MPEG-21 Digital Items in Research and Practice

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Digital Preservation Interoperability Framework (DPIF) Symposium
Dresden, Germany
22 April 2010
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Outline

• MPEG-21 Introduction
  ➔ more information at http://slidesha.re/7UB13

• Digital Item in Research and Practice
  – Practice: DIDL-Lite & LANL
  – Research: DANAE, ENTHRONE, P2P-Next

• Conclusions
Introduction to 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: Basic Concepts

**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

**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
- All parties that have a **requirement** within MPEG-21 to interact are categorized equally as Users
MPEG-21 Organisation – Parts

**Digital Rights Management**
- Pt. 4: IPMP Components
- Pt. 5: Rights Expression Lang
- Pt. 6: Rights Data Dictionary
- Pt. 19: Media Value Chain Ontology

**Adaptation**
- Pt. 7: Digital Item Adaptation
- Amd.1: Convers. And Permissions
- Amd.2: Dynamic and Distributed Adaptation

**Processing**
- Pt. 10: Digital Item Processing
- Amd.1: Add’l C++ bindings

**Systems**
- Pt. 9: File Format
- Pt. 16: Binary Format
- Pt. 18: Digital Item Streaming

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

**Vision, Declaration, and Identification**
- Pt. 1: Vision, Technologies and Strategy
- Pt. 2: Digital Item Declaration
- Pt. 3: Digital Item Identification
Digital Item in Research and Practice

• Practice
  – UPnP: DIDL-Lite (dialect of MPEG-21 DIDL)
  – Microsoft’s Interactive Media Manager (IMM): OWL implementation of DID model
  – Adactus (www.adactus.no)
  – Enikos (www.enikos.com)
  – ContentGuard (www.contentguard.com) and Rightscom (www.rightscom.com)

• Research
  – DANAE: Advanced MPEG-21 Infrastructure
  – ENTHRONE: End-to-End Management of Heterogeneous Environments
  – AXMEDIS: Automated Production of Cross-Media Digital Items
  – P2P-Next: Next Generation P2P Systems
  – Los Alamos National Laboratory (LANL): Information Asset Management in a Digital Library

\[
\begin{align*}
\text{container} & ::= \text{descriptor}^* \text{container}^* \text{item}^* \\
\text{item} & ::= \text{condition}^* \text{descriptor}^* \text{choice}^*
\begin{align*}
& (\text{item}|\text{component})^* \text{annotation} \\
\text{component} & ::= \text{condition}^* \text{descriptor}^* \text{resource anchor} \\
\text{anchor} & ::= \text{condition}^* \text{descriptor}^* \text{fragment} \\
\text{descriptor} & ::= \text{condition}^* \text{descriptor}^* \\
& (\text{component}|\text{statement})^* \\
\text{condition} & ::= \text{predicate}^+ \\
\text{choice} & ::= \text{condition}^* \text{descriptor}^* \text{selection}^+ \\
\text{selection} & ::= \text{condition}^* \text{descriptor}^* \text{predicate} \\
\text{annotation} & ::= \text{assertion}^* \text{descriptor}^* \text{anchor}^* \\
\text{assertion} & ::= \text{predicate}^*
\end{align*}
\]
UPnP: DIDL-Lite

- **DIDL dialect**
- **UPnP-specific objects**
  - class, container, res-attr.
- **Dublin Core metadata**
  - `desc` for anything else

```
upnp:forContainer ::= <some properties>
upnp:forItem ::= upnp:forContainer
allowed-under-container ::= upnp:forContainer | dc
| desc | item | container | res
allowed-under-item ::= upnp:forItem | dc | desc | res
upnp:class ::= [object.item]
  [object.item.imageItem] ...
  [object.container] [object.container.person] ...
  [object.container.bookmarkFolder]

container ::= dc:title allowed-under-container*
  upnp:class allowed-under-container*
item ::= dc:title allowed-under-item* upnp:class
  allowed-under-item*

res-attributes ::= protocolInfo [importUri] [size]
  [duration] [bitrate] [sampleFrequency]
  [bitsPerSample] [nrAudioChannels] [resolution]
  [colorDepth] [tspec] [allowedUse]
  [validityStart] [validityEnd] [remainingTime]
  [usageInfo] [rightsInfoURI] [contentInfoURI]
  [recordQuality] [protection]
res ::= anyURI res-attributes

desc ::= any
DIDL-Lite ::= ( item | container | desc )*
```
Information Asset Management in a Digital Library

- **DID**: representing (and serializing) complex digital library objects
- **DII**: identification of DIDs and assets therein
- **DIP**: dynamically add processing information to DIDs

```xml
<?xml version="1.0" encoding="UTF-8"?>
<didd:DIDL xmlns:didd="urn:mpeg:mpeg21:2002:02-DIDL-NS">
  <didd:Container>
    <!-- Item containing a MARCXML metadata record -->
    <didd:Item>
      <!-- Component containing the MARCXML datastream -->
      <didd:Component>
        <!-- The actual MARCXML datastream -->
        <didd:Resource mimeType="text/xml; charset=UTF-8">
          <record xmlns="http://www.loc.gov/MARC21/slim">
            <leader>01142cam 2200301 a 4500</leader>
            <controlfield tag="005">19930521155141.9</controlfield>
            <datafield tag="010" ind1=" " ind2=" ">
              <subfield code="a">92005291</subfield>
            </datafield>
            ...
          </record>
        </didd:Resource>
      </didd:Component>
    </didd:Item>
  </didd:Container>
</didd:DIDL>
```
Manages the **open sessions**, retrieves or generates and customizes museum catalogue and **content DIDs** according to the context of a user, delivers the DIDs, and invokes the adaptation engine if required. Clearly, the server side DIP engine is also involved in **session migration** activities.

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**DANAE: Advanced MPEG-21 Infrastructure**

**• DID + DIA + DIP**

End-to-end representation of *The Content*

**Usage Environment** Description

**Adaptation** Quality of Service

**Universal Constraints** Description

**generic Bitstream Syntax** Description

http://danae.rd.francetelecom.com/
ENTHRONE: End-to-End Management for QoS

Business entities

- **Content Provider**: prepares the actual multimedia content as MPEG-21 Digital Items
- **Service Provider**: MM services to end-user wrt SLAs
- **Adaptation Provider**: QoS of content delivery; optimizing available system and network resources across the end-to-end chain
- **Network Provider**: QoS-based network connectivity services at its autonomous domain level

DIDL

- Declaration(s) (referable descriptors)
- Container
  - Descriptor(s) (top-level container descriptors)
  - Item (composed item)
  - Descriptor(s) (top-level item descriptors)
  - Item (final item)
  - Descriptor(s) (item-level descriptors)
- Component(s)
  - Descriptor(s) (component-level descriptors)
- Resource

  - Item(s) (further composed or final items)
  - Item(s) (further composed or final items)
Next Generation Peer-to-Peer Networks

- **P2P networks:** Distribution cost shared amongst the peers

- **Key requirement**
  - Backwards compatibility with BitTorrent

- **DID:** declaration of P2P-Next Items
- **DII:** identification and type setting
- **DIA:** adaptation and scalability metadata

http://p2p-next.org/
Conclusions

• MPEG-21: powerful, generic, and flexible for a plethora of use cases and application domains

• Deployment issues
  – Interoperability on a large (end-to-end) scale in practical settings is difficult to achieve
  – Complex middleware and intricate interplay between various layer and levels (e.g., application, transport, network, system, etc.)
  – Benefits for a single stakeholder in the multimedia chain?
  – Potential users might still be insufficiently aware of the MPEG-21 family of standards

• There is still hope ➔ MPEG Extensible Middleware (MXM), a comprehensive middleware comprising application programming interfaces (APIs) and protocols
  ➔ See http://mxm.wg11.sc29.org/ for details
Thank you for your attention

... questions, comments, etc. are welcome ...