Dr. Christian Timmerer, Klagenfurt University, Austria

THE MPEG-21 MULTIMEDIA FRAMEWORK

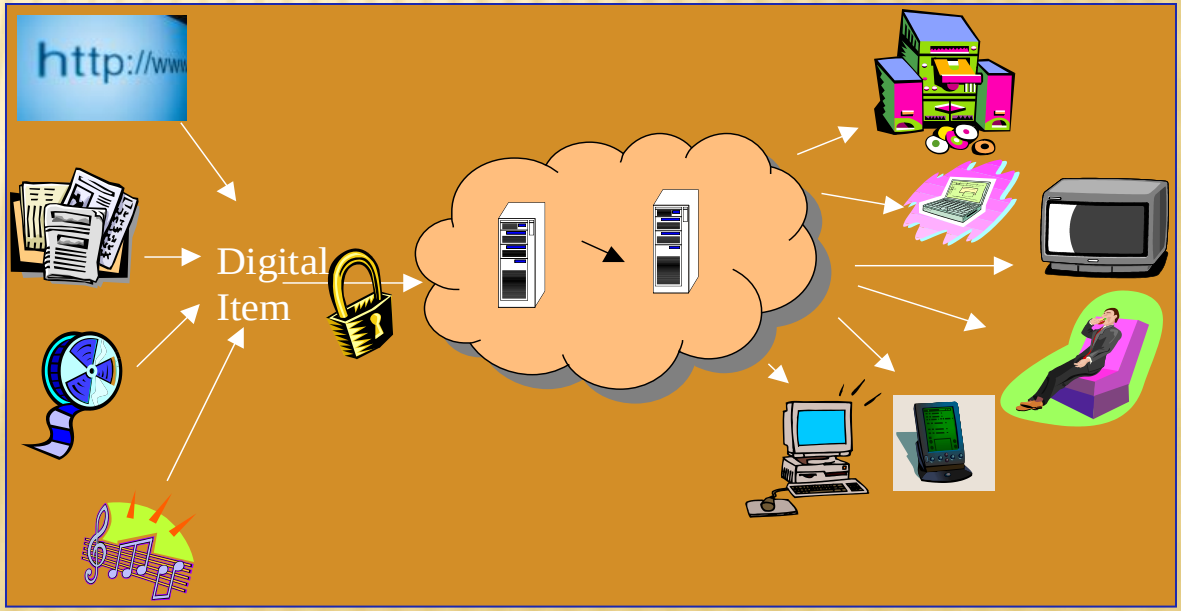
Acknowledgments: I. Burnett, H. Hellwagner, F. Pereira, A. Vetro, R. Van de Walle

OUTLINE

- Introduction and Overview
- Digital Item Declaration and Identification
- Digital Rights Management
- Digital Item Adaptation
- Digital Item Processing
- Digital Item Streaming
- Conclusions

INTRODUCTION – 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

MPEG-21 BASIC CONCEPTS

What ? – Digital Items (DIs)

- A Digital Item (DI) is a structured digital object with a standard representation, identification, and metadata 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
- All parties that have a requirement within MPEG-21 to interact are categorized equally as 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

A DIGITAL ITEM: A REAL EXAMPLE

Game Program – security allows 15 plays before purchase

JPEG image (watermarked)

http://www.starwars.com

Web site link

STAR WARS – The Motion Picture

Sound Files at another site (different rates available)

Link to the pay movie - 10 different rates dependent on network and terminal

Movie Scripts

Digital Item

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

MPEG-21 ORGANISATION – PARTS

Digital Rights Management

- Pt. 4: **IPMP** Components
- Pt. 5: **R**ights **E**xpression **L**ang
- Pt. 6: **R**ights **D**ata **D**ictionary
- Amd.1: DII relationship types

Adaptation

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

Processing

- Pt. 10: **D**igital Item **P**rocessing
- Amd.1: Add'l C++ bindings

Systems

- Pt. 9: File Format
- Pt. 16: Binary Format
- Pt. 18: **D**igital Item **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, Technologies and Strategy
- Pt. 2: **D**igital Item **D**eclaration
- Pt. 3: **D**igital Item **I**dentification

DIGITAL ITEM DECLARATION

Why declare Digital Items?

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

- Different media types, with different representations
  - Still images (JPEG, JPEG2000, GIF, PNG, ...)
  - Video (MPEG-4, QuickTime, ...) and audio (WAV, MP3, ...)
  - Text (txt, doc, pdf, ...)
  - ...
- Metadata
  - Descriptive information about actual data (MPEG-7, ...)
  - DRM information (rights expressions, IPMP, ...)
  - Configuration information (usage environment descriptions, ...)
  - ...
- But how do these elements relate to each other ? ⇨ Structure

⇨ **MPEG-21 Solution: Digital Item Declaration Language (DIDL)**

Digital Item Declaration (DID) – instance conforming to DIDL

DID EXAMPLE


```
<DIDL>
 <Item>
  <Descriptor>
   <Statement mimeType="text/plain">Best of Mozart</Statement>
  </Descriptor>
  <Descriptor>
   <Component><Resource mimeType="image/jpg" ref="cover.jpg"/></
  </Descriptor>
  <Item>
   <Descriptor>
    <Statement mimeType="text/plain">Le nozze di Figaro KV 492, Overtüre, 4:08</Statement>
   </Descriptor>
   <Component>
    <Descriptor>
     <Statement mimeType="text/plain">Bitrate 192kbps</Statement>
    </Descriptor>
    <Resource mimeType="audio/m4a" ref="track01.m4a"/>
   </Component>
  </Item>
  <!-- further items ... -->
 </Item>
</DIDL>
```

DIGITAL ITEM IDENTIFICATION

- 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

DIGITAL RIGHTS MANAGEMENT IN MPEG-21

- Rights Expression Language (REL)
- Rights Data Dictionary (RDD)
- Intellectual Property Management and Protection (IPMP) Components

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

RIGHTS EXPRESSION LANGUAGE

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 EXAMPLE

Grant: "John may play DI in 2007"

```
<license>
 <grant>
  <keyHolder licensePartId="John">…</keyHolder>          Principal
  <mx:play/>                                             Right
  <mx:diReference>                                       Resource
    <mx:identifier>urn:grid:a1-abcde-1234567890-f</mx:identifier>
  </mx:diReference>
  <validityInterval>                                     Condition
    <notBefore>2007-01-01T00:00:00</notBefore>
    <notAfter>2007-12-31T23:59:59</notAfter>
  </validityInterval>
 </grant>
 <issuer>                                                Issuer
   <keyHolder licensePartId="Xin">…</keyHolder>
 </issuer>
</license>
```

RIGHTS DATA DICTIONARY

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 COMPONENTS

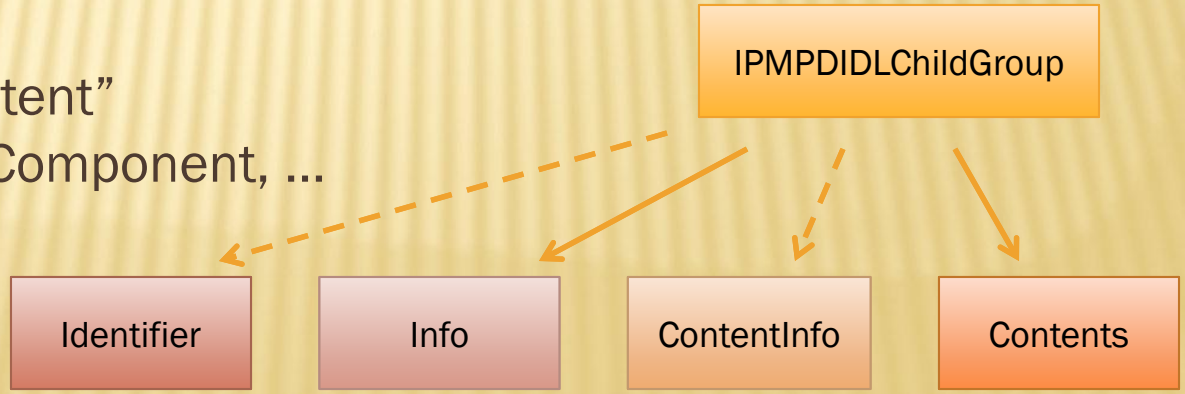
IPMP Components := how to include IPMP information and protected parts of Digital Items in a DIDL document

Goals:

- Encapsulates and protects a part of the hierarchy of a Digital Item
- Associates appropriate identification and protection information
- Purposely does not specify protection measures, keys, key management, trust management, encryption algorithms, certification infrastructures or other components that would also be needed as part of a complete IPMP solution

IPMP COMPONENTS

- Identifier
  - Appropriate identifier for the protected representation
  - E.g., dii:Identifier
- Info
  - Information about the governance
  - E.g., IPMP tools, rights expressions, signature, keys, …
- ContentInfo
  - Informtion about the governed „content“
  - E.g., MPEG-7 metadata
- Contents
  - The governed “content”
  - E.g., did:Item, did:Component, …

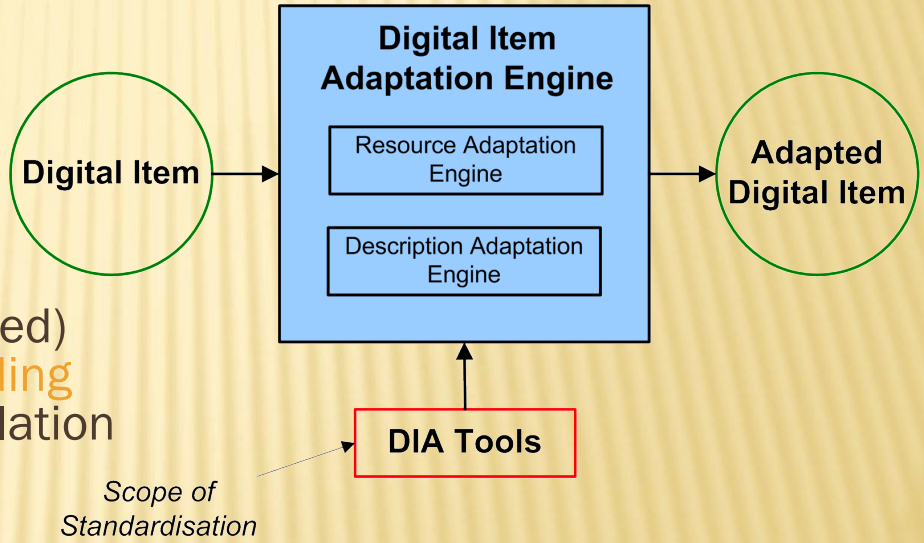


DIGITAL ITEM ADAPTATION

DIA := syntax and semantics of tools that assist in the adaptation of Digital Items

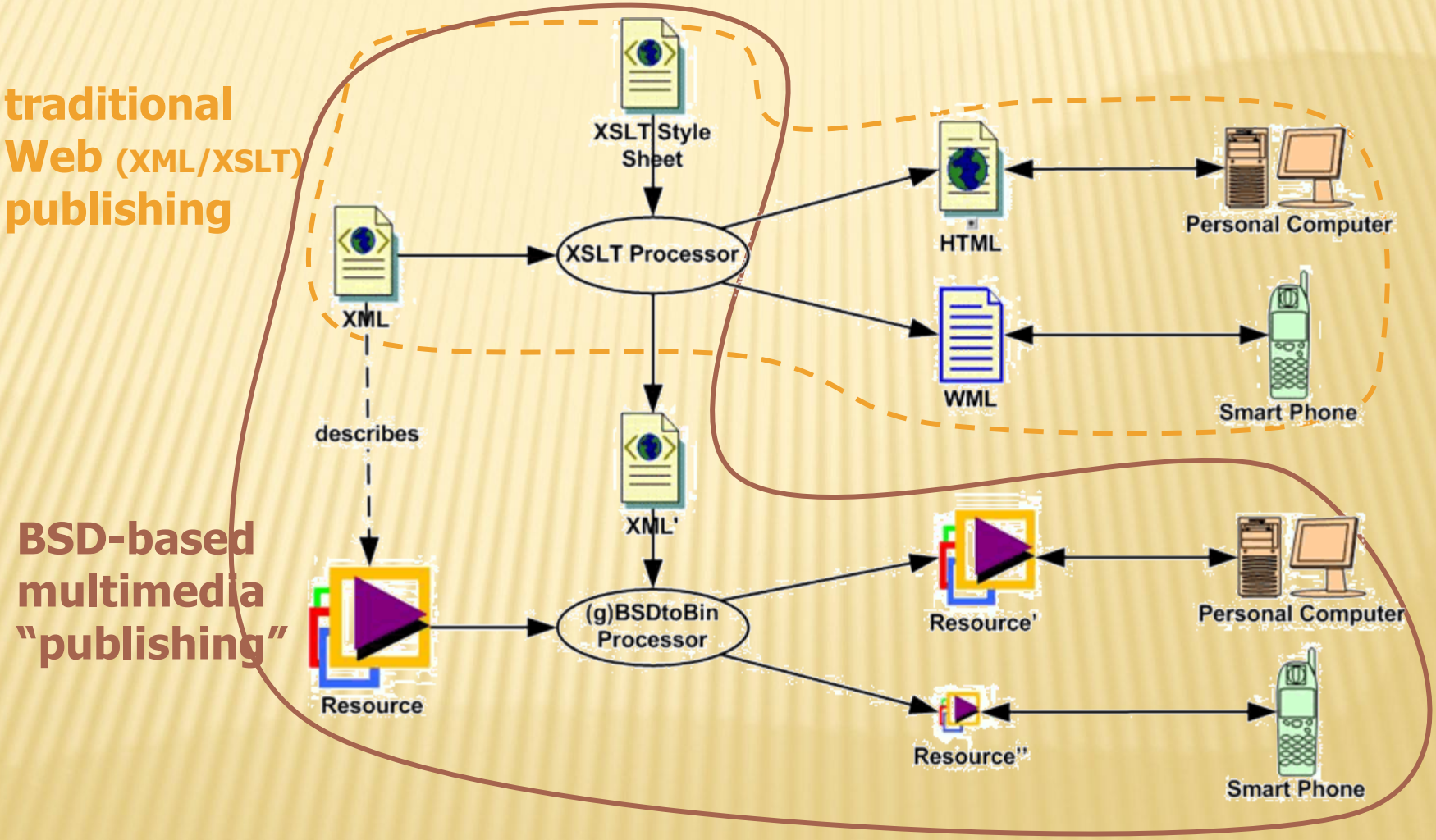
Goals:

- Satisfy transmission, storage and consumption constraints as well as Quality of Service (QoS) management
- Enable transparent access to (distributed) advanced multimedia content by shielding users from network and terminal installation issues



- Codec Format-independent mechanisms that provide support for Digital Item Adaptation in terms of:
  - Resource adaptation
  - Description adaptation
  - Quality of Service management
- The adaptation engines themselves are non-normative tools

BSD-BASED MULTIMEDIA PUBLISHING



DIGITAL ITEM PROCESSING

DIP := allow Users to add functionality to a static DI Declaration

Goals:

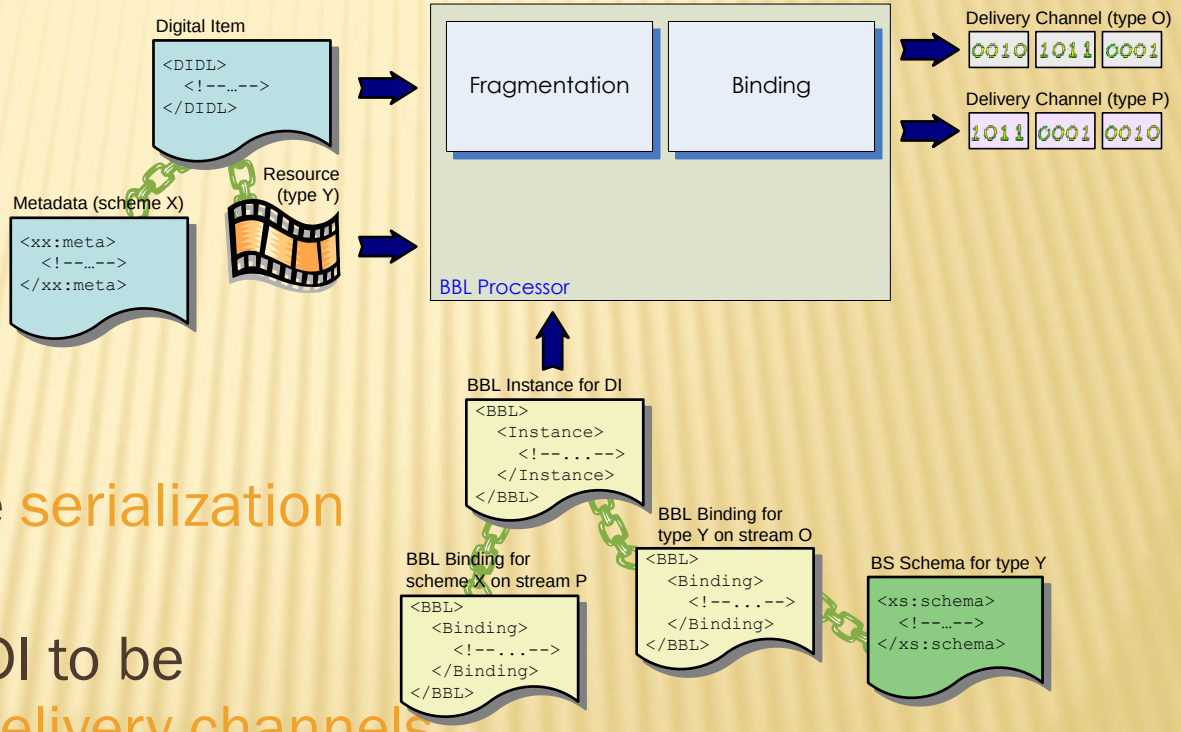
- Provide basic means for interaction with a Digital Item and its declaration
- Allow Users to add/select methods to be performed on Digital Items (e.g., display, select track, …)
- Provide list of basic operations and means for executing User-defined operations used within methods (standard library)

DIGITAL ITEM STREAMING

DIS := Bitstream Binding Language which describes how Digital Items can be mapped to delivery channels (e.g., MPEG-2 TS, RTP)

Goals:

- Fragment and insert (i.e., map) into one of several delivery channels
- Facilitate UMA to the serialization of Digital Items
- Different parts of a DI to be sent over separate delivery channels



CONCLUSIONS

- Enable transparent and augmented use of multimedia resources across a wide range of networks, devices, user preferences, and communities, notably for trading (of bits).
- MPEG-21 provides means for
  - declaring and identifying of Digital Items (DID, DII)
  - digital rights management (IPMP, REL, RDD)
  - (generic) adaptation of Digital Items according to the usage environment (DIA)
  - processing of Digital Items (DIP)
  - systems-related aspects (FF, Binary Format, DIS)
  - event reporting (ER)
  - reference software, conformance, technical reports

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Contact Information:

Dr. Christian Timmerer
Klagenfurt University
Department of Information Technology (ITEC)

Universitätsstrasse 65-67
A-9020 Klagenfurt

T +43 (463) 2700 3621
F +43 (469) 2700 3699
E christian.timmerer@itec.uni-klu.ac.at
W http://research.timmerer.com

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