INTERNATIONAL STANDARD

ISO/IEC 23006-1

Third edition
2018-05

Information technology — Multimedia service platform technologies —

Part 1: Architecture

Technologies de l'information — Technologies de la plate-forme de services multimédia —
Partie 1: Architecture

Reference number
ISO/IEC 23006-1:2018(E)

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Published in Switzerland

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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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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by 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 23006-1:2013), which has been technically revised.

The main changes compared to the previous edition are as follows:

— A new reference diagram of an MPEG-M device where the middleware is seen as a black box. ISO/IEC 23006-2 specifies a particular instance of the MPEG-M middleware which is organized in engines.

— High level API exposed by any MPEG-M middleware.

A list of all parts in the ISO/IEC 23006 series can be found on the ISO website.

Introduction

The ISO/IEC 23006 series has been developed to enable the easy design and implementation of media-handling value chains supported by devices that interoperate because they are all based on the same set of technologies, especially MPEG technologies. The functionalities provided by the MPEG technologies are accessible via application programming interfaces (API).

The ISO/IEC 23006 series specifies a service-oriented architecture (Part 1), middleware API (Part 2), conformance and reference software (Part 3), a set of protocols supporting elementary services (Part 4) and the combination of elementary services into aggregated services (Part 5).

MPEG-M supports the service providers' desire to designed and deploy at reduced cost innovative multimedia services. This is achieved by identifying a set of elementary services (ES) 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 An MPEG-M value chain is a collection of users, including creators, end users and service providers that conform to the ISO/IEC 23006 series.

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

Starting from ISO/IEC 23006-4, an aggregation of services can put together a number of services generating a complex ISO/IEC 23006 value network, having different topologies and associated services.

Using the ISO/IEC 23006 series, a digital media ecosystem 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;

— service providers can set up and launch new attractive MPEG-M services because innovative MPEG-M value chains can be easily designed and implemented;

— developers can make available a variety of multimedia applications;

— users can seamlessly create, offer, search, access, pay/cash and consume MPEG-M services.

The ISO/IEC 23006 series 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 geo-location, service provider, network provider, device manufacturer 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.

The ISO/IEC 23006 series is subdivided in five parts:

Part 1 — *Architecture* (the present document): specifies the architecture that can be used as a guide to an MPEG-M implementation;

Part 2 — *MPEG extensible middleware (MXM) API*: specifies the middleware APIs;

Part 3 — *Conformance and reference software*: specifies conformance criteria and a reference software implementation with a normative value;

Part 4 — *Elementary services*: specifies elementary service protocols between MPEG-M applications;

Part 5 — *Service aggregation*: specifies mechanisms enabling the combination of elementary services and other services to build aggregated services.

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Part 1: Architecture

1 Scope

This document specifies the MPEG-M architecture that is made accessible through the set of MPEG-M high level APIs, MPEG extensible middleware API, elementary services and service aggregation specified in ISO/IEC 23006-2, ISO/IEC 23006-4 and ISO/IEC 23006-5 and as a software implementation in ISO/IEC 23006-3, respectively.

NOTE Annex A provides an informative example of how MPEG-M can be used to create a fully-fledged multimedia platform.

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 23000-16, *Information technology — Multimedia Application Format (MPEG-A) — Part 16: Publish Subscribe Application Format*

ISO/IEC 23006-2, *Information technology — Multimedia service platform technologies — Part 2: MPEG extensible middleware (MXM) APIs*

ISO/IEC 23006-3, *Information technology — Multimedia service platform technologies — Part 3: Conformance and reference software*

ISO/IEC 23006-4, *Information technology — Multimedia service platform technologies — Part 4: Elementary services*

ISO/IEC 23006-5, *Information technology — Multimedia service platform technologies — Part 5: Service aggregation*

3 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:

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

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

3.1
application
software that runs in the environment and makes calls to the high-level API

3.2
computing platform
combination of hardware and basic software, such as operating system and drivers, that executes software

3.3
device
environment that includes software conforming to this specification

3.4
engine
component of the middleware that provides a defined functionality or set of functionalities accessible via API

3.5
environment
combination of hardware and software that exposes high-level API, and interfaces to devices that expose low-level API

3.6
high-level API
abstracted API exposed by a device to enable an application to access its functionalities and services

3.7
low-level API
programmatic interfaces exposed by devices, such as security devices, to the middleware

3.8
middleware
software providing functionalities to local and remote applications

3.9
middleware API
combination of the API of all engines in the middleware

3.10
orchestrator engine
special engine capable of creating chains of engines

EXAMPLE To set-up a sequence of connected engines to execute a high-level API call such as play.

3.11
user
any entity making use of a device

4 Abbreviated terms and elements of the MPEG-M architecture

4.1 Abbreviated terms

API	application programming interface
BPMN	business process model and notation
CEL	contract expression language
DASH	dynamic adaptive streaming over HTTP
DID	digital item declaration

DIDL	digital item declaration language
DII	digital item identification
ER	event report
ERR	event report request
HTTP	hypertext transport protocol
IPMP	intellectual property management and protection
PSAF	publish/subscribe application format
PubSub	publish/subscribe messaging model
REL	rights expression language
URI	uniform resource identifier

4.2 Elements of the MPEG-M architecture

Device	device conforming to this specification
Application	software component that runs on devices
High-level API	abstracted API exposed by a device to enable an application to access its functionalities and services
Middleware	software layer providing functionalities to local and remote applications
Engine	bundle of technologies that provide a defined functionality or set of functionalities
Engine API	API exposed by an engine to enable another engine/application to access its functionality
Mid-level API	collection of all engine API
Low-level API	API exposed by devices such as network, smart card or battery attached to a device
Orchestrator Engine	special engine capable of creating chains of engines to execute a high-level application call such as “play” that typically requires access to multiple engine functionalities

5 Namespace conventions

Throughout this document, qualified names are written with a namespace prefix followed by a colon followed by the local part of the qualified name.

For clarity, throughout this document, consistent namespace prefixes are used. Table 1 gives these prefixes and the corresponding namespace.

Table 1 — Namespaces and prefixes

Prefix	Corresponding namespace
mpegm	urn:mpeg:mpegM:schema:02-service-NS:2011
mpegmb	urn:mpeg:mpegM:schema:01-base-NS:2011
dia	urn:mpeg:mpeg21:2003:01-DIA-NS
erl	urn:mpeg:mpeg21:2005:01-ERL-NS

Table 1 *(continued)*

Prefix	Corresponding namespace
fru	urn:mpeg:mpegB:schema:FragmentRequestUnits:2007
mpeg7	urn:mpeg:mpeg7:schema:2004
mpeg7s	urn:mpeg:mpeg7:systems:2001
cel	urn:mpeg:mpeg21:cel:contract:2011
bbl	urn:mpeg:mpeg21:2007:01-BBL-NS
dii	urn:mpeg:mpeg21:2002:01-DII-NS
mpqf	urn:mpeg:mpqf:schema:2008
mpeg4ipmp	urn:mpeg:mpeg4:IPMPSchema:2002
ipmpdidl	urn:mpeg:mpeg21:2004:01-IPMPDIDL-NS
ipmpmsg	urn:mpeg:mpeg21:2006:07-IPMPMESSAGES-NS
ipmpinfo	urn:mpeg:mpeg21:2004:01-IPMPINFO-NS
didl	urn:mpeg:mpeg21:2002:02-DIDL-NS
didl-mpegm	urn:mpeg:mpegm:2011:12-DIDL-NS
didmodel	urn:mpeg:mpeg21:2002:02-DIDMODEL-NS
didl-msx	urn:mpeg:maf:schema:mediastreaming:DIDLextensions
dii	urn:mpeg:mpeg21:2002:01-DII-NS
rel-r	urn:mpeg:mpeg21:2003:01-REL-R-NS
rel-sx	urn:mpeg:mpeg21:2003:01-REL-SX-NS
xsd	http://www.w3.org/2001/XMLSchema
xsi	http://www.w3.org/2001/XMLSchema-instance
dsig	http://www.w3.org/2000/09/xmldsig#
xenc	http://www.w3.org/2001/04/xmlenc#

6 System overview

A general architecture of a device is given in Figure 1.

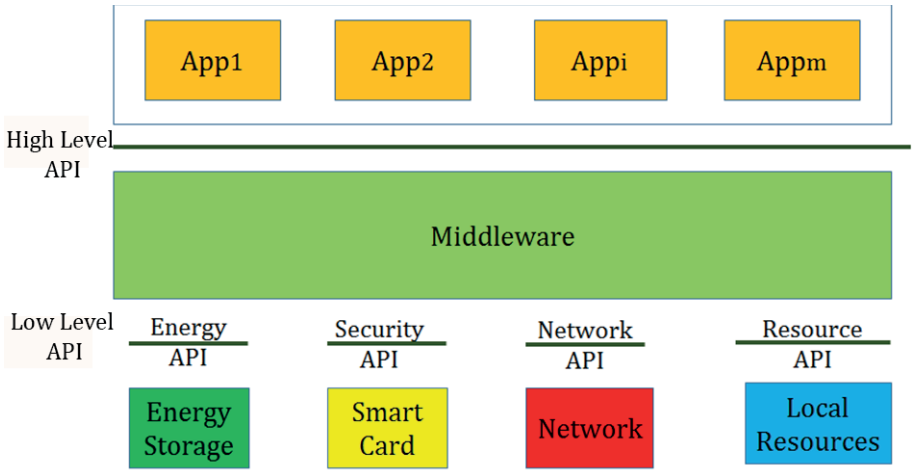

Figure 1 — Generic MPEG-M device architecture

Applications run on the device and perform their expected actions by accessing the middleware functionalities via the high-level API. In general a plurality of applications run on a device (there may be other non-MPEG-M applications but these are not relevant for this document). Some may be "resident", e.g., they have been loaded by the device manufacturer while some may be temporary, e.g., they have been downloaded for a specific purpose.

Examples of applications include:

— Video viewer: an application to view governed videos from a service provider;

— Content creator: an application to create content with audio-visual resources, metadata and rights information;

— Licence server: an application managing a licence-issuing service.

The **high-level API**s are abstracted APIs exposed by a device to enable an application to access its functionalities and services.

The **middleware** allows application easy access to platform functionalities.

Low-level APIs provide access to the functionalities of computing platform and external devices.

ISO/IEC 23006-2 specifies a particular middleware organisation, as depicted in Figure 2.

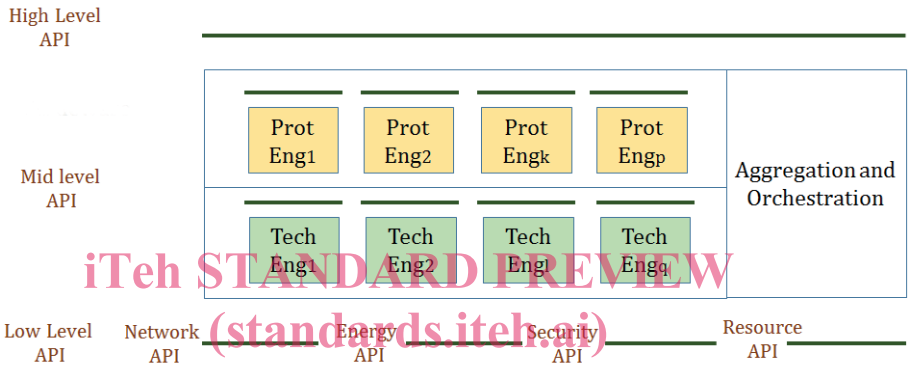

Figure 2 — Engine-based middleware

In this case, the **middleware** is made up of a number of engines (there may be other non-MPEG-M engines but these are not relevant for this specification).

Engines are of two types:

a) Protocol engines (specified in ISO/IEC 23006-4) that implement elementary services. Protocol engines can be combined by aggregation to implement aggregated services.

b) Technology engines (specified in ISO/IEC 23006-2) that implement specific technologies. Technology engines can be combined by orchestration to implement groups of technologies.

Middleware APIs are the combination of the APIs of all engines in the middleware.

Device is a combination of hardware and software conforming to this document. A device is often interfaced to other devices, e.g.:

a) **local resources** that provide computational resources,

b) **security device**, such as a smart card, that performs cryptographic functions,

c) **network** that provide connectivity with other devices, and

d) **energy device** that provides information on battery status.

Two applications running on different networked devices can communicate by executing service protocols, as depicted in Figure 3.

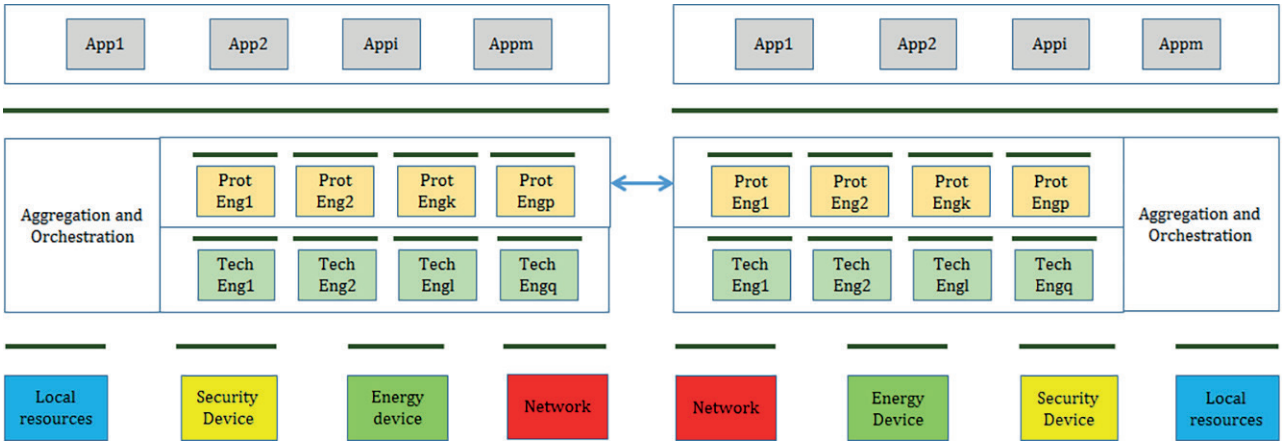

Figure 3 — Communication between two devices

When the device on the right-hand side (e.g., a "client") communicates with the device on the left-hand side (e.g. a "server"), the following happens:

a) A client application makes a service request (e.g., an elementary service such as create licence) using a protocol engine.

b) The corresponding server-side protocol engine, upon receiving the request, calls the appropriate orchestrator engine's API functionality (e.g., REL orchestration) or chain of engines.

c) The orchestrator engine on the server, if required, sets up a chain of engines: in the REL example, just one technology engine (the REL engine) creates the requested licence.

d) The server-side protocol engine returns the licence to the client-side protocol engine.

The same happens if the client application makes an aggregated service request. In this case the orchestrator engine sets up a more complex chain of technology and protocol engines.

When an application is executed, "low-level" calls may be made directly to some engines using the engine API of each specific engine, and high-level API calls like, say, "Play (GovernedContent)" which will be handled by the orchestrator engine. This is depicted in Figure 4.

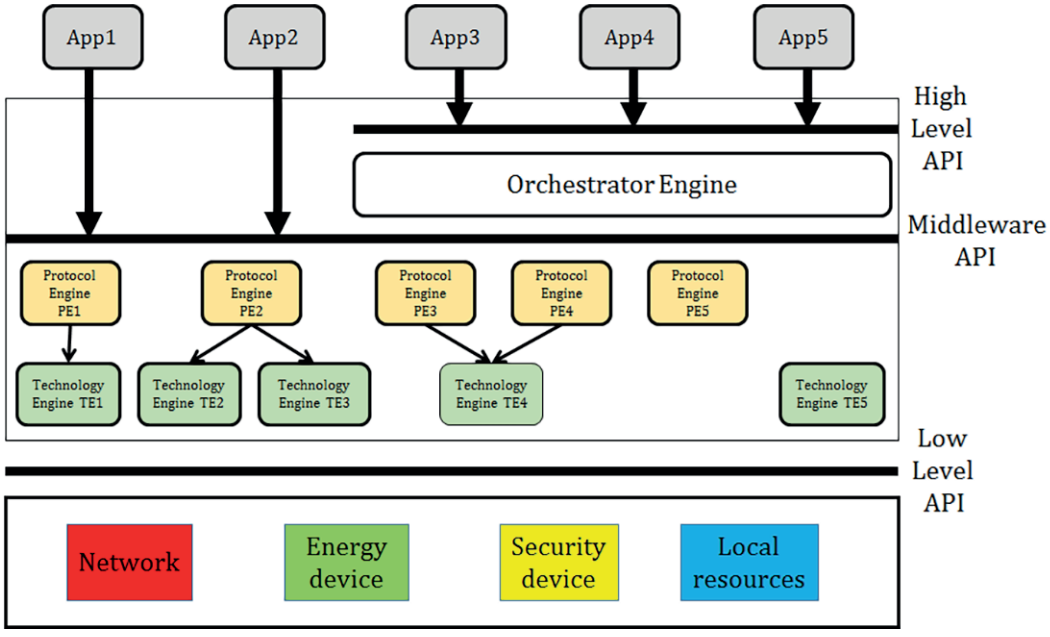

Figure 4 — View inside a device