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MPEG-I Network-Based Media Processing (NBMP) Overview

ABSTRACT

This white paper provides an overview of the ISO/IEC 23090-8 Network Based Medi Processing (NBMP) standard. The NBMP standard provides a framework to deploy media workflows on cloud services, independent of the underlying cloud platforms. The standard consists of a descriptive language to describe workflows and tasks functionalities and requirements, as well as APIs between the service provider, the workflow manager, tasks and function repositories.

1 Introduction

The MPEG committee (ISO/IEC JTC1/SC29/WG3) is developing MPEG-I standard for encoding, encapsulation, and delivery of immersive media. Part 8 of this standard, Network Based Media Processing (NBMP) provides a standard for building and deploying media workflows. Since media services require several processes and steps, the NBMP standard enables interoperable deployment of services on cloud platforms. The paper provides an overview of the NBMP standard and how it can be employed in the deployment of media workflows.

2 General Concept

The ISO/IEC 23090-8 standard: Network Based Media Processing [NBMP] is a standard for processing media using workflows of prebuild functions. Figure 1 demonstrates the general NBMP Workflow. Media Source provides the input of the workflow, and Media Sink receives or retrieves the output of the workflow. The media processing is implemented in the Workflow consisting of multiple Tasks. The input is provided to the fist or multiple Tasks. Those Tasks perform the first step(s) of the media processing and provide their outputs to the next Tasks, and so on. Eventually, the output is formed and provided to the Media Sink.

텍스트이(가) 표시된 사진

자동 생성된 설명

Figure 1: The NBMP Workflow Concept

As shown in Figure 1, the Workflow Manager manages setup, running and managing the Workflow. In order to set up the Workflow, Workflow Manager uses one or more Function Repositories. A Function Repository is a catalog of Functions, i.e. describing each Function’s characteristics including the functionalities, inputs, outputs, various possible configurations, processing requirements, the location of binary executables, monitoring and reporting setup and other info. Each Function can perform a media-processing Task such as scaling, encoding, decoding, upscaling, stitching. The Workflow Manager uses the Function Repositories to find the right Function for each Task, instantiate the Function as a Task, and set up the Workflow. Then, it can run the Workflow and monitor it.

3. High-Level Architecture

Figure 2 demonstrates the NBMP high-level architecture. In this figure, NBMP Source is the entity requesting to set up and run the media processing. It talks to NBMP Workflow Manager which is responsible for setting up and running the Workflow on the actual Cloud Platform(s). NBMP Source also has access to the Function Repository, so that to be aware of what media processing Functions are available to build a Workflow. Media Source and Media Sink as described in the previous sections are the source and destination of the Workflow.

MPE

NBMP Workflow

Manager

(Builds workflow/DAG, allocates tasks, runtime configuration/stream binding)

NBMP Source

Function Repository

*Function Discovery API*

*NBMP Workflow API*

*Workflow Description*

Media Processing Entity (MPE)

Runtime Configuration/  
Stream/Event Binding

*Function Description*

*Function Discovery API*

*Function   
Description*

Task 1

configuration

media processing

*NBMP*

*Task*

*API*

Task 2

*Task configuration,   
reporting the current task status*

Media Source

Media Sink

*Media flow*

*control flow*

*data flow*

*Media flow*

Figure 2: The NBMP Architecture

In order to instantiate a Task on a targeted Cloud Platform, the Workflow Manager uses the Cloud Platform’s own Application Protocol Interfaces (API) to load and instantiate the task on Cloud Platform’s Media Processing Entity. Media Processing Entity is an abstraction level of the actual Cloud Platform’s hardware which runs one or multiple NBMP Tasks.

4. NBMP Document Hierarchal Model

The NBMP standard also includes documents exchanged through the above APIs. These documents describe the properties of Workflows, Functions, and Tasks. The standard defines a normative language for these documents based on the data hierarchal model shown in Figure 3.

Workflow

Description Document (WDD)

1 Workflow Description (WO) Object

Workflow

Resource (WR)

Task

Description Document (TDD)

1 Task Description (TO)

Object

Task

Resource (TR)

Function

Description Document (FDD)

One Function Description (FO)

Object

Function

Resource (FR)

Workflow Description (WD)

Task Description

(TD)

Function Description (FD)

General

Descriptor

Input

Descriptor

Output

Descriptor

Processing

Descriptor

Requirement

Descriptor

**Logical items**

**JSON objects**

**REST resources**

Parameters

Descriptors

Descriptions

Figure 3. NBMP hierarchal data model

Figure 3 shows three levels of abstraction. The REST API exchange REST resources. Those resources are:

1. Workflow Resource (WR): resource exchanged in Workflow API
2. Task Resource (TR): resource exchanged in Task API
3. Function Resource (FR): resource exchanged in Function Discovery API

As is shown in Figure 3, the JSON objects that constitute the resources are call Workflow Description Document (WDD), Task Description Document (TDD) and Function Description Document (FDD) respectively.

Each Description Document is a JSON object and is built on the logical concept of Description. A Description is a set of Descriptors. Each Descriptor describes some characteristics of the entity. While Workflow Description (WD), Task Description (TD) and Function Description (FD) describe the different entities, they use the same pool of Descriptors. As shown in Figure 4, some of these descriptors are General, Input, Output, Processing and Requirement Descriptors. Note that while the pool of descriptors is the same, not every Description uses all the possible Descriptors in the pool.

Each NBMP Descriptor consists of a set of parameters. Each parameter defines one aspect of the entity and includes name, precise definition, unit of measurement, data type, and restrictions. Again, descriptors share a single pool of parameters as shown in Figure 3, but no every descriptor includes every possible parameter in the pool.

5. The Scope of Standard

Figure 3 also demonstrates the APIs that are described in the standard. The NBMP Standard includes the following interfaces:

1. NBMP Workflow API: the API between NBMP Source and NBMP Workflow Manager for setting up a Workflow, top-level command and control and monitoring the Workflow status.
2. Task APIs: the API between NBMP Workflow Manager and each Task for running, managing and monitoring the Task.
3. Function Discovery API: the API between NBMP Source or NBMP Workflow Manager and the Function Repository for discovery and getting information about one or more Functions.

Table 1 lists the methods for the above APIs.

Table 1: The NBMP APIs

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  | | --- | | Workflow API | | CreateWorkflow | | UpdateWorkflow | | DeleteWorkflow | | RetrieveWorkflow | | |  | | --- | | Task API | | CreateTask | | UpdateTask | | GetTask | | DeleteTask | | |  | | --- | | Function Repository API | | DiscoverFunctions | | DiscoverFunctionsInGroup | | DiscoverGroupsOfFunction | |

As is shown in Table 1, the Workflow/Task APIs are designed based on REST[REST] principles, i.e. each API can be used for creating, retrieving, updating, deleting and erasing a Workflow/Task. The Function Repository API is for discovering one or more Functions. It is worth to note that the NBMP standard also includes optional methods for adding a Function to the repository.

6. Normative Aspects of NBMP

The NBMP standard has a normative language for the following aspects:

1. APIs: Workflow, Task and Function Discovery
   1. Operation calls for each above API
   2. Resource for each above API
2. Operational requirements for the following entities:
   1. NBMP Workflow Manager
   2. NBMP Task
   3. NBMP Function Repository

The normative aspects of the standard define the conformance requirement for each entity or the document, meaning that for interoperable interaction between each of the entities shown in Figure 2, the normative aspects should be observed by the involved entities, API and documents.