

INTERNATIONAL  
STANDARD

ISO/IEC  
23090-8

First edition  
2020-12

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**Information technology — Coded  
representation of immersive media —  
Part 8:  
Network based media processing**

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Reference number  
ISO/IEC 23090-8:2020(E)

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Published in Switzerland

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## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)) or the IEC list of patent declarations received (see <http://patents.iec.ch>).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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](http://www.iso.org/members.html).

## 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*

<https://standards.iteh.ai/catalog/standards/sist/a3037dce-ec7-4fa8-874a->

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/>

### 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)

**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

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 '-'.

- 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<sup>53</sup>-1.

## 5 Overview

### 5.1 General

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 ISO/IEC 23090-8:2020

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.

- Function discovery API provides the means for workflow manager and/or NBMP source to discover media processing Functions that can be loaded as part of a media processing workflow.
- Task API is used by the workflow manager to configure and monitor a task at runtime.

On the media plane, NBMP defines the media formats, the metadata, and the supplementary information formats between the NBMP source and the task, as well as between the tasks themselves.

The discovery of the NBMP workflow manager and function repository is out of scope.

The NBMP architecture is shown in Figure 1.

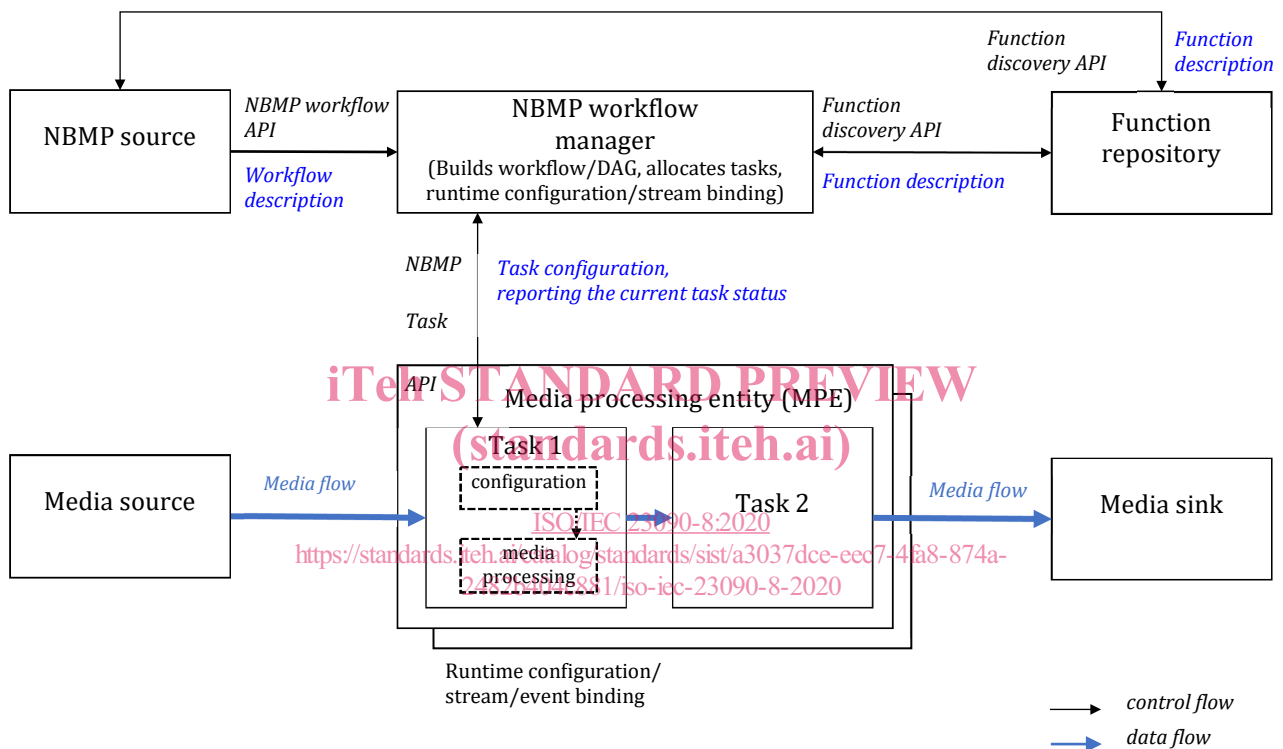


Figure 1 — NBMP reference architecture

### 5.3 NBMP workflow

#### 5.3.1 General

The workflow manager receives a workflow description document from a NBMP source and builds a workflow for requested media processing. This subclause describes how media processing functions are selected, and then the corresponding tasks are configured and distributed to a set of media processing entities as part of the workflow procedure.

#### 5.3.2 Workflow processing model

This subclause describes the detailed processing model of the workflow manager.

Since the set of functions that are provided by a function repository can be read by an NBMP source, the workflow description document can be composed in two different ways, based on use cases and actual needs.

- a) The NBMP source requests the creation of a workflow using a set of functions in the function repository: with this type of workflow creation request, the NBMP source is responsible for the selection of functions that are included in the workflow. In this case, the NBMP source requests the creation of the workflow:
- 1) using a description of tasks by which the workflow is to be created;
  - 2) specifying the connection map to define the connections of the inputs and outputs of tasks. The details of the connection map can be found in subclause 8.5. When the workflow manager receives the above information from NBMP source, it instantiates the tasks based on function names and connects the tasks according to what is defined in the connection map.
- b) The NBMP source requests the creation of a workflow using a set of keywords by which the workflow manager constructs the workflow. In this case, the NBMP source may not be aware of a set of functions to be inserted into the workflow, and requests the creation of the workflow:
- 1) using a set of keywords by which the workflow manager finds the appropriate functions;
  - 2) specifying the requirements of the workflow using descriptors from Table 4 in the workflow description document (WDD).

When the workflow manager receives the above information from the NBMP source, it will create the workflow by searching for appropriate Functions using the keywords specified in the processing descriptor. The workflow manager will then use the other descriptors in the workflow description document to provision Tasks and connect them to create the final workflow.

The processing model of the workflow manager can be described using the following steps.

- i) Discovery of available media processing functions:

The NBMP function repository provides the function discovery interface as defined in subclause 7.4, to allow external entities to query for a media processing function that fulfils the requested processing. The workflow manager has access to a directory service that offers a searchable list of media processing functions. The workflow manager can use the description of the tasks in the workflow description document to find the appropriate functions for the current workflow.

- ii) Selection of media processing tasks to prepare the workflow:

When a request for media processing arrives from the NBMP source, the workflow manager searches the function repository to find the list of all functions that could fulfil the workflow. Using the workflow description from the NBMP source, the workflow manager finds the functions from the function repository needed to implement the workflow. This step depends on the information for media processing from the NBMP source, such as the input and output description, and the description of the requested processing; and the information in other descriptors (as documented in Clause 8) for each function in the function directory. The mapping of the source requests to appropriate media processing tasks to be included in the workflow is part of the implementation of the NBMP in the network. To reference and link input sources with input port names and output port names at the time of task creation, the input-ports and output-ports shall be used to make references to the input streams. The architecture of the workflow manager interworking with the function repository is shown in Figure 2.