INTERNATIONAL STANDARD

ISO/IEC 23000-5

First edition
2008-08-15

Information technology — Multimedia application format (MPEG-A) —

Part 5: Media streaming application format

Technologies de l'information — Format pour application multimédia (MPEG-A) —

Partie 5: Format pour application de transmission multimédia en continu

Reference number
ISO/IEC 23000-5:2008(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. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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.

ISO/IEC 23000-5 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 23000 consists of the following parts, under the general title *Information technology — Multimedia application format (MPEG-A)*:

— *Part 1: Purpose for multimedia application formats* [Technical Report]

— *Part 2: MPEG music player application format*

— *Part 3: MPEG photo player application format*

— *Part 4: Musical slide show application format*

— *Part 5: Media streaming application format*

— *Part 7: Open access application format*

— *Part 8: Portable video application format*

— *Part 9: Digital multimedia broadcasting application format*

— *Part 10: Video surveillance application format*

Introduction

ISO/IEC 23000 (also known as “MPEG-A”) is a recent addition to a sequence of standards that have been developed by JTC 1/SC 29. Parts of ISO/IEC 23000 are developed by selecting existing technologies from published JTC 1/SC 29/WG 11 standards and combining them into so-called “Multimedia Application Formats” or MAFs. In justified instances external standards or specifications may also be referenced.

ISO/IEC 23000 aims to serve clearly identified market needs by facilitating the swift development of innovative and standards-based multimedia applications and services. This application driven process results in normative specifications of multimedia formats along with reference software implementation allowing interoperability on an application level.

ISO/IEC 23000-5 is aimed at applications involving the distribution of governed media resources, metadata and related information over streaming channels to Media Streaming Players, possibly members of a domain in which the content can be securely distributed once stored in a file. Typical examples of such applications are the IPTV and the Digital Broadcasting without a return channel.

Information technology — Multimedia application format (MPEG-A) —

Part 5:
Media streaming application format

1 Scope

ISO/IEC 23000 specifies a digital item structure, a file format, and references a set of protocols used in a media streaming environment for applications where governed audio and video information is streamed to an end-user device by means of existing protocols such as MPEG-2 Transport Stream or Real Time Protocol over Internet Protocol (RTP/IP), and provides a set informative implementations corresponding to specific applications.

NOTE ISO/IEC 23000 offers a standardized solution for the streaming of audio-visual information and related data to facilitate simple and fully interoperable exchange across different devices and platforms. The Media Streaming Application Format allows conforming devices to access audio and video information that is governed or ungoverned, and reaches end user devices using a variety of means.

The format of the media streaming content specified in this part of ISO/IEC 23000 relies on a number of MPEG technologies such as ISO/IEC 21000-2, ISO/IEC 21000-3, ISO/IEC 21000-4, ISO/IEC 21000-5, ISO/IEC 21000-9, ISO/IEC 21000-18, as well as on several MPEG-2/4 standards related to audio/video encoding, as this MAF specifies “native” resources for some application scenarios. Some of the International Standards mentioned above are referenced in their entirety by ISO/IEC 23000-5, whilst others, are only used partially, and in a specific way.

2 Normative references

The following referenced documents are indispensable for the application 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 14496-12:2005, *Information technology — Coding of audio-visual objects — Part 12: ISO base media file format*[1)]

ISO/IEC 14496-14:2003, *Information technology — Coding of audio-visual objects — Part 14: MP4 file format*

ISO/IEC 21000-2:2005, *Information technology — Multimedia framework (MPEG-21) — Part 2: Digital Item Declaration*

ISO/IEC 21000-3:2003, *Information technology — Multimedia framework (MPEG-21) — Part 3: Digital Item Identification*

ISO/IEC 21000-4:2006, *Information technology — Multimedia framework (MPEG-21) — Part 4: Intellectual Property Management and Protection Components*

1) Technically identical to ISO/IEC 15444-2.

ISO/IEC 21000-5, *Information technology — Multimedia framework (MPEG-21) — Part 5: Rights Expression Language*

ISO/IEC 21000-9:2005, *Information technology — Multimedia framework (MPEG-21) — Part 9: File Format*

ISO/IEC 21000-16:2005, *Information technology — Multimedia framework (MPEG-21) — Part 16: Binary Format*

ISO/IEC 21000-18:2007, *Information technology — Multimedia framework (MPEG-21) — Part 18: Digital Item Streaming*

ISO/IEC 23001-1:2006, *Information technology — MPEG systems technologies — Part 1: Binary MPEG format for XML*

ISO/IEC 23001-3, *Information technology — MPEG systems technologies — Part 3: XML IPMP Messages*

ISO/IEC 29116-1, *Information technology — Supplemental media technologies — Part 1: Media streaming application format protocols*

ETSI TS 102 822-3-1 V1.1.1 (2004-08); *Broadcast and On-line Services: Search, select, and rightful use of content on personal storage systems ("TV-Anytime Phase 1"); Part 3: Metadata; Sub-part 1: Metadata schemas*

3 Terms and definitions

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

3.1
content provider device
device delivering content to another **device**

3.2
device
combination of hardware and software or just an instance of software that allows a user to perform actions

3.3
domain management device
device managing the lifecycle of a domain and the membership of **devices** and **users** part of it

3.4
IPMP processor
module in a Media Streaming Player in charge of retrieving, instantiating, initialising and managing the **IPMP tools** required to perform actions on content

3.5
IPMP tool
module performing (one or more) IPMP functions such as authentication, decryption, watermarking, etc

3.6
IPMP tool agent
module instantiating, initialising, authenticating, and supervising any operation performed between IPMP tools within an IPMP tool group

3.7
IPMP Tool Body
executable code implementing either a **single IPMP tool** or an **IPMP tool pack**

3.8
IPMP tool group
combination of several IPMP tools

3.9
IPMP Tool Pack
module that comprises an **IPMP tool group** and its **IPMP tool agent**

3.10
IPMP tool provider device
device delivering **IPMP tools** to another **device**

3.11
license provider device
device delivering licenses to another **device**

3.12
media streaming device
any **device** used in media streaming environments including **media streaming player**, **content provider device**, **license provider device**, **IPMP tool provider device**, and **domain management device**

3.13
media streaming player
device capable of consuming content for human use

3.14
user
any entity interacting in a media streaming environment using a **media streaming device**

4 Abbreviated terms

CPD	Content Provider Device
DID	Digital Item Declaration
DI	Digital Item
DIDL	Digital Item Declaration Language
DII	Digital Item Identification
IPMP	Intellectual Property Management and Protection
LPD	License Provider Device
MSD	Media Streaming Device
MS-MAF	Media Streaming application format
MSP	Media Streaming Player
URI	Uniform Resource Identifier
XML	eXtensible Markup Language

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 part of ISO/IEC 23000, consistent namespace prefixes are used. Table 1 gives these prefixes and the corresponding namespace.

Table 1 — Namespaces and prefixes

Prefix	Corresponding namespace
ipmpdidl	urn:mpeg:mpeg21:2004:01-IPMPDIDL-NS
ipmpmsg	urn:mpeg:mpegB:schema:IPMP-XML-MESSAGES:2007
ipmpinfo-msx	urn:mpeg:maf:Schema:mediastreaming:IPMPINFOextensions:2007
ipmpinfo	urn:mpeg:mpeg21:2004:01-IPMPINFO-NS
didl	urn:mpeg:mpeg21:2002:02-DIDL-NS
didmodel	urn:mpeg:mpeg21:2002:02-DIDMODEL-NS
didl-msx	urn:mpeg:maf:schema:mediastreaming:DIDLextensions:2007
dii	urn:mpeg:mpeg21:2002:01-DII-NS
msap	urn:mpeg:maf:schema:mediastreaming:accessprotocol:2007
msd	urn:mpeg:maf:schema:mediastreaming:domain:2007
msdi	urn:mpeg:maf:schema:mediastreaming:deviceidentifier:2006:07
msdp	urn:mpeg:maf:schema:mediastreaming:domainprotocol:2007
ms-tva	urn:mpeg:maf:Profile:mediastreaming:tva:2007
dsig	http://www.w3.org/2000/09/xmldsig# [9]
r	urn:mpeg:mpeg21:2003:01-REL-R-NS
tva	urn:tva:metadata:2002
xenc	http://www.w3.org/2001/04/xmlenc# [8]
xsd	http://www.w3.org/2001/XMLSchema
xsi	http://www.w3.org/2001/XMLSchema-instance

6 System overview

Figure 1 depicts a general systems overview. As this part of ISO/IEC 23000 is not an end-to-end specification but only a “streaming format” and associated protocols leading to a Media Streaming Player specification, only the relationships with other devices that are directly functional to the performance of the Media Streaming Player are considered. For example, the Media Streaming Player MAF does not provide the specification for a device registration protocol.

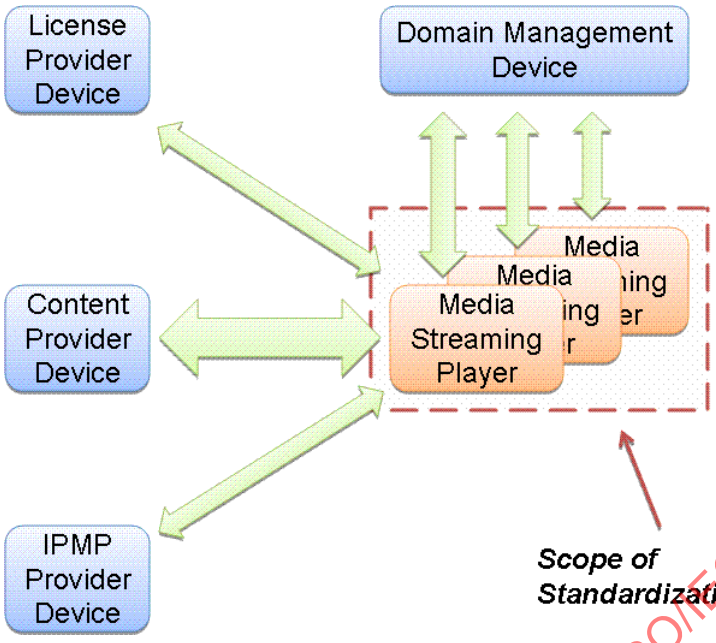


Figure 1 — Reference diagram for Media Streaming applications

In Figure 1 the data flowing through the dotted block are the subject to this part of ISO/IEC 23000.

Any device in the reference diagram is called a *Media Streaming Device* (MSD). An MSD can be any of the following devices

a) *Media Streaming Player, i.e., a device capable of consuming content for human use.*

b) *Content Provider Device, i.e.,* a device capable of interacting with a *Media Streaming Player* to provide Media Streaming Content.

c) *License Provider Device, i.e.,* a device capable of interacting with a *Media Streaming Player* to provide Licenses.

d) *IPMP Tool Provider Device, i.e.,* a device capable of interacting with a *Media Streaming Player* to provide IPMP Tools.

e) *Domain Management Device, i.e.,* a device capable of managing various functions needed for a proper functioning of a domain, e.g.,

1) create domain,

2) renew domain,

3) delete domain,

4) add device to domain, or

5) remove device from domain.

To exchange data with other devices a *Media Streaming Player employs* several types of Media Streaming Protocols specified in ISO/IEC 29116-1.

The following walkthrough explains the role of the technologies specified by this part of ISO/IEC 23000.

In the most general case a Media Streaming Player 1 obtains streaming content from a Content Provider Device using a Content Access Protocol. In order to use that content, a Media Streaming Player obtains a license from a License Provider Device using a License Access Protocol. Further, to actually process the content, a Media Streaming Player may need to obtain the appropriate IPMP Tools from an IPMP Tool Provider Device using an IPMP Tool Access Protocol.

This Media Streaming Player standard:

a) specifies how to use specific MPEG technologies

b) references the data formats exchanged between an MSD and a Media Streaming Player

c) references the transport protocols specified in ISO/IEC 29116-1 used to move data between an MSD and a Media Streaming Player

d) references the domain protocols used to exchange the data between an MSD and a Media Streaming Player specified in ISO/IEC 29116-1.

The user may have a plurality of Media Streaming Players and may like to be able to use the content on all of them. In order to do that, he needs to have a domain created using a Domain Management Device and then obtain a domain-wide license. All interactions between Media Streaming Players and the Domain Management Device can be implemented by a set of protocols specified in ISO/IEC 29116-1.

Media Streaming Player 1 may create, depending on the license, a file that contains licenses, IPMP Tools, resources, etc. and possibly transfer the file to other Media Streaming Players for use in the domain.

7 Information representation

7.1 Introduction

In this part of ISO/IEC 23000, the information is represented by employing the XML technology. Depending on the type of information represented, this part of ISO/IEC 23000 references an existing standard in its entirety or references a suitable profile of an existing standard.

The following sections list and reference the representation of the different information types that are required for this part of ISO/IEC 23000.

7.2 Digital Item

This part of ISO/IEC 23000 utilises ISO/IEC 21000-2 to associate media content with a set of related information which a device requires in order to properly render it. Annex A specifies how to use the Digital Item Declaration to represent a Digital Item in the Media Streaming MAF.

7.3 Metadata

The metadata used to describe the content is taken as a profile of the TV-Anytime metadata specification, published by ETSI and available as ETSI TS 102 822-3-1 V1.2.1.

The profile of TV-Anytime Metadata, whose URI is “urn:mpeg:maf:Profile:mediastreaming:tva:2007” is a limited set of elements defined in `TVAMainType` to include only the `Copyright`, `Classification` and `ProgramDescription` elements. The syntax of TVAMain element is specified in Figure 2, while for the semantics refer to ETSI TS 102 822-3-1 V1.2.1.

```
<element name="TVAMain" type="TVAMainType"/>
<complexType name="TVAMainType">
    <sequence>
        <element name="CopyrightNotice" type="string" minOccurs="0"/>
        <element name="ClassificationSchemeTable" type="ClassificationSchemeTableType"
minOccurs="0"/>
        <element name="ProgramDescription" type="ProgramDescriptionType" minOccurs="0"/>
    </sequence>
    <attribute ref="xml:lang" use="optional" default="en"/>
    <attribute name="publisher" type="string" use="optional"/>
    <attribute name="publicationTime" type="dateTime" use="optional"/>
    <attribute name="rightsOwner" type="string" use="optional"/>
    <attribute name="version" type="unsignedInt" use="optional"/>
</complexType>
```

Figure 2 — TVAMain element showing selected child elements

The *ProgramDescription* element defined in ETSI TS 102 822-3-1 V1.2.1 has been reduced to include only the *ProgramInformation*, *GroupInformationTable* and *CreditsInformationTable* elements. The *ProgramDescriptionType* complex type defined in this MAF is related to the TV-Anytime elements as follows;

```
<complexType name="ProgramDescriptionType">
<sequence>
    <element name="ProgramInformationTable" type="ProgramInformationTableType"
minOccurs="0"/>
    <element name="GroupInformationTable" type="GroupInformationTableType" minOccurs="0"/>
    <element name="CreditsInformationTable" type="CreditsInformationTableType"
minOccurs="0"/>
</sequence>
</complexType>
```

Figure 3 — The TVA ProgramDescription element showing selected child elements

NOTE Since the elements omitted from the TV-Anytime Specification are all defined as optional, an instance document complying with this profile of the TV-Metadata will also be compliant with a TV-Anytime phase 1 implementations.

7.4 Digital Item Signature

In media streaming applications, the Digital Items representing content may need to be digitally signed. In this case, a digital signature can be attached to the DIDL by inserting it in a `didl:DISignature` child of a `didl:DIDLInfo` which in turn is child of the top-level `didl:DIDL` element in the Digital Item. Such a digital signature shall conform to the Digital Signature specification [9].

7.5 Identifiers

Every item of content can be composed by a number of other items of content or by resources, which all need to be uniquely identified. This part of ISO/IEC 23000 utilises ISO/IEC 21000-3 to achieve this purpose. Annex A specifies which elements part of ISO/IEC 21000-3 are used within a Digital Item Declaration.

7.6 Resources

This section covers video and audio resources which are native to this part of ISO/IEC 23000.

Table 2 — ISO/IEC 23000-5 native audio and video resources

Video	
MPEG-2 Video Main Profile	ISO/IEC 13818-2:2000 Information technology — Generic coding of moving pictures and associated audio information: Video [2]
MPEG-4 Visual Advanced Simple Profile	ISO/IEC 14496-2:2004 Information technology — Coding of audio-visual objects — Part 2: Visual [4]
MPEG-4 Advanced Video Coding Main Profile	ISO/IEC 14496-10:2005 Information technology — Coding of audio-visual objects — Part 10: Advanced Video Coding [6]
MPEG-4 Scalable Video Coding	ISO/IEC 14496-10:2005 Amd. 3 Scalable video coding
Audio	
MPEG-1 Audio Layer II	ISO/IEC 11172-3:1993 Information technology — Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s — Part 3: Audio [1]
MPEG-4 Advanced Audio Coding	ISO/IEC 14496-3:2005 Information technology — Coding of audio-visual objects — Part 3: Audio [5]
MPEG-4 High Efficiency-AAC	ISO/IEC 14496-3:2005 Information technology — Coding of audio-visual objects — Part 3: Audio [5]

7.7 IPMP information

Digital Items and/or parts thereof such as media resources or metadata declarations may need for effective management and protection when distributed over heterogeneous access and delivery infrastructures. For this purpose, Annex D in this part of ISO/IEC 23000 specifies how to use ISO/IEC 21000-4 to protect Digital Items and parts thereof.

The Media Streaming MPEG-21 IPMP Components represents a flexible and extensible framework for applying protection mechanisms to a Digital Item. However, the protection mechanisms are based on the IPMP Tool model as defined in ISO/IEC 13818-11 and ISO/IEC 14496-14. The Application Programming Interface enabling interoperable operations of IPMP Tools on a device is provided by ISO/IEC 23001-3.

7.8 License

In this part of ISO/IEC 23000, licenses governing the use of content or parts thereof are expressed according to the Dissemination and Capture (ISO/IEC 21000-5 Amd 2) and Open Release Content (ISO/IEC 21000-5 Amd 3) profiles of ISO/IEC 21000-5.

7.9 Key

Media Streaming applications may require the use of encryption and decryption keys during their execution. There are two types of keys:

- time-independent keys, i.e., keys that do not need to be synchronised to the content delivery. These are represented as specified in [8].
- time-dependent keys, i.e., keys that are synchronised to timely packet delivery, for instance for the timely decoding of streamed content.

The decryption keys required to a Media Streaming Player are represented as specified in ISO/IEC 23001-3. How these are exchanged between MSDs or IPMP Tools is also part of ISO/IEC 23001-3.

7.10 IPMPX Messages

In order to allow a Device to host a number of non normative IPMP Tools, a Media Streaming Player shall employ the message-based interface defined in ISO/IEC 23001-3. This part of ISO/IEC 23000 requires the use of IPMP Tools to enforce Intellectual Property Management and Protection on a Media Streaming Player. For this purpose, ISO/IEC 23001-3 defines a set of messages which are employed in a Media Streaming Player for three purposes:

a) to enable a Media Streaming Player to instantiate, initialise, authenticate and manage IPMP Tools throughout their lifecycle in an standard way

b) to enable IPMP Tools to exchange information between them or with the Media Streaming Player in an interoperable way

c) to enable an IPMP Tool to receive IPMP information from a Media Streaming Device through the Digital Item streamed to the Media Streaming Player on which the IPMP Tool is instantiated

ISO/IEC 23001-3 specifies how the IPMP-X messages are employed in a media streaming scenario to enable the three scenarios above.

7.11 Device information

Media Streaming MAF employs a combination of IPMP-X Messages and IPMP Components to signal the technical characteristics of a device (e.g. type of operating system, memory, CPU, IPMP Tool instantiation and initialisation API) in order to allow each device to choose among a set of IPMP Tool Bodies identified by the same IPMP Tool identifier, the one(s) suitable for running on it.

7.12 Binary XML

To optimise the delivery of Digital Items, this part of ISO/IEC 23000 shall use ISO/IEC 21000-16 and ISO/IEC 23001-1.

8 Transport protocols

8.1 Introduction

Digital Items possibly including resources need to be transferred between devices as files or streams.

8.2 Streaming protocols

The Media Streaming MAF adopts ISO/IEC 21000-18, Digital Item Streaming (DIS), for the streaming of Digital Items. DIS defines the Bitstream Binding Language (BBL) for providing instructions on how to fragment a Digital Item for delivery over a given transport protocol.

In the case of the DIDL document representing a Digital Item, fragments may include additional information provided by BBL to assist in re-constructing the DIDL document. This information is provided as BBL provided attributes of the transported fragments.

EXAMPLE 1: A bbl:context attribute provided on the root of a subtree of a fragment indicates the location it is to be attached in the re-constructed DIDL document.

EXAMPLE 2: A bbl:fragmentRef attribute provided on the root of a subtree of a fragment matches the value of a bbl:fragmentID attribute sent previously to locate the point the subtree is to be attached in the re-constructed DIDL document.

8.3 File format

Digital Items, together with included or referenced resources that are received via streaming are stored according to the MPEG-21 file format. Annex F specifies the usage of MPEG-21 file format for media streaming applications.

9 Device to Device Protocols

9.1 Access Protocols

This part of ISO/IEC 23000 uses a set of protocols to access content, license, IPMP Tool Bodies and keys, both as file or as a stream of data. These protocols are specified in ISO/IEC 29116-1.

9.2 Domain Management Protocols

In case there is a need to license content to a plurality of Media Streaming Players or users, the domain management technology specified in ISO/IEC 29116-1 is used.

10 Reference software

The ISO/IEC 23000-5 reference software is available in the java programming language from the Chillout software repository [8]. The software is structured in four layers as shown in the figure below:

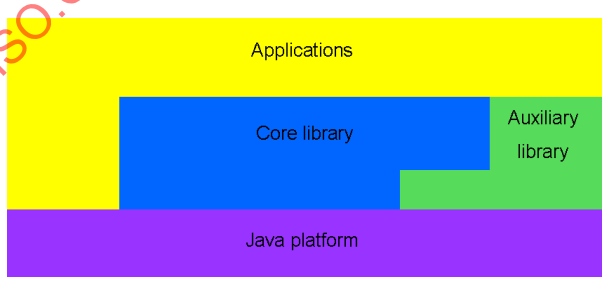


Figure 4 — The structure of ISO/IEC 23000-5 reference software

The high level description of each layer is given below:

- Java Platform Layer: this layer provides the Java running environment on which MSDs depend on. It comprises of the Java Development Kit (JDK), plus a number of add-ons provided by third parties, such as the Apache Tomcat servlet container [14] to power web applications, the Apache Axis [15][14] SOAP implementation, providing web-service capability, the EJBCA [16] providing a Certificate Authority for authentication and authorization, and a choice between the Java Media Framework [17] and GStreamer [19] for rendering media resources, etc.

- Core library: library of classes implementing the core functionalities as specified in this International Standard. The Chillout Core Library provides the functionalities needed to generate any XML structure conformant to this specification, and conversely to extract any information contained within. A set of classes part of this library have been generated automatically by an Open Source software tool called Java Architecture for XML Binding (JAXB) [18] by taking in input the schemas. Additionally, this library provides the methods to generate and parse an MPEG-21 File Format conformant to this specification.

- Auxiliary library: library of classes encapsulating the functionalities that every MSD must have when operating in a real environment, such as digital signature calculation, secure storage of certificate and licenses, IPMP Tools, etc.

- Applications: a set of sample applications with the purpose of showing how to use the Core and Auxiliary libraries. This category includes a number of MSD, such as the Media Streaming Player, a License Provider Device (LPD), a Content Provider Device (CPD), etc.

More information on the software and detailed instructions to installing and running it are available from the Chillout Project website [13].

11 Conformance testing

The purpose of the ISO/IEC 23000-5 conformance is to enable a user to test that an implementation of a Media Streaming Player conforms to this standard. Therefore the following (non-exhaustive list of) test suites are provided:

a) Digital Items of the following types

   1) with/without IPMP Information Descriptors/IPMP DIDL

   2) with/without licenses

   3) with/without IPMP Tools

b) Licenses granting

   1) a number of rights (e.g. mx:play, m1x:governedCopy) to a MSP under a number of conditions typical of the DAC profile

   2) the right to play and distribute content within a domain

c) IPMP Tools (examples of)

In order to allow MSD developers to test their implementation for conformance, the following example implementations of MSDs based on the reference software are provided:

a) Media Streaming Player

b) Content Provider Device

c) License Provider Device

d) IPMP Tool Provider Device

e) Domain Management Device

Annex A
(normative)

Usage of DIDL in the Media Streaming MAF

A.1 Media Streaming DIDL profile

A.1.1 Overview

The following subclauses specify the DIDL elements employed in the Media Streaming DIDL profile.

A.1.2 Media Streaming DIDL elements definition

A Media Streaming DIDL instance may use the following elements from ISO/IEC 21000-2: `Item`, `Descriptor`, `Statement`, `Component`, and `Resource`. Compliant Media Streaming Players shall support the elements and complex types defined in this Annex as a minimum. However, a compliant Media Streaming Player may be able to interpret additional elements from ISO/IEC 21000-2 or from other specification, if still conformant to this part of ISO/IEC 23000.

A.1.2.1 Item

The Item element can appear either as the root element of a Media Streaming DIDL instance document, or as child of another Item. In the former case, it represents a particular instance of content, while in the latter it represent either another particular instance of content contained in another instance of content, or a media resource.

A.1.2.2 Descriptor

A Descriptor is a container of Statement elements only.

A.1.2.3 Statement

The DIDL Media Streaming instances restrict the number of child elements that a Statement may contain, as specified in A.1.3. The information contained in a Statement element is related to the content or the resource represented by the parent Item that contains such Statement in a Descriptor element.

In the particular case in which the Statement is a child element of a Descriptor whose parent element is a top-level Item (representing an instance of Content), then the Statement may contain the `ipmpinfo:IPMPGeneralInfoDescriptor`.

A.1.2.4 Component

A Component is a container of a Resource element.

A.1.2.5 Resource

A Resource element defines an individually identifiable Asset such as a video or audio clip, an image, an electronic ticket, or a textual Asset.

A.1.3 Profile definition

Element/Child Element	Restrictions
didl:DIDL	The top level element in a Digital Item is always a didl:DIDL element, except in those cases where a Digital Item is nested within another Digital Item, in which case the top-level element of the nested component is a didl:Item element.
didl:Item	The Item element can appear either as the root element of a Media Streaming DIDL instance document, as a child of didl;DIDL element, or as child of another Item. In the first two cases, it represents a Digital Item, while in the latter represents either a Digital Item nested in the parent Digital Item, or a resource part of a Digital Item.
didl:DIDLInfo	A container for digital signatures for the digital item.
didl:Item	This element is restricted to include at least one didmodel:Descriptor element and one or more choices between didmodel:Item and didmodel:Component elements.
didl:Descriptor	This element associates information with the parent didl:Item.
didl:Item	As child of another didl:Item, a didl:Item represents either a Digital Item nested in the parent Digital Item, or a resource part of a Digital Item.
didl:Component	This element associates a didl:Resource to the didl:Item representing it.
didl:DIDLInfo	Restricted to contain the DISignature element only.
didl:Descriptor	This element is restricted to include a didmodel:Statement element only or a didlmodel:Component element only. Note: A didl:Component element child of a didl:Descriptor may be used to contain any type media describing the item.
didl:Statement	A didl:Statement element contains information related to the nearest didl:Item containing it.
didl:Component	This element is restricted to include a didmodel:Resource element only.
didl:Resource	As defined in 7.2.11 in ISO/IEC 21000-2.
didl:Statement	This element is restricted to include a choice between the following elements: dii:Identifier, didl-msx:Metadata, dii:RelatedIdentifier, ipmpinfo:IPMPGeneralInfoDescriptor and ContentElementSignature. The Statement element child of the first Descriptor, which is child of an Item shall always contain a dii:Identifier.
dii:Identifier	As defined in ISO/IEC 21000-1.
didl-msx:Metadata	As defined in A.2.1.

	dii:RelatedIdentifier	As defined in ISO/IEC 21000-1.
	Ipmpinfo:IPMPGeneralInfoDescriptor	As defined in D.1.5 An IPMPGeneralInfoDescriptor element shall only appear once in a protected DIDL document, and only in a Statement included in a Descriptor child of a top-level Item.
	didl:ContentElementSignature	element of type dsig:SignatureType containing the hash value or Signature of the Content Element represented by the Item containing the Statement
didl:Choice		As defined in 7.2.16 of ISO/IEC 21000-2.
didl:Resource		As defined in 7.2.11 of ISO/IEC 21000-2.
didl:Selection		As defined in 7.2.17 of ISO/IEC 21000-2.
didl:Condition		As defined in 7.2.18 of ISO/IEC 21000-2.

Example: The figure below shows an example of two Media Streaming DIs nested in another DI. The text in bold font shows the Content ID of the top-level DI (urn:myContent:0003) containing the two other DIs identified by urn:myContent:0001 and urn:myContent:0002

```
<didl:DIDL>
    <didl:Item id="A1">
        <didl:Descriptor>
            <didl:Statement mimeType="text/xml">
                <dii:Identifier>urn:myContent:0003</dii:Identifier>
            </didl:Statement>
        </didl:Descriptor>
        <didl:Item id="B1">
            <didl:Descriptor>
                <didl:Statement mimeType="text/xml">
                    <dii:Identifier>urn:myContent:0001</dii:Identifier>
                </didl:Statement>
            </didl:Descriptor>
            <didl:Item id="C1">
                <didl:Descriptor>
                    <didl:Statement mimeType="text/xml">
                        <dii:Identifier>urn:myResources:Audio:0001</dii:Identifier>
                    </didl:Statement>
                </didl:Descriptor>
            </didl:Item>
            <didl:Item id="C2">
                <didl:Descriptor>
                    <didl:Statement mimeType="text/xml">
                        <dii:Identifier>urn:myResources:Video:0001</dii:Identifier>
                    </didl:Statement>
                </didl:Descriptor>
            </didl:Item>
        </didl:Item>
            <didl:Item id="B2">
            <didl:Descriptor>
                <didl:Statement mimeType="text/xml">
                    <dii:Identifier>urn:myContent:0002</dii:Identifier>
                </didl:Statement>
            </didl:Descriptor>
            <didl:Item id="C3">
                <didl:Descriptor>
                    <didl:Statement mimeType="text/xml">
                        <dii:Identifier>urn:myResources:Audio:0002</dii:Identifier>
                    </didl:Statement>
```

```
            </didl:Descriptor>
        </didl:Item>
        <didl:Item id="C4">
            <didl:Descriptor>
                <didl:Statement mimeType="text/xml">
                    <dii:Identifier>urn:myResources:Video:0002</dii:Identifier>
                </didl:Statement>
            </didl:Descriptor>
        </didl:Item>
    </didl:Item>
</didl:Item>
</didl:DIDL>
```

Figure A.1 — The Media Streaming profile of the DIDL schema

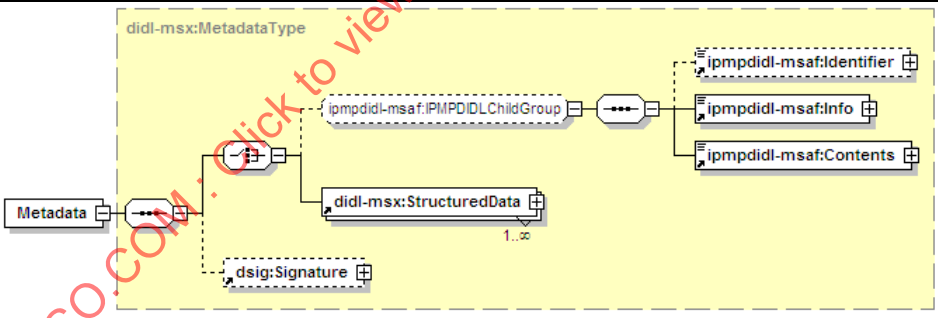
A.2 Media Streaming Descriptors

Media Streaming DIDL Descriptors defined in A.1.3 may contain a didl-msx:Metadata element describing the nearest didl:Item containing it. The didl-msx:Metadata is described below.

A.2.1 Metadata

The Metadata element allows the inclusion of either encrypted metadata or metadata in clear format. Metadata contained in a Statement is related to the Asset represented by the Item parent of the Descriptor containing the above mentioned Statement In the first case, metadata is conveyed as specified in ISO/IEC 21000-4, while in the second case, metadata is conveyed in the StructuredData element. An identifier for the enclosed metadata can be conveyed by means of the optional attribute “id.”

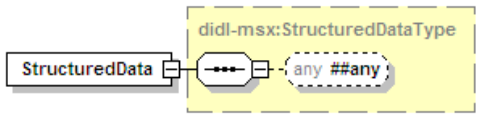
Table A.1 — METADATA element syntax

<table>
<tr><td>Diagram</td><td colspan="3"> 
</td></tr>
<tr><td>Used by</td><td colspan="3"><Statement></td></tr>
<tr><td rowspan="2">Attributes</td><td>Name</td><td>Type</td><td>Description</td></tr>
<tr><td>id</td><td>anyURI</td><td>The identifier for the metadata</td></tr>
<tr><td>Source</td><td colspan="3"><pre>
<element name="Metadata" type="didl-msx:MetadataType"/>
<complexType name="MetadataType">
    <sequence>
        <choice>
            <group ref="ipmpdidl:IPMPDIDLChildGroup" minOccurs="0"/>
            <element ref="didl-msx:StructuredData" maxOccurs="unbounded"/>
        </choice>
        <element ref="dsig:Signature" minOccurs="0"/>
    </sequence>
    <attribute name="id" type="anyURI" use="optional"/>
</complexType>
</pre></td></tr>
<tr><td></td><td colspan="3"></td></tr>
</table>

A.2.2 StructuredData

The StructuredData element can contain metadata from any namespace. The “ref” attribute identifies the schema in use. If this attribute is omitted, the default value is “urn:mpeg:maf:Profile:mediastreaming:tva:2007” which is the namespace defined in 7.3.

Table A.2 — STRUCTUREDDATA element syntax

<table>
<tr><td>Diagram</td><td colspan="3"> 
</td></tr>
<tr><td>Used by</td><td colspan="3"><Metadata></td></tr>
<tr><td rowspan="2">Attributes</td><td>Name</td><td>Type</td><td>Description</td></tr>
<tr><td>Ref</td><td>anyURI</td><td>The URI of the metadata schema namespace.</td></tr>
<tr><td>Source</td><td colspan="3"><pre>
<element name="StructuredData" type="didl-msx:StructuredDataType"/>
<complexType name="StructuredDataType">
    <sequence>
        <any namespace="##any" processContents="lax" minOccurs="0"/>
    </sequence>
    <attribute name="Ref" type="anyURI"
default="urn:mpeg:maf:Profile:mediastreaming:tva:2007"/>
</complexType>
</pre></td></tr>
</table>

Example: The figure below shows an example of a Media Streaming Player digital item containing metadata conformant to “urn:mpeg:maf:Profile:mediastreaming:tva:2007”:

```
<DIDL>
    <Item id="P1">
        <Descriptor>
            <Statement mimeType="text/plain">
                <dmp1_dii:Identifier>urn:myContent:0123</dmp1_dii:Identifier>
            </Statement>
        </Descriptor>
        <Descriptor>
            <Statement mimeType="text/xml">
                <didl-msx:Metadata>
                    <didl-msx:StructuredData ref="urn:dmp:idp2:tva:metadata:2002:2006:02">
                        <ms-tva:TVAMain>
                            <ms-tva:ProgramDescription>
                                <ms-tva:ProgramInformationTable>
                                    <tva:ProgramInformation
programId="crid://foo.com/1234567">
                                        <tva:BasicDescription>
                                            <tva:Title><![CDATA[Around the World in 80
Treasures]]></tva:Title>
                                            <tva:Synopsis length="short"><![CDATA[Dan
Cruickshank visits India and Sri Lanka as he continues his search for the world's most
beautiful and precious treasures. [S,SL]]]></tva:Synopsis>
                                            <tva:Genre
href="urn:tva:metadata:cs:ContentCS:2002:3.1.5.3">
                                                <tva:Name><![CDATA[History]]></tva:Name>
                                            </tva:Genre>
                                            <tva:Genre
href="urn:tva:metadata:cs:IntentionCS:2002:1.3">
                                                <tva:Name><![CDATA[EDUCATION]]></tva:Name>
                                            </tva:Genre>
                                            <tva:Genre
href="urn:tva:metadata:cs:ContentCS:2002:3.1.4">
                                                <tva:Name><![CDATA[Arts & Media]]></tva:Name>
                                            </tva:Genre>
                                            <tva:CaptionLanguage closed="true">EN-
UK</tva:CaptionLanguage>
                                            <tva:SignLanguage translation="true"
type="BSL">EN-UK</tva:SignLanguage>
                                        </tva:BasicDescription>
                                        <tva:AVAttributes>
                                            <tva:AudioAttributes>
                                                <tva:NumOfChannels>2</tva:NumOfChannels>
                                            </tva:AudioAttributes>
                                            <tva:VideoAttributes>
                                                <tva:AspectRatio>16:9</tva:AspectRatio>
                                            </tva:VideoAttributes>
                                        </tva:AVAttributes>
                                    </tva:ProgramInformation>
                                </ms-tva:ProgramInformationTable>
                            </ms-tva:ProgramDescription>
                        </ms-tva:TVAMain>
                    </didl-msx:StructuredData>
                </didl-msx:Metadata>
            </Statement>
        </Descriptor>
    </Item>
</DIDL>
```


Figure A.2 — An example of DI containing metadata

Annex B
(informative)

The Media Streaming DIDL profile schemas

B.1 Media Streaming DIDL Profile schema

```
<?xml version="1.0"?>
<schema targetNamespace="urn:mpeg:mpeg21:2006:07-DIDL-NS"
        xmlns="http://www.w3.org/2001/XMLSchema"
        xmlns:didl="urn:mpeg:mpeg21:2006:07-DIDL-NS"
        xmlns:didl-msx="urn:mpeg:maf:schema:mediastreaming:DIDLextensions"
        xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS"
        xmlns:ipmpdidl="urn:mpeg:mpeg21:2004:01-IPMPDIDL-NS"
        xmlns:didmodel="urn:mpeg:mpeg21:2002:02-DIDMODEL-NS"
        xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS"
        xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
        elementFormDefault="qualified" attributeFormDefault="unqualified" version="0.1">
    <!--============================================================-->
    <attributeGroup name="ID_ATTRS">
        <attribute name="id" type="ID" use="optional"/>
    </attributeGroup>
    <element name="DIDL" type="didl:DIDLType"/>
    <complexType name="DIDLType">
        <sequence>
            <element ref="didl:DIDLInfo" minOccurs="0" maxOccurs="unbounded"/>
            <element ref="didmodel:Item"/>
        </sequence>
        <anyAttribute namespace="##other" processContents="lax"/>
    </complexType>
    <element name="DIDLInfo" type="didl:DIDLInfoType"/>
    <complexType name="DIDLInfoType">
        <sequence>
            <element name="DISignature" type="dsig:SignatureType"/>
        </sequence>
    </complexType>
    <element name="Item" type="didl:ItemType" substitutionGroup="didmodel:Item"/>
    <complexType name="ItemType">
        <complexContent>
            <extension base="didmodel:ItemType">
                <sequence>
                    <element ref="didmodel:Descriptor" maxOccurs="unbounded"/>
                    <choice minOccurs="0" maxOccurs="unbounded">
                        <element ref="didmodel:Item"/>
                        <element ref="didmodel:Component"/>
                    </choice>
                </sequence>
                <attributeGroup ref="didl:ID_ATTRS"/>
            </extension>
        </complexContent>
    </complexType>
    <element name="Descriptor" type="didl:DescriptorType"
substitutionGroup="didmodel:Descriptor"/>
    <complexType name="DescriptorType">
        <complexContent>
            <extension base="didmodel:DescriptorType">
                <sequence>
                    <element ref="didmodel:Statement"/>
                </sequence>
            </extension>
        </complexContent>
```

```
    </complexType>
    <element name="Statement" type="didl:StatementType"
substitutionGroup="didmodel:Statement"/>
    <complexType name="StatementType" mixed="true">
        <complexContent mixed="true">
            <extension base="didmodel:StatementType">
                <sequence>
                    <choice>
                        <element ref="dii:Identifier"/>
                        <element ref="dii:RelatedIdentifier"/>
                        <element ref="didl-msx:Metadata"/>
                        <element ref="ipmpinfo:IPMPGeneralInfoDescriptor"/>
                        <element name="ContentElementSignature" type="dsig:SignatureType"/>
                    </choice>
                </sequence>
                <attribute name="mimeType" type="string"/>
                <attribute name="ref" type="anyURI"/>
            </extension>
        </complexContent>
    </complexType>
    <element name="Component" type="didl:ComponentType"
substitutionGroup="didmodel:Component"/>
    <complexType name="ComponentType">
        <complexContent>
            <extension base="didmodel:ComponentType">
                <sequence>
                    <element ref="didmodel:Resource" maxOccurs="unbounded"/>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
    <element name="Resource" type="didl:ResourceType"
substitutionGroup="didmodel:Resource"/>
    <complexType name="ResourceType" mixed="true">
        <complexContent mixed="true">
            <extension base="didmodel:ResourceType">
                <sequence>
                    <any namespace="##any" processContents="lax" minOccurs="0"/>
                </sequence>
                <attribute name="mimeType" type="string" use="required"/>
                <attribute name="ref" type="anyURI"/>
                <attribute name="encoding" type="string"/>
                <attribute name="contentEncoding" type="NMTOKENS"/>
            </extension>
        </complexContent>
    </complexType>
    <element name="Choice" type="didl:ChoiceType" substitutionGroup="didmodel:Choice"/>
    <complexType name="ChoiceType">
        <complexContent>
            <extension base="didmodel:ChoiceType">
                <sequence>
                    <element ref="didmodel:Condition" minOccurs="0" maxOccurs="unbounded"/>
                    <element ref="didmodel:Descriptor" minOccurs="0"
maxOccurs="unbounded"/>
                    <element ref="didmodel:Selection" maxOccurs="unbounded"/>
                </sequence>
                <attribute name="minSelections" type="nonNegativeInteger"/>
                <attribute name="maxSelections" type="positiveInteger"/>
                <attribute name="default" type="IDREFS"/>
                <attribute name="choice_id" type="ID"/>
                <anyAttribute namespace="##other" processContents="lax"/>
            </extension>
        </complexContent>
    </complexType>
    <element name="Selection" type="didl:SelectionType"
substitutionGroup="didmodel:Selection"/>
    <complexType name="SelectionType">
```

```
        <complexContent>
            <extension base="didmodel:SelectionType">
                <sequence>
                    <element ref="didmodel:Condition" minOccurs="0" maxOccurs="unbounded"/>
                    <element ref="didmodel:Descriptor" minOccurs="0"
maxOccurs="unbounded"/>
                </sequence>
                <attribute name="select_id" type="ID" use="required"/>
                <anyAttribute namespace="##other" processContents="lax"/>
            </extension>
        </complexContent>
    </complexType>
    <element name="Condition" type="didl:ConditionType"
substitutionGroup="didmodel:Condition"/>
    <complexType name="ConditionType">
        <complexContent>
            <extension base="didmodel:ConditionType">
                <attribute name="require" type="IDREFS"/>
                <attribute name="except" type="IDREFS"/>
            </extension>
        </complexContent>
    </complexType>
</schema>
```

Figure B.1 — The Media Streaming profile of the DIDL schema

B.2 Media Streaming DIDL Extensions schema

```
<?xml version="1.0"?>
<schema targetNamespace="urn:mpeg:maf:schema:mediastreaming:DIDLextensions"
        xmlns="http://www.w3.org/2001/XMLSchema"
        xmlns:didl-msx="urn:mpeg:maf:schema:mediastreaming:DIDLextensions"
        xmlns:ipmpdidl="urn:mpeg:mpeg21:2004:01-IPMPDIDL-NS"
        xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
        elementFormDefault="qualified" attributeFormDefault="unqualified" version="0.1">
    <element name="Metadata" type="didl-msx:MetadataType"/>
    <complexType name="MetadataType">
        <sequence>
            <choice>
                <group ref="ipmpdidl:IPMPDIDLChildGroup" minOccurs="0"/>
                <element ref="didl-msx:StructuredData" maxOccurs="unbounded"/>
            </choice>
            <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
        <attribute name="id" type="anyURI" use="optional"/>
    </complexType>
    <element name="StructuredData" type="didl-msx:StructuredDataType"/>
    <complexType name="StructuredDataType">
        <sequence>
            <any namespace="##any" processContents="lax" minOccurs="0"/>
        </sequence>
        <attribute name="ref" type="anyURI" default="urn:mpeg:ms-maf:tva:2006:07"/>
    </complexType>
</schema>
```

Figure B.2 — The Media Streaming extensions of the DIDL schema

Annex C
(informative)

The Media Streaming TV Anytime Profile schema

C.1 The Media Streaming TV Anytime Profile schema

```
<?xml version="1.0" encoding="UTF-8"?>
<schema targetNamespace="urn:mpeg:maf:Profile:mediastreaming:tva:2007"
        xmlns:tva="urn:tva:metadata:2002"
        xmlns:tva-msaf="urn:mpeg:maf:Profile:mediastreaming:tva:2007"
        xmlns:mpeg7="urn:mpeg:mpeg7:schema:2001"
        xmlns="http://www.w3.org/2001/XMLSchema"
        elementFormDefault="qualified" attributeFormDefault="unqualified">
    <element name="TVAMain" type="tva-msaf:TVAMainType"/>
    <complexType name="TVAMainType">
        <sequence>
            <element name="CopyrightNotice" type="string" minOccurs="0"/>
            <element name="ClassificationSchemeTable"
type="tva:ClassificationSchemeTableType" minOccurs="0"/>
            <element name="ProgramDescription" type="tva-msaf:ProgramDescriptionType"
minOccurs="0"/>
        </sequence>
        <attribute ref="xml:lang" use="optional" default="en"/>
        <attribute name="publisher" type="string" use="optional"/>
        <attribute name="publicationTime" type="dateTime" use="optional"/>
        <attribute name="rightsOwner" type="string" use="optional"/>
        <attribute name="version" type="unsignedInt" use="optional"/>
    </complexType>
    <complexType name="ProgramDescriptionType">
        <sequence>
            <element name="ProgramInformationTable" type="tva:ProgramInformationTableType"
minOccurs="0"/>
            <element name="GroupInformationTable" type="tva:GroupInformationTableType"
minOccurs="0"/>
            <element name="CreditsInformationTable" type="tva:CreditsInformationTableType"
minOccurs="0"/>
        </sequence>
    </complexType>
</schema>
```

Figure C.1 — The Media Streaming profile of TV Anytime schema

Annex D
(normative)

Usage of IPMP Components in the Media Streaming MAF

D.1 Media Streaming IPMP Components profile

D.1.1 Overview

The following subclauses specify the IPMP Components elements employed in the Media Streaming IPMP Components profile.

D.1.2 Media Streaming IPMP DIDL elements definition

A Media Streaming IPMP DIDL instance may use the following elements from ISO/IEC 21000-4:, `Item`, `Statement`, `Resource`, `Contents`, `Info`, `Identifier`, and `ProtectedAsset`. Compliant Media Streaming Players shall support the elements and complex types defined in D.1 as a minimum. However, a compliant Media Streaming Player may be able to interpret additional elements from ISO/IEC 21000-4 or from other specification, if still conformant to this part of ISO/IEC 23000.

D.1.3 Media Streaming IPMP Information Descriptor elements definition

IPMP Information Descriptors in Media Streaming Extensions are conformant to IPMP Information Descriptors in ISO/IEC 21000-4. IPMP Information Descriptors in Media Streaming Player are composed of the subset of IPMP Information Descriptor schema with/without restrictions and extensions.

Element/Child Element	Restrictions
ipmpinfo:IPMPInfoDescriptor	As defined in 7.3 of ISO/IEC 21000-4.
ipmpinfo:Tool	As defined in 7.4 of ISO/IEC 21000-4.
ipmpinfo:RightsDescriptor	As defined in 7.5 of ISO/IEC 21000-4.
dsig:Signature	As defined in 7.6 of ISO/IEC 21000-4.
ipmpinfo:Tool	As defined in 7.4 of ISO/IEC 21000-4.
ipmpinfo:ToolBaseDescription	As defined in 7.4.4 of ISO/IEC 21000-4.
ipmpinfo:ToolRef	As defined in 7.4.5 of ISO/IEC 21000-4.
ipmpinfo:InitializationSettings	This element is restricted to include an `ipmpinfo:InitializationData` element only
ipmpinfo:RightsDescriptor	This element is restricted to include a choice between `ipmpinfo:License` and `ipmpinfo:LicenseReference` elements only.
dsig:Signature	As defined in 7.4.8 of ISO/IEC 21000-4.

ipmpinfo:InitializationData	This element is restricted to contain the following elements: `ipmpmsg:ControlPointID`, `ipmpmsg:ControlPointAddress` elements and any element extending the `ipmpmsg:Data_BaseClass` complex type only.
ipmpmsg:ControlPointID	As defined in 5.2.6.1 of ISO/IEC 21000-4.
ipmpmsg:ControlPointAddress	As defined in 5.2.6.1 of ISO/IEC 21000-4
ipmpmsg:Data_BaseClass	As defined in 5.1.2 of ISO/IEC 21000-4
ipmpinfo:ToolBaseDescription	
ipmpinfo:IPMPToolID	As defined in 7.4.4.4 of ISO/IEC 21000-4.
ipmpinfo:Inline	As defined in 7.4.4.5 of ISO/IEC 21000-4.
ipmpinfo:Remote	As defined in 7.4.4.6 of ISO/IEC 21000-4
ipmpinfo:ConfigurationSettings	As defined in 7.4.4.6 of ISO/IEC 21000-4.
dsig:Signature	As defined in 7.4.4.8 of ISO/IEC 21000-4.
ipmpinfo:ConfigurationSettings	
ipmpinfo:Configuration	This element is restricted to contain the ipmpinfo_msx:ToolBody element only, described in D.1.4.
Ipmpinfo:Update	As defined in 7.4.4.7.4 of ISO/IEC 21000-4.

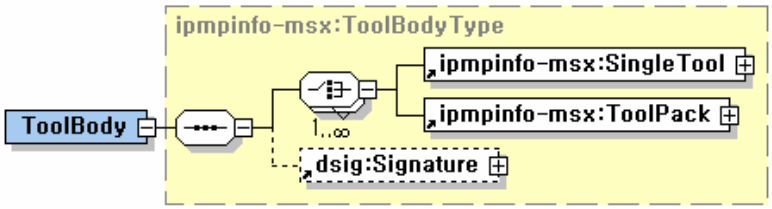
D.1.4 Media Streaming IPMP Information Descriptor extension elements definition

IPMP Information Descriptors in Media Streaming Extensions are extended by the ipmpinfo_msx:ToolBody element. In the MS MAF, an IPMP Tool can be either a single Tool or a combination of IPMP Tools. In the latter case, the structure of the combinations and how they are described is specified in the section below:

D.1.4.1 ToolBody

The `ToolBody` element specifies information associated with IPMP Tool embodiments. When a Tool or Tool groups are signaled, Tool embodiment shall be instantiated on a device to enable access to the governed content. IPMP Tools are software or hardware modules performing one or more IPMP functions such as authentication, decryption, watermarking, etc. They may operate as “stand alone” Tools or they can be aggregated in a single entity or in a Tool Group.

A `ToolBody` element contains a `SingleTool` element which indicates stand-alone typed tool embodiment or a `ToolPack` element describing a tool group and its agent module, and an optional `Signature`.

Diagram	
Children	<SingleTool><ToolPack><Signature>
Used by	<inline>
Source	<element name="ToolBody" type="ipmpinfo-msx:ToolBodyType"/> <complexType name="ToolBodyType"> <sequence> <choice maxOccurs="unbounded"> <element ref="ipmpinfo-msx:SingleTool" /> <element ref="ipmpinfo-msx:ToolPack" /> </choice> <element ref="dsig:Signature" minOccurs="0"/> </sequence> </complexType>

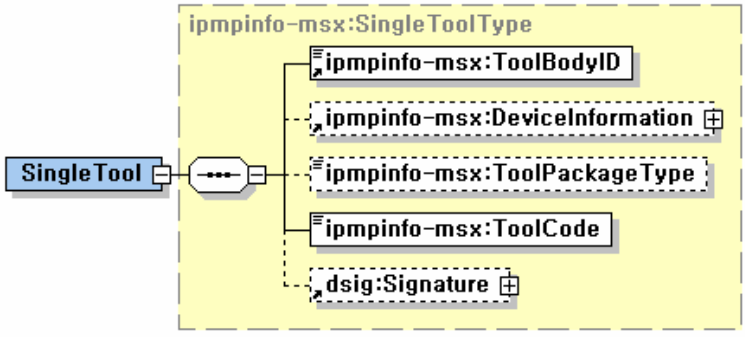
D.1.4.1.1 Example

The figure below is an example of Tool Body.

```
<ipmpinfo-msx:ToolBody>
    <ipmpinfo-msx:ToolPack>
        <ipmpinfo-msx:ToolBodyID>urn:Origin:ToolBodyID:01</ipmpinfo-msx:ToolBodyID>
        <ipmpinfo-msx:DeviceInformation>
            <mpeg4ipmp:OperatingSystem>
                <mpeg4ipmp:Vendor>Red Hat</mpeg4ipmp:Vendor>
                <mpeg4ipmp:Model>Enterprise</mpeg4ipmp:Model>
                <mpeg4ipmp:Version>9.0</mpeg4ipmp:Version>
            </mpeg4ipmp:OperatingSystem>
        </ipmpinfo-msx:DeviceInformation>
       <ipmpinfo-msx:ToolAgent>
            <ipmpinfo-msx:ToolAgentID>urn:Origin:ToolPack:ToolID:ABC9:ToolAgentID:01
            </ipmpinfo-msx:ToolAgentID>
            <!-- Include the code implementing the IPMP Tool in the element below -->
            <ipmpinfo-msx:ToolAgentBody>AB67543EF5554CD0</ipmpinfo-msx:ToolAgentBody>
        </ipmpinfo-msx:ToolAgent>
        <ipmpinfo-msx:ToolPackageType>application/zip</ipmpinfo-msx:ToolPackageType>
    </ipmpinfo-msx:ToolPack>
</ipmpinfo-msx:ToolBody>
```


D.1.4.2 <SingleTool>

The `SingleTool` element specifies a Single IPMP Tool structure with tool code information concerning the environment on which it may operate. In addition to the binary IPMP Tool code, this element allows to convey further information, such as information on the device characteristics on which the tool may run, or the type of package containing the tool. The `ToolBodyID` defines identification for the `ToolBody` and the `DeviceInformation` element describes information about Tool's implementation or Tool's utilization such as API configurations. The `ToolPackageType` element describes the type of the embodied binary `ToolCode` element.

Diagram	
Children	<ToolBodyID><DeviceInformation><ToolPackageType><ToolCode><Signature>
Used by	<ToolBody>
Source	<element name="SingleTool" type="ipmpinfo-msx:SingleToolType"/> <complexType name="SingleToolType"> <sequence> <element ref="ipmpinfo-msx:ToolBodyID"/> <element ref=" ipmpinfo-msx:DeviceInformation" minOccurs="0"/> <element name="ToolPackageType" type="string" minOccurs="0"/> <element name="ToolCode" type="base64Binary"/> <element ref="dsig:Signature" minOccurs="0"/> </sequence> </complexType>

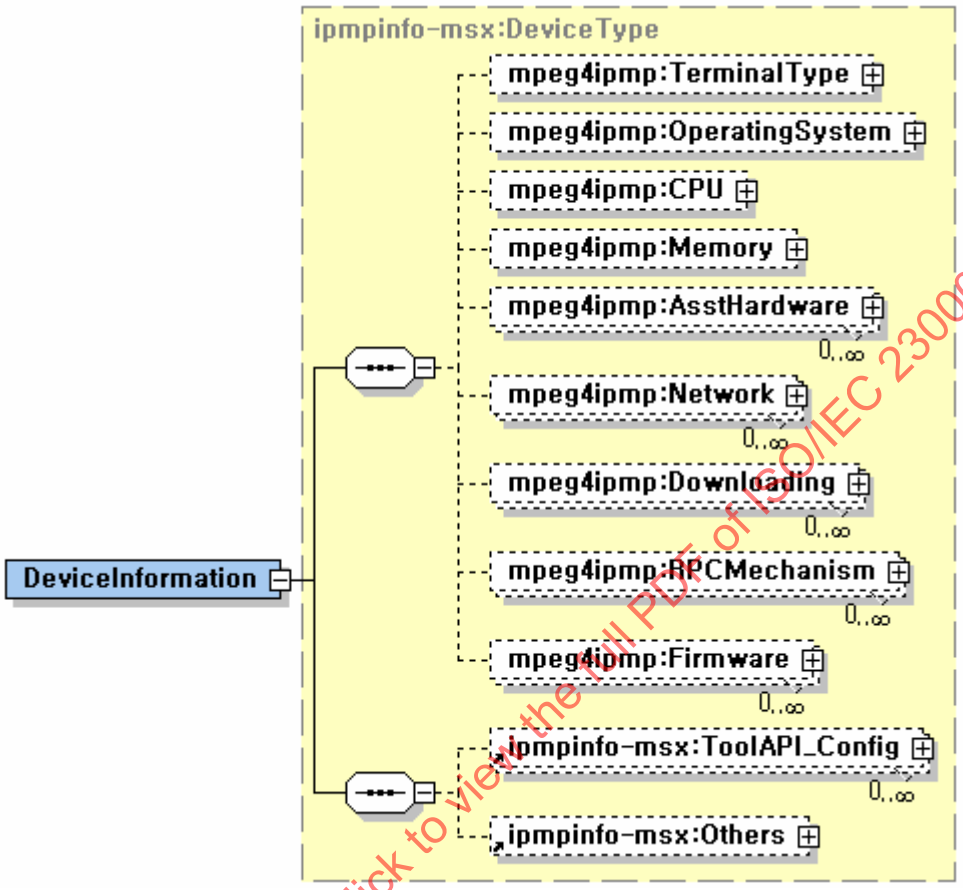
D.1.4.3 <ToolBodyID>

The `ToolBodyID` conveys the ToolBody identifier.

Diagram	
Used by	<singleTool><ToolPack>
Source	<element name="ToolBodyID" type="anyURI"/>

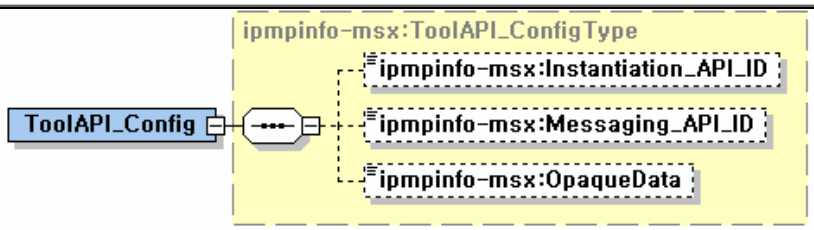
D.1.4.4 <DeviceInformation>

The `DeviceInformation` element specifies information about the environment on which the Tool may operate, and the API for instantiating and managing it.

Diagram	
Children	<ToolAPI_Config><Others>
Used by	<singleTool><ToolPack>
Source	<element name="DeviceInformation" type="ipmpinfo-msx:DeviceType"/> <complexType name="DeviceType"> <complexContent> <extension base="mpeg4ipmp:TerminalIDType"> <sequence> <element ref="ipmpinfo-msx :ToolAPI_Config" minOccurs="0" maxOccurs="unbounded"/> <element ref="ipmpinfo-msx:Others" minOccurs="0"/> </sequence> </extension> </complexContent> </complexType>

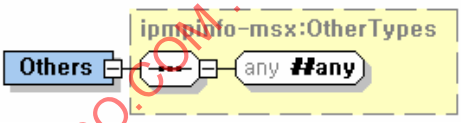
D.1.4.5 <ToolAPI_Config>

The `ToolAPI_Config` element indicates the API supported by the IPMP Tool in order to instantiate it and exchange information with it. The `Instantiation_API_ID` and the `Messaging_API_ID` element specify the identifier of the APIs (of type anyURI) supported by the IPMP Tool for its instantiation and message exchange. These identifiers are registered and maintained by a Registration agency provided by [3] and [7].The `OpagueData` element may be employed to convey proprietary configuration information to a tool.

Diagram	
Children	<Instantiation_API_ID><Messaging_API_ID><OpaqueData>
Used by	<DeviceInformation>
Source	<element name="ToolAPI_Config" type="ipmpinfo-msx:ToolAPI_ConfigType"/> <complexType name="ToolAPI_ConfigType"> <sequence> <element name="Instantiation_API_ID" type="anyURI" minOccurs="0"/> <element name="Messaging_API_ID" type="anyURI" minOccurs="0"/> <element name="OpaqueData" type="hexBinary" minOccurs="0"/> </sequence> </complexType>

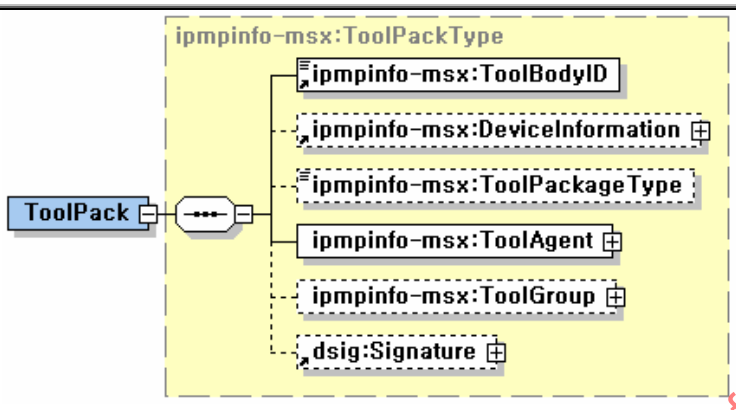
D.1.4.6 <Others>

The `Others` element describes other information of device for tool or tool API execution.

Diagram			
Used by	<DeviceInformation>		
Attributes	**Name**	**Type**	**Description**
	ref	anyURI	The ref attribute shall be employed to indicate the URI of any schema extending the `Others` element, if present.
Source	<element name="Others" type="ipmpinfo-msx:OtherTypes"/> <complexType name="OtherTypes"> <sequence> <any namespace="##any" processContents="lax"/> </sequence> <attribute name="ref" type="anyURI" use="required"/> </complexType>		

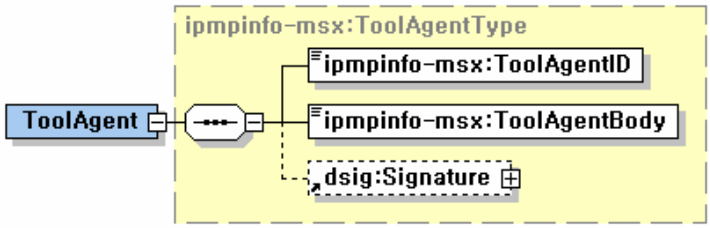
D.1.4.7 <ToolPack>

A logical IPMP Tool can be composed of several modules. The `ToolPack` element describes a structured group of IPMP Tools and the environment in which they operate. An IPMP Tool Pack is a special case of an IPMP Tool because it consists of a group of IPMP Tools, named the IPMP Tool Group, plus a special component named the IPMP Tool Agent. The IPMP Tool Agent manages the Tool Group, performing functions such as instantiation, initialisation, etc. The device information element in a Tool Pack indicates the hardware and software environment in which the Tool Pack may operate.

Diagram	
Children	`<ToolBodyID><DeviceInformation><ToolPackageType><ToolAgent><ToolGroup><Signature>`
Used by	`<ToolBody>`
Source	<element name="ToolPack" type="ipmpinfo-msx:ToolPackType"/> <complexType name="ToolPackType"> <sequence> <element ref="ipmpinfo-msx:ToolBodyID"/> <element ref="ipmpinfo-msx:DeviceInformation" minOccurs="0"/> <element name="ToolPackageType" type="string" minOccurs="0"/> <element name="ToolAgent" type="ipmpinfo-msx:ToolAgentType"/> <element name="ToolGroup" type="ipmpinfo-msx:ToolGroupType" minOccurs="0"/> <element ref="dsig:Signature" minOccurs="0"/> </sequence> </complexType>

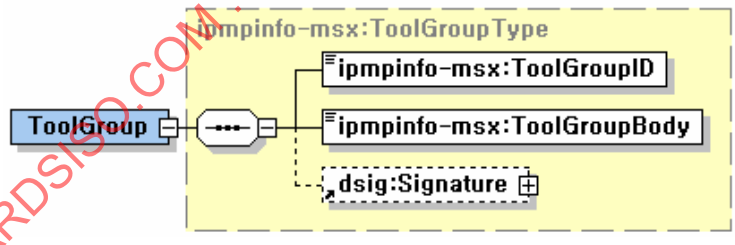
D.1.4.8 <ToolAgent>

The `ToolAgent` element conveys information about the IPMP Tool Agent logical component part of a Tool Group. The role of the IPMP Tool Agent is to instantiate, initialize, authenticate and supervise any operation performed by the IPMP Tools in the Tool Group.

Diagram	
Children	<ToolAgentID><ToolAgentBody><Signature>
Used by	<ToolPack>
Source	<element name="ToolAgent" type="ipmpinfo-msx:ToolAgentType"/> <complexType name="ToolAgentType"> <sequence> <element name="ToolAgentID" type="anyURI"/> <element name="ToolAgentCode" type="base64Binary"/> <element ref="dsig:Signature" minOccurs="0"/> </sequence> </complexType>

D.1.4.9 <ToolGroup>

The `ToolGroup` element conveys structured information related to an IPMP Tool Group. An IPMP Tool Group is a group of several IPMP Tools that can be instantiated and managed by the Tool Agent. In that case, the `ToolGroup` element can contain the binary code of all the IPMP Tools in the Tool Group.

Diagram	
Children	<ToolGroupID><ToolGroupBody><Signature>
Used by	<ToolPack>
Source	<element name="ToolGroup" type="ipmpinfo-msx:ToolGroupType"/> <complexType name="ToolGroupType"> <sequence> <element name="ToolGroupID" type="anyURI"/> <element name="ToolGroupCode" type="base64Binary"/> <element ref="dsig:Signature" minOccurs="0"/> </sequence> </complexType>

D.1.5 Media Streaming IPMP General Information Descriptor elements definition

All elements in the IPMP General Information Descriptor may be used by applications conformant to this specification. IPMP General Information Descriptors in the Media Streaming Player are composed of the subset of IPMP Information Descriptor schema with or without restrictions and/or extensions as specified in the following table.

Element/Child Element	Restrictions
ipmpinfo:IPMPGeneralInfoDescriptor	As defined in 8.3 of ISO/IEC 21000-4.
ipmpinfo:ToolList	This element is restricted to include only `ipmpinfo:ToolDescription`.
ipmpinfo:LicenseCollection	As defined in 8.5 of ISO/IEC 21000-4.
dsig:Signature	As defined in 8.6 of ISO/IEC 21000-4.
ipmpinfo:ToolList	Restricted not to include the `dsig:Signature` element.
ipmpinfo:ToolDescription	Restricted not to include the `ipmpInfo:ConfigurationSettings` element.
ipmpinfo:ToolDescription	This element is restricted to include the following child elements only a `ipmpinfo:IPMPToolID`, an optional `ipmpinfo:MemberOf`, an optional `ipmpinfo:Inline` or `ipmpinfo:Remote`, an optional `ipmpinfo:RightsDescriptor` and an optional `dsig:Signature`.
ipmpinfo:IPMPToolID	As defined in 8.4.4.3 of ISO/IEC 21000-4.
ipmpinfo:MemberOf	As defined in 8.4.4.4 of ISO/IEC 21000-4.
ipmpinfo:Inline	As defined in 8.4.4.5 of ISO/IEC 21000-4.
ipmpinfo:Remote	As defined in 8.4.4.6 of ISO/IEC 21000-4.
ipmpinfo:RightsDescriptor	As defined in 8.4.4.8 of ISO/IEC 21000-4.
dsig:Signature	As defined in 8.4.4.9 of ISO/IEC 21000-4.
@localID	As defined in 8.4.4.1 of ISO/IEC 21000-4.

Annex E
(informative)

Media Streaming IPMP Components schemas

E.1 IPMP Information Descriptor Media Streaming profile schema

```
<?xml version="1.0"?>
<schema targetNamespace="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS"
       xmlns="http://www.w3.org/2001/XMLSchema"
       xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS"
       xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
       xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS"
       xmlns:ipmpmsg="urn:mpeg:mpegB:schema:IPMP-XML-MESSAGES:2007"
       xmlns:mpeg4ipmp="urn:mpeg:mpeg4:IPMPSchema:2002"
       xmlns:ipmpinfo-
msx="urn:mpeg:maf:Schema:mediastreaming:IPMPINFOextensions:2007"
       elementFormDefault="qualified" attributeFormDefault="unqualified"
version="0.01">
    <!-- elements-->
    <element name="IPMPInfoDescriptor" type="ipmpinfo:IPMPInfoDescriptorType"/>
    <complexType name="IPMPInfoDescriptorType">
        <sequence>
            <element ref="ipmpinfo:Tool" minOccurs="0" maxOccurs="unbounded"/>
            <element ref="ipmpinfo:RightsDescriptor" minOccurs="0"
maxOccurs="unbounded"/>
            <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
    </complexType>
    <element name="Tool" type="ipmpinfo:ToolType"/>
    <complexType name="ToolType">
        <sequence>
            <choice>
                <element ref="ipmpinfo:ToolBaseDescription"/>
                <element ref="ipmpinfo:ToolRef"/>
            </choice>
            <element ref="ipmpinfo:InitializationSettings" minOccurs="0"/>
            <element ref="ipmpinfo:RightsDescriptor" minOccurs="0"/>
            <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
        <attribute name="order" type="positiveInteger"/>
    </complexType>
    <element name="ToolBaseDescription" type="ipmpinfo:ToolBaseDescriptionType"/>
    <complexType name="ToolBaseDescriptionType">
        <sequence>
            <element ref="ipmpinfo:IPMPToolID"/>
            <choice minOccurs="0">
                <element ref="ipmpinfo:Inline"/>
                <element ref="ipmpinfo:Remote"/>
            </choice>
            <element ref="ipmpinfo:ConfigurationSettings" minOccurs="0"/>
            <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
    </complexType>
    <element name="ToolRef" type="ipmpinfo:ToolRef"/>
```

```
    <complexType name="ToolRef">
       <attribute name="localidref" type="IDREF" use="required"/>
    </complexType>
    <element name="IPMPToolID" type="anyURI"/>
    <element name="Inline" type="ipmpinfo:InlineType"/>
    <complexType name="InlineType">
       <sequence>
          <element ref="ipmpinfo:Binary"/>
          <element ref="dsig:Signature" minOccurs="0"/>
       </sequence>
    </complexType>
    <element name="Binary" type="base64Binary"/>
    <element name="Remote" type="ipmpinfo:RemoteType"/>
    <complexType name="RemoteType">
       <sequence>
          <element ref="dsig:Signature" minOccurs="0"/>
       </sequence>
       <attribute name="ref" type="anyURI"/>
    </complexType>
    <element name="ConfigurationSettings"
type="ipmpinfo:ConfigurationSettingsType"/>
    <complexType name="ConfigurationSettingsType" mixed="true">
       <sequence>
          <element ref="ipmpinfo:Configuration"/>
          <element ref="ipmpinfo:Update" minOccurs="0"/>
       </sequence>
    </complexType>
    <element name="Configuration" type="ipmpinfo:ConfigurationType"/>
    <complexType name="ConfigurationType" mixed="true">
       <sequence>
          <element ref="ipmpinfo-msx:ToolBody"/>
       </sequence>
    </complexType>
    <element name="Update" type="ipmpinfo:UpdateType"/>
    <complexType name="UpdateType">
       <sequence>
          <element ref="ipmpinfo:Location" maxOccurs="unbounded"/>
          <element ref="ipmpinfo:ScheduledUpdateTime" minOccurs="0"/>
          <element ref="ipmpinfo:SupportedPlatform" minOccurs="0"
maxOccurs="unbounded"/>
          <element ref="dsig:Signature" minOccurs="0"/>
       </sequence>
    </complexType>
    <element name="Location" type="ipmpinfo:RemoteType"/>
    <element name="Condition" type="ipmpinfo:ConditionType"/>
    <complexType name="ConditionType">
       <sequence>
          <element ref="ipmpinfo:ScheduledUpdateTime" minOccurs="0"/>
          <element ref="ipmpinfo:SupportedPlatform" minOccurs="0"
maxOccurs="unbounded"/>
       </sequence>
    </complexType>
    <element name="ScheduledUpdateTime" type="ipmpinfo:ScheduledUpdateTimeType"/>
    <complexType name="ScheduledUpdateTimeType">
       <simpleContent>
          <extension base="dateTime">
             <attribute name="periodic" type="duration" use="optional"/>
          </extension>
       </simpleContent>
    </complexType>
    <element name="SupportedPlatform" type="ipmpinfo:SupportedPlatformType"/>
```

```
    <complexType name="SupportedPlatformType">
        <sequence>
            <element ref="ipmpinfo-msx:DeviceInformation"/>
        </sequence>
    </complexType>
    <element name="InitializationSettings"
type="ipmpinfo:InitializationSettingsType"/>
    <complexType name="InitializationSettingsType" mixed="true">
        <sequence>
            <element ref="ipmpinfo:InitializationData"/>
        </sequence>
    </complexType>
    <element name="InitializationData" type="ipmpinfo:InitializationDataType"/>
    <complexType name="InitializationDataType" mixed="true">
        <sequence>
            <sequence minOccurs="0" maxOccurs="unbounded">
                <element ref="ipmpmsg:ControlPointID" minOccurs="0"/>
                <element ref="ipmpmsg:ControlPointAddress" minOccurs="0"/>
            </sequence>
            <element ref="ipmpmsg:Data_BaseClass" minOccurs="0"
maxOccurs="unbounded"/>
        </sequence>
    </complexType>
    <element name="RightsDescriptor" type="ipmpinfo:RightsDescriptorType"/>
    <complexType name="RightsDescriptorType">
        <sequence>
            <choice minOccurs="0">
                <element ref="ipmpinfo:License"/>
                <element ref="ipmpinfo:LicenseReference"/>
            </choice>
        </sequence>
    </complexType>
    <element name="License" type="ipmpinfo:LicenseType"/>
    <complexType name="LicenseType" mixed="true">
        <sequence>
            <element ref="r:License" maxOccurs="unbounded"/>
        </sequence>
    </complexType>
    <element name="LicenseReference" type="ipmpinfo:LicenseReferenceType"/>
    <complexType name="LicenseReferenceType">
        <simpleContent>
            <extension base="anyURI"/>
        </simpleContent>
    </complexType>
</schema>
```

E.2 IPMP General Information Descriptor Media Streaming profile schema

```
<?xml version="1.0"?>
<schema targetNamespace="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS"
       xmlns="http://www.w3.org/2001/XMLSchema"
       xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS"
       xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
       xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS"
       xmlns:ipmpmsg="urn:mpeg:mpegB:schema:IPMP-XML-MESSAGES:2007"
       xmlns:mpeg4ipmp="urn:mpeg:mpeg4:IPMPSchema:2002"
       xmlns:ipmpinfo-
msx="urn:mpeg:maf:Schema:mediastreaming:IPMPINFOextensions:2007"
       elementFormDefault="qualified" attributeFormDefault="unqualified"
version="0.01">
    <element name="IPMPGeneralInfoDescriptor"
type="ipmpinfo:IPMPGeneralInfoDescriptorType"/>
    <complexType name="IPMPGeneralInfoDescriptorType">
       <sequence>
          <element ref="ipmpinfo:ToolList" minOccurs="0"/>
          <element ref="ipmpinfo:LicenseCollection" minOccurs="0"/>
          <element ref="dsig:Signature" minOccurs="0"/>
          <!--Signature for the IPMPGeneralInfoDescriptor element and children --
>
       </sequence>
    </complexType>
    <element name="ToolList" type="ipmpinfo:ToolListType"/>
    <complexType name="ToolListType">
       <sequence>
          <element ref="ipmpinfo:ToolDescription" maxOccurs="unbounded"/>
       </sequence>
    </complexType>
    <element name="ToolDescription" type="ipmpinfo:ToolDescriptionType"/>
    <complexType name="ToolDescriptionType">
       <sequence>
          <element ref="ipmpinfo:IPMPToolID"/>
          <element ref="ipmpinfo:MemberOf" minOccurs="0"/>
          <choice minOccurs="0">
             <element ref="ipmpinfo:Inline"/>
             <element ref="ipmpinfo:Remote"/>
          </choice>
          <element ref="ipmpinfo:RightsDescriptor" minOccurs="0"/>
          <element ref="dsig:Signature" minOccurs="0"/>
       </sequence>
       <attribute name="localID" type="ID" use="required"/>
    </complexType>
    <element name="MemberOf" type="ipmpinfo:MemberOfType"/>
    <complexType name="MemberOfType">
       <sequence maxOccurs="unbounded">
          <element ref="ipmpinfo:AlternateGroup"/>
       </sequence>
    </complexType>
    <element name="AlternateGroup" type="ipmpinfo:AlternateGroupType"/>
    <complexType name="AlternateGroupType">
       <attribute name="groupID" type="positiveInteger" use="required"/>
    </complexType>
    <element name="LicenseCollection" type="ipmpinfo:LicenseCollectionType"/>
    <complexType name="LicenseCollectionType" mixed="true">
       <sequence>
          <element ref="ipmpinfo:RightsDescriptor" maxOccurs="unbounded"/>
       </sequence>
    </complexType>
</schema>
```

E.3 IPMP Information Descriptor Media Streaming profile extensions schema

```
<?xml version="1.0"?>
<schema
targetNamespace="urn:mpeg:maf:Schema:mediastreaming:IPMPINFOextensions:2007"
       xmlns="http://www.w3.org/2001/XMLSchema"
       xmlns:ipmpinfo-
msx="urn:mpeg:maf:Schema:mediastreaming:IPMPINFOextensions:2007"
       xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
       xmlns:rmsaf="urn:mpeg:mpeg21:2003:01-REL-R-NS"
       xmlns:mpeg4ipmp="urn:mpeg:mpeg4:IPMPSchema:2002"
       elementFormDefault="qualified" attributeFormDefault="unqualified"
version="0.01">
    <!--********************************* -->
    <!--          ToolBody                 -->
    <!--********************************* -->
    <element name="ToolBody" type="ipmpinfo-msx:ToolBodyType"/>
    <complexType name="ToolBodyType">
        <sequence>
            <choice maxOccurs="unbounded">
                <element ref="ipmpinfo-msx:SingleTool"/>
                <element ref="ipmpinfo-msx:ToolPack"/>
            </choice>
            <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
    </complexType>
    <element name="ToolPack" type="ipmpinfo-msx:ToolPackType"/>
    <complexType name="ToolPackType">
        <sequence>
            <element ref="ipmpinfo-msx:ToolBodyID"/>
            <element ref="ipmpinfo-msx:DeviceInformation" minOccurs="0"/>
            <element name="ToolPackageType" type="string" minOccurs="0"/>
            <element name="ToolAgent" type="ipmpinfo-msx:ToolAgentType"/>
            <element name="ToolGroup" type="ipmpinfo-msx:ToolGroupType"
minOccurs="0"/>
            <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
    </complexType>
    <element name="ToolAgent" type="ipmpinfo-msx:ToolAgentType"/>
    <complexType name="ToolAgentType">
        <sequence>
            <element name="ToolAgentID" type="anyURI"/>
            <element name="ToolAgentCode" type="base64Binary"/>
            <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
    </complexType>
    <element name="ToolGroup" type="ipmpinfo-msx:ToolGroupType"/>
    <complexType name="ToolGroupType">
        <sequence>
            <element name="ToolGroupID" type="anyURI"/>
            <element name="ToolGroupCode" type="base64Binary"/>
            <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
    </complexType>
    <element name="SingleTool" type="ipmpinfo-msx:DRMToolType"/>
    <complexType name="DRMToolType">
        <sequence>
            <element ref="ipmpinfo-msx:ToolBodyID"/>
            <element ref="ipmpinfo-msx:DeviceInformation" minOccurs="0"/>
            <element name="ToolPackageType" type="string" minOccurs="0"/>
```

```
            <element name="ToolCode" type="base64Binary"/>
            <element ref="dsig:Signature" minOccurs="0"/>
        </sequence>
    </complexType>
    <complexType name="ToolUpdateType"/>
    <element name="ToolBodyID" type="anyURI"/>
    <!--********************************* -->
    <!--       DeviceInformation          -->
    <!--********************************* -->
    <element name="DeviceInformation" type="ipmpinfo-msx:DeviceType"/>
    <complexType name="DeviceType">
        <complexContent>
            <extension base="mpeg4ipmp:TerminalIDType">
                <sequence>
                    <element ref="ipmpinfo-msx:ToolAPI_Config" minOccurs="0"
maxOccurs="unbounded"/>
                    <element ref="ipmpinfo-msx:Others" minOccurs="0"/>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
    <element name="Others" type="ipmpinfo-msx:OtherTypes"/>
    <complexType name="OtherTypes">
        <sequence>
            <any namespace="##any" processContents="lax"/>
        </sequence>
        <attribute name="ref" type="anyURI" use="required"/>
    </complexType>
    <element name="ToolAPI_Config" type="ipmpinfo-msx:ToolAPI_ConfigType"/>
    <complexType name="ToolAPI_ConfigType">
        <sequence>
            <element name="Instantiation_API_ID" type="anyURI" minOccurs="0"/>
            <element name="Messaging_API_ID" type="anyURI" minOccurs="0"/>
            <element name="OpaqueData" type="hexBinary" minOccurs="0"/>
        </sequence>
    </complexType>
</schema>
```


E.4 IPMP DIDL Media Streaming profile schema

```
<?xml version="1.0"?>
<schema targetNamespace="urn:mpeg:mpeg21:2004:01-IPMPDIDL-NS"
        xmlns="http://www.w3.org/2001/XMLSchema"
        xmlns:ipmpdidl="urn:mpeg:mpeg21:2004:01-IPMPDIDL-NS"
        xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-IPMPINFO-NS"
        xmlns:didmodel="urn:mpeg:mpeg21:2002:02-DIDMODEL-NS"
        elementFormDefault="qualified" attributeFormDefault="unqualified"
version="0.01">
    <element name="Item" type="ipmpdidl:ItemType"
substitutionGroup="didmodel:Item"/>
    <complexType name="ItemType">
        <complexContent>
            <extension base="didmodel:ItemType">
                <sequence>
                    <group ref="ipmpdidl:IPMPDIDLChildGroup"/>
                </sequence>
            </extension>
        </complexContent>
    </complexType>
```

```
    <element name="Statement" type="ipmpdidl:StatementType"
substitutionGroup="didmodel:Statement"/>
    <complexType name="StatementType" mixed="true">
       <complexContent mixed="true">
          <extension base="didmodel:StatementType">
             <sequence>
                <group ref="ipmpdidl:IPMPDIDLChildGroup"/>
             </sequence>
          </extension>
       </complexContent>
    </complexType>
    <element name="Resource" type="ipmpdidl:ResourceType"
substitutionGroup="didmodel:Resource"/>
    <complexType name="ResourceType" mixed="true">
       <complexContent mixed="true">
          <extension base="didmodel:ResourceType">
             <sequence>
                <group ref="ipmpdidl:IPMPDIDLChildGroup"/>
             </sequence>
          </extension>
       </complexContent>
    </complexType>
    <!-- elements from here onward are unique to the IPMP DIDL Representation-->
    <group name="IPMPDIDLChildGroup">
       <sequence>
          <element ref="ipmpdidl:Identifier" minOccurs="0"/>
          <element ref="ipmpdidl:Info"/>
          <element ref="ipmpdidl:Contents"/>
       </sequence>
    </group>
    <element name="Contents">
       <complexType mixed="true">
          <sequence>
             <any namespace="##any" processContents="lax" minOccurs="0"/>
          </sequence>
          <attribute name="ref" type="anyURI"/>
       </complexType>
    </element>
    <element name="Info">
       <complexType mixed="true">
          <sequence>
             <element ref="ipmpinfo:IPMPInfoDescriptor" maxOccurs="unbounded"/>
          </sequence>
       </complexType>
    </element>
    <element name="Identifier">
       <complexType mixed="true">
          <sequence>
             <any namespace="##any" processContents="lax" minOccurs="0"/>
          </sequence>
       </complexType>
    </element>
    <element name="ProtectedAsset" type="ipmpdidl:ProtectedAssetType"/>
    <complexType name="ProtectedAssetType">
       <sequence>
          <group ref="ipmpdidl:IPMPDIDLChildGroup"/>
       </sequence>
       <attribute name="mimeType" type="string" use="required"/>
       <attribute name="contentEncoding" type="string"/>
    </complexType>
</schema>
```

Annex F
(normative)

Media Streaming MAF file format

F.1 Introduction

Digital Items, together with included or referenced resources that are received via streaming are stored according to the MPEG-21 file format.

A Media Streaming Player MAF file is an MPEG-21 file as defined in ISO/IEC 21000-9, in which the primary item must be an MPEG-21 DIDL as defined in the sections above. The brand for indicating compatibility with this specification is 'msmf'. In the case that this is the major brand, the minor version is '0'.

The MPEG-21 File Format is based on ISO/IEC 14496-12, which defines how to contain timed media information for a presentation.

In ISO/IEC 21000-9, files are formed as a series of objects, called boxes. All data is contained in boxes; there is no other data within the file.

F.2 Supported boxes in the Media Streaming MAF file format

Table F.1 is a subset of the table described in ISO/IEC 21000-9, and provides a view of the encapsulation of boxes. The first three columns represent the 4CC identifying the box type; this information is displayed on three columns in order to show the nesting level of the boxes.

Table F.1 — Supported boxes

			Mandatory	Description
ftyp			yes	*file type and compatibility*
meta			yes	*Metadata*
	hdlr		yes	*handler, declares the metadata (handler) type*
	dinf			*Data information box, container*
		dref		*Data reference box*
	iloc		yes	*item location*
	iinf			*item information*
	bxml			*binary XML container*
	xml			*XML container*
	pitm			*primary item reference*
mdat				*media data container*
free				*free space*

The boxes defined in Table F.1 shall be conformant to ISO/IEC 21000-9. In a Media Streaming Player MAF, either the 'bxml' or the 'xml' box shall be present, and shall contain a Digital Item Declaration conformant to the specification in 6.

Other data files as needed may appear as items in the MPEG-21 file. However, the "item protection" box is not allowed in a Media Streaming Player MAF file, as the protection information shall be expressed as specified in IPMP DIDL.

Annex G
(informative)

An Example of Media Streaming MAF: IPTV

G.1 Scenario description

In this scenario a Content Provider Device streams resources and Digital Items on an IP network with a guaranteed Quality of Service (QoS) using the Real Time Protocol (RTP) over User Datagram Protocol (UDP). The Digital Items streamed contain, in addition to other service-related metadata, the IPMP Tools that are needed to play the resources and the corresponding licenses. Additionally, there is a separate License Provider Device, which a Media Streaming Player can access to obtain additional licenses.

A subscriber to the IPTV service can play content received depending on subscription terms and, if the license permits it, the Media Streaming Player can create a file out of that content and store it for later play. If the MSP is part of a domain, it can request and obtain a further license to copy and/or move the file and have it used by the MSPs of the domain.

G.2 Data type examples

G.2.1 Digital Items

The following example shows a Digital Item describing a list of audio and video streams inside a program. Some of the items in the program are protected, as specified in the related governance information, using ISO-IEC 21000-4 as specified in this document.

```
<?xml version="1.0" encoding="UTF-8"?>
<DIDL xmlns="urn:mpeg:mpeg21:2006:07:DIDL-NS" xmlns:didl-
msx="urn:mpeg:maf:schema:mediastreaming:DIDLextensions"
xmlns:dii="urn:mpeg:mpeg21:2002:01-DII-NS" xmlns:ipmpdidl="urn:mpeg:mpeg21:2004:01-IPMPDIDL-NS"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:ipmpinfo="urn:mpeg:mpeg21:2004:01-
IPMPINFO-NS" xmlns:ipmpinfomsx="urn:mpeg:maf:Schema:mediastreaming:IPMPINFOextensions:2007"
xmlns:ipmpmsg="urn:mpeg:mpeg21:schema:IPMP-XML-MESSAGES:2007" xmlns:tva_ms-
maf="urn:mpeg:maf:Profile:mediastreaming:tva:2007" xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS"
xmlns:mx="urn:mpeg:mpeg21:2003:01-REL-MX-NS" xmlns:mpeg4ipmp="urn:mpeg:mpeg4:IPMPSchema:2002"
xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
xmlns:mp7smp="urn:mpeg:mpeg7:smp:schema:2001">
<Item id="Program3">
<Descriptor>
    <Statement mimeType="text/plain">
        <dii:Identifier>Identifier of IPTV Program 1</dii:Identifier>
    </Statement>
</Descriptor>
<Descriptor>
    <Statement mimeType="text/xml">
        <didl-msx:Metadata>
            <didl-msx:StructuredData ref="urn:urn:mpeg:maf:schema:media-
streaming:represent:metadata">
                <tva_ms-maf:TVAMain>
                    <tva_ms-maf:ProgramDescription>
                        <tva_ms-maf:ProgramInformationTable>
                            <tva_ms-maf:ProgramInformation programId="crid://foo.com/1234567">
                                <tva_ms-maf:BasicDescription>
                                    <tva_ms-maf:Title><![CDATA[Around the World in 80
Treasures]]></tva_ms-maf:Title>
                                    <tva_ms-maf:Synopsis length="short"><![CDATA[Dan Cruickshank
visits India and Sri Lanka as he continues his search for the world's most beautiful and precious
treasures. [S,SL]]]></tva_ms-maf:Synopsis>
                                    <tva_ms-maf:Genre href="urn:tva_ms-
maf:metadata:cs:ContentCS:2002:3.1.5.3">
```

```
                                        <tva_ms-maf:Name><![CDATA[History]]></tva_ms-maf:Name>
                                    </tva_ms-maf:Genre>
                                    <tva_ms-maf:Genre href="urn:tva_ms-
maf:metadata:cs:IntentionCS:2002:1.3">
                                        <tva_ms-maf:Name><![CDATA[EDUCATION]]></tva_ms-maf:Name>
                                    </tva_ms-maf:Genre>
                                    <tva_ms-maf:Genre href="urn:tva_ms-
maf:metadata:cs:ContentCS:2002:3.1.4">
                                        <tva_ms-maf:Name><![CDATA[Arts & Media]]></tva_ms-maf:Name>
                                    </tva_ms-maf:Genre>
                                    <tva_ms-maf:CaptionLanguage closed="true">EN-UK</tva_ms-
maf:CaptionLanguage>
                                    <tva_ms-maf:SignLanguage translation="true" type="BSL">EN-
UK</tva_ms-maf:SignLanguage>
                                </tva_ms-maf:BasicDescription>
                                <tva_ms-maf:AVAttributes>
                                    <tva_ms-maf:AudioAttributes>
                                        <tva_ms-maf:NumOfChannels>2</tva_ms-maf:NumOfChannels>
                                    </tva_ms-maf:AudioAttributes>
                                    <tva_ms-maf:VideoAttributes>
                                        <tva_ms-maf:AspectRatio>16:9</tva_ms-maf:AspectRatio>
                                    </tva_ms-maf:VideoAttributes>
                                </tva_ms-maf:AVAttributes>
                                <tva_ms-maf:MemberOf xsi:type="tva_ms-maf:MemberOfType"
crid="crid://foo.com/SERAroundtheWorldin80Treasures"/>
                            </tva_ms-maf:ProgramInformation>
                        </tva_ms-maf:ProgramInformationTable>
                    </tva_ms-maf:ProgramDescription>
                </tva_ms-maf:TVAMain>
            </didl-msx:StructuredData>
        </didl-msx:Metadata>
    </Statement>
</Descriptor>
<Descriptor>
    <Statement mimeType="text/xml">
        <ipmpinfo:IPMPGeneralInfoDescriptor>
            <ipmpinfo:ToolList>
                <ipmpinfo:ToolDescription localID="TPABCDEF9">
                    <ipmpinfo:IPMPToolID>urn:foo:ToolPack:ToolID:ABCDEF9</ipmpinfo:IPMPToolID>
                    <ipmpinfo:Remote ref="http:\\www.fooToolPacks.com\ToolID:ABCDEF9"/>
                    <ipmpinfo:ConfigurationSettings>
                        <ipmpinfo:Update>
                            <ipmpinfo:Location ref="http:\\www.fooToolPacks.com\ToolPackUpdate"/>
                            <ipmpinfo:ScheduledUpdateTime periodic="P1D">2005-03-07T00:00:00
</ipmpinfo:ScheduledUpdateTime>
                        </ipmpinfo:Update>
                    </ipmpinfo:ConfigurationSettings>
                </ipmpinfo:ToolDescription>
            </ipmpinfo:ToolList>
        </ipmpinfo:IPMPGeneralInfoDescriptor>
    </Statement>
</Descriptor>
<Component>
    <Resource mimeType="application/mp21-ipmp">
        <ipmpdidl:ProtectedAsset mimeType="video/MP2P">
            <ipmpdidl:Identifier>urn:mpegRA:mpeg21:dii:isan:006A-15FA-002B-C95F-B
</ipmpdidl:Identifier>
            <ipmpdidl:Info>
                <ipmpinfo:IPMPInfoDescriptor>
                    <ipmpinfo:Tool localIDRef="TPABCDEF9"/>
                    <ipmpinfo:InitializationSettings>
                        <ipmpinfo:InitializationData>
                            <ipmpmsg:AddToolNotificationListener>
                                <ipmpmsg:dataID>98765</ipmpmsg:dataID>
                                <ipmpmsg:scope>00</ipmpmsg:scope>
                                <ipmpmsg:EventType>02</ipmpmsg:EventType>
                            </ipmpmsg:AddToolNotificationListener>
                        </ipmpinfo:InitializationData>
                    </ipmpinfo:InitializationSettings>
                    <ipmpinfo:RightsDescriptor>
                    <!-- Here is Rights Information related to IPMP Tools -->
                    </ipmpinfo:RightsDescriptor>
                    </ipmpinfo:Tool>
                    <ipmpinfo:RightsDescriptor>
                        <ipmpinfo:License>
                        <r:license licenseId="012345">...</r:license>
```

```
                        </ipmpinfo:License>
                    </ipmpinfo:RightsDescriptor>
                </ipmpinfo:IPMPInfoDescriptor>
            </ipmpdidl:Info>
            <ipmpdidl:Contents ref="myserver.com/asset.mpgencoded"/>
            </ipmpdidl:ProtectedAsset>
            </Resource>
</Component>
    <Item id="AudioStream1">
        <Descriptor>
            <Statement mimeType="text/xml">
                <dii:Identifier>urn:mpegRA:mpeg21:dii:isrc:US-ZO3-99-32476</dii:Identifier>
                <!-- ISRC identifying the sound recording -->
            </Statement>
        </Descriptor>
        <Descriptor>
            <Statement mimeType="text/xml">
                <dii:RelatedIdentifier>urn:mpegRA:mpeg21:dii:iswc:T-034.524.680-1
</dii:RelatedIdentifier>
                <!-- ISWC identifying the underlying musical work -->
            </Statement>
        </Descriptor>
        <Descriptor>
            <Statement mimeType="text/xml">
                <didl-msx:Metadata>
                    <!-- Metadata related to this Content Item is Governed now -->
                    <ipmpdidl:Info>
                        <ipmpinfo:IPMPInfoDescriptor/>
                    </ipmpdidl:Info>
                    <ipmpdidl:Contents>01234567890ABCDEF</ipmpdidl:Contents>
                    <!-- Insert the Governed - obfuscated metadata in element below -->
                </didl-msx:Metadata>
            </Statement>
        </Descriptor>
        <Component>
            <Resource ref="110xxxxx" mimeType="audio/mpeg"/>
            <!-- Audio streams are identified by a stream ID like the one above -->
        </Component>
    </Item>
    <Item id="VideoStream1">
        <Descriptor>
            <Statement mimeType="text/xml">
                <dii:Identifier>urn:mpegRA:mpeg21:dii:isan:006A-15FA-002B-B012-A</dii:Identifier>
            </Statement>
        </Descriptor>
        <Descriptor>
            <Statement mimeType="text/xml">
                <didl-msx:Metadata>
                    <didl-msx:StructuredData ref="urn:mpeg:mpeg7:schema:2001">
                        <!-- MPEG-7 SMP metadata describing the movie-->
                    </didl-msx:StructuredData>
                </didl-msx:Metadata>
            </Statement>
        </Descriptor>
        <Component>
            <Resource ref="1110xxxx" mimeType="video/mpeg"/>
            <!-- Video streams are identified by a stream ID like the one above -->
        </Component>
    </Item>
</Item>
</DIDL>
```

G.2.2 Licenses

The following example shows a license granting the play right with buffering over a broadcast program, which can be used within a Domain of devices.

The program is available at the following conditions:

- for 10 days and 12 hours after receiving the license
- available only within KOREA
- it does not allow to be accessed by more than 3 MSP devices at the same time

```
<?xml version="1.0" encoding="UTF-8"?>
<license xmlns="urn:mpeg:mpeg21:2003:01-REL-R-NS" xmlns:mx="urn:mpeg:mpeg21:2003:01-REL-MX-NS"
xmlns:dacx="urn:mpeg:mpeg21:2006:01-REL-DACX-NS" xmlns:dsig="http://www.w3.org/2000/09/xmldsig#"
xmlns:xenc="http://www.w3.org/2001/04/xmlenc#" xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS"
xmlns:sx="urn:mpeg:mpeg21:2003:01-REL-SX-NS" xmlns:bpx="urn:mpeg:mpeg21:2005:01-REL-BPX-NS"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" sx:profileCompliance="dmp-IDP2-rel-1.0"
xsi:schemaLocation="urn:mpeg:mpeg21:2006:01-REL-DACX-NS rel-dacx-v1.xsd">
    <grant>
        <bpx:identityHolder>
            <bpx:idSystem>urn:mpeg:mpeg21:2006-01-REL-DACX-NS:DM-1000:DO-0001</bpx:idSystem>
            <bpx:idValue>DE0001</bpx:idValue>
        </bpx:identityHolder>
        <mx:play/>
        <bpx:protectedResource>
            <digitalResource>
                <nonSecureIndirect URI="urn:uci:foo-10357"/>
            </digitalResource>
            <xenc:EncryptedKey>
                <xenc:CipherData>
                    <xenc:CipherValue>
    ujnDATAPgvq5dPDvTGPPhJIpqnSieHWK2BEn2JYi2AgiTWtTqSsCIqg/76hHCmzSHAXrFaqTl/Zi3LtbXoCV
    MoDXgMFkUGIWVyLGDFmq5VxyOwzYM/WMWCEMF1qIUtKW62chDiPaEOfY6dPFyHxtUi4wXMpd3TcIYwV/QTQDMDg=
                    </xenc:CipherValue>
                </xenc:CipherData>
            </xenc:EncryptedKey>
        </bpx:protectedResource>
        <allConditions>
            <sx:validityIntervalFloating>
                <sx:duration>P10DT12H</sx:duration>
            </sx:validityIntervalFloating>
            <sx:territory>
                <sx:location>
                    <sx:country>KR</sx:country>
                </sx:location>
            </sx:territory>
            <dacx:destinationPrincipal>
                <bpx:identityHolder>
                    <bpx:idSystem>urn:mpeg:mpeg21:2006-01-REL-DACX-NS:DM-1000</bpx:idSystem>
    <bpx:idValue>DO0001</bpx:idValue>
                </bpx:identityHolder>
            </dacx:destinationPrincipal>
            <dacx:simultaneousAccessCount>
                <dacx:count>3</dacx:count>
            </dacx:simultaneousAccessCount>
        </allConditions>
    </grant>
    <issuer>
        <keyHolder>
            <info>
                <dsig:KeyName>Issuer's signing key</dsig:KeyName>
            </info>
        </keyHolder>
    </issuer>
</license>
```

G.2.3 IPMP Components, etc.

The following example shows an IPMPGeneralInfoDescriptor element conveying a set of information related to an IPMP Tool required to process protected content.

```
<ipmpinfo:IPMPGeneralInfoDescriptor>
    <ipmpinfo:ToolList>
        <ipmpinfo:ToolDescription localID="TPABCDEF9">
            <ipmpinfo:IPMPToolID>urn:foo:ToolPack:ToolID:ABCDEF9</ipmpinfo:IPMPToolID>
            <ipmpinfo:Remote ref="http:\\www.fooToolPacks.com\ToolID:ABCDEF9"/>
            <ipmpinfo:ConfigurationSettings>
                <ipmpinfo:Update>
                    <ipmpinfo:Location ref="http:\\www.fooToolPacks.com\ToolPackUpdate"/>
                    <ipmpinfo:ScheduledUpdateTime periodic="P1D">2005-03-07T00:00:00
</ipmpinfo:ScheduledUpdateTime>
                </ipmpinfo:Update>
            </ipmpinfo:ConfigurationSettings>
        </ipmpinfo:ToolDescription>
    </ipmpinfo:ToolList>
</ipmpinfo:IPMPGeneralInfoDescriptor>
```

The following example shows the declaration of a Resource protected by the IPMP Tool declared in the figure above.

```
<Resource mimeType="application/mp21-ipmp">
    <ipmpdidl:ProtectedAsset mimeType="video/MP2P">
        <ipmpdidl:Identifier>urn:mpegRA:mpeg21:dii:isan:006A-15FA-002B-C95F-B</ipmpdidl:Identifier>
            <ipmpdidl:Info>
                <ipmpinfo:IPMPInfoDescriptor>
                    <ipmpinfo:Tool localIDRef="TPABCDEF9"/>
                    <ipmpinfo:InitializationSettings>
                        <ipmpinfo:InitializationData>
                            <ipmpmsg:AddToolNotificationListener>
                                <ipmpmsg:dataID>98765</ipmpmsg:dataID>
                                <ipmpmsg:scope>00</ipmpmsg:scope>
                                <ipmpmsg:EventType>02</ipmpmsg:EventType>
                            </ipmpmsg:AddToolNotificationListener>
                        </ipmpinfo:InitializationData>
                    </ipmpinfo:InitializationSettings>
                    <ipmpinfo:RightsDescriptor>
                        <!-- Here is Rights Information related to IPMP Tools -->
                    </ipmpinfo:RightsDescriptor>
                    </ipmpinfo:Tool>
                    <ipmpinfo:RightsDescriptor>
                        <ipmpinfo:License>
                            <r:license licenseId="012345">
                            </r:license>
                        </ipmpinfo:License>
                    </ipmpinfo:RightsDescriptor>
                </ipmpinfo:IPMPInfoDescriptor>
            </ipmpdidl:Info>
        <ipmpdidl:Contents ref="myserver.com/asset.mpgencoded"/>
    </ipmpdidl:ProtectedAsset>
</Resource>
```