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Information technology — MPEG extensible middleware (MXM) —

Part 1: MXM architecture and technologies

Technologies de l'information — Intergiciel MPEG extensible (MXM) —

Partie 1: Technologies et architecture MXM

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Foreword

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ISO/IEC 23006-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

ISO/IEC 23006 consists of the following parts, under the general title *Information technology — MPEG extensible middleware (MXM)*:

— *Part 1: MXM architecture and technologies*

— *Part 2: MXM API*

— *Part 3: MXM reference software*

— *Part 4: MXM protocols*

Introduction

ISO/IEC 23006 is a suite of standards that has been developed for the purpose of enabling the easy design and implementation of media-handling value chains whose devices interoperate because they are all based on the same set of technologies accessible from the MXM middleware.

This will enable the development of a global market of

— MXM applications that can run on MXM devices thanks to the existence of a standard MXM application API,

— MXM devices executing MXM applications thanks to the existence of a standard MXM architecture,

— MXM engines thanks to the existence of standard MXM architecture and standard 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.

Information technology — MPEG extensible middleware (MXM) —

Part 1:
MXM architecture and technologies

1 Scope

This part of ISO/IEC 23006 specifies the MXM architecture and references the technologies that are made accessible through the set of MXM APIs specified in ISO/IEC 23006-2.

The elements of the MXM Architecture are as follows:

a) MXM Engines – collections of specific technologies that it is meaningful to bundle together;

b) MXM Engine APIs – APIs that can be used to access MXM Engine functionality;

c) Orchestrator Engine – a special MXM Engine capable of creating chains of MXM Engines to execute a high-level application call such as “Play”;

d) MXM Orchestrator Engine APIs;

e) MXM Device – a device equipped with MXM;

f) MXM Application – an application that runs on an MXM Device and makes calls to the MXM Application API and MXM Engine APIs;

g) MXM Protocols for enabling MXM to MXM communications.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
content creation device
CCD
device enabling the creation of content

NOTE Content can include audio-visual resources, rights information, metadata, etc.

2.2
content identification device
CID
device providing content identification and authentication services to another device

2.3
content provider device
CPD
device on which content may be stored and which delivers content to another device

2.4
content search device
CSD
device providing responses to queries made by other devices about content items satisfying some criteria

2.5
device
combination of hardware and software or just an instance of software that allows a user to perform actions

2.6
domain
set of devices sharing a set of common properties such as ownership

2.7
domain management device
DMD
device managing the lifecycle of a domain and the membership of devices and users that are part of it

2.8
Event Report
representation of an Event(s) as specified by the related Event Report Request

[ISO/IEC 21000-15]

2.9
event report collection device
ECD
device collecting Event Reports generated by other devices

2.10
Inter-MXM Protocol
protocol that enables communication between MXM Devices

2.11
IPMP Tool
module performing one or more IPMP functions such as authentication, decryption, watermarking, etc.

2.12
IPMP Tool Body
executable code implementing an IPMP Tool

2.13
IPMP Tool provider device
ITD
device delivering IPMP Tools to another device

2.14
licence provider device
LPD
device delivering licences to another device according to a previously stored Licence Template

2.15
Licence Template
licence granting rights to issue licences to a device

2.16
MXM Application
application that runs on an MXM Device and makes calls to the MXM Application API and MXM Engine APIs

2.17
MXM Device
device equipped with a selected assembly of MXM Engines

2.18
MXM Engine
collection of specific technologies that it is meaningful to bundle together

2.19
MXM Engine API
API of a single MXM Engine

2.20
MXM Orchestrator API
API of the MXM Orchestrator Engine

2.21
MXM Orchestrator Engine
special MXM Engine capable of creating chains of MXM Engines, i.e. to set up a sequence of connected MXM Engines for the purpose of executing a high-level application call such as play

2.22
MXM Technology
technology that is supported by (a profile of) MXM

2.23
user
any entity making use of an MXM Device

3 Abbreviated terms

BBL Bitstream Binding Language

DIA Digital Item Adaptation

DID Digital Item Declaration

DIDL Digital Item Declaration Language

DII Digital Item Identification

DIS Digital Item Streaming

ER Event Report

ERR Event Report Request

IPMP Intellectual Property Management and Protection

MSAF Media Streaming Application Format (ISO/IEC 23000-5)

REL Rights Expression Language

URI Uniform Resource Identifier

4 System overview

4.1 Introduction

The MPEG extensible Middleware is an architecture containing MPEG standard multimedia technologies whose purpose is to enable the easy design and implementation of media-handling value chains whose devices interoperate because they are all based on the same set of technologies exposed through standard APIs.

4.2 MXM Device

An MXM Device is a combination of hardware and software or just an instance of software implementing this International Standard.

Figure 1 depicts an MXM Device.

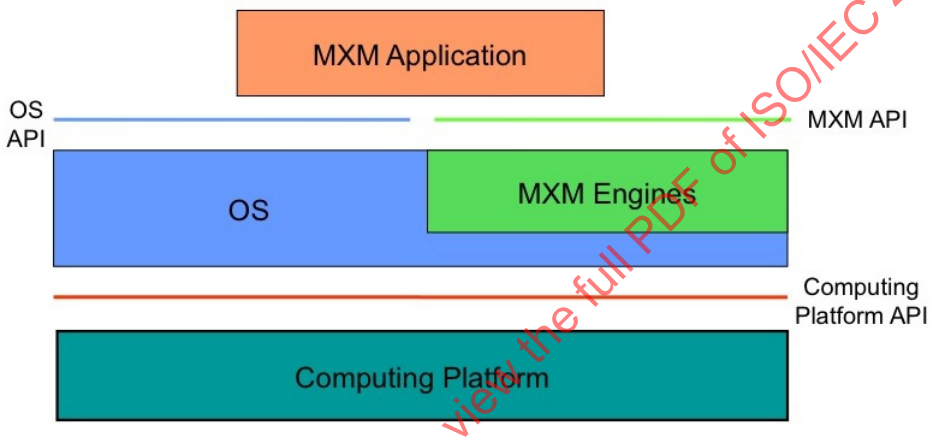

Figure 1 — An MXM Device

4.3 MXM Architecture

The elements of the MXM Architecture are

a) MXM Engines, collections of specific technologies that it is meaningful to bundle together

b) MXM Engine APIs, APIs that can be used to access MXM Engine functionality

c) Orchestrator Engine, a special MXM Engine capable of creating chains of MXM Engines to execute a high-level application call such as “Play”

d) MXM Application API, the API of the MXM Orchestrator Engine

e) MXM Device, a device equipped with MXM

f) MXM Application, an application that runs on an MXM Device and makes calls to the MXM Application API and MXM Engine APIs

Figure 2 shows a general model of an MXM device

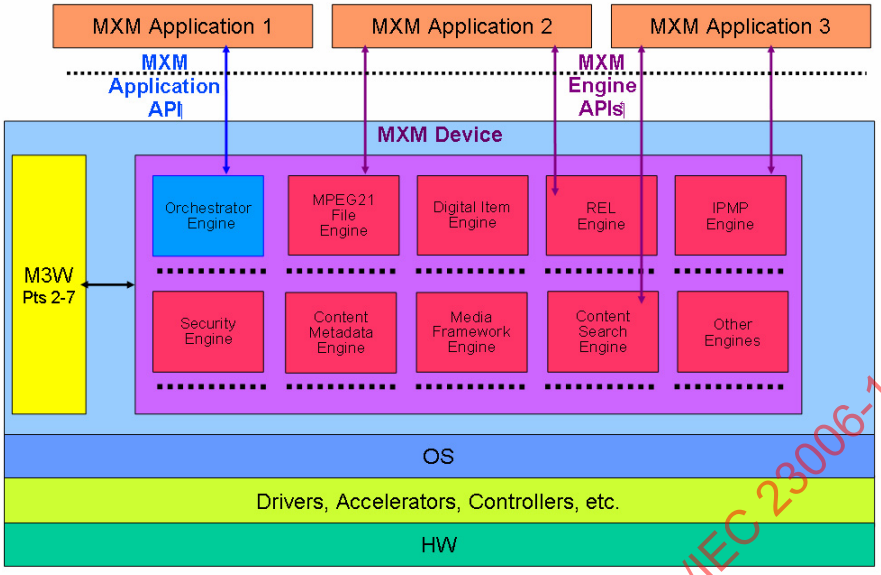

Figure 2 — The MXM architecture

As shown in Figure 2 above, MXM comprises a framework hosting a number of Engines. These are containers of a specific set of MXM Technologies accessible by the MXM API specific of that Engine. As is typical of most MPEG standards, the MXM standard will only define the interfaces of the MXM Engines, named MXM Engine APIs and the MXM Orchestrator API.

In general an MXM Device can have several MXM Applications running on it (there may be other applications but these are not relevant here). Some may be "resident", i.e. they have been loaded by the MXM manufacturer and some may be temporary, i.e. they have been downloaded for a specific purpose.

When an MXM Application is executed, there may be "low-level" calls directly to some MXM Engines using the MXM Engine APIs of each specific Engines, and "high-level" calls like, say, "Play (GovernedContent)" which will be handled by the Orchestrator Engine. The MXM Orchestrator, by calling the MXM Engine APIs of specific engines, is capable of setting up a chain of MXM 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 MXM Applications from the logic of handling them. Each MXM Engine will contain a specific set of MXM Technologies accessible by an MXM Application, the MXM Orchestrator and any other MXM Component in MXM, by means of its own MXM Engine API.

For instance, in the case of "Play (GovernedContent)" the Orchestrator engine could set-up the following chain:

a) MP21 File engine (e.g. open the file and extract the Digital item);

b) DI engine (e.g. extract metadata and rights information);

c) REL engine (e.g. verify if the right to play is granted);

d) IPMP engine (e.g. set up IPMP Tools to decrypt protected resources);

e) Security engine (e.g. initialise the IPMP Tools with decryption keys);

f) Content Metadata engine (e.g. present content metadata to the user);

g) Media Framework engine (e.g. demux, decode and render audio-visual resources).

... and possibly others.

NOTE Only the APIs of an MXM Engine are mandatory; how each Engine handles the operations needed to carry out a request is dependent on the specific software or hardware MXM Engine implementation.

A specific MXM Device may also make use of the M3W standard [31] because this offers several technologies from its parts 2 to 8, such as Resource and Quality Management, Fault Management and System Integrity Management, that may be useful in an implementation.

MXM Devices are not only used as stand-alone devices possibly interacting with a server, but are also devices meant to be used in a media value chain possibly with different MXM Applications that correspond to the different roles that value chains users play in the value chain (e.g. creating content, issuing licences upon request, streaming content, etc.)

This is depicted in Figure 3, which represents the full scope of the MXM standard and the communication between two MXM Devices via the inter-MXM Protocols. These are protocols that an application need not carry with it because they are already available in the MXM as MXM Engines.

Media technologies are normatively listed in Clause 6.

Figure 3 depicts the target of the MXM standard.

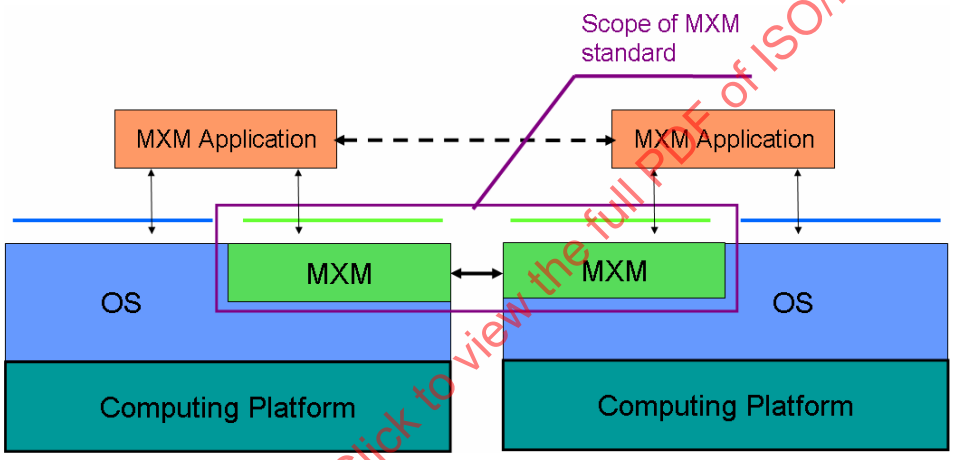

Figure 3 — Scope of MXM standardisation

Examples of MXM Applications include:

— Video Viewer – a program to view videos;

— Photo Player – a program to view still pictures;

— Content Creator – a program to create content with audio-visual resources, metadata and rights information;

— MPEG-J applet;

— Licence server – a remote service issuing licences upon request.

5 MXM Architecture

5.1 Introduction

MXM specifies an architecture in which each technology is encapsulated in one MXM Engine defining the MXM APIs for that Engine.

The list of MXM Engines is provided in the table below.

The MXM Engine APIs are divided in three categories. The first two categories include those recurring for more than one engine, while the latter category includes those APIs which are specific for one Engine. The terminology for the three categories is given below.

— Creation APIs: these include APIs to create data structures, files, elementary streams, etc. conforming to the respective standards.

— Access APIs: these include APIs to parse data structures, files, decode elementary streams, etc. in order to retrieve the information contained within.

— Engine-specific: these include specific APIs of an MXM Engine.

NOTE An “X” in the table below indicates that an API for either Creation or Access is present.

Table 1 — MXM Engines and classification of their APIs

No.	Engine	Creation	Access	Engine-specific
1	Digital Item	X	X	
2	MPEG-21 File	X	X	
3	REL	X	X	• Authorisation
4	IPMP	X	X	
5	Media Framework	X	X	See specific table below
6	Metadata	X	X	
7	Digital Item Streaming	X		• Stream
8	Digital Item Adaptation	X	X	
9	Event Reporting	X	X	• Register Events • Transmit Event Reports
10	Content Protocol			• Identify Content • Authenticate Content • Access Content • Store Content
11	Licence Protocol			• Access Licence • Store Licence • Revoke Licence
12	IPMP Tool Protocol			• Access IPMP Tool Body • Access IPMP Tool Info List
13	Content Search	X	X	• Search Content

Table 1 (*continued*)

No.	Engine	Creation	Access	Engine-specific
14	Security	X	X	• Authentication • Trust verification • Store • Retrieve
15	MVCO	X	X	• Attribute IP Entity • Verify Licence
16	Domain			• Create Domain Protocol • Renew Domain Protocol • Delete Domain Protocol • Add Device/User Protocols • Renew Device/User Protocols • Leave Device/User Protocols
17	Rendering			• See details in ISO/IEC 23006-2
18	Orchestrator			• Play • PresentDigitalItem • Adapt • ProcessDigitalItem

NOTE 1 Where no engine-specific API is defined it implies that the corresponding MXM Engine has no Engine-specific API.

NOTE 2 In the case of Protocol Engines, Access is not to be confused with the "Access" API category, as in this case it implies retrieving data from a remote location rather than parsing a data structure.

6 MXM Engines

6.1 Introduction

Throughout this Clause, if a specific profile has not been indicated it implies that the full standard is supported.

6.2 Digital Item Engine

6.2.1 Technologies

The Digital Item Engine provides access to the technologies specified in Table 2.

Table 2 — Technologies supported by the Digital Item Engine

Standard	Profile or Technology	Reference
Digital Item Declaration	Main, MSAF	ISO/IEC 21000-2, ISO/IEC 23000-5
Digital Item Identification		ISO/IEC 21000-3

6.3 MPEG-21 File Engine

6.3.1 Technologies

The MPEG-21 File Engine provides access to the technologies specified in Table 3.

Table 3 — Technologies supported by the MPEG-21 File Engine

Standard	Profile or Technology	Reference
MPEG-21 File Format		ISO/IEC 21000-9

6.4 REL Engine

6.4.1 Technologies

The REL Engine provides access to the technologies specified in Table 4.

Table 4 — Technologies supported by the REL Engine

Standard	Profile or Technology	Reference
Rights Expression Language	MAM profile	ISO/IEC 21000-5:2004/Amd.2:2007
	DAC profile	ISO/IEC 21000-5:2004/Amd.3:2008
	OAC profile	ISO/IEC 21000-5:2004/Amd.3:2008

6.5 IPMP Engine

6.5.1 Technologies

The IPMP Engine provides access to the technologies specified in Table 5.

Table 5 — Technologies supported by the IPMP Engine

Standard	Profile or Technology	Reference
MPEG-21 IPMP Components	MSAF	ISO/IEC 21000-4, ISO/IEC 23000-5
XML Representation of IPMP-X messages		ISO/IEC 23001-3

6.6 Media Framework Engine

6.6.1 Technologies

The Media Framework Engine provides access to the technologies specified in the Subclauses below.

6.6.1.1 Audio

Table 6 — Audio technologies supported by the Media Framework Engine

Standard	Profile or Technology	Reference
MPEG-1 Audio	layer II	ISO/IEC 11172-3
MPEG-1 Audio	layer III	ISO/IEC 11172-3
MPEG-4 AAC		ISO/IEC 14496-3
MPEG-4 HE-AAC		ISO/IEC 14496-3

6.6.1.2 Video

Table 7 — Video technologies supported by the Media Framework Engine

Standard	Profile or Technology	Reference
MPEG-1 Video		ISO/IEC 11172-2
MPEG-2 Video	Main Profile	ISO/IEC 13818-2
MPEG-4 Visual	Simple Profile	ISO/IEC 14496-2
	Advanced Simple Profile	ISO/IEC 14496-2
MPEG-4 AVC		ISO/IEC 14496-10, ISO/IEC 14496-15

6.6.1.3 Mixed Content

Table 8 — Mixed content technologies supported by the Media Framework Engine

Standard	Profile or Technology	Reference
MPEG-1 Systems		ISO/IEC 11172-1
MPEG-2 Systems	Transport Stream	ISO/IEC 13818-1
	Program Stream	ISO/IEC 13818-1
MPEG-4 Systems		ISO/IEC 14496-1
ISO Base Media File Format		ISO/IEC 14496-12
MPEG-4 File Format		ISO/IEC 14496-14

6.6.1.4 3D Graphics coding

Table 9 — 3D graphics technologies supported by the Media Framework Engine

Standard	Profile or Technology	Reference
Geometry		ISO/IEC 14496-25
Appearance		ISO/IEC 14496-25
Texture		ISO/IEC 14496-25
BBA Animation		ISO/IEC 14496-25
FAMC Animation		ISO/IEC 14496-25

6.6.1.5 Composition coding

Table 10 — Composition technologies supported by the Media Framework Engine

Standard	Profile or Technology	Reference
LASeR	Core	ISO/IEC 14496-20
BIFS		ISO/IEC 14496-11

Figure 4 shows the various components of the MXM Media Framework Engine at a high level.

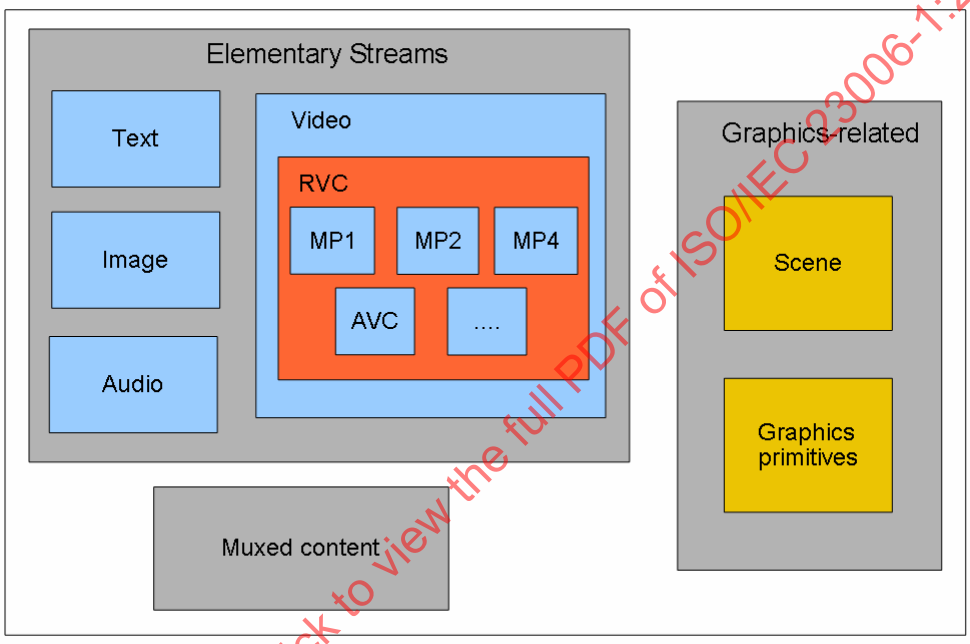

Figure 4 — Technologies of the MXM Media Framework Engine

6.7 Metadata Engine

6.7.1 Technologies

The Content Metadata Engine provides access to the technologies specified in Table 11.

Table 11 — Technologies supported by the Content Metadata Engine

Standard	Profile or Technology	Reference
MPEG-7 MDS	Simple Metadata Profile	ISO/IEC 15938-9
MPEG-7 Visual	Dominant Color Descriptor Scalable Color Descriptor Color Layout Descriptor Color Structure Descriptor Edge Histogram Descriptor Homogeneous Texture Descriptor	ISO/IEC 15938-3
MPEG-7 Audio		ISO/IEC 15938-4

6.8 Digital Item Streaming Engine

6.8.1 Technologies

The Digital Item Streaming Engine provides access to the technologies specified in Table 12.

Table 12 — Technologies supported by the Digital Item Streaming Engine

Standard	Profile or Technology	Reference
Digital Item Streaming		ISO/IEC 21000-18

6.9 Digital Item Adaptation Engine

6.9.1 Technologies

The Digital Item Adaptation Engine provides access to the technologies specified in Table 13.

Table 13 — Technologies supported by the Digital Item Adaptation Engine

Standard	Profile or Technology	Reference
Digital Item Adaptation	Usage Environment Description (UED)	ISO/IEC 21000-7

6.10 Event Reporting Engine

6.10.1 Technologies

The Event Reporting Engine provides access to the technologies specified in Table 14.

Table 14 — Technologies supported by the Event Reporting Engine

Standard	Profile or Technology	Reference
Event Reporting		ISO/IEC 21000-15

6.11 Content Protocol Engine

6.11.1 Technologies

The Content Protocol Engine provides access to the technologies specified in Table 15.

Table 15 — Technologies supported by the Content Protocol Engine

Standard	Profile or Technology	Reference
Authenticate Content Protocol		ISO/IEC 23006-4
Identify Content Protocol		ISO/IEC 23006-4
Access Content Protocol		ISO/IEC 23006-4
Store Content Protocol		ISO/IEC 23006-4

6.12 Licence Protocol Engine

6.12.1 Technologies

The Licence Protocol Engine provides access to the technologies specified in Table 16.

Table 16 — Technologies supported by the Licence Protocol Engine

Standard	Profile or Technology	Reference
Access Licence Protocol		ISO/IEC 23006-4
Store Licence Template Protocol		ISO/IEC 23006-4
Revoke Licence Protocol		ISO/IEC 23006-4