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Information technology — Multimedia framework (MPEG-21) —

Part 1: Vision, Technologies and Strategy

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

Partie 1: Vision, Technologies et Stratégie

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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 Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.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;

[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.

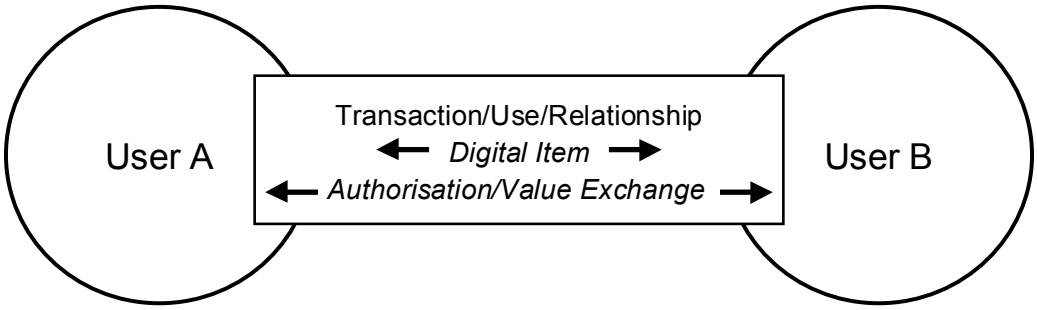

Figure 1: Users are defined by their role in a specific transaction

Examples that illustrate the possible roles of Users in MPEG-21 are included in in Annex E.

At its most basic level, MPEG-21 provides a framework in which one User interacts with another User and the object of that interaction is a Digital Item commonly called content. *Some* such interactions are creating content, providing content, archiving content, rating content, enhancing and delivering content, aggregating content, delivering content, syndicating content, retail selling of content, consuming content, subscribing to content, regulating content, facilitating transactions that occur from any of the above, and regulating transactions that occur from any of the above.

Any of these are “uses” of MPEG-21, and the parties involved are Users.

5.2 User Model

Moreover, this interaction between Users using Digital Items may be described further by seven core qualifiers (Figure 2):

1. *Digital Item Declaration* (what is the structure of the fundamental unit of distribution and transaction?);
2. *Digital Item Identification & Description* (what content actually has been delivered?);
3. *Content Handling and Usage* (how is the content used and how is it delivered?);
4. *Intellectual Property Management & Protection* (how are rights controlled in respect of each User?);
5. *Networks & Terminals* (is the content delivered over a cable line or cell phone?);
6. *Content Representation* (is it natural or synthetic content, how does the content scale?);
7. *Event Reporting* (what reportable event has happened and how is it described?)”.

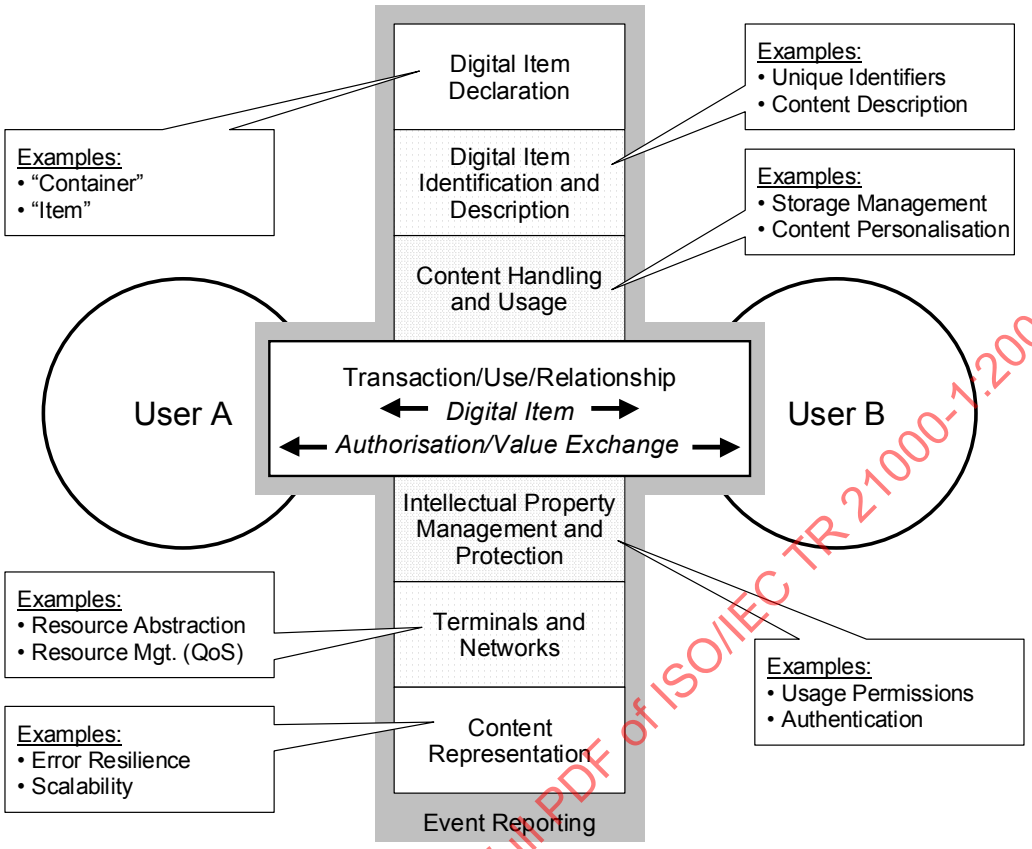

Figure 2: Interactions are described by seven elements: Event Reporting provides metrics and interfaces for six key elements

5.3 User Requirements

Users represent a wide and diverse set of interests, and no list of their requirements could ever be complete. That said, as a general introduction to our undertaking, *some* common, broad User Requirements for an MPEG-21 multimedia framework are:

5.3.1 The ease of understanding the terms of use ("agreements");

5.3.2 The enforcement of business and usage rules through the value chain;

5.3.3 The support of regulations and statutes and the incorporation of societal factors as necessary;

5.3.4 The provision of User protection, including reliability of service, statutory rights, liability and insurance for purchase, loss and damage, and escrow arrangements to eliminate risks;

5.3.5 The management and protection of User privacy;

5.3.6 The personalisation of content;

5.3.7 The ability to add metadata as content moves through the value chain;

5.3.8 The verification of the integrity of Digital Items and the provision of means to check when, by which method and by which authority this integrity was verified;

5.3.9 The ability to track content and transactions;

5.3.10 The secure use of content and exchange of value;

5.3.11 The enabling quality and flexibility of interactive service;

In a heterogeneous environment, End Users expect an automated selection of the appropriate quality levels for their particular network connection and terminal. This implies a flexible infrastructure that might include support for, for example, price differentiation and giving the Users control over the flow of content.

5.3.12 The provision of metrics to communicate performance for each segment and function of MPEG-21: transactions, content interaction, etc.;

5.3.13 The enabling of interoperability of other multimedia frameworks with and into MPEG-21;

5.3.14 The support of existing standards outside of MPEG;

5.3.15 The ability to provide, provide for, support, adopt, reference or integrate:

5.3.15.1 business processes among ad-hoc or established independent business partners by electronic means for extra-business operation (business to business and business to consumer),

5.3.15.2 a library of common, standard intra-business processes;

5.3.16 To allow for both business processes and enabling technologies to evolve independently while retaining long-term investments in both;

5.3.17 To develop specifications that do not hinder the establishment of legitimate new business models.

From a technical perspective, these functionalities are expressed as requirements in each of the architectural elements:

1. Interoperability
2. Transparency
3. Robustness
4. Integrity
5. Scalability
6. Extensibility
7. Customisation
8. Event management
9. Protection
10. Rights management
11. Standard metrics and interfaces
12. Privacy
13. Interactivity

6 Elements in the Framework

The following subclauses elaborate the elements in the framework as defined in Subclause 4.6. For each element, an overview of the current situation is given. Subsequently, the existing shortcomings are identified. Finally, the opportunities for innovation and standardisation are highlighted.

6.1 Digital Item Declaration

The goal is to establish a uniform and flexible abstraction and interoperable schema for defining Digital Items.

6.1.1 Overview

Within any system (such as MPEG-21) that proposes to facilitate a wide range of actions involving "Digital Items", there is a strong need for a very concrete description for defining exactly what constitutes such an "item". Clearly there are many kinds of content, and probably just as many possible ways of describing it. This presents a strong challenge to lay out a powerful and flexible model for Digital Items which can accommodate the myriad forms that content can take (and the new forms it will assume in the future). Such a model is only truly useful if it yields a format that can be used to represent any Digital Items defined within the model unambiguously and communicate them, and information about them, successfully.

6.1.2 An Example

A simple "web page" can be considered as a Digital Item. This web page typically consists of an HTML document with embedded "links" to (or dependencies on) various image files (e.g. JPEGs and GIFs), and possibly some layout information (e.g. Style Sheets). In this simple case, it is a straightforward exercise to inspect the HTML document and deduce that this Digital Item consists of the HTML document itself, plus all of the other resources upon which it depends.

Now let's modify the example to assume that the "web page" contains some custom scripted logic (e.g. JavaScript, etc.) to determine the preferred language of the viewer (among some predefined set of choices) and to either build/display the page in that language, or to revert to a default choice if the preferred translation is not available.

The key point in this modified example is that the presence of the language logic clouds the question of exactly what constitutes this Digital Item now and how this can be unambiguously determined.

The first problem is one of actually determining all of the dependencies. The addition of the scripting code changes the declarative "links" of the simple web page into links that can be (in the general case) determined only by running the embedded script on a specific platform. This could still work as a method of deducing the structure of the Digital Item, *assuming* that the author intended each translated "version" of the web page to be a separate and distinct Digital Item.

This assumption highlights the second problem: it is ambiguous whether the author actually intends for each translation of the page to be a standalone Digital Item, or whether the intention is for the Digital Item to consist of the page with the language choice left unresolved. If the latter is the case, it makes it impossible to deduce the *exact* set of resources that this Digital Item consists of which leads back to the first problem.

This simple example was designed to highlight two of the many types of difficulties that any multimedia framework will encounter without an explicit Digital Item Declaration that is unambiguous. In this case, the two sources of ambiguity are the presence of the scripting code (which in the general case makes it impossible to deduce content structure) and the inability of the author to make explicit her intentions.

6.1.3 Definition of the Current Situation

Currently, there is no standard model or representation for a Digital Item. Models and some representations do exist in specific application areas and/or media types, but there is no general, flexible and interoperable solution for all kinds of content in any context.

As a part of the above situation, there is also no uniform way of linking all types of descriptive information to any kind of media resource (or other descriptive information). Since the very concept of a Digital Item is built upon the

notion of explicitly capturing the relationship between media data and descriptive data (so that complex relationships can be made unambiguous), it is a serious limitation that no standard model or representation for this capability currently exists.

In addition, the above current limitations make it very difficult to implement key applications across all content types. An example would be a standard content delivery paradigm that incorporates important capabilities such as the ability to define and process highly configurable content packages in a standard way (especially where the configuration may be desirable at multiple points along a delivery chain). Another more consumer motivated example is the ability to intelligently manage collections of content of diverse types and from multiple sources.

6.1.4 Opportunities for Change

The overall Digital Item Declaration goal is to establish a uniform and flexible abstraction and interoperable schema for declaring Digital Items.

A Digital item must be unambiguously declarable via a framework with the following characteristics:

6.1.4.1 Digital items are open and extensible to any and all media resources types and description schemes;

6.1.4.2 Composite items can be constructed from other items, without losing the structure and properties of the sub-items;

6.1.4.3 Multiple composite items may share individual elements;

6.1.4.4 An individual element may be referenced by multiple locations within a Digital Item;

6.1.4.5 The framework needs to enable applications to correctly manipulate and validate Digital Items;

6.1.4.6 Identification and revision of Digital Items and their components must be supportable in an open and extensible manner.

Digital Items explicitly define the relationships between elements and their corresponding descriptors:

6.1.4.7 Descriptors may be simple statements or full media components;

6.1.4.8 Descriptors can be described by other descriptors;

6.1.4.9 Anchors must be declarable within a component that allow:

6.1.4.9.1 descriptors to be associated with a specific point or range within a media resource, and

6.1.4.9.2 linking back from within a media resource to the anchor;

6.1.4.10 Normative descriptors need to be present within MPEG-21, allowing for the definition of questions and comparisons (e.g., numeric, time and string-based comparisons);

To enable a wide variety of configurations via a flexible mechanism for defining decision trees within a Digital Item, the framework must allow definition of containers which:

6.1.4.11 Permit hierarchical and referential structures to contain Digital Items;

6.1.4.12 Provide a standard structural foundation for the packaged delivery of Digital Items;

6.1.4.13 Provide a standard structural foundation for the organisation and management of collections of Digital Items; and

6.1.4.14 Allow annotation of containers with arbitrary descriptors that suit a particular User or application need.

6.2 Digital Item Identification and Description

Currently, the majority of content lacks identification and description. Additionally, there is no mechanism to ensure that this identity and description information is persistently associated[5] with the content, is a constraint to any kind of efficient content usage.

In an MPEG-21 context, Digital Items are exchanged between Users. Digital Items that are identified and described are more manageable and therefore bear a higher value within a multimedia framework by enabling a large number of possible applications including Intellectual Property Management and Protection (IPMP), Content Handling and Usage (e.g. search, filtering, and cataloguing), Event Reporting and efficient usage by network and terminal resource managers.

6.2.1 Definition of the Current Situation

The environment in which content is identified and described is fragmented, non-exhaustive and dynamic. Many parties are involved in this environment. It is a complex framework involving legal and contractual issues. Today, proprietary identification and description systems co-exist with standardised schemes.

Some identifiers have been successfully implemented and commonly used for several years but they are specific to individual media types (for example, ISBN (International Standard Book Number), ISRC (International Standard Recording Code), ISWC (International Standard musical Work Code), etc.). Some new initiatives are addressing the problem of cross-domain identification (for example, ISAN (International Standard Audio-visual Number), DOI (Digital Object Identifier), and cIDf (content ID forum), etc.). These are in most cases still under development and therefore not yet widely deployed or used.

1. Most identification systems include some accompanying descriptive information. To be useful, descriptive information must be organised and structured in a manner that enables common entities (such as different sound recordings of the same music work) to be distinguished from one another. In recent years, there have been some major initiatives to develop standard metadata schemas to meet the needs of different User communities. Three examples of such schemes are: ISO/IEC 15938 (MPEG-7) is well advanced to provide tools for the description of audio-visual content to support the development of advanced search and retrieval applications;

2. ONIX International[6] is a metadata schema used by the book trade to provide the information used in the supply chain to aid consumers to find things they want to buy. Although its origins were in text, the schema now extends to encompass descriptions of eBooks, serials, audiovisual content and an extension for sound recording products is planned;

3. The international trade bodies representing music publishers, authors, composers and the recording industry are working collectively to develop a system for the identification and description of sound recording releases and related business transactions. As music can be packaged in a range of different formats, a unique identifier will be crucial to enable the delivery of music content to consumers, and the management of the associated rights. The identifier will support the sales, licensing and tracking needs crucial to the successful operation of online music commerce.

Descriptive information about content does not necessarily have to be carried with the content itself. It is sufficient within the context of MPEG-21 to allow an identifier associated with content to provide the means of navigation, or resolution, to its associated description and vice versa.

Proprietary solutions for the persistent association of identifiers and descriptive metadata with content such as labelling and watermarking for the insertion, modification, and extraction of identifiers and descriptions have

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[5] The term “persistent association” is used to categorise all the techniques for managing identifiers with content. This will include the carriage of identifiers within the context of different content file and transport formats, including file headers and embedded into content as a watermark. It also encompasses the ability for identifiers associated with content to be protected against their unauthorised removal and modification.

[6] http://www.editeur.org/onix.html

emerged in recent years. However, no international standard is available today for the deployment of such technologies.

6.2.2 List of Shortcomings and Problems

This subclause lists shortcomings and problems with the current situation regarding Digital Item identification and description, which need to be resolved.

6.2.2.1 Lack of integration between the different schemas of different sectors;

6.2.2.2 Lack of standard dynamic identification schemas when entities related to the content (Digital Item) change;

6.2.2.3 Lack of standard methods to differentiate between versions of a Digital Item when it is revised;

6.2.2.4 Absence of mechanisms to control Digital Item Identification (e.g., a registration or other governance authority);

6.2.2.5 Lack of interoperability among identification schemas for the purpose of common applications e.g. automated transaction/billing systems;

6.2.2.6 Lack of international standard identification schemas for some entities (i.e. text, images, speech, etc.);

6.2.2.7 Lack of scalability in the identification management processes to accommodate the different requirements ranging from small self-publication to large-scale content production;

6.2.2.8 Conflicting requirements for the identification of content on behalf of different Users (e.g., ISRC is the authoritative identification system for sound recordings but its associated descriptions are not available to End Users);

6.2.2.9 Lack of interoperability between schemas for use within different application contexts by organisations within the same media sector (e.g., text publishing, sound recordings);

6.2.2.10 Lack of harmonised mechanisms for the resolution of identifiers.

6.2.3 Requirements for Digital Item Identification and Description

6.2.3.1 Generic Requirements

6.2.3.1.1 The MPEG-21 Digital Item Identification and Description scheme shall be able to identify uniquely and describe:

6.2.3.1.1.1 Content – which could be represented as an abstraction[7], an expression[8], a manifestation[9] or an artefact[10] of a Digital Item,

6.2.3.1.1.2 Transactions, contracts and other Events,

6.2.3.1.1.3 Users – all parties and their roles within the Multimedia Framework;

[7] a distinct intellectual or artistic creation or concept

[8] the intellectual or artistic realisation of an abstraction

[9] the physical or digital embodiment of an expression

[10] a single exemplar instantiation of a manifestation

6.2.3.1.2 The content identification and description framework shall support interoperability with the other elements of MPEG-21, including support for technologies for IPMP, privacy, rights management and Event Reporting;

6.2.3.1.3 The Digital Item Identification and Description framework shall be scalable (i.e., the identification and description at all levels of the Digital Item Declaration);

6.2.3.1.4 The Digital Item Identification and Description framework shall be persistent;

6.2.3.1.5 The Digital Item Identification and Description framework shall be efficient (i.e., the framework shall achieve all requirements while minimising the amount of required information, processing, infrastructure and associated cost);

6.2.3.1.6 The Digital Item Identification and Description framework shall be extensible. This is, it shall allow for upgrades and extensions while maintaining backward compatibility;

6.2.3.1.7 The Digital Item Identification and Description framework shall accommodate and support existing ISO-standardised and other identification systems;

6.2.3.1.8 The solution shall allow for the building of systems which would support only some of the requirements expressed here;

6.2.3.1.9 The unique identification and description of a User may require their consent.

6.2.3.2 Requirements for Identifiers

6.2.3.2.1 Digital Item Identifiers shall be globally unique for a period of time that is longer than needed for the purpose envisaged;

6.2.3.2.2 Digital Item Identifiers shall be location-independent (i.e., the name should not depend on the physical location of the Digital Item);

6.2.3.2.3 Digital Items may have more than one unique identifier;

6.2.3.2.4 The Digital Item Identification framework shall be able to identify the content type;

6.2.3.2.5 The Digital Item Identification framework shall be able to identify the identification and description system used for a Digital Item;

6.2.3.2.6 The Digital Item Identification framework shall, to the extent possible, protect the integrity of identifiers. When the integrity cannot be guaranteed, the identifiers should degrade gracefully;

6.2.3.2.7 The framework should allow the distributed assignment of unique identifiers.

6.2.3.3 Requirements for Descriptions

Systems for the description of Digital Items shall:

6.2.3.3.1 ensure persistency and consistency of accurate information in accordance with their intended use.

Note: The framework should allow for a range of associations between content and its descriptions (e.g. from loose to tight binding);

6.2.3.3.2 make it possible to unambiguously relate a metadata scheme to an identification system for Digital Items.

Note: It is likely that it will be necessary to uniquely identify metadata schemes. Two examples for such metadata schemes are ONIX International and MPEG-7

6.2.3.3.3 make it possible to change/alter/amend a description within a given schema (e.g., a sub-item is deleted from the Digital Item, the permission relating to its use change);

6.2.3.3.4 make it possible for the authorised User of a description to control the right of access to make changes;

6.2.3.3.5 make it possible for the authorised User of a description to manage and protect its use.

6.2.3.4 Requirements for persistent association of Identifiers and descriptive information with content

6.2.3.4.1 The Digital Item Identification and Description framework shall make it possible to persistently associate identifiers and descriptors with content. This includes that the association of Content with Identifiers and/or Descriptors may need to be authenticated;

6.2.3.4.2 The environment for the storage of identifiers and descriptions associated with Digital Items shall fulfil the following requirements in a standardised way:

6.2.3.4.2.1 It shall be possible that descriptors contain binary and/or textual information; (e.g., HTML, AAC, JPEG, etc);

6.2.3.4.2.2 It shall be possible to associate descriptors with those elements within a hierarchical Digital Item that contain multimedia resources;

6.2.3.4.2.3 It shall be possible to store, within the Digital Item, a reference to descriptive metadata regardless of its location;

6.2.3.4.3 The Digital Item Identification and Description framework shall allow for locating Digital Items from its descriptions and vice versa. Note that this does not necessarily imply that they are bundled together;

6.2.3.4.4 The Digital Item Identification and Description framework shall provide an efficient resolution system for related Digital Items, such as different versions, different manifestations of the same Digital Item, different names of the same Digital Item (e.g. aliases, nick names), their elements, etc.;

6.2.3.4.5 The Digital Item Identification and Description framework should provide, provide for, support, adopt, reference or integrate mechanisms to define levels of access to descriptions within the rights guidelines, such as the discovery of usage rules.

6.2.4 Expected Impact

Common identification and description of Digital Items will enable efficient deployment of business models and applications requiring rights management, automated transaction and billing, monitoring, search, retrieval, and cataloguing.

6.3 Content Handling and Usage

The availability and access of content within networks is exponentially increasing over time. With the goal of MPEG-21 to enable transparent use of this content over a variety of networks and devices, it becomes extremely important that standards exist to facilitate searching, locating, caching, archiving, routing, distributing and using content (which can be any media data and/or descriptive data). In addition to these aspects, the content has to be relevant to the User for a better experience for the consumer and a better return for the business that makes this content available. In this regard, content handling will also include personalisation and User profile management. Thus, the goal of content handling standardisation efforts within MPEG-21 can be summarised as follows:

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 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.

6.3.1 Definition of the Current Situation

The current situation is one of chaos for the consumer and the service provider. Typically, the content handling, if any, is tied to the access points and segments of a network and is not conducive to moving the content from one node in the network to another. The lifetime and associated usage rules for the content are not well defined and systems are not built to enforce these rules, even if they were prescribed to the content. End Users have limited storage space on their devices and hence cannot keep all the content and are forced to inefficiently manage their space manually. Both from a End Users' point of view and the service providers' point of view, this is limited in nature.

1. End Users are flooded with content presently and this is going to get worse in the future. They need systems that can manage, categorise, and filter content.

   With the availability of large amounts of content, End Users are overwhelmed and are looking for solutions that will simply manage and organise content for them. This problem is going to get worse in the future and will also hinder businesses from getting End Users' attention amongst all the "noise".

2. Decision making about content selection and acquisition is dependent on the specific service provider and the type of service.

   Selection of content that fits a User's needs and profile is currently dependent on the specific network or service being accessed. There is no way to express one's preferences and build up a profile that can be used by a "non-human entity" (or "agent") to acquire content irrespective of service provider and service.

3. Content caching and management is typically not available on most terminals. When it is present, it is quite limited and does not consider the requirements of rights holders or the User's right to privacy.

   Content caching is an issue that is pervasive across the network. Presently, there are solutions that address this issue in a specific domain but they are not conducive to managing lifetimes and usage rules in a flexible manner.

4. Currently, text is the only type of content that is ubiquitously searchable. For other types of media, search is typically limited to text input.

5. Typically, content is stored within the User's control. But, this is changing and hence better systems to manage and secure content on shared environments will be required.

6. Current asset management systems do not communicate with each other; content cannot readily be identified across those asset management systems, or accessed in an easy-to-use, distributed fashion.

7. There is currently no standard way of associating distributed content with its use. Standard interfaces can be used to achieve this.

   For example, a Digital Item can be thought of not as a single entity, but as a compound document consisting of multiple representations (e.g. it's not just a digital still image, it's a single digital still image available in a variety of forms: in JPEG format, in GIF format, in PNG format, in PDF, at 640x480 resolution, at 1600x1200 resolution, etc.) A standard interface may be a set of pointers to different representations of the Digital Item, or a pointer to a service and data from which alternative forms can be created.

8. Users currently need to have very explicit format and technology knowledge in order to utilise format-conversion tools.

In summary, as illustrated above, there are numerous shortcomings throughout the distribution and consumption networks. Where standards do exist, they tend to address a specific problem or domain and are not comprehensive enough to make a difference to the complete solution.

6.3.2 Opportunities for Change

Given the current situation, there are a number of areas where MPEG could make a difference by standardisation efforts. Some of these are directly within the scope of the Content Handling activity and some of them are requirements on identification, description and representation efforts.

6.3.2.1 Content storage management requirements

Search, Storage and Retrieval of Content and Descriptions

6.3.2.1.1 Users should be able to search and locate content of interest, which includes:

6.3.2.1.1.1 searches and acquisition by agents, and

6.3.2.1.1.2 searching across distributed asset management systems;

6.3.2.1.2 Users in the network must be able to securely store and retrieve content;

6.3.2.1.3 The ability to search and locate content at finer levels of detail within a container should be provided. For example, if an album is a secured container, it should be possible to search for specific songs within that album;

6.3.2.1.4 Lifetime control of content within all the nodes on a given network should be supported with configurable policies;

6.3.2.1.5 Mechanisms should be provided to enable Users to identify where all copies of content are located if they have the right to do so.

6.3.2.1.6 The serialisation of formats and protocols for the exchange and communication of Digital Items should be supported.

Archiving and cataloguing

6.3.2.1.7 Support for archiving content for later use along with preservation of any associated rights should be provided;

6.3.2.1.8 Ability to organise and catalogue content within collections should be supported.

Controlled Access and Change Tracking

6.3.2.1.9 The ability to control access and modification of content and associated descriptions by Users and groups of Users should be supported;

6.3.2.1.10 The ability to track changes and versions of content with associated descriptions should be supported.

6.3.2.2 End user profile handling

Exchanging End User Profiles for Services

6.3.2.2.1 The ability should be provided to clearly identify what information an End User is willing to trade in exchange for services (name, address, credit card, usage history, and profile). It should be able to match the profiles of an End User's privacy preferences with other Users' requirements for service delivery as well;

6.3.2.2.2 MPEG-21 shall enable the development of tools, which allow End Users to handle privacy in the context of the use of Digital Items and applicable law.

6.3.2.3 Personalisation of content and presentation

Arbitrary Organisation of Content

6.3.2.3.1 A User should be able to add descriptions to elements such as item, container, component, choice, selection, anchor, and/or annotation that are declared in the Digital Item Declaration (ISO/IEC 21000-2) that may be used to organise a group of items with related descriptions.

Automated Organisation of Content

6.3.2.3.2 The framework should allow organisation of content based on User preferences and appropriate descriptors associated with the items.

6.3.2.4 Agent enabled networks and terminals

A better management of the complexity of the content handling and usage can be achieved by giving the User the possibility to delegate some specific functions (instantiated in a goal) to non-human entities. Some examples are:

1. Routing of content across distributed networks in an intelligent manner;
2. In the Internet domain, deciding on the content set to be served up, based on connection characteristics (bandwidth, network type, reliability, QoS etc.) and profile of the requesting device;
3. In the broadcast domain, using the programming information to filter and insert content into the multiplexed transport stream;
4. Making decisions using intelligent ways of caching content within the network for best delivery; and
5. Negotiating deals with other agents for reaching certain assigned goals, including any User's right to privacy.

6.4 Intellectual Property Management and Protection

6.4.1 Definition of the Current Situation

When looking at the situation of how Digital Items are managed and protected today, the following observations can be made:

1. Most of the e-content existing today is governed by at best rudimentary IPMP systems;
2. No IPMP system has yet emerged as a de-facto standard;
3. While various IPMP systems exist today, no framework exists to allow for interoperation amongst such systems;
4. One problem for End Users interacting with e-content today is the lack of interoperability between IPMP systems;
5. Owners of rights[11] in content require the freedom to exercise their rights by choosing channels and technologies (including IPMP Systems) through which to offer and make available their content;
6. There is a lack of standardised methods for monitoring and detecting infringements of rights.
7. Consumers of content may in some circumstances require the freedom to manage their privacy, which includes interacting with content without disclosing their identity to any other User in the value chain;

[11] Through new technologies (e.g., the Internet), End Users increasingly become owners of rights in content.

8. The differences between the national and regional legislations relating to IP law (and the lack of any universal legislation to protect rights holders) challenge existing IPMP systems to accommodate the evolution of global commerce in an digital environment.

6.4.2 Opportunities for Change

MPEG-21 should provide a uniform framework that enables all Users to express their rights and interests in, and agreements related to, Digital Items and to have assurance that those rights, interests and agreements will be persistently and reliably managed and protected across a wide range of networks and devices.

The main requirements for this work area should support the standardisation of tools that enable the following:

6.4.2.1 Access to and interaction with Digital Items while keeping the amount of (additional) hardware to a minimum. There shall be no duplication of similar devices to interact with similar content from different sources. E.g., content should be able to be played on similar devices from multiple vendors. Examples of interaction with content are playback, copy, edit, create and so forth;

6.4.2.2 Easy interaction with Digital Items from different sources without swapping of physical modules; that is without requiring action on the part of the End User. Addition of modules is acceptable if it requires a one-time action, if the device supports it, and if the cost is reasonable;

6.4.2.3 Conditions for the interaction of content between Users to be agreed upon and clearly communicated. An example is payment for playback;

6.4.2.4 Protection of User privacy;

Note: In many countries legislation requires that no User information shall be disclosed without the explicit consent of the End User. However, the capacity to disclose the End User's identity shall be technically preserved, in the event that disclosure of such identity is required, subject to applicable laws and regulations. This could, for example, be achieved by a third party, which is acting as broker between the End User and the content provider.

6.4.2.5 MPEG-21 terminal mobility, e.g. End Users can be able to use the same device in different locations and keep their rights to interact with the content;

6.4.2.6 Content mobility across MPEG-21 terminals, e.g. End Users can be able to move to a different terminal and keep their rights to interact with the content;

Note: Assuming easy access to the content, this mainly applies to the portability of the rights to interact with it.

6.4.2.7 Content and the End User's rights to interact with it to survive changing to a new version of similar hardware or software;

Note: Assuming easy access to the content, this mainly applies to the renewability of the rights to interact with it.

6.4.2.8 Content and the End User's rights to interact with it to survive changing to a different type of MPEG-21 hardware;

Note: Assuming easy access to the content, this mainly applies to the survivability of the rights to interact with it.

6.4.2.9 Transferring of User rights according to the conditions under which the rights have been acquired;

6.4.2.10 Enabling content owners to control which of their assets are available when, where and under what conditions;

6.4.2.11 Persistent security over time and renewability of that security;

6.4.2.12 The flexible expression of different business models/rules, which might yet be unknown and which may change over time, markets and geography;

Note: Some business models are envisaged that involve “super distribution”, in which End Users are authorised to act as distributors.

6.4.2.13 Enabling content owners and other authorised business partners to change business rules as appropriate;

6.4.2.14 The solution shall not impose policies.

Note: Imposing policies is the legitimate domain of content, service and application providers, and governments.

MPEG-21 shall, as appropriate, incorporate and extend the MPEG-7 metadata scheme and shall address, to the appropriate extent, the MPEG-7 IPMP requirements as set forth in the MPEG-7 Requirements Document v14.

6.5 Terminals and Networks

6.5.1 Definition of the Current Situation

Accessibility of heterogeneous content is becoming widespread to many networked devices (set-top boxes for terrestrial/cable/satellite networks, personal digital assistants, mobile phones, computers, TV etc.).

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. This makes it difficult for service providers to ensure that content is available “anywhere, anytime” and can be used and rendered in a meaningful way.

The overall goal of MPEG-21, to enable transparent use of multimedia resources across a wide range of networked devices, obviously has an impact on the way network and terminal resources themselves are being dealt with.

Users accessing content should be offered services with a (a priori) known subjective quality (at a known/agreed price). They should be shielded from network and terminal installation, management and implementation issues. This "ease of use" becomes increasingly important given the imminent installation base of multiple, heterogeneous coexisting (wired and wireless) networks such as GPRS, Universal Mobile Telecommunication Services (UMTS), DVB-T, -S, -C, xDSL, LMDS, MMDS, etc.

This implies that the "high-level" User parameters (mainly subjective quality and price) need to be mapped in a transparent way to the underlying network and terminal parameters. The User should thus be given a service with a (guaranteed) Quality of Service (QoS), without having to worry how this translates into network and terminal QoS.

From the network point of view, it is therefore desirable that the application servicing the User can translate the User requirements into a network "QoS contract". This contract, containing a summary of negotiated network parameters, is handled between the User (or an agent acting on behalf of the User) and the network and guarantees the delivery of a given QoS network service. The implementation of this QoS contract is likely to have a dynamic nature given the changing environments in which the User will be communicating in (e.g. a drop in bandwidth in wireless access when moving outdoors). This negotiation process could be handled automatically by software agents.

Note that the actual implementation of network QoS itself does not fall within the scope of MPEG-21. The intent is to make use of these mechanisms and to propose requirements to network QoS functionality extensions to fulfil the overall MPEG-21 QoS demands.

To enable application independent solutions, the network should be unaware of the specifics of the media it is transporting, only offering a generic (parameter and priority) interface to the applications.

Network technologies must facilitate a new rich and widely distributed multimedia experience. Network resources shall be provisioned 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 arbitrary sets of Users, such that the quality of the User experience will be guaranteed.

Underlying networking technology shall execute requests for QoS based media streams, provide mechanisms for addition and deletion of media channels and supports administrative monitoring. In addition, the network interface shall make possible dynamic reconfiguration and assignment of network resources appropriate for broadband usage.

Ideally, the content demands should to be able to shape the network to deliver a compelling User experience. In practice, the actual implementation will be bounded by the QoS contract.

Application network interfaces shall be used to request multimedia delivery services by configuring and programming the main attributes of network-based multimedia services. These attributes (see also Figure 3) are connectivity, bandwidth and network QoS as a whole (also including delay and loss). The network interfaces will probably be hierarchical since not all Users and applications will (want to) interact at the same abstraction level. The translation from high-level interactions to low-level interactions might take place automatically by software agents or could be done by the application itself.

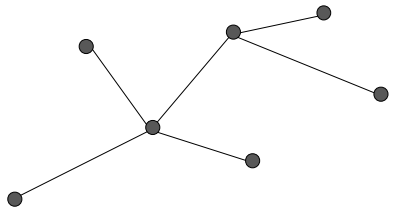
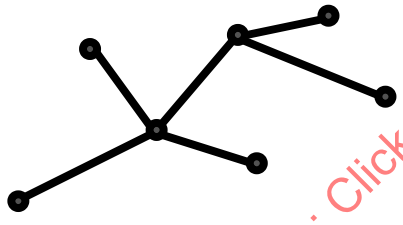
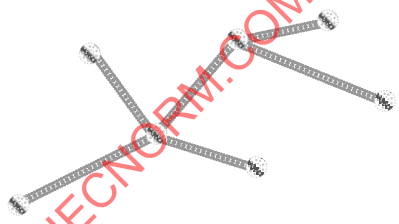
Multimedia Delivery Service Attribute	Functionality
	*Connectivity* Connectivity allows the interconnection of Users to create a networked community. For instance, point to point (e.g., unicast), point to multipoint (e.g., multicast), multipoint to multipoint (e.g., virtual network), point to many points (e.g., broadcast), etc.
	*Bandwidth* Bandwidth provides the necessary bit rate to deliver multimedia content among Users belonging to the community. In other words, the bandwidth is the thickness or diameter of the pipe/link that carries information.
	*QoS* QoS provides the basis for delivery of rich multimedia content against raised community expectations. The combination of connectivity, bandwidth, delay and loss bounds defines the “colour” of the service.

Figure 3: Main attributes of network-based multimedia services

Known standards and systems partially addressing these issues include IEEE P1520, Multiservice Switching Forum (MSF), and MPEG-4 DMIF (see Annex A).

From the terminal point of view, the impact on the User perception of the variation in (processing and memory) resource requirements associated to accessing dynamic, heterogeneous content (video, audio, VRML, etc.) should be kept hidden or minimal. The terminal QoS management should allow for (continuous) trade-offs between the available resource budget and the User perception.

This approach requires an abstraction of the resource budgets (defining the terminal capabilities) and the media access complexity (decoding, rendering, etc.) associated with the content.

Known standards and systems partially addressing subsets of these issues include the following:

6.5.1.1 MPEG-4 offers hooks to describe the complexity of decoding video objects (version 1) and 3D graphics (version 2) in a platform independent way;

6.5.1.2 MPEG-4 profiles and levels limit the upper complexity level of (decoding the) multimedia streams;

6.5.1.3 MPEG-J provides APIs to allow cross-platform operation of applications, including access to terminal resources (but only includes a very limited management thereof); and

6.5.1.4 DVB-MHP is a specification of a receiver and a common platform-based infrastructure for building broadcast applications.

6.5.2 Shortcomings, Problems and Issues

No complete solutions exist today that transparently exploit flexible network and terminal resources. This issue becomes even more complex when multiple services are to be used simultaneously. As an example, one could consider watching a broadcast program through one service provider and receiving a videoconference call through another. This can give rise to problems both at the network level (e.g. bandwidth renegotiations) and at the terminal level (e.g. processing resources).

Some on-going efforts in this field are ISO/IEC 14496-6 (DMIF, see above), IEEE P1520, IETF GSMP, and MS Forum (vendors and service providers).

From a network point of view, the following requirements of multimedia delivery applications need to be fulfilled by the network interface:

6.5.2.1 The need/demand, not the physical location determines access, utility and communication (e.g. interactivity anywhere, anytime);

6.5.2.2 Best-effort failure is replaced by negotiated-contract using guarantees;

6.5.2.3 Distributed management provides distributed utilisation of network bandwidth resources, with the possibility to include transcoding to meet the network capabilities;

6.5.2.4 Operating system, network protocol, and hardware solutions must interoperate; and

6.5.2.5 Software based infrastructure, independent of the Physical and Link layers (e.g. seamless utilisation of network and transport protocols over optical, wireless, twisted-pair, etc.).

From a terminal point of view, terminal capabilities are currently being extended, both in terms of performance and flexibility. To cope with this, API and protocol development is underway in some specific application domains, such as the broadcast environment (Advanced TV Enhancement Forum (ATVEF), DVB-MHP, ITEA/EUROPA). The general acceptance of these APIs is however still questionable. Additionally, no cross-platform APIs exist yet.

Given the broad range of media the terminal can access, functional compliance with standards such as MPEG-2, MPEG-4, W3C, etc. will be required. Given the increased flexibility of terminal capabilities, this compliance can probably be achieved in more than one way (e.g. hardwired vs. programmable). Additionally, the content could be transcoded (either in the network or the terminal) to fit the terminal capabilities.

Besides the above-mentioned requirement for an abstraction of the terminal resource budgets and the media access complexity, a common architecture for the network interface is probably necessary.

From a combined terminal and network point of view, no open APIs exist that allow for combined network/terminal (QoS) trade-offs (although ITU H.245 offers functionality to perform static end-to-end negotiation). However, some proprietary solutions are emerging that address this issue.

6.5.3 Opportunities for Change

From the network point of view, the cost in using networks will move from bit transport to services associated with the bits, e.g. managing the security, network management, etc. Additionally, if the simultaneous use of different service providers can be made transparent to Users and applications, this will enable a shift from a vertical to a horizontal business model.

Compelling new multimedia applications require more sophisticated use of delivery media and bandwidth than existing network services can provide. Network services are fragmented between bandwidth capabilities and heterogeneous network protocols. Real-time, full-motion engaging media currently forces producers to compromise both media resolution and content when building multimedia products and delivering them to the target audience. Open Programmable Network interfaces implement a communication and transport platform well suited for this challenge.

The DMIF/DAI interface reflects and supports the complexity of new multimedia applications. By hiding the details of the network system and protocols, the DAI presents a simple, open channel addition interface well suited for aggregation, broadcast, and distribution of rich multimedia application streams. The DAI interface enables multimedia creators to add varied mixed-bandwidth components to their applications, with the expectation that each media component will be handled according to its resolution and use. For instance, through DMIF/DAI services multimedia applications can achieve a new level of versatility, control, and adaptability in execution.

Since DMIF is an evolving standard, MPEG-21 should try to align with this effort to avoid duplicate work.

From the terminal point of view, the proposed abstraction/common architecture approach can enable horizontal (open) business models (this is for example one of the driving ideas behind DVB-MHP and ATSC-DASE). Horizontal business models require the definition of a generic interface between interactive digital applications and the terminals on which those applications execute. This interface de-couples different providers' applications from the specific hardware and software details of different terminal implementations. It will enable digital content providers to address all types of terminals ranging from mobile terminals, low-end to high-end set top boxes, integrated digital TV sets and multimedia PCs.

Such interfaces will extend existing open standards for broadcast and interactive services in transmission networks including satellite, cable, terrestrial and microwave systems. They support many kinds of applications like electronic program guides (EPG), information services ("super teletext", news tickers, stock tickers), applications synchronised to TV content (score cards, local play-along games), e-commerce and secure transactions.

The interfaces enable access to the platform at three layers: resources, system software and applications. Typical resources are I/O devices, CPU, memory, a graphics system and MPEG audio-visual processing. The system software uses the available resources in order to provide an abstract view of the platform to the applications. Implementations include a default application navigator to control the access to and download of the applications that will run on it.

It is clear that "consumer electronics-like" behaviour of the terminals will be wanted/needed, i.e.:

6.5.3.1 Avoiding User intervention for upgrades and extensions;

6.5.3.2 Long(er) life-time/installation legacy;

6.5.3.3 Application stability;

6.5.3.4 Being able to prioritise between media, possibly from different service providers; and

6.5.3.5 Exploiting scalability.

From a combined terminal and network point of view, it is not yet clear how to exploit the increasing scalability of both media (see also 4.2.3) and networks efficiently. However, solutions addressing both issues should be superior in performance.

MPEG-21 will develop a framework that addresses the existing shortcomings in the management of flexible network and terminal resources. The proposed roadmap is the development of APIs and associated behaviour (implemented in *managers*) to manage resources in a structured, possibly hierarchical, way.

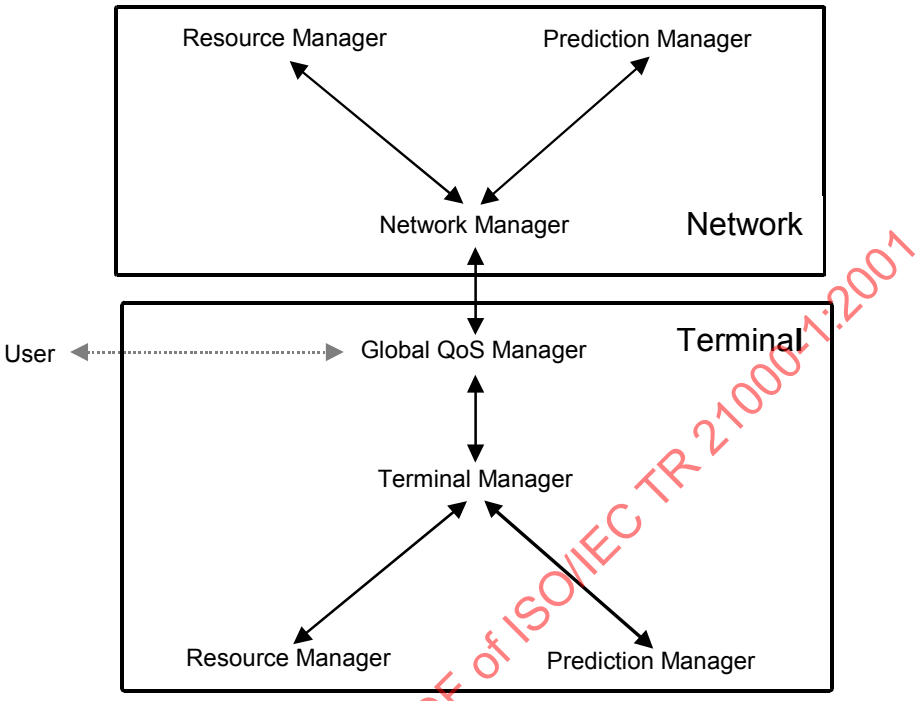


Figure 4: Simplified MPEG-21 resource management framework

Figure 4 shows a *simplification* of the proposed resource management framework, arrows denote control flow communication through APIs, not necessarily media flows. Both the terminal and the network contain resource and prediction managers. The network prediction manager calculates the complexity of the content that is being streamed to the terminal, while the terminal prediction manager uses the predicted results to calculate the impact it will have on terminal resources. Resource managers are used to manage resources in both the network and the terminal. The resource manager and prediction manager are consulted and controlled by their respective *terminal manager* and *network manager*. The *global QoS manager* couples User, terminal and network. The User (application) impacts how global QoS management is performed (priorities, preferences, etc.).

Although there are existing protocols that can be used in this framework, particularly on the network side, further development of new protocols will be required.

6.6 Content Representation

Content is obviously an essential element of a multimedia framework. Within the framework, content is coded, identified, described, stored, delivered, protected, transacted, consumed, etc.

Although MPEG-21 assumes that content is available in digital format, it is typically required that content is digitally represented (coded) fulfilling a set of requirements not accomplished by uncompressed formats (e.g., video). It is well known that the efficient representation of digital content allows the deployment of many new services, not possible without coding technology. Indeed, Users are becoming more mobile and have a need to access information on multiple devices in different contexts at different locations. Currently, content providers and authors have to create multiple formats of content and deploy them in a multitude of networks. Also, no satisfactory automated configurable way of delivering and consuming content exists that scales automatically to different network characteristics and device profiles. This framework element addresses the technology needed in order that content is represented in a way adequate to pursue the general objectives of MPEG-21.

6.6.1 Definition of the Current Situation

The problem of content representation or coding has been addressed for many years and many well known coding standards exist already, fulfilling different types of requirements and addressing several types of media. This enumeration is not meant to be exhaustive as other relevant references exist.

In the area of images and video, relevant standards include: JPEG, JPEG-LS and JPEG2000 for the coding of still pictures, H.261, H.263, MPEG-1 and MPEG-2 Video for the coding of frame-based video and MPEG-4 Visual for the coding of object-based pictures and video.

In the area of audio, relevant standards include MPEG-1, MPEG-2 and MPEG-4 Audio, while in the area of speech, G.723, G.728 and MPEG-4 Audio are relevant standards.

With regard to synthetic content, it is worthwhile to mention in the visual arena the VRML and MPEG-4 Visual standards and in the audio arena the MIDI and MPEG-4 Audio standards.

The current situation in terms of content representation addresses the relevant requirements of existing systems. Some of these will also be relevant within the multimedia framework. However, developments of the multimedia framework and the complexity of new media resources may require adaptations and additions within content representation.

6.6.2 Content Representation Requirements

Content representation has to fulfil a certain number of requirements to allow or facilitate the deployment of new or improved services in the context of MPEG-21. MPEG-21 content consists of one or a combination of: (i) content represented by MPEG standards, (ii) content used by MPEG but not covered by MPEG standards e.g. plain text, HTML, XML, SGML; (iii) content that can be represented by (i) and (ii) but is represented by different standards or proprietary specifications[12], and (iv) future standards for other sensory media.

MPEG-21 should be able to support new forms of content consumption such as those represented by the slogan “content anytime anywhere”. This indicates some high level requirements such as:

6.6.2.1 Efficiency,

6.6.2.2 Scalability (adaptivity, survivability),

6.6.2.3 Error resilience,

6.6.2.4 Interactivity, and

6.6.2.5 Synchronisation and multiplexing.

6.6.3 Opportunities for Change

The provision of some essential content representation functionality is a precondition that is needed to achieve interoperability. It is envisaged that MPEG-21 will define (mostly by reference) a default representation format for the different types of content. Other media formats will likely be accommodated in another way, e.g. by registration. MPEG-21 shall allow for inclusion, at a later stage, of representation schemes for new media types and major improvements in representation of types already present in MPEG-21.

The exploitation of the content representation requirements has to be linked to the other architectural elements (e.g. networks and terminals) to exploit solutions addressing combined issues, resulting in superior performance.

Examples include the relation at the Framework level between content representation and:

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[12] This type of content is recognised by some mechanism, for example through Registration Authorities.

6.6.3.1 the provisioning of QoS for terminals and networks;

6.6.3.2 the functionality required for IPMP (e.g., the best way to scramble various media types); and

6.6.3.3 the relation at the Framework level between content representation and the provisioning of QoS for terminals and networks.

6.7 Event Reporting

6.7.1 Definition of the Current Situation

Every interaction is an event. Arising from this event, there is the opportunity to describe what occurred. However, there are a number of difficulties in providing an accurate report about the event. Different observers of the event may have vastly different perspectives, needs, and focuses. They may emphasise certain elements to the detriment of others, or they may describe the events in a way that others may find confusing. Currently, there exists no standardised means of Event Reporting.

6.7.2 Identification of Shortcomings, Problems and Issues

In the real world, examples of the need for event reporting are plentiful. Here, we highlight three of the many areas where a set of standardised metrics within a multimedia framework does not yet exist.

Some of the wide-range benefits of Event Reporting include:

— Provide, provide for, support, adopt, reference or integrate relevant and timely information required to meet the strategic objectives of the organisation including:

  - Accurate product cost and profitability information,
  - Accurate customer cost and profitability information,
  - Accurate channel cost and profitability information,
  - Dissemination of information to the right people at the right time in the right format;

— Enable Users to simulate “what-if” scenarios upon which significant decisions will be based;

— Allow Users to understand operational processes and simulate process dynamics in order to optimise efficiencies and outputs.

Some specific cases are:

6.7.2.1 Effectiveness of financial reporting

Companies in every industry around the world report information about their performance to other Users (news providers, investors, regulators, the public, etc.). A number of issues make this difficult for the receiving Users to process this information:

— Different reporting formats;

— Different standards from country to country;

— Different currencies, languages, and other cultural and geographical factors for most companies in a global economy; and

— Different reporting practices from company to company, even within the same industry segment.

As such, information providers receive a vast set of unstructured content that becomes even more difficult for their readers to understand without a great deal of manual intervention.

6.7.2.2 Effectiveness of network service delivery

Service providers use a number of proprietary means to offer service level commitments. But such performance measurement issues as:

— Resource management,

— Dynamic traffic volume and mix, and

— Changing Internet infrastructures.

may hinder these Users from guaranteeing a standardised level of quality in the delivery of Digital Items to their customers. As a result, many providers offer “one size fits all” service with “seat-of-the-pants over-provisioning” to attempt to provide adequate throughput as service quality is not enforceable in real-time.

6.7.2.3 Effectiveness of advertising

Advertisers are Users who need to know whether their messages have reached other Users, to what extent, and with what impact. Currently, a series of issues make an accurate understanding of the events difficult. Some such issues include:

— Different definitions for unique Users

— No standards for log-file Calculations

— International traffic blurs traditional distinctions of Users

— Agents, robots and spiders make User-Content interaction difficult to measure

— Different metrics for how to describe the interaction (website clicks) and how long such interaction occurred.

6.7.3 Opportunities for Change

Common metrics about User-User interaction, User-Digital Item interaction, and Digital Item-Digital Item interaction, such as what a subscriber is, what constitutes a transaction, etc. will enable enhanced analysis and reporting for Users. With such metrics, Users can better understand the activities within MPEG-21. For example:

— Percentage of transactions completed versus aborted

— Percentage of subscribers to employees

— Average minutes of use per subscriber

— Average period of customer loyalty

— Product adoption rates

Fundamentally, Event Reporting in MPEG-21 will benefit Users by:

— Standardising metrics and interfaces for performance of all reportable events in MPEG-21;

— Providing a means of capturing and containing these metrics and interfaces that refers to identified Digital Items, environments, processes, transactions and Users.

Opportunities exist for creating metrics and interfaces for event reporting in all areas, but five functional areas merit specific focus:

1. Integrity
2. Interactivity
3. Transactions
4. Delivery
5. Rules/Processes/Models

6.7.3.1 Integrity

Develop event reporting tools that enable:

6.7.3.1.1 An audit trail of Digital Items

6.7.3.1.2 Enforcement of package integrity

6.7.3.1.3 Ensuring fidelity of presentation

6.7.3.2 Interactivity

Develop event reporting that enables:

6.7.3.2.1 Standardised measurements of interaction between

6.7.3.2.1.1 User(s) - User(s)

6.7.3.2.1.2 User(s) - Digital Item(s)

6.7.3.2.1.3 Digital Item(s) - Digital Item(s)

6.7.3.2.2 Management of User personalisation and User privacy

6.7.3.2.3 Content rating and filtering

6.7.3.3 Transactions

Develop event reporting that enables:

6.7.3.3.1 Assurance of complete and secure transaction;

6.7.3.3.2 A value exchange of any kind (payment/money, rights, equity, information, barter, etc.);

6.7.3.3.3 Means of interoperating with a User's internal systems, including Customer Relationship Management, Enterprise Resource Planning, Knowledge management and other systems as the case may be;

6.7.3.3.4 Audit trail, including for dynamic payment models (subscription, royalty/event, one-time);

6.7.3.3.5 Commerce measurement for regulatory compliance (e.g. auditing, taxes);

6.7.3.3.6 Integration of existing business reporting languages to support transaction measurement between Users;

6.7.3.3.7 Usage tracking.

6.7.3.4 Delivery

Develop event reporting that enables:

6.7.3.4.1 Guaranteed service levels based on business objectives;

6.7.3.4.2 Differentiated service levels for different Users;

6.7.3.4.3 Metrics for infrastructure performance, in the event of failure and denial of service attacks;

6.7.3.4.4 Assurance of dynamic and automated control of infrastructure to deliver service quality.

6.7.3.5 Rules, processes and models

Develop event reporting that enables:

6.7.3.5.1 Enforcement of business and usage rules

6.7.3.5.2 Regulatory compliance

6.7.3.5.3 Process integration between Users

6.7.3.5.4 Interoperability of MPEG-21 with other frameworks

6.7.3.5.5 Supporting processes from other environments, where appropriate

6.7.3.5.6 Integrating MPEG-21 events into other frameworks, where appropriate

6.7.3.6 Tracking and performance metrics

Predefined Set of Content Metrics

6.7.3.6.1 The framework should predefine a set of metrics applicable to content usage. These metrics should be based upon a framework-wide metric representation model.

Some predefined content personalisation metrics could include the number of times content was rendered, the last time content was rendered, how many times was it purchased, how long it was used, how many times was it completely listened to, etc.

Packaging of Metric Information for Exchange

6.7.3.6.2 Any User should be able to package metric information for exchange with other Users in the distribution chain. This User should be allowed to make this content available for sale in the framework.

7 Proposals and Recommendations

Based on the findings of the previous clauses, the following recommendation for MPEG standardisation activities are formulated:

7.1 Digital Item Declaration

7.1.1 To establish a uniform and flexible abstraction and interoperable schema for declaring Digital Items;

7.1.2 To ensure that media resources and descriptive data are fully separable;

7.1.3 To ensure that Digital items are open and extensible to any and all media resources types and description schemes;

7.1.4 To ensure that composite items can be constructed from other items, without losing the structure and properties of the sub-items;

7.1.5 To ensure that flexible configuration decision trees are declarable within the schema;

7.1.6 To ensure that hierarchies of containers and Digital Items can be efficiently searched and traversed;

7.1.7 To ensure that all Users can build and organise annotated hierarchical collections, including referential structures;

7.1.8 To ensure that Identification and revision of Digital Items and their components are supportable in an open and extensible manner.

7.2 Digital Item Identification and Description

MPEG should define a framework of common Digital Item identification (how to assign an ID to a Digital Item) and description:

7.2.1 Investigate functionalities of identifiers and descriptions in potential applications and business models including usage reporting, monitoring, tracking, licensing, etc.;

7.2.2 Investigate appropriate structure of identifiers such as self-descriptive and meaningful ones (e.g. country code included, etc.);

7.2.3 Clarify the requirements for new identification systems which do not presently exist (for ‘creations’, ‘people’, and the rights associated with creations and people) and investigate means for extensible identification and description;

7.2.4 Allow and enable various approaches for governance of ID issuing;

7.2.5 Provide, provide for, support, adopt, reference or integrate resolution system(s) to persistently associate identifiers with the location of the Digital Items;

7.2.6 Provide, provide for, support, adopt, reference or integrate standard access methods to Digital Item ID and descriptions;

7.2.7 Provide, provide for, support, adopt, reference or integrate interfaces to existing identification schemas and applications;

7.2.8 Provide a solid numbering policy and guidelines for identification and description of related Digital Items, granularity, multiple IDs, versioning, etc.;

7.2.9 Provide, provide for, support, adopt, reference or integrate solutions for integrity and security of IDs and descriptions;

7.2.10 Provide, provide for, support, adopt, reference or integrate standard solutions for insertion, modification and extraction of IDs and descriptions;

7.2.11 Provide, provide for, support, adopt, reference or integrate standard ID and description format;

7.2.12 Provide, provide for, support, adopt, reference or integrate solution for interoperability of identifiers by their integration (creating links, relationships and associations between different identification schemes used to identify components of multimedia objects);

7.2.13 Provide, provide for, support, adopt, reference or integrate solutions for organisation of identifiers in association with Digital Item (how is each identification system is identified and how identifiers are structured when associated with content);

7.2.14 Harmonisation/integration with/of existing standards.

7.3 Content Handling and Usage

7.3.1 Define interfaces and protocols for search, storage, organisation and management of Digital Items and descriptions that enable and support:

7.3.1.1 Users to express their preferences;

7.3.1.2 End Users to personalise their content;

7.3.1.3 Users to locate relevant content in the network, device etc.;

7.3.1.4 The integration and interoperability of different asset management systems;

7.3.1.5 Content lifetime management and associated configurable policies;

7.3.1.6 Tracking changes to Digital Items and Descriptions;

7.3.1.7 Users to identify where all copies of content they own are located with associated usage restrictions.

7.3.2 Define interfaces and protocols for User Profile Management and Metrics that enable and support:

7.3.2.1 Creating, modifying and managing User profiles;

7.3.2.2 Creating, tracking and packaging of content usage metrics information;

7.3.2.3 Interchange formats for User profiles with other systems;

7.3.2.4 End Users to express and handle their privacy.

7.3.3 Define interfaces and protocols to bring the benefits of intelligent agents within the framework.

7.3.3.1 To operate, intelligent agents need a representation of the User's self (User profile), a knowledge about the specific domain (an ontology) and a standard language that allows the non-human entities to entertain a dialogue with other non-human entities (which will again possess knowledge about the humans they represent and a shared ontology) to achieve the goal that has been set;

7.3.3.2 To allow that a single language (Agent Communication Language) be defined. Therefore, a standardised representation of User information will be needed. Ontologies for the different domains will also need to be referenced, when available, and their development stimulated when not available. In some specific cases MPEG may need to develop specific ontologies itself.

7.4 Intellectual Property Management and Protection

In the area of managing and protecting Digital Items, it is essential to work on a trusted framework of IPMP Systems. One possible approach is detailed in in Annex D. Issues to be addressed are:

7.4.1 Define the attributes of a trusted environment (including technical, legal, financial, commercial, etc) for persistent management and protection of Digital Items;

7.4.2 Define the attributes of the interfaces between Users and agents;

7.4.3 Specify a framework for the enforcement of the management and protection of Digital Items;

7.4.4 Encompass work for the management and protection of MPEG-4 Audio-visual Objects and MPEG-7 Descriptors, Description Schemes and Descriptions, and adapt this to MPEG-21 as appropriate. In addition, the work shall be extended to cover the management and protection of other Digital Item types including personal data and rights to its use;

7.4.5 Specify the interfaces between transaction systems for rights management and the systems that manage and protect Digital Items.

7.5 Terminals and Networks

To achieve interoperable transparent access to (distributed) Digital Items by shielding Users from network and terminal installation, management and implementation issues, MPEG should standardise:

7.5.1 APIs and associated protocols (behaviour) for terminal QoS management;

7.5.2 NPIs and associated protocols (behaviour) for network QoS management;

7.5.3 APIs and associated protocols (behaviour) for joint terminal and network QoS management;

7.5.4 Rules for QoS contract negotiation and implementation;

7.5.5 APIs enabling QoS agent technologies.

7.6 Content Representation

Provide, adopt or integrate content representation technologies able to efficiently represent MPEG-21 content, in a scalable and error resilient way. The content representation of the media resources shall be synchronisable and multiplexed and allow interaction.

7.7 Event Reporting

MPEG-21 Event Reporting should:

7.7.1 Standardise metrics and interfaces for performance of all reportable events in MPEG-21;

7.7.2 Provide a means of capturing and containing these metrics and interfaces that refers to identified Digital Items, environments, processes, transactions and Users.

Such metrics and interfaces will enable Users to understand precisely the performance of all reportable events within the framework. “Event Reporting” must provide 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.

Annex A

List of Activities Related to the Multimedia Framework

This annex gives a non-exhaustive list of activities related to the Multimedia Framework. The activities are grouped into four different categories:

— Standardised models and frameworks

— Current standardisation activities

— Forums and consortia

— Specifications produced by forums and consortia

A. 1 Standardised Models and Frameworks

A.1.1 CWA (CEN Workshop Agreement) 13699 "Model for Metadata for Multimedia Information"

It defines the terms information resource, metadata and multimedia, comments on the nature of metadata and explores the relationship between metadata and the information to which it refers. A conceptual model for metadata for multimedia information resources was elaborated based on three concepts: metadata classes, roles and actions. Three major roles were identified in the metadata model, creators, service providers and users, who perform actions that apply equally to both information resources and metadata. A life cycle model was described which can be applied either to an information resource or to its associated metadata and illustrates the phases through which an information resource and its associated metadata may pass from creation or acquisition to retention or disposal. The Agreement recommended the development of standardised mechanisms for performing actions on multimedia information resources and metadata.

A.1.2 CWA 13700 "Requirements for metadata for multimedia information"

It presents a requirements taxonomy that identifies a set of basic general requirements. They are classified into *a)* metadata, and *b)* facilities needed in association with metadata. The classifications are aligned, respectively, with related concepts in the metadata model (metadata classes) and in the metadata framework (framework decomposition into delivery, access, protocols, discovery and asset management and interoperability). Most of the identified requirements come from several application domains such as Retail, Services, Public Administration, Entertainment, Scientific and Cultural heritage, Publishing, Education and Healthcare. Requirements from two application examples, audio-visual publishing and brokerage, are described in more detail and the taxonomy is used to list requirements in real applications such as the Danish Library use of Dublin Core metadata.

A.1.3 The Metadata for Multimedia Information Framework

It provided a structured classification of information and activities involving metadata for multimedia information in early 1999; providing brief information on a topic, the specifications and standards being developed, what consortia or research projects were actively working in a field and what reference material (books, magazine articles and web sites) were relevant. The framework was never progressed to a CEN Workshop Agreement since it was intended to be a "live" resource with constant updating. Another CEN/ISSS project the "Metadata Observatory" under the auspices of the MMI-DC workshop will now provide web-based information on projects using Dublin Core.

A.1.4 IEC TR 61988 Model and Framework for Standardisation in Multimedia Equipment and Systems

This technical report was compiled by a project team of IEC TC 100; it provided models and frameworks for the standardisation of multimedia technology, being undertaken or to be undertaken by IEC. It covered system interfaces, user interfaces, interchange and distribution, measurement and management and multimedia data and contents. Requirements for physical and logical connectivity, easy operation, safety and security, easy

implementation, and environmental safeguards were discussed in the light of a generic model and specific models addressing models of physical and logical connectivity, and inter-system and inter-device models data distribution and management models and information appliance models. Informative annexes discussed possible standardisation requirements in some specific fields such as digital TV broadcasting, internet broadcasting, display systems and games systems.

A.1.5 DAVIC (Digital Audio Visual Council) Framework

DAVIC was formed in 1994 and over five years some 220 organisations from 25 countries representing all sectors of audio and visual manufacturing (computer, consumer electronics and telecommunications equipment) and services (broadcasting, telecommunications and CATV) government agencies and research organisations collaborated to develop specifications of open interfaces and to maximise interoperability across geographical boundaries and between diverse applications, services and industries. The DAVIC specification 1.3.1 was standardised in 1999 as ISO/IEC 16500 (normative) and ISO/IEC 16501 (informative). The specification had a Requirements and Framework section which described digital audio-visual functionalities, system reference models and scenarios. In addition there were architectural guides, technology tool sets and sections on systems integration, implementation and conformance.

A.1.6 IEC ITA OPIMA Specification 1.1

The Open Platform Initiative for Multimedia Access (OPIMA) provides a standardised framework allowing the secure downloading, installation and running of proprietary protection systems (called IPMP systems).

The specification presents an architecture and a description of the function required to implement an OPIMA-compliant system and considers four usage scenarios, portable devices for secure digital music, broadcasting of protected content, wireless access to multimedia content and access to multimedia content on physical data centres. The OPIMA specification is device and content independent. Content includes all multimedia types and executables. The specification is independent of all digital content processing devices and content types. Rules (information that stipulates how content may be used on a given device) determine how business models are established. An IPMP (Intellectual Property Management and Protection) system controls access and use of the content by enforcing the rules associated with it. OPIMA provides a specific Secure Authenticated Channel (SAC) and appropriate interfaces between the IPMP systems and the applications. This communication is enabled by the so-called OPIMA Virtual Machine (OVM), the environment in which the content processing takes place. The IPMP system required to access the content oversees the content processing including decryption (e.g., using DES) and decoding (e.g., using MPEG-4) of content and communicates with the OVM through the IPMP Services API.

A.1.7 ISO/IEC 14496-6 Delivery Multimedia Integration Framework DMIF

Delivery Multimedia Integration Framework allows each delivery technology to be used for its unique characteristics in a way transparent to application developers. DMIF's main purposes are to provide an application interface independent of the networking technology that hides the details of the transport network from the user, and to ensure signalling and transport interoperability between end-systems and managing in real time, QoS sensitive channels. DMIF therefore performs a natural mapping function for an application's network service requests.

A.1.8 DVB-MHP (Multimedia Home Platform)

DVB-MHP (ETSI TS 101-812) is a series of measures designed to promote the harmonised transition from analogue TV to a digital interactive multimedia future. Based around a series of mandatory Java APIs (Application Programming Interfaces) as well as an optional definition of content and applications format elements from the HTML family, DVB-MHP promises to provide a domestic platform which will facilitate convergence.

Some 1000 pages long, MHP defines the application lifecycles, security and data download mechanisms for enhanced broadcast, interactive and indeed full Internet. DVB standards are published by ETSI.

Other standards from DVB such as TS 101 224 Home Access Network, TS101 225 In Home Digital Network and TS 101 226 In Home Digital Networks Guide are also relevant to MPEG-21.

A.1.9 IEEE P1520 (includes value added interfaces)

The objective of IEEE P1520 is to enable the development of open signalling, control and management applications as well as higher level multimedia services, through value added service level interfaces, on networks. The scope of the networks considered extends from ATM switches to hybrid switches such as high speed IP switches and routers.

A.2 Current standardisation activities

A.2.1 Mediacom 2004

The project Mediacom 2004 has been established by Study Group 16 in its capacity as lead Study Group for multimedia studies in the ITU-T. The intent of the project is to generate a framework for multimedia communications studies for use within the ITU and other SDOs. The formation of this project has been endorsed by the World Telecommunication Standardisation Assembly 2000.

The project Mediacom 2004 has been established in recognition that:

— global standards and harmonized regulations are essential for an effective and democratic Information Society, and consistent multimedia systems and services are part of the core in this Information revolution;

— many standards development organizations (SDOs) and industry forums are developing multimedia standards;

— the present convergence trends are bringing further overlaps in standardisation work and, as a consequence, introduce the need for costly and complex gateways to maintain end-to-end interoperability;

— the rapid increase in diversity of services and systems increases the possibility of confusion amongst users;

The main objective of Mediacom 2004 is to establish a framework for the harmonised and co-ordinated development of global multimedia communication standards. It is intended that this will be developed with the support of, and for use by, all relevant ITU-T and ITU-R Study Groups, and in close cooperation with other regional and international standards development organisations (SDOs).

The key Framework Standardisation Areas (FSA) identified for study within Mediacom 2004 are as follows:

— Multimedia architecture

— Multimedia applications and services

— Interoperability of multimedia systems and services

— Media coding

— Quality of service and end-to-end performance in multimedia systems

— Security of multimedia systems and services

— Accessibility to multimedia systems and services

The Mediacom 2004 project documentation is available at:
http://www.itu.int/ITU-T/com16/mediacom2004/index.html

A.2.2 MoU between ISO, IEC, ITU and UN/ECE on electronic business

These organisations have signed an MoU in the field of electronic business to co-operate on standardisation of components involved in the areas of business scenarios, message and interoperability standards for business transactions, and product definition data standards for design, manufacturing and product support.

Each organisation recognises that co-ordinated standards (standards developed within their respective domains) are essential and must be interoperable and technically consistent. Recognising that within electronic business, there is the potential for convergence for all types of data interchange, the work programme will be tailored to bring all types of information exchange development within a single framework. Ongoing activities include:

— The Basic Semantic Register (BSR) project in ISO/TC 154 Processes, data elements and documents in commerce, industry and administration

— Development of standards for naming, defining and coding of data elements in ISO/IEC JTC 1/SC 32 Data Management and Interchange, ISO/TC 184/SC 4 Industrial Data-Parts Libraries and in IEC/SC 3D Data sets for libraries of electric component data

— security in Electronic Data Interchange (EDI) transmission (e.g. ISO/TC 68 Banking, securities and other financial services

— maintenance of Open-edi reference model (ISO/IEC 14662)

— technical documentation in ISO/IEC JTC 1/SC 24 Computer graphics and image processing and in IEC/SC 3B

— standards for processing multiple languages, character sets and encoding in ISO/IEC JTC 1/SC 2 Coded character sets

— Commerce at Light Speed (CALS) International work on a generic electronic business reference model in a virtual enterprise to support the CALS business scenarios

— ITU-T Global Information Infrastructure (GII) Projects

A.2.3 CEN/ISSS

The mission of CEN/ISSS is to provide market players with a comprehensive and integrated range of standard-oriented services and products in order to contribute to the success of the information society in Europe.

A.2.3.1 CEN/ISSS MMI-DC Workshop

Recognizing the importance of metadata agreements for the European content industry, CEN started a new CEN/ISSS Workshop on Metadata. A growing number of information services on the Web are using Dublin Core as their basis for descriptions for Web resources. The Dublin Core Metadata Element Set is designed for simple resource description and to provide minimum interoperability between metadata systems. The workshop provides guidance on the use of Dublin Core and is maintaining a metadata observatory.

A.2.3.2 E-commerce Workshop

The CEN/ISSS Electronic Commerce Workshop has been established to provide an open and flexible framework for market players (manufacturers, service providers, users, research bodies, administrations, etc.) to identify and progress Electronic Commerce standards and standards-related issues, and to deliver outputs. As Electronic Commerce impacts on all business processes, a common, multi-sectoral approach is crucial for resolving interoperability between technical solutions, which need to be implemented across businesses and value chains. The Workshop offers a coherent and cohesive focus for EC standardization at a European level, within the context of global EC standardization activities.

A.2.3.3 Electronic Signatures (E-SIGN) Workshop

While the EU Directive on Electronic Signatures provides a comprehensive legal framework for the harmonisation of the security infrastructures and authentication services using electronic signatures across Europe, it needs the appropriate technical support that will achieve the full implementation of its legislative prescriptions into the member states laws.

Under the auspices of the EESSI work programme, the E-SIGN WS has been developing a set of deliverables proposing consistent to the Directive and interoperable solutions in a number of key areas: use of trustworthy systems by the Certificate Service Providers (CSPs), development of security-enhanced signature creation interfaces, creation of reliable signature creation devices, elaboration of guidelines on how best to verify a signature with short and long-term validation results, preparation of a set of requirements addressing appropriate conformity assessment mechanisms.

A.2.3.4 ISO TC 46/SC 9

The organisations involved in the administration of identifier systems and projects within ISO TC 46/SC 9 has formed a Joint Initiative to work together on issues relating to the interoperability of their identifier schema. This Joint Initiative is being co-ordinated and assisted by the ISO TC 46/SC 9 Secretariat. The work of this Joint Initiative has been divided into several phases. Phase 1 consists of an analysis of the requirements for identifiers and descriptors in three broadly defined business functions that are central to the content industries: production, distribution, and the management and protection of intellectual property rights. The purpose of this analysis is to establish a shared frame of reference for describing the nature of the business and information transactions that take place in the course of production, distribution, and rights management. It focuses specifically on the requirements of the originators, producers, distributors, registration authorities, and rights administrators involved in the development and delivery of intellectual and artistic content.

Phase 1 of this Joint Initiative is nearing completion. The main deliverable is the document "Content Delivery and Rights Management: Functional Requirements for Identifiers and Descriptors for Use in the Music, Film, Video, Sound Recording, and Publishing Industries".

A.3 Forums and Consortia

A.3.1 WorldWideWeb Consortium W3C

W3C is the organisation that develops primary specifications for the web. XML will form the basis for information interchange between the next generation of computer systems.

XML and pointers to all different XML frameworks e.g., NewsML, ebXML, Open XML[13], IRML, XBRL/XFRML,CWM (see below).

A.3.2 Multiservice Switching Forum (MSF)

The MSF mission is to accelerate the deployment of open communications systems that realise economic benefits (in the sense of more optimal use), which result from the flexible support of a full range of network services using multiple infrastructure technologies.

A.3.3 Society of Motion Picture and Television Engineers (SMPTE)

The SMPTE 330M-2000 Television - Unique Material Identifier (UMID) standard describes a unique identifier scheme for use in a broadcast environment. The SMPTE 298M standard specifies Universal Labels for the Unique Identification of Digital Data.

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[13] OpenXML is an open source, pure Java, commercial-grade, fully featured framework for XML-based applications. OpenXML covers the entire cycle of XML documents production, processing and delivery for dynamic content publishing and application to application communication.

SMPTE Metadata dictionary structure is defined in SMPTE 335M while the associated Metadata Dictionary Contents Recommended practice defines a registered set of metadata element descriptions for association with essence or other Metadata, the two specifications must be used together as a pair – neither may be used in isolation.

A.3.4 The European Broadcasting Union (EBU)

The EBU had a PMC P/META (Metadata exchange standards) project (ended in December 2000) with as goals:

1. To establish understanding between EBU members of the media-related data interchange requirements of media commissioner/publishers (broadcasters), suppliers (producers) and End Users

2. To validate and extend the Standard Media Exchange Framework (SMEF) model as appropriate against members' requirements in terms of data and process, noting local synonyms (or translations), to create an "E-SMEF".

3. Using E-SMEF, to apply emerging SMPTE metadata standards to the production and broadcast or distribution process, and study the feasibility of creating and adopting common exchange formats for essence and metadata.

4. To establish understanding of the use of unique identifiers in metadata e.g. the SMPTE UMID, as a crucial linkage tool between unwrapped data (metadata) and wrapped or embedded metadata in media files or streams, and develop protocols for their management between members.

5. As an aid to commercial and system interoperability between members, and in co-operation with standards bodies in related industries such as music and print publishing, to collate all relevant unique identifier schemes and map them against each other.

A.3.5 TV Anytime Forum

The TV Anytime Forum is an association of organisations that seeks to develop specifications to enable audio-visual and other services based on mass-market high volume digital storage.

The Forum is working to develop open specifications designed to allow Consumer Electronics Manufacturers, Content Creators, Telcos, Broadcasters and Service Providers to exploit high volume digital storage in consumer platforms.

A.3.6 3GPP (Third Generation Partnership Project)

The mission of 3GPP is for the partners to co-operate in the production of globally applicable Technical Specifications and Technical Reports for a 3rd Generation Mobile System based on evolved GSM core networks and the radio access technologies supported by the 3GPP partners.

A.3.7 Wireless Application Protocol (WAP) Forum

The WAP Forum is the industry association that has developed the Wireless Application Protocol (WAP), used for wireless information and telephony services on digital mobile phones and other wireless terminals.

The primary goal of the WAP Forum is to bring together companies from all segments of the wireless industry value chain to ensure product interoperability and growth of wireless market.

A.3.8 Dublin Core

The Dublin Core has become an important part of the emerging infrastructure of the Internet. Many communities are eager to adopt a common core of semantics for resource description, and the Dublin Core has attracted broad ranging international and interdisciplinary support for this purpose. The Dublin Core Initiative has from its beginning been an international consensus-building activity. The Dublin Core Directorate will, in consultation with advisory committees, render judgments as to the character of the consensus and the state of the Dublin Core. The Directorate coordinates Dublin Core workshops, working group activities, and dissemination of information about

the Dublin Core initiative via the Web site and other publications. The Dublin Core Directorate is currently hosted by the OCLC Office of Research and Special Projects.

A.3.9 Audio Engineering Society (AES)

The AES serves its members, the industry and the public by stimulating and facilitating advances in the constantly changing field of audio. It encourages and disseminates new developments through annual technical meetings and exhibitions of professional equipment, and through the Journal of the Audio Engineering Society, the professional archival publication in the audio industry.

A.3.10 IRTF Internet DRM WG

IDRM is an IRTF (Internet Research Task Force) Research Group formed to research issue and technologies relating to Digital Rights Management (DRM) on the Internet (http://www.idrm.org). The IRTF is a sister organization of the Internet Engineering Task Force (IETF).

A.3.11 OpenEBook Forum

The Open eBook Forum (OeBF) is an association of hardware and software companies, publishers, authors and users of electronic books and related organisations whose goals are to establish common specifications for electronic book systems, applications and products. OeBF will benefit creators of content, makers of reading systems and, most importantly, consumers, helping to catalyse the adoption of electronic books. OeBF will encourage the broad acceptance of these specifications on a world-wide basis among members of the Forum, related industries and the public and it will increase awareness and acceptance of the emerging electronic publishing industry.

A.3.12 cIDf (Content ID Forum)

cIDf is a forum to standardize "Content ID", which is a set of well-defined meta-data including a unique code embedded in each digital content item, guarantees content uniqueness and stabilizes content value. It creates an environment for open-type content distribution that encourages active usage such as the creation of derivative products.

A.4 Specifications produced by forums and consortia

A.4.1 Common Warehouse Metamodel (CWM) Specification, published by OMG

It addresses the problem of metadata management and specifically reconciliation of inconsistent metadata when data from different sources are merged. In addition, CWM standardises the syntax and semantics needed for import, export, and other dynamic data warehousing operations. The CWM specification extends to APIs interchange formats, and services that support the entire lifecycle of metadata management.

A.4.2 Biztalk Framework

The Microsoft BizTalk Framework is an Extensible Markup Language (XML) framework for application integration and electronic commerce. It includes a set of guidelines for how to publish schemas in XML and how to use XML messages to easily integrate software programs together in order to build rich new solutions. Microsoft Corp., other software companies and industry standards bodies will use the BizTalk Framework to produce XML schemas in a consistent manner.

A.4.3 RosettaNet

RosettaNet specifies standard electronic business interfaces for the business-to-business exchange of technical information for Electronic Components enabling for secure electronic communications between foundries and their customers, suppliers and marketing partners. The immediate focus for establishing a uniform electronic system for the foundry industry includes: online order entry, tracking work in progress, engineering reports, project status, delivery status, forecasting and planning, and payment.

Annex B

Example of a Generic Description of a Model for Content Delivery and Rights Management

Led by content delivery and rights management experts, considerable effort has been applied to 'map' the delivery of content, the exchange of value, and the associated flow of rights transactions in an e-commerce trading environment. One such example was the European Commission-funded IMPRIMATUR project which produced, through consensus between representatives drawn from a broad range of business sectors including rights holders, telecommunications companies, IP lawyers, and IT companies, a conceptual business architecture for rights management in an e-commerce trading environment (Figure B.1).[14]

B.1 Scope

A content delivery and rights management business architecture aims to provide a blueprint to support current and future business practices for the trading and licensing of multimedia content in a digital trading environment. By adopting a set of straightforward terminology to describe the processes required to conduct the trading of copyright material in a secure manner, it enables a broad cross-section of readers to acquire an advanced level of understanding about this complex subject.

Such a model can provide the conceptual framework for the development of a prototype ERMS (Electronic Rights Management System). It identifies the roles involved in the creation and distribution of multimedia works as well as the relationships between these roles. This includes a detailed analysis of the requirements of each of the business architecture roles and fully defines their separate and distinct activities in terms of the goals to be achieved. The model can provide a framework and reference point for legal and technical work as well consensus building activities.

B.2 Requirements

There are a variety of different possible trading relationships, situations, arrangements, or business models for the trading of Intellectual Property Rights (IPRs) as well as a range of accompanying technical and legal issues.

The requirements for a content delivery and rights management Business architecture are that it:

— provides a tool suitable for investigating and analysing IPR issues in a digital trading environment

— is flexible and modular enough to take into account a range of different trading situations

— identifies the key relationships in the ERMS trading environment

— does not preclude other relevant business models

— does not preclude any relevant legal or technical IPR issues

— is sufficiently detailed to allow a functional specification for the technical development

— is sufficiently focused to allow development within the resources available in the project

— accounts for user privacy

[14] Extract taken from "Synthesis of the IMPRIMATUR Business Model", The IMPRIMATUR Project, Document number 4087a

Such a model is designed to embrace a complete ERMS within which digital content, payment mechanisms and rights management must fully comply with the requirements of an electronic trading architecture.

B.3 Overview of a Conceptual Business Architecture for Content Delivery and Rights Management

A Conceptual Business Architecture is comprised of a set of roles and role relationships.

B.4 Roles

Roles are the basic building blocks of a conceptual business architecture. In the context of rights management, each of the roles represents a fundamental activity in the trading of intellectual property rights and is necessary in order for one or more aspect of trading to take place. Roles in some way initiate or facilitate the flow of payments, rights and information. A role is not necessarily represented by any one individual or organisation and any organisation or individual can be responsible for performing a number of roles.

By way of example, the roles defined within the IMPRIMATUR Business Architecture are summarised in the following table:

Role	Fundamental Activity/Defining Characteristic
Creator	Creation of Information and therefore IPR's
Creation Provider	Makes creation available for commercial exploitation
Media Distributor	Distributes creation
Rights Holder	Holder of IPR's
Purchaser	Acquires the information
IPR Database	Retains current information on IPR ownership and restrictions
Monitoring Service Provider	Check legal/illegal use of information
Certification Authority	Authenticate users (media distributors, purchasers)
Unique Number Issuer	Provides a unique number for creation or a mechanism for uniquely identifying Digital Items
Bank	Facilitates payments

Each role can carry out a number of functions relating to its fundamental activity/defining characteristic.

B.5 The Role Relationships

The role relationships are the transactions that occur between the roles such as the flow of digital content, rights, payments and information. Each transaction can result in one or more flows. These simple relationships and the interfaces they define between the roles are important in developing practical implementations in the form of modular software.

B.6 Goals

Another way to view a rights management business architecture is in terms of the goals that it explores. These common objectives give a concrete idea of the requirements that an ERMS may encounter.

These are the following:

— To be able to offer creations for commercial exploitation in a digital form;

— To protect the copyright in a creation;

— To provide access control;

— To represent the creator's rights in relation to creations for given territories, media and duration;

— To promote the need for effective legislation to protect the rights of creators and to ensure their adequate remuneration from the exploitation of their creations;

— To be able to take into account multiple rights holders as documented in the IPR database and to transmit royalties correspondingly;

— To support the clearance of rights through the provision of automated licence transactions;

— To be able to specify the amount of royalties to be received for each creation as well as the usage rights associated with the creation according to the assignments set forth in the IPR database;

— To be able to generate personalised copies of digital content and thus enable the tracking of IPR's;

— To be able to collect and distribute royalties for each copy sold according to the assignments set forth in the IPR database;

— To support the automated monitoring of the number of copies downloaded from the media distributor to report usage to rights holders and creators;

— To ensure the flow of payment data between the parties involved in the ERMS;

— To provide evidence that a digital copy has been legally acquired;

— To manage the privacy of the consumer (with respect to tracking and anonymity);

— To ensure a representation of fuzzy aspects of law, such as Fair Use Law.

The roles, their relationships and transactions can be expressed in many ways. The following diagram is just one example of the manner in which it may be represented.

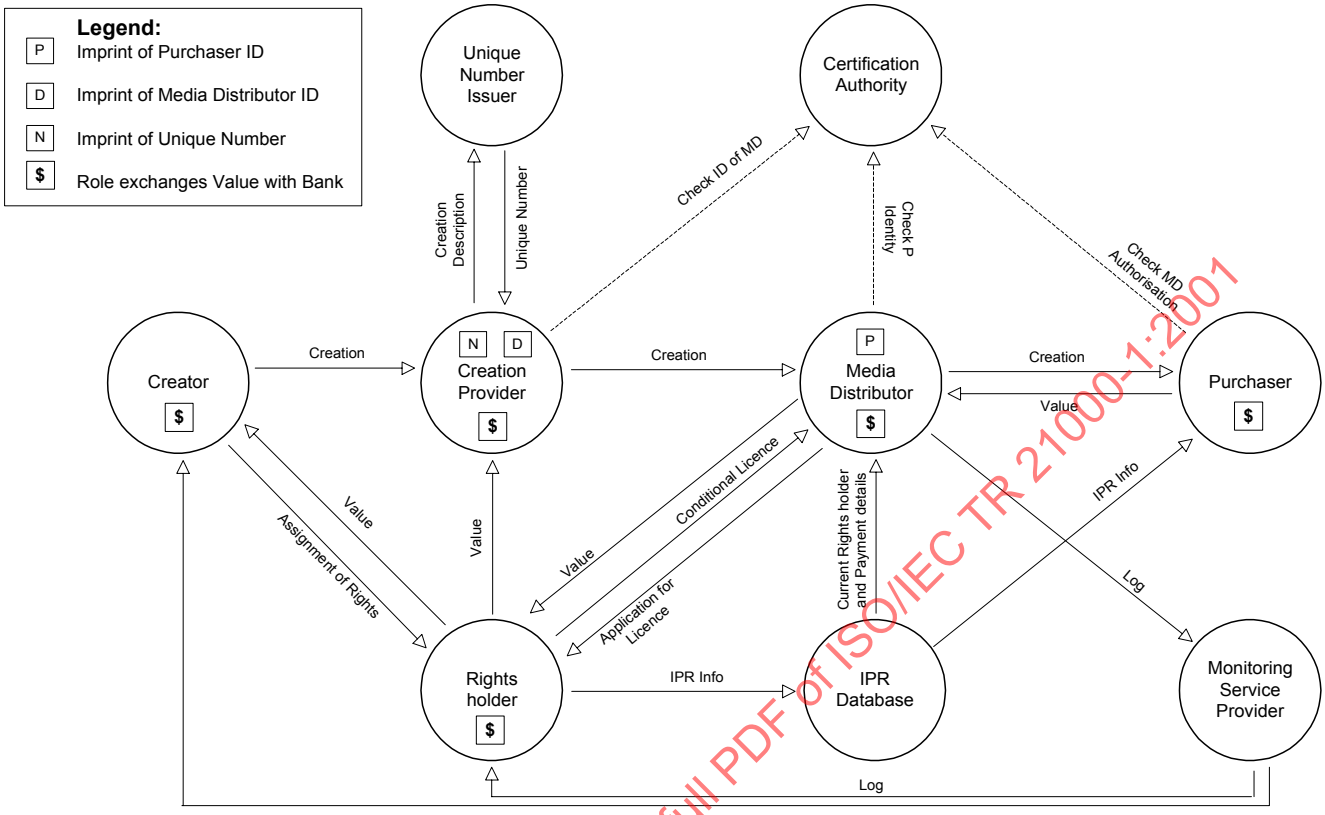

Figure B.1: The IMPRIMATUR business model

Annex C

Table of Key Issues for User Interoperability

	Key Issues	Related Issues	Explanation of Issues
1.	**Network delivery**	a) Connectivity b) Bandwidth c) QoS d) Network independence e) Consistency and reliability of networks f) Mobility g) Cost/performance	Today there is a one-to-one association of content with the delivery system used: a) DVD movies versus VHS movies versus pay-TV movies. The last, however, are received via cable or satellite and, once the service is digital, there are no longer differences in quality between the two. b) MC music versus CD music versus (in the future) DVD Audio music versus (in the future) SuperCD movies This is rapidly changing. The web is usually accessed with a telephone modem, but the use of cable modem is expanding. In parallel to this deployment of ADSL continues. In the future the web can be accessed via satellite. In these conditions an MP3 file is no longer associated with the delivery system but only with "the Internet". The file is moved to a RIO device but it is the MP3 file, the music, that moves, and this is no longer associated with the delivery system. With the progress of digitisation this trend will accelerate. The end point will be the complete unawareness of the use of the delivery system. These will only be seen in terms of the performance offered (i.e., QoS) and the associated price. The delivery system shall be highly flexible to allow multimedia applications to connect arbitrary sets of users, with a reserved bandwidth, such that the quality of the user experience will be guaranteed a) Connectivity allows the interconnection of several peers to create a networked community. For instance, point to point (e.g., unicast), point to multipoint (e.g., multicast), multipoint to multipoint (e.g., virtual network), point to many points (e.g., broadcast), etc. b) Bandwidth provides the necessary bit rate to deliver multimedia content among peers belonging to a networked community. In other words, the bandwidth is the thickness of the pipe/link that carries information. . The multimedia application usually expresses the bandwidth in terms of the traffic characteristics of the multimedia streams (e.g., average bit rate, maximum bit rate, etc.). c) QoS provides the basis for delivery of rich multimedia content against raised community expectations. QoS is the delivered guarantee of bandwidth. QoS is defined in terms of delay and reliability (i.e., error and losses). The QoS is negotiated by the user according to the requirements of the multimedia application. For instance in the case of delay, a file transfer may be subject to delay, a play/stop command can tolerate a small latency, a high quality streaming video can only tolerate a short delay, and a multimedia conferring system requires a strict end-to-end delay. Regarding reliability, some transport protocols like TCP provide error free transport. However,

	Key Issues	Related Issues	Explanation of Issues
			other transport mechanism used in broadcast satellite delivery does not provide error/loss free transport. Depending on the type of multimedia application, error and losses may have a strong impact on the quality of content. d) Multimedia applications are unaware of network delivery mechanisms. Each media component is transparently delivered, for instance, through satellite, fiber optic, cable, DSL or wireless bandwidth providers. The choice of a network delivery technology is a function of the appropriate QoS and the associated cost. Additionally, simultaneous use of different service and network providers can be transparent to users and application. e) On one hand, reactive networks (e.g., IP) do not provide QoS guarantees since no previous allocation of resources is made. These type of networks provide best-effort services, since they maximise the QoS according to the available resources in the network at one particular time instant. For these kind of networks, mechanisms of monitoring and re-negotiation are useful to mitigate network congestion conditions. For instance, TCP/IP provides flow control mechanism in the presence of congestion. On the other hand, proactive networks (e.g., ATM) provide QoS guarantees, which are establish during the multimedia service request (i.e., admission control). In these type of network, the transport service is defined as an end-to-end connection-oriented service with negotiated QoS guarantees. In both cases, reactive and proactive network, the multimedia application requires mechanisms of re-negotiation to change/upgrade the QoS requirements. f) A satellite broadcast delivery transports data with practically no delay (apart from propagation). An IP network has unpredictable delay. Methodologies to characterise these networks are important g) Many networks provide access to fixed terminals. Mobile networks, such as GSM and GPRS provide access to mobile devices. These provide two-way communication. DAB provides only one-way communication. IMT 2000 provides both one-way and two-way communication. h) The cost in using networks is a trade-off between the cost of transporting bits (i.e., bandwidth) and the services associated with the transported bits (i.e., management and signalling).
2.	**Quality and flexibility of service**	a) Reliability b) Measurement of quality c) User perceived quality d) Integrity of information e) Value f) Ease of use g) Dynamic and responsive to End Users needs	a) The End User must be able to rely on the content being delivered on time and without having been deteriorated during the delivery. The End User must also be able to rely on the authentication and authorisation of the content and its usage. b) Objective measurements of the quality of the service, both of the content itself (e.g. image or audio quality) and of the service or content delivery over some access form (transmission quality, e.g. bit stream errors, transmission delay or lost information). c) The End User judges the quality according to a number of subjective parameters and also perceives quality as a function of price and expectation. These issues need to be considered when evaluating the quality of service.

	Key Issues	Related Issues	Explanation of Issues
		Users needs h) 'On demand' i) Efficient & smooth rendering j) Predictable & continuous k) Accessibility of service	d) The information sent over any delivery network must be protected against unauthorised usage (e.g. viewing or copying) as well as from being altered or destroyed by others than the creator or other legitimate content owners. e) The End User should receive content quality and service performance that responds to his current needs. That includes choosing an appropriate level of cost/performance, delivering at any time content suited for the current application. This may include using different transport media for different applications, e.g. a fast reliable network for demanding real time services and a slower, cheaper network for downloading of information for later use. f) Any service provided to the End User should be intuitive and provide user-friendly interfaces. The End User wants to recognise the user interface when switching from one device to another; i.e. for different versions of an application (used on different devices) the same navigating principles should be used. The End User should be able to specify the performance of the required service in everyday language, without having to specify requirements for bandwidth, delay time, or other technical service parameters. g) The End User shall have access to content according to his specific needs. The End User's preferences should be stored in profiles and re-used the next time any service is used. The user should also be able to interact "on-line" with the service, changing the performance, content or cost according to his changing needs. The changing needs of the End User could be satisfied using source/device communication, or by using scalable services where the end device decodes and renders a subpart of the total transmission. h) Any content or service should be available on End User request, regarding both accessibility and timeliness. i) The content should be rendered and presented in an efficient and smooth manner, providing a high quality experience without disruption or pauses in the presentation of the content. j) The content or information must be brought to the user within predictable time and to a pre-decided quality. The rendering of the content should also run continuously, without delay, interrupts or errors caused by the access media. k) The user must be able to access the content at any time, any place and through any device.
3.	**Quality of content (rendering)**	a) Authority and Integrity b) Fidelity and user perceived quality/measure-ment of quality (Intelligible) c) Consistent with price d) Genuine e) Durable	a) The user has to be able to rely on the source of the content and that the content has not be (illicitly) altered by any intermediary b) The user wants content of high perceived quality (at least the highest possible quality given a certain channel). c) The relationship between price and perceived quality has to be so that the user is willing to pay for the content. d) The content should be what it claims to be – a perfect digital copy, bit for bit, taken from a digital 'master' e) Content shall not degrade its perceived quality when ageing (in contrary to analogue tapes)

	Key Issues	Related Issues	Explanation of Issues
		f) Timeliness	Content has to be consumable at the point in time the End User wishes so. Content like news programmes have to be kept up to date (though older news have also to be accessible)
4.	**Quality of content (artistic)**	a) Branding b) Source c) Richness d) Recommendation (reviews, etc.) e) Consistency	While acknowledging that the judgement of artistic quality of content is a highly subjective issue that is probably less suited to technical standardisation, it remains, nevertheless, a very important issue for the End User and it is therefore appropriate to list it here. a) End Users are influenced by branding, and generally associate different levels of artistic quality with different brands (i.e. associating a particular content producer with quality content in a specific genre) b) End Users who have a particular liking for a content type often become more knowledgeable, and in turn they become more selective about he content they consume. The source (or origin) of the content (i.e. a particular TV production company, record label, etc) can often be associated by the End User with a perceived level of artistic quality c) A End User may be influenced in their choice by the richness, breadth and variety of content which is available within a particular artistic genre d) To support their choice End Users are often interested in the endorsement (or not!) of others by reading about the recommendations of content reviewers e) End Users appreciate consistency of artistic quality and will often purchase the right to consume a specific piece of content because they have come to expect a consistent level of artistic quality from that source
5.	**Ease of use (online and offline) of Services and Devices**	a) Ergonomy b) Simplicity c) Intuitive d) Intelligent (but not more than the user) e) Complex connectivity (cabling) f) Consistency when migrating between devices (colour coding, compatibility, etc) g) Robustness h) Cross platform interoperability i) International compatibility j) Impact of national culture on device design	a) The design of products (SW or HW) in a natural way regarding how users will use or interact with them. e.g. : new mice and keyboards take into account how human hands work b) The User Interface (UI) should not be too complex to understand/use (no need to learn rudimentary use at a minimum) c) The user should understand the UI without need of reference or learning d) The device/UI should be able to help/teach users about its functions. It might anticipate things, or learn from past users' actions, but should not take control over the user. e) Systems should be able to connect everywhere at any time, without the need of multiple cables, plugs… f) The UI should have a "minimal" generic set of commands (icons, buttons…), so that going from one device to another allows quick understanding of the basic operations g) Devices should resist various "physical attacks" (water, collisions…) h) Going from one device to another (e.g. portable device to car device to home device) should be easily done, without the need of converters (HW or SW) or with transparent conversion.