Panos Kudumakis, Xin Wang,
Sergio Matone, and Mark Sandler

MPEG-M: Multimedia Service Platform Technologies

MPEG-M is a suite of ISO/IEC standards (ISO/IEC 23006) that has been developed under the auspices of Moving Picture Experts Group (MPEG). MPEG-M, also known as Multimedia Service Platform Technologies (MSPT), facilitates a collection of middleware application programming interfaces (APIs) and elementary services (ESs) as well as service aggregation so that service providers (SPs) can offer users a plethora of innovative services by extending current Internet Protocol television (IPTV) technology toward the seamless integration of personal content creation and distribution, e-commerce, social networks, and Internet distribution of digital media.

MOTIVATION

With the deployment of broadband networks enabling new ways to deliver and exchange multimedia services and the improvement of hardware performance allowing many service aspects to be implemented as Web-service software, businesses related to media services are facing significant changes. These changes are opening new business opportunities for multimedia services, such as those generated by the recent introduction of IPTV services for which several standards have been or are being developed. Examples of already developed standards are: ITU-T Q.13/16, Open IPTV Forum, Alliance for Telecommunications Industry Solutions IPTV Interoperability Forum, Digital Video Broadcasting IPTV, Hybrid Broadcast Broadband TV, and YouView.

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However, most of the current IPTV efforts stem from rather conventional value chain structures thus standing in stark contrast with the buoyant Web environment where new initiatives—sometimes assembling millions of users in a fortnight—pop up almost daily with exciting new features, such as Apple's and Google's APIs, enabling third parties to provide applications and services.

At the same time, we are witnessing cases where the closed delivery and content bundles offered by some operators are being either abandoned (e.g., mobile phone brands linked to a particular content service) or complemented with the possibility offered to users to freely access services (e.g., broadband, mobile, and IPTV) of their choice. The latter becomes more eminent by the appearance of new operators offering service components (e.g., cloud services) and the need for these to be interoperable.

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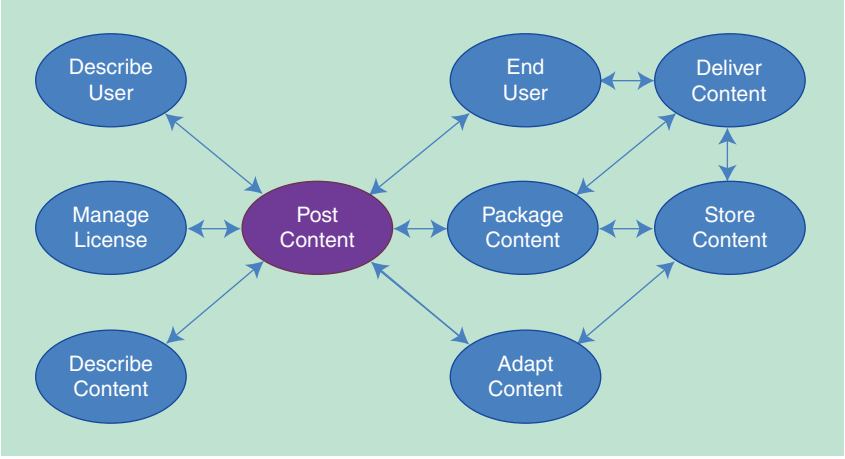
MPEG has been the provider of some enabling technologies and has developed a large portfolio of standards that can be assembled to provide multimedia services (see "MPEG technologies" under the section "Resources"). Continuing its approach of providing standards for the next generation of products, services, and applications MPEG has developed MPEG-M, a standard for advanced IPTV services. MPEG-M is based on a flexible architecture capable of accommodating and extending in an interoperable fashion many of the features that are being deployed on the Web for delivering and consuming multimedia content (e.g., Hulu, Netflix, or Apple TV), next to those enabled by the recent standard MPEG technologies (e.g., high-efficiency video coding and dynamic adaptive streaming over HTTP).

Thanks to the MPEG-M suite of standards aimed at facilitating the creation and provisioning of vastly enhanced IPTV services, it is envisaged that a thriving digital media economy can be established, where

- *developers* can offer MPEG-M service components to the professional market because a market will be enabled by the standard MPEG-M component service API
- *manufacturers* can offer MPEG-M devices to the global consumer market because of the global reach of MPEG-M services
- *SPs* can set up and launch new attractive MPEG-M services because of the ease to design and implement innovative MPEG-M value chains
- *users* can seamlessly create, offer, search, access, pay/cash, and consume MPEG-M services.

The MPEG-M suite of standards extends the devices capabilities with advanced features such as content generation, processing, and distribution by a large number of users; easy creation of new services by combining service components of their choice; global, seamless and transparent use of services regardless of geolocation, service provider, network provider, device manufacturer,



[FIG1] **A possible chain of services centered around postcontent SP.**

and provider of payment and cashing services; diversity of user experience through easy download and installation of applications produced by a global community of developers since all applications share the same middleware APIs; and innovative business models because of the ease to design and implement media-handling value chains whose devices interoperate because they are all based on the same set of technologies, especially MPEG technologies.

OBJECTIVES

The scope of the MPEG-M is to support the SPs' drive to deploy innovative multimedia services by identifying a set of ESs and defining the corresponding set of protocols and APIs to enable any user in an MPEG-M value chain to access those services in an interoperable fashion. Note that an MPEG-M value chain is a collection of users, including creators, end users, and SPs that conform to the MPEG-M standard.

Assuming that in an MPEG-M value chain there is a SP for each ES, a user may ask the postcontent SP to get a sequence of songs satisfying certain content and user descriptions (metadata). The "mood" of a group of friends could be a type of user description.

With reference to Figure 1, the end user would contact the post content SP who would get appropriate information from both the describe content SP and the describe user SP to prepare the sequence of songs according to the "mood" of the friends by using, for example, a semantic music playlist generator (see "SoundBite" under the section "Resources"). The end user would then get the necessary licenses from the manage license SP. The sequence of songs would then be handed over to the package content SP, possibly in the form of an "MPEG-21 Digital Item," the latter being a container for resources, metadata, rights, and their interrelationships. The package content SP will get the resources from the store content SP and hand over the packaged content to the deliver content SP who will stream the packaged content to the end user.

In many real-world MPEG-M value chains, SPs would not be able to exploit the potential of the standard if they were confined to only offer ESs. Therefore SPs will typically offer bundles of ESs, known as aggregated services (ASs). In general, as shown in Figure 2, there will be a plurality of SPs offering the same or partially overlapping ASs, for example, a SP offering user description services, may offer content description services as well.

Starting from MPEG-M ESs, the aggregation of services can put together a certain amount of services generating a complex MPEG-M value network, having different topologies and associating services in several ways. For example, the payment and cashing and rights negotiation ESs are aggregated to create AS#4, while content delivery and license provision ESs are both shared between AS#6 and AS#7.

ISSUING BODY, STRUCTURE OF THE STANDARD, AND SCHEDULE

MPEG-M (ISO/IEC 23006) is a suite of standards that has been developed under the auspices of MPEG.

ISO/IEC 23006 is referred as MPEG Extensible Middleware (MXM) in its first edition, and it specifies an architecture (Part 1), an API (Part 2), a reference software (Part 3), and a set of protocols to which MXM devices had to adhere (Part 4).

MPEG-M (ISO/IEC 23006) is referred to as multimedia service platform technologies (MSPT) in its second edition, and it conserves the architecture and design philosophy of the first edition, but stressing the Service Oriented Architecture character. It specifies also how to combine ESs into aggregated services (Part 5) and usage guidelines (Part 6).

The latter is subdivided into six parts:

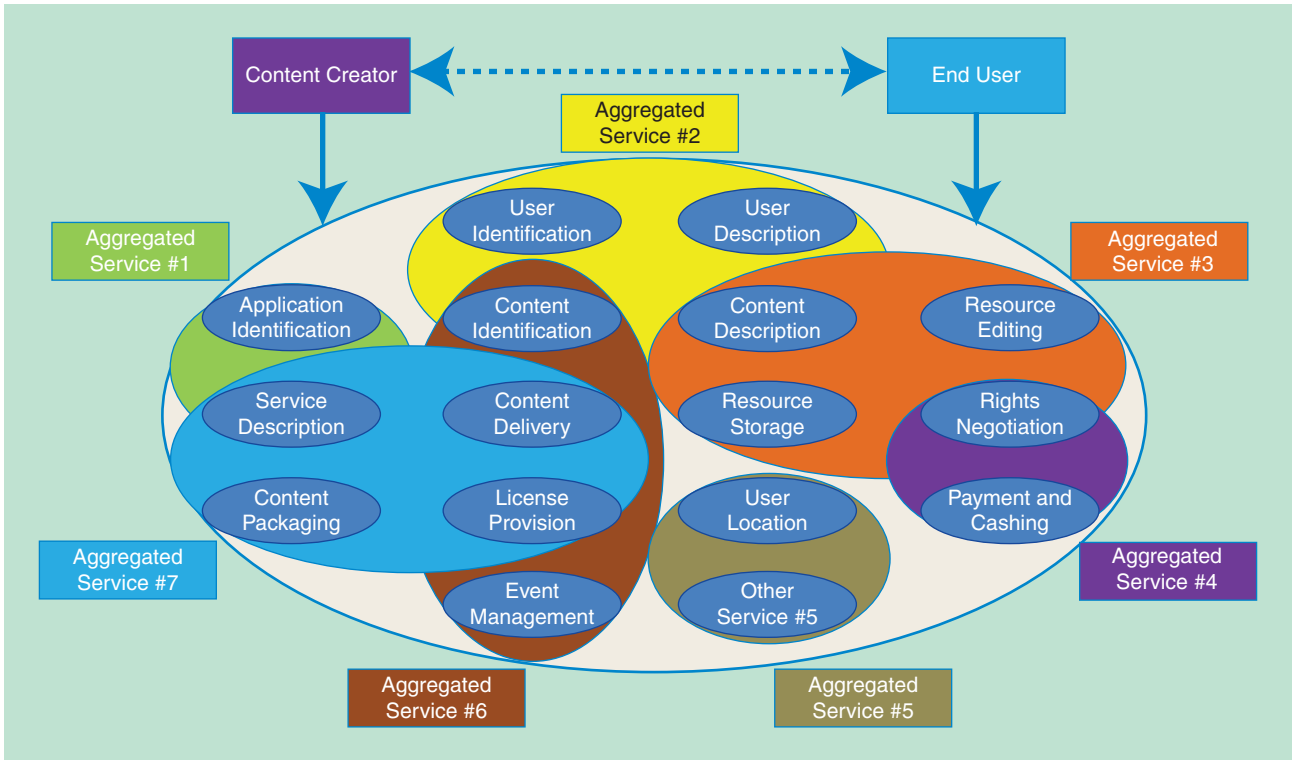
- *Part 1—Architecture*: specifies the architecture that is part of an MPEG-M implementation
- *Part 2—MXM API*: specifies the middleware APIs
- *Part 3—Conformance and Reference Software*: specifies conformance tests and the software implementation of the standard
- *Part 4—ESs*: specifies ES protocols between MPEG-M applications
- *Part 5—Service Aggregation*: specifies mechanisms enabling the combination of ESs and other services to build aggregated services
- *Part 6—Usage Guidelines*: specifies examples on elementary and aggregated services.

The specification of the MPEG-M suite of standards reached Study of Draft International Standard (SoDIS) status in July 2011, while its reference software and conformance tests are planned to be finalized in April 2012.

TECHNOLOGY

ARCHITECTURE AND SUPPORTED COMPONENTS

Next we describe the six parts of the MPEG-M suite of standards.



[FIG2] MPEG-M standard-enabled digital media services ecosystem underpinning and supporting the activities of content creators and consumers.

PART 1—ARCHITECTURE (23006-1)

A general architecture of an MPEG-M device is given in Figure 3, where MPEG-M applications running on an MPEG-M device could call the technology engines (TEs) in the middleware, via an application-middleware API, to access local functionality modules, and the protocol engines (PEs) to communicate with applications running on other devices by executing elementary or aggregated service protocols among them. The role of the orchestrator engine is to set up a more complex chain of TEs and PEs.

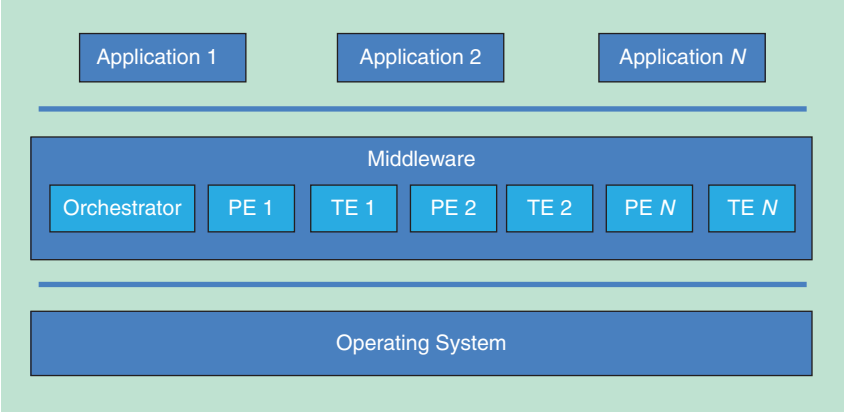
Typical TEs include those implementing MPEG technologies such as audio, video, 3-D graphics, sensory data, file format, streaming, metadata, search, rendering, adaptation, rights management and media value chain ontologies (see "MPEG Technologies" in the section "Resources").

Typical PEs include those implementing the ESs, as described earlier in the music "mood" example, such as describe user, describe content, manage license, package content, and deliver content.

The elements of the MPEG-M architecture are listed as follows:

- *MPEG-M engines* are collections of specific technologies that can be meaningfully bundled together.
- *The MPEG-M engine APIs* can be used to access MPEG-M engine functionality.
- *The MPEG-M orchestrator engine* is a special MPEG-M engine capable of creating chains of MPEG-M engines to execute a high-level application call such as "Photo Slide Show."
- *The MPEG-M orchestrator engine API* can be used to access the MPEG-M orchestrator engine.
- *An MPEG-M device* is a device equipped with MPEG-M engines.
- *An MPEG-M application* is an application that runs on an MPEG-M device and makes calls to the MPEG-M engine APIs and the MPEG-M orchestrator engine API.

In general, an MPEG-M device can have several MPEG-M applications running on it, e.g., a music or video



[FIG3] MPEG-M device architecture. The middleware is populated by TEs and PEs.

player as well as a content creator combining audio-visual resources with metadata and rights information. Some applications may be resident (i.e., loaded by the MPEG-M manufacturer) while some may be temporary (i.e., downloaded for a specific purpose).

When an MPEG-M application is executed, there may be "low-level" calls directly to some MPEG-M engines through their APIs and "high-level" calls such as the "Photo Slide Show," which will be handled by the orchestrator engine. The MPEG-M orchestrator is capable of setting up a chain of MPEG-M engines for handling complex operations, orchestrating the intervention and send/receive data to/from the particular chain of engines that a given high-level call will trigger, thus relieving MPEG-M applications from the logic of handling them.

PART 2—APPLICATION PROGRAMMING INTERFACE (23006-2)

This part of ISO/IEC 23006 specifies a set of APIs so that MPEG-M applications executing on an MPEG-M device can access the standard multimedia technologies contained in its middleware as MPEG-M TEs, as specified by Part 1 of ISO/IEC 23006.

The middleware APIs belong to two classes:

- The MPEG-M engine APIs, i.e., the collection of the individual MPEG-M engine APIs providing access to a single MPEG technology (e.g., video coding) or to a group of MPEG technologies where this is convenient
- The MPEG-M orchestrator API, i.e., the API of the special MPEG-M engine that is capable of creating chains of MPEG-M engines to execute a high-level application call such as "Photo Slide Show," as opposed to the typically low-level MPEG-M engine API calls.

The MPEG-M engine APIs are divided in four categories: creation APIs, editing APIs, access APIs, and engine-specific APIs.

1) *Creation APIs* are used to create data structures, files, and elementary streams conforming to the respective standards.

2) *Editing APIs* are used to modify an existing data structure, file, elementary stream to obtain a derived object still conforming to the respective standard.

3) *Access APIs* are used to parse data structures, files, and decode elementary streams to retrieve the information contained within.

WIM.TV IS CONSTANTLY ENRICHED WITH MORE FEATURES TO ENABLE MORE BUSINESS ROLES AND MAKE THE ECOSYSTEM AS LIVELY AND EFFICIENT AS POSSIBLE.

4) *Engine-specific APIs* are those that do not fall into the above categories, such as APIs for license authorization and content rendering.

[TABLE 1] ESs CLASSIFIED BY OPERATIONS AND ENTITIES.

	CONTENT	CONTRACT	DEVICE	EVENT	LICENSE	SERVICE	USER
AUTHENTICATE	X	X					
CHECK WITH		X					
CREATE	X	X			X		
DELIVER	X	X					
DESCRIBE	X		X			X	X
IDENTIFY	X	X	X				
NEGOTIATE		X			X		
PACKAGE	X						
PRESENT		X					
PROCESS	X				X		
REQUEST	X	X	X	X	X		
REVOKE		X			X		
SEARCH	X	X	X		X	X	X
STORE	X	X		X	X		
TRANSACT	X				X		
VERIFY		X	X		X		

PART 3—CONFORMANCE AND REFERENCE SOFTWARE (23006-3)

This part of ISO/IEC 23006 specifies conformance tests and the software implementation of the standard.

PART 4—ELEMENTARY SERVICES (23006-4)

This part of ISO/IEC 23006 specifies a set of ESs and protocols enabling distributed applications to exchange information related to content items and their parts, including rights and protection information.

In particular, each ES corresponds to an operation and a type of entity on which the operation is performed. Table 1 shows the ESs defined in this part of MPEG-M with the rows indicating the operations and the columns indicating the entities.

ESs can be combined in well-defined sequences to build aggregated services, both of them are called, in general, multimedia services. The multimedia services are provided by and consumed by multimedia devices in an MPEG-M ecosystem, an example of which is the advanced IPTV terminal.

PART 5—SERVICE AGGREGATION (23006-5)

The Business Process Model and Notation (BPMN) was useful toward the implementation of the MPEG-M vision, that is, the creation of aggregated services from a number of predefined ESs. The primary goal of the BPMN is to provide a standard notation that is readily understandable by all business stakeholders. These business stakeholders include the business analysts who create and refine the processes, the technical developers responsible for implementing the processes, and the business managers who monitor and manage the processes. Consequently, BPMN is intended to serve as common language to bridge the communication gap that frequently occurs between business process design and implementation.

BPMN specifies both a graphical notation and an XML representation for processes; it is a formalism to describe service workflows. Using this notation, it is possible to represent temporal events, associations, and precedences that are

combining ESs into an aggregated service. From this point of view, service aggregation is seen as an instance of a process described using BPMN.

A service aggregation can express a process flow realizing a specific task as well as a new service. The SP can expose elementary or aggregated services, constructed from several other services. Since service aggregation is a key point of MPEG-M, BPMN has been adopted because it allows efficient description of service interactions. Moreover many different aggregation topologies (not only a serial version of aggregation) and contacts among services can be quite easily illustrated employing the BPMN graphical notation.

PART 6—USAGE GUIDELINES ON ELEMENTARY AND AGGREGATED SERVICES (23006-6)

Part 6 will provide usage guidelines for a number of aggregated services. Services under consideration, for inclusion in this part of the MPEG-M standard, include selling music on the Web; buying advertisement space on video streaming services; user-centric TV programming with advertisements; professional content mash-up; IPTV content marketplace; advanced music services; personal casting of traffic events; distance learning; video-on-demand services via speech interface; and management of content adaptation.

FURTHER TECHNICAL DEVELOPMENTS

The further technical developments related to MPEG-M suite of standards is the provision of the reference software and conformance tests, as is the policy for every MPEG standard. Toward this goal a special project, Open Connected TV (OCTV), has been set up by the Digital Media Project.

The expected outcome of OCTV will not be a complete product or a running service, but a commercial-grade implementation of software—instead of the usual provided reference software—that may be used direct by implementers in commercial products and services.

Furthermore, Web/Internet/Mobile TV (WIM.TV) is an early implementation of the MPEG-M suite of standards. WIM.TV is a digital media ecosystem for diffuse trading of video content. Currently the following business roles are supported: creators, advertisers, syndicators, agents, Web TVs, end users, event minitowers, and Web banks. However, WIM.TV is constantly enriched with more features to enable more business roles and make the ecosystem as lively and efficient as possible.

RESOURCES

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STANDARD

ISO/IEC JTC 1/ SC 29/ WG 11 Information Technology—Multimedia Service Platform Technologies (23006):

- Part 1—Architecture (23006-1), N11934, Mar. 2011
- Part 2—MXM API (23006-2), N11936, Mar. 2011
- Part 3—Conformance and Reference Software (23006-3), N12148, Aug. 2011
- Part 4—ESs (23006-4), N12149, July 2011.
- Part 5—Service Aggregation (23006-5), N12150, Aug. 2011
- Part 6—Usage Guidelines on Elementary and Aggregated Services (23006-6), N12151, July 2011.

SERVICE

WIM.TV. (2011). [Online]. Available: http://www.wim.tv/wimtv-webapp/wimTvHome.do

AUTHORS

Panos Kudumakis (panos.kudumakis@eecs.qmul.ac.uk) is a research manager at qMedia, Queen Mary University of London, United Kingdom. He is coeditor of ISO/IEC Multimedia Service Platform Technologies—Part 1: Architecture (23006-1) and has been an active member of the ISO/IEC MPEG Standard Committee since 1998.

Xin Wang (xwang@huawei.com) is the head of the Multimedia Systems Lab at Corporate Research of Huawei Technologies, Santa Clara, California, United States. He is cochair of the MPEG-M ad hoc group and coeditor of ISO/IEC Multimedia Service Platform Technologies—Part 1: Architecture (23006-1).

Sergio Matone (sergio@cedeo.net) is a digital media technologist at CEDEO.net, Torino, Italy. He is coeditor of ISO/IEC Multimedia Service Platform Technologies—Part 2: MXM API (23006-2), Part 4: ESs (23006-4) and Part 5: Service Aggregation (23006-5).

Mark Sandler (mark.sandler@eecs.qmul.ac.uk) is the head of the School of Electronic Engineering and Computer Science and director of qMedia, Queen Mary University of London, United Kingdom.

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