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Information technology — Multimedia framework (MPEG-21) —

Part 7: Digital Item Adaptation

Technologies de l'information — Cadre multimédia (MPEG-21) —

Partie 7: Adaptation d'article 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.

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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.

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ISO/IEC 21000-7 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This second edition cancels and replaces the first edition (ISO/IEC 21000-7:2004), which has been technically revised. It also incorporates the Amendments ISO/IEC 21000-7:2004/Amd.1:2006 and ISO/IEC 21000-7:2004/Amd.2:2007.

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 14: Conformance Testing*

— *Part 15: Event Reporting*

— *Part 16: Binary Format*

— *Part 17: Fragment Identification of MPEG Resources*

— *Part 18: Digital Item Streaming*

Introduction

The multimedia industry is growing at a rapid pace. For this industry, the term 'content' is widely used across different segments and applied in many different ways. For this reason, the term is deliberately avoided within the context of ISO/IEC 21000, where it has been replaced by the defined terms: Digital Item, media resource and resource. Equally important for the specifications of the multimedia framework is the notion of the User. A User of a system includes all members of the value chain (e.g., creator, rights holders, distributors and consumers of Digital Items).

Access devices, with a large set of differing terminal and network capabilities, are making their way into people's lives. Additionally, these access devices are used in different locations and environments; anywhere and at anytime. The Users, however, are currently not given tools to deal efficiently with all the intricacies of this new multimedia usage context.

Solutions with advanced multimedia functionality are becoming increasingly important as individuals are producing more and more digital media, not only for professional use but also for their personal use. All these 'resource providers' have many of the same concerns: management, re-purposing based on consumer and device capabilities, protection of rights, protection from unauthorised access/modification, protection of privacy of providers and consumers, etc. For example, it is becoming increasingly difficult to identify and understand the different intellectual property rights that are associated with the elements of multimedia resources. The boundaries between the delivery of audio (both music and spoken word), accompanying artwork (graphics), text (lyrics), video (visual) and synthetic spaces will become increasingly blurred. New solutions are required to manage the access and delivery process of these different resource types in an integrated and harmonized way, entirely transparent to the many different Users of multimedia services.

The need of these solutions motivates the initiatives of the ISO/IEC 21000 Multimedia Framework, which aims to enable transparent and augmented use of multimedia resources across a wide range of networks and devices.

ISO/IEC 21000-7 specifies tools for the adaptation of Digital Items (as specified in ISO/IEC 21000-2).

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Information technology — Multimedia framework (MPEG-21) —

Part 7:
Digital Item Adaptation

1 Scope

1.1 General

This part of ISO/IEC 21000 specifies the syntax and semantics of tools that may be used to assist the adaptation of Digital Items, i.e., the Digital Item Declaration and resources referenced by the declaration. The tools could be used to satisfy transmission, storage and consumption constraints, as well as Quality of Service management by the various Users. It is important to emphasize that the adaptation engines themselves are non-normative tools of this part of ISO/IEC 21000.

1.2 Organization of the document

This clause describes the various Digital Item Adaptation tools specified in this part of ISO/IEC 21000. Throughout this part of ISO/IEC 21000, each tool is described by the following subclauses:

- Syntax: Normative specification of the syntax of the tool using XML Schema.
- Semantic: Normative specification of the semantics of the tool and its components.
- Informative examples: Optionally, informative examples illustrating use of the tool.

1.3 Overview of Digital Item Adaptation

The goal of the Terminals and Networks element described in ISO/IEC 21000-1 is to achieve interoperable transparent access to (distributed) advanced multimedia content by shielding Users from network and terminal installation, management and implementation issues. To achieve this goal, the adaptation of Digital Items is required. This concept is illustrated in Figure 1. As shown in this conceptual architecture, a Digital Item is subject to a resource adaptation engine, as well as a description adaptation engine, which together produce the adapted Digital Item.

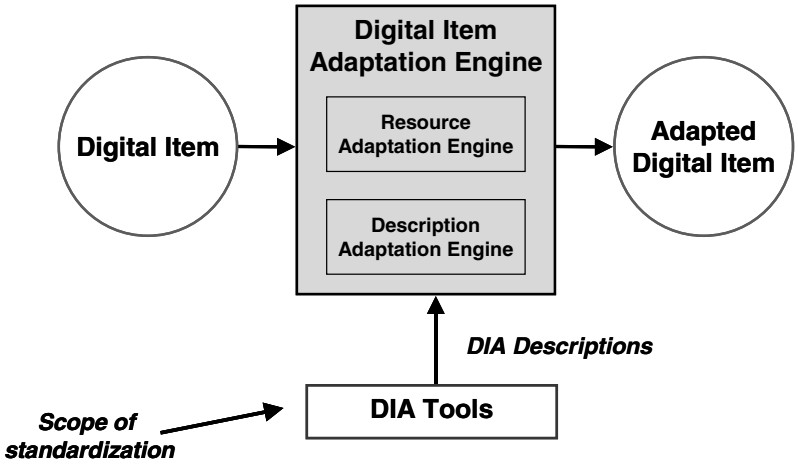

Figure 1 — Illustration of Digital Item Adaptation

It is important to emphasise that the adaptation engines themselves are non-normative tools of Digital Item Adaptation. However, descriptions and format-independent mechanisms that provide support for Digital Item Adaptation in terms of resource adaptation, description adaptation, and/or Quality of Service management are within the scope of the standardization, and are collectively referred to in Figure 1 as DIA Tools.

1.4 Overview of Digital Item Adaptation tools

The Digital Item Adaptation tools in this part of ISO/IEC 21000 are clustered into eight major categories as illustrated in Figure 2.

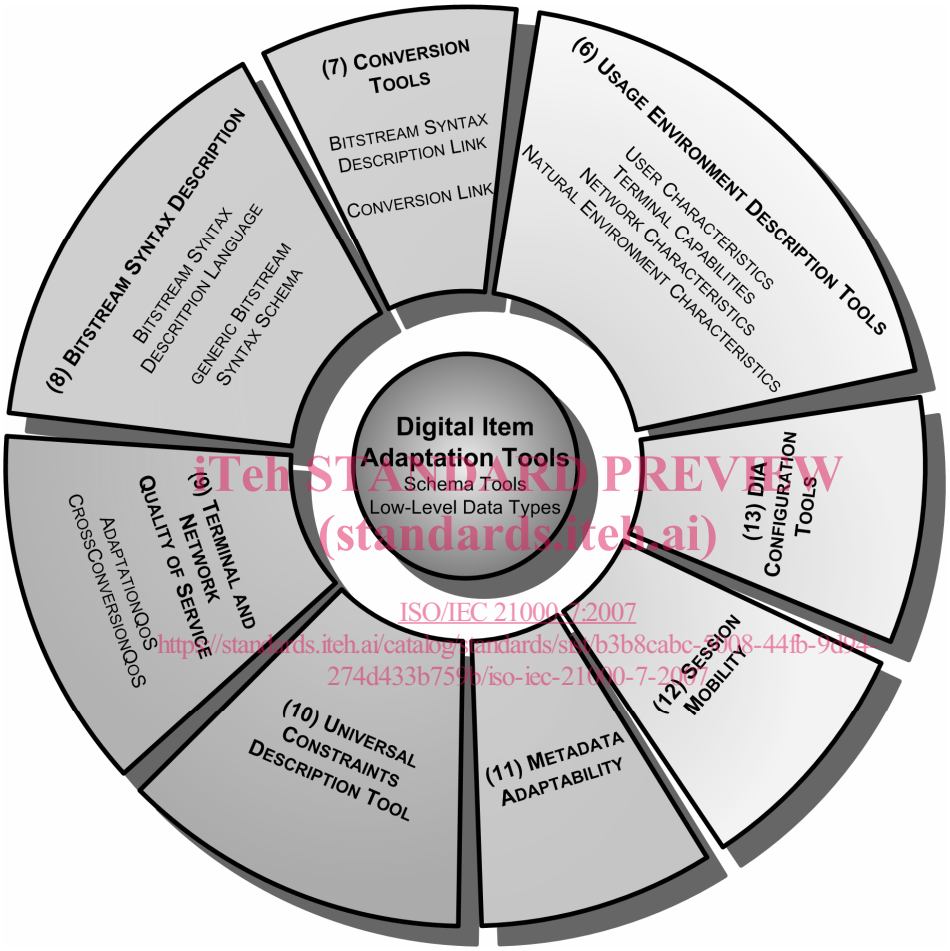

Figure 2 — Overview and organization of Digital Item Adaptation tools

The categories are clustered according to their functionality and use for Digital Item Adaptation around the *Schema Tools* and *Low-Level Data Types*. The schema tools provide uniform root elements for all DIA descriptions as well as some low-level and basic datatypes which can be used by several DIA tools independently. The syntax and semantics of the schema tools and low-level datatypes are specified in clauses 4 and 5, respectively.

— The first major category is the *Usage Environment Description Tools* and includes User characteristics, terminal capabilities, network characteristics and natural environment characteristics. These tools provide descriptive information about the various properties of the usage environment, which originate from Users, to accommodate, for example, the adaptation of Digital Items for transmission, storage and consumption. The syntax and semantics of these tools are specified in clause 6.

— The second category is referred to as *Conversion Tools* and provides the facilities to create a rich variety of adaptation architectures based on tools specified within this part of ISO/IEC 21000, ISO/IEC 21000-2, and ISO/IEC 15398 among others. The syntax and semantics of this tool is specified in clause 7.

— *Bitstream Syntax Description* tools comprise the third major category of Digital Item Adaptation tools. A BSD describes the syntax – in most cases, the high level structure – of a binary media resource. Using such a description, a Digital Item resource adaptation engine can transform the bitstream and the corresponding description using editing-style operations such as data truncation and simple modifications. Streaming instructions enhance the BSD by defining a set of properties and attributes which describe the fragmentation, timing and random access point indication for the BSD and its described resource. They are used for streamed processing and transport, e.g., in dynamic and distributed adaptation scenarios. These tools are specified in subclause 7.3.

— The fourth category of tools is referred to as *Terminal and Network Quality of Service*. The tools specified in this category describe the relationship between QoS constraints (e.g., on network bandwidth or a terminal's computational capabilities), feasible adaptation operations satisfying these constraints and associated media resource qualities that result from adaptation. This set of tools therefore provides the means to trade-off these parameters with respect to quality so that an adaptation strategy can be formulated and optimal adaptation decisions can be made in constrained environments. The syntax and semantics of these tools are specified in clause 9.

— The *Universal Constraints Description Tools* form the fifth category of tools which enables the possibility to describe limitation and optimisation constraints on adaptations. The syntax and semantics of these tools are specified in subclause 9.10.

— The sixth category is referred to as *Metadata Adaptability*. This tool specifies hint information that can be used to reduce the complexity of adapting the metadata contained in a Digital Item. On the one hand, they are used for filtering and scaling, and on the other hand, for integrating XML instances. The syntax and semantics of this tool are specified in clause 11.

— For *Session Mobility*, the seventh category of tools, the configuration state information that pertains to the consumption of a Digital Item on one device is transferred to a second device. This enables the Digital Item to be consumed on the second device in an adapted way. The syntax and semantics of these tools are specified in clause 12.

— Finally, the eighth category of tools is referred to as *DIA Configuration Tools* and provides information required for the configuration of a Digital Item Adaptation Engine. The syntax and semantics of these description tools are specified in clause 13.

1.5 Relation between Digital Item Adaptation and other parts of ISO/IEC 21000

The Digital Item is the fundamental unit of distribution and transaction in the Multimedia Framework. While the different parts of ISO/IEC 21000 deal with the components and different aspects of Digital Items, together they form a complete integrated interoperable framework. This subclause describes the relationship of this part of ISO/IEC 21000 with the other parts of ISO/IEC 21000 in addressing the specific function of adapting Digital Items.

ISO/IEC 21000-2 enables the declaration of Digital Items. A Digital Item is a packaging of resources, descriptions and rights expression. A Digital Item may contain elements that conform to ISO/IEC 21000-3, ISO/IEC 21000-4, ISO/IEC 21000-5, ISO/IEC 21000-6, and tools that are defined in this part of ISO/IEC 21000.

A Digital Item may be input to a Digital Item Adaptation Engine. The Adaptation Engine can modify the input Digital Item by adapting the resources or metadata within the Digital Item or the declaration of the Digital Item to the usage environment. Additionally, the identifiers and rights expressions pertaining to the adapted Digital Item need not be the same as those pertaining to the input Digital Item.

ISO/IEC 21000-5 and ISO/IEC 21000-6 provide the tools to permit playing, modifying, and adapting by controlling the kinds of things that can be changed. This part of ISO/IEC 21000 provides tools for use with ISO/IEC 21000-5 to provide the means by which the control over the changes that can occur when playing, modifying, or adapting digital items and their component resources can be effected. It is expected that users of this part of ISO/IEC 21000 will register terms describing their specific adaptations with the Registration Authority described in ISO/IEC 21000-6 in order to provide interoperability.

1.6 Relation between Digital Item Adaptation and ISO/IEC 15938

ISO/IEC 15938 is a standard for multimedia content description. For the most part, the description of multimedia content is used to satisfy a User's request for the resources contained in a particular Digital Item. This search would be carried out by a search engine. However, given the Digital Item of interest, ISO/IEC 15938 descriptions could also be used in the adaptation process. For example, ISO/IEC 15938 offers tools for the summarization of media resources, tools that provide transcoding hints about the media resources, and tools that indicate the available variations of a given media resource. See ISO/IEC 15938 for further information on the syntax and semantics of these tools.

Besides serving as an input to the Digital Item Adaptation Engine, several ISO/IEC 15938 tools are also referenced by the DIA specification. For example, tools that indicate a User's preference have been adopted as part of the DIA usage environment description tools, along with tools that indicate location and time associated with a User. The multimedia description schemes specified by ISO/IEC 15938 can also be used to specify the decoding and encoding formats as part of the terminal capabilities description tool. In this particular case, there exists symmetry between tools that are used to describe media resources and tools that are used to describe the capabilities of a terminal. In this way, the media resources can easily be matched or adapted to satisfy the terminal capabilities.

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 14496-1, *Information technology — Coding of audio-visual objects — Part 1: Systems*

ISO/IEC 14496-2, *Information technology — Coding of audio-visual objects — Part 2: Visual*

ISO/IEC 14496-10, *Information technology — Coding of audio-visual objects — Part 10: Advanced Video Coding*

ISO/IEC 14977:1996, *Information technology — Syntactic metalanguage — Extended BNF*

ISO/IEC 15938-3, *Information technology — Multimedia content description interface — Part 3: Visual*

ISO/IEC 15938-5, *Information technology — Multimedia content description interface — Part 5: Multimedia description schemes*

ISO/IEC 16262, *Information technology — ECMAScript language specification*

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

ISO/IEC 23001-5, *Information technology — MPEG systems technologies — Part 5: Bitstream Syntax Description language (BSDL)*

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

IEEE 754-1985, IEEE Standard for Binary Floating-Point Arithmetic

IETF RFC 1034, *Domain Names — Concepts and Facilities*, November 1987

IETF RFC 1738, *Uniform Resource Locators (URL)*, December 1994

IETF RFC 2141, *URN Syntax*, May 1997

IETF RFC 2396, *Uniform Resource Identifiers (URI): Generic Syntax*, August 1998

Namespaces in XML, World Wide Web Consortium, 14 January 1999

Extensible Markup Language (XML) 1.0 (Second Edition), W3C Recommendation, 6 October 2000

XSL Transformations (XSLT), Version 1.0, W3C Recommendation, 16 November 1999

XML Schema Part 1: Structures, W3C Recommendation, 2 May 2001

XML Schema Part 2: Datatypes, W3C Recommendation, 2 May 2001

XML Information Set, W3C Recommendation 24 October 2001

XML Base, W3C Recommendation 27 June 2001

XML Path Language (XPath), Version 1.0, W3C Recommendation 16 November 1999

XPointer Framework, W3C Recommendation 25 March 2003

XPointer xmlns() Scheme, W3C Recommendation 25 March 2003

XPointer element() Scheme, W3C Recommendation 25 March 2003

3 Terms, definitions, symbols, and abbreviated terms

3.1 Terms and definitions

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

3.1.1 General terms and definitions

3.1.1.1
description
instantiation of one or more **tools**

3.1.1.2
Digital Item
structured digital object conforming to ISO/IEC 21000-2 that is the fundamental unit of transaction and distribution in the multimedia framework

3.1.1.3
media resource
resource corresponding to audio-visual or multimedia data

3.1.1.4
receiver
side of a multimedia transaction that receives a **resource**

3.1.1.5
resource
component of a **Digital Item** corresponding to a digital asset or other form of intellectual content

3.1.1.6
sender
side of a multimedia transaction that sends a **resource**

3.1.1.7
tool
definition of syntax and corresponding semantics

3.1.1.8
User
user of a multimedia system, which includes all participants of a value network, e.g., creator, rights holders, distributors and consumers of **Digital Items**

NOTE A **User** may correspond to a single physical person, as well as a group of people, or an organization.

3.1.2 DIA-specific terms and definition

3.1.2.1
adaptation unit
refers to a unit of a logical decomposition of a **bitstream** into segments

3.1.2.2
bitstream
coded **resource** consisting of a structured sequence of binary symbols

3.1.2.3
bitstream syntax
encoding or format of a **bitstream**

3.1.2.4
Bitstream Syntax Description
specification of the high-level structure of a **bitstream** using **Bitstream Syntax Description Language**.

3.1.2.5
Bitstream Syntax Description Language
language specified in this part of ISO/IEC 21000 for defining a **Bitstream Syntax**

3.1.2.6
Bitstream Syntax Schema
XML Schema written in the **Bitstream Syntax Description Language** describing the syntax of a given coding representation format

3.1.2.7
Bitstream Syntax Description transformation
process where a **Bitstream Syntax Description** is modified, producing a new description from which an adapted **bitstream** can be generated. This process may be specified for instance by an XSLT style sheet

3.1.2.8
Digital Item Adaptation
process of manipulation of a **Digital Item** to produce a modified **Digital Item** in order to adapt it to the **usage environment**

3.1.2.9
generic Bitstream Syntax Schema
generic, coding format independent XML Schema for the description of any binary **media resource**

3.1.2.10
resource adaptation
process of manipulation of a **resource** within a **Digital Item** in order to adapt it to the **usage environment**

3.1.2.11
scalable bitstream
bitstream in which data is organized in such a way that, by retrieving the **bitstream**, it is possible to first render a degraded version of the **resource**, and then progressively improve it by loading additional data

3.1.2.12
usage environment description
refers to metadata that specifies **User** characteristics, terminal capabilities, network characteristics and natural environment characteristics according to ISO/IEC 21000

3.1.3 Conversion and permission-specific terms and definitions

3.1.3.1
conversion
process that changes the characteristics of a **resource**

NOTE In general a conversion performs the act as defined by the ISO/IEC 21000-6 term 'adapt'.

3.1.3.2
conversion act
conversion and its parameters, including the actual name of the parameters. The semantics shall be defined through ISO/IEC 21000-6

3.1.3.3
conversion tool
hardware and/or software module that implements a **conversion act** in order to perform the **conversion** as specified by the ISO/IEC 21000-6 term defining this **conversion**

3.1.4 Dynamic and Distributed Adaptation-specific terms and definitions

3.1.4.1
dynamic adaptation
dynamic adaptation refers to the adaptation of **Digital Items** according to dynamically changing **usage environments**

EXAMPLE The available bandwidth may drop during a streaming session and the Digital Item is consequently adapted to this new usage environment.

3.1.4.2
distributed adaptation
distributed adaptation refers to multiple adaptation steps successively performed on different ISO/IEC 21000 **peers**

EXAMPLE A same resource may be successively adapted on a server, network node and/or terminal.

3.1.4.3
process unit
well-formed fragment of a BSD or other XML metadata used for adaptation purposes, that can be consumed as such by the ISO/IEC 21000 **peer**, and to which a time information may be attached, indicating the point in time when it becomes available to the ISO/IEC 21000 **peer** for consumption

NOTE A process unit is a processing-oriented concept rather than a delivery-oriented concept. It does not depend on any encoding method used for delivering it.

3.1.4.4
XML fragmentation
authoring process by which an XML document is split into **process unit**s meaningful for consumption purposes. This process may attach time information to the output **process unit**s indicating the point in time when they become available to the ISO/IEC 21000 **peer** for consumption

3.1.4.5
processing time
point in time when a **process unit** is available to the ISO/IEC 21000 **peer** for consumption