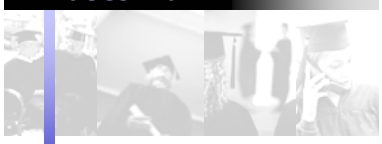
Privatissimum



Department of Information Technology, University Klagenfurt

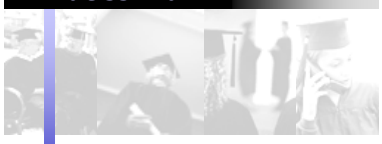
Multimedia Resource Adaptation using XML within the MPEG-21 Multimedia Framework

Christian Timmerer

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

Klagenfurt, 2002/12/02

Privatissimum

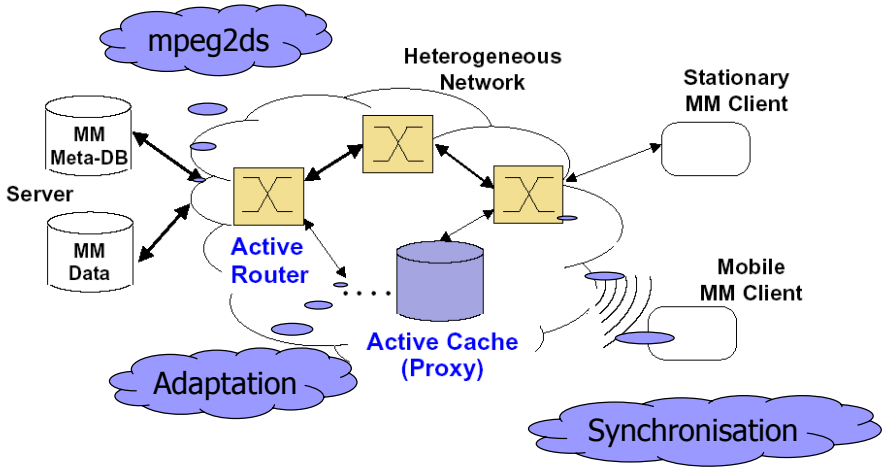


MPEG@ITEC

Outline

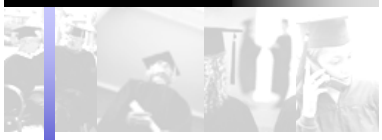
- Introduction – Retrospection
- ISO/IEC WD 21000-7: Digital Item Adaptation
- (generic) Bitstream Syntax Description ((g)BSD)
- Adaptation Experiments
- Outcomes
- Conclusion/Future Work

Introduction - Retrospection



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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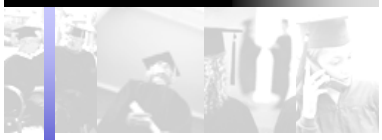


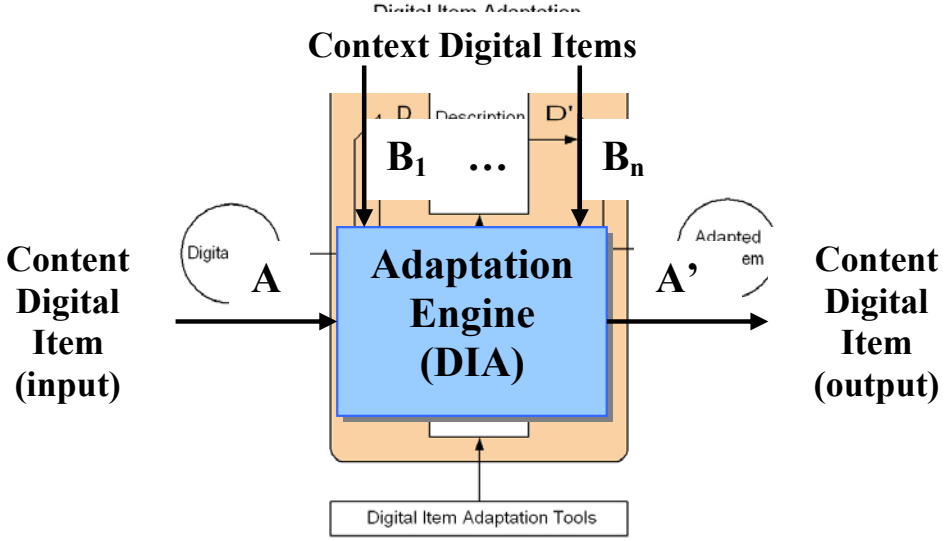
MPEG@ITEC

Digital Item Adaptation

- … provide interoperable and transparent access to m[illegible]media content
- [illegible]ging in preparation of [illegible]nal devices
- [illegible]or produce this

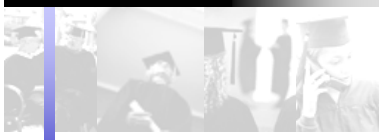
To enable transparent and augmented use of multimedia resources across a wide range of networks and devices

Digital Item Adaptation (cont'd)



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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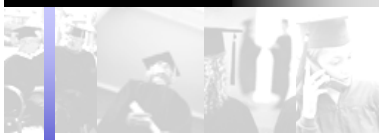

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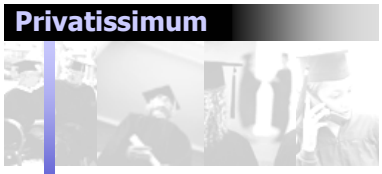
Bitstream Syntax Description

- 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



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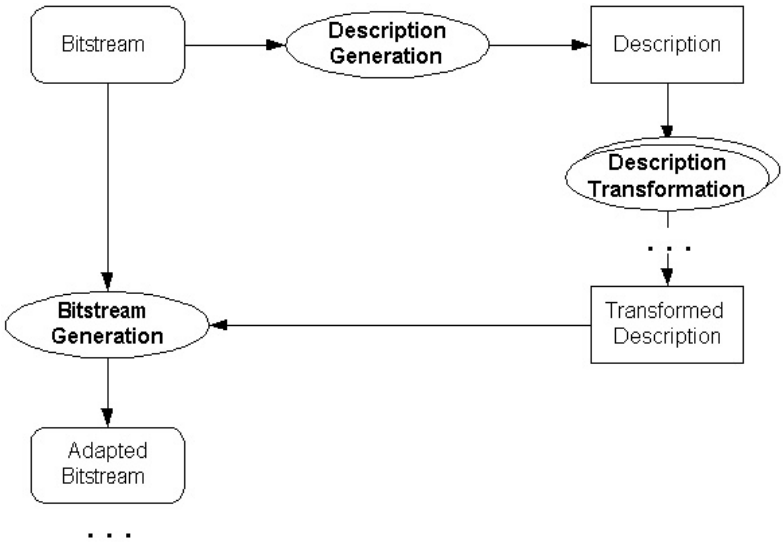
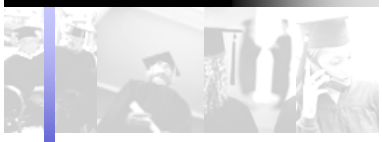
Bitstream Syntax Description (cont'd)

Adaptation Architecture





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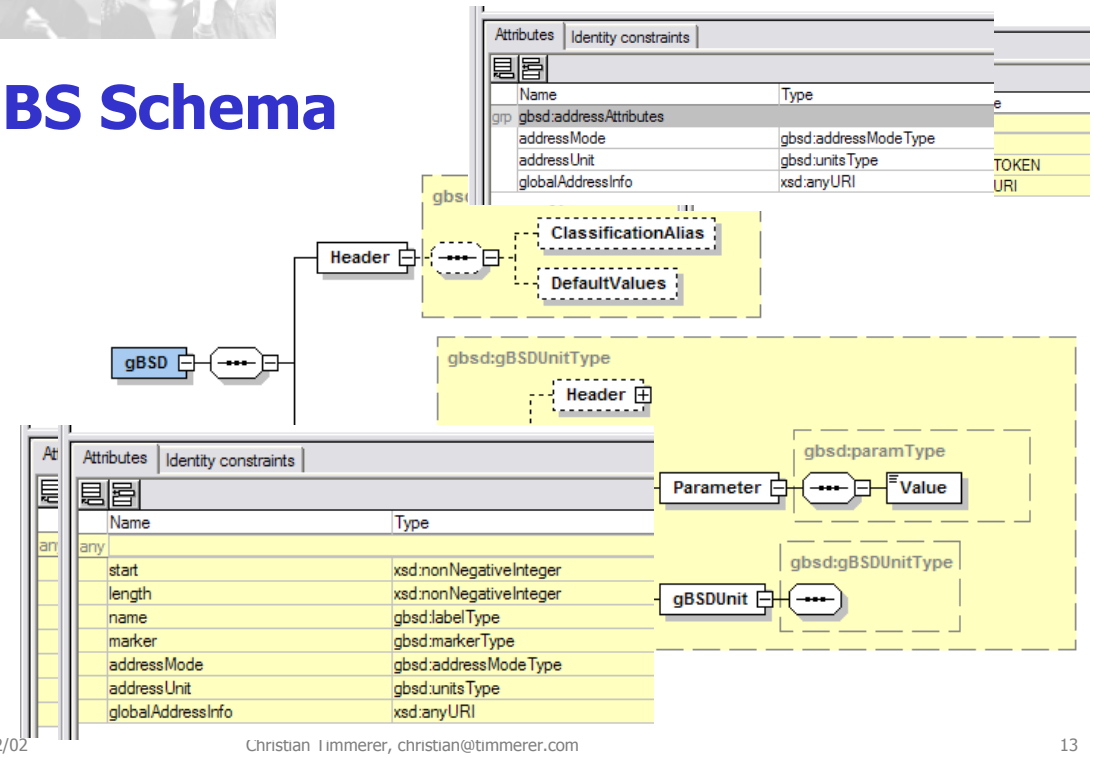
generic Bitstream Syntax Description

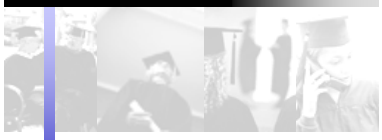
- Universal, coding format independent schema for describing bitstreams
- Means to adapt media resources w.r.t. semantic aspects ("semantic handles") and/or syntactical labels
- Introduces elements for describing the bitstream in a hierarchical fashion

gBS Schema



gBSD Sample

```
<?xml version="1.0" encoding="UTF-8"?>
<gBSD
   xsi:schemaLocation="gBSD gBSSchema.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"/>
      <!--... and so on ...-->
   </gBSDUnit>
   <gBSDUnit start="456749" length="52009" marker="violent-4">
      <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="456749" length="1986"/>
      <gBSDUnit syntacticalLabel=":MV4:I_VOP" start="458735" length="1695"/>
      <!--... and so on ...-->
      <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="506268" length="1310"/>
      <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="507578" length="1180"/>
   </gBSDUnit>
   <gBSDUnit start="508758" length="44235" marker="violent-3">
      <gBSDUnit syntacticalLabel=":MV4:I_VOP" start="508758" length="4648"/>
      <gBSDUnit syntacticalLabel=":MV4:P_VOP" start="513406" length="3909"/>
      <!--... and so on ...-->
   </gBSDUnit>
   <!--... and so on ...-->
</gBSD>
```



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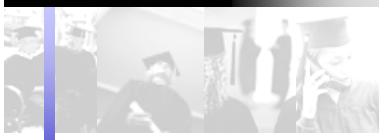


MPEG@ITEC

Adaptation Experiments (CEs)

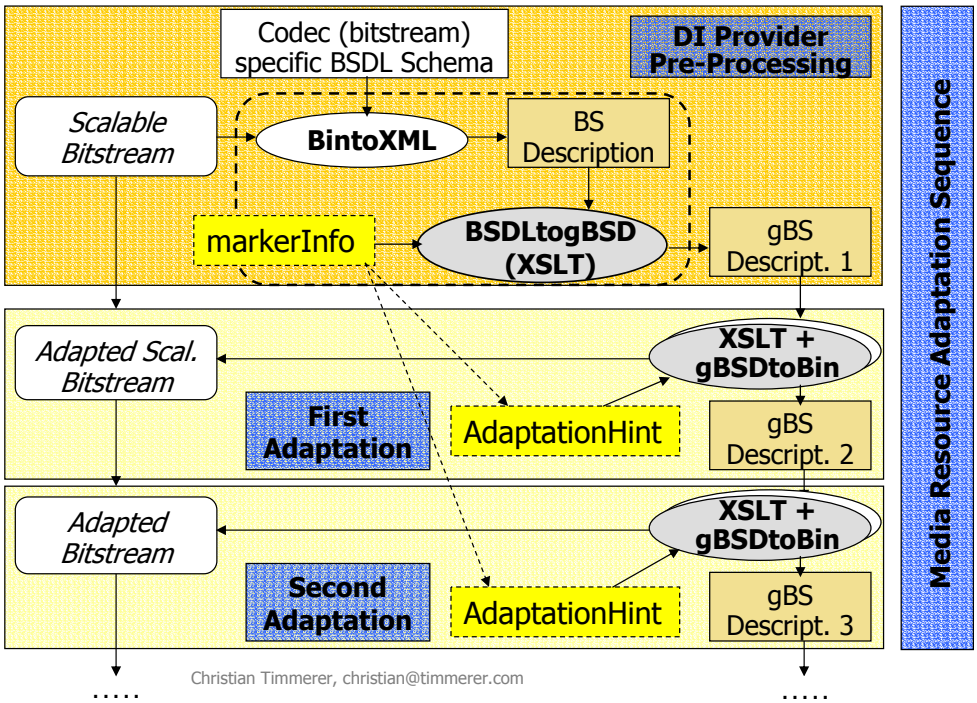
- **Main issues**
  I. Multi-step adaptation
  II. Description generation
  III. Compactness of the Description
  IV. Functionality and feasibility of the marker approach to control the adaptation process
- **Resources (Content)**
  - MPEG-4 Visual Elementary Streams
  - JPEG2000 Images (performed by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

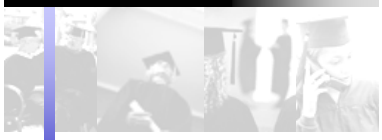
Adaptation Experiments (cont'd)

- **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

Adaptation Experiments (cont'd)

Multi-step Adaptation Architecture





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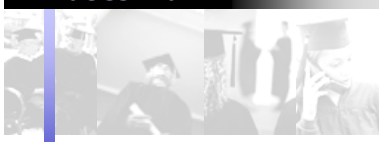
Adaptation Experiments (cont'd)

- **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

Privatissimum



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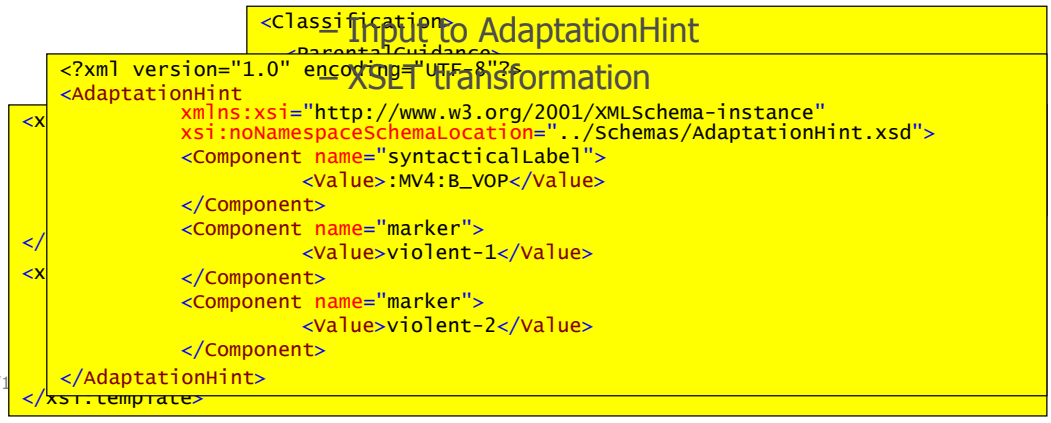
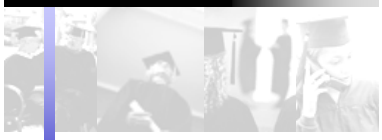
Adaptation Experiments (cont'd)

- **Control of the Adaptation Process**
  - MPEG-7 ParentalRating Descriptor
    - ICRAParentalRatingViolenceCS



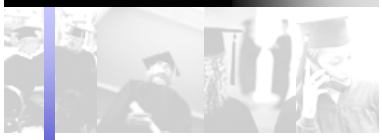


Adaptation Experiments (cont'd)

Results

Filename/ Method	Bitstream [bytes]	XML descr. [bytes]	BiM size [bytes]	XML/ Bitstream	BiM/ Bitstream
foreman					
BSDL*)	572100	38198	?	6,68%	?
gBSD	572100	22287	6107	3,90%	1,07%
akiyo					
BSDL*)	165034	37821	?	22,92%	?
gBSD	165034	21828	6085	13,23%	3,69%
starwars					
BSDL*)	2515959	230474	?	9,16%	?
gBSD	2515959	131955	36314	5,24%	1,44%

*) without MPEG-4 Visual ES Schema



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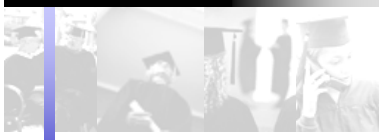

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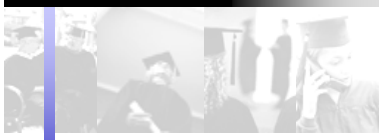
Outcomes

- **2 Proposals for MPEG-21 DIA***
  - Additional requirements for DIA
  - **g**eneric **B**itstream **S**yntax **D**escription (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

Privatissimum



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- **Outcomes**
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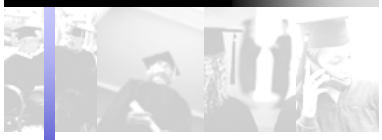

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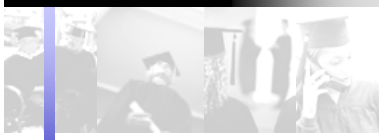
Conclusion

- **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)



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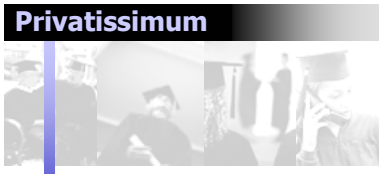
Future Work

- **… 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 …**



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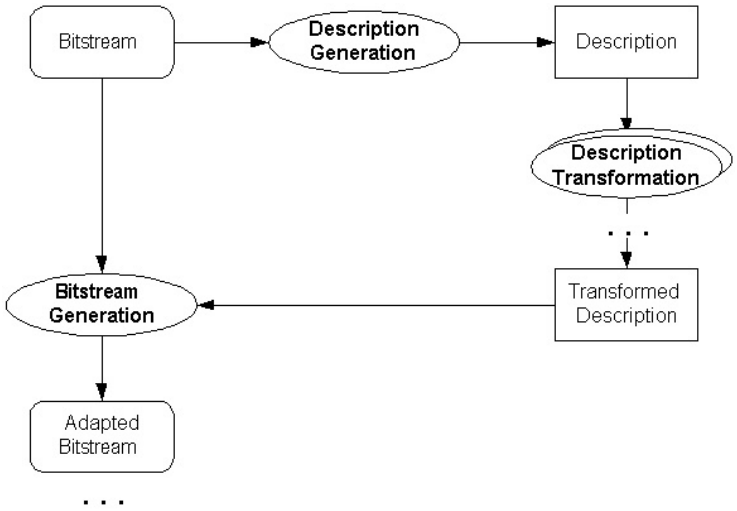
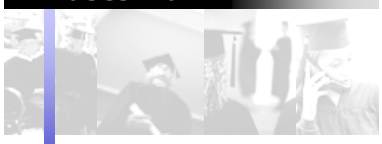
The Big Picture





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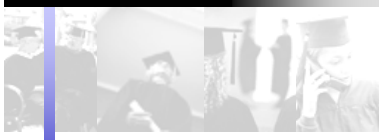
Backup Slides



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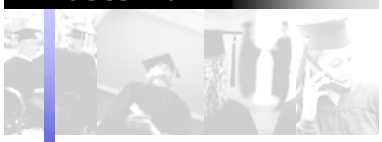
XSLT - BSDtogBSD

```
<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>
```

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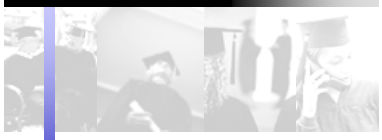
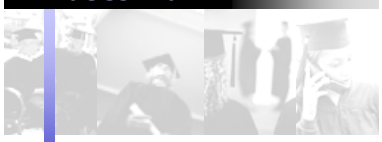
XSLT – BSDtogBSD (cont'd)

```
<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>
```



MPEG-7 - ParentalRating

```
<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>
            <ParentalRating
href="urn:mpeg:mpeg7:cs:ICRAParentalRatingViolenceCS:2001:5"/>
            <Region>de</Region>
         </ParentalGuidance>
      </Classification>
   </CreationInformation>
   <MediaTime>
      <MediaRelIncrTimePoint>0</MediaRelIncrTimePoint>
      <MediaIncrDuration mediaTimeUnit="PT1N30F">
         275
      </MediaIncrDuration>
   </MediaTime>
</VideoSegment>
```

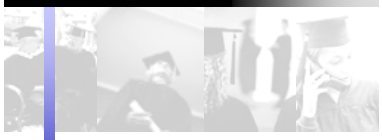



Multi-step Adaptation

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Bitstream description for MPEG4 video file akiyo.mpg4-->
<Bitstream xmlns="mpeg4" xmlns:xsi="http://www.w3.org/2000/10/XMLSchema-instance"
           xsi:schemaLocation="mpeg4 MPEG4Bitstream.xsd">
  <Header start="0" end="17">akiyo.mpg4</Header>
   <I_VOP start="18" end="4658">akiyo.mpg4</I_VOP>
   <P_VOP start="4659" end="4756">akiyo.mpg4</P_VOP>
   <B_VOP start="4757" end="4772">akiyo.mpg4</B_VOP>
  <B_VOP start="4773" end="4795">akiyo.mpg4</B_VOP>
  <P_VOP start="4796" end="4973">akiyo.mpg4</P_VOP>
  <B_VOP start="4974" end="5026">akiyo.mpg4</B_VOP>
  <B_VOP start="5027" end="5065">akiyo.mpg4</B_VOP>
  <P_VOP start="5066" end="5300">akiyo.mpg4</P_VOP>
  <!-- and so on... -->
</Bitstream>
```

```
<?xml version="1.0" encoding="UTF-8"?>
<Bitstream xmlns="mpeg4"  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="mpeg4 Schema_MPEG4.xsd">
      <Header>akiyo.mpg4#0-17</Header>
      <I_VOP start="18" end="4658">akiyo.mpg4</I_VOP>
      <P_VOP start="4659" end="4756">akiyo.mpg4</P_VOP>
      <P_VOP start="4757" end="4934">akiyo.mpg4</P_VOP>
      <P_VOP start="4935" end="5169">akiyo.mpg4</P_VOP>
      <!-- and so on... -->
</Bitstream>
```

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