Multimedia Resource Adaptation using XML within the MPEG-21 Multimedia Framework

Christian Timmerer

Univ. of Klagenfurt: Hermann Hellwagner, Harald Kosch
Siemens Munich: Andreas Hutter, Jörg Heuer, Gabriel Panis

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Outline

• Introduction – Retrospection
• ISO/IEC WD 21000-7: Digital Item Adaptation
• (generic) Bitstream Syntax Description ((g)BSD)
• Adaptation Experiments
• Outcomes
• Conclusion/Future Work
Introduction - Retrospection

- mpeg2ds

- Heterogeneous Network

- Stationary MM Client

- Mobile MM Client

- Active Cache (Proxy)

- Adaptation

- Synchronisation

Privatissimum

Introduction – Retrospection (cont’d)

- MPEG-7 Variation DS
  - Extraction of Descriptors

- DiffServ
  - discarded ;-)

- MPEG-21/DIA/BSDL
  - Analysis, Extensions, Experiments

- Synchronisation
  - never started ;-)

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Christian Timmerer, christian@timmerer.com
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Digital Item Adaptation

- ... provide interoperable and transparent access to multimedia content
- To enable transparent and augmented use of multimedia resources across a wide range of networks and devices
**Digital Item Adaptation (cont’d)**

- **User Characteristics**
- **Terminal Capabilities**
- **Network Characteristics**
- **Natural Environment Characteristics**
- **Resource Adaptability**
  - Bitstream Syntax Description
  - Terminal and Network QoS (AdaptationQoS)
  - Metadata Adaptability
- **Session Mobility**
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Bitstream Syntax Description

- Generic approach to provide interoperability in DIA by using XML
- ...to describe the high-level structure of a bitstream in a scalable way
- Codec aware processor for generating description and/or bitstream → BSDL*
- Codec independent schema → gBS Schema developed at Univ. of Klagenfurt in cooperation with Siemens Munich
  * ...Philips Research France
Bitstream Syntax Description (cont’d)

Adaptation Architecture

- Bitstream
- Bitstream Generation
- Description Generation
- Description
- Description Transformation
- Transformed Description
- Adapted Bitstream

generic Bitstream Syntax Description

- Universal, coding format independent schema for describing bitstreams
- Means to adapt media resources w.r.t. semantic aspects (“semantic handles”) and/or syntactical labels
- Introduces elements for describing the bitstream in a hierarchical fashion
<?xml version="1.0" encoding="UTF-8"?>
<gBSD
  xsi:schemaLocation="gBSD gBSD.xsd"
  xmlns="urn:mpeg:mpeg21:dia:schema:gBSD:2003"
  xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance">
  <Header>
    <ClassificationAlias alias="MV4" href="urn:mpeg:mpeg4:video:cs:syntacticalLabels"/>
    <defaultValues addressUnit="byte" addressMode="Absolute" globalAddressInfo="Content/starwars.cmp"/>
  </Header>
  <gBSDUnit syntacticalLabel=":MV4:VO" start="0" length="26"/>
  <gBSDUnit start="26" length="99983" marker="violent-5">
    <gBSDUnit syntacticalLabel=":MV4:I_VOP" start="26" length="2877"/>
    <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="2903" length="64"/>
    <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="2967" length="56"/>
  </gBSDUnit>
  <gBSDUnit start="456749" length="52009" marker="violent-4">
    <gBSDUnit syntacticalLabel=":MV4:I_VOP" start="456749" length="1986"/>
    <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="2503" length="64"/>
    <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="2567" length="56"/>
  </gBSDUnit>
  ... and so on...
</gBSD>
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Adaptation Experiments (CEs)

- Main issues
  I. Multi-step adaptation
  II. Description generation
  III. Compactness of the Description
  IV. Functionality and feasibility of the marker approach to control the adaptation process
- Resources (Content)
  - MPEG-4 Visual Elementary Streams
  - JPEG2000 Images (performed by Siemens Munich)
Adaptation Experiments (cont’d)

- **Input**
  - Test bitstreams
  - Schemas (BSDL-1, BSDL-2, BS Schemas, gBS Schema)
  - BintoBSD, BSDtoBin, BIM software
  - MPEG-7/21 Descriptions

- **Output**
  - gBSDs for test bitstreams
  - XSLT style sheets for generating gBSDs and performing the adaptation
  - Adapted bitstreams and transformed gBSDs
  - gBSDtoBin software
  - Reports on results, conclusions and recommendations

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Adaptation Experiments (cont’d)

Multi-step Adaptation Architecture
Adaptation Experiments (cont’d)

• Feasibility and Functionality of gBSD
  – Correctness:
    • gBSD descriptions and their (corrected) adaptations are valid descriptions of bitstreams and their adaptations
  – Adaptations:
    • Described & automatically performed by XSLT style sheets
  – Sequence of adaptations:
    • Successfully performed
  – gBSDs could be binarized using BiM codec

• Outstanding
  – Control of adaptations

Adaptation Experiments (cont’d)

• Control of the Adaptation Process
  – MPEG-7 ParentalRating Descriptor
  – ICRAParentalRatingViolenceCS

<?xml version="1.0" encoding="UTF-8"?>
<AdaptationHint xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:noNamespaceSchemaLocation="../Schemas/AdaptationHint.xsd">
  <Component name="syntacticalLabel">
    <Value>MV4:B_VOP</Value>
  </Component>
  <Component name="marker">
    <Value>violent-1</Value>
  </Component>
  <Component name="marker">
    <Value>violent-2</Value>
  </Component>
</AdaptationHint>
Adaptation Experiments (cont’d)

Results

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>foreman</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSDL*)</td>
<td>572100</td>
<td>38198</td>
<td>?</td>
<td>6,68%</td>
<td>?</td>
</tr>
<tr>
<td>gBSD</td>
<td>572100</td>
<td>22287</td>
<td>6107</td>
<td>3,90%</td>
<td>1,07%</td>
</tr>
<tr>
<td>akiyo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSDL*)</td>
<td>165034</td>
<td>37821</td>
<td>?</td>
<td>22,92%</td>
<td>?</td>
</tr>
<tr>
<td>gBSD</td>
<td>165034</td>
<td>21828</td>
<td>6085</td>
<td>13,23%</td>
<td>3,69%</td>
</tr>
<tr>
<td>starwars</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BSDL*)</td>
<td>2515959</td>
<td>230474</td>
<td>?</td>
<td>9,16%</td>
<td>?</td>
</tr>
<tr>
<td>gBSD</td>
<td>2515959</td>
<td>131955</td>
<td>36314</td>
<td>5,24%</td>
<td>1,44%</td>
</tr>
</tbody>
</table>

*) without MPEG-4 Visual ES Schema

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- 2 Proposals for MPEG-21 DIA*
  - Additional requirements for DIA
  - generic Bitstream Syntax Description (Language)
- 2 CE Reports*
- 1 Publication submitted to Image Communication Eurasip Journal*
- Promotion to Working Draft during Shanghai Meeting (Oct. 2002)*
- 1 Ongoing CE*
  - 7 participating Companies/Institutes/Departments

→ A MPEG-21 Tool for generic resource adaptation
  * ... Co-Author

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Conclusion

- gBSD provides a flexible and standardized way for describing resources
- gBSD enables coding format independent adaptation
- gBSD allows for an efficient, optimized implementation
  - E.g., no schema delivery to adaptation node
- gBSD’s marker concept:
  - Provides a handle to include semantic adaptation info
  - Supports powerful adaptations on “thin devices” (through provider-side preparation)

Future Work

- … finishing master thesis
- … gBSD → CD → FCD → FDIS
- … integration of MPEG-21 DIA Engine into Proxy-Server
- … Digital Item Processing, Event Reporting …
- … parallel/distributed adaptation
- … implementation/realisation …
The Big Picture

Backup Slides
XSLT - BSDtogBSD

```xml
<xsl:template name="calcLen">
  <xsl:param name="nodes"/>
  <xsl:param name="index" select="1"/>
  <xsl:param name="runningTotal" select="0"/>
  <xsl:variable name="start" select="substring-before($nodes[$index]/mp4:Payload, '-') - 5"/>
  <xsl:variable name="currentLength" select="substring-after($nodes[$index]/mp4:Payload, '-') - $start + 1"/>
  <xsl:variable name="remainingLength">
    <xsl:choose>
      <xsl:when test="$index=count($nodes)">
        <xsl:value-of select="0"/>
      </xsl:when>
      <xsl:otherwise>
        <xsl:call-template name="calcLen">
          <xsl:with-param name="nodes" select="$nodes"/>
          <xsl:with-param name="index" select="$index+1"/>
          <xsl:with-param name="runningTotal" select="$runningTotal+$currentLength"/>
        </xsl:call-template>
      </xsl:otherwise>
    </xsl:choose>
  </xsl:variable>
  <xsl:value-of select="$currentLength+$remainingLength"/>
</xsl:template>
```

XSLT – BSDtogBSD (cont’d)

```xml
<xsl:variable name="sumLen">
  <xsl:call-template name="calcLen">
    <xsl:with-param name="nodes" select="following-sibling::mp4:VOP[position() &lt; $lengthFrame]"/>
    <xsl:with-param name="index" select="1"/>
    <xsl:with-param name="runningTotal" select="0"/>
  </xsl:call-template>
</xsl:variable>
```
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MPEG-7 - ParentalRating

```xml
<VideoSegment id="preface">
  <CreationInformation>
    <Creation>
      <Title xml:lang="en" type="popular">Segment 1</Title>
      <Abstract>
        <FreeTextAnnotation>
          Preface of Starwars2 Trailer
        </FreeTextAnnotation>
      </Abstract>
    </Creation>
    <Classification>
      <ParentalGuidance>
      </ParentalGuidance>
    </Classification>
    <MediaTime>
      <MediaRelIncrTimePoint>0</MediaRelIncrTimePoint>
      <MediaIncrDuration mediaTimeUnit="PT1N30F">275</MediaIncrDuration>
    </MediaTime>
  </CreationInformation>
</VideoSegment>
```

Privatissimum

Multi-step Adaptation

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE Bitstream[
<![<!ENTITY mp4 "mpeg4" ][<!ENTITY xsi "http://www.w3.org/2000/10/XMLSchema-instance" ][<!ENTITY xsischemalocation "http://www.w3.org/2000/10/XMLSchema-instance" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!DOCTYPE Bitstream[
<![<!ENTITY mp4 "mpeg4" ][<!ENTITY xsi "http://www.w3.org/2001/XMLSchema-instance" ][<!ENTITY xsischemalocation "http://www.w3.org/2001/XMLSchema-instance" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!DOCTYPE Bitstream[
<![<!ENTITY mp4 "mpeg4" ][<!ENTITY xsi "http://www.w3.org/2001/XMLSchema-instance" ][<!ENTITY xsischemalocation "http://www.w3.org/2001/XMLSchema-instance" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!DOCTYPE Bitstream[
<![<!ENTITY mp4 "mpeg4" ][<!ENTITY xsi "http://www.w3.org/2001/XMLSchema-instance" ][<!ENTITY xsischemalocation "http://www.w3.org/2001/XMLSchema-instance" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!DOCTYPE Bitstream[
<![<!ENTITY mp4 "mpeg4" ][<!ENTITY xsi "http://www.w3.org/2001/XMLSchema-instance" ][<!ENTITY xsischemalocation "http://www.w3.org/2001/XMLSchema-instance" >]
<!ENTITY mpeg4 "mpeg4" >]
<!ENTITY Mpeg44Bitstream.xsd "mpeg44/Bitstream.xsd" >]
<!ENTITY mpeg4 "mpeg4" >]>
```

NO gap in the addresses
Multi-step Adaptation (cont’d)

- **Address corrections**
  - Address information may become outdated after performing an adaptation
  - Following attributes are affected
    - globalAddressInfo
    - start (in case of absolute or offset address mode)
    - length

- **Two possibilities**
  - ... after adaptation process (in a separate process)
  - ... incorporated into bitstream generation process