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Information technology — Multimedia framework (MPEG-21) —

Part 1: Vision, Technologies and Strategy

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

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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 3.

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.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this part of ISO/IEC TR 21000 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 TR 21000-1, which is a Technical Report of type 3, 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 TR 21000 consists of the following parts, under the general title *Information technology — Multimedia framework (MPEG-21)*:

— *Part 1: Vision, Technologies and Strategy*

— *Part 2: Digital Item Declaration*

— *Part 3: Digital Item Identification and Description*

— *Part 4: Intellectual Property Management and Protection*

— *Part 5: Rights Expression Language*

— *Part 6: Rights Data Dictionary*

Further parts may be added.

Executive Summary

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 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 for use by all the players in the delivery and consumption chain. This open framework thus 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 consumer 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.

Part 1 of MPEG-21 (ISO/IEC TR 21000-1):

1. Provides a *vision* for a multimedia framework to enable transparent and augmented use of multimedia resources across a wide range of networks and devices to meet the needs of all Users[1];
2. Facilitates the integration of components and standards in order to harmonise *technologies* for the creation, management, manipulation, transport, distribution and consumption of content;
3. Provides a *strategy* for achieving a multimedia framework by the development of specifications and standards based on well-defined functional requirement through collaboration with other bodies.

[1] A User is any entity that interacts in the MPEG-21 environment or makes use of a Digital Item (all capitalised terms are used as defined in Clause 2).

Introduction

Currently, multimedia technology provides the different players in the multimedia value and delivery chain (from content creators to end-users) with an excess of information and services. Access to information and services from almost anywhere at anytime can be provided with ubiquitous terminals and networks. However, no complete solutions exist that allow different communities, each with their own models, rules, procedures, interests and content formats, to interact efficiently using this complex infrastructure. Examples of these communities are the content, financial, communication, computer and consumer electronics sectors and their customers. Developing a common multimedia framework will facilitate co-operation between these sectors and support a more efficient implementation and integration of the different models, rules, procedures, interests and content formats. This will enable an enhanced user experience.

The multimedia content delivery chain encompasses content creation, production, delivery and consumption. To support this, the content has to be identified, described, managed and protected. The transport and delivery of content will occur over a heterogeneous set of terminals and networks within which events will occur and require reporting. Such reporting will include reliable delivery, the management of personal data and preferences taking user privacy into account and the management of (financial) transactions.

The MPEG-21 multimedia framework identifies and defines the key elements needed to support the multimedia delivery chain as described above, the relationships between and the operations supported by them. Within the parts of MPEG-21, MPEG will elaborate the elements by defining the syntax and semantics of their characteristics, such as interfaces to the elements. MPEG-21 will also address the necessary framework functionality, such as the protocols associated with the interfaces, and mechanisms to provide a repository, composition, conformance, etc.

The seven key elements defined in this document are:

1. Digital Item Declaration (a uniform and flexible abstraction and interoperable schema for declaring Digital Items);

2. Digital Item Identification and Description (a framework for identification and description of any entity regardless of its nature, type or granularity);

3. Content Handling and Usage (provide interfaces and protocols that enable creation, manipulation, search, access, storage, delivery, and (re)use of content across the content distribution and consumption value chain);

4. Intellectual Property Management and Protection (the means to enable Digital Items and their rights to be persistently and reliably managed and protected across a wide range of networks and devices);

5. Terminals and Networks (the ability to provide interoperable and transparent access to content across networks and terminals);

6. Content Representation (how the media resources are represented);

7. Event Reporting (the metrics and interfaces that enable Users to understand precisely the performance of all reportable events within the framework).

MPEG-21 recommendations will be determined by interoperability requirements, and their level of detail may vary for each framework element. The actual instantiation and implementation of the framework elements below the abstraction level required to achieve interoperability, will not be specified.

Information technology — Multimedia framework (MPEG-21) —

Part 1:
Vision, Technologies and Strategy

1 Scope

This Technical Report has been prepared within ISO/IEC JTC 1/SC 29/WG 11 to introduce the MPEG-21 Multimedia Framework. It identifies the requirements that need to be met to achieve the definition of this framework. It is proposed that this will be achieved through a combination of WG 11's efforts to standardise the parts of the multimedia framework where it has the appropriate expertise, and the integration with standards initiatives which are being developed by other bodies. It is expected that this collaborative approach to standardisation linked with a common vision will maximise harmonisation of efforts and enable effective standards solutions to be implemented in the shortest possible time.

The Technical Report is introduced by a problem statement and a solution statement. The problem statement describes a multimedia usage environment founded upon ubiquitous networks that is encouraging new business models for trading digital content. In this environment, the distinction between content types is less clear as their integration as multimedia resources in new products and services makes the traditional boundaries less distinct. In addition, individuals are becoming increasingly aware of the value, both commercial and intrinsic, of their own digital asset resources and new possibilities presented by the tools which enable them to create and collect, package and distribute content. The solution statement introduces the vision of the multimedia framework to support transactions that are interoperable and highly automated, which is required to support these new types of commerce.

Seven architectural elements are identified as key to the multimedia framework as previously described in the Scope of the Technical Report. In addition, the user requirements within a multimedia framework are described separately as they impact upon each of the seven architectural elements.

In creating its definition of a multimedia framework and in making its proposals and recommendations for further standardisation, it is necessary for MPEG-21 to take account of other related multimedia activities. The Technical Report identifies other multimedia initiatives that are currently in progress that should be considered as candidates for future interaction and collaboration with the standards work plan agreed by MPEG-21.

2 Terms and Definitions

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

2.1 Anchor
An Anchor associates Descriptors with a fragment of a media resource and provides an externally identifiable target for links from a location within a media resource.

2.2 Container
A potentially hierarchical structure that allows Digital Items to be grouped.

2.3 Digital Item
A Digital Item is a structured digital object with a standard representation, identification and meta-data within the MPEG-21 framework. This entity is also the fundamental unit of distribution and transaction within this framework.

2.4 End User
A User taking the role of consumer, i.e. being at the end of a value or delivery chain (a human consumer, an agent operating on behalf of a human consumer, etc.). Note: “User” refers to all participants in the value or delivery chain.

2.5 Privacy
Privacy is the ability of a User to control access to that particular User’s private information.

2.6 Resource
A resource is an individually identifiable asset such as a video or audio clip, an image, or a textual asset. A resource may also potentially be a physical object.

2.7 Trust
Is synonymous with predictability, e.g. a trusted device is one which exhibits predictable behaviour.

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

3 Symbols and abbreviated terms

3.1 API
Application Program Interface

3.2 ATSC
Advanced Television Systems Committee

3.3 CATV
Community Aerial Television

3.4 CD
Compact Disc

3.5 CPU
Central Processing Unit

3.6 DAI
DMIF Application Interface

3.7 DASE
DTV Applications Software Environment

3.8 DMIF
Multimedia Integration Framework

3.9 DSL
Digital Subscriber Line

3.10 DTV
Digital TV

3.11 DVB
Digital Video Broadcasting

3.12 EPG
Electronic Programme Guide

3.13 GIF
Graphics Interchange Format

3.14 GPRS
Generalised Packetised Radio System

3.15 HTML
Hypertext Mark-up Language

3.16 HW
HardWare

3.17 ID
IDentifier

3.18 IEEE
Institute of Electrical and Electronic Engineers

3.19 I/O
Input/Output

3.20 IPMP
Intellectual Property Management and Protection

3.21 ITU
International Telecommunication Union

3.22 JPEG
Joint Photographic Experts Group

3.23 JPG
JPEG file extension

3.24 LMDS
Local Multipoint Distribution Systems

3.25 MHP
Multimedia Home Platform

3.26 MIDI
Musical Industry Digital Interface

3.27 MMDS
Microwave Multipoint Distribution System

3.28 MPEG
Motion Picture Expert Group

3.29 MSF
Multiservice Switching Forum

3.30 NPI
Network Program Interface

3.31 PC
Personal Computer

3.32 PDF
Portable Document Format

3.33 PNG
Portable Network Graphics

3.34 QoS
Quality of Service

3.35 SGML
Standard Generalized Markup Language

3.36 SW
SoftWare

3.37 TR
Technical Report

3.38 TV
TeleVision

3.39 UI
User Interface

3.40 UMTS
Universal Mobile Telecommunications Systems

3.41 VRML
Virtual Reality Modeling Language

3.42 XML
eXtensible Markup Language

4 Structure of the Technical Report

The Technical Report first sets out the User requirements in the multimedia framework. A User is any entity that interacts in the MPEG-21 environment or makes use of a Digital Item. Such Users include individuals, consumers, communities, organisations, corporations, consortia, governments and other standards bodies and initiatives around the world. Users are identified specifically by their relationship to another User for a certain interaction. From a purely technical perspective, MPEG-21 makes no distinction between a “content provider” and a “consumer”—both are Users. A single entity may use content in many ways (publish, deliver, consume, etc.), and so all parties interacting within MPEG-21 are categorised as Users equally. However, a User may assume specific or even unique rights and responsibilities according to their interaction with other Users within MPEG-21. These requirements are defined and further described in Clause 5.

Clause 6 of the Technical Report elaborates the seven elements in the framework identified in the TR structure description above. For each element, an overview of the current situation is given. Subsequently, the existing shortcomings, problems and issues associated with each element are identified. Finally, the opportunities for innovation and standardisation are highlighted.

Clause 7 of the Technical Report sets out the proposals and recommendations for the future work plan to standardise components of the architecture to support a multimedia framework. Although these proposals and recommendations are organised within the context of each of the elements of the framework described earlier in the report, it makes no assumption that any future standards development should be organised in this way. Indeed, there is sufficient convergence between some of the areas recommended for standardisation that it may be appropriate to either combine or subdivide the work on another basis. This may also be influenced by the standardisation work currently in progress by other bodies, where organisation of tasks should take account of components which may already be under development. Finally, MPEG recognises that the vision of the multimedia framework can only be realised with the co-operation from, and in collaboration with, other standards bodies and organisations which possess skills that may not typically be found amongst the MPEG community of participants.

4.1 Problem Statement

End Users’ appetite for content and the accessibility of information is increasing at an incredible pace. Access devices, with a myriad set of differing terminal and network capabilities, are making their way into End Users’ lives. Additionally, these access devices are used in different locations and environments. Users, however, are currently not given tools to deal efficiently with all the intricacies of this new multimedia usage context.

Enabling “ease of use” for Users is becoming increasingly important as individuals are producing more and more digital media for their personal use and for sharing among family and friends (as is evidenced by the large number of amateur music, photo and media sharing web sites). These “content providers” have many of the same concerns as commercial content providers[2].

Such developments rewrite existing business models for trading physical goods with new models for distributing and trading digital content electronically. Indeed, it is becoming increasingly difficult to separate the different intellectual property rights that are associated with multimedia content from the content itself. The boundaries between the delivery of audio sound (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 delivery process of these different content types in an integrated and harmonised way, entirely transparent to the User of multimedia services.

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 MPEG-21 is to describe how these various elements fit together. Where gaps exist, MPEG-21 will recommend which new standards are required. MPEG will then develop new standards as

2 Management of content, re-purposing content based on consumer/device capabilities, protection of rights, protection from unauthorised access/modification, protection of privacy of providers and consumers, etc.

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 consumer providing them access to a large variety of content in an interoperable manner.

4.2 Solution Statement

A multimedia framework is required to support this new type of multimedia usage. Such a framework requires that a shared vision, or roadmap, is understood by its architects, to ensure that the systems that deliver multimedia content are *interoperable* and that transactions are simplified and, if possible, *automated*. This should apply to the infrastructure requirements for content delivery, content security, rights management, secure payment, and the technologies enabling them – and this list is not exhaustive.

The scope of MPEG-21 could therefore be described as the integration of the critical technologies enabling transparent and augmented use of multimedia resources across a wide range of networks and devices to support functions such as: content creation, content production, content distribution, content consumption and usage, content packaging, intellectual property management and protection, content identification and description, financial management, user privacy, terminals and network resource abstraction, content representation and event reporting

From its background in key technology and information management standards related to the management, delivery and representation of multimedia content, MPEG is well positioned to initiate such an activity. However, it is recognised that the integration of such disparate technologies can only be achieved by working in collaboration with other bodies.

4.3 Vision Statement and Goals

MPEG-21 takes the following statement to describe its vision: *To enable transparent and augmented use of multimedia resources across a wide range of networks and devices.*

Its goal is to create an interoperable multimedia framework by:

4.3.1 Understanding how the components of the framework are related and identifying where gaps in the framework exist;

4.3.2 Developing new specifications which allow:

- 4.3.2.1 access, (re)use of and interaction with multimedia objects across networks and/or capable devices,
- 4.3.2.2 the implementation of multiple business models including those requiring the automated management of rights and payments transactions throughout the value chain, and
- 4.3.2.3 the privacy of Users to be respected; and

4.3.3 Achieving the integration of components and standards to facilitate harmonisation of technologies for the creation, management, transport, manipulation, distribution, and consumption of digital items.

4.4 Normative Implications

The multimedia framework will be developed through a combination of MPEG's efforts to standardise the parts of the multimedia framework where it has the appropriate expertise, and the integration with other multimedia initiatives which are being developed by other bodies. MPEG will hence contribute to the definition of the framework by developing new MPEG standards or by developing interfaces for other existing or future standards and services to provide the required interoperability or architectural elements.

MPEG-21's normative recommendations will be determined by interoperability requirements, and their level of detail may vary for each framework element. The actual instantiation and implementation of the framework elements below the abstraction level required to achieve interoperability, will not be specified.

4.5 Conformance

Conformance is an essential element of each MPEG standard. However, within this scope of this Technical Report, no conformance criteria are given. It is understood that some subsequent part(s) of MPEG-21 will contain such criteria. It is expected that conformance to each individual architectural element will be possible.

4.6 Description of a Multimedia Framework Architecture

To define where standards are required in a multimedia framework which is capable of supporting the delivery of digital content, it is necessary first to reach a shared understanding about common concepts. This presents a difficulty, as there are many examples of different architectures that evolve in response to a variety of models for the use of content. In order to avoid giving undue preference to one model above another, it is proposed to describe the multimedia framework as a generic architecture of conceptual design. Such a broad and high-level approach will allow for more specific use cases to be elaborated, which can be mapped back against the generic architecture as the work continues.

The intent is to maintain an MPEG-21 Use Case Scenario document in conjunction with the Technical Report to provide examples of potential MPEG-21 applications.

The functionalities of such a Multimedia Framework Architecture, as described above, have been grouped by MPEG-21 into seven architectural elements. They are:

1. Digital Item Declaration
2. Digital Item Identification and Description
3. Content Handling and Usage
4. Intellectual Property Management and Protection
5. Terminals and Networks
6. Content Representation
7. Event Reporting

Even though some overlap exists between these elements, it is considered that a sufficient distinction can be made for the purposes of standardisation.

4.6.1 Digital Item[3] Declaration

MPEG-21 shall establish a uniform and flexible abstraction and interoperable schema for declaring Digital Items.

4.6.2 Digital Item Identification and Description

MPEG-21 shall design a method for identification and description that is interoperable to provide, provide for, support, adopt, reference or integrate for:

4.6.2.1 Accuracy, reliability and uniqueness of identification;

4.6.2.2 Seamless Identification of any entity regardless of its nature, type or granularity;

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[3] As defined in clause 2.

4.6.2.3 Persistent and efficient methods for the association of identifiers with Digital Items;

4.6.2.4 Security and integrity of IDs and descriptions which will survive all kinds of manipulations and alterations; and

4.6.2.5 Automated processing of rights transactions and content location, retrieval and acquisition.

4.6.3 Content Handling and Usage

The MPEG-21 Multimedia Framework should provide interfaces and protocols that enable creation, manipulation, search, access, storage, delivery, and (re)use of content (which can be any media data and descriptive data) across the content distribution and consumption value chain; with emphasis on improving the interaction model for users with personalisation and content handling. The above should be supported both when the End User is performing the above functions and when the functions are delegated to "non human entities" (such as “agents”). In this context, content handling should not be understood as managing the rights of the content.

4.6.4 Intellectual Property Management & Protection

The MPEG-21 Multimedia Framework should provide a multimedia digital rights management framework that enables all Users[4] to express their rights to, interests in, and agreements related to Digital Items and enable all Users to derive appropriate levels of assurance that those rights, interests and agreements will be persistently and reliably managed and protected across a wide range of networks and devices.

One possible approach to the issue of cross-domain management and protection of intellectual property is detailed in Annex D.

4.6.5 Terminals and Networks

The goal is to achieve interoperable transparent access to (distributed) advanced multimedia content by shielding Users from network and terminal installation, management and implementation issues.

This will enable the provision of network and terminal resources on demand to form User communities where multimedia content can be created and shared, always with the agreed/contracted quality, reliability and flexibility, allowing the multimedia applications to *connect* diverse sets of Users, such that the *quality* of the user experience will be guaranteed.

This implies that as a minimum:

4.6.5.1 Networks should provide content transport functions according to a Quality of Service (QoS) contract established between the user and the network;

4.6.5.2 Terminals and networks should provide scalable execution functions as requested by content; and

4.6.5.3 Access to network and terminal resources will happen through standard interfaces.

4.6.6 Content Representation

MPEG-21 shall provide content representation technology able to efficiently represent content of all data types with the following features:

4.6.6.1 The ability to match the QoS offered by terminals and networks in an optimal way, especially for real-time media such as video and audio, e.g. by providing scalability and error resilience; and

4.6.6.2 The ability to be synchronised and multiplexed and allow for interaction.

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[4] which, in MPEG-21, is defined to include legislative bodies and regulatory agencies, see Subclause 5.1.

4.6.7 Event Reporting

MPEG-21 should provide metrics and interfaces that enable Users to understand precisely the performance of all reportable events (such as transactions) within the framework. Such “Event Reporting” then provides Users a means of acting on specific interactions, as well as enabling a vast set of out-of-scope processes, frameworks and models to interoperate with MPEG-21. Event Reporting creates a standardised set of metrics and interfaces with which to describe the temporally unique events and interactions within MPEG-21.

4.7 Activities Related to the Multimedia Framework

In creating its definition of a multimedia framework and making its proposals and recommendations for further standardisation, it is necessary for MPEG to take other related multimedia activities into account. MPEG will seek collaboration (e.g. through liaisons) with relevant initiatives to expedite the work.

This Technical Report identifies some other multimedia initiatives that could be considered as potential building blocks or candidates for future interaction and collaboration with the standards work plan agreed by MPEG. A non-exhaustive list of these is given in Annex A. The monitoring and updating of these activities is intended to be a continuous MPEG activity. During its previous standards developments, MPEG has always recognised the importance of establishing liaisons with other bodies and organisations with which it shares complementary or common objectives. These liaisons have provided a useful channel for communicating between the parties to ensure that any overlap between concurrent standards activities is minimised and that, where necessary, common technology can be shared.

The broad scope of the task of defining a multimedia framework presents new challenges and opportunities for collaboration between those initiating standards activities in this area. The value of an integrated framework for the management and delivery of multimedia content is considerable and is attracting the interest and enthusiasm of major standards bodies. Overlap between standardisation activities is almost inevitable and demands a consultative approach between those standards bodies which are prepared to meet the challenge to avoid duplication of effort and to maximise interoperability.

Within this Technical Report MPEG is describing a vision of a multimedia framework in order to pinpoint the components of the framework which require further standardisation. However, it makes no assumption that MPEG will undertake the task of actually standardising all of the identified components. Rather, MPEG would like to co-ordinate its work with other standards bodies to ensure that it can concentrate on those areas which are best suited to and compatible with the mandate of MPEG. It is expected that a high level of practical integration with other standards bodies will be necessary in order to complete some standardisation tasks successfully. With this in mind, this Technical Report has identified some initiatives (and welcomes approaches from other initiatives) which have ambitions to address aspects of the multimedia framework, and with which MPEG would like to co-ordinate its own efforts (Annex A).

5 User Requirements

5.1 Users

A User is any entity that interacts in the MPEG-21 environment or makes use of a Digital Item. Such Users include individuals, consumers, communities, organisations, corporations, consortia, governments and other standards bodies and initiatives around the world.

Users are identified specifically by their relationship to another User for a certain interaction (Figure 1). From a purely technical perspective, MPEG-21 makes no distinction between a “content provider” and a “consumer”—both are Users. A single entity may use content in many ways (publish, deliver, consume, etc.), and so all parties interacting within MPEG-21 are categorised as Users equally. However, a User may assume specific or even unique rights and responsibilities according to their interaction with other Users within MPEG-21.