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Information technology — Coded representation of immersive media —

Part 8:
Network based media processing

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Foreword

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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.*

A list of all parts in the ISO/IEC 23090 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.

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Introduction

This document defines a framework that enables initializing and controlling media processing in a network. A network-based media processing (NBMP) source describes the requested media processing and provides information about the nature and format of the media data. Based on that, an NBMP workflow manager establishes the media processing workflow and informs the NBMP source that the workflow is ready, and that media processing can start. The media source(s) can then start transmitting their media to the network for processing.

An NBMP workflow can be understood as a connected graph of media processing tasks, each of which performs a well-defined media processing operation. The workflow manager ensures the correct operation of the workflow by configuring and monitoring each task as well as the workflow output. The workflow manager is responsible for the selection of the media processing functions and instantiating them as tasks based on the workflow description that is received from the NBMP source.

NBMP abstracts the underlying computing platform interactions to establish, load, instantiate and monitor the media processing entities that will run the media processing tasks. NBMP defines application programming interfaces (APIs) between an NBMP source and workflow manager; workflow manager and task(s); and an API to discover appropriate function(s). NBMP is media format and protocol agnostic. However, it identifies and signals the media, metadata and auxiliary information formats for data exchanged between media source, the workflow manager and tasks.

Annex C provides schema for identifying MPEG compatible functions.

Annex E provides an interface for managing function descriptions in function repository.

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Information technology — Coded representation of immersive media —

Part 8:
Network-based media processing

1 Scope

The network-based media processing (NBMP) framework defines the interfaces including both data formats and application programming interfaces (APIs) among the entities connected through digital networks for media processing. Users can access and configure their operations remotely for efficient, intelligent processing. This document describes and manages workflows to be applied to the media data. This process includes uploading of media data to the network, instantiation of the media processing tasks, and configuration of the tasks. The framework enables dynamic creation of media processing pipelines, as well as access to processed media data and metadata in real-time or in a deferred way. The media and metadata formats used between the media source, workflow manager and media processing entities in a media processing pipeline are also specified.

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 9899, *Information technology — Programming languages — C*

ISO/IEC 23001–7, *Information technology — MPEG systems technologies — Part 7: Common encryption in ISO base media file format files*

IETF RFC 3339:2002, *Date and Time on the Internet: Timestamps*, https://tools.ietf.org/html/rfc3339

IETF RFC 3986:2005, *Uniform Resource Identifier (URI): Generic Syntax*, https://tools.ietf.org/html/rfc3986

IETF RFC 7231, *Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content*, https://tools.ietf.org/html/rfc7231

IETF RFC 6381:2011, *The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions 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/

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3.1.1
function description
FD
logical description of the details of a NBMP function including input and output description, media processing, requirements, etc.

3.1.2
function description document
FDD
document containing function object

3.1.3
function object
FO
function description in JSON format

3.1.4
function repository
storage place where NBMP function description are retrieved from by an NBMP workflow manager or NBMP source

3.1.5
function resource
FR
REST resource identified with a URL and containing a function description document

3.1.6
media processing entity
MPE
entity that runs one or more media processing task(s)

3.1.7
media sink
entity that consumes the output of the NBMP workflow through existing delivery methods

3.1.8
media source
entity that provides media content to the NBMP workflow to be processed

3.1.9
NBMP function
implementation of a standalone and self-contained media processing operation and the corresponding description of that operation

3.1.10
NBMP descriptor
a group of NBMP parameters which describe a set of related characteristics of workflow, function or task

3.1.11
NBMP parameter
variable expressing a characteristic of workflow, function or task

3.1.12
NBMP source
entity that describes media processing in the network

3.1.13
NBMP system
system for processing media across one or more processing entities in the network and consisting of media source (s), a NBMP source, a NBMP workflow manager, a function repository, media processing entity(ies) and media sink(s)

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3.1.14
NBMP workflow
graph of one or more connected task(s) that achieve the requested media processing

3.1.15
NBMP workflow manager
entity that provisions tasks and connects them to create, control, manage and monitor a complete NBMP workflow based on a workflow description document

3.1.16
port
logic input and output endpoints by specifying where the data comes in and out

3.1.17
port mapping
PM
data structure used to make references for NBMP function ports to the workflow input and output streams, especially to dynamic inputs and outputs

3.1.18
stream ID
unique string for identifying an input or output stream of workflow/function/task

3.1.19
supplementary information
metadata or auxiliary information related to the media data

3.1.20
task
runtime instance of NBMP function that gets executed inside a media processing entity

3.1.21
task description
logical description of the runtime details of a task, including input and output, requirements, configuration etc.

3.1.22
task description document
TDD
document containing task description object

3.1.23
task object
TO
task description in JSON format

3.1.24
task resource
TR
REST resource identified with an URL and containing task description document

3.1.25
workflow description
logical description of the details of the media processing including input and output description details, requested media processing, requirements etc.

3.1.26
workflow description document
WDD
document containing workflow description object

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3.1.27
workflow object
WO
workflow description in JSON format

3.1.28
workflow resource
WR
REST resource identified with an URL and containing workflow description document

3.2 Abbreviated terms

API	application programming interface
CPU	central processing unit
DAG	directed acyclic graph
DASH	dynamic adaptive streaming over HTTP
GPU	graphics processing unit
HTTP	hyper-text transfer protocol
JSON	JavaScript object notation
MMT	MPEG media transport
NBMP	network-based media processing
NVP	name value pair
PCC	point-cloud compression
RTP	real-time transport protocol
TCP	transmission control protocol
UDP	user datagram protocol
URI	uniform resource identifier
URL	uniform resource locator
URN	uniform resource name
XML	eXtensible Markup Language

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4 Conventions

The following naming convention apply in this document:

— Names comply to dash-case convention, i.e. words in a name are separated with '-'.

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— Operations, resources, documents, descriptions and descriptors are identified by an upper-case first letter. In these names, words after '-' start with an upper-case letter. All other letters are lower-case.

— Parameters and their values are identified by lower-case letters. No uppercase letter is used in these names.

— Parameter values are identified by '', e.g. 'value'.

— JSON objects comply to dash-case convention with all lower-case letters.

The following legends are used in tables:

— cardinality: 1 = exactly one, 0-1 = zero or one, 0-N = zero or more, 1-N = one or more

— P: parameter

— O: object

— N/A: not applicable

The range of "unsigned integer" is 0 to 2^{53}-1.

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5 Overview

5.1 General

The network-based media processing (NBMP) framework enables the creators, service providers and consumers of digital media to describe media processing operations that are to be performed by the media processing entities in a network, as shown in Figure 1. It provides a method to describe a workflow by composing a set of media processing functions that are accessible through NBMP application programming interfaces (APIs). A media processing entity (MPE) runs processing tasks applied on the media data and the related metadata received from media sources or other tasks. MPE provides capabilities for configuring, managing and monitoring processing tasks. A media processing task is a process applied to media and metadata input(s), producing media data and related metadata output(s) to be consumed by a media sink or other media processing tasks.

The NBMP framework is media format agnostic and supports any format of media content, including the existing MPEG codecs and MPEG formats such as ISO/IEC 13818-1 (Reference [10]), ISO/IEC 14496-12, ISO/IEC 23008-1 (Reference [12]) and ISO/IEC 23009-1 (Reference [13]).

The NBMP framework supports the delivery over IP-based networks using common transport protocols such as TCP, UDP, RTP (Reference [17]) and HTTP.

The NBMP framework also support the existing delivery methods such as streaming, file delivery, push-based progressive download, hybrid delivery, multipath and heterogeneous network environments.

5.2 Architecture

NBMP specifies interfaces to create and control media processing workflows in the network. NBMP can be split into a control plane and a media plane. The control plane covers the following APIs:

— Workflow API is used by NBMP source to create and control a media processing workflow.

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