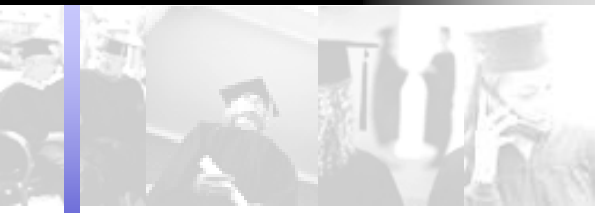

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MPEG Standards Enabling Universal Multimedia Access

MPEG-21 Multimedia Framework – Overview

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1st Int'l. Conf. on
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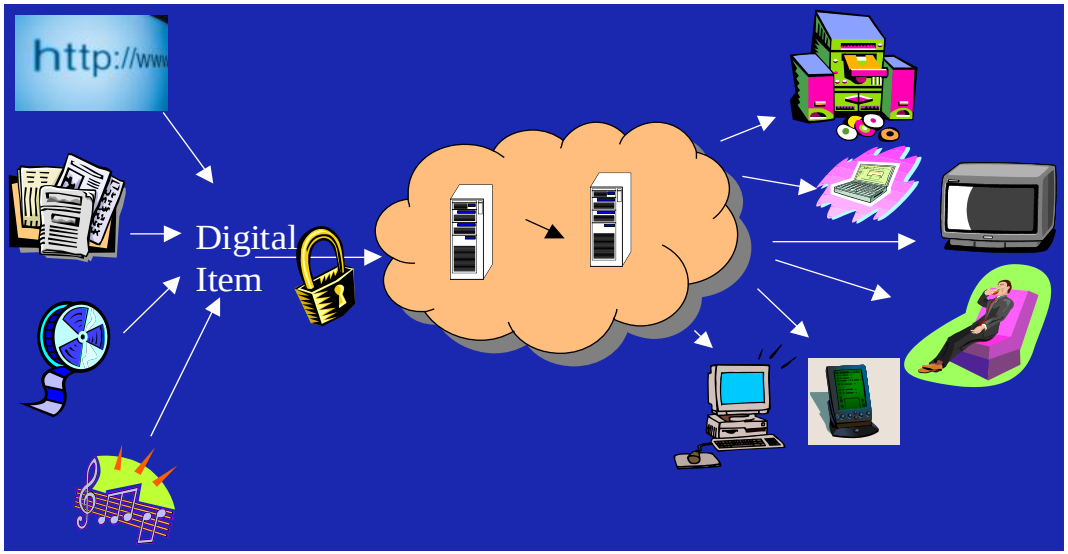
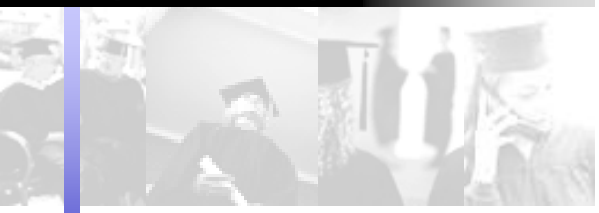
MPEG-21 Vision

To enable transparent and augmented use of multimedia resources across a wide range of networks, devices, user preferences, and communities, notably for trading (of bits).

- **Assumption: every human is potentially a node of a network involving billions of …**
  - **content providers**
  - **value adders**
  - **packagers**
  - **service providers**
  - **consumers**
  - **resellers**

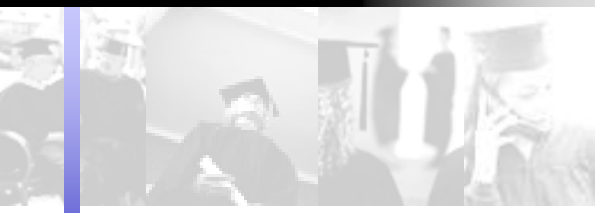




MPEG-21 Integration Goals

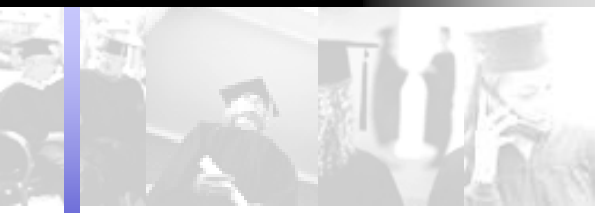
MPEG-21's goal is to create an interoperable and integrated multimedia framework in three steps:

- **Develop "big picture": understand how the components of the framework are related and identify where gaps in the framework exist**
- **Fill the gaps: develop new standard specifications where needed**
- **Integrate: achieve the integration of standards to support harmonized technologies for the management of multimedia content**



Functions to Support

- Content creation
- Content production
- Content distribution
- Content adaptation
- Content consumption and usage
- Content packaging
- Digital rights management
- Content identification and description
- Financial management
- User privacy
- Terminals and network resource abstraction
- Content representation
- Event reporting



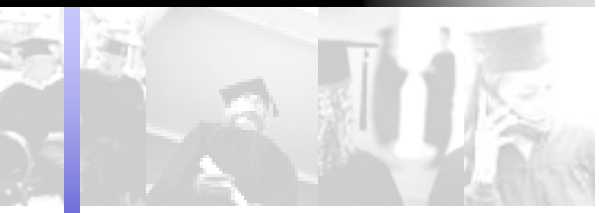
MPEG-21 Basic Concepts

What ? – Digital Items (DIs)

- **A Digital Item (DI) is a structured digital object with a standard representation, identification, and metadata (e.g., digital rights) within the MPEG-21 framework. Digital Items are "the content".**

Who ? – Users

- **A User is any entity that interacts in the MPEG-21 environment or makes use of a Digital Item. Users will assume rights and responsibilities according to their interaction with other Users.**



What is a Digital Item ?

Digital Item = Resources + Metadata + Structure

Resources: individual assets, (distributed) content

Metadata: (distributed) data about or pertaining to the DI or its resources

Structure: relationships among the parts of the DI

- Tangibility: content is more than "files on a disk"
- Configurability: can express options/augmentations for specific users, groups, locales, prices
- Deliverability: more automated, less end-user involvement

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Digital Item: a Real Example

The DI is the fundamental unit for distribution and transaction within the MPEG-21 framework.

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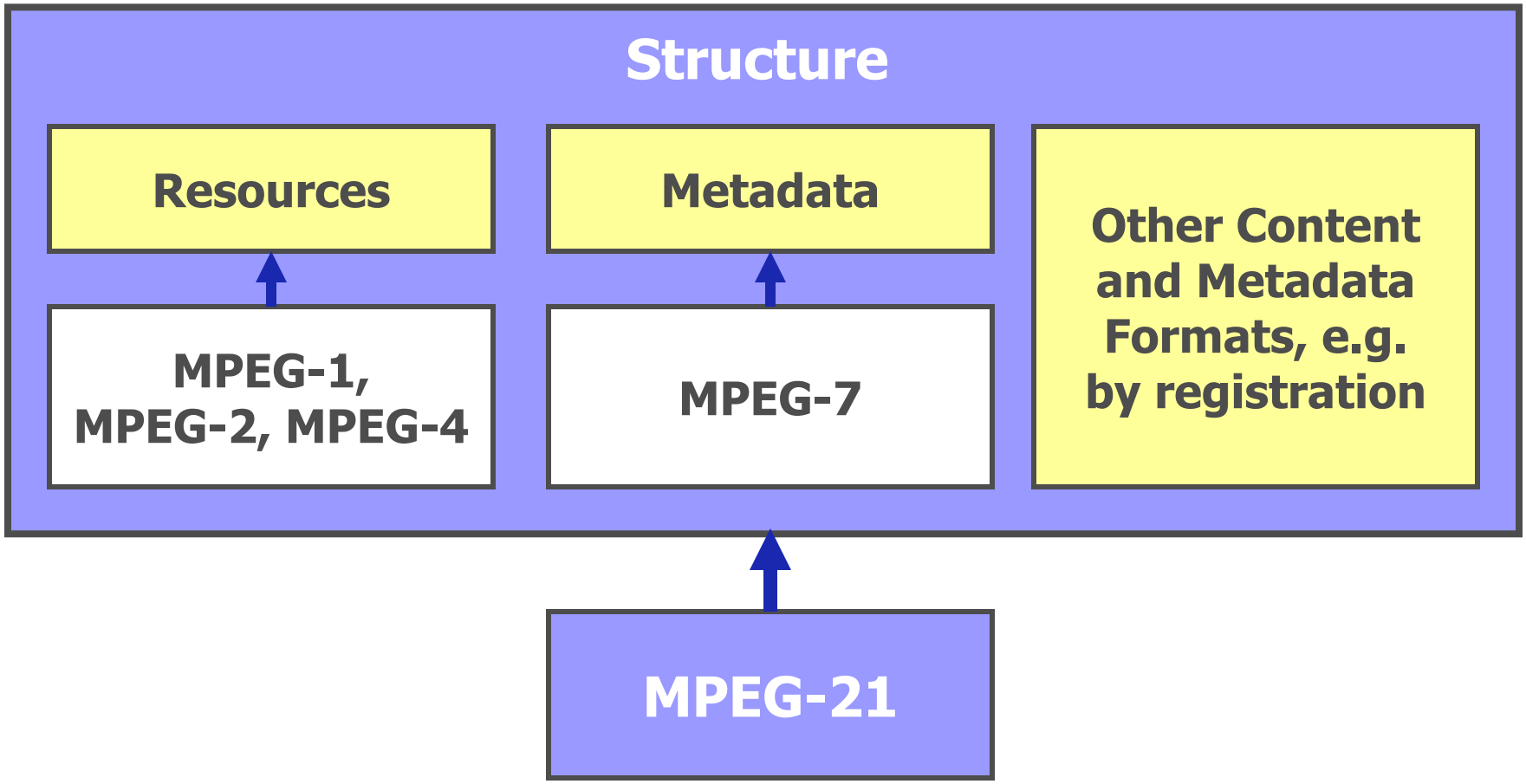
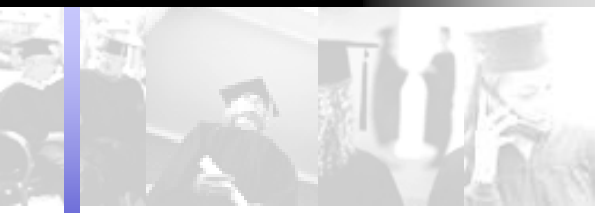
Digital Item: MPEG-based or not ...



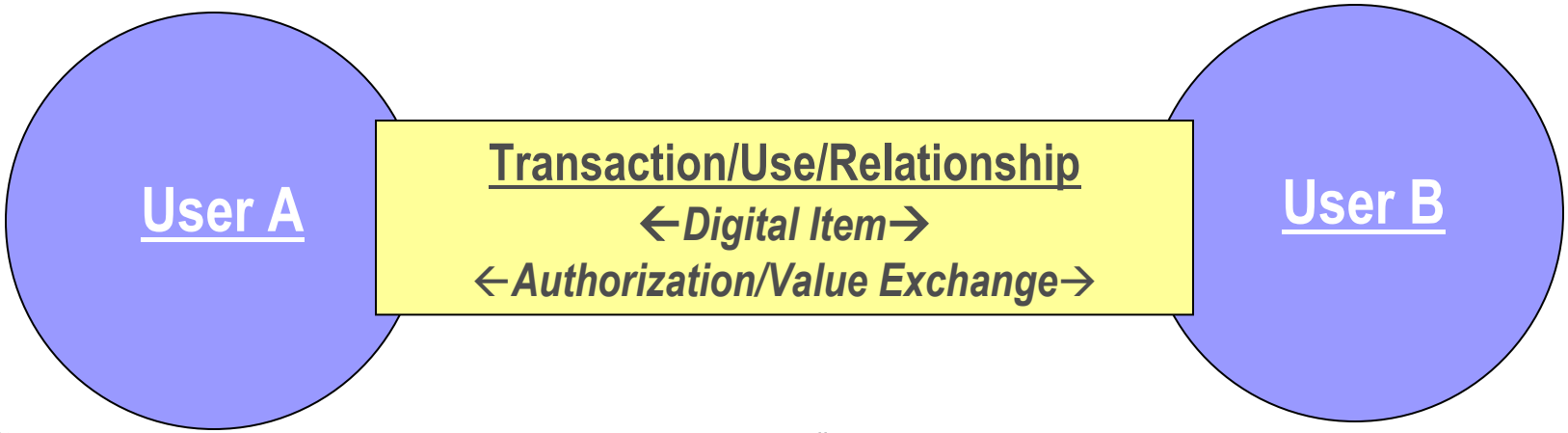


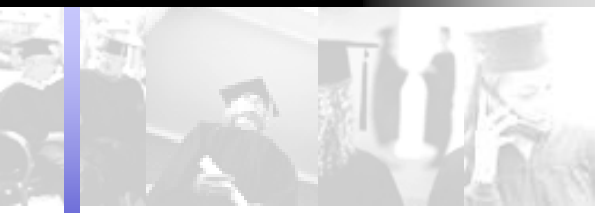
MPEG-21 Users

- MPEG-21 considers all Users of the multimedia infrastructure
- A User is any entity that interacts in the MPEG-21 environment or makes use of a Digital Item
  - Includes individuals, consumers, communities, organisations, corporations, consortia, governments and other standards bodies and initiatives around the world
  - Roles including creators, consumers, rights holders, content providers, distributors, etc; there is no technical distinction between providers and consumers
- All Users need to be able to express and manage their interests in Digital Items.

User Interaction

- MPEG-21 provides a framework in which Users interact and the object of the interaction is a Digital Item
- All parties that have a requirement within MPEG-21 to interact are categorized equally as Users
- Each User will assume specific rights and responsibilities according to their interaction with other Users





What Users Need to Do

- Create content
- Provide content
- Archive content
- Rate content
- Enhance/adapt content
- Deliver content
- Aggregate content
- Syndicate content
- Retail sale of content

- Consume content
- Subscribe to content
- Regulate content
- Facilitate transactions that occur from any of the above
- Regulate transactions that occur from any of the above

MPEG-21 organization (parts)

Digital Rights Management

- Pt. 4: **IPMP** Components
- Pt. 5: **R**ights **E**xpression **L**ang
- Pt. 6: **R**ights **D**ata **D**ictionary

Adaptation

- Pt. 7: **D**igital **I**tem **A**daptation
- Amd.1: Convers. And Permissions
- Amd.2: Dynamic and Distributed Adaptation

Processing

- Pt. 10: **D**igital **I**tem **P**roc.

Systems

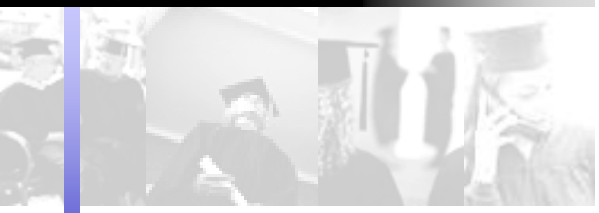
- Pt. 9: File Format
- Pt. 16: Binary Format
- Pt. 18: **D**igital **I**tem **S**treaming

Misc

- Pt. 8: Reference Software
- Pt. 11: Persistent Association
- Pt. 12: Test Bed
- Pt. 14: Conform.
- Pt. 15: Event Reporting
- Pt. 17: Fragment Idenfication

Vision, Declaration, and Identification

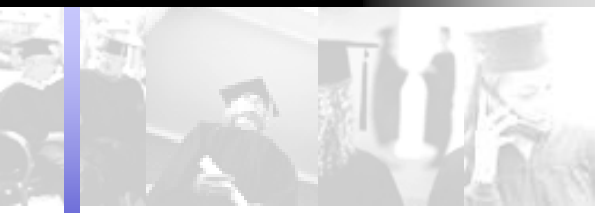
- Pt. 1: Vision, Tech-nologies and Strategy
- Pt. 2: **D**igital **I**tem **D**eclaration
- Pt. 3: **D**igital **I**tem **I**dentification



Digital Item Declaration (DID)

- ISO/IEC 21000-2

- Why ?
- MPEG-21 solution: DID Language



Why Declare DIs ?

Currently, multimedia applications are based on transfer/processing/presentation/... of:

- **Different media types, with different representations**
  - Still images (JPEG2000, GIF, PNG, ...)
  - Video (MPEG-4, QuickTime, ...) and audio (WAV, MP3, ...)
  - Text (txt, doc, ...)
  - ...
- **Metadata**
  - Descriptive information about actual data (MPEG-7, ...)
  - DRM information (e.g., copyright statement)
  - Configuration information
  - ...

But how do these elements relate to each other ? **Structure**

Structure in Digital Media: Example

aria title: Nessun Dorma
track number: 04

nessunDorma.txt
type: lyrics
composer: Giacomo Puccini
opera: Turandot
copyright: Ricordi & co
...

nessunDorma.mp3
type: audio
format: mp3
duration: 200 s
bitrate: 192 kbps
copyright: EMI
...

ACA01039.jpg
type: album cover art
format: image/jpeg
size: 300x400
copyright: EMI
...

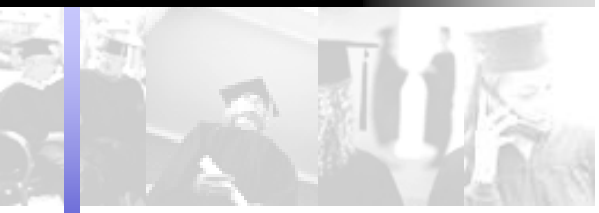
aria title: O mio babbino caro
track number: 07

babbinoCaro.doc
type: lyrics
composer:Giacomo Puccini
opera: Gianni Schicci
copyright: DECCA
...

babbinoCaro.wav
type: audio
format: wav
duration: 170 s
bitrate: 128 kbps
copyright: DECCA
...

title: concert recording
date: July 2003
location: Covent Garden
...

concert.mov
type: concert video
type: video/mov
duration: 4500 s
bitrate: 500 kbps
size: 320x240
copyright: DECCA
...



MPEG-21 Solution: DID Language

A Digital Item is ...

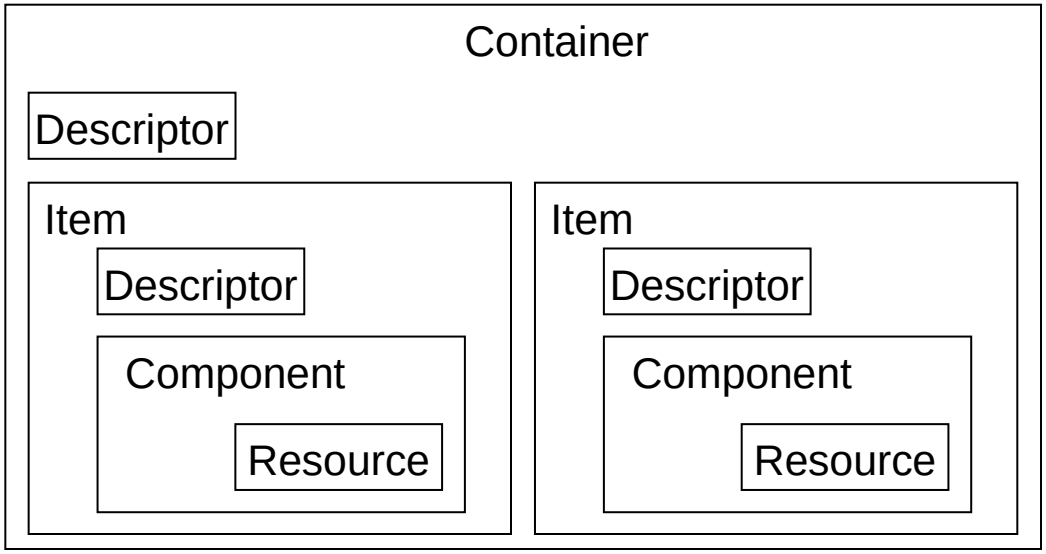
- **structured, with a standard representation, identification, and metadata**

  Structure
  - **Resources (e.g., MPEG-4, other/new formats)**
  - **Metadata (e.g., MPEG-7, other/new formats)**

- **the fundamental unit of distribution and transaction in the multimedia framework**
- **expressed by the Digital Item Declaration Language (DIDL), based on XML schema**

DID Language (DIDL)

- Generic container structure
- Set of building blocks
- Expressed in XML
- Allows declaration of any Digital Item



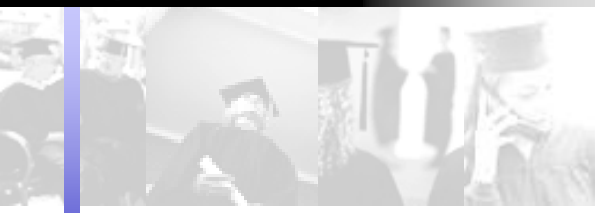
DID Example


```
<DIDL>
  <Item>
    <Descriptor>
      <Statement mimeType="text/plain">
        Prokofiev: Romeo and Juliet
      </Statement>
    </Descriptor>
    <Item>
      <Descriptor>
        <Statement mimeType="text/plain">
        Valery Gergiev
        </Statement>
      </Descriptor>
      <Component>
        <Resource
            ref="Prokofiev_RnJ.mp3"
                type="audio/mp3"/>
      </Component>
    </Item>
    …
  </Item>
</DIDL>
```

DID Building Blocks

DID described in three normative sections:

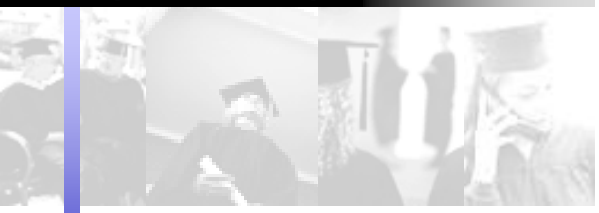
- **Model**
  - Describes set of abstract terms and concepts
  - Digital Item is the digital representation of "a work"
  - DI is the thing that is acted upon within the model
  - DIs are managed/handled/processed, described, exchanged, collected, ...
- **Representation**
  - DID elements are represented in XML
  - Normative description of their syntax and semantics
- **Schema**
  - Normative XML schema
  - Comprising entire grammar of the DID



DIDL Building Blocks

Variety of elements with different semantics and use:

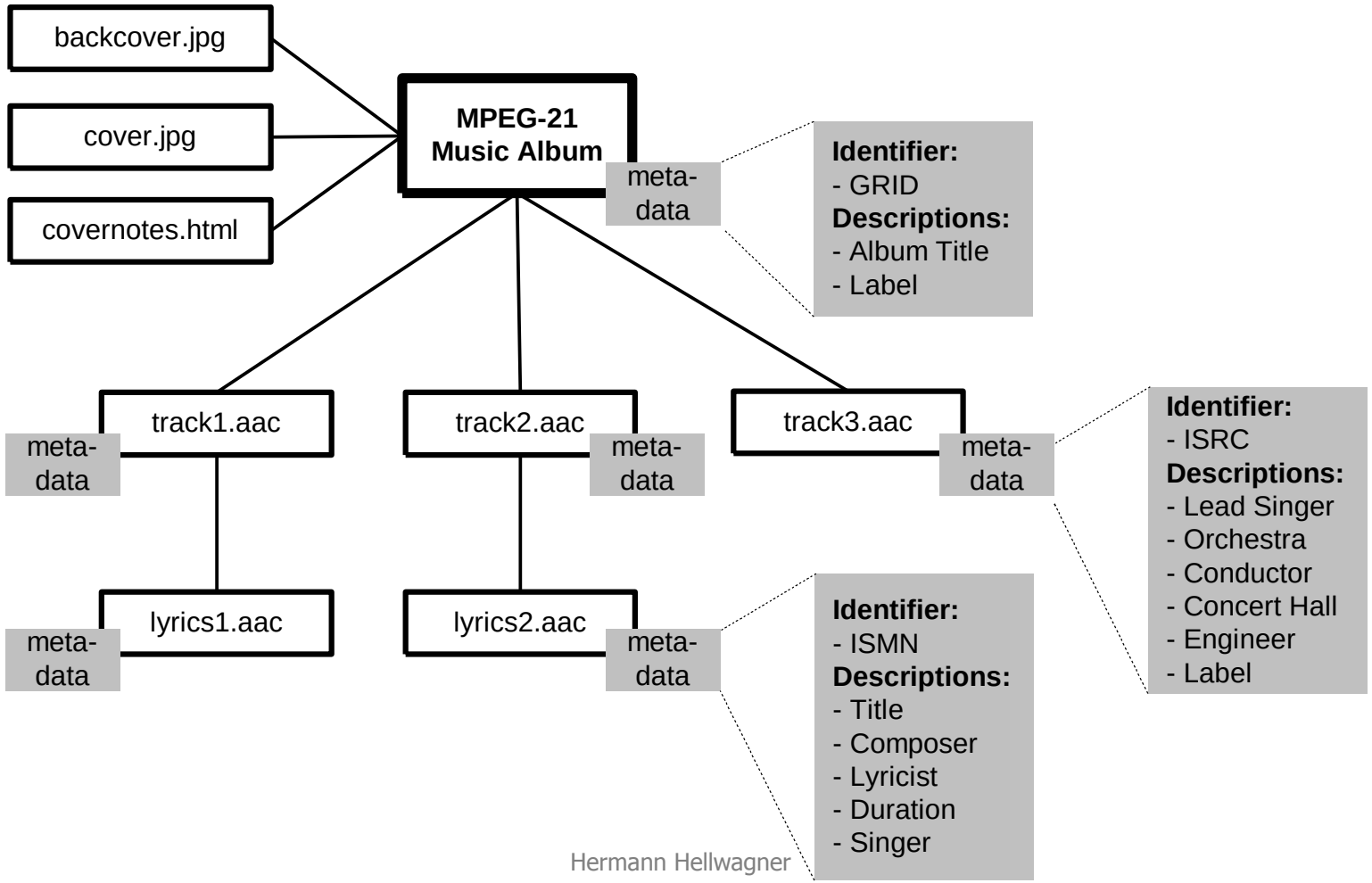
- Container
- Descriptor
- Item
- Component
- Resource
- Fragment
- Anchor
- Condition
- Choice
- Selection
- Predicate
- Assertion
- Annotation
- Statement



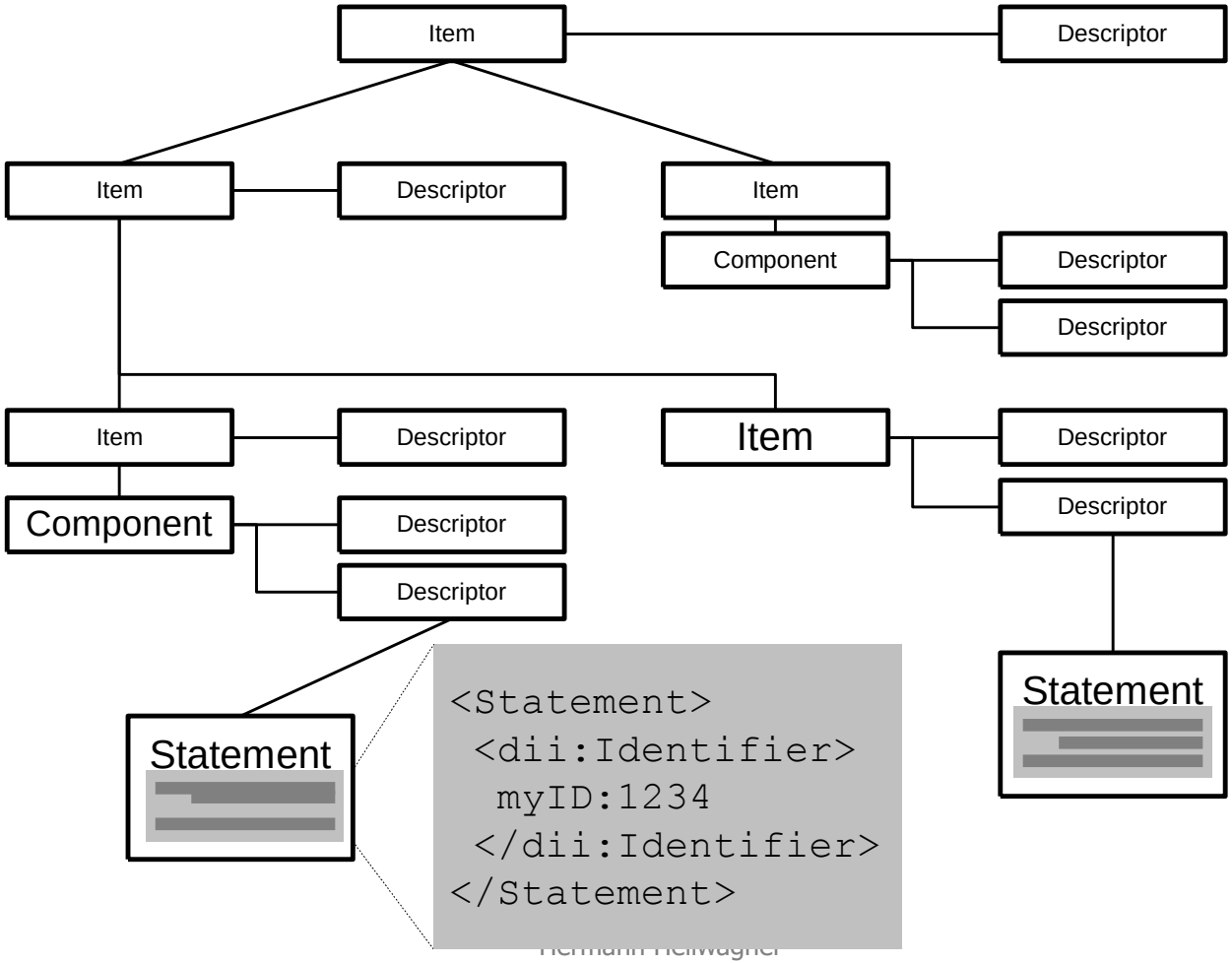
Digital Item Identification (DII)

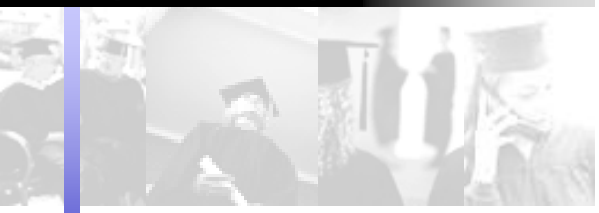
- ISO/IEC 21000-3
- Scope: How to …
  - uniquely identify DIs and parts thereof (including resources)
  - uniquely identify IP related to the DIs and parts thereof (e.g., abstractions)
  - uniquely identify Description Schemes
  - use identifiers to link DIs with related information such as descriptive metadata
  - identify different types of DIs
- Identifiers can be associated with DIs by including them in a *statement* element

DII: Example


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

Relationship DID – DII

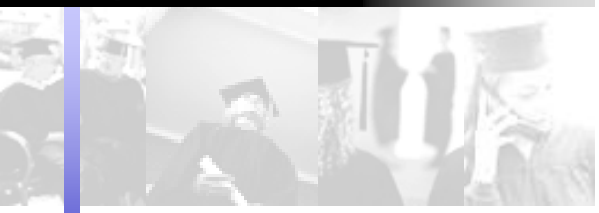




Digital Rights Mgmt. in MPEG-21

- **Rights Expression Language (REL)**
  - **ISO/IEC FDIS 21000-5**
- **Rights Data Dictionary (RDD)**
  - **ISO/IEC FDIS 21000-6**
- **Intellectual Property Management and Protection (IPMP)**
  - **ISO/IEC 21000-4**

A flavor only – the specifications run to hundreds of pages of definitions ...



REL

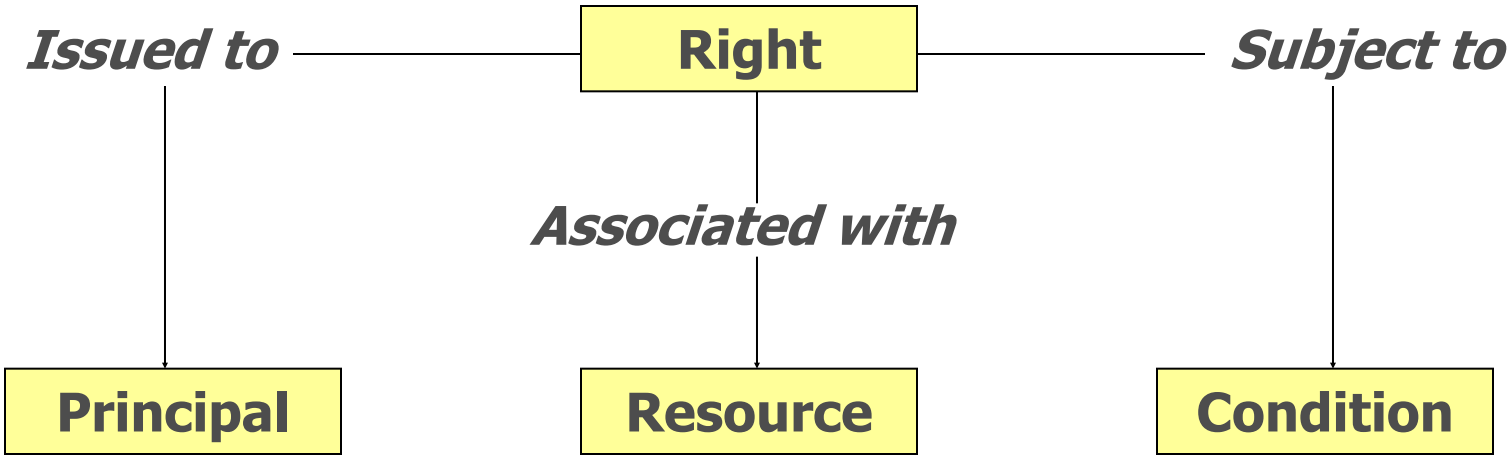
REL := machine-readable language that can declare rights and permissions on digital resources

Goals:

- **Provide a standard way to express rights/interests**
  - **For protection of digital contents**
  - **For privacy and use of personal data**
- **Provide a standard way to express grants of rights**
  - **Specify access and use of controls for digital content**
  - **Honor the rights, conditions, and fees specified**
- **Support guaranteed end-to-end interoperability**

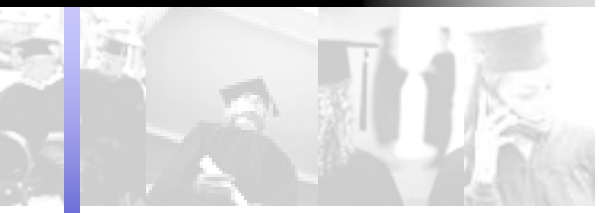
REL Data Model

- **Grant:** four basic entities and their relationship



Using this model, flexible rights expressions can be generated

- **License:** grant and issuer



REL Example

Grant: "John may play DI in 2003"

```
<license>
   <grant>
        <keyHolder licensePartId="John">…</keyHolder>
        <mx:play/>
        <mx:diReference>
                <mx:identifier>urn:grid:a1-abcde-1234567890-f</mx:identifier>
        </mx:diReference>
        <validityInterval>
                <notBefore>2003-01-01T00:00:00</notBefore>
                <notAfter>2003-12-31T23:59:59</notAfter>
        </validityInterval>
   </grant>
   <issuer>
        <keyHolder licensePartId="Xin">…</keyHolder>
   </issuer>
</license>
```

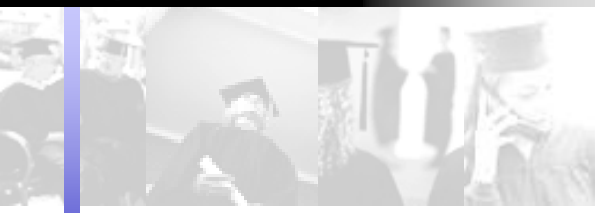
Principal

Right

Resource

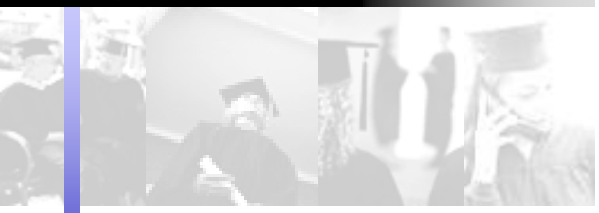
Condition

Issuer



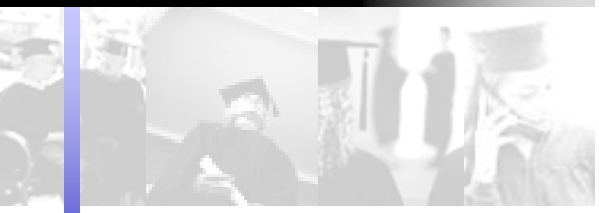
REL Basic Entities (1)

- **Principal:**
  - Party identified by unique information
  - E.g., keyHolder: someone possessing the private key corresponding to the public key specified
- **Right:**
  - Action (or activity) or a class of actions that a principal may perform on or using the associated resource
  - Multimedia rights: e.g., play, print, adapt digital media
  - Meta-rights (rights relating to other rights): e.g., issue, obtain, revoke rights
  - PossessProperty: claiming ownership of a property
  - .....



REL Basic Entities (2)

- **Resource:**
  - **Digital resource (work): e.g., music file, e-book**
  - **Service: e.g., e-mail or B2B transaction service**
  - **DI reference: to Container, Descriptor, Item, … of a DI**
  - **Piece of information, property, collection of resources**
  - **…..**
- **Condition:**
  - **Time, fee, count, territory, freshness, integrity, marking, signed-by, … conditions**
  - **Existence is valid prerequisite rights, resource attribute specific conditions, …**
  - **…..**



RDD

RDD := set of clear, consistent, structured, integrated, uniquely identified terms to support REL

Goals:

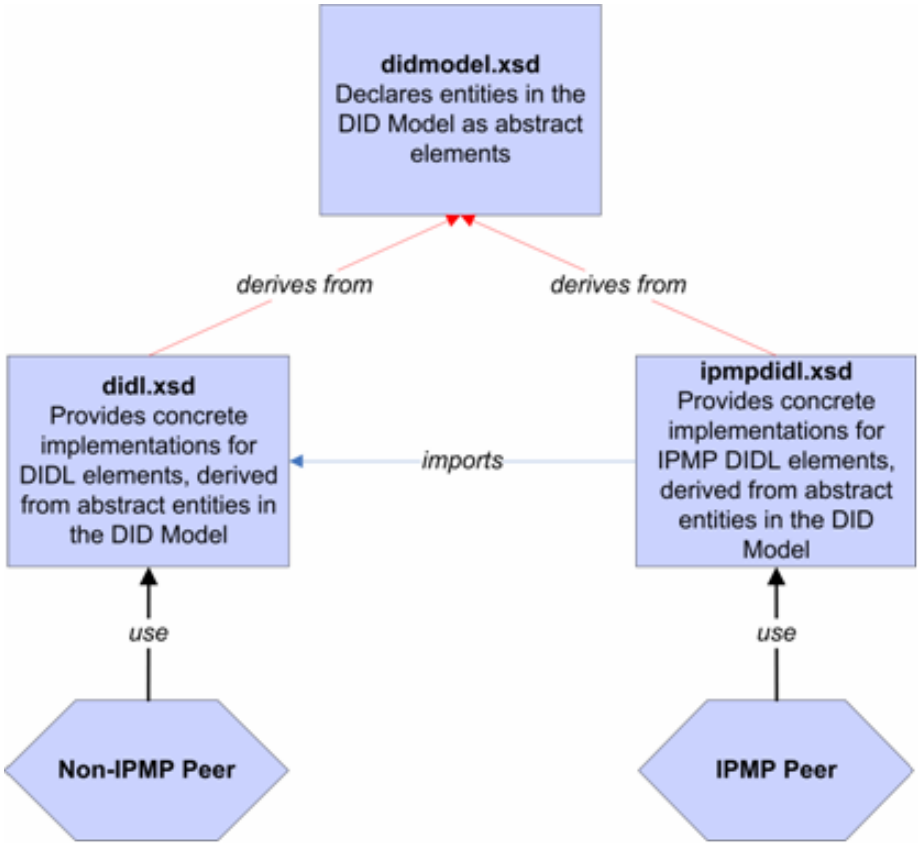
- **Provide a standard way to describe the semantics of terms based on their relations to other terms**
- **Support mapping/transformation of metadata from the terminology of one namespace (or authority) into that of another namespace (or authority)**

IPMP

IPMP := MPEG-21 DRM System

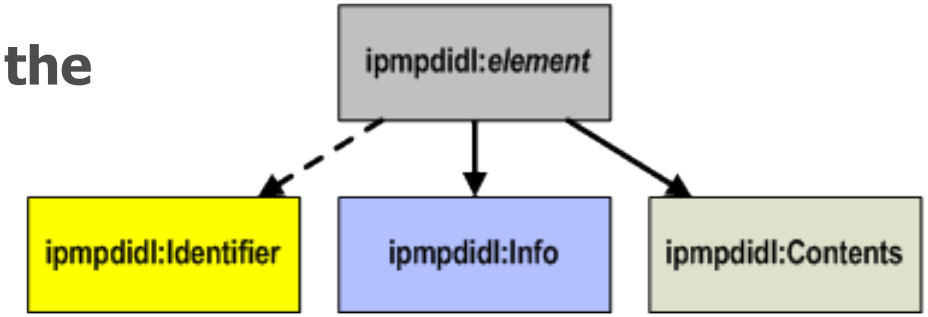
Goals:

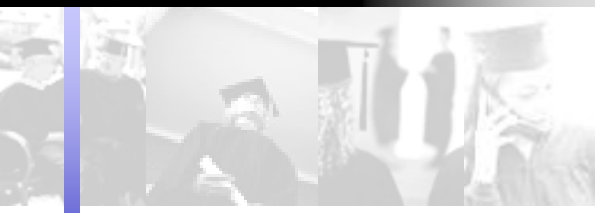
- **Extend beyond MPEG-4 IPMP "hooks" to provide more interoperable and concrete IPMP system and tools**
- **Provide standardized ways for**
  - Protected representation of the DID model (encrypted, digitally signed, or otherwise governed)
  - Defining structures for expressing information relating to the protection of content, including tools, mechanisms, and licenses
- **Provide for integration of REL/RDD rights expressions**



IPMP Elements

- ipmp:Identifier
  - Appropriate identifier for the protected representation
  - E.g., dii:Identifier
- ipmp:Info
  - Information about the governance
  - E.g., IPMP tools, rights expressions, signature
- ipmp:Contents
  - The governed content
  - E.g., did:Item, did:Component, …

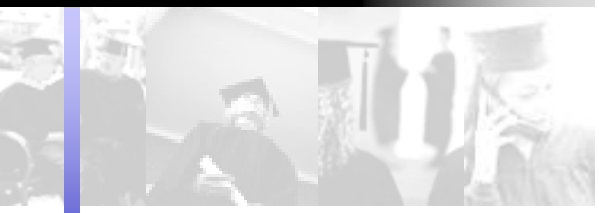




Digital Item Adaptation (DIA)

- ISO/IEC FDIS 21000-7

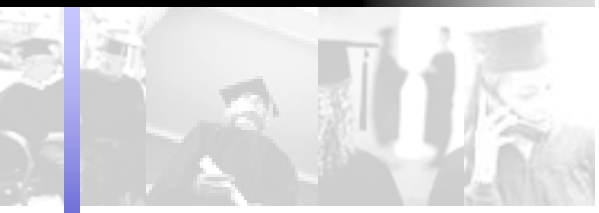
Christian



Digital Item Processing (DIP)

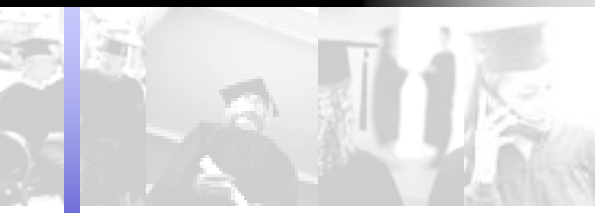
- ISO/IEC CD 21000-10

- Why ?
- Idea/concepts



DIP: Motivation

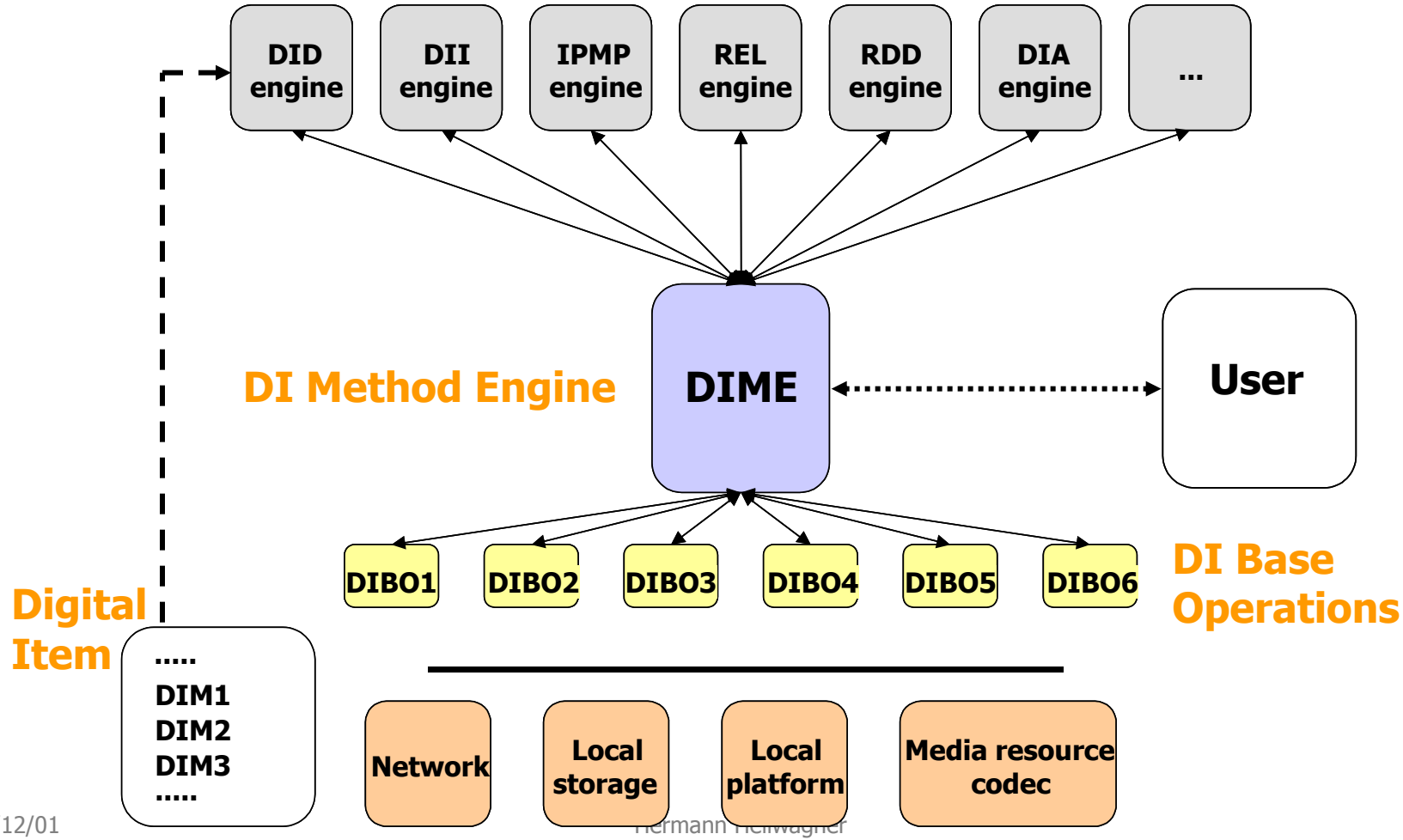
- **Declaration of a Digital Item …**
  - defines "structure" of the DI
  - is static
- **What happens when a DI arrives at a terminal ?**
  So far – nothing !
- **Digital Item Processing/Methods allow Users to add functionality to a DI Declaration**
- **On receipt of a DID, …**
  - list of DI Methods that can be applied to the Digital Item is presented to the User
  - User chooses a Method which is then executed

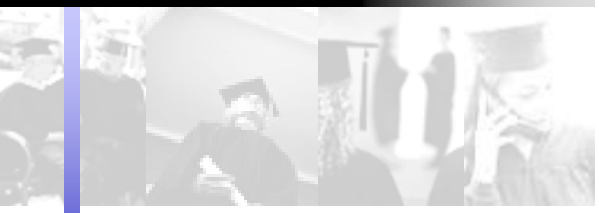


DIP: Scope

- **DI Methods provide a way for Users of the DI …**
  - to select preferred procedures by which the DI should be handled
  - at the level of the DI itself
- **Example:**
  - Music Album DI
  - "AddTrack" DIM
- **NOT intended to be utilized for implementing the processing of media resources themselves !**

DIP: Current Model





DIMs and DIBOs and ...

Digital Item Methods (DIMs) := "a list of operations"

- Specified in normative language: DIM Language (DIML)
- One DIML has been chosen: ECMAScript

Digital Item Base Operations (DIBOs) :=

set of normative basic operations on which DIMs are built

- Analogous to standard library of functions of a prog. language
- Atomic operations
- Normative, high-level interface
- Implemented in any language
- Access to Multimedia Middleware API

Digital Item eXtension Operations (DIXOs)

References

- **Adopted MPEG standards → ISO/IEC**

  http://www.iso.org

- **MPEG standards under development and working documents → MPEG Website**

  http://www.chiariglione.org/mpeg/index.htm

- **I. Burnett, R. Koenen, F. Pereira, R. Van de Walle (eds.), *The MPEG-21 Book*, Wiley, 2006 (to appear)**