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Information technology — Multimedia framework (MPEG-21) —

Part 10: Digital Item Processing

Technologies de l'information — Cadre multimédia (MPEG-21) — Partie 10: Traitement d'élément numérique

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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 21000-10 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 21000 consists of the following parts, under the general title *Information technology — Multimedia framework (MPEG-21)*:

— *Part 1: Vision, Technologies and Strategy* [Technical Report]

— *Part 2: Digital Item Declaration*

— *Part 3: Digital Item Identification*

— *Part 4: Intellectual Property Management and Protection Components*

— *Part 5: Rights Expression Language*

— *Part 6: Rights Data Dictionary*

— *Part 7: Digital Item Adaptation*

— *Part 8: Reference Software*

— *Part 9: File Format*

— *Part 10: Digital Item Processing*

— *Part 11: Evaluation Tools for Persistent Association Technologies* [Technical Report]

— *Part 12: Test Bed for MPEG-21 Resource Delivery* [Technical Report]

— *Part 16: Binary Format*

The following parts are under preparation:

— *Part 14: Conformance Testing*

— *Part 15: Event Reporting*

— *Part 17: Fragment Identification of MPEG Resources*

— *Part 18: Digital Item Streaming*

Introduction

Today, many elements exist to build an infrastructure for the delivery and consumption of multimedia content. There is, however, no “big picture” to describe how these elements, either in existence or under development, relate to each other. The aim for ISO/IEC 21000 (MPEG-21) is to describe how these various elements fit together. Where gaps exist, MPEG-21 will recommend which new standards are required. ISO/IEC JTC 1/SC 29/WG 11 (MPEG) will then develop new standards as appropriate while other relevant standards may be developed by other bodies. These specifications will be integrated into the multimedia framework through collaboration between MPEG and these bodies.

The result is an open framework for multimedia delivery and consumption, with both the content creator and content consumer as focal points. This open framework provides content creators and service providers with equal opportunities in the MPEG-21 enabled open market. This will also be to the benefit of the content consumers, providing them access to a large variety of content in an interoperable manner.

The vision for MPEG-21 is to define a multimedia framework *to enable transparent and augmented use of multimedia resources across a wide range of networks and devices* used by different communities.

A key concept of the multimedia framework is the Digital Item. In MPEG-21 a Digital Item is a structured digital object with a standard representation, identification, and metadata. An equally important concept in the multimedia framework is the notion of the User. In MPEG-21 a User is any entity that interacts with the multimedia framework and as such includes all members of the value chain (e.g., creator, rights holders, distributors and consumers of Digital Item(s) and include, for example, individuals, consumers, communities, organizations, corporations, consortia, and governments.

Part 2 of MPEG-21 specifies the mechanism for declaring the structure and makeup of Digital Items. Such Digital Item Declarations are static by nature. This 10th part of MPEG-21 specifies tools enabling Users to provide suggested interactions with Digital Items, thereby enabling the inclusion of a dynamic aspect to the static declaration of Digital Items.

Information technology — Multimedia framework (MPEG-21) —

Part 10:
Digital Item Processing

1 Scope

This Part of ISO/IEC 21000, entitled Digital Item Processing (DIP), specifies the syntax and semantics of tools that may be used to process Digital Items. The tools provide a normative set of tools that specify the processing of a Digital Item in a predefined manner.

This technology is specified in one normative clause and three normative annexes:

— Digital Item Methods:

  Digital Item Methods (Clause 5) specifies the set of tools enabling Digital Item Users to include sequences of instructions for adding predefined functionality to a Digital Item. Such a sequence of instructions is a Digital Item Method. Digital Item Methods are authored with the Digital Item Method Language (see 5.2) which includes bindings to Digital Item Base Operations (see 5.4). For extended functionality, Digital Item eXtension Operations (see 5.6) allow such processing to be implemented more efficiently in a higher level programming language. Tools for integrating Digital Item Methods into Digital Item Declarations are also specified (see 5.3).

— ECMAScript bindings for Digital Item Base Operations:

  Annex A specifies the ECMAScript bindings for the Digital Item Base Operations described in 5.3.

— Java bindings for Digital Item Base Operations:

  Annex B specifies the Java bindings for the Digital Item Base Operations described in 5.4.

— Calling Java based DIXOs from Digital Item Methods:

  Annex C specifies the mechanism for calling Java based Digital Item eXtension Operations. Digital Item eXtension Operations are described in 5.6.

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 16262:2002, *Information technology — ECMAScript language specification*

ISO/IEC 21000 (all parts), *Information technology — Multimedia framework (MPEG-21)*

IETF RFC 2046, *Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types*, 1996

IETF RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax*, 2005

W3C REC-DOM-Level-3-Core-20040407, *Document Object Model (DOM) Level 3 Core Specification, Version 1.0*, W3C Recommendation 07 April 2004

W3C REC-DOM-Level-3-LS-20040407, *Document Object Model (DOM) Level 3 Load and Save Specification, Version 1.0*, W3C Recommendation 07 April 2004

W3C REC-xml-20040204, *Extensible Markup Language (XML) 1.0 (Third Edition)*, W3C Recommendation 04 February 2004

W3C REC-xml-names-19990114, *Namespaces in XML*, World Wide Web Consortium 14 January 1999

W3C REC-xmlschema-1-20041028, *XML Schema Part 1: Structures Second Edition*, W3C Recommendation 28 October 2004

W3C REC-xmlschema-2-20041028, *XML Schema Part 2: Datatypes Second Edition*, W3C Recommendation 28 October 2004

W3C REC-xpath-19991116, *XML Path Language (XPath), Version 1.0*, W3C Recommendation 16 November 1999

3 Terms, definitions, and abbreviated terms

For the purposes of this part of ISO/IEC 21000, the following terms, definitions and abbreviations apply:

3.1
Argument Type
type of the Digital Item Method Argument specified by an `Argument` element of the associated Digital Item Method declaration

NOTE 1 Argument Type is part of the Object Map allowing mapping of DIM Arguments to DID Objects.

NOTE 2 For further information see 5.3.5.

3.2
Digital Item
DI
structured digital object, including a standard representation, identification and metadata within the MPEG-21 framework

NOTE This entity is the fundamental unit of distribution and transaction within the multimedia framework as a whole.

[ISO/IEC TR 21000-1:2004, definition 2.3]

3.3
DIA
Digital Item Adaptation as specified by ISO/IEC 21000-7

3.4
Digital Item Base Operation
DIBO
base operation providing access to functionality implemented within an MPEG-21 environment and used in authoring a Digital Item Method

NOTE For further information see Clause 5.4.

3.5
Digital Item Base Operation implementation
manner in which a particular implementer of a Digital Item Base Operation chooses to implement the normative semantics of the Digital Item Base Operation

3.6
Digital Item Declaration
DID
declaration of the resources, metadata and their interrelationships of a Digital Item specified by ISO/IEC 21000-2

3.7
Digital Item Declaration Language
DIDL
XML-based language including validation rules specified by ISO/IEC 21000-2 for the standard representation in XML of a Digital Item Declaration

3.8
Digital Item Declaration Language document
a document using the Digital Item Declaration Language to declare a Digital Item in a standard representation in XML specified by ISO/IEC 21000-2

3.9
Digital Item Declaration Language element
XML element of the Digital Item Declaration Language specified by ISO/IEC 21000-2

3.10
Digital Item Declaration Model

set of abstract terms and concepts specified by ISO/IEC 21000-2 forming a model for declaring Digital Items

3.11
Digital Item Declaration Model entity
entity of the Digital Item Declaration Model specified by ISO/IEC 21000-2

3.12
Digital Item Declaration Object
Object
object representation in the Digital Item Method Language of a Digital Item Declaration element and associated with an Object Type

NOTE 1 A Digital Item Declaration Object has an Object Type that allows it to be processed in a Digital Item Method according to the Object Type. A Digital Item Declaration element is mapped to an Object Type by the Object Map.

NOTE 2 An Object Type is associated with a Digital Item Declaration element by an `ObjectType` element contained in a DESCRIPTOR-STATEMENT child of the Digital Item Declaration element. For further information see 5.3.

NOTE 3 The capitalized term Object is used in this part of ISO/IEC 21000 to mean a Digital Item Declaration Object. Other uses of the term object without an initial uppercase letter is used for an object as understood in the context of object-oriented programming.

3.13
Digital Item eXtension Operation
DIXO
operation allowing extended functionality to be invoked from a Digital Item Method

NOTE For further information see Clause 5.6.

3.14
Digital Item eXtension Operation Language
DIXL
programming language in which a Digital Item eXtension Operation is defined

3.15
DII
Digital Item Identification as specified by ISO/IEC 21000-3

3.16
Digital Item Method
DIM
tool for expressing the suggested interaction of a User with a Digital Item at the level of the Digital Item Declaration

NOTE 1 For further information see Clause 5.

NOTE 2 A Digital Item Method is composed of a Digital Item Method definition and its declaration.

3.17
Digital Item Method Argument
argument to a Digital Item Method as represented in the Digital Item Method Language

3.18
Digital Item Method declaration
declaration of the Digital Item Method as being part of a particular Digital Item

NOTE For further information see Clause 5.3.

3.19
Digital Item Method definition
code written in the Digital Item Method Language that defines the Digital Item Method and that is either embedded inline with the Digital Item Method declaration or located separately and referenced from the Digital Item Method declaration

NOTE Whether the Digital Item Method definition is embedded inline or referenced from a separate location, it is the Digital Item Method definition itself that is the *resource* (in terms of the Digital Item Declaration Model).

3.20
Digital Item Method Language
DIML
language providing the syntax and structure for authoring a Digital Item Method utilizing the Digital Item Base Operations

NOTE For further information see Clause 5.2

3.21
Digital Item Processing engine
component within an MPEG-21 environment that supports ISO/IEC 21000-10 and is responsible for providing such supporting functionality (including execution of Digital Item Methods)

3.22
DOM
Document Object Model (see W3C REC-DOM-Level-3-Core-20040407)

3.23
End User
User taking the role of consumer, i.e. being at the end of a value or delivery chain

EXAMPLE A human consumer or an agent operating on behalf of a human consumer, etc.

[ISO/IEC TR 21000-1:2004, definition 2.4]

3.24
GUI
Graphical User Interface

3.25
IPMP
Intellectual Property Management and Protection as specified by ISO/IEC 21000-4

3.26
JPEG
Joint Photographic Experts Group

3.27
MIME
Multipurpose Internet Mail Extensions (see IETF RFC 2046)

3.28
MP3
MPEG-1/2 layer 3 (audio coding)

3.29
MPEG
Moving Picture Experts Group

3.30
Object Map
map of Digital Item Declaration elements in a Digital Item Declaration to Digital Item Declaration Objects with their associated Object Types

EXAMPLE An object map might map several ITEM elements to an Object Type of “music track”, and another ITEM element to an Object Type of “album information”.

NOTE For further information see 5.3.5.

3.31
Object Type
type of the Digital Item Declaration Object specified by an `ObjectType` descriptor of the associated DIDL element

NOTE 1 Object Type is part of the Object Map allowing mapping of DID Objects to DIM Arguments.

NOTE 2 For further information see Clause 5.3.5.

3.32
Peer
device or application that compliantly processes a Digital Item

[ISO/IEC TR 21000-1:2004, definition 2.7]

3.33
RDD
Rights Data Dictionary as specified by ISO/IEC 21000-6

3.34
REL
Rights Expression Language as specified by ISO/IEC 21000-5

3.35
URI
Uniform Resource Identifier (see IETF RFC 3986)

3.36
URL
Uniform Resource Locator (see IETF RFC 3986)

3.37
User
entity that interacts in the MPEG-21 environment or makes use of Digital Items

NOTE This includes all members of the value chain (e.g., creator, rights holders, distributors and consumers of Digital Items).

[ISO/IEC TR 21000-1:2004, definition 2.9]

3.38
W3C
World Wide Web Consortium

3.39
XML
Extensible Markup Language (see W3C REC-xml-20040204)

4 Overview and Conventions

4.1 Overview of Digital Item Processing

The Digital Item Declaration Language described in ISO/IEC 21000-2 is for creating a static declaration. Digital Item Processing assists processing of a Digital Item by providing tools allowing a User to add User specified functionality to a Digital Item Declaration. The standardization of Digital Item Processing enables interoperability at the processing level.

A key component of Digital Item Processing is the Digital Item Method (see 5). A Digital Item Method is the tool whereby a User (as defined in 21000-1) specifies suggested interactions with the Digital Item. As such, Digital Item Methods provide a way for a User to specify a selection of suggested procedures for processing a Digital Item at the level of the Digital Item itself.

EXAMPLE A Digital Item representing a music album can contain a Digital Item Method to add a new music track to the album. Such a Digital Item Method can be used to ensure that the new music track is added to the Digital Item while maintaining a suggested format for the Digital Item Declaration of such a music album Digital Item (i.e., elements added in the correct place in the Digital Item Declaration structure, correct Descriptors are included, etc.).

A Digital Item Method is expressed using the Digital Item Method Language (see 5.2) which includes a binding for Digital Item Base Operations (see 5.4). Digital Item eXtension Operations (see 5.6) provide a mechanism that allows the functionality provided by the standard set of Digital Item Base Operations to be extended.

Digital Item Methods, and the Digital Item Base Operations and Digital Item eXtension Operations called by them, can be considered as requests to the Digital Item Processing engine to process the Digital Item in some manner, or to execute some action.

The interface through which a User interacts with a Digital Item using Digital Item Processing is implementation dependent. Some implementations might support specification of aspects of the interface by metadata included in the Digital Item. Some possible scenarios follow.

— On receipt of a Digital Item Declaration, a list of Digital Item Methods (contained or referenced from within the DIDL document representing the Digital Item) can be presented to the User. The User can choose a Digital Item Method and then the Objects on which it operates. The Digital Item Processing engine then executes the chosen Digital Item Method with the chosen Objects as arguments;

— On receipt of a Digital Item Declaration, a list of Objects is presented based on the presence of Identifiers of the DII XML Namespace. The User chooses one or more of these Object(s). A list of Digital Item Methods that takes as arguments the (set of) Object(s) is then presented to the User. The User selects a Digital Item Method that is then executed by the Digital Item Processing engine.

4.2 Relation of Digital Item Processing with other parts of ISO/IEC 21000

Digital Item Processing is related to ISO/IEC 21000-2 by providing normative tools that enable functionality to be included in a Digital Item.

Implementations of DIBOs might have requirements or choices of implementation related to other parts of ISO/IEC 21000. ISO/IEC 21000-4, for instance, is expected to require that DIBO implementations accessing governed resources are required to check for permissions before doing so. In such cases, DIBO implementations would check for permissions and, in so doing, may take advantage of information compliant with ISO/IEC 21000-5 and ISO/IEC 21000-6. DIBO implementations may also make use of information compliant with ISO/IEC 21000-7, if appropriate to the DIBO semantics.

NOTE Annex G provides guidance on how to support DIP while maintaining a level of interaction with a Digital Item that is consistent with the available rights.

Overall processing of a Digital Item remains largely at the discretion of an application. Digital Items are intended to be used throughout the delivery chain, and thus different applications and different Users will perform different overall processing of a Digital Item. Digital Item Methods can be regarded as a 'menu' of User interaction possibilities. Digital Item Methods can then be utilized during processing of Digital Items to understand the Digital Item Method author's suggested manner of User interaction with a Digital Item. Different Digital Item Methods can be authored such that they provide different suggested interactions appropriate for different Users at various junctures in the delivery chain. This part of ISO/IEC 21000 specifies how to author Digital Item Methods and integrate them in a Digital Item Declaration. It does not specify how to restrict access to a Digital Item Method. This can be achieved, by utilizing other parts of ISO/IEC 21000 such as ISO/IEC 21000-4 and ISO/IEC 21000-5.

4.3 Documentation conventions

Literal machine-readable character sequences are shown in `fixed width font`.

References to DID Model entity names are shown in *italics*.

References to DIDL element names are shown in FIXED WIDTH SMALL CAPS FONT.

Normative syntax for DIP tools specified by XML Schema declarations and definitions are shown in this document using a separate font and background as follows.

EXAMPLE

```
<complexType name="ExampleType">
   <simpleContent>
      <extension base="string"/>
   </simpleContent>
</complexType>
```

XML Schema declarations and definitions as in the above example are to be considered fragments of a complete schema within an XML schema wrapper as described in 4.4.

Normative semantics for XML Schema declarations and definitions are set out in a table as follows.

EXAMPLE

Semantics of `ExampleType`:

Name	*Definition*
`ExampleType`	Example type semantics.

4.4 Schema wrapper

XML Schema declarations and definitions provided as XML fragments are to be understood as fragments of a complete schema and contained within an XML Schema `schema` element as follows.

```
<?xml version="1.0"?>
<!-- Digital Item Processing ISO/IEC 21000-10 -->
<schema
   targetNamespace="urn:mpeg:mpeg21:2005:01-DIP-NS"
   xmlns="http://www.w3.org/2001/XMLSchema"
   xmlns:dip="urn:mpeg:mpeg21:2005:01-DIP-NS"
   elementFormDefault="qualified" attributeFormDefault="unqualified">

</schema>
```


4.5 Use of namespace prefixes

Qualified Names are written with a namespace prefix followed by a colon followed by the local part of the Qualified Name as shown in the following example.

EXAMPLE `dip:ObjectType`

For clarity, consistent namespace prefixes as listed below are used in this part of ISO/IEC 21000.

Table 1 — Mapping of prefixes to namespaces

Prefix	**Namespace**
`dia`	`urn:mpeg:mpeg21:2003:01-DIA-NS`
`didl`	`urn:mpeg:mpeg21:2002:02-DIDL-NS`
`dii`	`urn:mpeg:mpeg21:2002:01-DII-NS`
`dip`	`urn:mpeg:mpeg21:2005:01-DIP-NS`
`xsd`	`http://www.w3.org/2001/XMLSchema`
`xsi`	`http://www.w3.org/2001/XMLSchema-instance`
`xi`	`http://www.w3.org/2001/XInclude`
NOTE The prefixes `xml` and `xmlns` are normatively defined by *Namespaces in XML (see* W3C REC-xml-names-19990114*)*. All other prefixes are not normative and are used by convention for consistency in this part of ISO/IEC 21000.	

For informative examples provided as XML fragments without namespace declarations, the default namespace by convention in this part of ISO/IEC 21000 is defined as `urn:mpeg:mpeg21:2002:02-DIDL-NS` and the different prefixes are bound to the namespaces as listed above.

5 Digital Item Methods

5.1 Introduction

Digital Item Methods (DIMs) provide for a programmatic invocation of Digital Item Base Operations (DIBOs). Thereby a suggested interaction of the User with the Digital Item is provided. DIMs should thus be viewed from a User perspective; they are intended to be related to User interaction with a Digital Item.

DIMs are intended for working with parts of a DI at the DID level. DIMs are not intended to be utilized for implementing the processing of media resources themselves.

EXAMPLE DIMs are not intended to be used for implementing transcoding of media resources. However DIMs might be used for adaptations of the DID at the DID level.

NOTE While the intention is that media resource processing is not implemented directly within a DIM definition, DIBO implementations, such as the `adapt` DIBO (see 5.4.2.4.2), might have semantics that can lead to media resource processing. In addition media resource processing might take place in a DIXO (see 5.6).

Arguments to DIMs are DID Objects representing DIDL elements. The relationship between DIDL elements, DID Objects and DIM Arguments is specified by the Object Map (for further information on the Object Map see 5.3.5).

Digital Item Method tools include the following:

— Digital Item Base Operations (DIBOs) – the Digital Item Base Operations specify a high level normative interface to the basic types of interaction with a Digital Item. The set of normatively defined DIBOs have general application across a wide range of resources, applications, etc.;

— Digital Item Method Language (DIML) – the Digital Item Method Language specifies the normative language for defining interoperable DIMs and from which the DIBOs are able to be called. The ECMAScript binding of the DIBOs is a normative part of the DIML;

— Digital Item Method linkage with DID – this clause also specifies the normative mechanisms for including of Digital Item Methods in a DID;

— Digital Item Method execution – this clause also specifies the execution environment of a DIM; and

— Digital Item eXtension Operations (DIXO) – Digital Item eXtension Operations specify a normative mechanism for enabling functionality that extends beyond the basic functionality of the normative set of DIBOs in an efficient way.