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395 Wellington Street
Ottawa, CANADA
K1A 0N4

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395, rue Wellington
Ottawa, CANADA
K1A 0N4

Telephone - Téléphone
(819) 994-6939
Fax : (819) 953-0291
E-mail: iso.tc46.sc9@nlc-bnc.ca

ISO/TC 46/SC 9 N 297

2000-09-30

To: Directors of RA for ISRC, ISSN, ISBN, ISMN, and ISRN identifier systems
Project Leaders/Convenors for ISAN, ISWC, and ISTC identifier projects

cc. P-members of ISO/TC 46/SC 9 (for information)

Subject: MPEG-21 project stream on "Digital Item Identification"

Dear Colleagues,

I am writing to you in your capacity as the manager/representative of an identifier system or project developed within ISO/TC 46/SC 9. This message is also being copied for information to other participants in the ISO-related portion of our February 2000 meeting on "Common Issues for Information Identifier Systems".

Attached is a document from the Moving Picture Experts Group (MPEG) concerning their new "Multimedia Framework" project, known as MPEG-21. This document is a draft Technical Report that sets out the MPEG-21 vision and user requirements for "an environment that is capable of supporting the delivery and use of all content types by different categories or users in multiple application domains".

The MPEG-21 initiative includes a project stream on "Digital Item Identification and Description" which is why I am contacting you. Sections 4.3 and 5.3 of the attached document relate specifically to identification and description issues but other sections (such as those on Intellectual Property Management and Protection) will also be of concern to your work.

These sections of MPEG-21 are very closely related to the subject of the identifiers meeting we held in Paris this past February. They concern interoperability issues and the role of and requirements for identifier systems within the digital information and e-commerce environment.

My question concerns whether and how the existing ISO identifier systems/projects (ISRC, ISAN, ISBN, ISSN, ISWC, ISTC, ISMN and ISRN) want to participate in the MPEG 21 work on "Digital Item Identification and Description". Would you be interested in participating as a collective group of identifier systems or would you prefer to participate in MPEG-21 on an individual basis? One approach, for example, would be to establish a joint ISO/TC 46/SC 9 and MPEG-21 Working Group for the "Digital Item Identification and Description" project stream.

The MPEG-21 project will have important ramifications for existing identifier systems. I encourage you to give serious consideration to the attached document and to how you want to approach this initiative.

I will be meeting with the editor for the MPEG "Multimedia Framework" on October 17 to discuss these matters at greater length and will keep you informed of any further developments.

In the meantime I look forward to hearing your comments.

With regards,

[original signed by]

Jane Thacker
ISO/TC 46/SC 9 Secretariat
National Library of Canada

[Redistributed to ISO/TC 46/SC 9 as document N 297]

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Information technology — Multimedia framework (MPEG-21) —

Part 1: (title to be decided)

Contents

Foreword

ISO (the International Organisation for Standardisation) is a world-wide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organisations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardisation.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 18034 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

Technical Report ISO/IEC TR 18034-1 was prepared by ISO/IEC JTC 1/SC 29/.

ISO/IEC 18034 consists of the following parts, under the general title Information technology — Multimedia framework (MPEG-21):

— *Part 1: (to be decided)*

— *Part 2: (to be decided).*

Scope

This Technical Report has been prepared within ISO/IEC JTC 1/SC 29/WG 11 to introduce the most recent area of development by the Moving Picture Expert Group (MPEG) titled MPEG-21 Multimedia Framework. It sets out a vision for the future of an environment that is capable of supporting the delivery and use of all content types by different categories of users in multiple application domains. The Technical Report identifies the requirements for achieving such an environment. It proposes to achieve this through a combination of WG 11's efforts to standardise the parts of the multimedia framework where it has identified it has the appropriate expertise, integrated with standards initiatives which are currently being developed by other bodies. It is expected that this collaborative approach to standardisation linked to a common vision will maximise harmonisation of effort and enable effective standards solutions to be implemented over the fastest possible time frame.

The Technical Report is introduced by a problem statement and a solution statement. The problem statement describes an electronic trading 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 in new products and services make 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.

The vision statement for such a multimedia framework is "to enable transparent and augmented use of multimedia resources across a wide range of networks and devices". This is accompanied by goals, which will lead to the attainment of this vision. A more detailed description of a multimedia framework follows which sets out the functionalities of such an architecture, grouped into seven architectural elements. Inevitably it is recognised that there will be some overlap between the elements but it is considered that a sufficient distinction can be made for the purposes of standardisation.

In addition, the user requirements within a multimedia framework are described separately as they impact upon each of the seven architectural elements. In summary the elements comprise:

- Digital Item Declaration (a uniform and flexible abstraction and interoperable schema for declaring Digital Items)
- Content Representation (how the data is represented as different media)
- Digital Item Identification and Description (a framework for identification and description of any entity regardless of its nature, type or granularity)
- Content Management 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)
- Intellectual Property Management and Protection (the means to enable content to be persistently and reliably managed and protected across a wide range of networks and devices)
- Terminals and Networks (the ability to provide interoperable and transparent access to content across networks and terminal installations)
- Event Reporting (the metrics and interfaces that enable Users to understand precisely the performance of all reportable events within the framework)

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.

Information technology — Multimedia framework (MPEG-21) —

Part 1: xxxx (title to be decided)

1 Terms and definitions

For the purposes of this part of ISO/IEC 18034, the terms and definitions given in Annex A apply.

2 Introduction

The Technical Report sets out the requirements of the user 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.

Section 4 of the Technical Report elaborates the elements in the framework identified 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.

The final section 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 and 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, WG11 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.

For its future work, WG11 will further elaborate this Technical Report through the various stages of standardisation. It will form the basis for a number of Calls for Proposals inviting contributors of applicable systems and technologies to respond to the task of developing the specifications and standards that will result from this challenging and exciting vision.

2.1 Problem Statement

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 the specification of these elements , either in existence or under development, relate to each other. The aim of starting MPEG-21 has been: (1) to understand if and how these various

components fit together and (2) to discuss which new standards may be required, if gaps in the infrastructure exist and, once the above two points have been reached, (3) to actually accomplish the integration of different standards.

The digital market place, which is founded upon ubiquitous international communication networks such as the Internet, rewrites existing business models for trading physical goods with new models for distributing and trading digital content electronically. In this new market place, it is becoming increasingly difficult to separate the different intellectual property rights that are associated with multimedia content. The quest to bring to the consumer the ultimate experience in multimedia entertainment means that 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, complex solutions are required to manage the delivery process of these different content types in an integrated and harmonised way, entirely transparent to the consumer of multimedia services. And this is only one of the issues that needs to be addressed; there are others, like finding content and ensuring quality of service.

In addition, 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 photo sharing web sites, music sharing sites, media trading services, etc. These “content providers” have many of the same concerns as commercial content providers: management of content, re-purposing content based on consumer/device capabilities, protection of rights, protection from unauthorised access/modification, protection of privacy of provider and consumer, etc.

The purpose of this effort is to globalise consumer choice. There are very few if any standard technologies that would allow the implementation of such a capability. There is a need to produce specifications of standardised interfaces and protocols which allow consumers to access the widest possible variety of content providers, both commercial and non-commercial. Putting the consumer as the focal point will expand the business opportunities on a global basis. Content and service providers of all sizes will have the opportunity to reach a previously unreachable and/or fragmented consumer market.

2.2 Solution Statement

A multimedia framework is required to support this new type of commerce. Such a framework requires that a shared vision, or roadmap, is understood by its architects, to ensure that the systems that deliver e-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 the list is probably 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 the following functions:

- Content creation
- Content production
- Content distribution
- Content consumption and usage
- Content representation
- Intellectual property management and protection
- Content identification and description
- Financial management

- User privacy
- Terminals and network resource abstraction
- Event reporting

From its background in key technology and information management standards related to the management and delivery of multimedia content, MPEG is uniquely 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.

This may look like a very complex project to address, but it is believed that the enabling factor is the integration of a set of critical technologies implementing the functionalities mentioned above, that can be brought to bear on the problem.

2.3 Vision and Goals

MPEG-21 takes the following statement to describe its overall 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:

- Understanding how the components of the framework are related and identify where gaps in the framework exist;
- Achieving the integration of standards to support harmonised technologies for the management of multimedia content;
- Developing new specifications which allow:
  - Access, (re)use of and interaction with multimedia objects across networks and/or capable devices
  - The implementation of multiple business models including those requiring the management of automated rights and payments transactions throughout the value chain
  - The privacy[1] of content users to be respected.

2.4 Description of a Multimedia Framework Architecture

To define where standards are required in a multimedia framework which is capable of supporting the electronic delivery of digital content it is necessary to first reach a shared understanding about a common business architecture. This presents a difficulty, as there are many examples of different business architectures that continue to evolve in response to the trade of different types of content to meet the needs of different trading models. In order to avoid giving undue preference to one trading 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 as necessary as the work continues which can be mapped back against the generic architecture.

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 in the previous section, have been grouped into seven architectural elements. Even though some overlap exists between these elements, it is considered that a sufficient distinction can be made for the purposes of standardisation.

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[1] As defined in Annex A

First, user requirements are formulated that are relevant for all seven architectural elements:

- To satisfy the experience of all types of users in the multimedia framework through the extension of existing and the development of new technology
- To ensure that the increasing sophistication of technological solutions do not undermine the user experience
- To achieve interoperability of systems through the integration of the components of the multimedia framework
- To provide the means to protect the intellectual property of all categories of user
- To ensure that the privacy of users will be respected

2.4.1 MPEG-21 Digital Item[2] Declaration

Establish a uniform and flexible abstraction and interoperable schema for declaring Digital Items.

2.4.2 Content Representation

MPEG-21 shall provide content representation technology able to efficiently represent any content of all the relevant data types, of natural and synthetic origin, or any combination thereof, in a scalable and error resilient way. The various elements in a multimedia scene shall be independently accessible, synchronisable and multiplexed and allow various types of interaction.

2.4.3 Digital Item Identification and Description

To design a framework for identification and description that is interoperable and integrated to provide:

- Accuracy, Reliability and Uniqueness of Identification
- Seamless Identification of any entity regardless of its nature, type or granularity
- Persistent and efficient methods for the association of identifiers with Digital Items
- Security and integrity of IDs and descriptions which will survive all kinds of manipulations and alterations
- Automated processing of rights transactions and content location, retrieval and acquisition

2.4.4 Content Management 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 personalization and content management. The above should be supported both when the user is himself performing the above functions and when the functions are delegated to "non human entities" (such as “agents”). In this context, content management should not be understood as managing the rights of the content.

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[2] As defined in Annex A

2.4.5 Intellectual Property Management & Protection

The MPEG-21 Multimedia Framework should provide a multimedia digital rights management 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.

- Enables, to the extent possible, the capture, codification, dissemination and reflection of updates of relevant legislation, regulations, agreements and cultural norms that together create the setting and generally accepted societal platform for commerce involving Digital Items.

- Provides, to the extent possible, a uniform technical and organisational foundation for domain governance organisations that govern (on behalf of all users of Digital Items) the behaviour of devices, systems and applications involved in interacting with Digital Items and services that provide transactional support within the MPEG-21 Framework.

2.4.6 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* arbitrary sets of users, such that the *quality* of the user experience will be guaranteed.

This implies that as a minimum:

- Networks should provide content transport functions according to a QoS contract established between the user and the network

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

- Access to network and terminal resources will happen through standard interfaces

2.4.7 Event Reporting:

MPEG-21 should provide metrics and interfaces that enable Users to understand precisely the performance of all reportable events 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 inter operate 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.

2.5 Normative Implications

Since no single framework yet exists to address all of the above, the elements of the multimedia framework MPEG-21 envisions may be:

A. Standardised outside of MPEG;

B. Not standardised, but met by proprietary services;

C. Not standardised, but which are deemed outside the competence of the MPEG-21 community.

D. Not standardised, and which are deemed within the competence of the MPEG-21 community.

As such, the User Requirements for MPEG-21 fall into two categories:

- MPEG-21 should develop such new standards; and/or
- MPEG-21 should develop interfaces for the other existing/future standards and services.

Consequently, MPEG's role will be:

A. Existing standards (XML, MPEG-2, TCP/IP, etc.).

MPEG develops interfaces for existing standards to plug into the MPEG-21 framework.

B. Existing proprietary services (CyberCash, BizTalk, eGroups, etc.).

Where appropriate, MPEG develops interfaces for existing services to plug into the MPEG-21 framework.

C. Need standards, but out of competence (TBD).

MPEG develops interfaces for future standards and services to plug into the MPEG-21 framework.

D. Need standards, and within competence.

MPEG develops standards that together create a unified multimedia framework.

2.6 Developing a Template to Discuss Technology Harmonisation

The Table in Annex B identifies areas where the harmonisation of technologies should be considered to create an integrated multimedia framework. It attempts to organise these areas by categorising them and relating them to generic activities and functions within a generic architecture. More specifically, the table lists functions and related processes, requirements, business model roles, transaction types and standards activities related to these.

2.7 Activities Related to the Multimedia Framework

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, which are currently in progress that should be considered as candidates for future interaction and collaboration with the standards work plan agreed by MPEG-21. A non-exhaustive list of these is given in Annex C.

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 who 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 and compatible with the mandate of WG11. 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, the Technical Report has identified initiatives which have ambitions to address aspects of the multimedia framework, and with which MPEG would like to co-ordinate its own efforts (Annex C).

3 User Requirements

3.1 Users

A User is any entity that interacts in the MPEG-21 environment or makes use of an 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.

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

Three examples are provided to illustrate possible MPEG-21 usage cases:

1. Joe is planning an anniversary party for his parents. The event will culminate in an evening of dancing, with a DJ spinning all his parents' favourite hits. Instead of hiring a DJ, he will create his own "dance CD" using the music kiosk at the local S-Mart store. Though he knows some of the songs by name, in other cases he knows only the performer; a few he knows only by a fragment of a lyric. At the kiosk, he identifies the music using a combination of search criteria; he can hear the selected songs using headphones at the kiosk as it streams from many different commercial music sites found during the search. Once he has selected all the music, he saves the "project" and tells the kiosk to burn the necessary CD(s), providing his credit card to pay for services and usage rights. Later, he'll upload videos and pictures shot at the dance to the project; party attendees can visit S-Mart on-line to "re-live" the party, purchase memorabilia, create their private copy of the project on CD, etc.

2. A User, "Sally," will be constructing the advertisement for a User (a magazine) using photos from one of several photography Users (brokers) offering photos "on-line". Sally does an outline of the advertisement using desktop publishing software available from potentially someone who may or may not be a User of MPEG-21 (perhaps an application service provider). Next, she searches and finds several suitable photos from three different commercial Users (photo brokers). She downloads a watermarked image of each to add to her photo light box application, creates the advertising mock-up, and saves it and photo light box in a protected session. Next she sends a pointer to the session to other Users (her manager and their client). She initiates a conference call from her PC, and talks her manager and their client through the proposed advertisement, and together they examine the potential photos. After the final photo is selected, it is automatically purchased for use in the publication, the layout is completed, the final advertisement is stored in the project; and another User (the magazine's production department) picks up the ad from the project when producing the final layout for the magazine.

3. A User, "Infomediaries.Com," is in the business of acquiring multimedia content. They support another User (their subsidiary MedicalPortal.Com), and also re-syndicate the content they acquire to many other Users (affiliate sites).

Infomediaries.Com negotiates a deal with a User (a content provider, Publishing Empire, Inc.), which includes isolated video clips, already published multimedia productions, and computer animation. A third User creates abstracts of the videos. Each kind of Digital Item has different rights and restrictions that Infomediaries' affiliates will need to enforce, and Infomediaries.com is obliged to enforce the temporal restrictions and intellectual property usage for each item negotiated from a vast number of other rights holding Users. Infomediaries.Com and Publishing Empire, Inc. form a new User (a joint venture) to provide the delivery channel to the affiliates of Infomediaries.com. JointVenture.com must provide personalised dynamic delivery and service levels models to the affiliates, and an audit trail back to Infomediaries.Com and Publishing Empire, Inc. As part of the arrangement, the Digital Items are collections of resources and referenced items (images, Java, data files, audio, video, etc.) that the affiliate must be able to customise for their Users (consumers—sometime called the “end-user”). Finally, the Digital Items specify terms and conditions of use, editorial rights, attribution, update frequency, etc., and information that is returned from the subscriber site (which is itself a Digital Item) includes usage data, ad revenue data and other performance metrics relating to consumer activity.

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 include:

- 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
- Regulating transactions that occur from any of the above

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

3.2 User Model

Moreover, this interaction between Users using Digital Items may be described further by five core qualifiers:

- *Networks & Terminals*. (Is the content delivered over a cable line or cell phone?)
- *Intellectual Property Management & Protection*. (What rights does each User have about the item?)

- *Content Definition*. (Is the item one piece of content or a collection?)
- *Content-related Identification & Description*. (What content actually has been delivered?)
- *Content Management and Usage*. (Is the content downloaded or does it come streaming?)

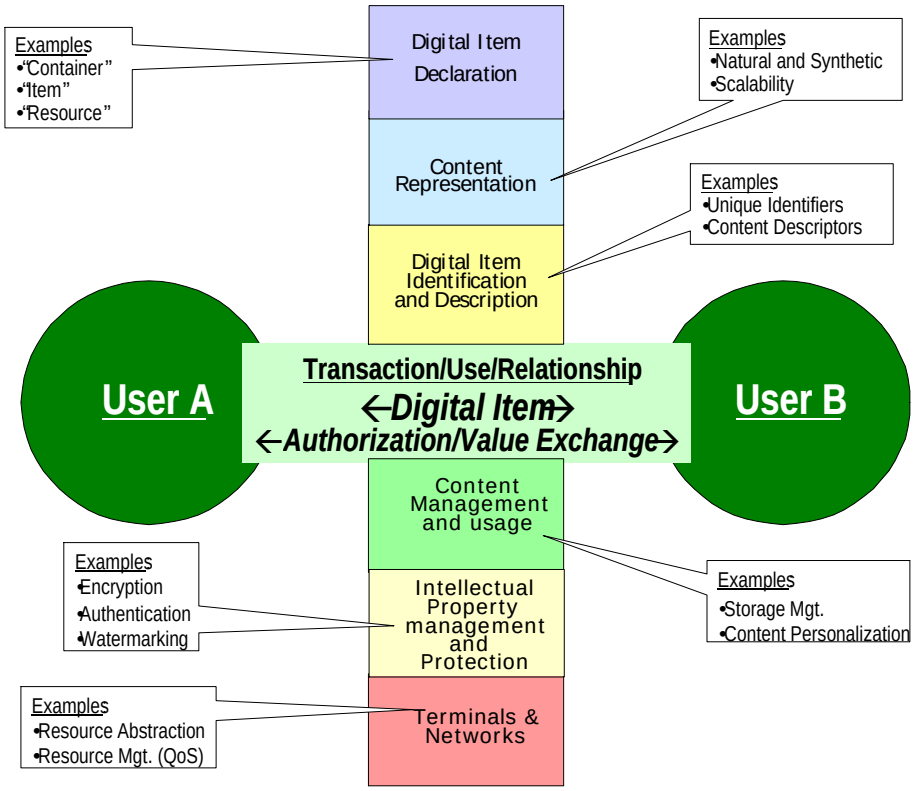


Figure 2: Interactions are described by six core qualifiers or "elements"

The activity in any of these elements for a specific interaction can be measured and reported to the Users through metrics and interfaces, which we term *Event Reporting*.

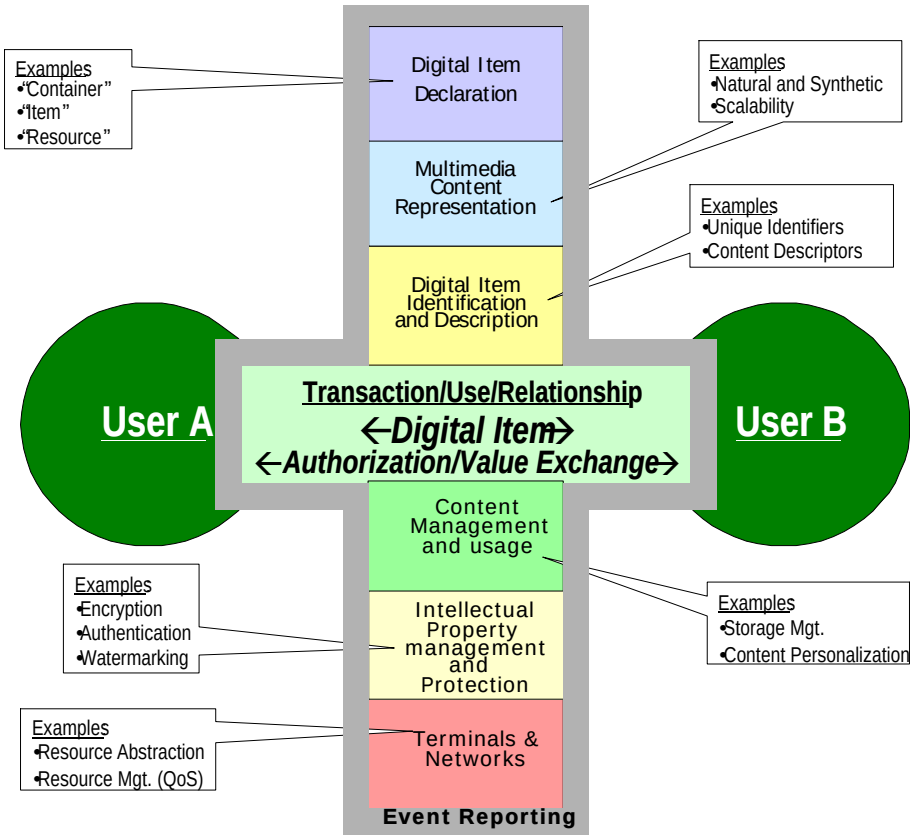


Figure 3: Event reporting, by creating metrics and interfaces, further describes specific interactions

3.3 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 include:

- Secure delivery of content and exchange of value
- Quality and flexibility of interactive service
- Ease of understanding the terms of use ("agreements")
- Content personalization
- Enforcement of business and usage rules through the value chain
- Allow compliant content to operate in the MPEG-21 framework
- Allow other multimedia frameworks interoperability with and into MPEG-21
- Leverage and support existing and future standards outside of MPEG

- Comply with regulatory statutes and incorporate societal factors as necessary
- Metrics to communicate performance for each segment and function of MPEG-21: transactions, content interaction, etc.
- Ability to add metadata as content moves through the value chain
- Protection of User privacy
- Ensure integrity of Digital Items
- Content and transaction tracking
- Provide a view for integration of business processes among ad-hoc or established independent business partners by electronic means
- Provide and support a library of common, standard intra-business processes
- Allow for both business processes and enabling technologies to evolve independently while retaining long-term investments in both
- User protection, including reliability of service, liability and insurance for purchase, loss and damage, and escrow arrangements to eliminate risk
- Specifications that do not hinder the establishment of legitimate new business models

From a technical perspective, these requirements may be stated as:

- Interoperability
- Transparency
- Robustness
- Integrity
- Scalability
- Flexibility
- Customisation
- Event management
- Protection
- Rights management
- Tangibility
- Standard metrics and interfaces.

4 Elements in the Framework

The following subsections elaborate the elements in the framework as defined in Section 2.4. 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.

4.1 Digital Item Declaration

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

4.1.1 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 unambiguously represent and interoperably communicate about any Digital Items defined within the model.

4.1.2 An Example

Consider a simple “web page” as a Digital Item. A web page typically consists of an HTML document with embedded “links” to (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 that it has a dependency on.

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 fallback to a default choice if the preferred translation isn’t available.

The key point in this modified example is that the presence of the language logic clouds the question of exactly what this Digital Item now consists of 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.

4.1.3 Define 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 all sources.

4.1.4 Identify where opportunities for Change Exist/are Required

Note: Assumptions about the relationship between MPEG-21 Content Representation and other parts of MPEG: MPEG-21 should incorporate MPEG-4 and MPEG-7, but should also “wrap” any other media resource and descriptive statement formats.

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:

- Digital items are open and extensible to any and all media resources types and description schemes.
- Composite items can be constructed from other items, without losing the structure and properties of the sub-items.
- Multiple composite items may share individual elements.
- An individual element may be referenced by multiple locations within a Digital Item.
- The framework needs to enable applications to correctly manipulate and validate Digital Items.
- 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.

- Descriptors may be simple statements or full media components.
- Descriptors can be described by other descriptors.
- Anchors must be declarable within a component that allow:
    - Descriptors to be associated with a specific point or range within a media resource.
    - Linking back from within a media resource to the anchor.

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:

- Permit hierarchical and referential structures to contain Digital Items.
- Provide a standard structural foundation for the packaged delivery of Digital Items.
- Provide a standard structural foundation for the organisation and management of collections of Digital Items.
- Allow annotation of containers with arbitrary descriptors that suit a particular User or application need.

4.2 Content Representation

4.2.1 Rationale

Multimedia 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. It is well known that the efficient representation of digital content allows the deployment of many new services, not possible without coding technology.

This framework element addresses the technology needed in order that multimedia content is represented in a way adequate to pursue the general objectives of MPEG-21.

4.2.2 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.

In the area of images and video, relevant standards are: 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 are 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. This enumeration is not meant to be exhaustive as other relevant references exist.

Although the current situation in terms of content representation standards is rather complete in terms of addressing the relevant requirements, it is possible that some requirements may not be completely covered by existing standards.

4.2.3 Content Representation Requirements

As stated above, multimedia digital 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. The most relevant requirements are:

- **Data Types** – it shall be possible to represent a large range of data types, both with natural and synthetic origin, as well as any combination of these data types, e.g. still pictures, frame-based as well as arbitrarily shaped video, specific and generic 3D models, graphics, text, natural and synthetic audio, natural and synthetic speech, etc.
- **Content Variety** – it shall be possible to represent any type of content for all the data types considered.

- **Efficiency** – it shall be possible to represent content for each of the data types above mentioned in the most bit efficient way for different target qualities; for a multimedia scene composed as a combination of various elements of the data types mentioned above, it shall be possible to selectively choose the coding efficiency/quality for each one of them.

- **Scalability** – it shall be possible to represent all the elements in the multimedia scene in a scalable way and with a fine granularity in the dimensions considered relevant, e.g. spatial, temporal, quality.

- **Random Access** – it shall be possible to randomly access, within a limited time and with fine resolution, at all scalable layers, all elements in the multimedia scene; for a multimedia scene composed as a combination of various elements of the data types mentioned above, it shall be possible to randomly access each one of them.

- **Error Resilience** – it shall be possible to selectively protect the various elements in a multimedia scene against channel errors with relevant error patterns, e.g. mobile networks, ATM networks or storage media.

- **Interaction** – it shall be possible to interact with the various elements in the multimedia scene, with a fine granularity, both in space and time; for a multimedia scene composed as a combination of various elements of the data types mentioned above, it shall be possible to independently interact with each one of them.

- **Synchronisation** – it shall be possible to synchronise all the elements in the multimedia scene as well as other relevant data.

- **Multiplexing** – it shall be possible to multiplex the coded data corresponding to the various elements in the multimedia scene as well as other relevant data.

4.3 Digital Item Identification and Description

4.3.1 Rationale

A Digital Item that is identified and described is more manageable and bears a higher value and enables a large number of possible applications including IPMP, search, filtering, and cataloguing.

4.3.2 Definition of the Current Situation

Identification is a fragmented, non-exhaustive and dynamic environment. Many parties are involved in this environment. It is a complex framework involving legal and contractual issues. Today, proprietary identification systems co-exist with standardised identification processes. Some identifiers have been successfully implemented and commonly used for several years but in a single media type, for instance ISBN (International Standard Book Number), ISRC (International Standard Recording Code), URN (Universal Resource Name), URI (Universal Resource Identifier), etc. Some initiatives are in progress addressing the problem of identification and its underlying structure, such as ISAN (International Standard Audio-visual Number), ISWC (Information System Work Code), DOI (Digital Object Initiative), and cIDf (content ID forum). These are in most cases still in progress and therefore not yet fully deployed or used.

There is currently need in many businesses such as archiving to make use of a unique identification mechanism on a global scale. Proprietary solutions such as labelling and watermarking for insertion, modification, and extraction of IDs have emerged in the past years. However, no international standard is available today for the deployment of such technologies.

4.3.3 Requirements for Digital Item Identification and Description

This section describes what is needed for efficient implementation of potential applications such as e-content commerce, as far as identification and description are concerned.

4.3.3.1 Requirements on the nature of identification and description

These include identification and description of:

- Content: which could be a representation of the abstract work
- Transactions and/or Contracts: such as transaction number
- Physical and/or Legal Persons: Rights Holders, Licensees, Publishers, Providers, Distributors, Retailers, Consumers
- Usage rules: Copy, Pay per view, Pay per listen, …

4.3.3.2 Requirements on the interaction with identifiers and descriptors

Access authorisation: read, change, write, …

Interactions with identifiers and descriptors can be made in various ways, and mechanisms should exist to accommodate flexible ways to interact with them. For instance, identifiers and descriptors should be accessible in plain, encrypted or embedded form depending on the application. They could be authenticated or not.

4.3.3.3 Requirements on operation modes of identifiers and descriptors

Systems and processes for identification should ensure persistency and consistency.

Systems for description should ensure consistency. Identification and description should be coherent with each other.

More over, they should also allow both static and dynamic identification and description schemas (e.g. the ID and description of a Digital Item could be changed when its right holder changes).

4.3.3.4 Requirements on the cost of identification and description

Systems and processes for identification and description should allow a full range of applications and business models from low cost and simple approaches to richer and more sophisticated ones.

4.3.4 List of Shortcomings and Problems

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

- Lack of integration between the different schemas of different sectors
- Lack of standard dynamic identification schemas when entities related to the content (Digital Item) change
- Lack of standard methods to differentiate between versions of a Digital Item when it is revised
- Lack of standard process for trusted third parties in Digital Item identification
- Lack of interoperability among identification schemas for the purpose of common applications e.g. automated transaction/billing systems.
- Lack of international standard identification schemas for some entities (i.e. text, images, speech, etc.)

- Lack of granularity definition/guideline for giving an ID to a Digital Item
- Lack of scalability in the identification process accommodating from self-publishing to large scale identification.
- Conflicting requirements to identify a Digital Item depending on the purpose of identification, such as
  - Commerce (search, purchase, acquisition, etc)
  - Rights management
- Inconsistency of schemas between and within media sectors

4.3.5 Expected impact

A framework for 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.

4.4 Content Management and Usage

4.4.1 Rationale

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 (see Section 5.1). 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 management will also include personalization and User profile management. Thus, the goal of content management 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 personalization and content management. The above should be supported both when the User is himself performing the above functions and when the functions are delegated to "non human entities" (such as “agents”). In this context, content management should not be understood as managing the rights of the content.

The above should be supported both when the User is himself performing the above functions and when the functions are delegated to "non human entities". In this context, content management should not be understood as managing the rights of the content.

4.4.2 Definition of the Current Situation

The current situation is one of chaos for the consumer and the service provider. Typically, the content management, 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. Consumers 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 consumers’ point of view and the service providers’ point of view, this is limited in nature.

- Majority of the content lacks identity and descriptions

  Content that is available currently on the Internet and broadcast networks lacks identity and persistent descriptions. The problem is made worse by the fact that there is no mechanism to ensure that this identity and description

information is persistently associated with the content. To enable any kind of management of content, this is a fundamental requirement.

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

  Consumers' appetite for content and the accessibility of information is increasing at an incredible pace. The access devices with a myriad set of differing capabilities are making their way into consumers' homes and offices. These access devices have different processing and rendering capabilities and are used in different localities, posing a challenge to service providers to ensure that their content is available and is used/rendered in a meaningful way on these devices.

- 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 to consumers, consumers 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 consumers attention among all the noise.

- Users are becoming more mobile and have a need to access similar information on multiple devices in multiple places.

  Currently content providers or authors have to author multiple formats of content and deploy them in each of the networks. There is no automated configurable way of delivering and consuming content that scales automatically to different device profiles.

- 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.

- 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. There are solutions that address issues in a specific domain and is not conducive to managing lifetimes and usage rules in a flexible manner.

- Content is typically packaged for specific services/delivery/devices with little ability to move from one environment to the other or be consumed on different devices.

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

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

- 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.

- There is currently no User-available association of services with distributed content – standard "hooks" for services that can be associated with the media.

  For example, think of a Digital Item 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

JPG format, in GIF format, in PNG format, in PDF, at 640x480 resolution, at 1200x1600 resolution, etc.) The hooks we're talking about may be pointers to the alternate representations of the Digital Item, or it could be a pointer to a service and data from which the alternate form can be created. This is one of many technologies currently being considered for digital libraries to track/implement versioning of Digital Items.

- 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.

4.4.3 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 Management activity and some of them are requirements on identification, description and representation efforts.

4.4.3.1 Relationships between content and descriptions

- The framework should allow for a range of associations between content and its descriptions. This should support solutions where the content and descriptions are bounds as well as where it is just a loose association to discover each other.

- The framework should provide support for locating content from the descriptions and descriptions from the content (this does not imply they are bundled together. It simply recognises the fact that this association should be navigable from either direction).

- The framework should provide facilities to define levels of access to descriptions within the rights guidelines.

4.4.3.2 Content Storage Management Requirements

Search, Storage and Retrieval of Content and Descriptions

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

  - searches and acquisition by agents

  - search across distributed asset management systems

- Users in the network must be able to securely store and retrieve content.

- 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.

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

- Users should be able to identify where all copies of content are located, as well as any usage rights that are in effect.

Formats and Protocols

- Serialisation formats for Digital Items should be defined within the framework.

Archiving and cataloguing

- Support for archiving content for later use along with preservation of any associated rights should be provided.
- Ability to organise and catalogue content within collections should be supported.

Controlled Access and Change Tracking

- The ability to control access and modification of content and associated descriptions by Users and groups of Users should be supported.
- The ability to track changes and versions of content with associated descriptions should be supported.

4.4.3.3 User Profile Management

Exchanging User Profiles for Services

- The system should clearly identify what information a 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 a User's privacy preferences with service provider's requirements for service delivery as well.

4.4.3.4 Tracking and Performance Metrics

Predefined Set of Content Metrics

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 personalization metrics could include:

- Number of times content was rendered
- Last time content was rendered
- How many times was it purchased
- How long was it used?
- How many times was it completely listened to, etc.

Packaging of Metric Information for Exchange

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

4.4.3.5 Personalization of content and presentation

Arbitrary Organisation of Content

- User should be able to add descriptions to an *item* and or a *container* that may be used to organise a group of items with related descriptions. *Exchanging User profiles for services*

Automated Organisation of Content

- System should allow organisation of content based on User preferences and appropriate descriptors associated with the items.

4.4.3.6 Agent Enabled Networks and Terminals

A better management of the complexity of the content management and usage can be achieved by giving the User the possibility to delegate some specific functions (instantiated in a goal) to non-human entities. Examples of goals would be: *Exchanging User profiles for services*

- Routing of content across distributed networks in an intelligent manner.
- In the Internet domain, decide on the content set to be served up, based on connection characteristics (bandwidth, network type, reliability, QoS etc.) and profile of the requesting device.
- In the broadcast domain, filter and insert content into the multiplex by being aware of the programming information.
- Make decisions on intelligent ways to cache content within the network for best delivery.
- Search and locate content based on identifications and descriptions at levels within the content store subject to privacy and rights constraints.
- Negotiate deals with other agents for reaching certain assigned goals, including any User's right to privacy.

4.5 Intellectual Property Management and Protection

4.5.1 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: *Exchanging User profiles for services*

1. Most of the e-content existent 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 consumers interacting with e-content today is the lack of interoperability between IPMP systems.
5. Owners of rights[3] of e-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. Consumers of e-content may in some circumstances require the freedom to manage their privacy, which includes interacting with content anonymously.
7. Most existing IPMP systems cannot deal with the subtleties of issues related to Intellectual Property Law.

[3] Through new technologies (e.g., the Internet), end users increasingly become owners of rights in content.

4.5.2 Opportunities for Change

4.5.2.1 Trusted Framework of IPMP Systems

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:

1. Access to and interaction with Digital Items while keeping the amount of hardware to a minimum. There shall be no duplication of similar devices to interact with similar content from different sources. To a lesser extent, the same applies to software. Examples of interaction with content are playback, copy, edit, create and so forth.

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.

3. Conveying to end users which conditions apply to what types of interaction with the content. An example is payment for playback.

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.

5. Service models in which the end user's identity is not disclosed to the service/content provider and/or to other parties. However, the capacity to disclose the User's identity shall be technically preserved, in the case the disclosure of such identity is required.

6. The preservation of User rights.

   Notes:

   For instance, the solution shall support preservation of User rights in such events as the provider going out of business.

   It is believed that an important requirement of end users is that their rights to interact with the content not be revoked for alleged misuse when the burden of disproving misuse is entirely on the end user. However, MPEG does not currently see any implications for these requirements.

7. The content and the end user's rights to interact with it to survive common accidents, e.g. an operating system crash, or a flat battery.

8. MPEG-21 terminal mobility, e.g. end users can be able to use the same device in different locations.

9. 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.

10. 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.

11. 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 the rights to interact with it.

12. Transferring of User rights according to the conditions under which the rights have been acquired.

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

14. Persistent security over time and renewability of that security.

15. 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 to involve "super distribution", in which content and rights to interact with it are passed along from one User to another

16. Enabling content owners to change business rules as appropriate.

17. Implementations that are cost effective with regard to the value of the content to be managed and protected.

18. Fast development of products and services.

19. Implementations into devices that have a long life cycle, i.e. at least five years.

20. Implementation of the solution shall be based on currently available technology.

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 v12.

4.5.2.2 Enabling the Codification of Norms and Rules

To the extent possible, MPEG-21 should provide a uniform framework that enables the capture, codification, dissemination and reflection of updates of relevant legislation, regulations, agreements and cultural norms that together create the setting and generally accepted societal platform for commerce involving Digital Items.

The main requirements for this work area are:

- The Framework shall allow for languages that support the codification of usage criteria for Digital Items based upon cultural, societal and other rules.

- The Framework shall allow for languages that support the construction of proof of illegal use of Digital Items.

- The Framework to codify rules shall be flexible and extensible. This would allow for an initial implementation able to express only a limited set of rules. In order to express a larger set of rules at a later stage, further languages can be added to the framework.

- The Framework shall not favour any particular human language, culture or legal/administrative/political system.

  Note: This neutrality applies only to the Framework. Specific codification languages within the Framework may be, for example, bound to a specific human language or legal system.

- The Framework shall allow for efficient implementations of codification languages with respect to the size of rules and the resources needed for processing such rules.
- Compliant languages within the Framework shall have unambiguous semantics and predictable effects.
- The Framework shall provide for a mechanism to resolve conflicts between rules governing the interaction with the same Digital Item.
- MPEG-21 shall provide means by which codified rules can be given precedence amongst themselves within the Framework.

4.5.2.3 Domain Governance Organisations

To the extent possible, MPEG-21 should provide a uniform technical and organisational foundation for domain governance organisations that govern (on behalf of all Users of Digital Items) the behaviour of devices, systems and applications involved in interacting with Digital Items and services that provide transactional support within the MPEG-21 Framework.

This foundation should also enable governance of usage of Digital Items. Such governance should be possible on devices, systems, applications, services, etc. as required by appropriate value chain participants, including governments.

The MPEG-21 IPMP Framework may define secure protocols and interfaces that enable multiple management and protection systems to be downloaded and “plugged into” MPEG-21 devices whenever needed.

One or more governance bodies may be needed to oversee and control the implementation of multiple IPMP systems within the same domain and amongst different domains.

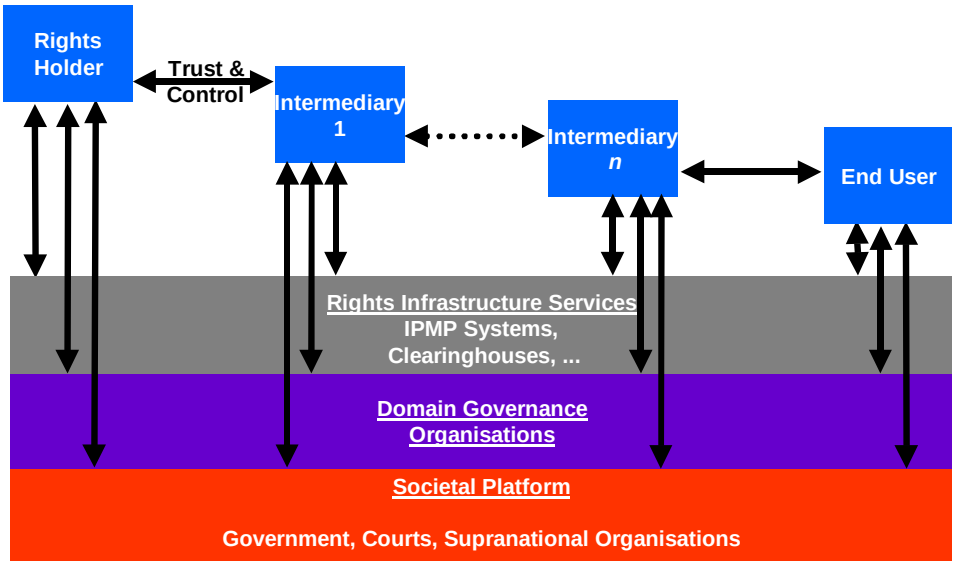


Figure 4: Support for Value Chain by Domain Governance Organisations

4.6 Terminals and Networks

4.6.1 Definition of the Current Situation

The overall goal of MPEG-21, to enable transparent use of multimedia resources across a wide range of networked devices, impacts how network and terminal resources are being dealt with.

Users accessing content should be offered services with a (a priori) known subjective perception (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 perception 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 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 5) 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 interaction to low-level interactions might take place automatically by software agents or could be done by the application itself.

Multimedia delivery Service Attribute	Functionality

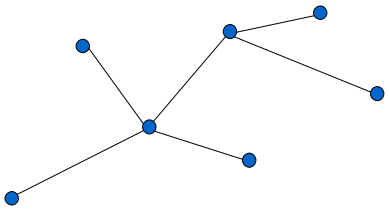
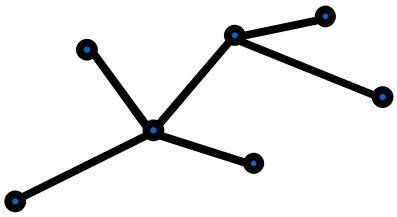
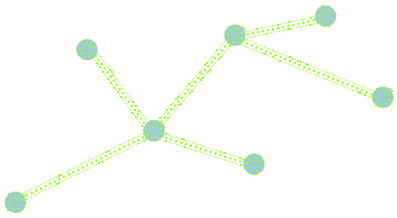
	*Connectivity* Connectivity allows the interconnection of Users to create a networked community. For instance, point to point (e.g. unicast), point to multipoint (e.g., multicast), multipoint to multipoint (e.g. virtual network), point to many points (e.g. broadcast), etc.
	*Bandwidth* Bandwidth provides 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 5: 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 C).

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:

- MPEG-4 offers hooks to describe the complexity of decoding video objects (version 1) and 3D graphics (version 2) in a platform independent way.
- MPEG-4 profiles and levels that limit the upper complexity level of (decoding the) multimedia streams
- MPEG-J provides APIs to allow cross-platform operation of applications, including access to terminal resources (but only includes a very limited management thereof)
- DVB-MHP is a specification of a receiver and a common platform-based infrastructure for building broadcast applications

4.6.2 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 receive 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:

- The need/demand, not the physical location determines access, utility and communication (e.g. interactivity anywhere, anytime)
- Best-effort failure is replaced by negotiated-contract using guarantees.
- Distributed utilisation of network bandwidth resources using distributed management, with the possibility to include transcoding to meet the network capabilities.
- Interoperability between OS, network protocol, and hardware solutions.
- 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, although DVB-MHP strives for harmonisation (using Java technology).

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 to make 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.

4.6.3 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 network OS and network protocol, 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 appropriate to 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 e.g. one of the driving ideas behind DVB-MHP).

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

- Avoiding User intervention for upgrades and extensions
- Long(er) life-time/installation legacy
- Application stability
- Being able to prioritise between media, possibly from different service providers
- Exploiting scalability

From a combined terminal and network point of view, it yet not clear how to efficiently exploit the increasing scalability of both media (here, links should be established with the content representation) and networks. 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.

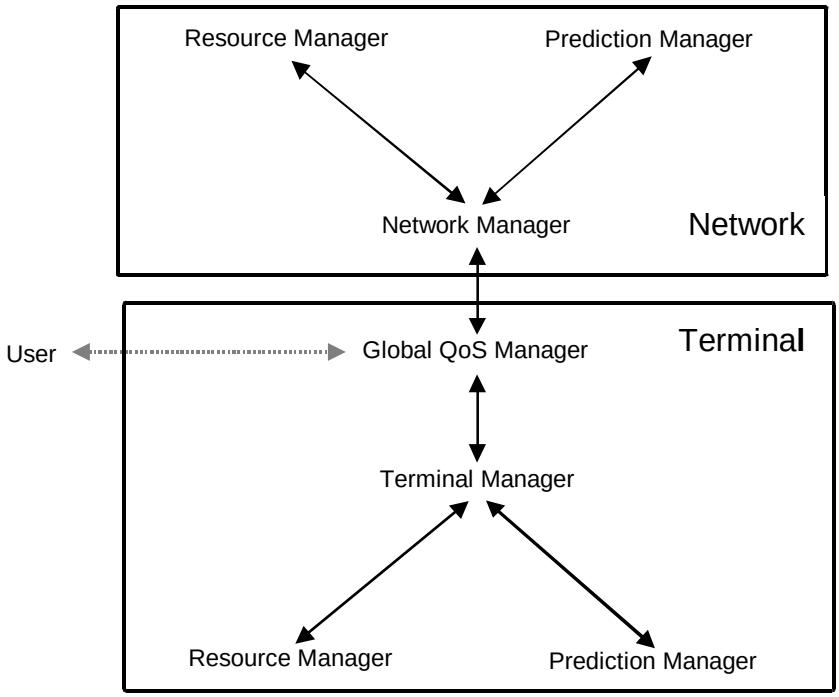


Figure 6: Simplified MPEG-21 Resource Management Framework

Figure 6 shows a *simplification* of the proposed resource management framework, arrows denote control flow communication through APIs, not necessarily media flows. These control flows are governed by protocols. On the network side, these can coincide with existing network protocols, some might be extensions thereof. Moreover, the development of new protocols is also expected.

Both terminal and network have *prediction managers* that predict the resource usage for a requested operation. The actual mapping on resources is done by the *resource managers*. Resource manager and prediction manager are consulted and controlled by a *terminal manager* and a *network manager* respectively. The *global QoS manager* couples User, terminal and network. The User (application) impacts how global QoS management is performed (priorities, preferences, etc.).

4.7 Event Reporting

4.7.1 Definition of the Current Situation

Every interaction is an event. Arising from every interaction, there is the opportunity to describe what occurred. However, there are a number of difficulties in accurately reporting 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. There exists no standardised means of Event Reporting.

4.7.2 Identification of Shortcomings, Problems and Issues

In the real world, examples of this need are plentiful. We highlight here just three of many areas where a set of standardised metrics within a multimedia framework does not yet exist and is much need.

Effectiveness of advertising. Advertisers are Users who want very much to know whether their messages have reached other Users, to what extent, and to what impact. Currently, a series of issues obfuscate an accurate understanding of the events. 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.

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). 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.
- 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.

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
- 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 and “seat-of-the-pants over-provisioning,” nor can they offer service quality that is enforceable in real-time.

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

- Provide 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.

4.7.3 Opportunities for Change

Common metrics about User-User interaction, User-Item interaction, and theoretically Item-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 vs. aborted.
- Percentage of subscribers to employees
- Average minutes of use per subscriber
- Average length of customer loyalty
- Product adoption rates

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

1. Standardising metrics and interfaces for performance of all reportable events in MPEG-21.
2. 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 three functional areas merit specific focus:

- Integrity
- Interaction
- Transactions
- Delivery
- Rules/Processes/Models

4.7.3.1 Integrity

Develop event reporting that enables

- An audit trail of Digital Items
- Enforcement of package integrity
- Ensuring fidelity of presentation

4.7.3.2 Interaction

Develop event reporting that enables

- Standardised measurements of interaction between
  - User-User
  - User-Digital Item(s)
- User personalization and User privacy
- Content rating and filtering

4.7.3.3 Transactions

Develop event reporting that enables

- Assurance of complete and secure transaction
- A value exchange of any kind (payment/money, rights, equity, information, barter, etc.)
- 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.
- Audit trail, including for dynamic payment models (subscription, royalty/event, one-time)
- Commerce measurement for regulatory compliance (e.g. auditing, taxes)
- Integration of existing business reporting languages to support transaction measurement between Users

4.7.3.4 Delivery

Develop event reporting that enables

- Guaranteed service levels based on business objectives
- Differentiated service levels for different Users
- Metrics for infrastructure performance, including failure, flash crowds, denial of service attacks.
- Assurance of dynamic and automated control of infrastructure to deliver service quality

4.7.3.5 Rules, processes and models

Develop event reporting that enables

- Enforcement of business and usage rules
- Regulatory compliance
- Process integration between Users
- Interoperability of MPEG-21 with other frameworks
- Supporting processes from other environments, where appropriate

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

5 Proposals and Recommendations

Based on the findings of the previous sections, the following recommendation for WG11 standardisation activities can be formulated:

5.1 Digital Item Declaration

- Establish a uniform and flexible abstraction and interoperable schema for declaring Digital Items.
- Media resources and descriptive data are fully separable.
- Digital items are open and extensible to any and all media resources types and description schemes.
- Composite items can be constructed from other items, without losing the structure and properties of the sub-items.
- Flexible configuration decision trees need to be declarable within the schema.
- Hierarchies of containers and Digital Items can be efficiently searched and traversed.
- All Users can build and organise annotated hierarchical collections, including referential structures.
- Identification and revision of Digital Items and their components must be supportable in an open and extensible manner.

5.2 Content Representation

Provide, adopt or integrate content representation technologies able to efficiently represent content of appropriate data types, of natural and synthetic origin, or any combination thereof, in a scalable and error resilient way. The various elements in a multimedia scene shall be independently accessible, synchronisable and multiplexed and allow various types of interaction.

5.3 Digital Item Identification and Description

- WG11 should define a framework of common Digital Item identification (how to assign an ID to a Digital Item) and description:
- Investigate functionalities of identifiers and descriptions in potential applications and business models including usage reporting, monitoring, tracking, licensing, etc.
- Investigate appropriate structure of identifiers such as self-descriptive and meaningful ones (e.g. country code included, etc.)
- 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.
- Allow and enable various approaches for governance of ID issuing
- Provide resolution system(s) to persistently associate identifiers with the location of digital objects

- Provide standard access methods to Digital Item ID and descriptions
- Provide interfaces to existing identification schemas and applications
- Provide a solid numbering policy and guidelines for identification and description of related Digital Items, granularity, multiple IDs, versioning, etc.
- Provide solutions for integrity and security of IDs and descriptions
- Provide standard solutions for insertion, modification and extraction of IDs and descriptions
- Provide standard ID and description format
- Provide solution for interoperability of identifiers by their integration (creating links, relationships and associations between different identification schemes used to identify components of multimedia objects)
- Provide solutions for organisation of identifiers in association with Digital Item (how is each identification system identified and how are identifiers structured when associated with content)
- Harmonisation/integration with/of existing standards

5.4 Content Management and Usage

1. Define interfaces and protocols for search, storage & management of Digital Items and descriptions.
    - User(s) should be able to express their preferences and locate relevant content in the network, device etc.
    - Should provide support for integration and interoperability of different asset management systems.
    - Should provide support for content lifetime management and associated configurable policies.
    - Should provide support for tracking changes to Digital Items and Descriptions.
    - User(s) should be able to identify where all copies of content they *own* are located with associated usage restrictions.
2. Define interfaces and protocols for User Profile Management and Metrics
    - Creating, modifying and managing User profiles.
    - Creating, tracking and packaging of content usage metrics information.
    - Interchange formats for User profiles with other systems.
3. Define interfaces and protocols to bring the benefits of intelligent Agents within the framework.
4. 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.
5. It would be desirable that a single language (Agent Communication Language) exist. Standardised representation of User information will be needed. Ontologies for the different domains will also need to be referenced, when

available, their development stimulated when not available. In some specific cases WG11 may need to develop specific ontologies.

5.5 Intellectual Property Management and Protection

In the area of managing and protecting Digital MPEG-21 Items, it is essential to address all three elements that are described in Section 4.5 in parallel. In order to allow efficient work in these areas, a prioritisation of the sub-tasks at hand is done within each of the three work areas:

5.5.1 Trusted Framework of IPMP Systems

1. Define the attributes of a trusted environment (including technical, legal, financial, commercial, etc) for persistent management and protection of Digital Items in accordance with the codified norms and rules as described in the section below. As a prerequisite to this work item, MPEG should engage with and seek input from relevant established governing organisations.

2. Define the attributes of the interfaces between Users and agents.

3. Specify a framework for the enforcement of such norms and rules.

4. Encompass work for the management and protection of MPEG-4 Audio-visual Objects and MPEG-7 Descriptors, Description Schemes and Descriptions, and adopt 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.

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

5.5.2 Enabling the Codification of Norms and Rules

1. Adopt or extend existing rights expression languages, where appropriate, for describing contractual usage rules for Digital Items. Start from the work being done in MPEG-7, but develop new languages if needed.

2. Expand these languages to allow the expression of rights and interest in personal data.

3. Expand these languages to allow the expression of public policies and rules stemming from sources other than Rights Holders, such as governments and other relevant rule-making bodies. This work item may require more time than available in the first phase of the development of MPEG-21. As soon as time and resources are available, this item should be undertaken.

5.5.3 Domain Governance Organisations

1. Identify and liaise with prospective Domain Governance Organisations. These liaisons should lead to more detailed requirements for MPEG-21 from such organisations.

5.6 Terminals and Networks

To achieve interoperable transparent access to (distributed) advanced multimedia content by shielding Users from network and terminal installation, management and implementation issues, WG11 should standardise:

- APIs and associated protocols (behaviour) for terminal QoS management

- NPIs and associated protocols (behaviour) for network QoS management

- APIs and associated protocols (behaviour) for joint terminal and network QoS management
- rules for QoS contract negotiation and implementation
- APIs enabling QoS agent technologies

5.7 Event Reporting

MPEG-21 Event Reporting should

- Standardise metrics and interfaces for performance of all reportable events in MPEG-21.
- 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
(normative)

Glossary of Terms

The function of this glossary is to list key terms which need to be defined to explain the context of terms within this document, and therefore, to MPEG 21. The glossary will be kept as concise as possible and used to define duplicate, overlapping and new terms.

Term	Definition or synonymous term(s)
End user	User/consumer at the end of a (value) chain. Note: “User” refers to all participants in the value chain.
Entity	TBC
IPMP	Intellectual Property Management & Protection
Digital Item	An 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
Trust	Is synonymous with predictability, e.g. a trusted device is one which exhibits predictable behaviour
User	User of a system. This includes all members of the value chain (e.g., creator, rights holders, distributors and consumers of Digital Items)

Annex B
(informative)

A Template for Technology Harmonisation

Function	Process	Requirement	Business Model Role(s)	Transaction between Role(s)
Infrastructure	1. Digitisation of all carriers with all topologies (1) 2. Transport protocols (2) 3. Interfaces with financial transactions	• Standardisation of high speed networks for content delivery • Transport protocols to support the requirements of different applications	• Creation Provider • Media Distributor • Purchaser • Bank	Creat Prov to Med Dist Med Dist to Purchaser 'Value' transactions
Production	1. Content authoring (14)	• Conformance to standards for packaging content as digital objects, including associated identifiers, usage rules, etc	• Creator • Creation Provider	Content delivery transactions
Distribution	1. Architecture (to be mapped to Business/Value based ref model) 2. Abstraction of applications from transport (3) 3. Abstraction of applications from User platform (4)	• Content Delivery according to Quality of Service (QoS) agreement • Interoperability between systems to ensure QoS for delivery and consumption	• Media Distributor • Purchaser	Med Dist to Purchaser
Representation	1. Information representation (5)	• Identification of generic audio-visual objects • Standardisation of delivery systems	• Unique No Issuer • Creation Provider • Media Distributor • Purchaser	UNI to Creation Prov. Creat Prov to Med Dist Med Dist to Purchaser

Metadata	1. Content description (6) 2. Content identification (8) 3. Usage rights (7)	• Unique identification and description of creations, people and deals	• Creator • Creation Provider • Rights Holder • IPR Database • Unique No. Issuer	Rights Holder to IPR DB UNI to Creation Prov Med Dist to Rights Hold Purchase to Rights Hold
Security/ trans-actions	1. Open (possibly anonymous) access to protected content (9) 2. Metering of content and technology usage (10) 3. Interfaces with financial transactions (15) 4. Secure distribution in the home (11) and consumption Distributed intelligence (13)	• Implement security in hardware devices to protect content and User privacy • Implement security in the provision of services at application level • Mechanisms to meter the access and use of content and technology rights • Intelligent agents for extended functionality between roles	• Creation Provider • Media Distributor • Purchaser • Certification Auth. • Bank	Creation Provider to Media Distributor Med Dist. to Purchaser Purchaser to Cert Auth Med Dist. to Cert Auth
Consumption	1. New interfaces for AV content (12) 2. New interfaces for joint terminal/network management	• Integrated navigation and enquiry applications for audio-visual content and services • Enable matching between content, terminal and network capabilities	• All Roles	All transactions

Annex C
(informative)

Non-exhaustive list of Activities Related to the Multimedia Framework

C.1 CEN/ISSS Metadata for Multimedia Information Workshop

From 1997 to 1999 this workshop gathered a wide mix of interests, including libraries, museums, broadcasters and publishing industry, engineering, manufacturing, tele-medicine, on-line education, retail, multimedia broking, visual image library, royalty collection, kiosk systems, multimedia rights and video on demand, and produced three output documents.

C.2 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.

C.3 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.

C.4 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.

C.5 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.

C.6 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.

C.7 IEC ITA OPIMA

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.

C.8 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, as well as to ensure signalling and transport interoperability between end-systems and managing in real time, QoS sensitive channels.

C.9 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 Java APIs (Application Programming Interfaces) for DVB set-top-boxes, DVB-MHP promises to provide a domestic platform which will facilitate convergence like no other DVB specification.

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.

C.10 MediaComm 2004: A Framework for Multimedia standardisation

The objective of the Mediacom 2004 Project of ITU SG16 is to establish a framework for Multimedia standardisation for use both inside and external to the ITU. The recent rapidly developing of the multimedia related technologies and standards requires urgently a framework to develop standards for applications, services and systems able to respond to users requirements in terms of mobility, ease of use, flexibility of systems and end-to-end interoperability with specific quality requirements.

The work plan includes the definition of the framework concept (objectives, architecture) and framework study areas, the standardisation of services, systems and terminals for multimedia applications over existing and future platforms, providing end-to-end interoperability and liaison and co-ordination of work with other bodies.

C.11 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 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 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
- 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

C.12 W3C

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

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.

C.13 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.

C.14 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.

C.15 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.

C.16 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.

C.17 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.

C.18 MPEG-4 DMIF (addresses both terminal and network issues)

DMIF (ISO/IEC 14496-6) is a Session Level protocol with support for QoS streams. DMIF hides the delivery technology details from the application in order to create a network independent multimedia delivery framework. DMIF provides a common API for an application to request transport channels suitable in quality appropriate to resolution and use. DMIF therefore performs a natural mapping function for an application's network service requests.

Annex D
(informative)

An Abstract Digital Item Definition Model

D.1 Purpose and Overview

The purpose of this Annex is to describe a set of abstract terms and concepts to form a useful model for defining Digital Items. Within this model, a Digital Item is the digital representation of "a work", and as such, they are the thing that is acted upon (managed, described, exchanged, collected, etc.) within the model. The goal of this model is to be as flexible and general as possible, while providing the "hooks" for higher level functionality that will allow it to serve as a key foundation in the building of higher level models in other domains (such as Identification & Description or Rights Management). This document specifically does not define a new definition scheme or language in and of itself. Instead, the model should provide a common set of abstract concepts and terms that can be used to define such a scheme, or to perform mappings between existing schemes capable of Digital Item definition, for comparison purposes.

D.2 Abstract Model

Please note that in the descriptions below, the defined elements in *italics* are intended to be unambiguous terms within this model. The prose descriptions define the semantic "meaning" of the terms, and the modified BNF representations define the precise intended relationship or structure between terms within the model.

Container

A *container* is a potentially hierarchical structure that allows *items* to be grouped. These groupings of *items* can be used to form logical *packages* (for transport or exchange) or logical *shelves* (for organisation). *Descriptors* allow for the "labelling" of *containers* with information that is appropriate for the purpose of the grouping (e.g. delivery instructions for a *package*, or category information for a *shelf*).

```
container ::= container* item* descriptor*
```

Item

An *item* is a grouping of sub-items and/or components that are bound to relevant *descriptors*. *Descriptors* associate information about the item, as a representation of a work. *Items* may contain *choices*, which allow them to be customised or configured. *Items* may be conditional (on predicates asserted by *selections* defined in the *choices*). If an *item* contains no sub-items, then it can be called an *entity*, a logically indivisible work. If it does contain sub-items, then it can be called a *compilation*, which designates it as a work composed of potentially independent sub-parts.

```
item ::= (item | component)+ choice* descriptor* condition*
```

Component

A *component* is the binding of a *resource* to all of its relevant *descriptors*. These *descriptors* are information related to all or part of the specific *resource* instance. Component descriptors will typically contain control or structural information

about the resource (such as bit rate, character set, start points or encryption information) but not information describing the “content” within.

```
component ::= resource descriptor* anchor* condition*
```

Anchor

An a*nchor* binds *descriptors* to a specific location or range within a *resource*.

```
anchor ::= reference descriptor* condition*
```

Descriptor

A *descriptor* associates information with the enclosing element. This information may be a *component* (such as a thumbnail of an image, or a text *component*), or a textual *statement.*

```
descriptor ::= descriptor* (component | statement) condition*
```

Condition

A *condition* describes the enclosing element as being optional, and links it to the *selection*(s) that affect its inclusion. Multiple *predicates* within a condition are combined as a conjunction (an AND relationship). Any *predicate* can be negated in a condition. Multiple *conditions* associated with a given element are combined as a disjunction (an OR relationship) when determining whether to include the element.

```
condition ::= predicate+
```

Choice

A *choice* describes a set of related *selections* that can affect the configuration of an *item*. The *selections* within a *choice* are either exclusive (choose exactly one) or inclusive (choose any number, including all or none).

```
choice ::= selection+ descriptor* condition*
```

Selection

A *selection* describes a specific decision that will affect one or more *conditions* somewhere within an *item*. If the *selection* is chosen, its predicate becomes true, if it is not chosen its predicate becomes false, and if it is left unresolved, its predicate is undecided.

```
selection ::= predicate descriptor* condition*
```

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. All *resources* must be locatable via an unambiguous address.

Reference

A *reference* unambiguously designates a specific point or range within a *resource*. *References* may be *resource* type specific.

Statement

A *statement* is a literal textual value that contains information, but not an asset. Examples of likely *statements* include descriptive, control, revision tracking or identifying information.

Predicate

A *predicate* is an unambiguously identifiable declaration that can be true, false or undecided.

Annex E
(informative)

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.[4]

E.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.

E.2 Requirements

There are a variety of different possible trading relationships, situations, arrangements, or business models for the trading of Intellectual Property Rights (IPR's) 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

---

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

- accounts for user privacy

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.

E.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.

E.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
Unique Number Issuer	Provides unique number for creation
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 mechanism for uniquely identifying digital objects
Bank	Facilitates payments

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

E.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.

E.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 protect the privacy rights of the consumer (with respect to tracking and in some cases 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

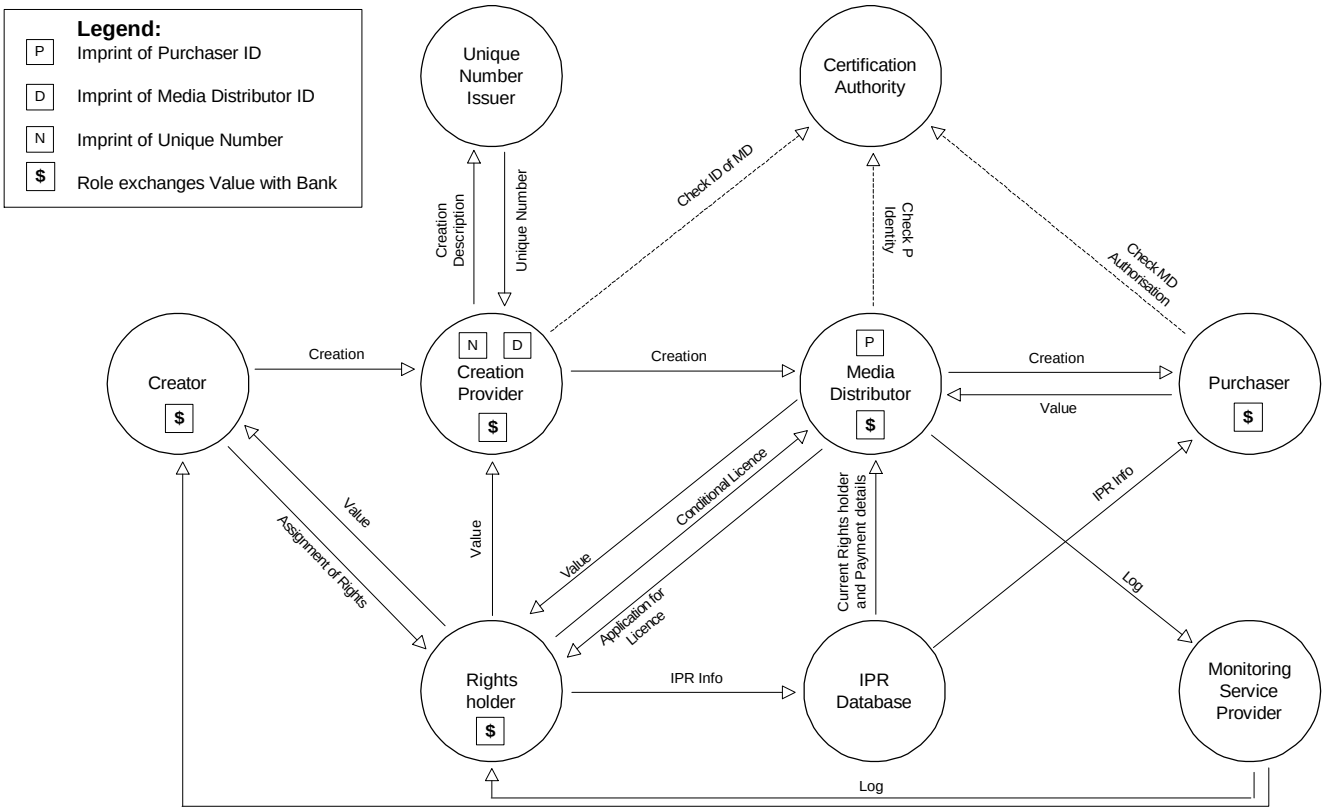


Figure 1: The IMPRIMATUR Business Model

Annex F
(informative)

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: • 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. • 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

	Key Issues	Related Issues	Explanation of Issues
			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, 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	a) The consumer must be able to rely on the content being delivered on time and without having been deteriorated during the delivery. The consumer must also be able to rely on the authentication and authorisation of the content and its usage.

	Key Issues	Related Issues	Explanation of Issues
		quality d) Integrity of information e) Value f) Ease of use g) Dynamic and responsive to consumers needs h) 'On demand' i) Efficient & smooth rendering j) Predictable & continuous k) Accessibility of service	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 consumer 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. 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 consumer 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 consumer should be intuitive and provide user-friendly interfaces. The consumer 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 consumer 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 consumer shall have access to content according to his specific needs. The consumer'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 consumer 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 consumer 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

	Key Issues	Related Issues	Explanation of Issues
			place and through any device.
3.	**Quality of content (rendering)**	a) Authority and Integrity b) Fidelity and user perceived quality/measurement of quality (Intelligible) c) Consistent with price d) Genuine e) Durable f) Timeliness	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) f) Content has to be consumable at the point in time the consumer 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 consumer and it is therefore appropriate to list it here. a) Consumers 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) Consumers 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 consumer with a perceived level of artistic quality c) A consumer 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 consumers are often interested in the endorsement (or not!) of others by reading about the recommendations of content reviewers e) Consumers 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**	a) Ergonomy b) Simplicity c) Intuitive d) Intelligent (but not	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

	Key Issues	Related Issues	Explanation of Issues
	Devices	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 k) Distributed intelligence between devices	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 shouldn't 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. i) Device/service/content should behave the same, in different countries. The UI should be easy to understand in different languages j) Impact of national culture on device design: products should be as neutral (no local influence) as possible in the way they express their UI – OR – could be smart enough to adapt to local culture when in different countries k) Through home networks, resources not available in one device to perform, could be found in another one, and downloaded or shared
6.	**Interopera-bility of Physical media formats**	a) Format independence of content b) Backward compatibility of formats c) Longevity of media (deterioration) d) Standard cross-platform storage media (smart media) e) Content transfer between media	a) The media is not dedicated to a specific type of content (Ex: CD-ROM versus CD Audio) b) The formats are designed in such a way that the devices using new formats can also be used with former formats (Ex: Digital 8 and 8mm video tapes for Camcorders) c) The data stored on the media can be retrieved as initially stored on a long period of time d) The format can be used on many different devices manufactured by many different companies (Ex: CD-ROM) e) The content stored on a media can be stored and used on a different media (Ex: from hard disk to CD-ROM)
7.	**Payment/subscription models (online and offline)**	a) Free services b) Services in exchange for the consumption of: – Advertisements	a) It must be possible to offer content for free. b) It must be possible to offer content in exchange for information instead of money c) Models like 'earning miles when flying' have to be possible.

	Key Issues	Related Issues	Explanation of Issues
		– Personal data c) Reward models for charging d) Rental e) Payment in kind f) Promotional copies g) On demand h) Subscription per service i) Super distribution j) Simplicity and clarity of charging models k) Proof of payment l) Dispute	d) It has to be possible for a user to get access to content for a certain period of time only. e) Models have to be possible where a user gets access to content when he is willing to send (self-produced?) content back to the distributor f) It has to be possible for a user to receive and use free promotional copies (under certain conditions) g) When a customer selects content, he receives the content. And only then, he will be charged. h) A customer should have the choice to subscribe to services. He will then not be charged on a per-use basis but on a , e.g., per-month basis i) It should be possible for a customer to pass content on to his friends. Those friends, however, will have to obey to the same rules as the person who passed the content on. j) Business models need to be clear and understandable to the user. k) The user has to have the possibility to get proof of his payment to the distributor l) The user needs to have the possibility to dispute a transaction
8.	**Multi-platform decoding and rendering**	a) Usage of content independent of device type b) Can be played on many platforms/applications but at variable quality levels (scalability) c) Transparency to the user of the different codecs d) Ability to render content on devices with different physical parameters	The tight coupling of the signal and the physical delivery systems make it impossible in most cases to enable the play back of content on one device if it has been produced for another device. This is still true in some cases for the digital domain, but more as a deliberate or careless decision of one or more parties involved. a) There are already many cases where the playback of content intended for different delivery media is possible. Actually this was the basic design parameter of all MPEG standards b) This seamless play back of content may encounter obstacles. Content may have produced at high bit rate but the delivery medium may allow only a lower bit rate. Or the bandwidth is available but the play back device does not have sufficient computing power to decode and render the content. An important feature is the ability to make some use of the content even if not at the highest quality level c) Content can represented according different methods, but if the decoder does not know the specific method content cannot be played back. MPEG has traditionally defined a single coding system that has achieved high popularity. Others have defined proprietary coding systems. This results in a diminished user experience d) Delivery and processing power are two critical parameters that determine the ability to understand coded content. Another element is the presentation device. For a user it is important that whatever the presentation device content may still be presented
9.	**Searching, filtering**	a) Consistent content identification and	a) One of the most important explanations to account for the progressive expansion of the Web is its ubiquity and the

	Key Issues	Related Issues	Explanation of Issues
	locating, retrieving and storing content	description b) Response time for query c) Personalised services for content selection – Payment mechanisms – Delivery services – Cost – Performance – Content type – Related content – Related services – New content d) Completeness e) Availability f) Reliability g) Certification authority for content authenticity h) Rating/categorisation i) Relevance and credibility j) Up to date k) Organisation of acquired content – Caching – Categorisation	choice available to consumers for acquiring all content types from this domain. However, the lack of consistent content identification and description makes the search and retrieval process much harder, and consequently less satisfying, than it need be. Consumers require content identification and description to give structure to the organisation of content b) Consumers will expect a minimum service level for system response to search and retrieval queries c) Consumers require tools to help them refine and filter the search and retrieval of content such as intelligent agents which can match services and content against highly specific customer 'profiles'. These 'profiles' must be capable of reflecting a wide range of options to manage alternative payment mechanisms, delivery services, cost, performance (timeliness of delivery), and content type. Choices of content by consumers will also increase the 'knowledge' of the intelligent user profile, leading the consumer to the acquisition of related content. It will also enable the selection of new services and alert consumers to the availability of newly released content d) Consumers should reasonably expect assurance that they are locating content from a source which is both comprehensive and complete e) Consumers should reasonably expect assurance that content which is located is also available for consumption f) Services for consumers relating to the selection and choice of content must be reliable g) Consumers wish to know whether content is 'authentic' and that it is what it claims to be. A certification authority (such as DMAT identified audio content which is SDMI compliant) can give consumers assurance about authenticity h) Content must be categorised in different ways to enable consumers to make choices based on genre, duration, censorship, etc i) Search and filter techniques should be sufficiently sophisticated to ensure that content is both relevant and credible j) Consumers wish to be able to search and retrieve the most up to date content (i.e. new releases of films, recordings, etc) k) Consumers require tools that enable them to manage and organise the content that they have acquired. Content may need to be stored either locally or remotely, depending upon the type of service and the terms of acquisition. Irrespective of this, content should be cached so that it is immediately available for use and reuse. It must also be clearly identifiable and sorted in a manner that allows the consumer to locate it easily.
l)	**Consumer Content**	a) Making ones self known	There is a trend for consumers to publish self-generated content or content that has been retrieved and modified (with added value). The

	Key Issues	Related Issues	Explanation of Issues
	Publishing	b) Protection and management of self created content c) Accessibility of self created content d) Ability to purchase rights to other content	number of virtual communities and personal web sites are increasing. Publishing also gives consumers a way to identify themselves. Consumers need tools to publish and manage their content at any place, any time. This self-created content has to be protected and be accessible by others. The way to publish content should not be a barrier for consumers. It has to be easy and flexible. For the ones who want to modify content, adding an artistic value or for others who want to create art of mediation (collecting, filtering, packaging and publishing of information), there should be a way to purchase rights to other content.
m)	**Usage rights of Consumers**	a) What rights do the consumer have to: – Own content – Use content e.g. Fair Use – Copy content – Edit – Pass on b) Do consumers understand what rights they have? Unambiguous interpretation of usage rules on multiple platforms	When consumers purchase CDs, they are not interested in what kind of rights are associated with them. They think as if they have every right since they posses the physical media. In reality, however, they have only playback rights on them. This example shows difficulty of consumers' understanding their rights correctly. By acquiring content whether by purchase or rent, consumers will encounter a variety of rights, such as owner rights, use rights, copyrights, edit rights, and pass-on rights. Since the Bern Treaty, copyright is automatically given when it is borne without any registration. This may cause some confusion to consumers and creators, especially in respect of digital contents. This variety of rights makes usage rule complex and thus ambiguous from the consumers' viewpoint. Therefore, almost all consumers would not read usage rules when they purchase 'shrink-wrapped' content (e.g. software). It is important to make consumers understand their rights on contents correctly and unambiguously when they purchase them. If they differ for each platform/media, it will cause some confusion to them. Furthermore, sometimes consumers will also be creators. So, mechanisms must exist which make it easy to enforce their rights, the expiring date or pass-on condition, and other matters of significance. Digital content is highly vulnerable to copyright misuse. At the same time, however, there exists the opportunity to resolve the ambiguousness of rights ownership for consumers through the use of technology.
n)	**Consumer Privacy**	a) Ability to negotiate personal transactional privacy policy between the consumer and the service provider or third parties b) Personal data will not be used by a service provider in a discriminatory manner	In the present E-commerce environment, when consumers shop at service providers, their transaction histories are automatically recorded. Those records are sometimes used for a providers' own business, in most cases, without permission of the consumers. Or, those transaction records are sometimes transferred to third parties who gather customer marketing information which is used for their business purposes. The fact stated above, in some cases, creates a disadvantage to consumers, such as receiving a pile of unsolicited advertisements through e-mail messages (Spam). Sometimes it exposes consumers to the menace of the disclosure of personal information to the public, and potentially leading to serious crimes. In some cases, however, it can bring benefits to customers. For example, best sales ranking information summing up anonymous customer transaction records is always one of the best references for customers, and timely advertisements are even welcomed by

	Key Issues	Related Issues	Explanation of Issues
			customers. Thus, what is crucial to customers is to have ability to control service providers' and the third parties' usage of customer transaction records with suitable conditions such as an agreed anonymity level and expiration date. For that purpose, ability to negotiate between service providers/ third parties and consumers on their usage of customer transaction records is needed. This negotiation requires easy interface for customers such as some illustration of the conditions. The negotiation protocol needs security such as 'peer entity authentication'. It would be practical if there existed a mechanism to observe violations of agreements on customer transaction record usage. In addition, considering practical application development, some set of profiles of customer transaction record usage may be useful.

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