|  |  |
| --- | --- |
| **Joint Collaborative Team on Video Coding (JCT-VC)**  **of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11**  8th Meeting: San José, CA, USA, 1–10 February, 2012 | Document: JCTVC-G0512 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Title:* | **APS fragmentation** | | |
| *Status:* | Input Document to JCT-VC | | |
| *Purpose:* | Proposal | | |
| *Author(s) or Contact(s):* | Ying Chen  Ye-Kui Wang  Rajan Joshi  Marta Karczewicz  5775 Morehouse Dr San Diego, CA 92121 USA | Tel: Email: | 1-858-845-6589 [cheny@qualcomm.com](mailto:cheny@qualcomm.com)  1-858-651-8345 [yekuiw@qualcomm.com](mailto:yekuiw@qualcomm.com)  1-858-658-4511 [rajanj@qualcomm.com](mailto:rajanj@qualcomm.com)  1-858-658-5673 [martak@qualcomm.com](mailto:martak@qualcomm.com) |
| *Source:* | Qualcomm Incorporated | | |

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

# Abstract

This is a follow-up proposal of JCTVC-G658. In JCTVC-G658, it was proposed that the quantization matrices are signaled in the Adaptation Parameter Set (APS). To solve the problem that an APS can be larger than the Maximum Transmission Unit (MTU) size, it was proposed that the APS may be fragmented into multiple NAL units, each of which can be independently parsed and applied. The problem was confirmed to be a valid problem at the previous meeting. In this proposal, the same idea is proposed again based on the updated syntax elements support for the quantization matrix signaling in the APS, such that an APS, if it contains information for quantization matrix, may contain only a number of quantization matrices.

# Introduction

Creation of a new type of NAL unit was proposed in JCTVC-F907 to signal quantization matrices. In the current HEVC design, six quantization matrices are needed for size 4×4, 8×8 or 16×16, and two matrices are needed for size 32×32.

Using the current enabled methods to signal all the 20 quantization matrices may require up to 2408 bytes for lossless coding if the each matrix is asymmetric. Thus, even when using efficient compression methods, it may not be feasible to fill the data corresponding to the quantization matrices into a single NAL unit of sufficiently small size, in bytes, such that the entire NAL unit can be encapsulated in one transmission unit (e.g., an RTP packet) without being framed by underlying transmission protocols. Such a framing of a NAL unit, e.g. an Adaptation Parameter Set (APS) NAL unit would result in received pieces of the framed NAL unit being useless when a single piece gets lost. Such framing typically happens when the transmission unit size is larger than the Maximum Transmission Unit (MTU) size of the end-to-end transmission path. For example, the MTU size of the Ethernet at the network layer (and hence over most of the Internet) is 1500 bytes. The MTU size of end-to-end transmission path involving wireless networks can be significantly smaller, e.g., 200 to 300 bytes.

To overcome this problem, a fragmentation mechanism is proposed to fragment one APS that contains quantization matrix into multiple NAL units, thus making the design more error resilient, in the sense that any received piece of the quantization matrix parameters is useful regardless of whether other pieces are received.

In JCTVC-G1016, it is agreed that the APS syntax is extended for the signaling of quantization matrix. The syntax table of the APS is as follows:

### Adaptation parameter set RBSP syntax

|  |  |
| --- | --- |
| aps\_rbsp( ) { | Descriptor |
| **aps\_id** | ue(v) |
| **aps\_scaling\_list\_data\_present\_flag** | u(1) |
| **aps\_sample\_adaptive\_offset\_flag** | u(1) |
| **aps\_adaptive\_loop\_filter\_flag** | u(1) |
| if( aps\_scaling\_list\_data\_present\_flag ) |  |
| scaling\_list\_param( ) |  |
| if( aps\_sample\_adaptive\_offset\_flag ) |  |
| sao\_param( ) |  |
| if( aps\_adaptive\_loop\_filter\_flag ) |  |
| alf\_param( ) |  |
| **aps\_extension\_flag** | u(1) |
| if( aps\_extension\_flag ) |  |
| while( more\_rbsp\_data( ) ) |  |
| **aps\_extension\_data\_flag** | u(1) |
| rbsp\_trailing\_bits( ) |  |
| } |  |

As noted in JCTVC-G1016, in the BoG on APS, it was agreed to recommend to JCT-VC to include a tool that allows MTU size matching for parameter sets and especially for the APS, if there is an expectation that a parameter set may become larger than commonly used MTU sizes.

# Proposal

## Syntax

### Adaptation parameter set RBSP syntax

|  |  |
| --- | --- |
| aps\_rbsp( ) { | Descriptor |
| **aps\_id** | ue(v) |
| **aps\_scaling\_list\_data\_present\_flag** | u(1) |
| **aps\_sample\_adaptive\_offset\_flag** | u(1) |
| **aps\_adaptive\_loop\_filter\_flag** | u(1) |
| if( aps\_scaling\_list\_data\_present\_flag ) { |  |
| **first\_aps\_fragment\_flag** | u(1) |
| **last\_aps\_fragment\_flag** | u(1) |
| scaling\_list\_param( ) |  |
| } |  |
| if( aps\_sample\_adaptive\_offset\_flag ) |  |
| sao\_param( ) |  |
| if( aps\_adaptive\_loop\_filter\_flag ) |  |
| alf\_param( ) |  |
| **aps\_extension\_flag** | u(1) |
| if( aps\_extension\_flag ) |  |
| while( more\_rbsp\_data( ) ) |  |
| **aps\_extension\_data\_flag** | u(1) |
| rbsp\_trailing\_bits( ) |  |
| } |  |

### Scaling list data syntax

|  |  |
| --- | --- |
| scaling\_list\_param( ) { | Descriptor |
| **use\_default\_scaling\_list\_flag** | u(1) |
| if( !use\_default\_scaling\_list\_flag ) |  |
| if( !first\_aps\_fragment\_flag **)** |  |
| **start\_matrix\_id** | ue(v) |
| if( !last\_aps\_fragment\_flag ) |  |
| **num\_matrix\_minus1** | ue(v) |
| for( mId=0, SizeID = 0; SizeID < 4; SizeID++ ) |  |
| for( MatrixID = 0; MatrixID < (SizeID = = 3) ? 2:6; MatrixID++, mId++ ) { |  |
| if( mId >= start\_matrix\_id | |   mId <= start\_matrix\_id + num\_matrix\_minus1 ) { |  |
| **pred\_mode\_flag** | u(1) |
| if( !pred\_mode\_flag ) |  |
| **pred\_matrix\_id\_delta** | ue(v) |
| else |  |
| scaling\_list( QuantMatrix[ SizeID ][ MatrixID ],  ( 1 << ( 4 + ( SizeID << 1) ) ) ) |  |
| } |  |
| } |  |
| } |  |

## Semantics

### Adaptation parameter set RBSP semantics

**first\_aps\_fragment\_flag** equal to 1 specified that the APS fragment NAL unit is the first APS fragment NAL unit of the APS identified by aps\_id. This syntax element equal to 0 specified that the APS fragment NAL unit is not the first APS fragment NAL unit of the APS identified by aps\_id.

**last\_aps\_fragment\_flag** equal to 1 specified that the APS fragment NAL unit is the last APS fragment NAL unit of the APS identified by aps\_id. This syntax element equal to 0 specified that the APS fragment NAL unit is not the last APS fragment NAL unit of the APS identified by aps\_id.

When first\_aps\_fragment\_flag and last\_aps\_fragment\_flag are both equal to 1, the APS identified by aps\_id contains only one APS fragment.

### Scaling list data semantics

**start\_matrix\_id** specifies the identifier of the first quantization matrix signalled in the scaling list data. When not present, the value of this syntax element shall be inferred to be equal to 0.

**num\_matrix\_minus1** plus 1 specifies the number of quantization matrices signalled in the scaling list data. When not present, the value of this syntax element is inferred to be equal to 19 – start\_matrix\_id.

# Discussions

Different parameters, e.g., ALF, SAO or quantization matrix may be put into an APS. An APS might contain only one specific type of parameters thus the APSs can be categorized.

Avoiding containing parameters of multiple categories can also decrease the size of the APS. Therefore, we think that in the current HEVC design, inclusion of a mechanism for fragmentation of only quantization matrix data in an APS is sufficient to solve the MTU size matching problem.

# Patent rights declaration(s)

**Qualcomm Incorporated may have current or pending patent rights relating to the technology described in this contribution and, conditioned on reciprocity, is prepared to grant licenses under reasonable and non-discriminatory terms as necessary for implementation of the resulting ITU-T Recommendation | ISO/IEC International Standard (per box 2 of the ITU-T/ITU-R/ISO/IEC patent statement and licensing declaration form).**