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

Part 13: MMT implementation guidance

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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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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This third edition cancels and replaces the second edition (ISO/IEC 23008-13:2017), which has been technically revised. The main changes compared to the previous edition are as follows:

— Guidance added to show how the MMT protocol can transmit media streams adaptively to environment changes such as network congestions, while also minimizing service quality degradation.

— Guidance added to describe the scenario in which MMT and MPEG-2 TS are used as transport schemes in broadband networks and broadcast channels, respectively.

— Guidance added for constraints on signalling splicing points that are specified for changing points or splicing points on MMT assets.

— Application Layer Forward Error Correction (AL-FEC) guidance added to describe the usage of Rate-Adaptive AL-FEC, Layer-Aware (LA) FEC coding structure and FEC scheme for interleaved source symbol block.

— Broadcasting MMT deployment guidance added to describe the implementation of MMT based on D-TMB in China and MMT Deployment in ATSC 3.0 systems.

— MMT deployment guidance added to show the usage of MMT signalling for multiple timed text assets and for the viewport-dependent baseline media profile with packed streaming for VR.

— MMT developments in mobile environments guidance added to describe the usage of true real time video streaming over lossy channels, dynamic asset change, and media adaptation for quality control.

— MMT developments in mobile environments guidance added to describe the usage of signalling messages for supporting Package retransmission and dynamic media resource allocation.

A list of all parts in the ISO/IEC 23008 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document provides guidance for implementation and deployment of multimedia systems based on ISO/IEC 23008-1. These document include the following:

— Guidance on usage of MMT functions;

— Guidance on deployment use cases designed based on ISO/IEC 23008-1.

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Part 13: MMT implementation guidance

1 Scope

This document provides guidance for implementing and deploying systems based on ISO/IEC 23008-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 23008-1:2017, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 1: MPEG media transport (MMT)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 23008-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 General overview of MPEG media transport

4.1 System overview

This clause describes the exemplary but typical system overview of MPEG media transport (MMT) as shown in Figure 1.

The media origin provides A/V media or generic files to MMT sending entity in the form of packages or assets which are defined in ISO/IEC 23008-1. A package is comprised of assets, presentation information and transparent characteristics, etc. physically, an asset is a group of MPUs or generic files.

The MMT sending entity fragments MPU/generic files and generates MMTP packets to deliver A/V media data itself. Concurrently, it also generates signalling message for the successful delivery and presentation of A/V media included on that MMTP packet flow.

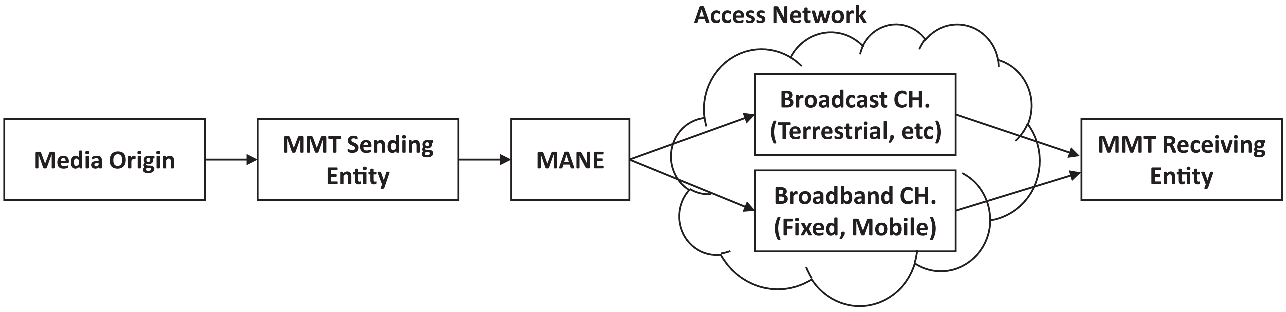

Figure 1 — Example of MMT-based media distribution chain

The MMT aware network element (MANE) may be any network element, such as, media caches and routers, that aware of MMTP and has augmented functions for its own purposes to utilize tools from MMT.

Then, MMTP packets can be transmitted through either or both of broadcast channel and broadband channel at its own environment and scenarios.

The CI information provides presentation information, such as the location of media objects as well as the timing and relation of the media objects that the MMT receiving entity has to follow. This information is provided by the MMT sending entity and also pushes related MMTP packet flow to the MMT receiving entity. It means it fully controls the media streaming session, i.e., it manages the on-time delivery, playback and temporal/spatial presentation information of the media.

4.2 Tools specified in ISO/IEC 23008-1

ISO/IEC 23008-1 specifies a set of tools to enable advanced media transport and delivery services. Figure 2 depicts the end-to-end architecture and illustrates the different functional tools and their relationships. Moreover, it shows interfaces between existing protocols and standards defined by ISO/IEC 23008-1 and those defined in other specifications. The tools spread over three different functional areas: media processing unit (MPU) format; delivery; and signalling defined in ISO/IEC 23008-1 as follows:

— The media processing unit (MPU) defines the logical structure of media content format of the data units to be processed by an MMT entity and their instantiation with ISO base media file format as specified in ISO/IEC 14496-12.

— The delivery function defines an application layer transport protocol and a payload format. The MMTP transport protocol provides enhanced features for delivery of multimedia data, e.g., multiplexing and support of mixed use of streaming and download delivery in a single packet flow. The payload format is defined to enable the carriage of encoded media data which is agnostic to media types and encoding methods.

— The signalling function defines formats of signalling messages to manage delivery and consumption of media data.

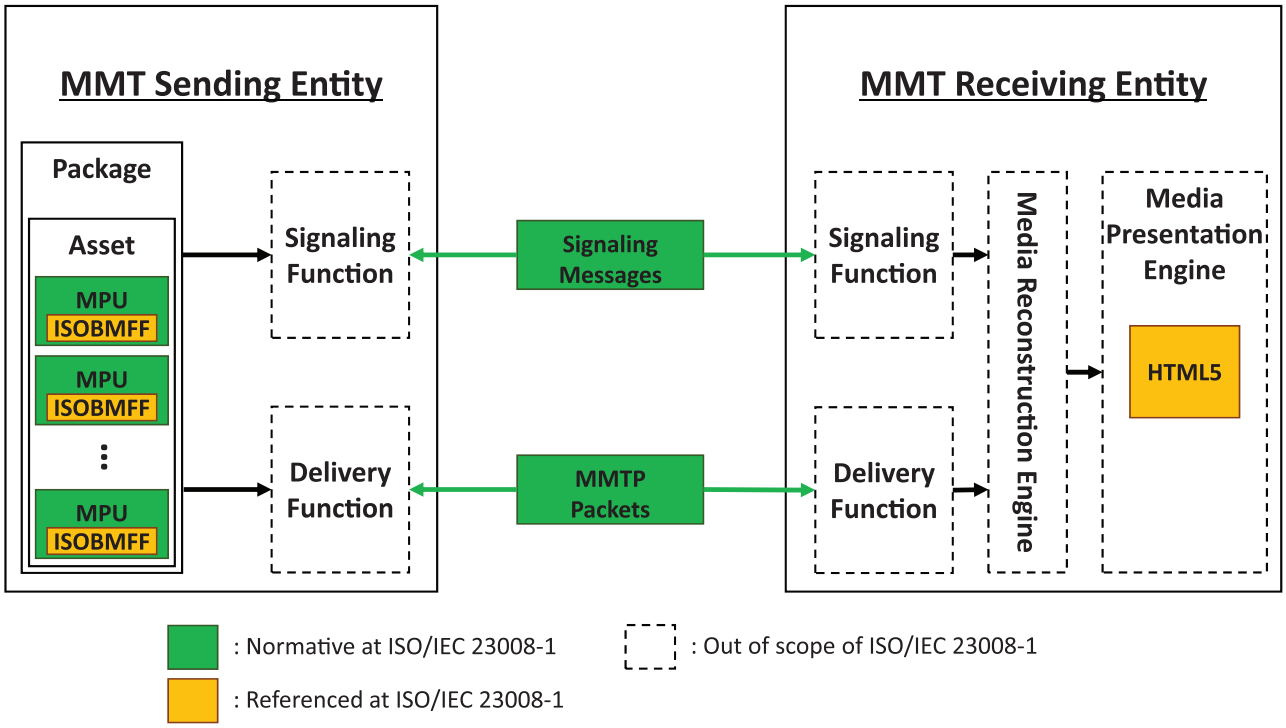

Figure 2 — MMT functions deployment

Other aspects, such as client implementations for media reconstruction and presentation itself are not defined in ISO/IEC 23008-1.

5 MMT function deployments

5.1 General

This clause gives implementation guidance on general MMT deployment based on basic functionalities provided by ISO/IEC 23008-1. In particular, it provides guidance on how to make best use of ISO/IEC 23008-1 for the basic topics such as, but not limited to;

— low delay media consumption;

— media adaptation;

— hybrid delivery;

— error recovery.

5.2 Object reconstruction

5.2.1 General

MMTP is designed to deliver object flows that may be multiplexed together in the same MMTP flow. The objects of an object flow are usually related to each other, meaning that the application is likely to consume all objects of an object flow, if the flow or one of its objects is of interest to that application.

Depending on the delivery mode, the recovery of the object may differ. The GFD mode usually requires that the full object is recovered prior to its delivery to the application. However, the application may request that correctly received contiguous byte ranges of the object are forwarded to the application.

The MPU mode is used to deliver MPUs and usually operates on movie fragments. Alternatively, the application may request that each received MFU is forwarded to the application without additional delay. It may also require that the complete MPU be reconstructed prior to forwarding it to the application.

5.2.2 Recovery in MPU mode

When operating in the MPU mode, the object flow consists of MPUs of the same asset. Each MPU is a single object in the object flow and shares the same *packet_id* as all MPUs of the same asset.

The MMT receiving entity performs the following steps:

1) Receive MMTP packet.

2) Check if *packet_id* is equal to the *packet_id* of the object flow of interest, discard packet and go to step 1 if it does not belong to an object flow of interest.

3) Assert that type of the MMTP packet is MPU.

4) If fragmentation flags are set (different than '00').

   a) If fragmentation flag is equal to '11', attempt to recover packet and if successful go to step 6.

   b) Else add packet to the list of packet fragments based on the MMTP sequence number and goto step 1.

5) If aggregation flag A is set, extract all aggregated data units and proceed to step 7 for each extracted data unit.

6) If object map with same *MPU_sequence_number* does not exist, create new object map for the MPU with that sequence number.

7) Check fragment type (FT) of the MPU payload header.

   a) If FT is MPU metadata:

      i) Check if MPU metadata is already received:

         1) If yes, discard the MPU metadata as being a duplicate;

         2) Else insert MPU metadata at the beginning of the object map:

            a. Optionally, forward MPU metadata to application.

      ii Go to step 1.

   b) If FT is fragment metadata:

      i) Check if movie fragment with the same *movie_fragment_sequence_number* already exists:

         1) If no, create a placeholder for the movie fragment in the object map.

         2) Else, check if fragment metadata has already been received:

            a) If yes, discard fragment metadata as being a duplicate;

            b) Otherwise, insert fragment metadata at the beginning of the fragment placeholder.

         3) Go to step 1.

c) If FT is MFU:

i) If fragment placeholder with sequence number *movie_fragment_sequence_number* does not exist in the object map of the MPU with sequence number *MPU_sequence_number*, then create movie fragment placeholder in the object map of the MPU.

ii) If timed metadata flag is set:

1) Insert payload in the fragment placeholder in the correct order based on the sample_ number and offset values.

2) Check if movie fragment is complete.

a) If yes, forward fragment to the application.

3) Go to step 1.

iii) If timed metadata flag is not set:

1) Insert payload in the item in the object map based on the item item_ID.

2) Recover item information from MPU metadata for the recovered item and forward the item to the application.

3) Go to step 1.

The sender may send the movie fragment out of order, i.e. sending the movie fragment header after sending all the media units that are contained in that movie fragment. At the receiver side, step 7)c) i) ensures that the movie fragment is recovered appropriately by reordering the received data using the *MPU_sequence_number* and the *movie_fragment_sequence_number*. This is necessary if the receiver is operating in the fragment mode or MPU mode, where only complete movie fragments or complete MPUs are forwarded to the application. When operating in the very low delay mode, the receiver will forward every single MFU to the application. In this case, it has to make sure that the content supports this operation, so that MFUs will be self-describing and self-contained. In particular, the receiver should be able to recover the presentation timestamp of that MFU payload using the sample number, *fragment_ sequence_number*, and *MPU_sequence_number*.

For fragments and items that cannot be recovered correctly by the time the fixed end to end delivery delay passes, error concealment is performed on the movie fragment or the partially recovered item.

An MFU may be fragmented by multiple fragments and the total number of fragments can be larger than the range which the fragment counter can present. It can be recognized by using the fragmentation indicator and the fragment counter. In this case, the fragmentation indicator (f_i) indicates that the received payload is neither the first nor the last fragment (which finally corresponds to value of '10'), but at the same time the fragment counter (*frag_count*) specifies that there is no succeeding MMTP payload (value of '0') containing fragments of same data unit. So the receiver can notice that the fragment counter is fully used but, after reaching 0, it will roll over and be reused. This is the way to provide information that an MFU is packetized by the larger number of fragments than the maximum number of fragment counter can present and to count that number. Figure 3 describes the operation.

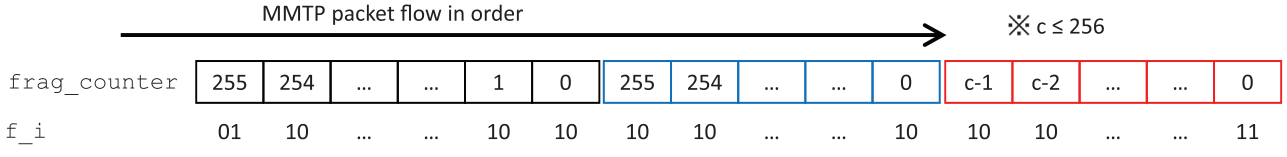

Figure 3 — Fragment counter and fragmentation indicator changes for 513~768 fragments