MPEG-21

Content

- Introduction
- Multimedia framework
- Seven elements of Mpeg-21
  * Digital Item Declaration
  * Digital Item Identification
  * Content Handling and Usage
  * Intellectual Property Management and Protection
  * Terminals and Networks
  * Content Representation

Introduction

- The aim for MPEG-21
  - many elements exist to build an infrastructure for the delivery and consumption of multimedia content.
  - The aim for MPEG-21 is to describe how these various elements fit together.
  - MPEG-21 will recommend which new standards are required.(ISO/IEC JTC 1/SC 29/WG 11 (MPEG))

MPEG-21 Multimedia Framework ISO/IEC 21000

- Situation: No complete solutions exist that allow different communities (content, financial, communications etc.), each with their own models, rules, procedures and content formats to interact efficiently.

- The multimedia content delivery chain encompasses different “players” (content creation, production, delivery etc.).
- To support this, the content has to be identified, described, managed and protected.

- Purpose: MPEG-21 MM-Framework shall enable interoperability in this situation.

What is Mpeg-21

- An open Framework for multimedia delivery and consumption
- Vision: Integration of the critical technologies enabling transparent and augmented use of multimedia resources across a wide range of networks and devices to support functions such as: content creation, content production, content distribution, content consumption and usage, content packaging, intellectual property management and protection, content identification and description, financial management, user privacy, terminals and network resource abstraction, content representation and event reporting

Multimedia Framework

- The multimedia content delivery chain:
  - *Content Creation*
  - *Production*
  - *Delivery*
  - *Consumption.*
- The content has to be *identified, described, managed and protected*.
- The delivery require *reporting* include *reliable delivery, the management of personal data and preferences taking user privacy into account and the management of (financial) transactions*.

Using MPEG-21

- Potential impact of MPEG-21
  - MPEG: ISO/IEC Committee
  - MPEG-1/MPEG-2/MPEG-4/MPEG-7/MPEG-21
  - expected industry support
- MPEG-21 Vision: ‘a normative open framework for multimedia delivery and consumption for use by all the players in the delivery and consumption chain’
  - applicability to Digital Libraries
  - ability to accomodate any media type and genre
- MPEG-21 is modular:
  - MPEG-21 Part 2: DIDL – representation of digital objects
  - MPEG-21 Part 3: DII – identification of digital objects
  - MPEG-21 Part 4: IPMP – enforcement of rights expressions
  - MPEG-21 Part 5: REL – declaration of rights expressions
  - MPEG-21 Part 7: DIA – transcoding based on contextual information
  - MPEG-21 Part 10: DIP – association of behaviors

Seven key Elements of MPEG-21

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

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

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

Seven key Elements of MPEG-21

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);

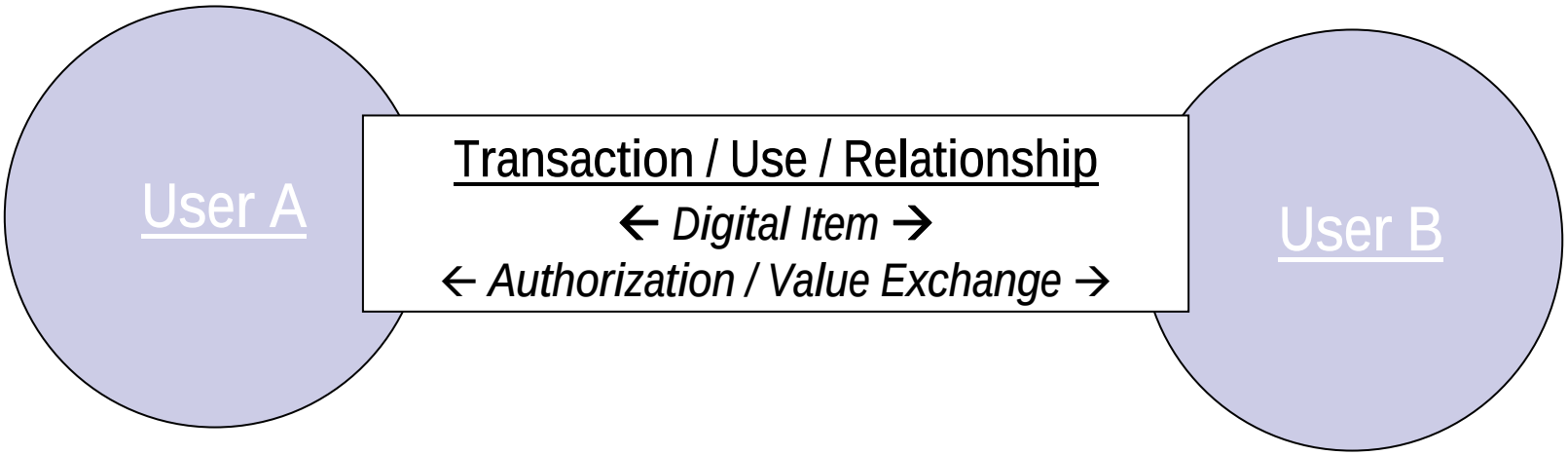
Terminals and Networks (the ability to provide interoperable and transparent access to content across networks and terminals);

Content Representation (how the media resources are represented);

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

The basic elements of the MPEG-21 framework

- What
  - A Digital Item is a structured digital object with a standard representation, identification meta-data and resource within the MPEG-21 framework.
- Who
  - A User is any entity that interacts in the MPEG-21 environment or makes use of a Digital Item.



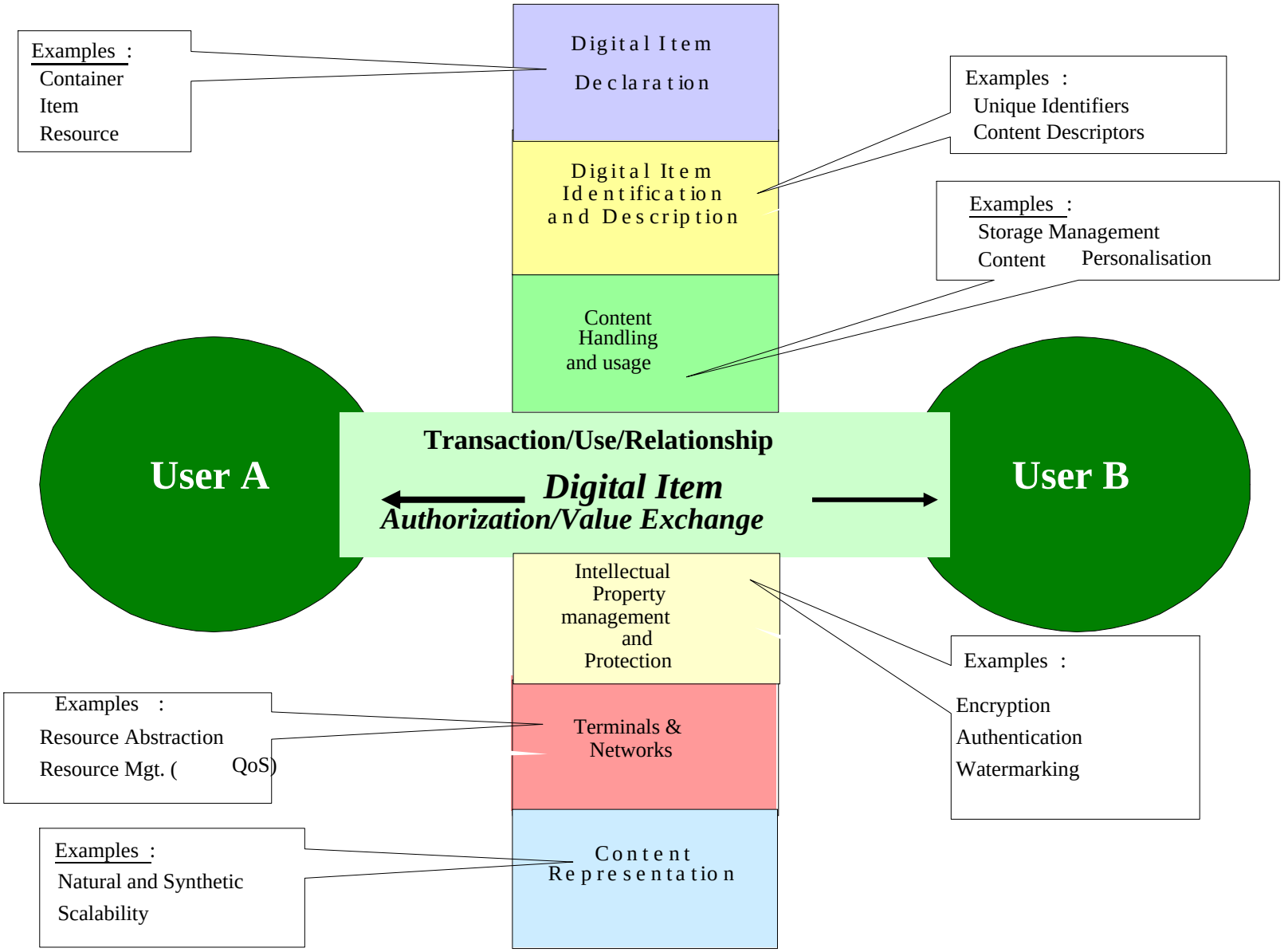
User Model

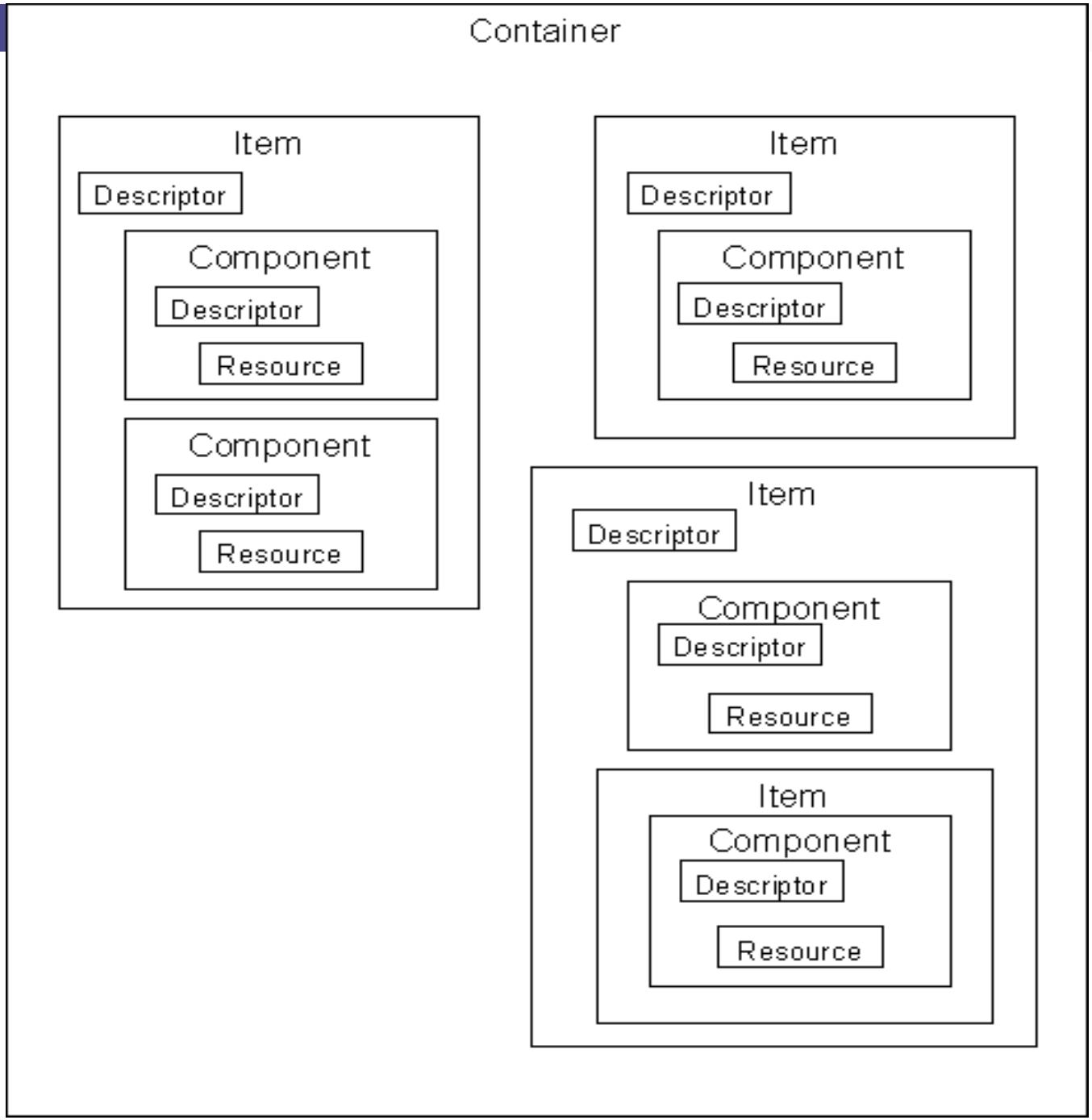
- **A *User* is any entity that interacts in the MPEG-21 environment or makes use of a Digital Item. Such Users include individuals, consumers, communities, organisations, corporations, consortia, governments and other standards bodies and initiatives around the world**

- no distinction between a “content provider” and a “consumer”

User Activities

- 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


Examples :
Container
Item
Resource
Digital Item Declaration
Examples :
Unique Identifiers
Content Descriptors
Digital Item Identification and Description
Examples :
Storage Management
Content Personalisation
Content Handling and usage
User A
Transaction/Use/Relationship
Digital Item
Authorization/Value Exchange
User B
Intellectual Property management and Protection
Examples :
Encryption
Authentication
Watermarking
Examples :
Resource Abstraction
Resource Mgt. (QoS)
Terminals & Networks
Examples :
Natural and Synthetic
Scalability
Content Representation


Container
Item
Descriptor
Component
Descriptor
Resource
Component
Descriptor
Resource
Item
Descriptor
Component
Descriptor
Resource
Item
Descriptor
Component
Descriptor
Resource
Item
Component
Descriptor
Resource

Element Types

- *Container*
- *Item*
- *Component*
- *Anchor*
- *Descriptor*
- *Choice*
- *Selection*
- *Condition*
- *Annotation*
- *Assertion*
- *Resource*
- *Statement*

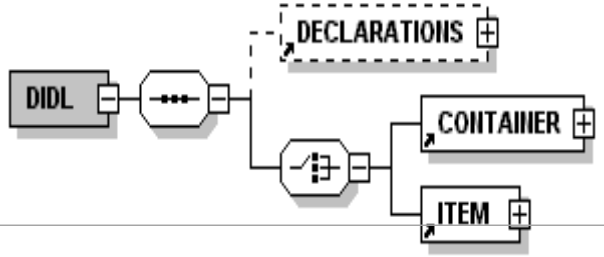
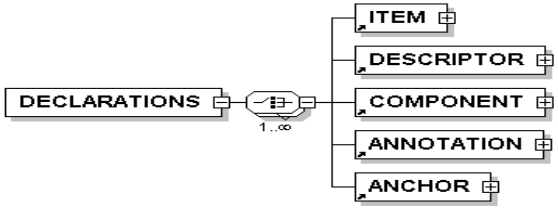
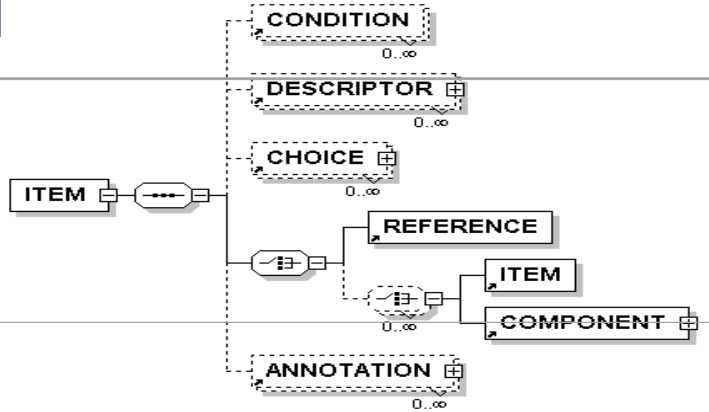
Diagram	
Children	<DECLARATIONS> <CONTAINER> <ITEM>
Source	<xsd:element name="DIDL"> <xsd:complexType> <xsd:sequence> <xsd:element ref="DECLARATIONS" minOccurs="0"/> <xsd:choice> <xsd:element ref="CONTAINER"/> <xsd:element ref="ITEM"/> </xsd:choice> </xsd:sequence> </xsd:complexType> </xsd:element>

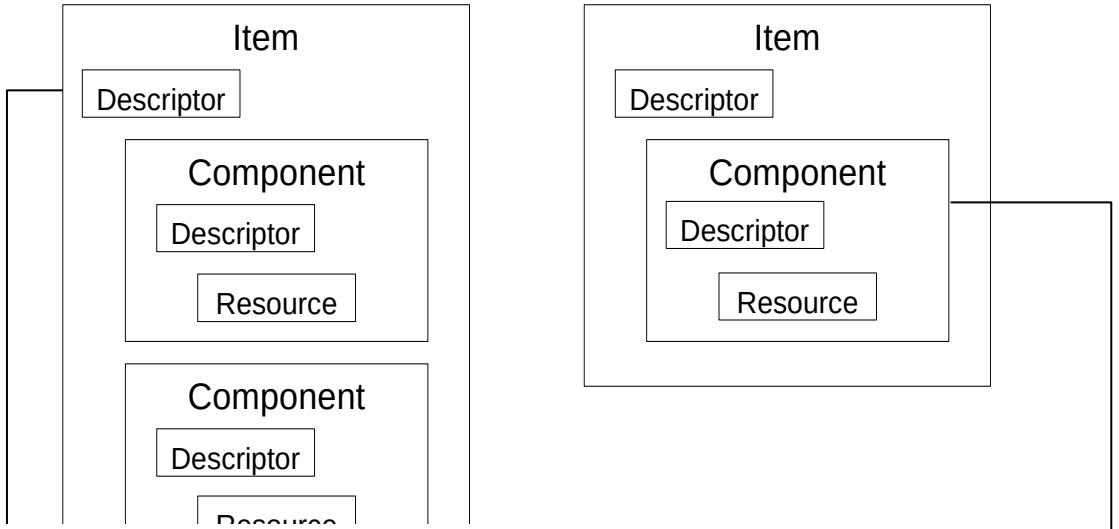
Diagram	
Children	<ITEM> <DESCRIPTOR> <COMPONENT> <ANNOTATION> <ANCHOR>
Used by	<DIDL>
Source	<xsd:element name="DECLARATIONS"> <xsd:complexType> <xsd:choice maxOccurs="unbounded"> <xsd:element ref="ITEM"/> <xsd:element ref="DESCRIPTOR"/> <xsd:element ref="COMPONENT"/> <xsd:element ref="ANNOTATION"/> <xsd:element ref="ANCHOR"/> </xsd:choice> </xsd:complexType> </xsd:element>

<table>
<tr><td>Diagram</td><td colspan="3"> 
</td></tr>
<tr><td>Children</td><td colspan="3"><CONDITION> <CHOICE> <DESCRIPTOR> <REFERENCE> <ITEM> <COMPONENT> <ANNOTATION></td></tr>
<tr><td>Used by</td><td colspan="3"><DECLARATIONS> <ITEM> <CONTAINER> <DIDL></td></tr>
<tr><td rowspan="2">Attributes</td><td>Name</td><td>Type</td><td>Description</td></tr>
<tr><td>ID</td><td>ID</td><td>A unique ID value.</td></tr>
</table>

The Digital Item

Example:

showing the hierarchical structure of the Digital Item Declaration Model.



Example: Digital Item Declaration (DID)

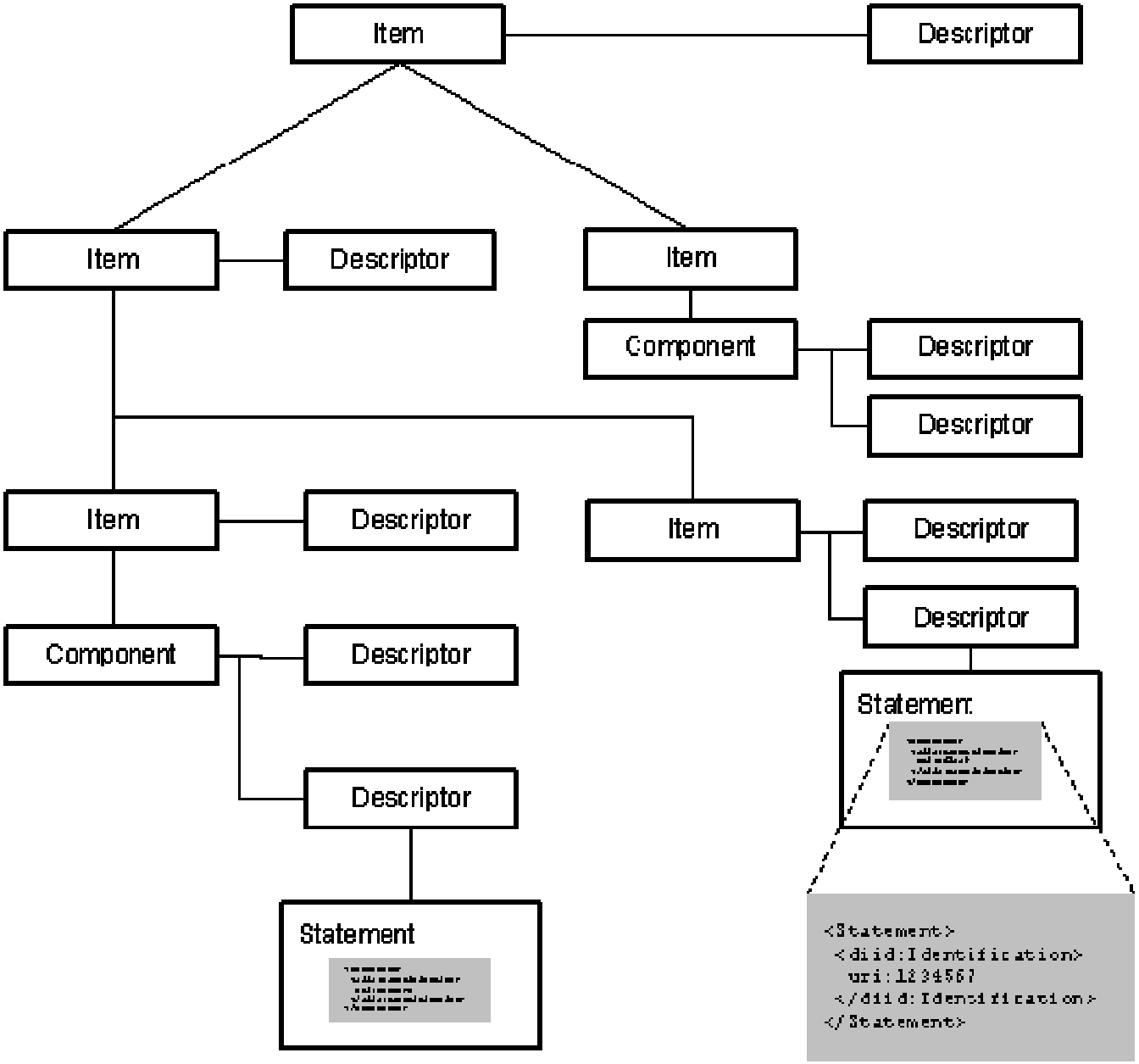
```
<Component>
  <Condition require="MPEG_FORMAT"/>
  <Descriptor>
    <Statement mimeType="text/xml">
      <mpeg7:Mpeg7>
        <mpeg7:DescriptionUnit
           xsi:type=“mpeg7:MediaFormatType">
          …
            <mpeg7:FileSize>136987</mpeg7:FileSize>
        </mpeg7:DescriptionUnit>
      </mpeg7:Mpeg7>
    </Statement>
  </Descriptor>
  <Resource mimeType="video/mpeg" ref="video.mpeg"/>
</Component>
```

Digital Item Declaration

- 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
- 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.*
- 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. Such *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.

Digital Item Identification

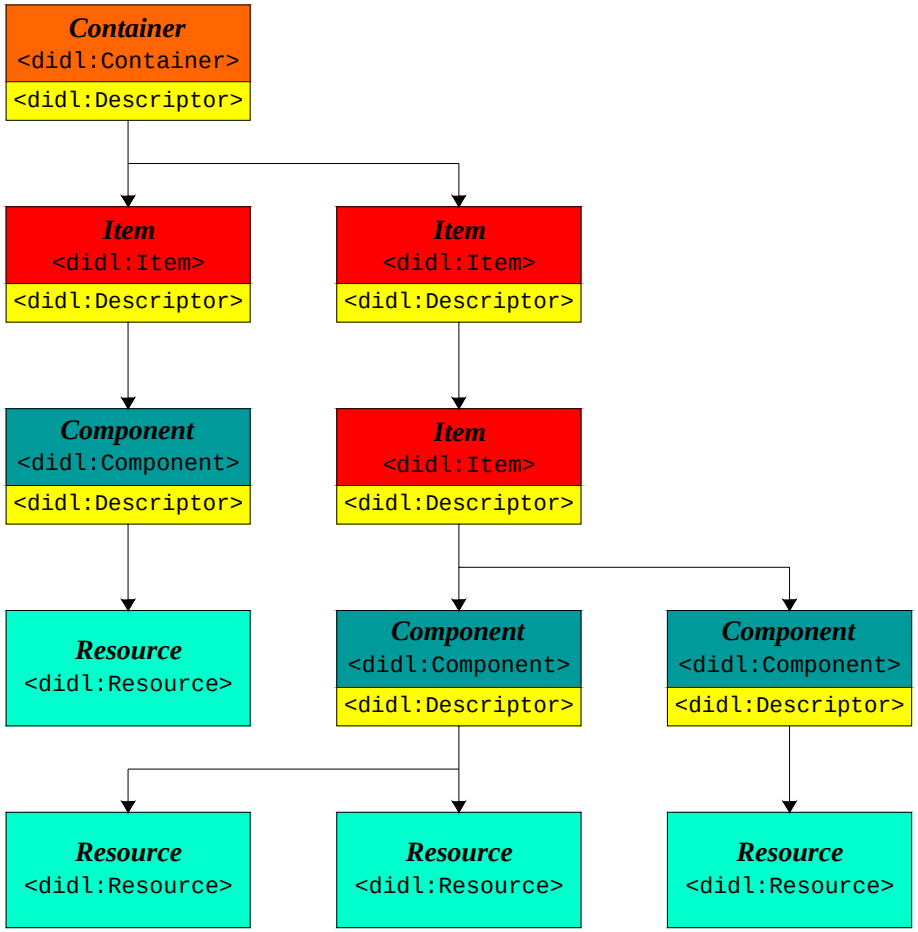
- How to uniquely identify Digital Items and parts thereof (including resources);
- How to uniquely identify IP related to the Digital Items (and parts thereof), for example abstractions;
- How to uniquely identify Description Schemes;
- How to use identifiers to link Digital Items with related information such as descriptive metadata


Item
Descriptor
Item
Descriptor
Item
Component
Descriptor
Descriptor
Item
Descriptor
Item
Descriptor
Descriptor
Component
Descriptor
Descriptor
Statement
<Statement>
<diid:Identification>
uri:1234567
</diid:Identification>
</Statement>

MPEG-21 DIDL - 1. Data Model

- Abstract Definitions + W3C XML Schema
- Entities
  - a ***Container*** `didl:Container`
  - an ***Item*** `didl:Item`
  - a ***Component*** `didl:Component`
  - a ***Resource*** `didl:Resource`
  - a ***Descriptor*** `didl:Descriptor`
  - …
- Remarks
  - not a cookbook
  - further profiling is necessary (applications/communities)
  - a DIDL compliant document == a DID

MPEG-21 DIDL - 1. Data Model



MPEG-21 DIDL - 2. Descriptors

- Secondary information pertaining to Entities
  - MPEG-21 defined uses
    - identification information – MPEG-21 Part 3 : DII
    - rights information – MPEG-21 Part 5 : REL / Part 4 : IPMP
    - processing information – MPEG-21 Part 10 : DIP
  - community/application specific uses

MPEG-21 DIDL - 2. Descriptors - Identifiers

```
<didl:Item>
   <didl:Descriptor>
      <didl:Statement mimeType="text/xml; charset=UTF-8">
         <dii:Identifier xmlns:dii="urn:mpeg:mpeg21:2002:02-DII-NS">
            urn:isbn:0-395-36341-1</dii:Identifier>
      </didl:Statement>
   </didl:Descriptor>
   …
</didl:Item>
```

MPEG-21 dii:Identifier

MPEG-21 DIDL - 2. Descriptors - rights

```
<didl:Item>
   …
   <didl:Descriptor>
      <didl:Statement mimeType="text/xml; charset=UTF-8">
         <r:license xmlns:r="urn:mpeg:mpeg21:2003:01-REL-R-NS">
            <!-- optionally, specific rights can be added here.-->
              <r:otherInfo>
                 <dc:rights xmlns:dc="http://purl.org/dc/elements/1.1/">
                 Copyright2003; American Physical Society</dc:rights>
            </r:otherInfo>
         </r:license>
      </didl:Statement>
   </didl:Descriptor>
   …
</didl:Item>
```

MPEG-21 r:license

MPEG-21 DIDL - 2. Descriptors

-

```
<didl:Component>
   …
   <didl:Descriptor>
      <didl:Statement mimeType="text/xml; charset=UTF-8">
         <dip:ObjectType xmlns:dip="urn:mpeg:mpeg21:2002:01-DIP-NS">
           urn:foobar:Argument</dip:ObjectType>
      </didl:Statement>
   </didl:Descriptor>
   …
</didl:Component>
```

Content

MPEG-21 dip:ObjectType

```
<didl:Item>
   …
   <didl:Descriptor>
      <didl:Statement mimeType="text/xml; charset=UTF-8">
         <dip:Argument xmlns:dip="urn:mpeg:mpeg21:2002:01-DIP-NS">
           urn:foobar:Argument</dip:Argument>
      </didl:Statement>
   </didl:Descriptor>
   <didl:Resource>
       function PlayTrack() {
       }
   </didl:Resource>
 …
</didl:Item>
```

Processing *Item*

MPEG-21 dip:Argument

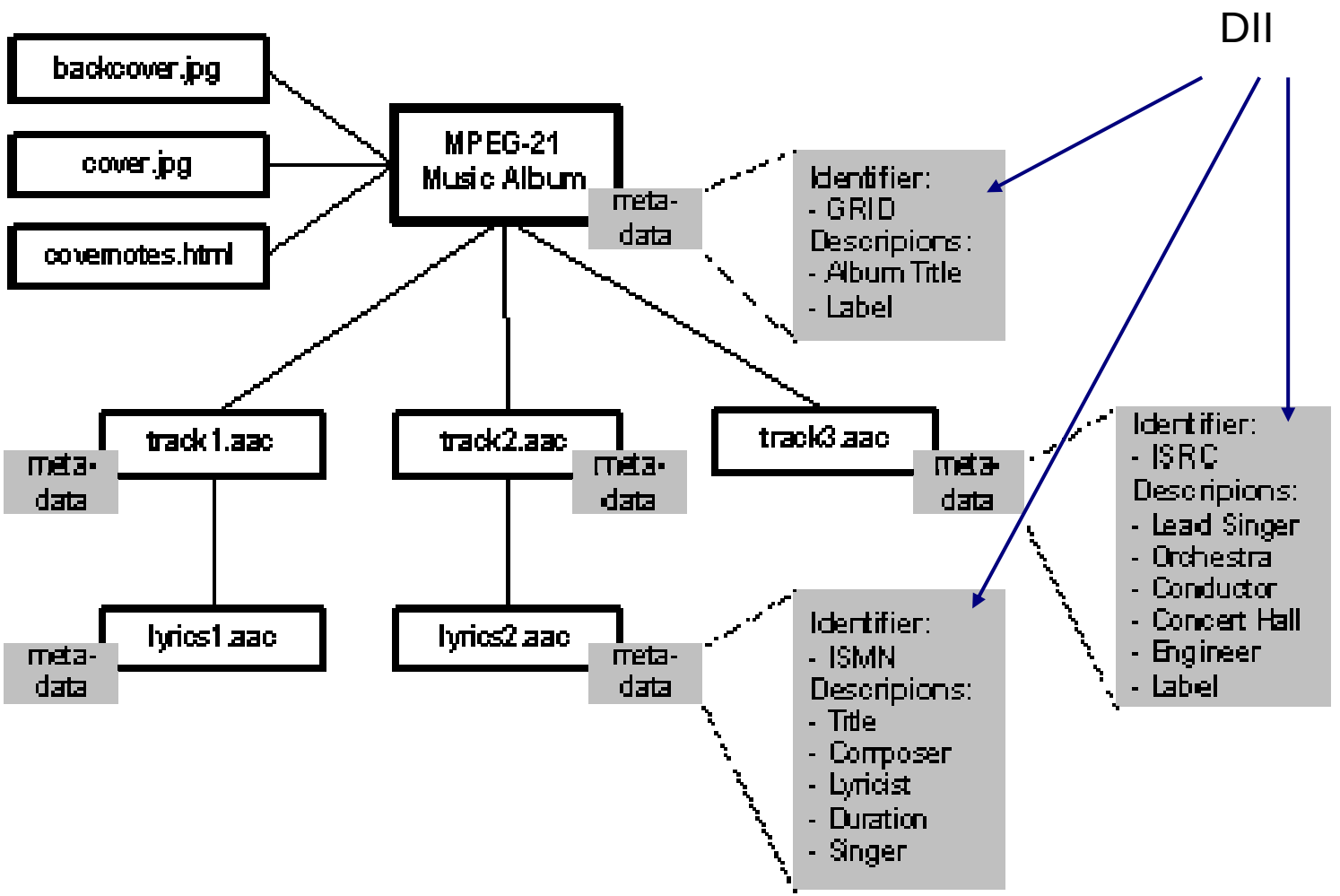
Digital Item Identification

- 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.
- Several elements within a Digital Item Declaration can have zero, one or more DESCRIPTORS. Each DESCRIPTOR may contain one STATEMENT which can contain one identifier relating to the parent element of the STATEMENT.

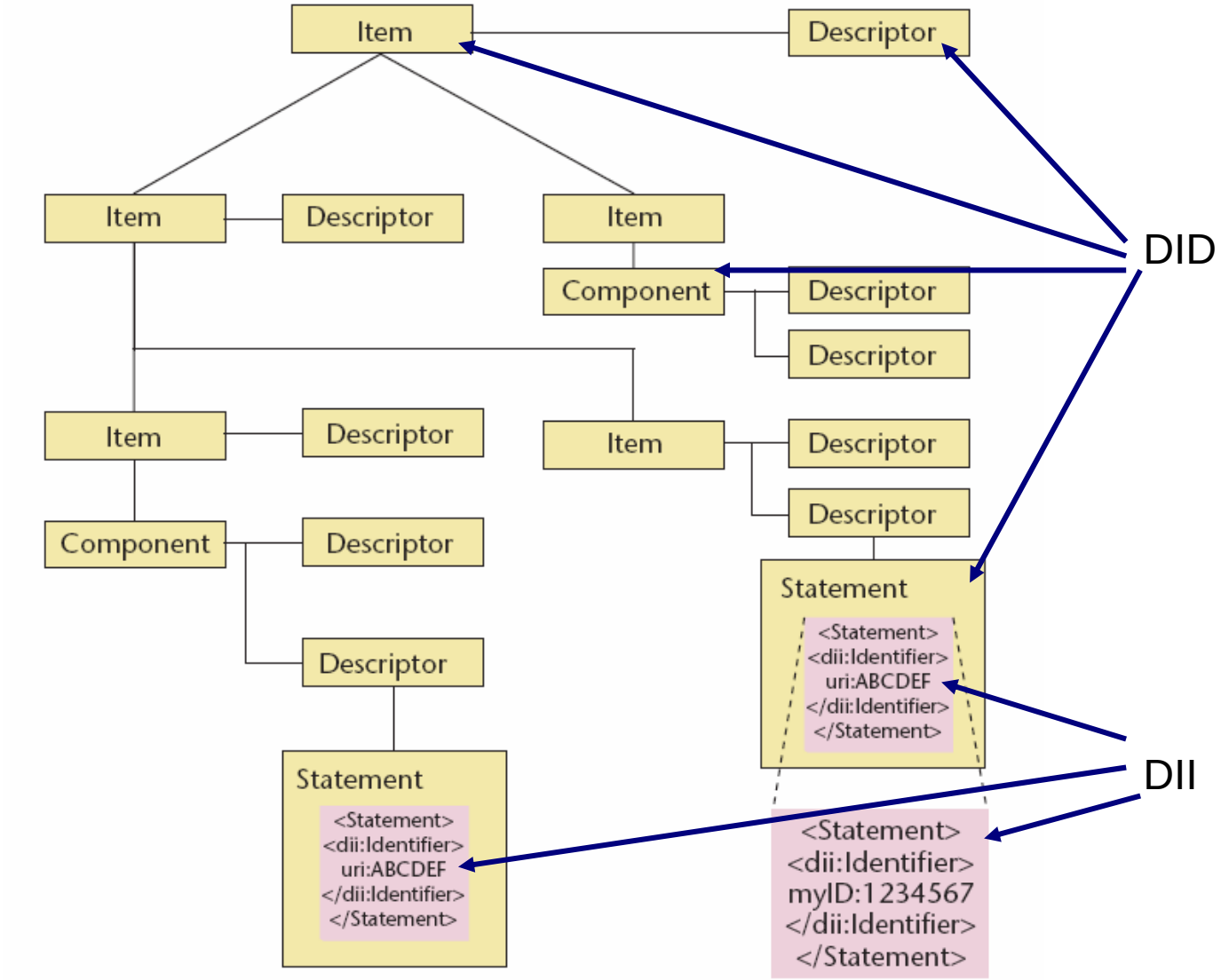
Uniform Resource Identifiers

- A Uniform Resource Identifier (URI) is a compact string of characters for identifying an abstract or physical resource, where a resource is defined as "anything that has identity".

- MPEG-21 identifier may be a Uniform Resource Locator (URL).


DII
backcover.jpg
cover.jpg
covernotes.html
MPEG-21
Music Album
meta-
data
Identifier:
- GRID
Descripions:
- Album Title
- Label
track1.aac
track2.aac
track3.aac
meta-
data
meta-
data
meta-
data
Identifier:
- ISRC
Descripions:
- Lead Singer
- Orchestra
- Conductor
- Concert Hall
- Engineer
- Label
lyrics1.aac
lyrics2.aac
meta-
data
meta-
data
Identifier:
- ISMN
Descripions:
- Title
- Composer
- Lyricist
- Duration
- Singer

DID and DII relation



- A *choice* describes a set of related selections that can affect an item’s configuration.
- A *selection* describes a specific decision that affects one or more conditions somewhere within an item.

```
<?xml version="1. 0" encoding="UTF -8"?>
<DIDL
xmlns="urn:mpeg:mpeg21:2002:01 -DIDL-NS"
xmlns:xsi ="http://www.w3.org/2001/XMLSchema -instance"
xsi:schemaLocation ="urn:mpeg:mpeg21:2002:01 -DIDL-NS E:\Users\RVdW\Temp\DIDL.xsd">
    <Container >
        <Descriptor >
            <Statement mimeType ="text/plain">
                This information package was developed by University Records Unlimited
            </Statement>
        </Descriptor >
        <Item>
            <Descriptor >
                <Statement mimeType ="text/plain">
                    Copyright owner: University Records Unlimited
                    Permission: Read  Only
                </Statement>
            </Descriptor >
            <Descriptor >
                <Component >
                    <Resource ref="http://www.uruweb.org/logos/uow.jpg " mimeType ="image/jpeg "/>
                </Component >
            </Descriptor >
            <Choice choice_id ="INFO_PICKER ">
                <Descriptor >
                    <Statement mimeType ="text/plain">
                        Choose the information you want to receive:
                    </Statement >
                </Descriptor >
                <Selection select_id ="VIDEO">
                    <Descriptor >
                        <Reference target="#VIDEO_TITLE "/>
                    </Descriptor >
                </Selection >
```

```
                    <Selection select_id="TEXT">
                        <Descriptor>
                            <Reference target="#TEXT_TITLE"/>
                        </Descriptor>
                    </Selection>
                </Choice>
                <Item>
                    <Condition require="VIDEO"/>
                    <Descriptor id="VIDEO_TITLE">
                        <Statement mimeType="text/plain">
                            Research over view video
                        </Statement>
                    </Descriptor>
                    <Component>
                        <Condition require="VIDEO"/>
                        <Resource ref="http://www.uruweb.org/video/research.mp4 " mimeType="video/mp4"/>
                    </Component>
                </Item>
                <Item>
                    <Condition require="TEXT"/>
                    <Descriptor id="TEXT_TITLE">
                        <Statement mimeType="text/plain">
                            Lecture notes
                        </Statement>
                    </Descriptor>
                    <Component>
                        <Condition require="TEXT"/>
                        <Resource ref="http://www.uruweb.org/text/lecturenotes.txt " mimeType="text/plain"/>
                    </Component>
                </Item>
            </Item>
        </Container>
    </DIDL>
```

Intellectual Property Management and Protection (IPMP)

- The project includes standardized ways of retrieving IPMP tools from remote locations, exchanging messages between IPMP tools and between these tools and the terminal. It also addresses authentication of IPMP tools, and has provisions for integrating Rights Expressions according to the Rights Data Dictionary and the Rights Expression Language.

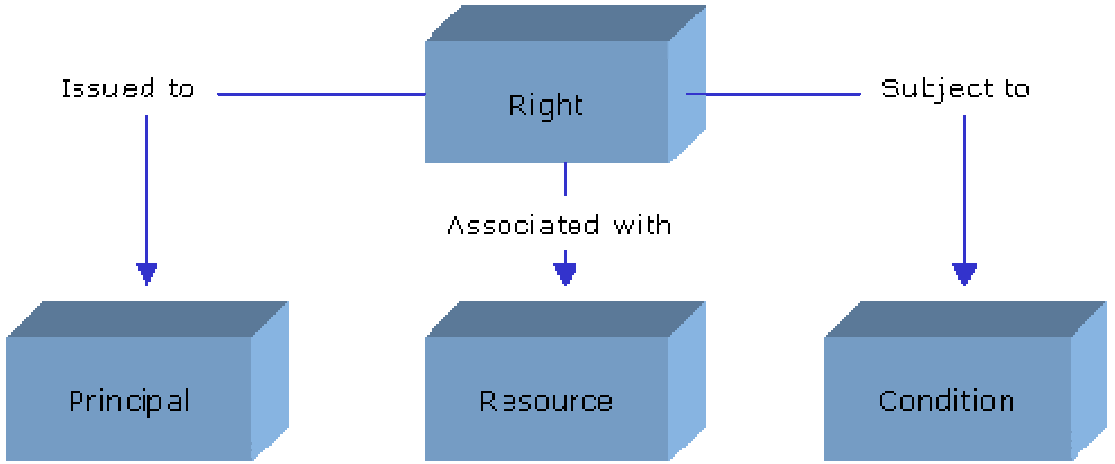
Rights Expression Language

- A Rights Expression Language is seen as a machine-readable language that can declare rights and permissions using the terms as defined in the Rights Data Dictionary.
- The REL is intended to provide flexible, interoperable mechanisms to support transparent and augmented use of digital resources in a way that protects digital content and honours the rights, conditions, and fees specified for digital contents.

MPEG REL Data model

The basic relationship between four basic entities of MPEG REL data model is defined by the MPEG REL assertion “grant”. Structurally, an MPEG REL grant consists of the following:

- The principal to whom the grant is issued
- The right that the grant specifies
- The resource to which the right in the grant applies
- The condition that must be met before the right can be exercised



Principal

A principal denotes the party that it identifies by information unique to that individual. Usefully, this is information that has some associated authentication mechanism by which the principal can prove its identity. The Principal type supports the following identification technologies:

- A principal that must present multiple credentials, all of which must be simultaneously valid, to be authenticated.
- A keyHolder, meaning someone identified as possessing a secret key such as the private key of a public / private key pair.
- Other identification technologies that may be invented by others.

Right

- A right is the "verb" that a principal can be granted to exercise against some resource under some condition. Typically, a right specifies an action (or activity) or a class of actions that a principal may perform on or using the associated resource.

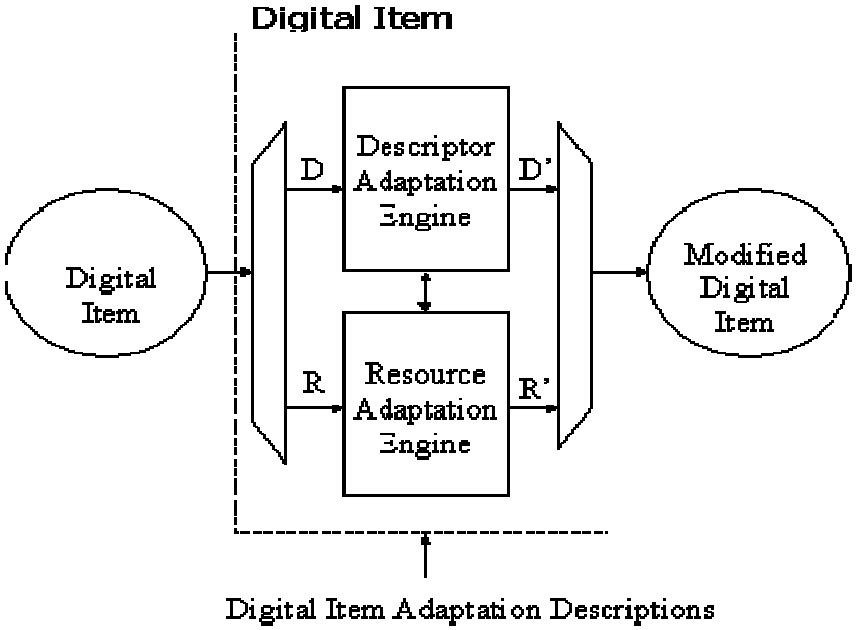
- MPEG REL provides a right element to encapsulate information about rights and provides a set of commonly used, specific rights, notably rights relating to other rights, such as issue, revoke and obtain. Extensions to MPEG REL could define rights appropriate to using specific types of resource. For instance, the MPEG REL content extension defines rights appropriate to using digital works (e.g., play and print)

Rights Data Dictionary

- The Rights Data Dictionary (RDD) comprises a set of clear, consistent, structured, integrated and uniquely identified Terms to support the MPEG-21 Rights Expression Language
- As well as providing definitions of Terms for use in the REL, the RDD specification is designed to support the mapping and transformation of metadata from the terminology of one namespace (or Authority) into that of another namespace (or Authority) in an automated or partially-automated way, with the minimum ambiguity or loss of semantic integrity

Digital Item Adaptation

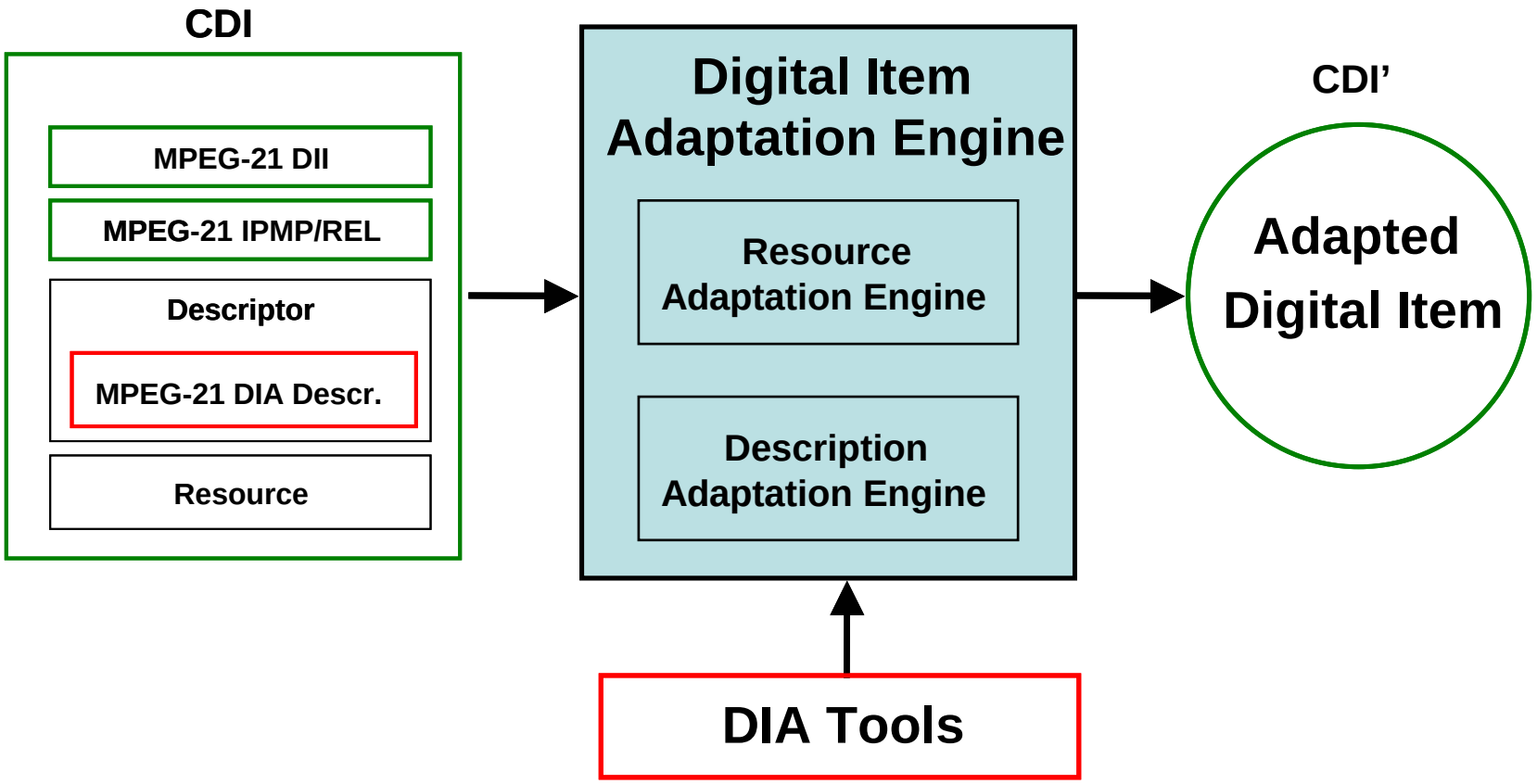
- User Characteristics
- Terminal Capabilities
- Network Characteristics
- Natural Environment Characteristics
- Resource Adaptability
- Session Mobility



Examples for Videos

- Temporal scaling
  - Reduce number of VOPs in the video resource
- Spatial scaling
  - Reduce the number of pixels in an image
- Frequency scaling
  - Reduce the number of DCT coefficients
- Color Scaling
  - Reduce the number of colors available
- Modality Translation
  - conversion of the modality (e.g., image, text, audio, graphics) of the source resource

MPEG-21: Digital Item Adaptation (Part 7)



Terminals and Networks

1. APIs and associated protocols (behaviour) for terminal QoS management;
2. NPIs and associated protocols (behaviour) for network QoS management;
3. APIs and associated protocols (behaviour) for joint terminal and network QoS management;
4. Rules for QoS contract negotiation and implementation;
5. APIs enabling QoS agent technologies.

Content Representation

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

Event Reporting

1. Standardise metrics and interfaces for performance of all reportable events in MPEG-21;
2. Provide a means of capturing and containing these metrics and interfaces that refers to identified Digital Items, environments, processes, transactions and Users.

- Such metrics and interfaces will enable Users to understand precisely the performance of all reportable events within the framework. “Event Reporting” must provide Users a means of acting on specific interactions, as well as enabling a vast set of out-of-scope processes, frameworks and models to interoperate with MPEG-21.

Reference Software & File Format

- Reference software will form the first of what is envisaged to be a number of systems-related specifications in MPEG-21. Other candidates for specification are likely to include a binary representation of the Digital Item Declaration and an MPEG-21 file format.

References

- MPEG-21: Goals and Achievements, I. Burnett, R. Van de Walle, K. Hill, J. Bormans and F. Pereira, IEEE Computer Society, Oct-Nov 2003
- MPEG-21 Digital item Adaptation: Enabling Universal Multimedia Access, A. Vetro, IEEE Multimedia, Jan-Mar 2004
- Using MPEG-7 and MPEG-21 for Personalizing Video, B. L. tseng, C-Y. Lin and J.R. Smith, IEEE Multimedia, Jan-Mar 2004
- http://www.chiariglione.org/mpeg/tutorials.htm

Credits

- Ebrahim Saberinia
- Harald Kosch
- Henry Jerez, Jeroen Bekaert and Herbert Van de Sompel
- Lou Reich