
| **if ( ami\_flags && 0x10 == 0x10 ){** |  |
| **ami\_backlight\_scaling\_idc**[ i ] | u(4) |
| } |  |
| } |  |
| } |  |
| **if (ami\_map\_number == 0){** |  |
| **ami\_energy\_reduction\_rate[ 0 ]** | u(5) |
| **if(ami\_flags && 0x20 == 0x20){** |  |
| **ami\_video\_quality\_metric[ 0 ]** | u(8) |
| **ami\_video\_quality\_reduction[ 0 ]** | u(16) |
| **}** |  |
| **}** |  |
| } |  |
| break; |  |
| default: |  |
| } |  |
| } |  |

*A.3.2*

*Replace the following in subclause A.3.2 (“Semantics”)*

green\_metadata\_type specifies the type of metadata that is present in the SEI message. If green\_metadata\_type is 0, then complexity metrics are present. Otherwise, if green\_metadata\_type is 1, then metadata enabling quality recovery after low-power encoding is present. Other values of green\_metadata\_type are reserved for future use by ISO/IEC.

*with*

green\_metadata\_type specifies the type of metadata that is present in the SEI message. If green\_metadata\_type is 0, then complexity metrics are present. If green\_metadata\_type is 1, then metadata enabling quality recovery after low-power encoding is present. If green\_metadata\_type is 2, then metadata enabling the use of Attenuation Maps for Display Adaptation is present. Other values of green\_metadata\_type are reserved for future use by ISO/IEC.

*B.3.2*

*Replace the title of subclause B.3.2 (“Green metadata production and transmission at the server side”)*

B.3.2 Green metadata production and transmission at the server side

*with*

B.3.2 Production and transmission of decoder and display power indication Green metadata at the server side

*B.3.3*

*Replace the title of subclause B.3.3 (“Use of green metadata at the client”)*

**B.3.3 Use of green metadata at the client**

*with*

**B.3.3** **Use of decoder and display power indication green metadata at the client**

*B.3*

*Add the following at the end of subclause B.3 (“*Energy-efficient media selection in adaptive streaming*”)*

B.3.4 Production and transmission of display attenuation map green metadata at the server side

Given a video representation, a set of *N* display attenuation maps is generated by the encoding system provided by the server to reduce locally and smartly the brightness of the video representation’s frames. Each display attenuation map *i* optimizes the tradeoff between the resulting video quality and energy reduction, for i = 0 to N – 1, as shown in Figure X.1. Such display attenuation maps can for example be generated by a dedicated deep neural network.

A black screen with white text

Description automatically generated

Figure X.1 — Display attenuation map computation and insertion.

The display attenuation map associated with a video representation is computed to reduce the energy consumption of displaying this representation by an energy-reduction rate indicated as a reduction percentage.

A display attenuation map Media Segment and its associated video Media Segment(s) are time aligned on Segment boundaries. A display attenuation map Media Segment is an ISOBMFF file which contains samples for a restricted video track, as shown in Figure X.2, where each sample is a coded display attenuation map frame. The carriage of display attenuation map data in ISOBMFF files is specified in ISO/IEC 23001-10 [3].



**Figure X.2 — Alternate group of multiple Display Attenuation Map Representations**

B.3.5 Display Attenuation Map signalling in a DASH MPD file

Display attenuation map Representations for a video are signalled in their own Adaptation Set within the MPD file. This Adaptation Set is henceforth referred to as a Display Attenuation Map Adaptation Set. The @codecs attribute for a Display Attenuation Map Adaptation Set, or Representations of this Adaptation Set if @codecs is not signalled for the **AdaptationSet** element, is set based on the respective codec used for encoding the attenuation map. The value of @codecs shall be set to 'resv.gmat.XXXX', where XXXX corresponds to the four-character code (4CC) of the video codec and should be identical to the original\_format field in the RestrictedSchemeInfoBox of the sample entry of the corresponding ISOBMFF track, ISO/IEC 23001-10 [3].

The association of a display attenuation map Representation with one or more video media Representations is signalled in the MPD through the @associationId and @associationType attributes. The @associationId attribute is set to a space separated list that includes the @id attribute values of the associated video Representations. The @associationType attribute shall be set to “amit”, indicating that this association is for display attenuation map information.

Multiple display attenuation maps with different characteristics (e.g., different values of ami\_energy\_reduction\_rate, different values of display model, different resolutions, etc.) can be generated for the same video Representation and each alternative attenuation map is represented by one Representation in the Display Attenuation Map Adaptation Set. As specified in ISO/IEC 23001-10 [3], these display attenuation map Representations that are alternatives of each other shall be indicated by the same value of alternate\_group in the TrackHeaderBox.

B.3.5.1 Attenuation Map Descriptors

To signal the characteristics of the display attenuation map(s) carried by a Display Attenuation Map Adaptation Set, an AttenuationMap descriptor is used. The XML elements and attributes for this descriptor are defined in a separate namespace "urn:mpeg:mpegI:green:2023”. The namespace designator “green:” is used to refer to this name space.

This descriptor is an EssentialProperty descriptor with the @schemeIdUri attribute set to the unique URI "urn:mpeg:mpegI:green:2023:ami".

At most one single AttenuationMap descriptor shall be present at the Adaptation level and/or at Representation level for each Representation in a Display Attenuation Map Adaptation Set.

The @value attribute of the AttenuationMap descriptor shall not be present. Table X.22 lists all the elements and attribute of the AttenuationMap descriptor.

Table X.22 - Elements and attributes of the AttenuationMap descriptor

|  |  |  |  |
| --- | --- | --- | --- |
| **Elements and attributes** | **Use** | **Data type** | **Description** |
| **AMI** | M | green:AMInfoType | An element whose attributes and sub-elements specify information for the display attenuation map present in the Representation(s) of the Adaptation Set. |
| **AMI**@displayModel | O | green:DisplayModelType | Indicates the display models on which the attenuation map may be used.  For ISO Base Media File Format Segments, the value of the @displayModel attribute shall be equal to ami\_display\_model in the AttenuationMapInformationBox in sample entries of the Initialization Segment. |
| **AMI**@attenuationUse | O | green:FourValueRangeType | Indicates which operation should be used to apply the attenuation map sample values to the corresponding frame in the associated video before rendering the frame on the display.  For ISO Base Media File Format Segments, the value of the @attenuationUse attribute shall be equal to ami\_attenuation\_use\_idc in the AttenuationMapInformationBox in sample entries of the Initialization Segment. |
| **AMI**@attenuationComponentIdc | O | green:AttenuationComponentIdcType | Indicates on which color component(s) of the associated video to apply the attenuation map using the operation defined by @attenuationUse. It also specifies how many components the attenuation map has.  For ISO Base Media File Format Segments, the value of the @attenuationComponentIdc attribute shall be equal to ami\_attenuation\_component\_idc in the AttenuationMapInformationBox in sample entries of the Initialization Segment. |
| **AMI**@energyReductionRate | O | green:EnergyReductionRateType | Indicates the expected energy saving rate (percentage) when the video is displayed after applying the attenuation map sample values on the sample values of the associated video.  For ISO Base Media File Format Segments, the value of the @energyReductionRate attribute shall be equal to ami\_energy\_reduction\_rate in the AttenuationMapInformationBox in sample entries of the Initialization Segment. |
| **AMI.QualityInfo** | O | green:QualityInfoType | An element whose attributes specify the quality reduction rate when the attenuation map is applied to the associated video representation. |
| **AMI.QualityInfo**@metric | M | xs:string | Indicates the video quality metric used to assess the quality reduction. |
| **AMI.QualityInfo**@reduction | M | xs:unsignedByte | Indicates the percentage of quality reduction in the media video as a result of applying the attenuation map to it. |
| **AMI.PreprocessingInfo** | O | green:PreprocessingInfoType | An element whose attributes and sub-elements specify information for the pre-processing interpolation model that should be used. |
| **AMI.PreprocessingInfo**@type | M | green:FourValueRangeType | Indicates which type of pre-processing interpolation model should be used to re-sample the attenuation map sample values at the same resolution as the associated video before applying it to the associated video frame. |
| **AMI.PreprocessingInfo**@max\_value | M | xs:unsignedByte | Indicates the maximum value of the attenuation map. This value can be optionally used to further adjust the dynamic range of the encoded attenuation map in the scaling process. |
| **AMI.PreprocessingInfo**@scale | M | xs:unsignedByte | Indicates the scaling that should be applied to obtain the attenuation map sample values before applying them on the sample values of the associated video. |
| **AMI.ApproxModel** | O | green:ApproxModelType | An element whose attributes specify the model used to extrapolate the attenuation map with individual energy reduction rate to another set of attenuation map with a different energy reduction rate. |
| **AMI.ApproxModel**@type | M | green:FourValueRangeType | Indicates the model used to extrapolate the attenuation map with a certain energy reduction rate to another set of attenuation map with a different energy reduction rate. |
| **AMI.WindowInfo** | O | green:WindowInfoType | An element whose attributes specify a bounding window defining a region of the associated media video to apply the attenuation map to. |
| **AMI.WindowInfo**@x | M | xs:unsignedByte | Indicates the x-coordinate of the top-left corner of the bounding window defining a region of the associated media video to apply the attenuation map carried by the display attenuation map track to |
| **AMI.WindowInfo**@y | M | xs:unsignedByte | Indicates the y-coordinate of the top-left corner of the bounding window defining a region of the associated media video to apply the attenuation map carried by the display attenuation map track to |
| **AMI.WindowInfo**@width | M | xs:unsignedByte | Indicates the width, in number of pixels, of the bounding window defining a region of the associated media video to apply the attenuation map carried by the display attenuation map track to |
| **AMI.WindowInfo**@height | M | xs:unsignedByte | Indicates the height, in number of pixels, of the bounding window defining a region of the associated media video to apply the attenuation map carried by the display attenuation map track to. |
| Key:  For attributes: M=Mandatory, O=Optional, OD=Optional with Default Value, CM=Conditionally Mandatory.  For elements: <minOccurs>..<maxOccurs> (N=unbounded)  Elements are **bold**; attributes are non-bold and preceded with an @. | | | |

The data types for various elements and attributes of the AttenuationMap descriptor are defined in the XML schema shown below.

<?xml version="1.0" encoding="UTF-8"?>

<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"

targetNamespace="urn:mpeg:mpegI:green:2023"

xmlns:green="urn:mpeg:mpegI:green:2023"

elementFormDefault="qualified">

<xs:element name="AMI" type="green:AMInfoType" />

<xs:complexType name="AMInfoType">

<xs:sequence>

<xs:element name="QualityInfo" type="green:QualityInfoType" minOccurs="0"

maxOccurs="1"/>

<xs:element name="PreprocessingInfo" type="green:PreprocessingInfoType"

minOccurs="0" maxOccurs="1" />

<xs:element name="WindowInfo" type="green:WindowInfoType" minOccurs="0"

maxOccurs="1" />

<xs:element name="ApproxModel" type="green:ApproxModelType" minOccurs="0"

maxOccurs="1" />

<xs:any namespace="##other" processContents="lax" minOccurs="0"

maxOccurs="unbounded" />

</xs:sequence>

<xs:attribute name="displayModel" type="green:DisplayModelType" />

<xs:attribute name="attenuationUse" type="green:FourValueRangeType" />

<xs:attribute name="attenuationComponentIdc"

type="green:AttenuationComponentIdcType" />

<xs:attribute name="energyReductionRate"

type="green:EnergyReductionRateType" />

<xs:anyAttribute namespace="##other" processContents="lax" />

</xs:complexType>

<xs:complexType name="QualityInfoType">

<xs:attribute name="metric" type="xs:string" use="required" />

<xs:attribute name="reduction" type="xs:unsignedByte" use="required" />

<xs:anyAttribute namespace="##other" processContents="lax" />

</xs:complexType>

<xs:complexType name="PreprocessingInfoType">

<xs:attribute name="type" type="green:FourValueRangeType" use="required" />

<xs:attribute name="max\_value" type="xs:unsignedByte" use="required" />

<xs:attribute name="scale" type="xs:unsignedByte" use="required" />

<xs:anyAttribute namespace="##other" processContents="lax" />

</xs:complexType>

<xs:complexType name="ApproxModelType">

<xs:attribute name="type" type="green:FourValueRangeType" use="required" />

<xs:anyAttribute namespace="##other" processContents="lax" />

</xs:complexType>

<xs:complexType name="WindowInfoType">

<xs:attribute name="x" type="xs:unsignedByte" use="required" />

<xs:attribute name="y" type="xs:unsignedByte" use="required" />

<xs:attribute name="width" type="xs:unsignedByte" use="required" />

<xs:attribute name="height" type="xs:unsignedByte" use="required" />

<xs:anyAttribute namespace="##other" processContents="lax" />

</xs:complexType>

<xs:simpleType name="DisplayModelType">

<xs:restriction base="xs:unsignedByte">

<xs:minInclusive value="0"/>

<xs:maxInclusive value="3"/>

</xs:restriction>

</xs:simpleType>

<xs:simpleType name="AttenuationComponentIdcType">

<xs:restriction base="xs:unsignedByte">

<xs:minInclusive value="0"/>

<xs:maxInclusive value="15"/>

</xs:restriction>

</xs:simpleType>

<xs:simpleType name="EnergyReductionRateType">

<xs:restriction base="xs:unsignedByte">

<xs:minInclusive value="0"/>

<xs:maxInclusive value="99"/>

</xs:restriction>

</xs:simpleType>

<xs:simpleType name="FourValueRangeType">

<xs:restriction base="xs:unsignedByte">

<xs:minInclusive value="0"/>

<xs:maxInclusive value="3"/>

</xs:restriction>

</xs:simpleType>

</xs:schema>

B.3.6 Use of Display Attenuation Maps at the client

A DASH client is guided by the information provided in the MPD. The following is an example client behavior for streaming videos with associated display attenuation maps using the signalling presented in Annex B, section B.3.4.

* The client first issues an HTTP request and downloads the MPD file from the content server. The client then parses the MPD file to generate a corresponding in-memory representation of the XML elements in the MPD file.
* To identify available display attenuation maps in a Period, the streaming client scans the AdaptationSet elements to find Adaptation Sets with an AttenuationMap descriptor whose @schemeIdUri is set to the unique URL "urn:mpeg:mpegI:green:2023:ami".
* For each Representation in the Display Attenuation Map Adaptation Set, the client also identifies the associated Representation in the video Adaptation Set using the @associationId.
* The client selects one of the Representations of the video Adaptation Set based on its capabilities and the network conditions and downloads the Initialization Segment for that Representation.
* The client downloads the Initialization Segment for all Representations from the Display Attenuation Map Adaptation Set that are associated with the selected video Representation.
* The client starts sequentially downloading Media Segments from the video Representation. The client regularly monitors the remaining power in the device’s battery and based on the battery level, remaining playback time, and the information signaled in the AttenuationMap descriptor selects one of the display attenuation map Representations. The client subsequently downloads with each Media Segment from the video Representation a corresponding Media Segment from the display attenuation map Representation.
* The downloaded display attenuation map Media Segments are decoded and the decoded frames are applied to the corresponding decoded frames from the video before rendering.

B.3.7 Examples of DASH MPD files for Display Attenuation Map signalling

## B.3.7.1 Example 1

This example demonstrates a DASH MPD with a presentation that includes a video Adaptation Set with three Representations and a Display Attenuation Map Adaptation Set with one Representation that is associated with the first video Representation. The attenuation map carried by the Display Attenuation Map Adaptation Set results in a 20% reduction in energy consumption when applied to the associated video Representation. The application of Display Attenuation Map Representation also results in a 5% reduction of the video quality in terms of PSNR.

<?xml version=”1.0” encoding=”UTF-8”?>

<MPD

xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xmlns="urn:mpeg:DASH:schema:MPD:2011"

xmlns:green="urn:mpeg:mpegI:green:2023"

xsi:schemaLocation="urn:mpeg:DASH:schema:MPD:xxxx"

type="static"

minBufferTime="PT4S"

profiles="urn:mpeg:dash:profile:isoff-on-demand:2011">

<BaseURL>http://cdn1.example.com/</BaseURL>

<BaseURL>http://cdn2.example.com/</BaseURL>

<Period>

<!-- Video -->

<AdaptationSet id="video" mimeType="video/mp4" codecs="avc1.4D401F"

frameRate="30000/1001" segmentAlignment="true" startWithSAP="1">

<BaseURL>video/</BaseURL>

<SegmentTemplate timescale="90000" media="$Bandwidth$/$Time$.mp4v">

<SegmentTimeline>

<S t="0" d="180180" r="432"/>

</SegmentTimeline>

</SegmentTemplate>

<Representation id="v0" width="320" height="240" bandwidth="250000"/>

<Representation id="v1" width="640" height="480" bandwidth="500000"/>

<Representation id="v2" width="960" height="720" bandwidth="1000000"/>

</AdaptationSet>

<AdaptationSet id="ami" mimeType="video/mp4" codecs="resv.gmat.avc1.4D401F">

<BaseURL>attenuation\_maps/</BaseURL>

<SegmentTemplate timescale="90000" media="$id$/$Time$.mp4v">

<SegmentTimeline>

<S t="0" d="180180" r="432"/>

</SegmentTimeline>

</SegmentTemplate>

<Representation id="ami0" bandwidth="1000" associationId="v0"

associationType="amit" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI displayMode="3" attenuationUse="1"

energyReductionRate="20">

<green:QualityInfo metric="PSNR" reduction="5" />

<green:ApproxModel type="0” />

</green:AMI>

</EssentialProperty>

</Representation>

</AdaptationSet>

</Period>

</MPD>

## B.3.7.2 Example 2

This example demonstrates a DASH MPD with a presentation that includes a video Adaptation Set with three Representations and a Display Attenuation Map Adaptation Set with two Representations that are associated with the first video Representation. The attenuation map carried by the first Representation of the Display Attenuation Map Adaptation Set results in a 20% reduction in energy consumption when applied to the video Representation, while the second Representation of the Display Attenuation Map Adaptation Set results in a 40% reduction in energy consumption when applied to the same video Representation.

<?xml version=”1.0” encoding=”UTF-8”?>

<MPD

xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xmlns="urn:mpeg:DASH:schema:MPD:XXXX"

xmlns:green="urn:mpeg:mpegI:green:2023"

xsi:schemaLocation="urn:mpeg:DASH:schema:MPD:xxxx"

type="dynamic"

minimumUpdatePeriod="PT2S"

timeShiftBufferDepth="PT30M"

availabilityStartTime="2011-12-25T12:30:00"

minBufferTime="PT4S"

profiles="urn:mpeg:dash:profile:isoff-live:2011">

<BaseURL>http://cdn1.example.com/</BaseURL>

<BaseURL>http://cdn2.example.com/</BaseURL>

<Period>

<!-- Video -->

<AdaptationSet id="video" mimeType="video/mp4" codecs="avc1.4D401F"

frameRate="30000/1001" segmentAlignment="true" startWithSAP="1">

<BaseURL>video/</BaseURL>

<SegmentTemplate timescale="90000" media="$Bandwidth$/$Time$.mp4v">

<SegmentTimeline>

<S t="0" d="180180" r="432"/>

</SegmentTimeline>

</SegmentTemplate>

<Representation id="v0" width="320" height="240" bandwidth="250000"/>

<Representation id="v1" width="640" height="480" bandwidth="500000"/>

<Representation id="v2" width="960" height="720" bandwidth="1000000"/>

</AdaptationSet>

<!-- Display Attenuation Map Adapatation Set for energy reduction for video -->

<AdaptationSet id="ami" mimeType="video/mp4" codecs="resv.gmat.avc1.4D401F">

<BaseURL>attenuation\_maps/</BaseURL>

<SegmentTemplate timescale="90000" media="$id$/$Time$.mp4v">

<SegmentTimeline>

<S t="0" d="180180" r="432"/>

</SegmentTimeline>

</SegmentTemplate>

<Representation id="ami0" bandwidth="1000" associationId="v0"

associationType="amit">

<EssentialProperty

schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI displayMode="3" attenuationUse="1"

energyReductionRate="20">

<green:ApproxModel type="1” />

</green:AMI>

</EssentialProperty>

</Representation>

<Representation id="ami1" bandwidth="1000" associationId="v0"

associationType="amit">

<EssentialProperty

schemeIdUri="urn:mpeg:mpegI:green:2023:attenuationMap">

<green:AMI displayMode="3" attenuationUse="1"

energyReductionRate="40">

<ami:ApproxModel type="1” />

</green:AMI>

</EssentialProperty>

</Representation>

</AdaptationSet>

</Period>

</MPD>

## B.3.7.3 Example 3

This example is similar to Example 2 but it uses one instance of the descriptor at the Adaptation Set level containing common information for all Representations and additional instances for each Representation with representation-specific information.

<?xml version=”1.0” encoding=”UTF-8”?>

<MPD

xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xmlns="urn:mpeg:DASH:schema:MPD:XXXX"

xmlns:green="urn:mpeg:mpegI:green:2023"

xsi:schemaLocation="urn:mpeg:DASH:schema:MPD:xxxx"

type="dynamic"

minimumUpdatePeriod="PT2S"

timeShiftBufferDepth="PT30M"

availabilityStartTime="2011-12-25T12:30:00"

minBufferTime="PT4S"

profiles="urn:mpeg:dash:profile:isoff-live:2011">

<BaseURL>http://cdn1.example.com/</BaseURL>

<BaseURL>http://cdn2.example.com/</BaseURL>

<Period>

<!-- Video -->

<AdaptationSet id="video" mimeType="video/mp4" codecs="avc1.4D401F"

frameRate="30000/1001" segmentAlignment="true" startWithSAP="1">

<BaseURL>video/</BaseURL>

<SegmentTemplate timescale="90000" media="$Bandwidth$/$Time$.mp4v">

<SegmentTimeline>

<S t="0" d="180180" r="432"/>

</SegmentTimeline>

</SegmentTemplate>

<Representation id="v0" width="320" height="240" bandwidth="250000"/>

<Representation id="v1" width="640" height="480" bandwidth="500000"/>

<Representation id="v2" width="960" height="720" bandwidth="1000000"/>

</AdaptationSet>

<!-- Display Attenuation Map Adapatation Set for energy reduction for video -->

<AdaptationSet id="ami" mimeType="video/mp4" codecs="resv.gmat.avc1.4D401F">

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI displayMode="3" attenuationUse="1" />

</EssentialProperty>

<BaseURL>attenuation\_maps/</BaseURL>

<SegmentTemplate timescale="90000" media="$id$/$Time$.mp4v">

<SegmentTimeline>

<S t="0" d="180180" r="432"/>

</SegmentTimeline>

</SegmentTemplate>

<Representation id="ami0" bandwidth="1000" associationId="v0"

associationType="amit">

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI energyReductionRate="20">

<green:ApproxModel type="1" />

</green:AMI>

</EssentialProperty>

</Representation>

<Representation id="ami1" bandwidth="1000" associationId="v0"

associationType="amit">

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI energyReductionRate="40">

<green:ApproxModel type="1" />

</green:AMI>

</EssentialProperty>

</Representation>

</AdaptationSet>

</Period>

</MPD>

## B.3.7.4 Example 4

This example is similar to Example 3 but it uses a Preselection to indicate the grouping of the video Adaptation Set and associated Display Attenuation Map Adaptation Sets.

<?xml version=”1.0” encoding=”UTF-8”?>

<MPD

xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xmlns="urn:mpeg:DASH:schema:MPD:2011"

xmlns:green="urn:mpeg:mpegI:green:2023"

xsi:schemaLocation="urn:mpeg:DASH:schema:MPD:xxxx"

type="static"

minBufferTime="PT4S"

profiles="urn:mpeg:dash:profile:isoff-on-demand:2011">

<BaseURL>http://cdn1.example.com/</BaseURL>

<BaseURL>http://cdn2.example.com/</BaseURL>

<Period>

<!-- Video -->

<AdaptationSet id="video" mimeType="video/mp4" codecs="avc1.4D401F"

frameRate="30000/1001" segmentAlignment="true" startWithSAP="1">

<BaseURL>video/</BaseURL>

<SegmentTemplate timescale="90000" media="$Bandwidth$/$Time$.mp4v">

<SegmentTimeline>

<S t="0" d="180180" r="432"/>

</SegmentTimeline>

</SegmentTemplate>

<Representation id="v0" width="320" height="240" bandwidth="250000"/>

<Representation id="v1" width="640" height="480" bandwidth="500000"/>

<Representation id="v2" width="960" height="720" bandwidth="1000000"/>

</AdaptationSet>

<AdaptationSet id="am1" mimeType="video/mp4" codecs="resv.gmat.avc1.4D401F">

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI displayMode="3" attenuationUse="1">

<green:ApproxModel type="0” />

<!-- To be applied video frame window as defined below -->

<green:WindowInfo x=0 y=0 width=160 height=240 />

</green:AMI>

</EssentialProperty>

<BaseURL>attenuation\_maps/</BaseURL>

<SegmentTemplate timescale="90000" media="$id$/$Time$.mp4v">

<SegmentTimeline>

<S t="0" d="180180" r="432"/>

</SegmentTimeline>

</SegmentTemplate>

<Representation id="ami1" bandwidth="1000" associationId="v0"

associationType="amit" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI energyReductionRate="20">

<green:QualityInfo metric="PSNR" reduction="5" />

</green:AMI>

</EssentialProperty>

</Representation>

<Representation id="ami2" bandwidth="1000" associationId="v0"

associationType="amit" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI energyReductionRate="40">

<green:QualityInfo metric="PSNR" reduction="10" />

</green:AMI>

</EssentialProperty>

</Representation>

</AdaptationSet>

<AdaptationSet id="am2" mimeType="video/mp4" codecs="resv.gmat.avc1.4D401F">

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI displayMode="3" attenuationUse="1">

<green:ApproxModel type="0” />

<!-- To be applied video frame window as defined below -->

<green:WindowInfo x=160 y=0 width=160 height=240 />

</green:AMI>

</EssentialProperty>

<BaseURL>attenuation\_maps/</BaseURL>

<SegmentTemplate timescale="90000" media="$id$/$Time$.mp4v">

<SegmentTimeline>

<S t="0" d="180180" r="432"/>

</SegmentTimeline>

</SegmentTemplate>

<Representation id="ami3" bandwidth="1000" associationId="v0"

associationType="amit" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI energyReductionRate="20">

<green:QualityInfo metric="PSNR" reduction="5" />

</green:AMI>

</EssentialProperty>

</Representation>

<Representation id="ami4" bandwidth="1000" associationId="v0"

associationType="amit" />

<EssentialProperty schemeIdUri="urn:mpeg:mpegI:green:2023:ami">

<green:AMI energyReductionRate="40">

<green:QualityInfo metric="PSNR" reduction="10" />

</green:AMI>

</EssentialProperty>

</Representation>

</AdaptationSet>

<Preselection id="amip" tag="1" preselectionComponents="video am1 am2"

codecs="avc1.4D401F">

<Role schemeIdUri="urn:mpeg:dash:role:2011" value="ami" />

</Preselection>

</Period>

</MPD>

*B.4.3*

*Replace title of subclause B.4.3 (“**Use of decoding operations reduction request”)*

B.4.3 Use of decoding operations reduction

*with*

B.4.3 Use of decoding operations reduction request (DOR-Req) and decoding operation response (DOR-Resp)

*Add the following at the end of subclause B.4.3*

In response to a DOR-Req message, a decoding operations reduction response (DOR-Resp) mechanism can also be used by the remote device to notify immediately the receiver without needing to get the information from the bistream (i.e., through the corresponding SEI message). The DOR-Respmessage provides information whether the remote encoders partially or globally accept the received request., The remote encoder can also decide to reply to the request with different changes in its coding process, than the ones requested by the decoder. Thus, it further allows the receiver to further adapt its power optimization behavior according to this response.

When a DOR-Resp mechanism is used to acknowledge a request of cancellation, with a list of requested types, it contains the list of types of the requests the encoder has accepted to perform. In this case, the last requests of types corresponding to the list are cancelled.

When nb\_dec\_pow\_reduction\_type\_resp of the DOR-Resp message equal 0, the message is used to acknowledge a global cancellation of all previous decoding operation reduction requests, independently of their type. In this case, the information of image resolution and frame rate are sent to the decoder.

*Annex B*

*Add a new subclause after subclause B.5(“*Cross-segment decoding for quality recovery after low-power encoding*”)*

B.6 Interactive signalling for display power reduction through the use of Attenuation Maps

B.6.1 General

This clause explains two modes of use of Attenuation Maps for Display Adaptation.

In a first mode, it explains how a receiver device can request Attenuation Maps with specific energy reduction rates while also giving information on which processes it is capable to apply on the Attenuation Maps. It also explains how the transmitter can respond to the receiver’s request.

In a second mode, it explains how a receiver device can request the transmitter to generate a given Display Attenuation Map and to apply it on the base video to generate an Attenuated Video. This Attenuated Video will then be encoded and transmitted up to the receiver. It also explains how the transmitter can respond to the receiver’s request.

B.6.2 Display Attenuation Map Power Reduction Request (DAMPR-Req) and Display Attenuation Map Power Reduction Response (DAMPR-Resp).

A use case example where a receiver is notified of a low level battery is shown in Figure X.3.

In this use case example, the transmitter has announced the service#1 as a green profile service in step1.

A picture containing text, screenshot, diagram, number

Description automatically generated

Figure X.3 Display Attenuation Map Power Reduction request when a low level of battery is raised.

In step 2, the user selects the service#1 from their service list, and its Energy aware application requests for the service.

In step 3, the reception of the video data is started.

In step 4, as an example, a low battery level is raised, and the receiver decides to initiate the process of Attenuation Map Display adaptation to reduce its energy consumption.

In step 5, the Display Attenuation Map Power Reduction Request (DAMPR-Req) is sent from the receiver to the transmitter with a list of Energy Reduction Rates, and possibly with its capabilities to use and apply Attenuation Maps. The transmitter sends a Display Attenuation Map Power Reduction Response (DAMPR-Resp) to acknowledge reception of the receiver’s request, which contains a list of the Attenuation Maps corresponding to the request, that will be sent.

In step 6, Attenuation Maps and Green AMI Metadata SEI are inserted in the bitstream and the Display adaptation process is performed to reduce energy consumption of the receiver.

In step 7, the receiver decides to stop the Display Adaptation process and sends a Display Attenuation Map Power Reduction Request with a cancel flag.

When the transmitter has stopped the production of the Attenuation map(s) and the relative AMI metadata, it sends the Display Attenuation Map Power Reduction Response (DAMPR-Resp) with an Acknowledgement of the cancel request.

B.6.3 Use of the Display Attenuation Map Power Reduction Request

On reception by the transmitter of a Display Attenuation Map Power Reduction Request, the transmitter will compute Attenuation Maps corresponding to the requested energy reduction rates and compatible with the capabilities of the receiver as per their use and application on the main video bit stream (step 5).

For example, if the receiver requested two Attenuation Maps for the energy reduction rates 10% and 20% and specifies that it can only apply them through multiplication of the Attenuation Map samples values with the sample values of the luminance component of the main decoded picture, the transmitter may compute and transmit two Attenuation Maps for 10% and 20%, that should be applied by multiplication of their sample values with the luminance component of the main decoded picture.

This will enable a saving of bandwidth by sending only specific Attenuation Maps as requested by the receiver.

The strategy used by the encoder to compute the Attenuation Maps is non normative. In the above use case, the transmitter may only transmit one single Attenuation Map which corresponds to the receiver’s request, for example for the energy reduction rate 10%, in case it is not capable of computing an Attenuation Map with the energy reduction rate of 20%. In this case, it will send a Display Attenuation Map Power Response (DAMPR-Resp) with information on only one Attenuation Map for 10%.

B.6.4 Display Power Reduction Attenuated Video Request (DPRAV-Req) and Display Power Reduction Attenuated Video Response (DPRAV-Resp).

Figure X.4 describes a use case example where the receiver has been notified by a low level of battery:



Figure X.4: Display Power Request Attenuated Video request when a low battery level is raised.

In step 1, the transmitter announces the service#1 as a green profile service.

In step 2, the user selects the service#1 from his service list, the Energy aware application request for the service and in step 3, the reception of the video data is started.

In step 4, as an example, a low battery level is raised and the receiver decides to initiate the process of Display adaptation to reduce its energy consumption.

In step 5, the Display Power Reduction Attenuated Video Request is sent from the receiver to the transmitter with an energy reduction rate and/or a video quality reduction expected value(s).

In step 6, a Display Attenuation Map is produced and applied to the video content. The Attenuated Video content is then inserted in the bitstream with the Green Metadata SEI. The bitstream is received by the receiver and the video content is rendered on the display.

In step 7, the receiver decides to stop the Display Adaptation Attenuated Video process and send a Display Power Reduction Attenuated Video Request with CANCEL flag.