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**Information technology — High
efficiency coding and media delivery
in heterogeneous environments —**

**Part 1:
MPEG media transport (MMT)**

**AMENDMENT 1: Additional technologies
for MPEG Media Transport (MMT)**

*Technologies de l'information — Codage à haute efficacité et livraison
des médias dans des environnements hétérogènes —*
Partie 1: Transport des médias MPEG

*AMENDEMENT 1: Technologies supplémentaires pour le transport
des médias MPEG*

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/IEC JTC 1, *Information technology, SC 29, Coding of audio, picture, multimedia and hypermedia information*.

ISO/IEC 23008 consists of the following parts, under the general title *Information technology — High efficiency coding and media delivery in heterogeneous environments*:

- *Part 1: MPEG media transport (MMT)*
- *Part 2: High efficiency video coding (HEVC)*
- *Part 3: 3D Audio*
- *Part 5: HEVC Conformance testing and reference software*
- *Part 8: Conformance Specification for HEVC*
- *Part 10: MPEG Media Transport Forward Error Correction (FEC) codes*
- *Part 11: MPEG Media Transport Composition Information*
- *Part 12: Image file format*
- *Part 13: MMT Implementation Guidelines*

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Information technology — High efficiency coding and media delivery in heterogeneous environments —

Part 1: MPEG media transport (MMT)

AMENDMENT 1: Additional technologies for MPEG Media Transport (MMT)

The following instructions apply to the (re-organized) first edition of ISO 23008-1.

Add the following definitions to 3.1, suitably numbered.

3.1.33 asset delivery characteristics

description about required Quality of Service (QoS) for delivery of Assets. ADC is represented by the parameters agnostic to specific delivery environment.

Add the following abbreviated terms to 3.2, suitably numbered

ADC asset delivery characteristics

ARQ automatic repeat request

In 5.2, amend the 1st paragraph to read as follows.

As shown in Figure 4, a Package is a logical entity. A Package shall contain one or more presentation information documents such as one specified in ISO 23008-11, one or more Assets and for each Asset an associated Asset Delivery Characteristics (ADC). In other words, as processing of a Package is applied per MPU basis and an Asset is a collection of one or more MPUs that share the same Asset ID. It can be also considered that one Package is composed of one Presentation Information, one or more MPUs and associated ADC for each Asset.

In 5.2.1, replace Figure 4 with the following figure.

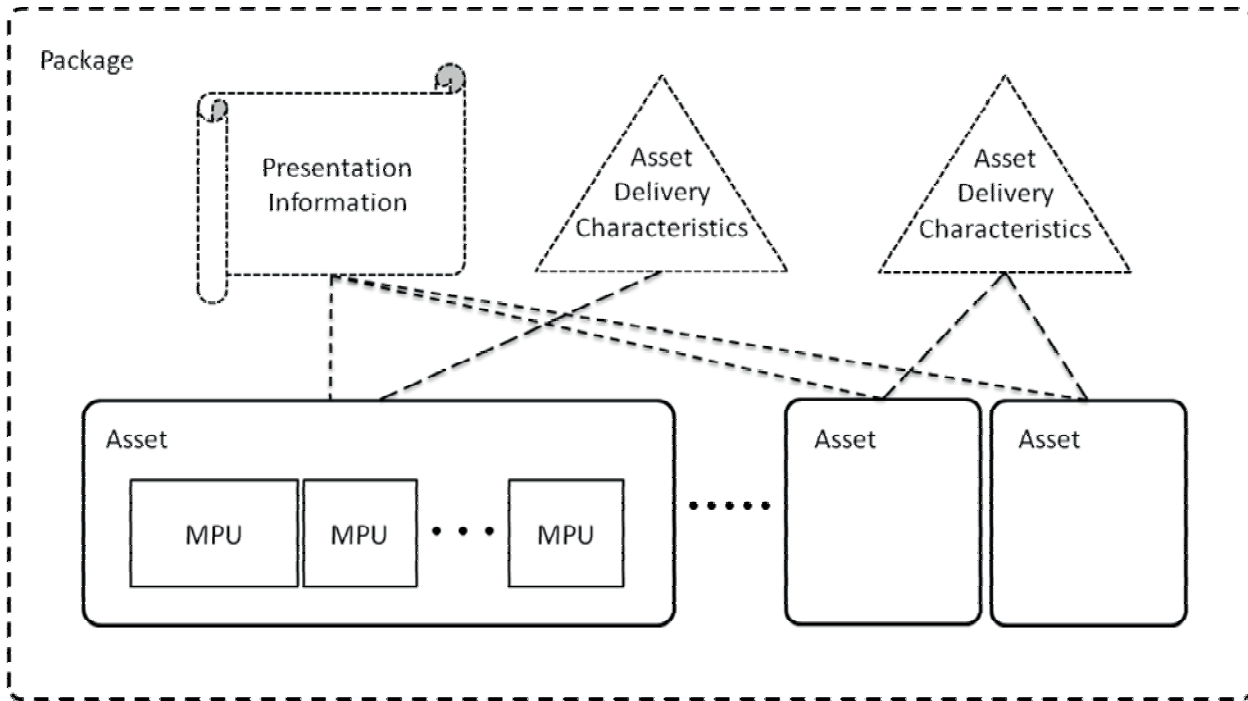


Figure — AMD1.1 — Overview of package
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In 5.2, insert the following paragraph after the one beginning in "Presentation Information (PI) document specify ...".

ISO/IEC 23008-1:2014/Amd 1:2015

<https://standards.itech.ai/catalog/standards/sist/32bafaa5-1de9-4c0e-ae7d-4c20ca2476/iso-iec-23008-1-2014-amd-1-2015>

Asset Delivery Characteristics (ADC) shall provide the required QoS information for transmission of Assets. Multiple Assets can be associated with a single ADC. However a single Asset shall not be associated with multiple ADCs. This information can be used by the entity packetizing the Package to configure the fields of the MMTP payload header and MMTP packet header for efficient delivery of the Assets.

Add the following sub-clause as 5.5.

5.5 Asset delivery characteristics

5.5.1 Introduction

The Asset Delivery Characteristics (ADC) describes the QoS requirements and statistics of Assets for delivery. Each Asset in a Package shall be associated with an ADC. The ADC for each Asset is used by an MMT sending entity to derive the appropriate QoS parameters and the transmission parameters to which a resource reservation and a delivery policy may apply. The ADC is represented in a protocol agnostic format to be generally used by QoS control service entity defined by other standard development organizations, such as IETF, 3GPP, IEEE, etc. It consists of a `QoS_descriptor` element and a `bitstream_descriptor` element. ADC is an XML file that conforms to the schema in section 5.5.3. The MIME type of ADC is defined as Annex H.

5.5.2 ADC Descriptors

5.5.2.1 QoS descriptor

The `QoS_descriptor` element defines required QoS levels on delay and loss for Asset delivery. It consists of `loss_tolerance` attribute, `jitter_sensitivity` attribute, `class_of_service` attribute and `bidirection_indicator` attribute.

5.5.2.2 Bitstream descriptor

The `bitstream_descriptor` element provides the statistics of Asset. It provides the parameters to implement token bucket traffic shaping such as sustainable rate and buffer size. In addition, peak rate and maximum MFU size represent burstiness of Asset as shown in Figure AMD1. 2., where burstiness is defined as a ratio between a `peak_rate` and `sustainable_rate`.

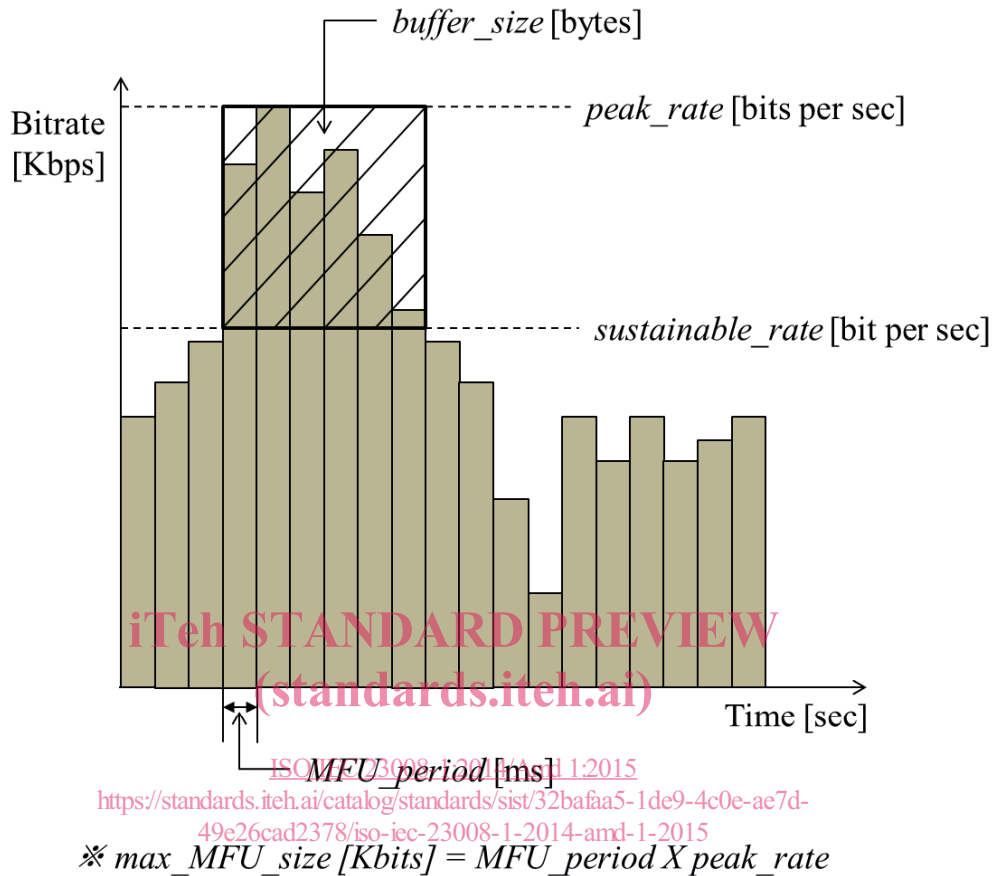


Figure — AMD1.2 — The `bitstream_descriptor` depicted for a variable bit-rate of Asset

5.5.3 Syntax

```

<complexType name="AssetDeliveryCharacteristic">
  <sequence>
    <element name="QoS_descriptor" type="mmt:QoS_descriptorType" />
    <element name="Bitstream_descriptor" type="mmt:Bitstream_descriptorType"/>
  </sequence>
</complexType>

<complexType name="QoS_descriptorType">
  <attribute name="loss_tolerance" type="integer"/>
  <attribute name="jitter_sensitivity" type="integer"/>
  <attribute name="class_of_service" type="boolean"/>
  <attribute name="bidirection_indicator" type="boolean"/>
</complexType>

<complexType name="Bitstream_descriptorType">
  <choice>
    <complexType name="Bitstream_descriptorVBRType">
      <attribute name="sustainable_rate" type="float"/>
      <attribute name="buffer_size" type="float"/>
      <attribute name="peak_rate" type="float"/>
      <attribute name="max_MFU_size" type="integer"/>
      <attribute name="mfu_period" type="integer"/>
    </complexType>
  </choice>
</complexType>

```

```

<complexType name="Bitstream_descriptorCBRType">
  <attribute name="peak_rate" type="float"/>
  <attribute name="max_MFU_size" type="integer"/>
  <attribute name="mfu_period" type="integer"/>
</complexType>
</choice>
</complexType>

```

5.5.4 Semantics

loss_tolerance — indicates required loss tolerance of the Asset for the delivery. The value of loss_tolerance attribute is listed in Table AMD1.1.

Table — AMD1.1 — Value of loss_tolerance attribute

Value	Description
0	This Asset requires lossless delivery
1	This Asset allows lossy delivery

jitter_sensitivity — indicates required jitter level of underlying delivery network for the Asset delivery between end-to-end. The value of jitter_sensitivity attribute is listed in Table AMD1.2.

Table — AMD1.2 — Value of jitter_sensitivity attribute

Value	Description
0	This Asset requires the preserve time variation between MMTP packets
1	This Asset doesn't require the preserve time variation between MMTP packets.

class_of_service — classifies the services in different classes and manage each type of bitstream with a particular way. For example, Media Aware Network Element (MANE) can manage each type of bitstream with a particular way. This field indicates the type of bitstream attribute as listed in Table AMD1.3.

Table — AMD1.3 — Value of class_of_service attribute

Value	Description
0	The Constant Bit Rate (CBR) service class shall guarantee peak bitrate at any time to be dedicated for transmission of the Asset. This class is appropriate for realtime services which require fixed bitrate such as VoIP without silence suppression.
1	The Variable Bit Rate (VBR) service class shall guarantee sustainable birate and allow peak bitrate for the Asset with delay constraints over shared channel. This class is appropriate for most realtime services such as video telephony, video conferencing, streaming service, etc.

Bidirection_indicator — If set to '1', bidirectional delivery is required. If set to '0', bidirectional delivery is not required.

Bitstream_descriptorVBRTYPE — when class_of_service is '1', "Bitstream_descriptorVBRTYPE" shall be used for "Bitstream_descriptorType".

Bitstream_descriptorCBRTYPE — when class_of_service is '0', "Bitstream_descriptorCBRTYPE" shall be used for "Bitstream_descriptorType".

sustainable_rate — defines the minimum bitrate that shall be guaranteed for continuous delivery of the Asset. The sustainable_rate corresponds to drain rate in token bucket model. The sustainable_rate is expressed in bits per second.

`buffer_size` — defines the maximum buffer size for delivery of the Asset. The buffer absorbs excess instantaneous bitrate higher than the `sustainable_rate` and the `buffer_size` shall be large enough to avoid overflow. The `buffer_size` corresponds to bucket depth in token bucket model. `Buffer_size` of a CBR (constant bit rate) Asset shall be zero. The `buffer_size` is expressed in bytes.

`peak_rate` — defines peak bitrate during continuous delivery of the Asset. The `peak_rate` is the highest bitrate during every `MFU_period`. The `peak_rate` is expressed in bits per second.

`MFU_period` — defines period of MFUs during continuous delivery of the Asset. The `MFU_period` is measured as the time interval of sending time between the first byte of two consecutive MFUs. The `MFU_period` is expressed in millisecond.

`max_MFU_size` — indicates the maximum size of MFU, which is `MFU_period*peak_rate`. The `max_MFU_size` is expressed in byte.

Add the following subclause as 5.6.

5.6 Bundle delivery characteristics

5.6.1 Introduction

The Bundle Delivery Characteristics (BDC) describes the QoS requirements and statistics of Bundle for delivery. Each Bundle in a Package shall be associated with an BDC. The BDC for each Bundle is used by an MMT sending entity to derive the appropriate QoS parameters and the transmission parameters to which a resource reservation and a delivery policy may apply. The BDC is represented in a protocol agnostic format to be generally used by QoS control service entity defined by other standard development organizations, such as IETF, 3GPP, IEEE, etc. It consists of a `QoS_descriptor` element and a `bitstream_descriptor` element as defined in ADC.

5.6.2 BDC descriptors

5.6.2.1 QoS descriptor

The `QoS_descriptor` element defines required QoS levels on delay and loss for Bundle delivery. It consists of `loss_tolerance` attribute, `jitter_sensitivity` attribute, `class_of_service` attribute and `bidirection_indicator` attribute.

5.6.2.2 Bitstream descriptor

The `bitstream_descriptor` element provides the statistics of Bundle. It provides the parameters to implement token bucket traffic shaping such as sustainable rate and buffer size. In addition, peak rate and maximum MFU size represent burstiness of Bundle where burstiness is defined as a ratio between a `peak_rate` and `sustainable_rate`.

5.6.3 Syntax

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

<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" targetNamespace="mmt">
  <xs:element name="BundleDeliveryCharacteristic"
type="mmt:BundleDeliveryCharacteristicType">
  <xs:attribute name="MMT_package_id" type="xs:string"/>
  </xs:element>

  <xs:complexType name="mmt:BundleDeliveryCharacteristicType">
    <xs:sequence>
      <xs:element name="Bundle" type="mmt:BundleType"
minOccurs="1" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>

  <xs:complexType name="mmt:BundleType">
    <xs:sequence>
      <xs:element name="Element_Asset_id" type="asset_id_T" minOccurs="1">
        <xs:attribute name="Intra_Bundle_Priority" type="xs:integer"/>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
</xs:schema>
```

```

        </xs:element>
    </xs:sequence>
    <xs:element name="Bundle_QoS_descriptor" type="mmt:QoS_descriptorType"/>
    <xs:element name="Bundle_Bitstream_descriptor" type="mmt:Bitstream_
descriptorType"/>
    <xs:attribute name="Bundle_id" type="xs:integer"/>
    <xs:attribute name="Inter_Bundle_Priority" type="xs:integer"/>
</xs:complexType>
<xs:complexType name="mmt:QoS_descriptorType">
    <xs:attribute name="loss_tolerance" type="xs:integer"/>
    <xs:attribute name="jitter_sensitivity" type="xs:integer"/>
    <xs:attribute name="class_of_service" type="xs:boolean"/>
    <xs:attribute name="distortion_levels" type="xs:integer"/>
    <xs:attribute name="bidirection_indicator" type="xs:boolean"/>
</xs:complexType>

<xs:complexType name="Bitstream_descriptorType">
    <xs:choice>
        <xs:complexType name="Bitstream_descriptorVBRType">
            <xs:attribute name="sustainable_rate" type="xs:float"/>
            <xs:attribute name="buffer_size" type="xs:float"/>
            <xs:attribute name="peak_rate" type="xs:float"/>
            <xs:attribute name="max_MFU_size" type="xs:integer"/>
            <xs:attribute name="mfu_period" type="xs:integer"/>
        </xs:complexType>
        <xs:complexType name="Bitstream_descriptorCBRTType">
            <xs:attribute name="peak_rate" type="xs:float"/>
            <xs:attribute name="max_MFU_size" type="xs:integer"/>
            <xs:attribute name="mfu_period" type="xs:integer"/>
        </xs:complexType>
    </xs:choice>
</xs:complexType>
</xs:choice>
</xs:complexType>
</xs:schema>
</xml>

```

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5.6.4 Semantics

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loss_tolerance — indicates required loss tolerance of the Bundle for the delivery. The value of loss_tolerance attribute is listed in Table AMD1.1.

Table — AMD1.4 — Value of loss_tolerance attribute

Value	Description
0	This Bundle requires lossless delivery
1	This Bundle allows lossy delivery

jitter_sensitivity — indicates required jitter level of underlying delivery network for the Bundle delivery between end-to-end. The value of jitter_sensitivity attribute is listed in Table AMD1.2.

Table — AMD1.5 — Value of jitter_sensitivity attribute

Value	Description
0	This Bundle requires the preserve time variation between MMT protocol packets
1	This Bundle doesn't require the preserve time variation between MMT protocol packets.

class_of_service — classifies the services in different classes and manage each type of bitstream with a particular way. For example, MANE can manage each type of bitstream with a particular way. This field indicates the type of bitstream attribute as listed in Table AMD1.3.

Table — AMD1.6 — Value of `class_of_service` attribute

Value	Description
0	The Constant Bit Rate (CBR) service class shall guarantee peak bitrate at any time to be dedicated for transmission of the Bundle. This class is appropriate for realtime services which require fixed bitrate such as VoIP without silence suppression.
1	The Variable Bit Rate (VBR) service class shall guarantee sustainable bitrate and allow peak bitrate for the Bundle with delay constraints over shared channel. This class is appropriate for most realtime services such as video telephony, videoconferencing, streaming service, etc.

`Bidirection_indicator` — If set to '1', bidirectional delivery is required. If set to '0', bidirectional delivery is not required.

`Bitstream_descriptorVBRType` — when `class_of_service` is '1', "Bitstream_descriptorVBRType" shall be used for "Bitstream_descriptorType".

`Bitstream_descriptorCBRType` — when `class_of_service` is '0', "Bitstream_descriptorCBRType" shall be used for "Bitstream_descriptorType".

`sustainable_rate` — defines the minimum bitrate that shall be guaranteed for continuous delivery of the Asset. The `sustainable_rate` corresponds to drain rate in token bucket model. The `sustainable_rate` is expressed in bytes per second.

`buffer_size` — defines the maximum buffer size for delivery of the Bundle. The buffer absorbs excess instantaneous bitrate higher than the `sustainable_rate` and the `buffer_size` shall be large enough to avoid overflow. The `buffer_size` corresponds to bucket depth in token bucket model. `Buffer_size` of a CBR (constant bit rate) Bundle shall be zero. The `buffer_size` is expressed in bytes

`peak_rate` — defines peak bitrate during continuous delivery of the Bundle. The `peak_rate` is the highest bitrate during every `MFU_period`. The `peak_rate` is expressed in bytes per second.

`MFU_period` — defines period of MFUs during continuous delivery of the Bundle. The `MFU_period` measured as the time interval of sending time between the first byte of two consecutive MFUs. The `MFU_period` is expressed in millisecond

`max_MFU_size` — indicates the maximum size of MFU, which is $MFU_period * peak_rate$. The `max_MFU_size` is expressed in byte.

`MMT_package_id` — this field is a unique identifier of the Package. This BDC describes delivery characteristics of all the possible Bundles within the scope of this package.

`Element_Asset_id` — identifier of asset which is an element of current bundle

`Bundle_id` — identifier of bundle which distinguish bundles within the package.

`Intra_Bundle_Priority` — defines the relative priority level among assets within a bundle, which ranges from 0(highest) to 12(lowest).

`Inter_Bundle_Priority` — defines the relative priority level among bundles, which ranges from 0(highest) to 12(lowest).

In 6.3.1, insert the following sentence in last sentence of the paragraph.

When it is required to store the ADC together with MPU, it shall be stored in the 'meta' box at the file level and its presence shall be indicated through the 'is_adc_present' flag and the MIME type of the item that stores the ADC.

Replace the following syntax in 6.3.2.

```
aligned(8) class MPUBox
  extends FullBox('mmpu', version, 0){
  unsigned int(1) is_complete;
  unsigned int(1) is_adc_present;
  unsigned int(6) reserved;
  unsigned int(32) mpu_sequence_number;
  AssetIdentifierBox();
}
```

Add the following semantics in 6.3.3.

`is_adc_present` — indicates whether the ADC is present as an XML box in a 'meta' box. The MIME type of the ADC file as defined Annex H shall be indicated in an item information box 'inf'.

Replace the following sentence in the 2nd paragraph in 8.1

The MMT protocol is an application layer transport protocol supporting delivery of Packages over heterogeneous packet-switched delivery networks, including IP-based network environments. The MMT protocol provides enhanced features for delivery of Packages such as protocol level multiplexing, which for example enables various Assets to be delivered over a single MMTP packet flow, and delivery timing model independent of presentation time to adapt to a wide range of network jitters

with the following sentence:

The MMT protocol is an application layer transport protocol supporting delivery of Packages over heterogeneous packet-switched delivery networks, including IP-based network environments. The MMT protocol provides enhanced features for delivery of Packages such as protocol level multiplexing, which for example enables various Assets to be delivered over a single MMTP packet flow, and delivery timing model independent of presentation time to adapt to a wide range of network jitters, and information to support Quality of Service (QoS).

In 8.2.1, replace the following sentence in the first paragraph

It supports several enhanced features, such as media multiplexing and network jitter calculation..

with the following sentence:

It supports several enhanced features, such as media multiplexing, network jitter calculation, and QoS indication.

In 8.2.1, add the following paragraph after the last paragraph.

MMT protocol provides priority related information to enable underlying network layers or the intermediate network entities to map the priority information in MMTP packet header such as `type_of_bitrate`, `delay_sensitivity`, `transmission_priority` and `flow_label` to the network protocol according to predetermined priority mapping policy. When DiffServ [RFC2474] is used, this priority information may be used to set the 6-bit DSCP value of the DS field in the IP header. The underlying network entity supporting Diffserv shall then process the IP packets according to the mapping defined by the priority related information in MMTP packet header.