EXPWAY
MAKING XML EFFICIENT™

SMIL & MPEG-7

Two complementary technologies for representing, describing and transmitting multimedia presentations

XML Europe 2003, Paris

Claude Seyrat
CTO, Co-founder

Expway
Mission & Business

- Mission
  - Making XML efficient with any data, in any environment and on any device by providing innovative, scalable and standard solutions that leverage your applications
- Products
  - Expway develops, markets and supports software components for managing XML transfer and processing based on its Binary XML technology, fundamental to improve performance of XML enabled-application
- Market targets
  - Broadcast, Wireless Telecom and Infrastructure & application software

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Presentation Topics

- MPEG-7 broad presentation
- SMIL and MPEG-7 – a fruitful collaboration
  - Generating SMIL presentation
    - Main principles
    - Ricoh MPMeister presentation
  - Describing SMIL presentation
- New media consumption mode
- More MPEG-7 – Efficient transmission of XML
- Conclusion

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Presentation of MPEG-7

Moving **P**icture **E**xpert **G**roup

Mission:

Develop standards for moving pictures, audio and their combination

- Mother Organisations
  - ISO International Standards Organization
  - IEC International Electro-technical Commission
  - Working group
    - ISO:IEC JTC1 / SC29 / WG11

MPEG Standards

- MPEG-1 — **11/1992**
  - Storage and coding of moving picture and audio
- MPEG-2 — **11/1994**
  - Digital Television
- MPEG-4 (v2) — **11/1999**
  - Coding of natural and synthetic media objects for multimedia applications
- MPEG-7 — **08/2001**
  - Multimedia Content description for AV material
- MPEG-21 — **coming soon**
  - Multimedia Framework

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MPEG-7 - Context

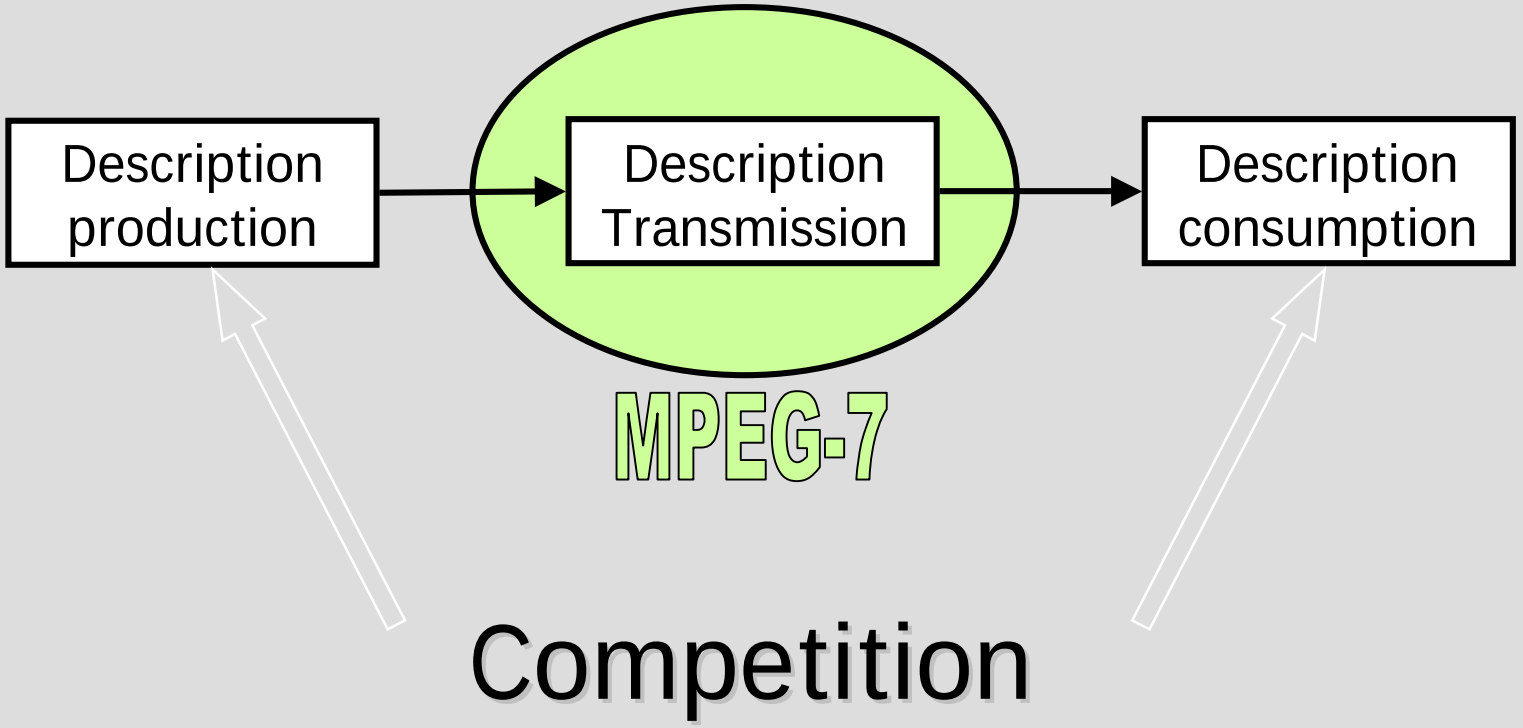
- Amount of audiovisual material is increasing
  - Example: Digital TV:
    - 300 h/h of TV today
    - 1000 h/h of TV programs in 2005 (24000 h/d !!)
- Finding, filtering and managing AV material is becoming a major issue

➔ MPEG-7

MPEG-7 - Means

- Standardize AV content meta-data
  - To ease the management of AV documents
    - Fast and efficient search
    - User oriented filtering
    - Classification / organizations of AV DB
    - ...
  - By describing different type of features
    - Low level — colors, shapes, ...
    - Structural — scene, shot, ...
    - Semantic — relations, entities, ...
    - Organizational — collections, models, ...
    - ...

MPEG-7 - Scope



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MPEG-7 Technical overview

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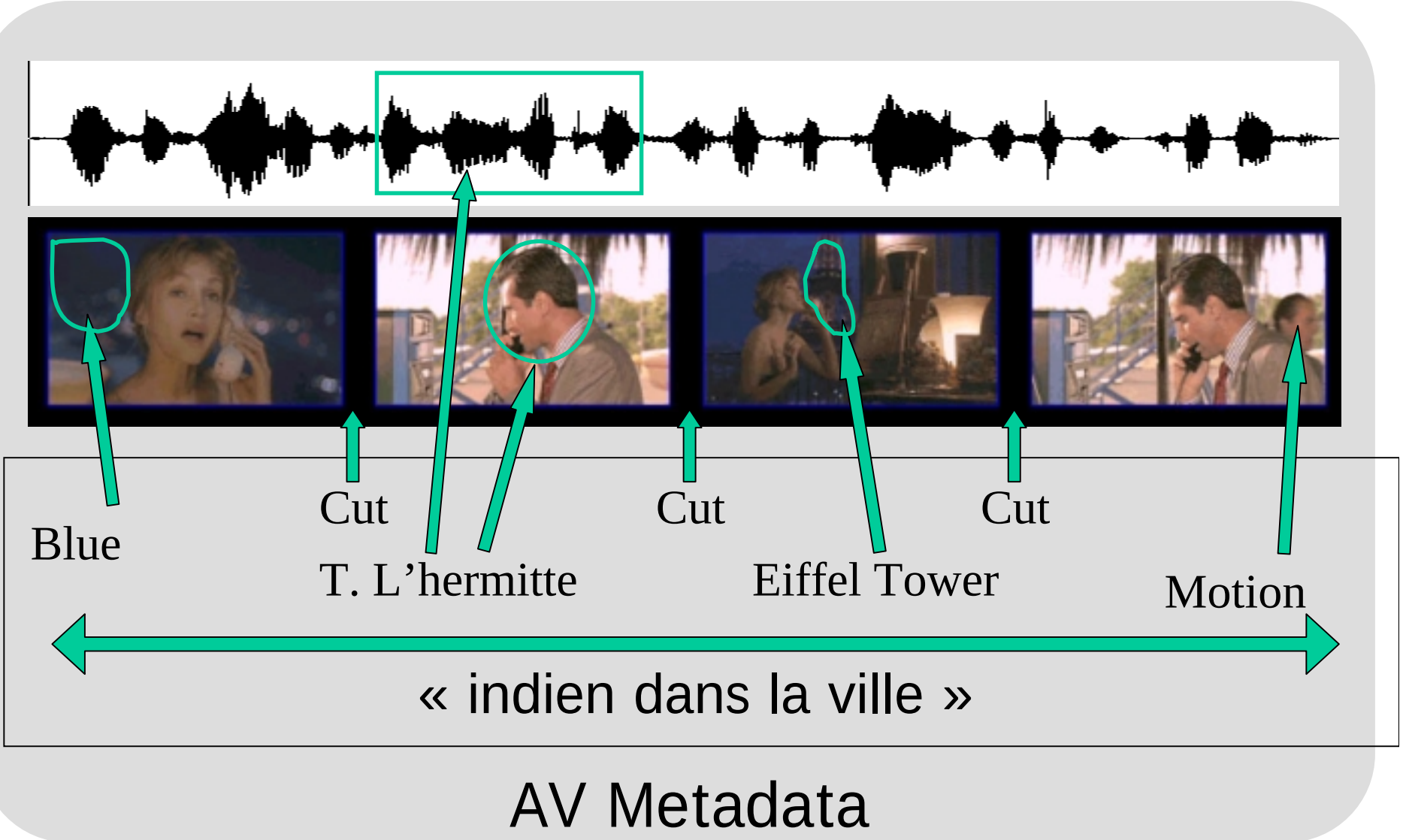
MPEG-7 - Terminology

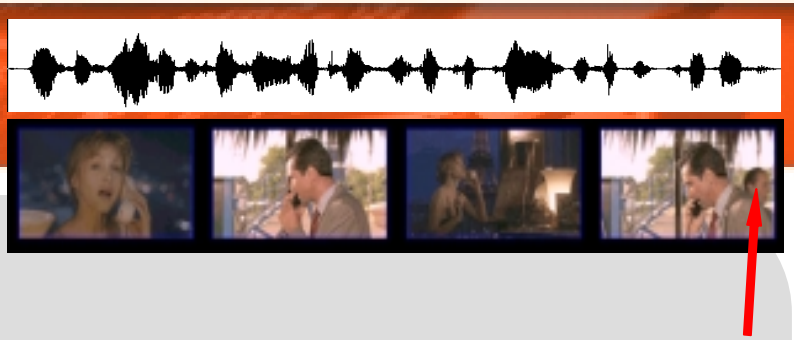
- Description — XML document
  - A metadata for AV material
- D : Descriptors — XML elements
  - Syntax and semantic of representation AV features,
- DS : Description Schemes — XML elements
  - Structure and semantics of relations between description components,
- DDL : Description Definition Language — XML Schema
  - Language to allow the creation and extension of DSs and Ds
- Systems tools — BiM / TeM
  - Encoding/decoding, compression and streaming of descriptions,

Audio-Visual Metadata



T. L’hermitte

```
<Person>
  <Name xml:lang="en">
    <GivenName>Thierry</GivenName>
    <FamilyName>L’hermitte</FamilyName>
  </Name>
  <Affiliation>
     <Organization>
        <Name>Independent cinema company</Name>
     </Organization>
   </Affiliation>
</Person>
```

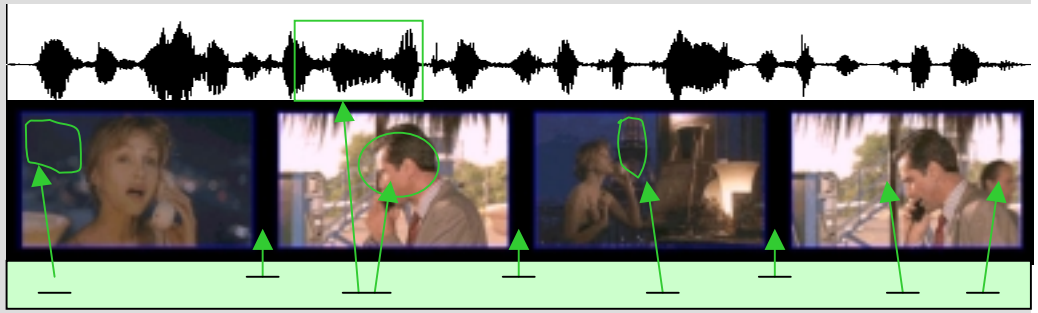


Motion

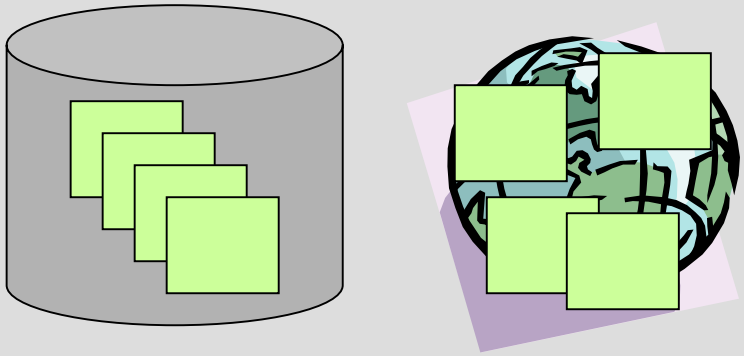
```
<Segment xsi:type="MovingRegionType">
   <TextAnnotation>
      <FreeTextAnnotation xml:lang="en">Person</FreeTextAnnotation>
   </TextAnnotation>

   <MediaTime>
     <MediaTimePoint> 00:00:15 </MediaTimePoint>
     <MediaDuration>  00:00:30 </MediaDuration>
   </MediaTime>

   <ParametricObjectMotion model="Translational">
         …
   </ParametricObjectMotion>
</Segment>
```

MPEG-7 – Location of descriptions

Embedded in media
(MPEG-2, MPEG-4, SMIL, JPG, ..)



In a database
On the web



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MPEG-7 – The standard

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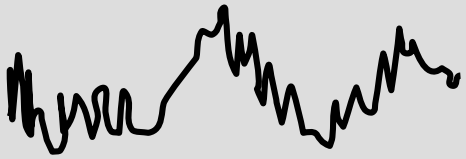
MPEG-7 Standard

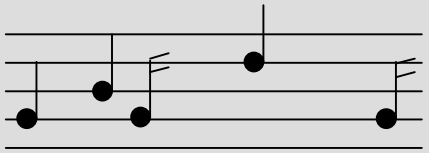
1. Systems	Transmission format
2. DDL	XML Schema
3. Audio	Audio MD
4. Visual	Visual MD
5. Multimedia DS	Structural MD
6. Reference Software	Open source soft
7. Conformance	Methods to test

Part3 – Audio
Some description tools

- Sound effects
  - Indexing and categorization of general sound effects
- Musical Instrument Timbre
  - Perceptual features of instrument sounds



- Spoken Content
  - Word and phone lattices for each speaker
- Melody Contour
  - Compact representation of melody

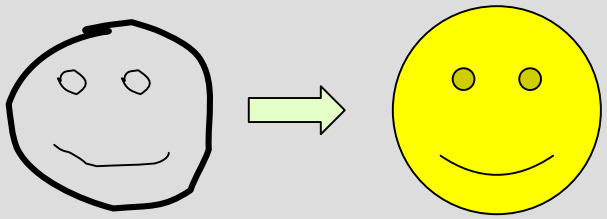


- Silence
  - Attach silence semantics to an audio segment

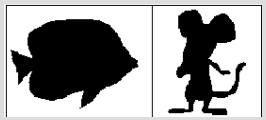
Part 4 – Visual
Some description tools

- Colors
  - Filter images by colors, ambiance, ..

- Texture
  - Distinguish clouds, walls, grass, ...
- Edges
  - Targets image-to-sketch matching

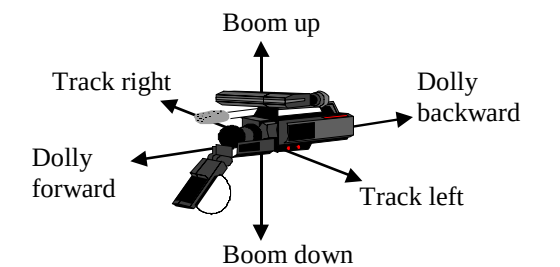


- Shapes
  - Describe visual object shapes

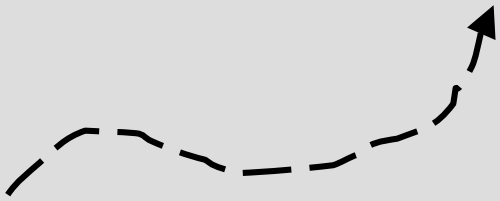


Part 4 – Visual
Other description tools

- Camera Motion
  - Pan, tilt, boom, track, dolly



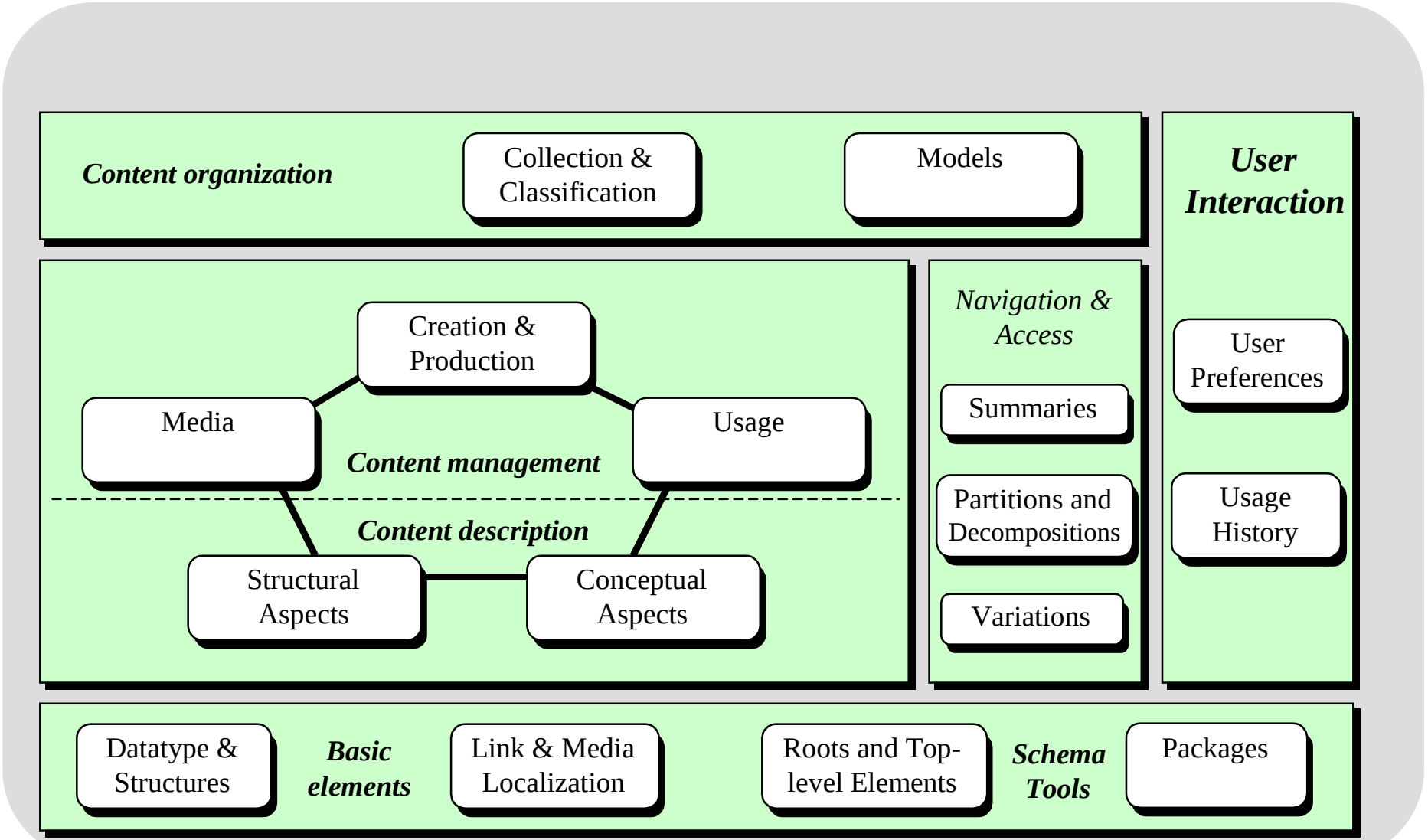
- Motion Trajectory
  - Precise localization in time and space of an object



- Parametric Motion
  - Description of the motion of an object

- Motion Activity
  - Retrieve high speed car chase, interview, ...

Part 5 – Multimedia Description Schemes



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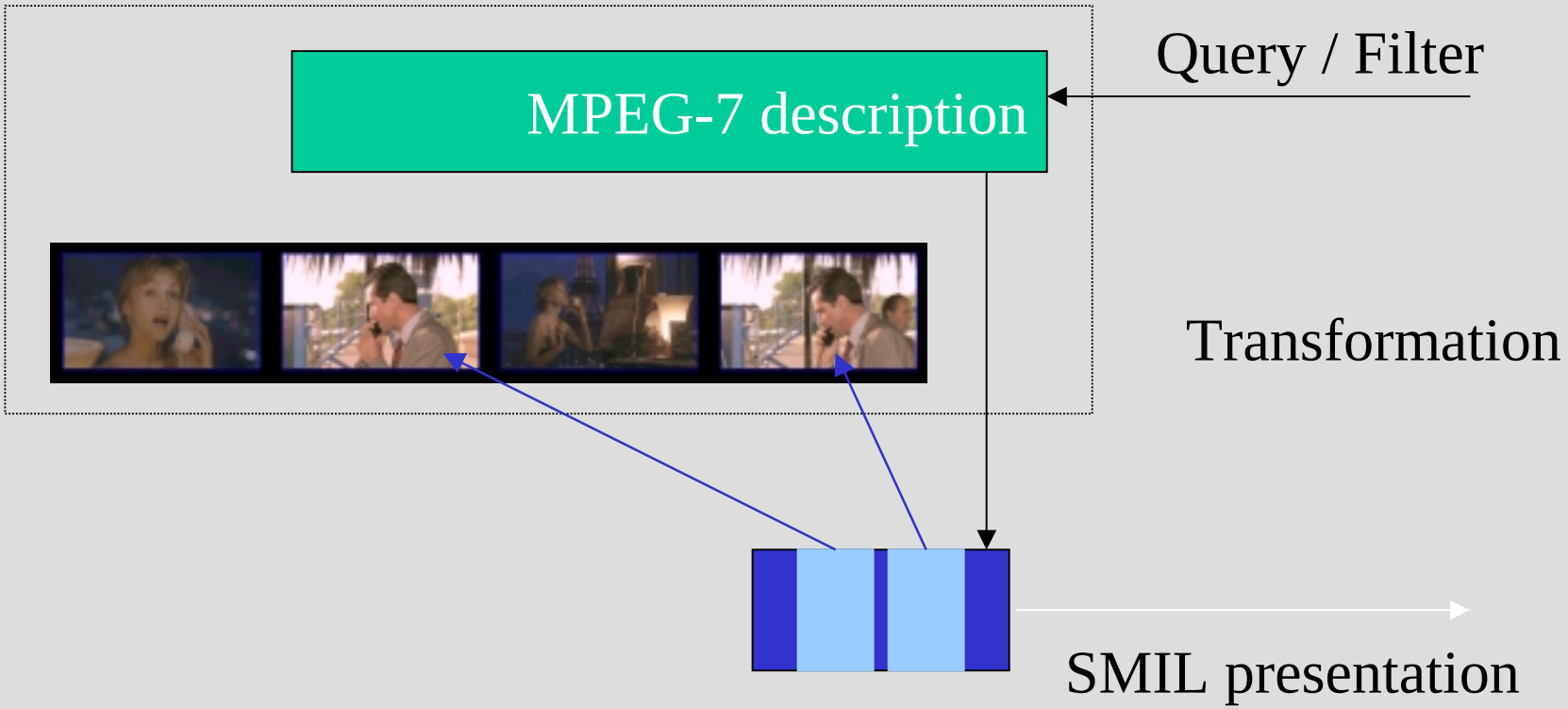
MPEG-7 for generating SMIL presentation

Generating SMIL



Some relevant MPEG-7 tools

- Summary
- Segmentation
  - Temporal segmentation
  - Spatial segmentation
- User preferences / User profiles
- Selection of relevant segments
  - Color / Speed / histogram / etc…
  - Content information
  - Person information (ex: actor name)

RICOH

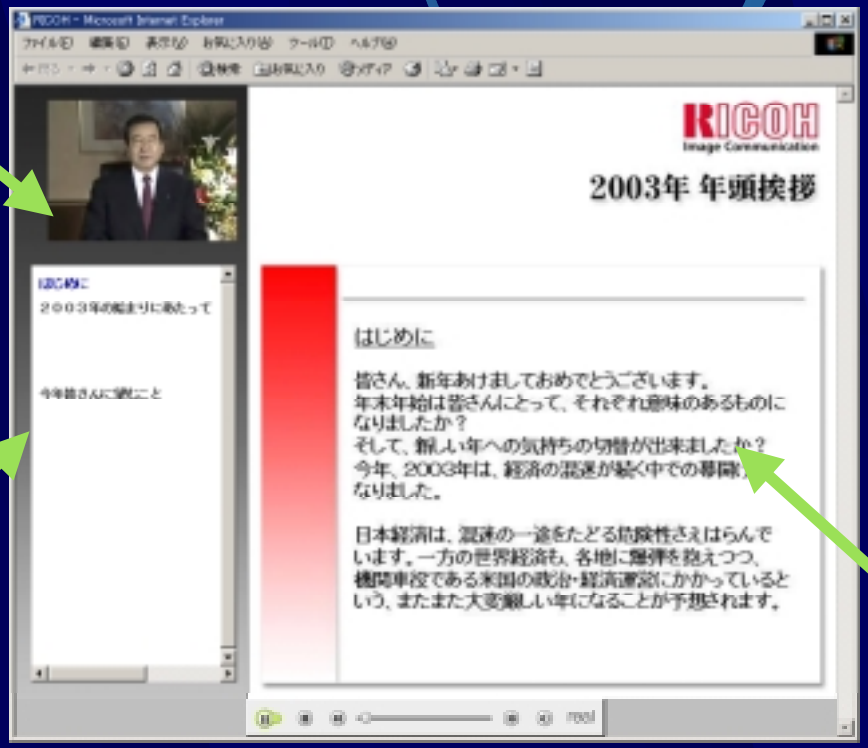
MPMeister

Takayuki KUNIEDA
Multimedia Lab
Software Research & Development Group
RICOH Co., Ltd.

What is Presentation Web Content ?

Combine Video, Slides and Table of Contents into an Easy-to-understand visual format

Video



ToC

Slide Image

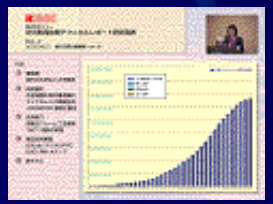
Delivery methods:

- CD-R/DVD+RW
- Streaming

Advantages of MPMeister

- **Two Clicks**, Automatic Content Generation
- **Just 1 minute**, after the presentation, you can deliver the results via Streaming Services or CD-ROM / DVD
- **MPEG-7 instances** are generated
- Best-suited to Technical Lecture, Education
- You can select the design from the templates provided

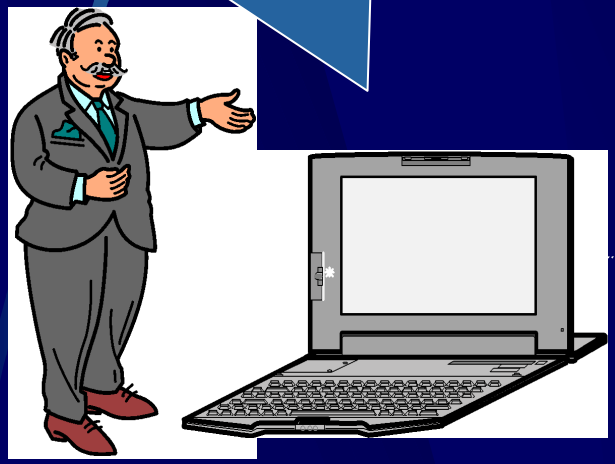




System Configuration

Presenter:
- Make the Presentation as usual
- Recorded the Presenter's Action
- One-person control is possible

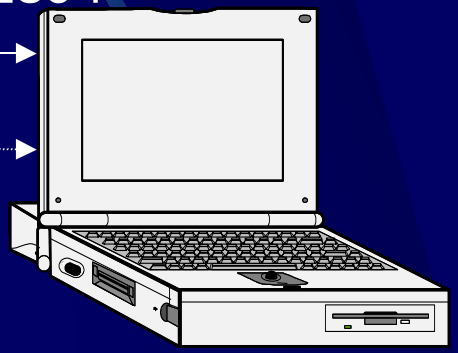
Recording Operator:
- Direct HDD Recording
- Automatic content transfer and Web content generate within 1 min.
- Content Retrieval is possible using MPEG-7



Presentation PC

IEEE1394

IEEE802.11b



Capturing PC

MPMeister

RICOH

Advantages of using MPEG-7

Slides

Motivation

Earth Friendly Printer

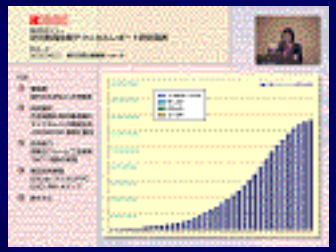
MPEG-7

```
<Mpeg7>
  <Abstract/>
  <Scene>
    <Title>Motivation</Title>
    <Content>
      Earth Friendly Printer
    </Content>
    <Time/>
  </Scene>
  ...
</Mpeg7>
```

Advantages:

- You can search and re-construct the huge archived content easily
- Utilized versatile application:
  ex. Automatic Portal Generation

Web Content



Content Archives

Adaptation of MPEG-7

- Creation Information
  - Input by hand before presentation
    - Using “CreationInformation DS”
- Video Structure
  - Auto-detection PPT operation
    - Using “AudioVisualSegment DS”
- Scene Annotation
  - Auto-extraction from PPT files
    - Using “TextAnnotation DS”

MPEG-7 → SMIL

MPEG-7 Representation (1)

CreationInformation for Presentation Content

```
<Mpeg7>
<CreationInformation id="creationInformation-3">
 <Creation id="creation-4">
  <Title type="main">RICOH Presentation</Title>
  <Title type="secondary">EXPWAY and RICOH techinical exchnage</Title>
 <Creator>
  <Role href="urn:ricoh:mmVISION:RoleCS:9">
   <Name>Speaker</Name>
  </Role>
  <Agent xsi:type="OrganizationType" id="agent-7">
   <Name>EXPWAY</Name>
   <Contact xsi:type="PersonType" id="contact-8">
    <Name><GivenName>Claude Seyrat</GivenName></Name>
   </Contact>
  </Agent>
 </Creator>
</CreationInformation>
...
<!– Part 1 -->
<!– Part 2 -->
</Mpeg7>
```

Presentation Title

Presentation Creator

MPEG-7 Representation (2)

AudioVisual Segment for Presentation Content

```
<AudioVisualSegment id="structure-186">
 <CreationInformation id="creationInformation-187">
  <Creation id="creation-188"> <Title>Presentation Slide 38</Title></Creation>
  <RelatedMaterial id="relatedMaterial-189">
   <MediaLocator xsi:type="ImageLocatorType">
    <MediaUri>file:///D|/Project/EXPWAY-RICOH4/PPTFile/1/1_38.JPG</MediaUri>
   </MediaLocator>
  </RelatedMaterial>
 </CreationInformation>
 <TextAnnotation type="headLine">
  <FreeTextAnnotation xml:lang="en">BinXML? Main characteristics</FreeTextAnnotation>
 </TextAnnotation>
 <TextAnnotation type="commentary">
  <FreeTextAnnotation>
  Generic Works for any XML language Adopted by international standards:
  </FreeTextAnnotation>
 </TextAnnotation>
 <MediaTime>
  <MediaRelTimePoint>P0DT0H13M23S15N30F</MediaRelTimePoint>
  <MediaIncrDuration mediaTimeUnit="P0DT0H0M0S1N30F">3989</MediaIncrDuration>
 </MediaTime>
</AudioVisualSegment>
```

PPT Image

Slide Title

Slide Contents

Position in Video

MPEG-7 Representation (3)

MediaInformation for Presentation Content

```
<MediaSourceDecomposition id="mediaSourceDecomposition-473" criteria="description"
overlap="true" gap="true">
 <AudioVisualSegment id="description-474">
  <MediaInformation id="mediaInformation-475">
   <MediaProfile id="mediaProfile-476">
    <MediaInstance id="mediaInstance-477">
     <MediaLocator xsi:type="TemporalSegmentLocatorType">
      <MediaUri>file:///D|/Project/EXPWAY-RICOH4/Real/mpout.rm</MediaUri>
      <MediaTime>
       <MediaRelTimePoint mediaTimeBase="../MediaUri">P0DT0H0M0S0N30F</MediaRelTimePoint>
       <MediaIncrDuration mediaTimeUnit="P0DT0H0M0S1N30F">122006</MediaIncrDuration>
      </MediaTime>
     </MediaLocator>
    </MediaInstance>
   </MediaProfile>
  </MediaInformation>
 </AudioVisualSegment>
 </MediaSourceDecomposition>
```

Recorded Presentation Video

Video Duration

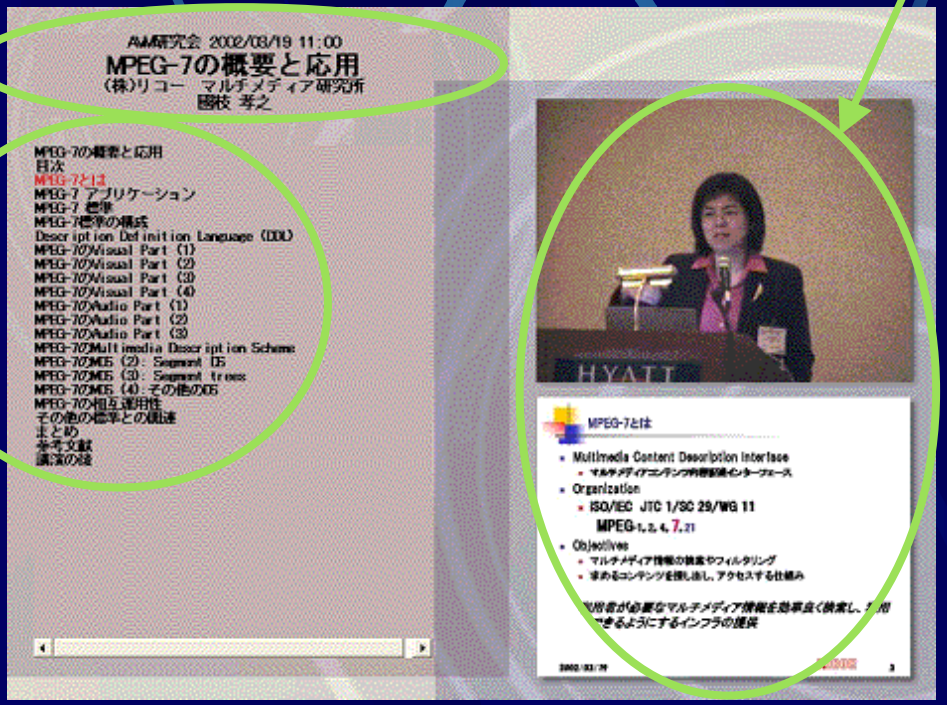
SMIL Content

- Presentation SMIL Web Content Automatic Generation System

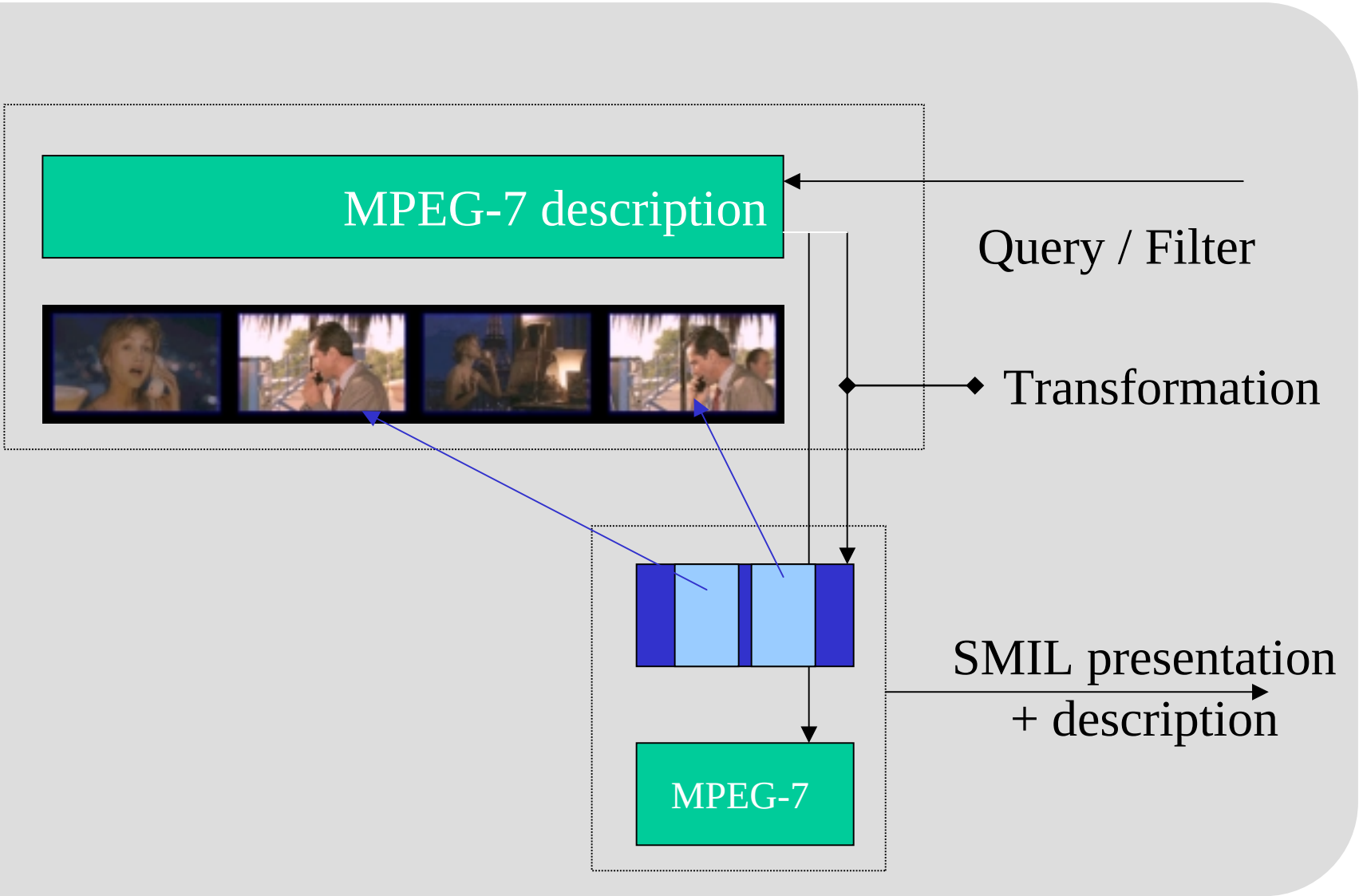
Mpeg7: AudioVisualSegment

Mpeg7: CreationInformation

Mpeg7: TextAnnotation



Automatic generation of presentation description



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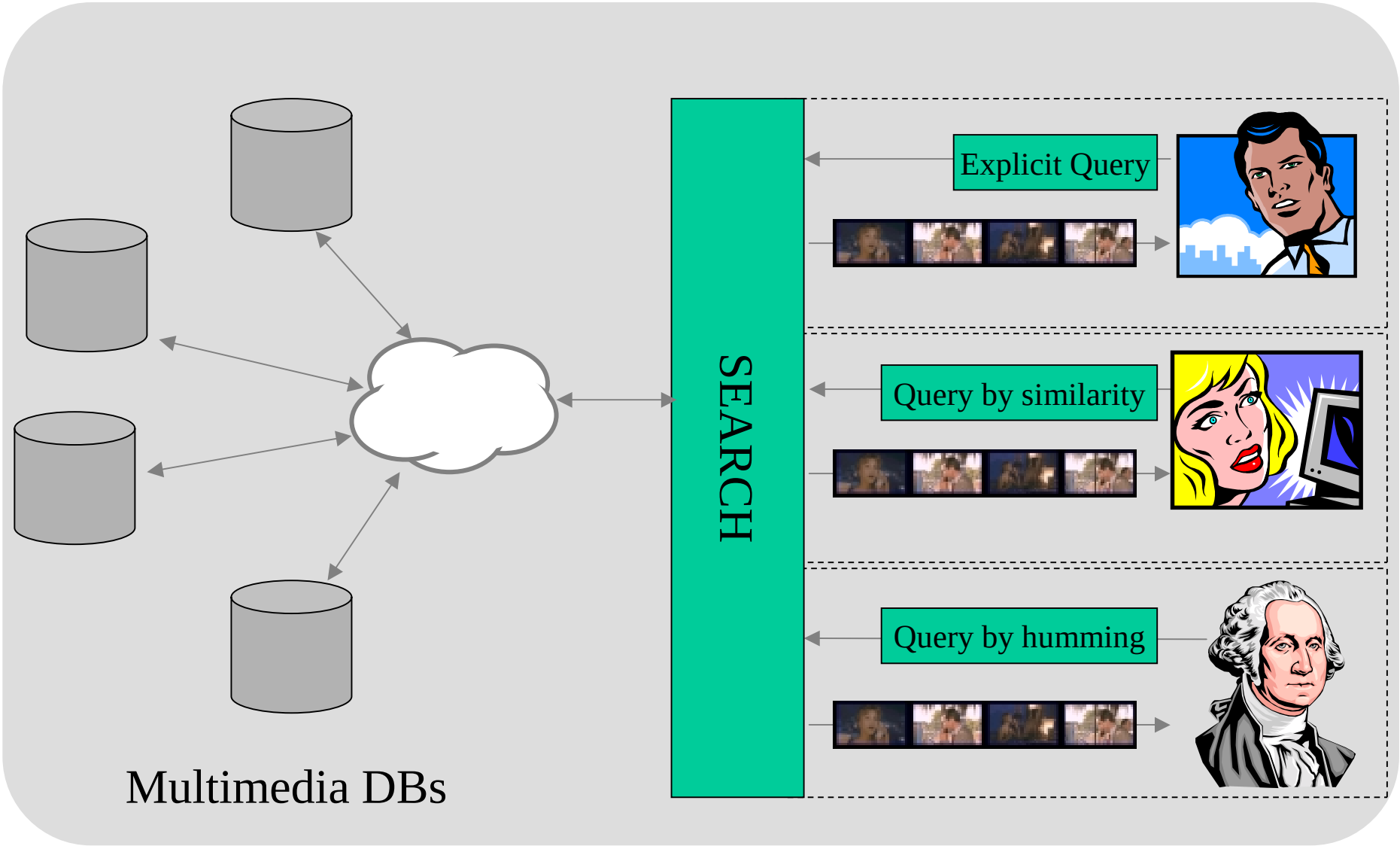
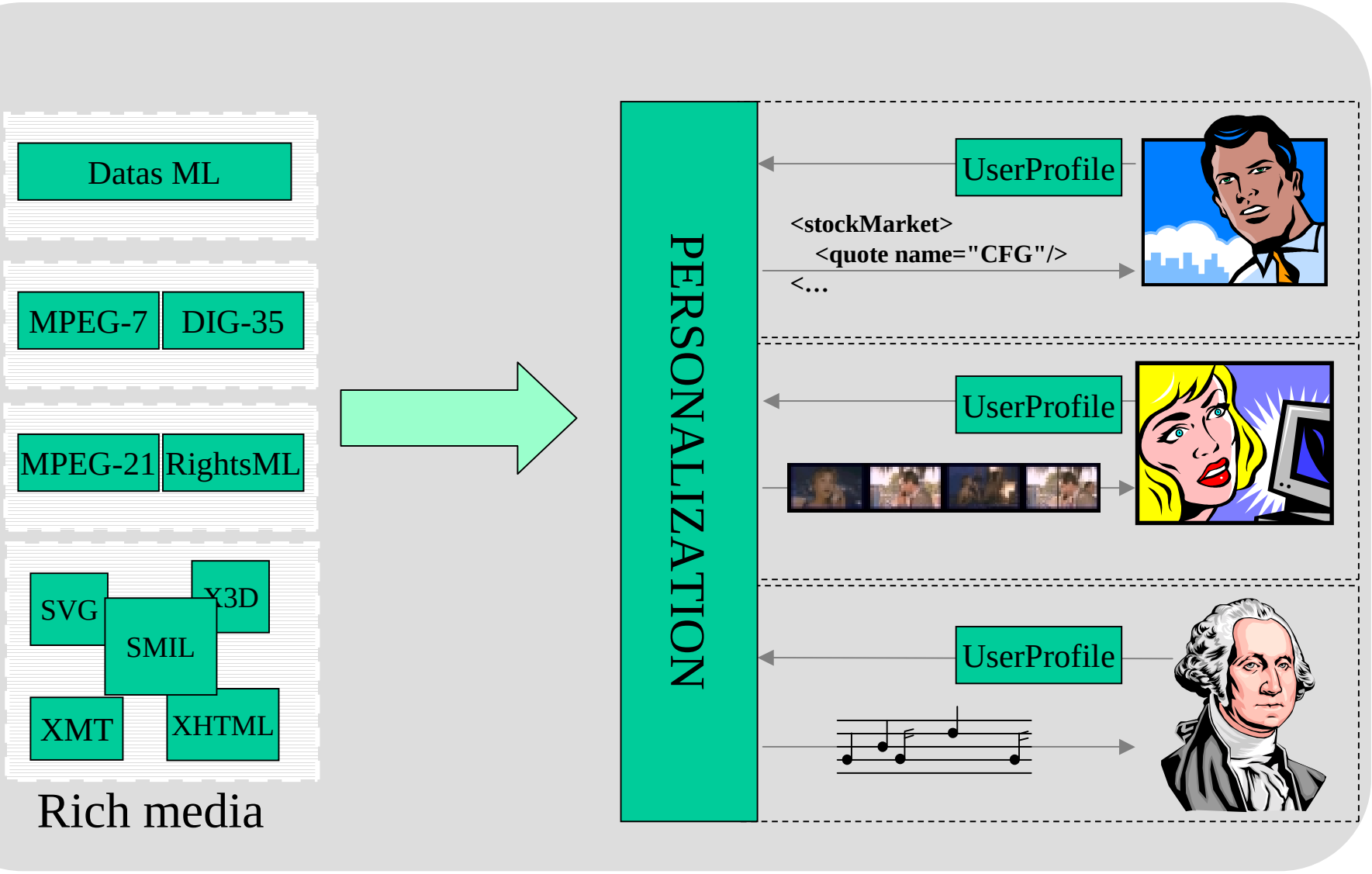
Multimedia content

new consumption models

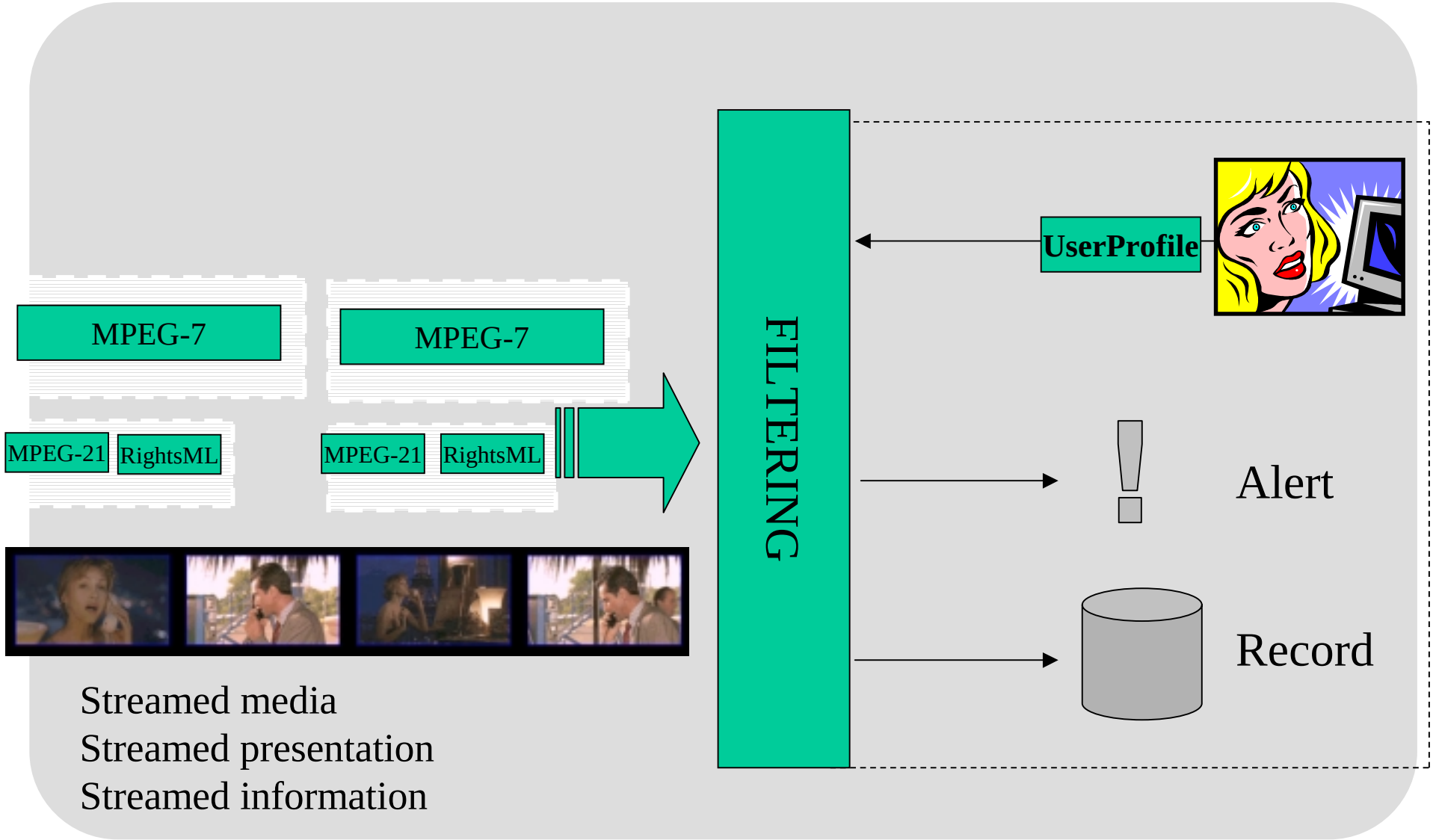
Search



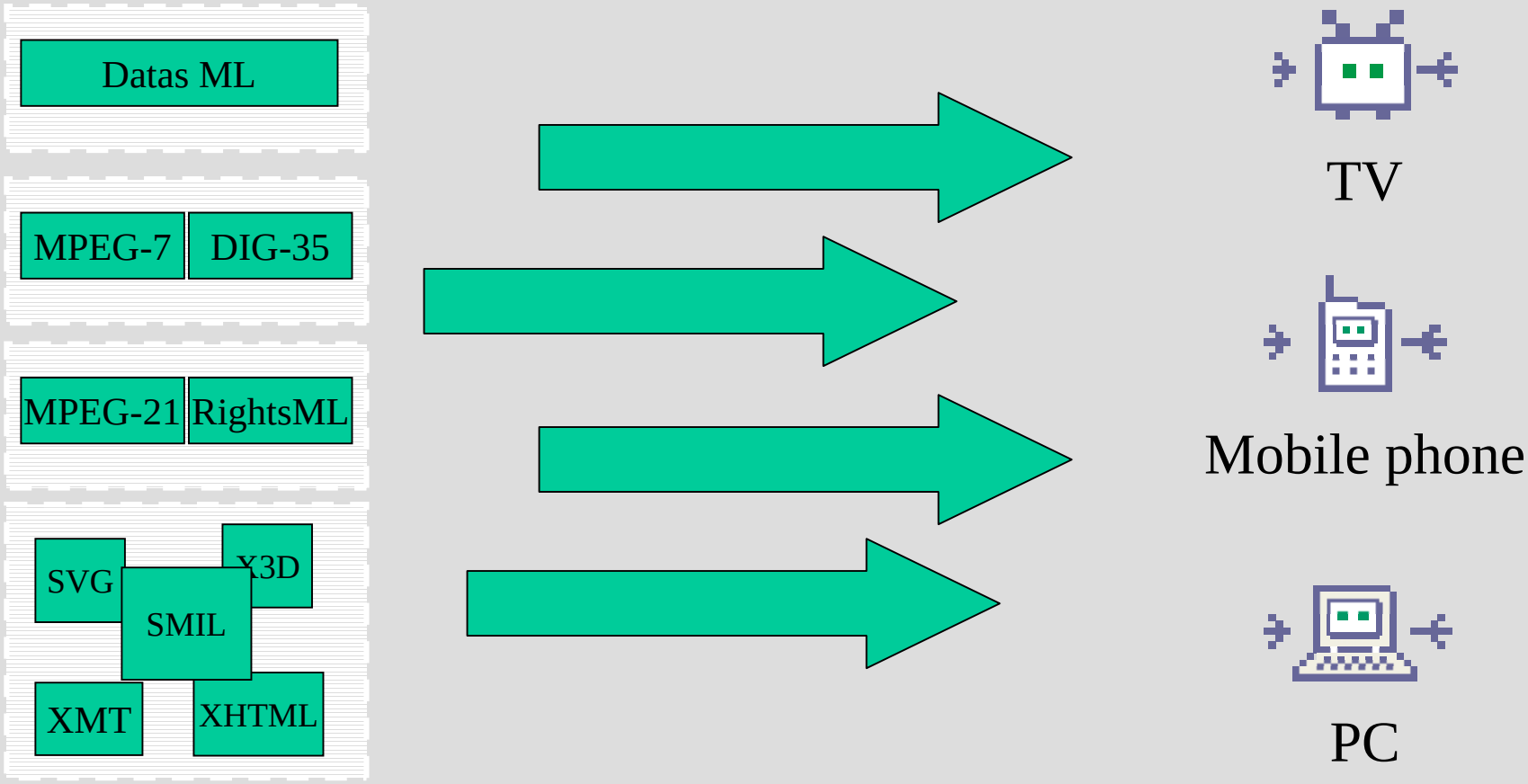
Personalization



Filtering



XML transfer



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Synthesis

- A wide variety of XML languages
  - For media — SMIL, SVG, …
  - For meta data — MPEG-7, DIG 35, …
  - For pure data — NewsML, FpML, …
- Different models of communication
  - Pushed or Pulled
  - Synchronous or asynchronous
  - Streamed or downloaded
- Different processing models
  - Transformation, adaptation
  - Personalization
  - Filtering, Search

More and more XML is sent to the client

To increase interactivity, flexibility

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MPEG-7 Systems – part 1

Efficient transmission of XML data

for MPEG-7 but also SMIL, SVG, ...

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Context

- Large volume of XML
- Environment constraints
  - Broadcast
    - Expensive bandwidth
    - Low end terminal – widely deployed
    - Unidirectional communication
  - Mobile
    - Expensive bandwidth
    - Low bitrate
  - Internet
    - Quality of service

→ A need for compact, efficient & streamable format

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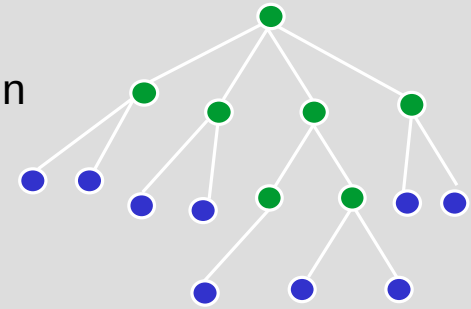
BiM Format
Main Characteristics

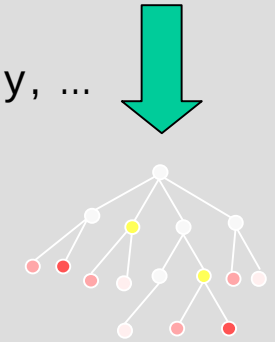
- Genericity
  - Works for any XML language
    - Adopted by international standards: MPEG-7, TV-Anytime, ARIB
    - Evaluated on : SVG, XHTML, NewsML, GML, SMIL, …
- High compression ratio
  - Average compression ratio: 85%
  - Very high compression ratio of the structure: 98%
    - ➔Highly structured documents for no cost !
- High processing speed
  - Up to 30 times faster than textual XML
    - Parsing done at the binary level

BiM Technology Main Principles

- Schema analysis
  - Generates automatically the syntax of the binary format
    - No need to develop both encoder and decoder (always in phase)
    - No need to design a specific binary format
    - Easy management of XML language evolution
    - ➔ Dramatically reduces development cost



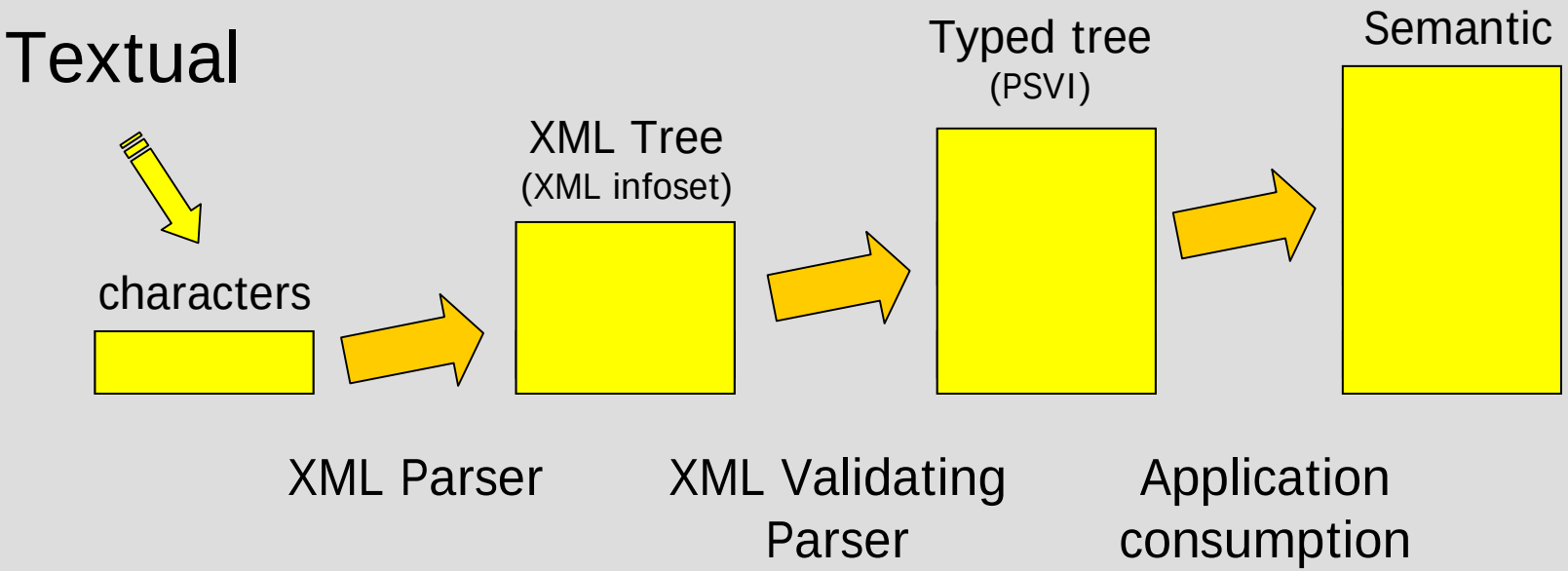
- Standard compression methods
  - For data
    - Compression : Statistical, Quantization, Dictionary, …
    - Encoding scheme: IEEE-754, UTF-8, UTF-16, …
  - For structure
    - FSA based : simple, efficient, scalable
    - ➔ Enables validation



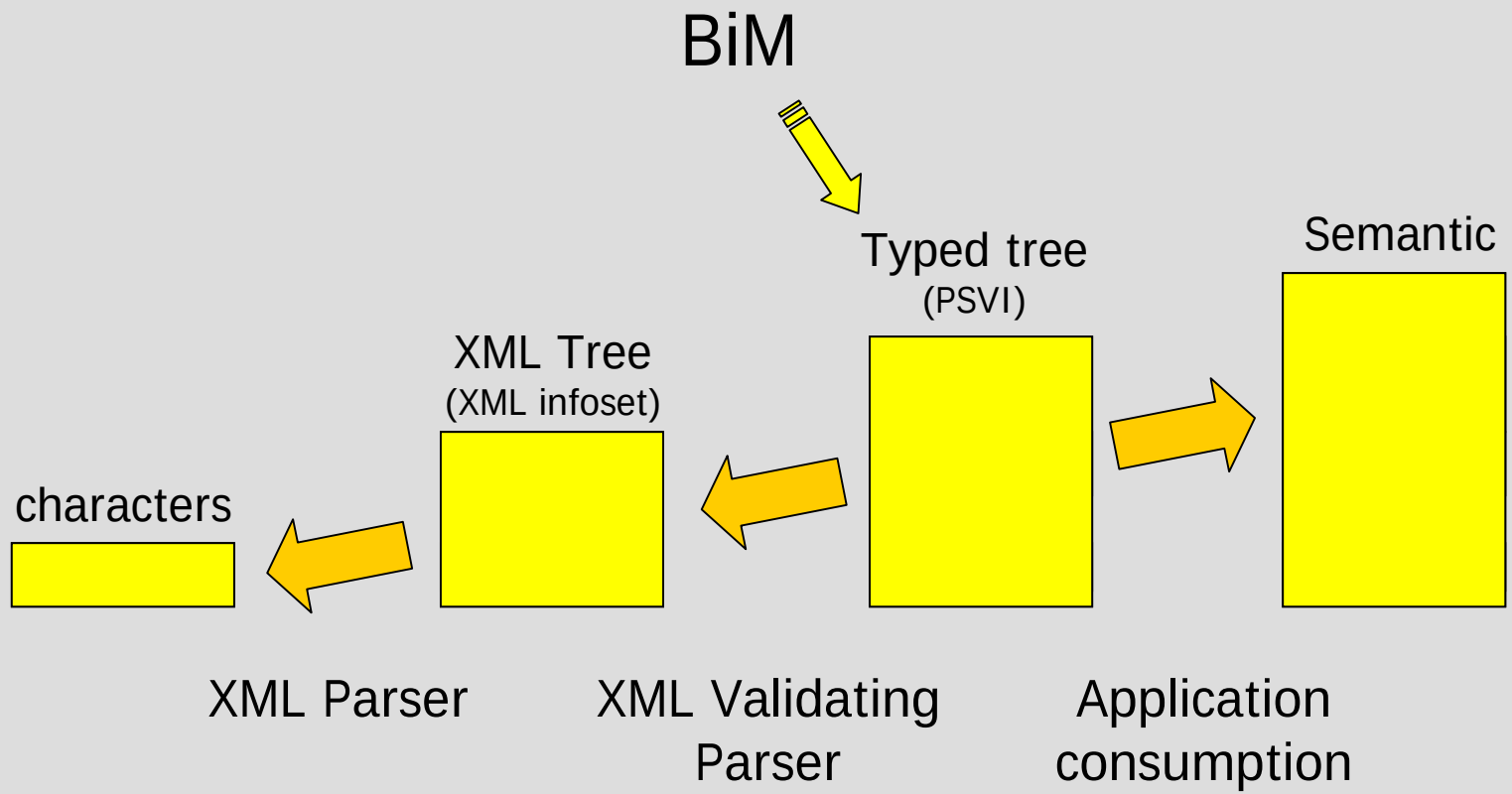
BiM Components
Main features

- Encoder-side parsing and validation
  - ➔ Allows very fast decoding, PSVI reconstruction
- Partial decoding
  - ➔ Improves filtering, large document parsing
- Flexible transmission
  - ➔ Allows progressive transfer, document update, …

Pipeline of Infosets



Pipeline of Infosets



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Encoder-side parsing and validation

- Pre-parsed format
  - No need for string matching, comparison
    - Identified elements & attributes
- Pre-validated format
  - No need for string conversion
    - Resolved entity, default values, types, normalized data

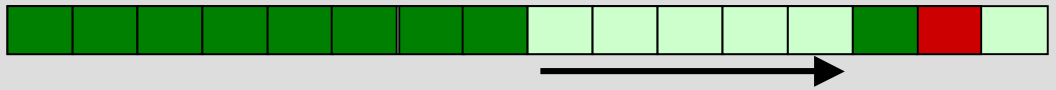
Decoding ⇔ Validating parsing

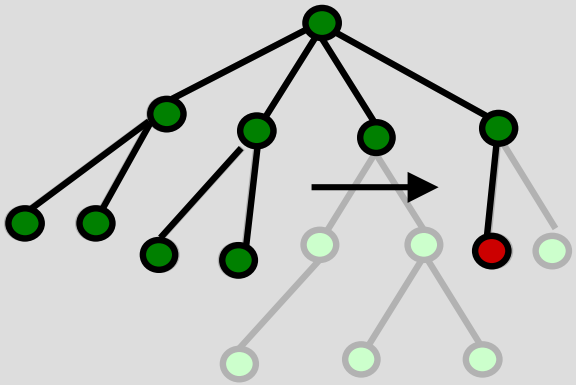
and

Direct access to the data

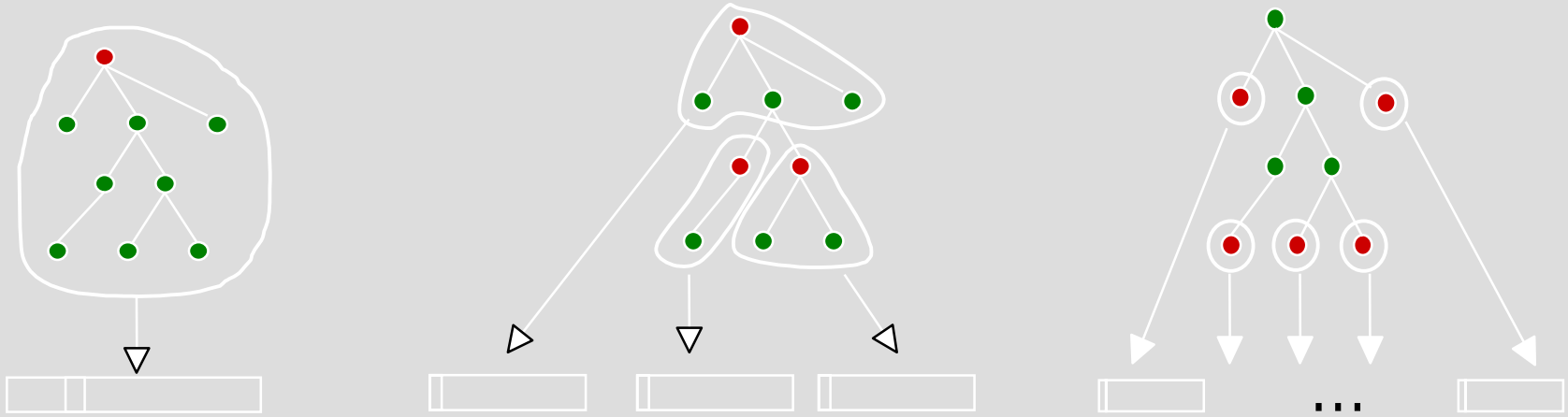
Partial decoding

- The decoder can skip document subparts





Flexible transmission



The entire document in one chunk

Sub-parts of the document in different chunks

Each leaf in one chunk

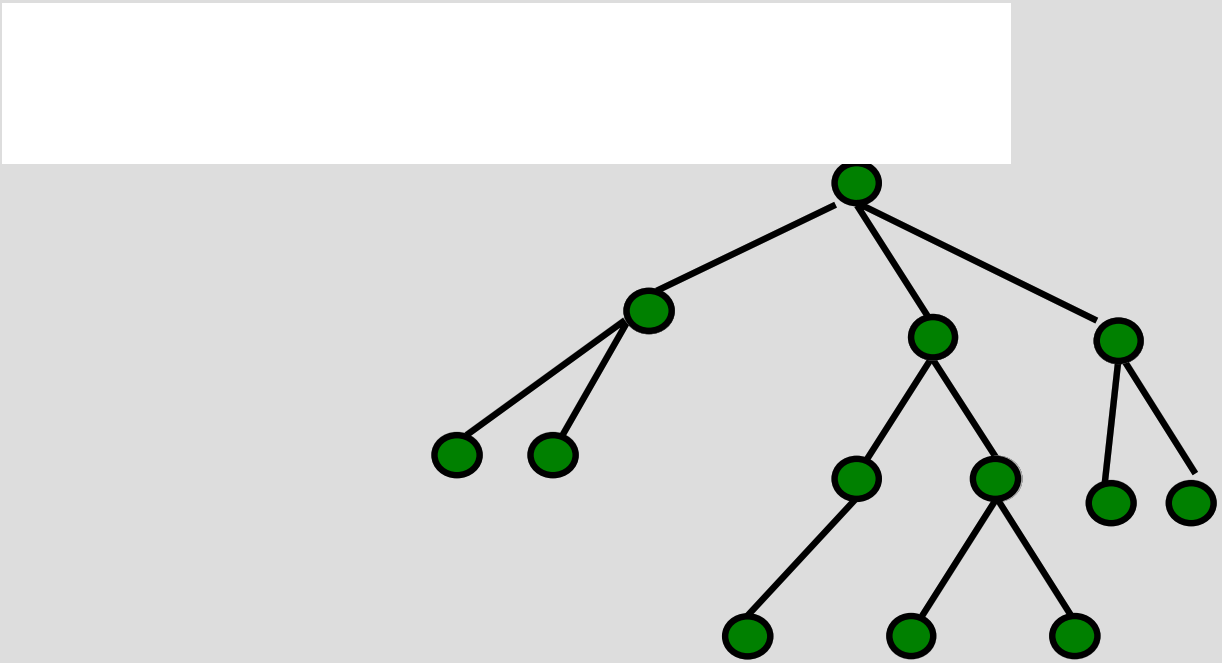
Flexible transmission

Use Case 1 – Progressive transfer

- An application can start using a document even if is not totally received
  - Improve pre-filtering
  - Allows pre-rendering
    - to reduce the perceived waiting time
  - ...

Back

Flexible transmission



Transmitted

To be transmitted

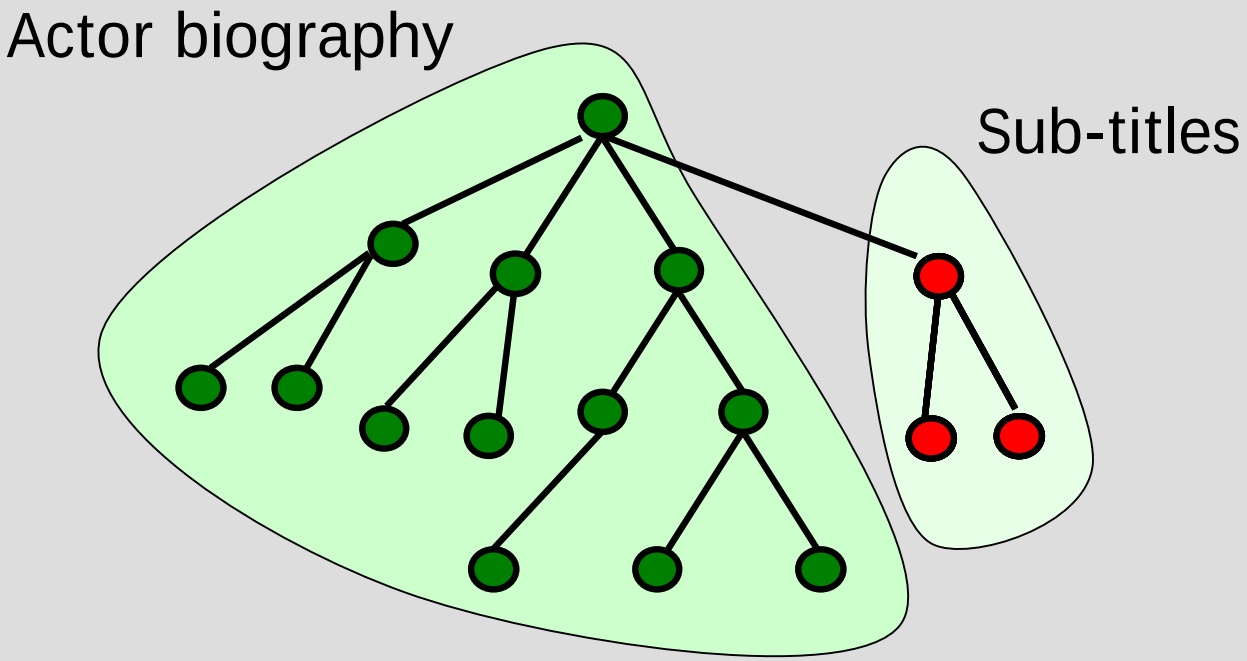
Flexible transmission

Use Case 2 – Dynamic updates

- Some documents change in time but all sub-parts do not evolve with the same frequency
  - Some sub-parts will never be updated
  - Others will be updated very often

Flexible transmission

Use Case 2 – Dynamic updates



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Conclusion

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Conclusion 1 / 4

- SMIL and MPEG-7
  - MPEG-7 as the semantic of an AV document
  - to generate SMIL presentations
  - to describe SMIL presentations
- More and more XML is being transmitted
  - For rich and interactive media
  - For metadata
  - For pure data exchange
- Several transmission and processing model
  - Streamed or downloaded
  - Client or server side adaptation / transformation

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Conclusion 2 / 4

- In this context MPEG-7 BiM
- Can be used to pack XML data in binary form
  - To save bandwidth / memory / CPU
  - To allow more XML to be used by low end devices
  - To improve quality of service
    - Reduce user perceived waiting time

Conclusion 3 / 4
SMIL / SVG / MP7 and BiM

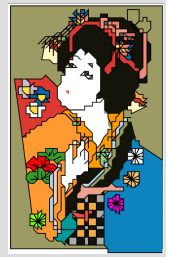
- Compressed and streamed XML
  - SMIL
    - Reduce starting time
    - Allow live events / real time presentation composition
  - SVG
    - Progressive loading of large files
    - Reduce memory consumption
  - MPEG-7
    - Filtering of presentations
    - Client side personalization of presentations

XML = **43333**

svgz = **9617**

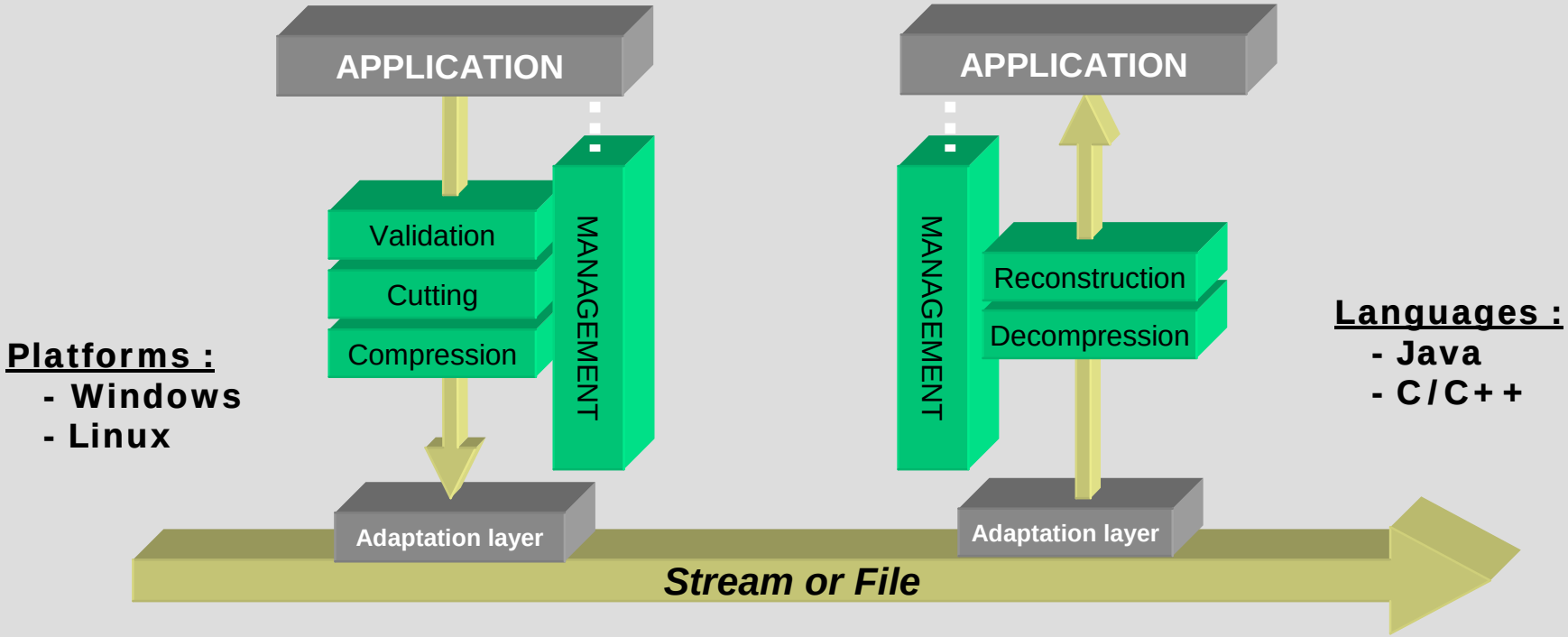
Lossless BiM = **5531**

Lossy BiM = **3521**



Conclusion 3 / 4
Expway products

- Bin-XML™ products allows to encode, decode and stream XML files



Credits

- Thank you
  - claude.seyrat@expway.fr
- More information
  - MPEG : http://www.cselt.it/mpeg
  - JPEG: http://www.jpeg.org
  - SVG and SMIL: http:// www.w3c.org
- Many thanks to Mr Takayuki KUNIEDA and its team from the Multimedia lab of Ricoh Japan
- Thanks to
  - Olivier Avaro, France Telecom
  - Antoine Quint, SVG consultant
  - Michael Wollborn, Bosch

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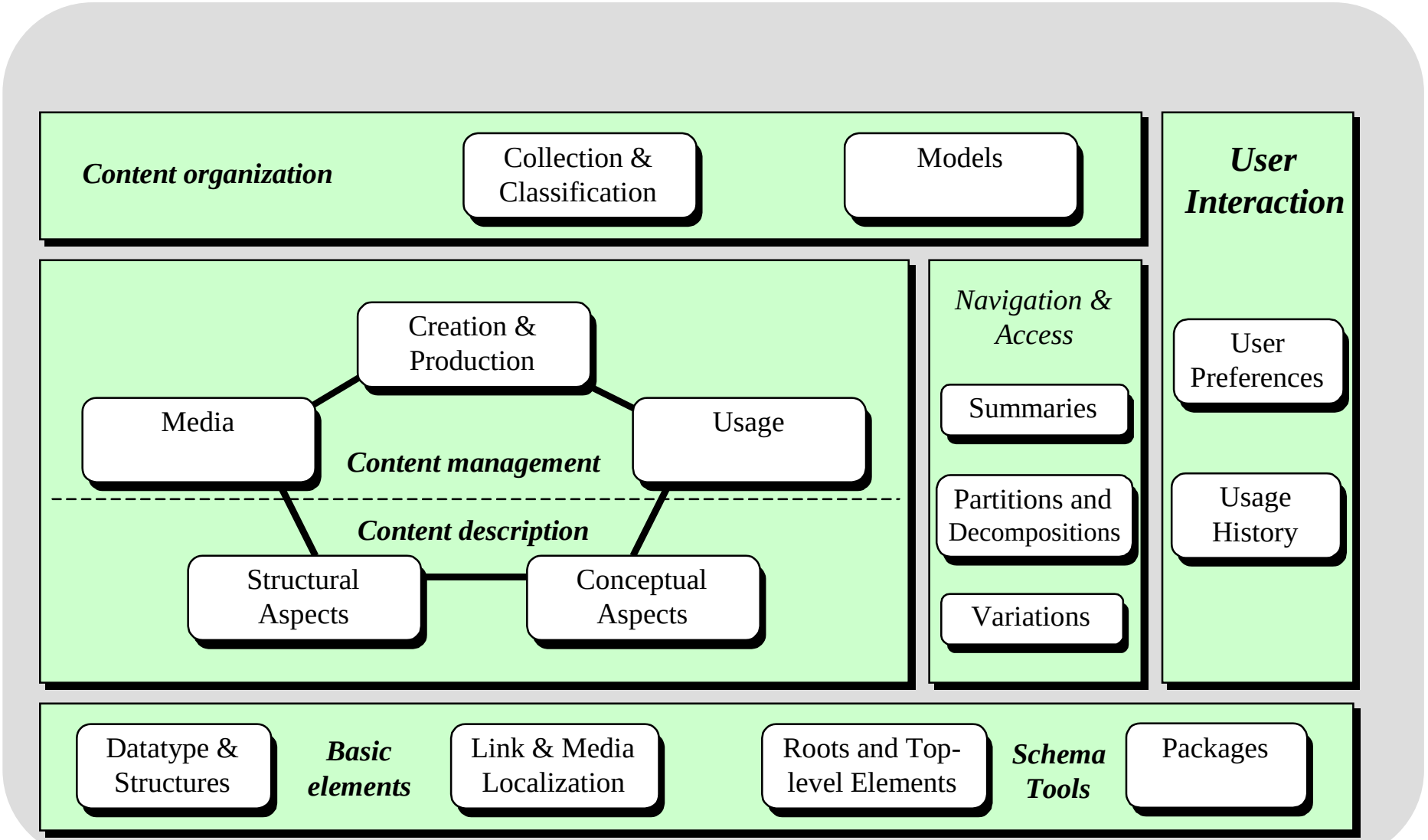
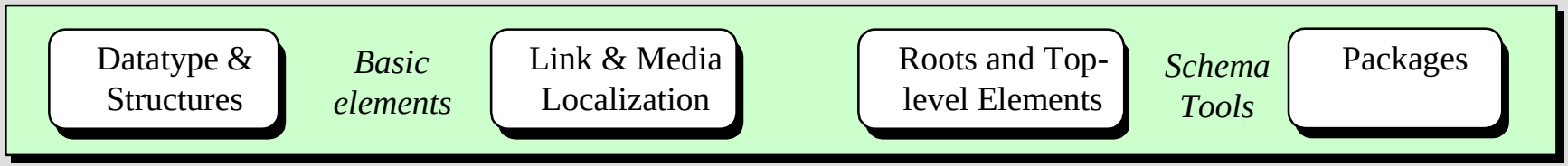
APPENDIX

MPEG-7 Part 5 - Details

General overview

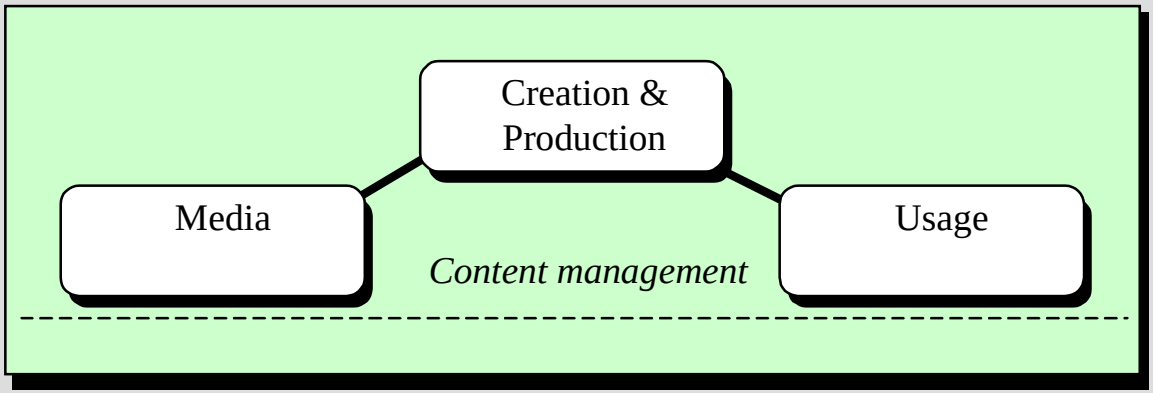


Basic Elements



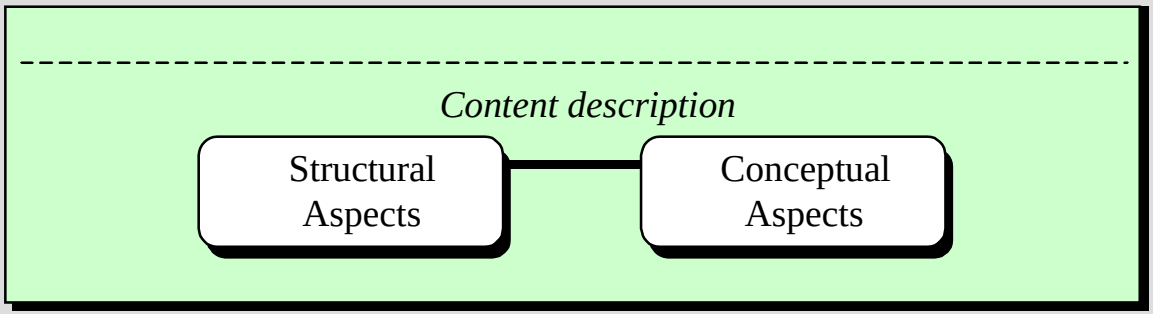
- Fundamental constructs :
  - Basic datatypes
  - Vectors, matrices
  - Linking and localization of segments
- DS for Time, place, person, individuals, …
- Textual annotation : free, structured, …

Content Management



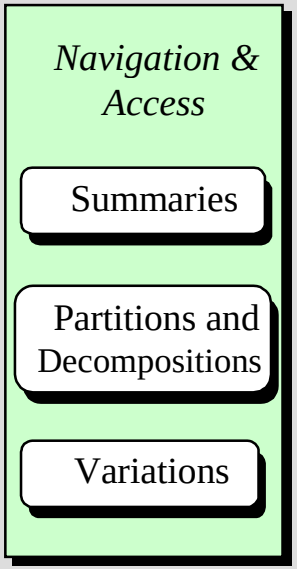
- Creation information
  - Title, creators, creation location, classification
- Usage information
  - Rights, availability, financial
- Media information
  - Coding format, coding parameters, aso…

Content description



- Structural information
  - Video segments, table of content, …
- Conceptual description
  - Events, objects, relationships,…

Navigation and access

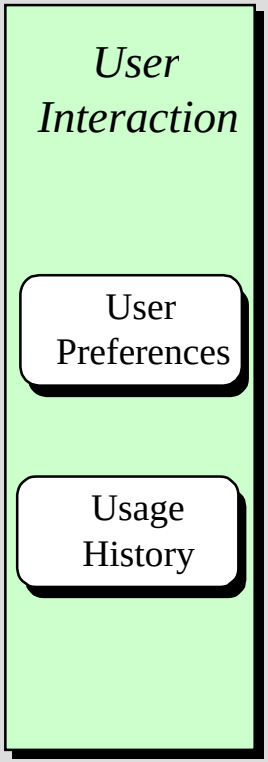


- Summaries
  - For browsing, navigation, visualization, …
  - Hierarchical or sequential.
- Partitions
  - Different view of the document
- Variations
  - About different versions,
  - Coding format, lossy compression,

Content organization

- Collections
  - Organizing collections of documents
  - unordered sets of AV data
- Models
  - Descriptions of collections or classes of AV content
  - Probability, Cluster, Analytic

User Interaction



- User Preferences
  - Tools for describing user preferences about AV content
- Usage History
  - History of the preferences