



VK Multimedia Information Systems

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Dienstags, 16.00 Uhr s.t., E.1.42



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Administrative



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- Lesson 11 – Metadata
 - Today
- Lesson 12 – Audio
 - June 9th
- Lesson 13 – Projects
 - June 16th
- Lesson 14 – Projects
 - June 23rd

June 16th



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1. Guggenberger, Müller
2. Pairitsch, ...
3. Korak, ...

Contents



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- **Introduction to Metadata**
- **Metadata Formats**
 - Media Production
 - Ontologies
 - Home User
- **MPEG-7**
- **MPEG-21**
- **Metadata Generation & Annotation**



What is Metadata?



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Metadata is Data about Data

Meta² data is data about metadata

Metadata Applications



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- Retrieval & Browsing
 - No need to download / view the whole video
- Management & Organization
 - Rights, Billing, Ordering, Classification
- Adaptation
 - Transformation to appropriate representation
- Service Description
 - Orchestration, Harmonization, Access
 - On technical and semantic level

Metadata Problems



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- Interoperability
 - Complexity & power of metadata models
 - Integration in (different) applications & scenarios
- Preservation
 - Readability in 100, 1000 years
 - Description how to decode ...
- Transmission
 - Synchronized, partially, etc.
- Timeliness
 - Changing with audiovisual content while editing?

Aspects of Metadata



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- Content Description
- Administrative Aspects
- Quality Metadata
- Legal Metadata
- Technical Metadata

Aspects of Metadata: Content Description



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- Agenda
 - Overview on sequence of information to particular topic
- Table of Contents
 - A list of all segments and their position
- Abstract
 - Describes the topic of a content within a few sentences
- Preface
 - Some words of the author ...
- Structure
 - For consumption & navigation

Aspects of Metadata: Content Description



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- Keywords & index
 - Content description and lookup of concepts
- Summary
 - Overview of the most important aspects
- Literature reference & footnotes
 - Additional material
- Comments
 - For interactive environments
- Categories
 - Conceptual classification in taxonomies (genre etc.)
- Languages
 - Which languages are used / available

Aspects of Metadata: Administrative Metadata



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- Associated persons
 - Authors: who created the content
 - Contributors: who contributed to the content
- History of changes
 - Changes in content and metadata
 - with author, date, location and sort of action
- Unique identifier
 - e.g. URI or database id
- Versions
 - Versioning information ... related to the history

Aspects of Metadata: Quality Aspects



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- Weight
 - Prioritization of segments
- Expiration Date
 - Time period of validity of the content
- Recessions
 - Opinions, arguments from others
- Process description & history
 - Who corrected, translated and approved the content e.g. within an workflow
- Quality Assessment
 - Rating of the (e.g. visual) quality of the content

Aspects of Metadata: Legal Metadata



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- Copyright
 - Person or company legally permitted to sell or trade with the content
- Publishing Date
 - Date when the content has been released to public
- License Model
 - Defines how consumers are allowed to reuse the content

Aspects of Metadata: Technical Metadata



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- Standards
 - Description of the standardized structure in which the content and the metadata are stored
- Application/System
 - Application the content and metadata can be / has been processed
- Resolution, compression of pictures or video clips
- Encryption Method
 - In case of encrypted content
- Storage Media
 - On which the content has been stored e.g. CDs, tapes, MO, paper etc.
- Logs
 - Technical history

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Standards Preface: XML



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- eXtensible Markup Language
- Recommendation by the W3C
 - Simplification of SGML
- Base language for many other recommendations
 - SVG, XHTML, SMIL, ...

XML: Overview



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- Header identifying version & coding
- Tree-like structure
- Simple structuring elements
 - Tags & attributes (Markup)
 - Entities
- DTD and XML Schema for model definition
 - DTD is 'simple' and small
 - XML Schema is XML based and rather powerful

XML Benefits



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- Existing Parsers
 - Document Object Model (DOM)
 - Tree structure in memory
 - Access through navigation in tree
 - Simple API for XML (SAX)
 - Event based, sequential
 - Low memory footprint, no random access
- Schema of data has to be defined
 - Parsers implementation is simple

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Media Production: Dublin Core



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- Aims to provide
 - Common denominator for metadata
 - Simple yet powerful schema
- Dublin Core Metadata Initiative defined
 - 15 elements (author, date, title, type, ...)
 - Further refinements (creation date, extent, ...)
- Dublin Core does not provide
 - A schema for storage
 - A schema for data types (e.g. dates)

Media Production: EBU P/Meta



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- Aims to provide ...
 - a universal standard for metadata exchange between professional media organizations
 - a definition of common meaning to the data fields and values that most broadcasters use in order to enable exchange
 - designed for use in a wide range of broadcasting activities
 - both language and system independent
 - a joint development by EBU (European Broadcasting Union) members on a not-for-profit basis
 - a scheme that makes use of other standards where possible, e.g. ISO country codes

Media Production: Other Standards



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- SMPTE Metadata Dictionary
 - Society of Motion Picture and Television Engineers
 - Since 1916, 61 members
 - Standard for metadata exchange in TV
 - Defines set of attributes / fields
- MXF DMS-1
 - Metadata bundled with the Material Exchange Format (MXF)
 - Open format for the broadcasting area (SMPTE + EBU)
- Virtually 'no information' about these is available
 - Just for exchange for insiders
 - Might not be royalty free

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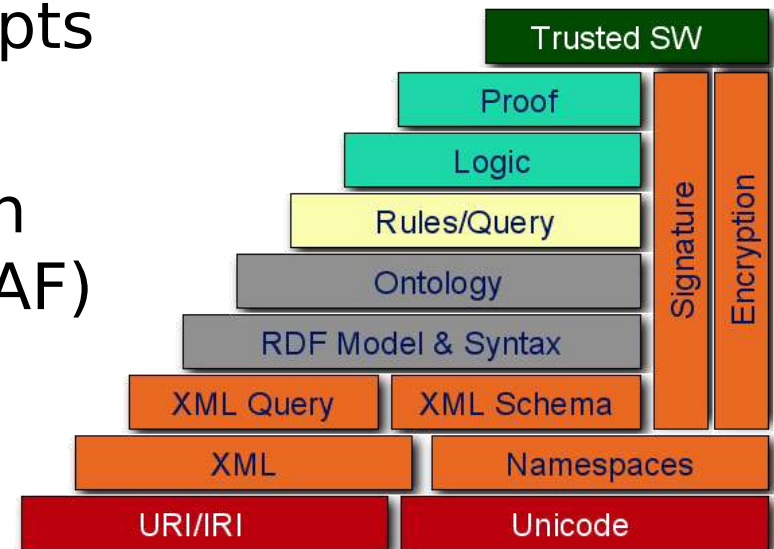


Ontologies: RDF



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- Metadata Model published by the W3C
 - Reaction on the insufficiency of HTML metadata for search & inference
 - Based on “Subject – Predicate – Object” triples
 - URIs for identifying concepts
 - Spans a directed graph
 - Is used in conjunction with vocabularies (e.g. DC, FOAF)



Ontologies: SKOS



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- Simple Knowledge Organization System
 - RDF Vocabulary for KOS
- Knowledge Organization Systems are
 - Taxonomies, Thesaurii, Classification Schemes, etc.
- Can be used to organize multimedia data

Ontologies MMSEM



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- Multimedia Semantics : Incubator Activity of the W3C
 - Closed Aug. 2007

Deliverables:

- Image Annotation on the Semantic Web.
 - use cases and general discussion about Semantic Web vocabularies and tools
- Multimedia Annotation Interoperability Framework.
 - a bottom-up approach to provide a simple extensible framework to improve interoperability
- MPEG-7 and the Semantic Web.
 - four current OWL/RDF proposals of MPEG-7, as well as a comparison of the different modeling approaches in the context of practical applications.

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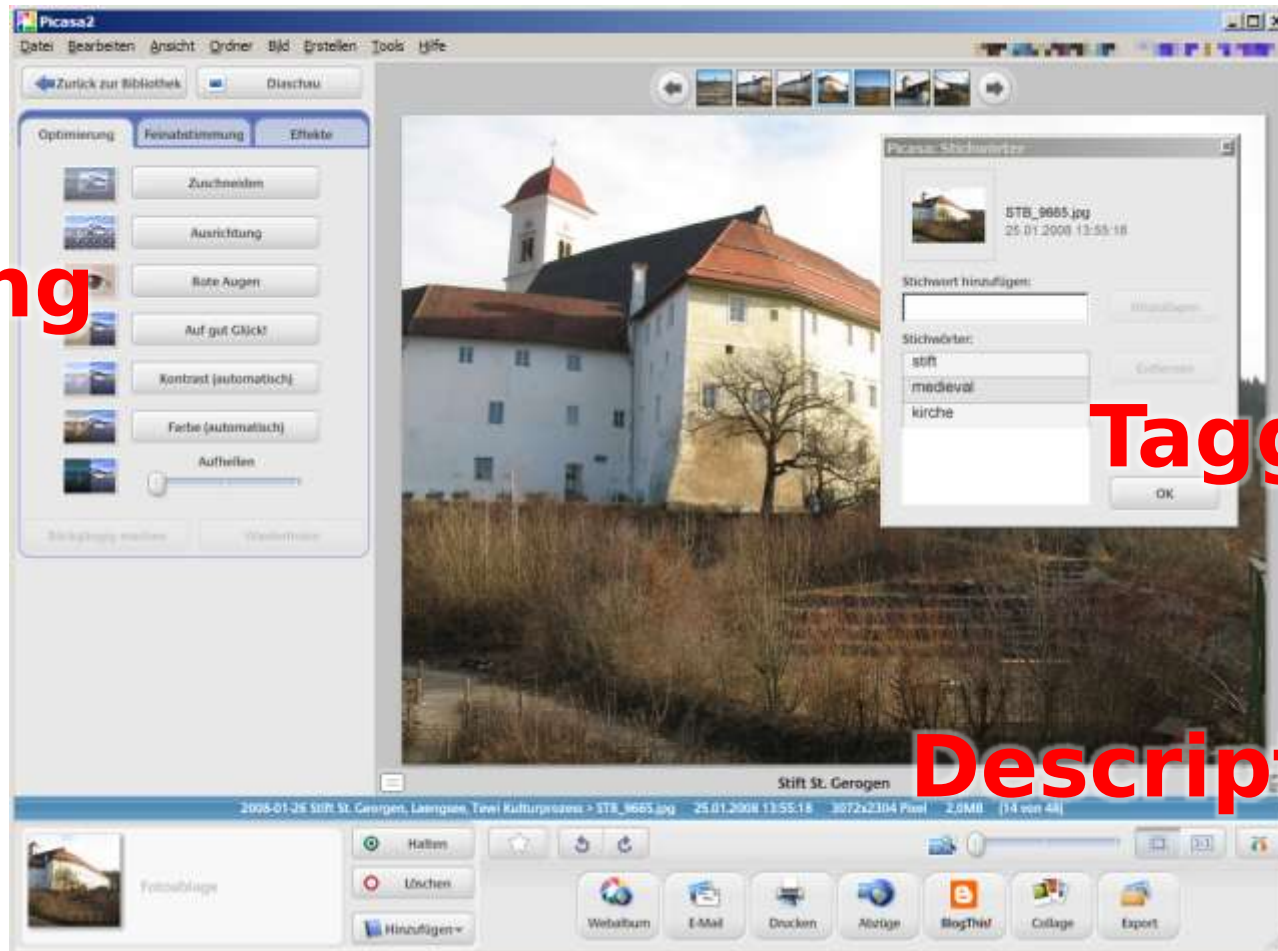


Home User: Metadata Applications



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Editing



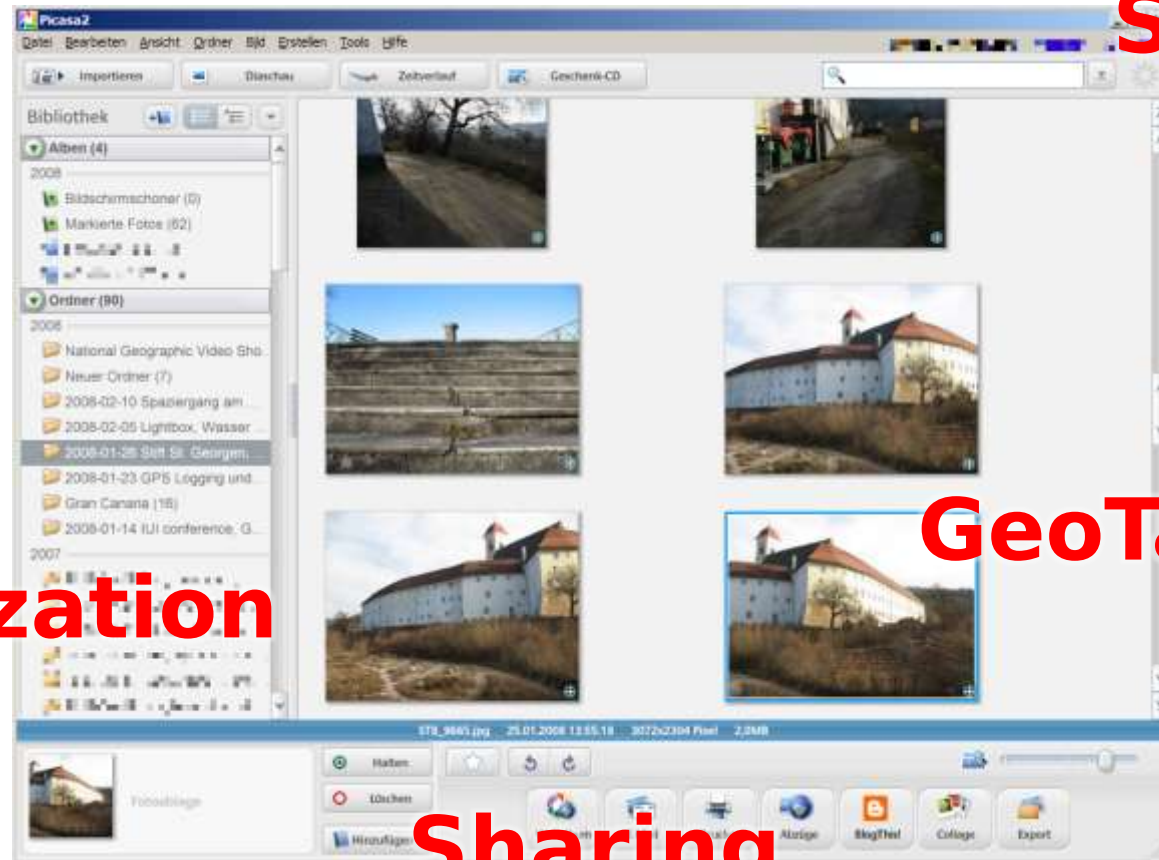
Tagging

Descriptions

Home User: Metadata Applications



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Search

GeoTagging

Sharing

Organization

Home User: EXIF



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- Exchangeable Image File Format (EXIF)
 - Japan Electronic and Information Technology Industries Association (JEITA)
 - Extensive format for technical aspects
 - Settings and sensor readings at the time of recording
 - Mostly images from digital cameras

EXIF - Example



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Make - Canon
Model - Canon PowerShot A620
Orientation - Top left
XResolution - 180
YResolution - 180
ResolutionUnit - Inch
DateTime - 2008:02:10 15:44:58
YCbCrPositioning - Centered
ExifOffset - 198
ExposureTime - 1/200 seconds
FNumber - 2.80
ExifVersion - 0220
DateTimeOriginal - 2008:02:10 15:44:58
DateTimeDigitized - 2008:02:10 15:44:58
ComponentsConfiguration - YCbCr
CompressedBitsPerPixel - 5 (bits/pixel)
ShutterSpeedValue - 1/202 seconds
ApertureValue - F 2.80
ExposureBiasValue - 0.00
MaxApertureValue - F 2.80

GPS information: -
GPSVersionID - 2.2.0.0
GPSLatitudeRef - N
GPSLatitude - 46 40 41.41
GPSLongitudeRef - E
GPSLongitude - 13 58 22.17
GPSAltitudeRef - Sea level
GPSAltitude - 503 m
GPSTimeStamp - 14 44 58

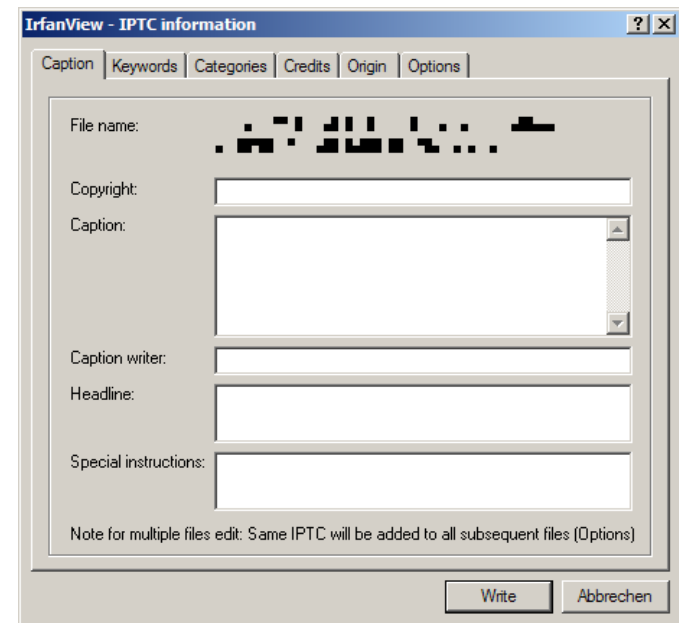
Maker Note (Vendor): -
Macro mode - Normal
Self timer - Off
Quality - Superfine
Flash mode - Auto + red-eye reduction
Sequence mode - Single or Timer
Focus mode - Single
Image size - Large
Easy shooting mode - Portrait
Digital zoom - None

Home User: IPTC



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- IPTC Information Interchange Model (IIM)
 - Several elements to describe images (assets)
 - Rather common format
 - Adobe Bridge / Photoshop
 - Google Picasa
 - Irfanview ...
 - Like a *predefined metadata form* ->



- eXtensible Metadata Platform (XMP)
 - Initiative from Adobe
 - Based on RDF, embedded in document
 - Also used in PDF, AI, PSD, etc.
- ID3
 - Metadata for MP3, spread by popular players
 - Two versions ...
 - v1: 128 Byte block coding some fields at end of file
 - v2: Several optional tags inside stream



- Electronic Program Guide (EPG)
 - In use in conjunction with DVB
 - Simple format in additional stream
- Multimedia Home Platform (MHP)
 - In use in Austrian DVB-T
 - Proprietary format for data + function
 - Based on Java

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- ISO/IEC Standard: **Multimedia Content Description Interface**
- Moving Pictures Expert Group
 - Specification goes on ...
- It's based on XML (Schema)
 - Binary representations possible (BiM)
- Allows differing granularity of descriptions
 - Extensive to very simple

MPEG-7 History



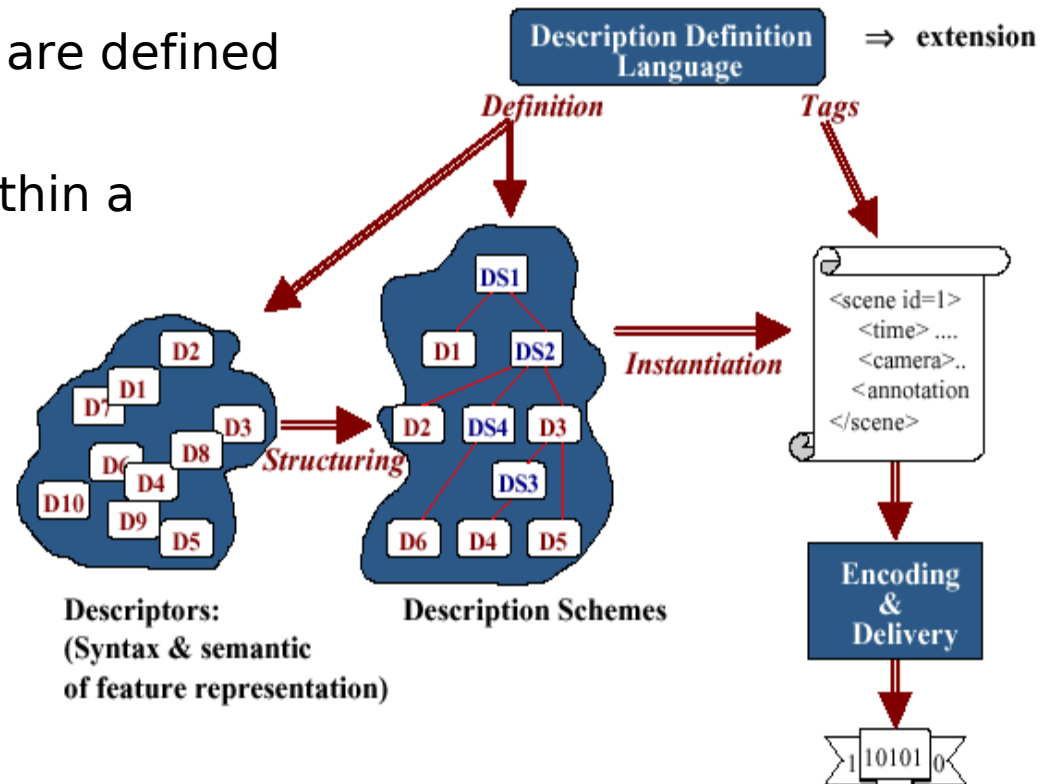
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- Call for Proposals: October 1998
- Evaluation: February 1999
- First version of Working Draft (WD): December 1999
- Committee Draft (CD): October 2000
- Final Committee Draft (FCD): February 2001
- Final Draft International Standard (FDIS): July 2001
- International Standard (IS): September 2001

MPEG-7 Basics

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- Descriptors
 - Syntax and semantics of exactly one (low or high level) elementary feature
 - Also base data types are defined
- Description Schemes
 - Defines structures within a framework
- Description Definition Language (DDL)
 - Extension of XML Schemes
- Coding Schemes
 - Create and interpret descriptions in BiM



MPEG-7 Parts



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1. MPEG-7 Systems

- Tools needed to prepare MPEG-7 descriptions for efficient transport and storage and the terminal architecture.

2. MPEG-7 Description Definition Language

- Language for defining the syntax of the MPEG-7 Description Tools and for defining new Description Schemes.

3. MPEG-7 Visual

- Description Tools dealing with (only) visual descriptions.

4. MPEG-7 Audio

- Description Tools dealing with (only) audio descriptions.

5. MPEG-7 Multimedia Description Schemes

- Description Tools dealing with generic features and multimedia descriptions.

MPEG-7 Parts



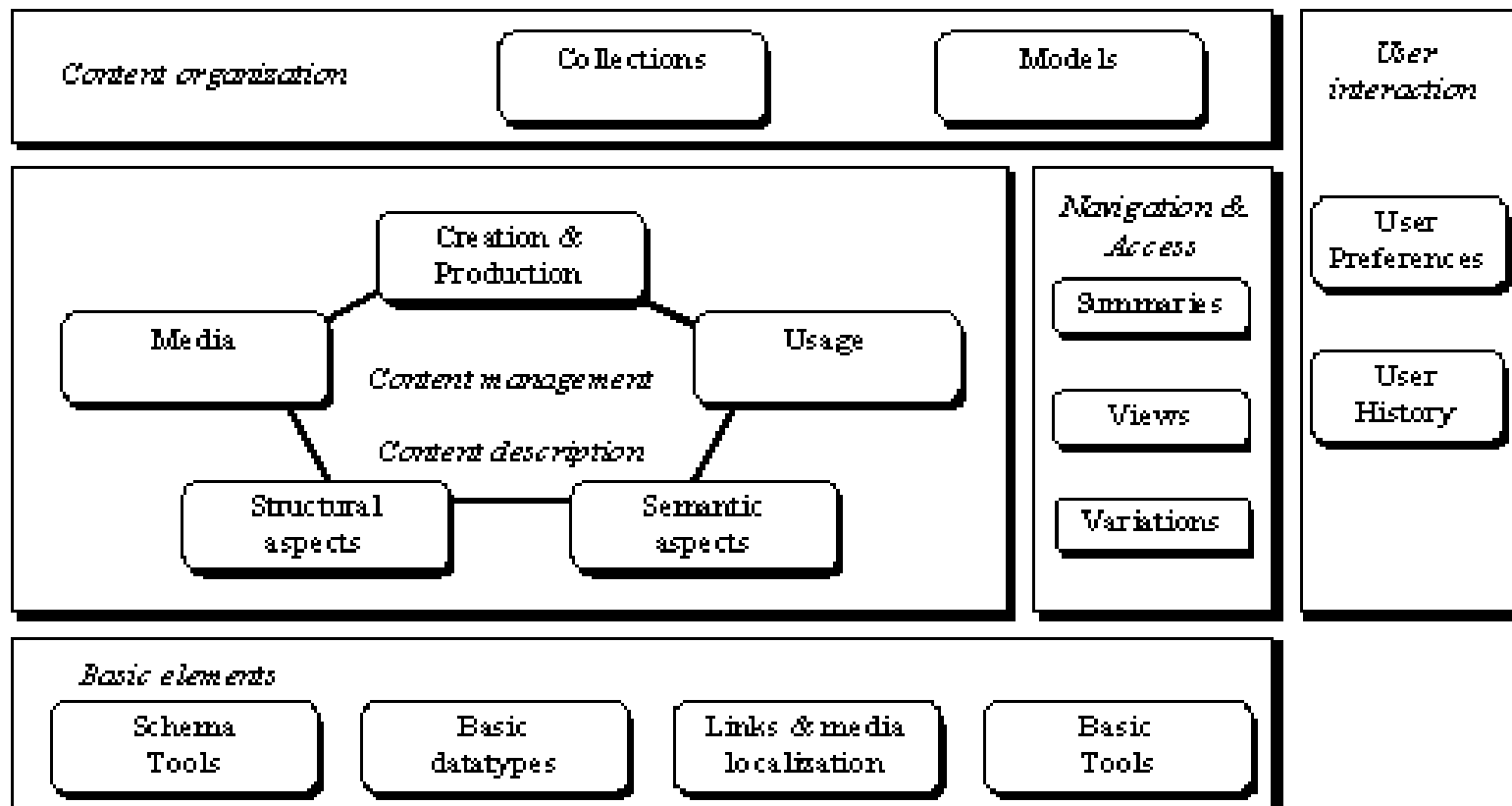
<http://www.uni-klu.ac.at>

6. MPEG-7 Reference Software
 - Implementation of relevant parts of the MPEG-7 Standard with normative status.
7. MPEG-7 Conformance Testing
 - Guidelines and procedures for testing conformance of MPEG-7 implementations
8. MPEG-7 Extraction and Use of Descriptions
 - Informative material about the extraction and use of some of the Description Tools.
9. MPEG-7 Profiles and levels
 - Provides guidelines and standard profiles.
10. MPEG-7 Schema Definition
 - Specifies the schema using the Description Definition Language

Scope of MPEG-7



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from: <http://www.chiariglione.org/mpeg/standards/mpeg-7/mpeg-7.htm>

Basic Elements



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Basic elements are fundamental constructs and used throughout the whole MPEG-7 description

- Basic datatypes
 - Time and date, relative and absolute
 - Numeric datatypes like matrices and vectors
- Links & Media Localization
 - Interconnections and content linking

Navigation & Access



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- Descriptors for Browsing & Retrieval
 - Summaries
 - Partitions (time, space & frequency)
 - Decompositions (time, space & frequency)
 - Variations

User Interaction



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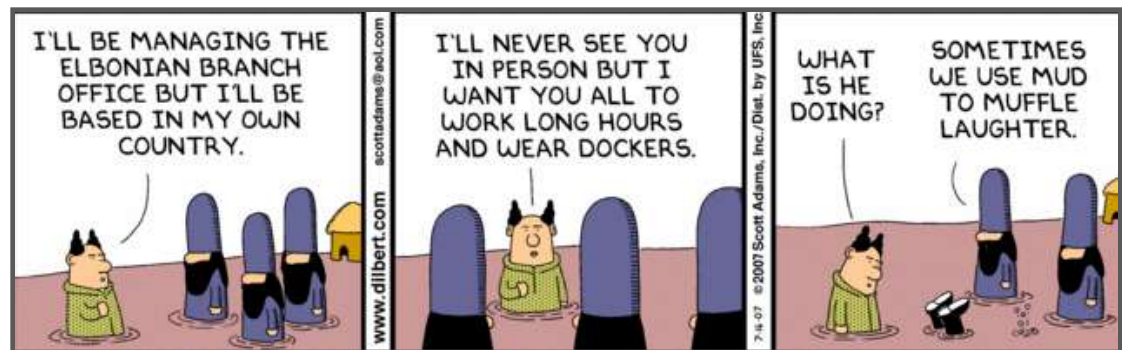
- Pertaining consumption of AV data
 - user preferences
 - usage history
- Meant to facilitate personalization
 - Matching User Interaction DS with content description
 - Is research topic @ ITEC

Content Organization



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- Organization & modelling of collections
 - Audio-visual content, segments, events, and/or objects
 - E.g. pictures, scenes, music files, etc.
 - Allows collection description as a whole
 - E.g. “Pictures of my holiday in Ebonia”



Content Management



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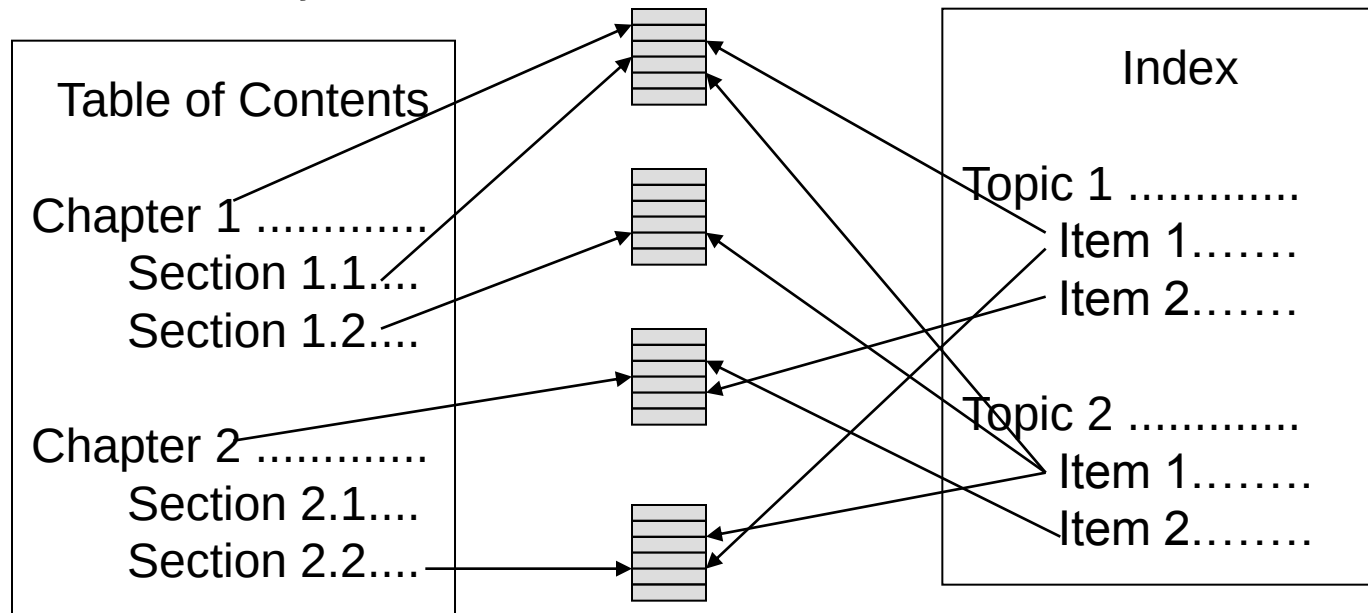
- Creation & Classification
 - Title, textual annotation, creators, creation locations, and dates.
 - Categories such as genre, subject, purpose or language.
 - Review and guidance information: Age classification, parental guidance, and subjective review.
 - Related material information.
- Media coding, storage & file formats
 - Media profiles & master media
- Content Usage
 - Usage rights, usage record, and financial information

Content Description: Structural vs. Conceptual Aspects



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- Program DS (in sense of TV program)
- Analogy to
 - Table of content – Region tree (linear partitioning)
 - Index – Object tree (non-linear structure)

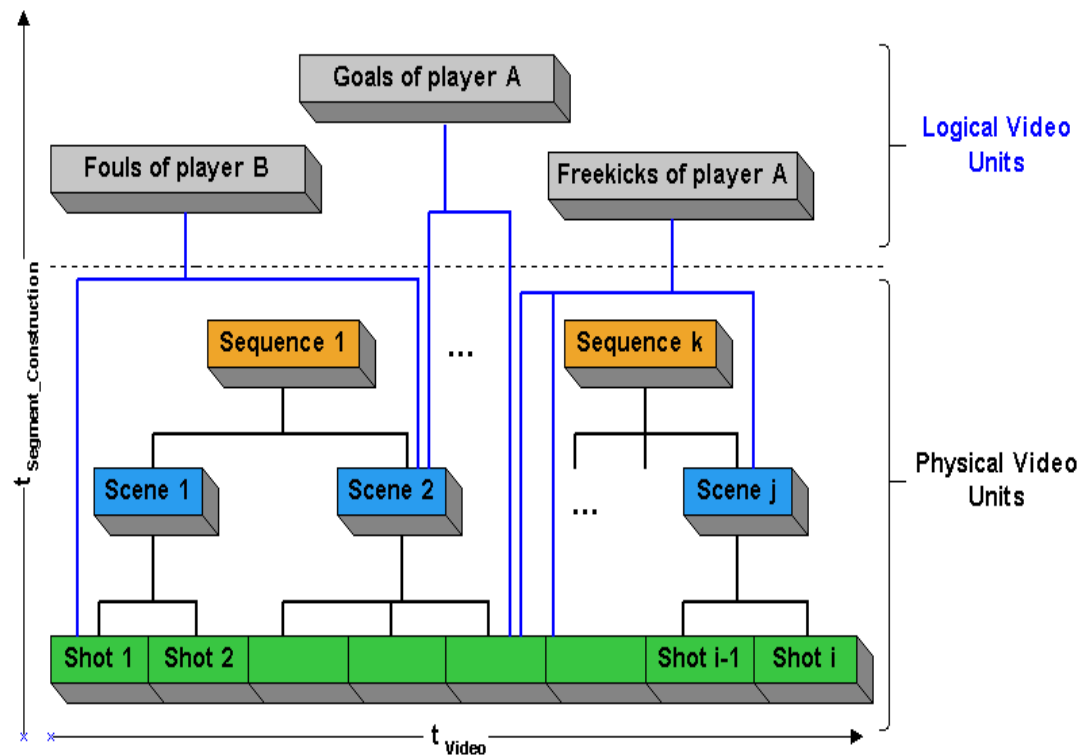


Content Description: Structural Aspects



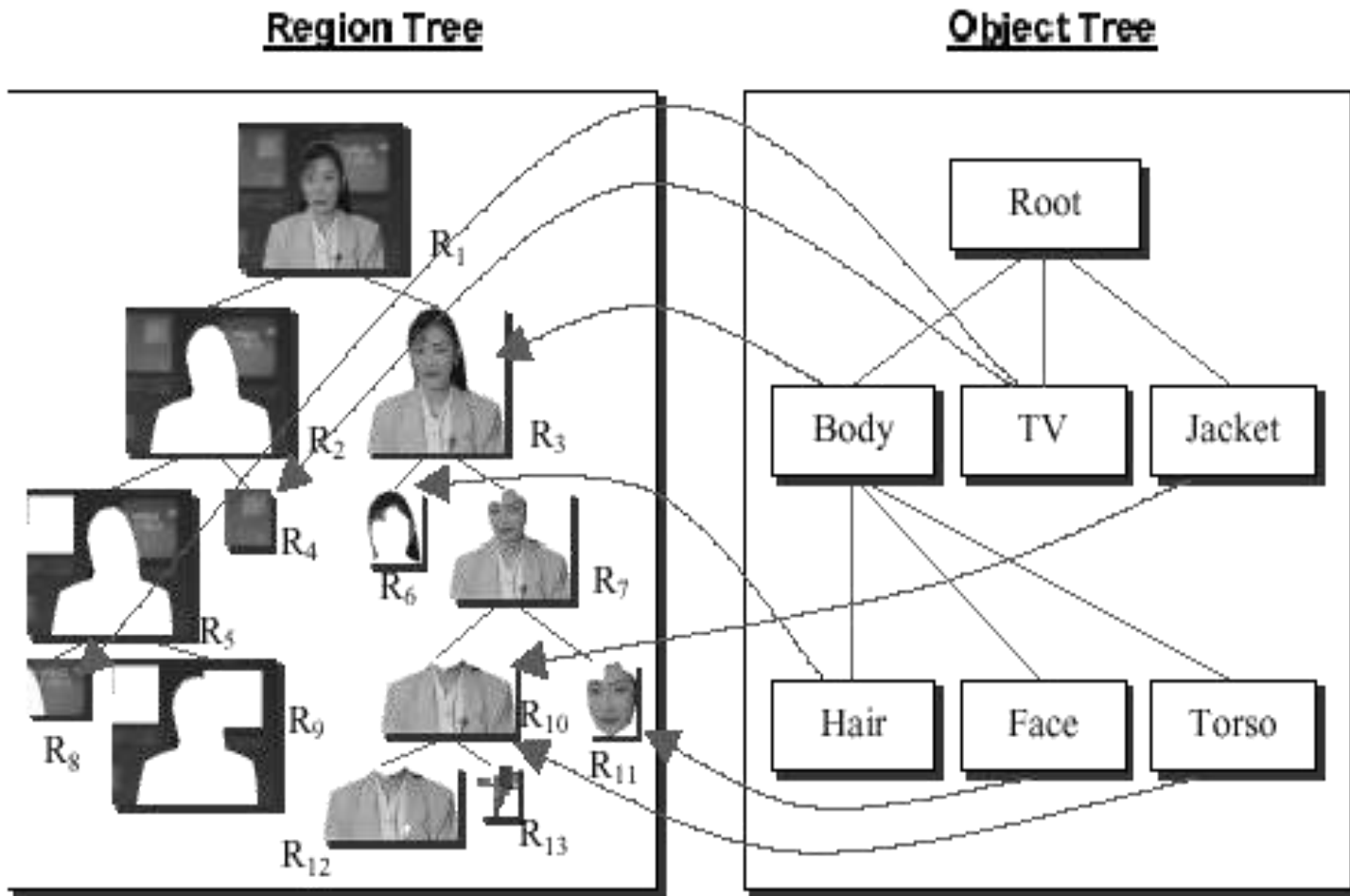
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- Divide a video stream into physical and logical video segments
- The higher the level of a physical video unit, the more semantic information is necessary
- Logical units are based on semantic content



Region and Object Trees

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Content Description: Semantic Aspects



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- Low Level Features
 - Extraction from Content
 - Descriptors for
 - Shape, color, texture (visual)
 - Timbre, rhythm (audio)
- High Level Features
 - Annotation
 - So called *semantic descriptors*
 - Textual information
 - Conceptual information

MPEG-7 High Level Descriptors



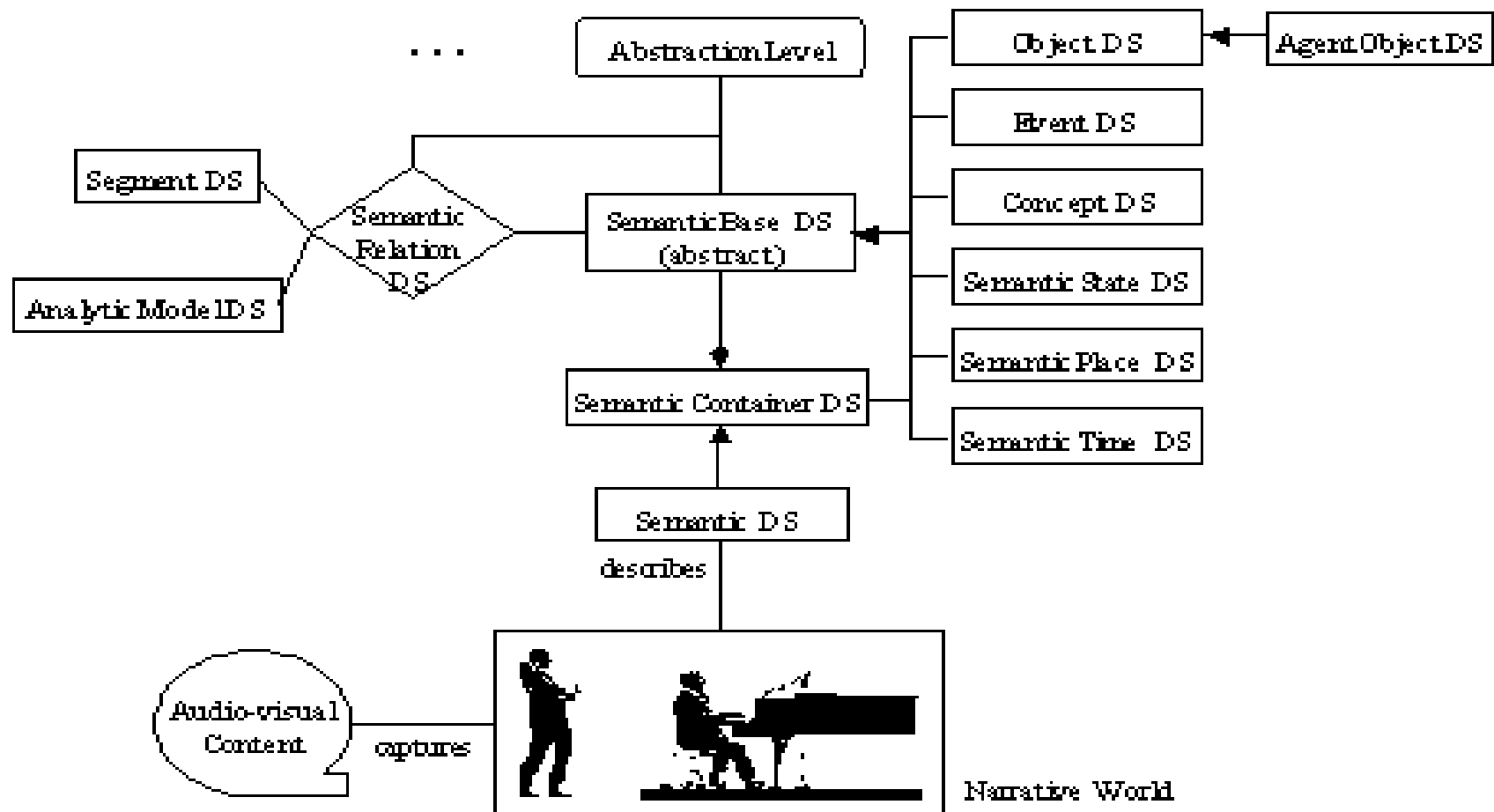
<http://www.uni-klu.ac.at>

- Textual Descriptions
 - Text to describe temporal / spatial regions
- The W's
 - Structured way of textual descriptions
 - Who, Where, What Object, When, Why, How & Where
- Instead of textual descriptions
 - Controlled Terms
 - Dictionaries, Taxonomies, Classifications Schemes
 - Semantic Description Scheme

MPEG-7 Semantic Description Scheme



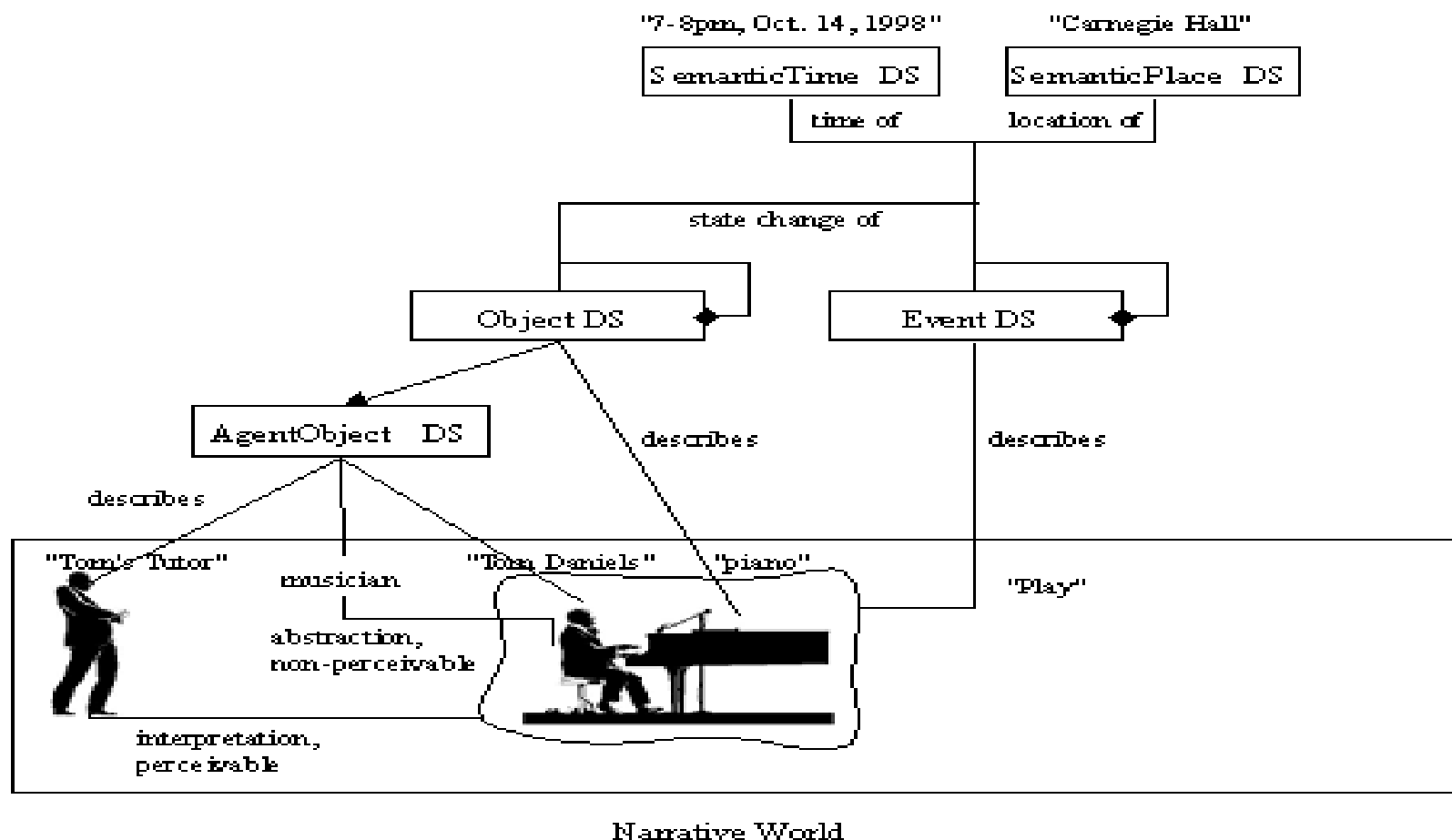
<http://www.uni-klu.ac.at>



Actual Description in MPEG-7



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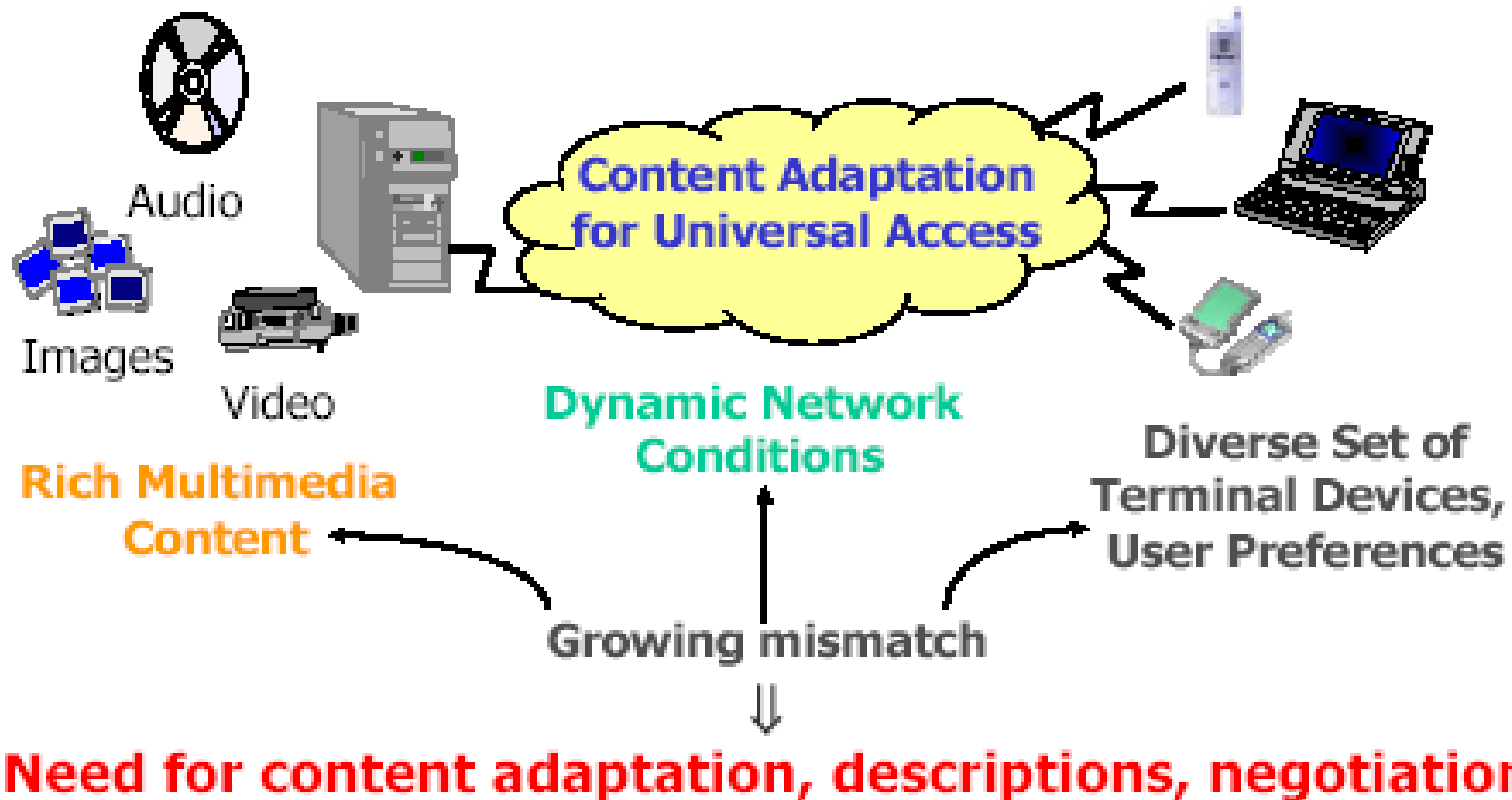
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MPEG-21 – motivation and scope



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MPEG-21 Objectives



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MPEG-21's goal is to create an *interoperable and integrated multimedia framework* in three steps:

1. **Develop “big picture”**: understand how the components of the framework are related and identify where gaps in the framework exist
2. **Fill the gaps**: develop new standard specifications where needed
3. **Integrate**: achieve the integration of standards to support harmonized technologies for the management of multimedia content

MPEG-21 Digital Item



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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”
- DIs consist of
 - Resources (individual assets, distributed content),
 - Metadata (data about or pertaining the DI) and
 - Structure (relationships between parts of the DI)

Digital Item - Example

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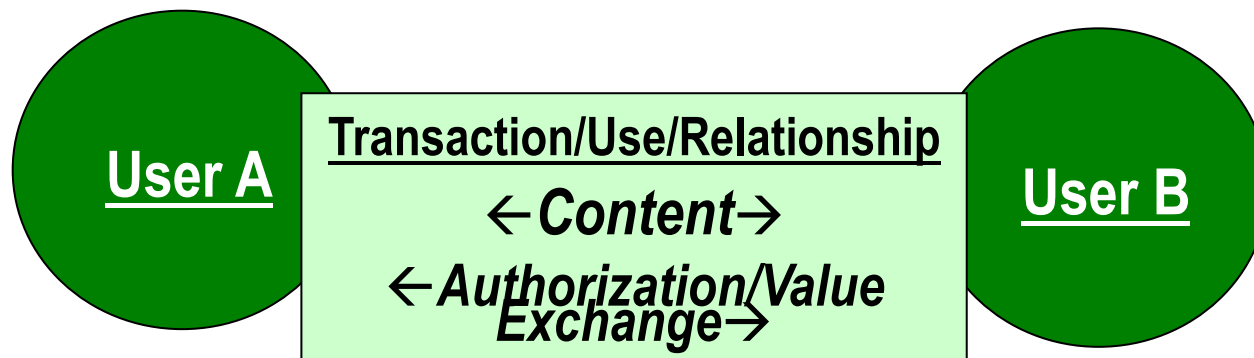
The DI is the fundamental unit for distribution and transaction within the MPEG-21 framework.

MPEG-21 User and User Interaction



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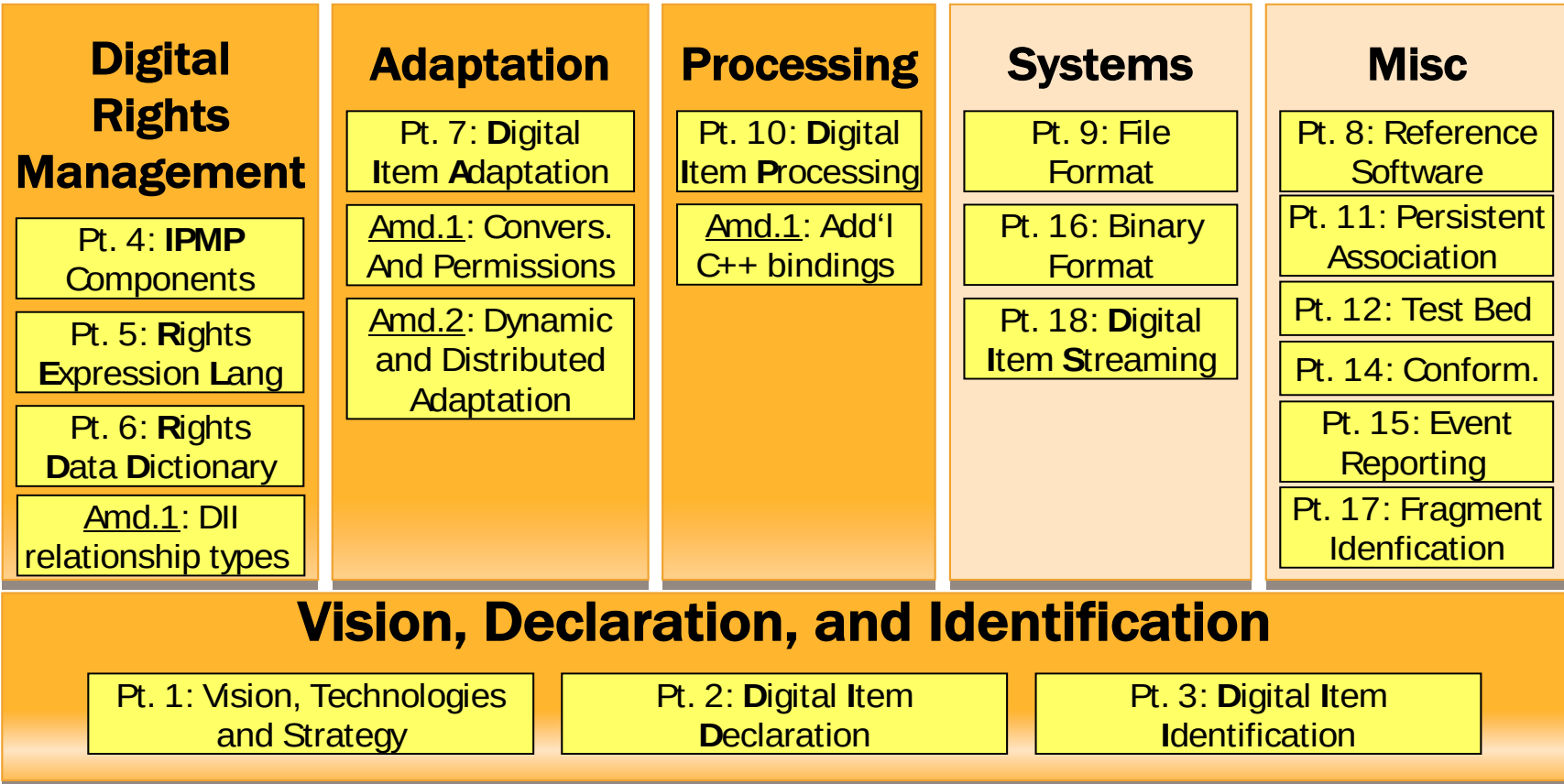
- Any entity that interacts in the MPEG-21 environment or makes use of a Digital Item
- Users include individuals, organisations, corporations, consortia, governments, other standards bodies, etc.
- Roles including creators, consumers, rights holders, content providers, distributors, etc.
- Each User will assume specific rights and responsibilities according to their interaction with other users



Seven Architectural “Elements”



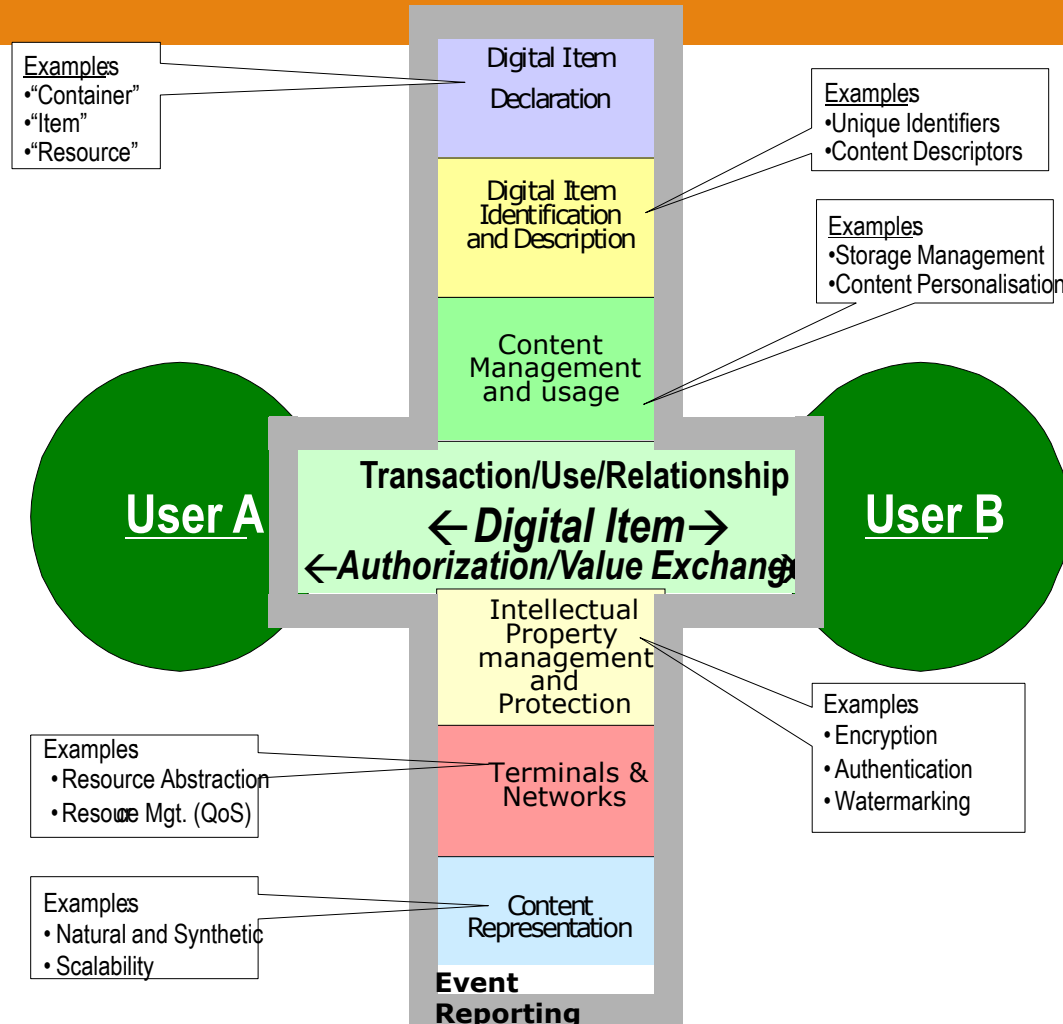
<http://www.uni-klu.ac.at>



Roles of the Architectural Elements



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Metadata Generation & Annotation



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- Process of creating data about data
- Content has to be known
 - Watch & understand video / image collection
 - Listen and assess audio
- Metadata standard has to be known
 - What are the possible fields
 - What are the used classification systems

Evaluation (1/2)



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- Goal: Identify the opinion of users on manual semantic annotation
- 5 Users with following (median) background:
 - 17 years of computer experience
 - Using a computer 50 h / week
 - 2 years experience with digital photo cameras
 - 4 years experience with imaging software

Evaluation (2/2)



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- 2 Tasks were given:
 - Annotate a photo with a given description and an extensive prior introduction to semantic photo annotation with Caliph
 - video was shown,
 - concept was explained and
 - questions were answered
 - Annotate a photo fully on your own
 - After Tasks:
 - Questionnaire with several subjective questions
 - Evaluation Scale from: -3 (strongly disagree) to 3 (strongly agree)

Evaluation Results: General Questions



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- The concept of meta data is very new to me: **-2.6**
- It was easy to understand the concept of semantic meta data while using Caliph: **1.8**
- The visualization of the semantic meta data within Caliph is easy to understand and interpret: **2.2**
- The annotation of images with textual descriptions can be done fast and easily: **1.4**
- The annotation of images with semantic meta data can be done fast and easily: **1.2**
- I can see an obvious benefit by using semantic meta data for image (multimedia) annotation: **1.4**

Scale: (disagree) -3 to 3 (agree)

Evaluation Results: Scenario based questions



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1. The complexity of semantic annotation is too high to be useful for organizing photos.
2. I would find it easy to annotate a large set digital photos (e.g. 100+).
3. I would recommend Caliph or a similar tool to annotate digital photos.
4. I can see an obvious benefit by using semantic meta data for the organization of photos.

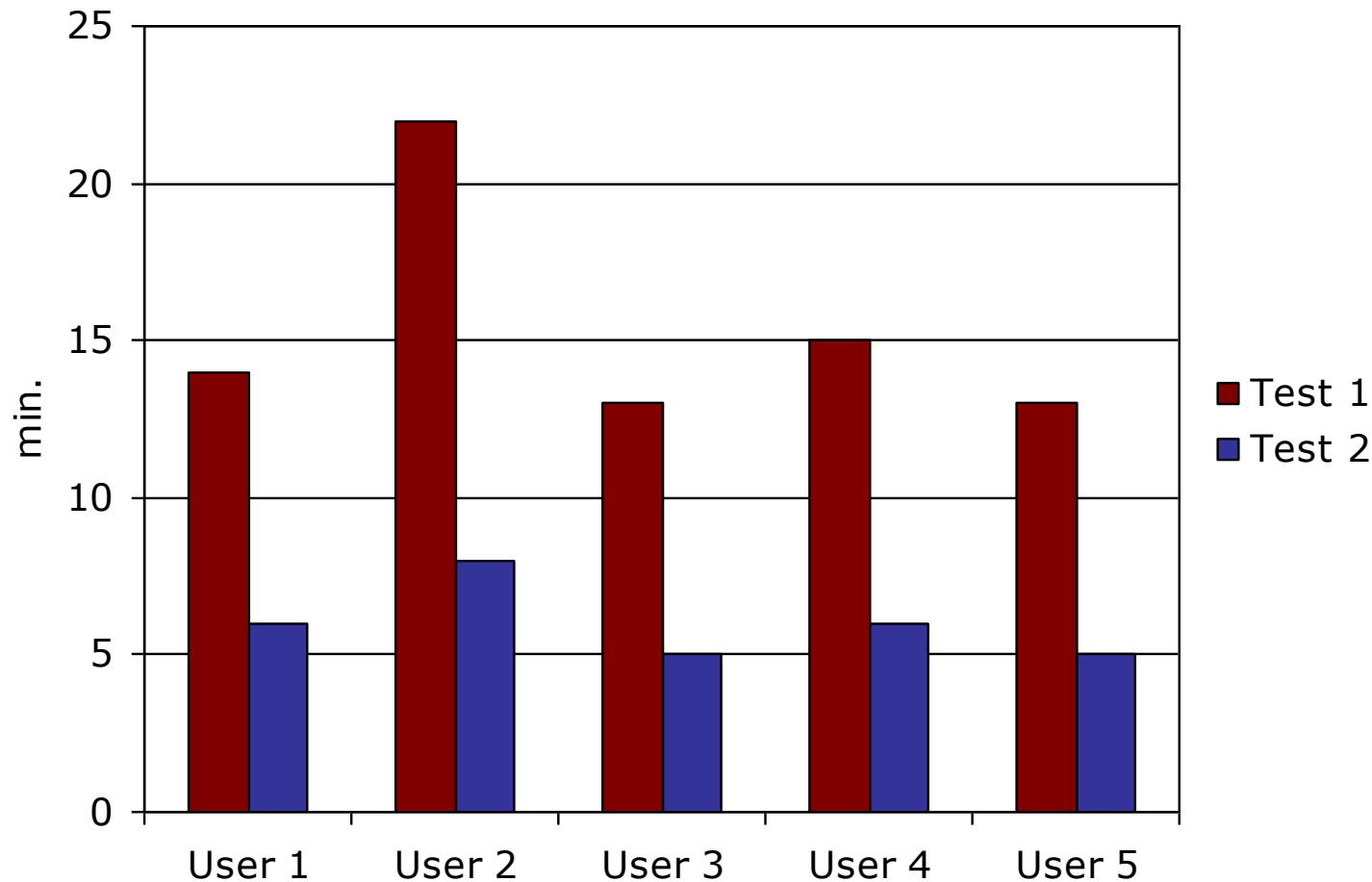
Personal	Newspaper
-0.6	-1.8
-0.6	-0.2
0.8	1.4
1.4	2.2

Scale: (disagree) -3 to 3 (agree)

Evaluation Results: Annotation performance



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Evaluation Results: Annotation performance



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- Median times for annotation:
 - 15.4 minutes for the 1st test and
 - 6 minutes for the 2nd test
- Median time in a self test with 17 photos:
 - 1 minute and 53 seconds per photo
- That results in an approximate time of 10 h 27 min. for annotation of a set of 333 photos

Evaluation Results: Diversity of Annotations (2nd test)



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- Structured text annotation field “Who”:
 1. Vedran, Wolfgang, Armin
 2. Wolf, Armin, Vedran
 3. Wolfgang Kienreich, Vedran Sabol, Armin Ulbrich
 4. wolfgang, armin, vedran
 5. W.Kienreich,A.Ulbrich,V.Sabol

Evaluation Results: Diversity of Annotations (2nd test)



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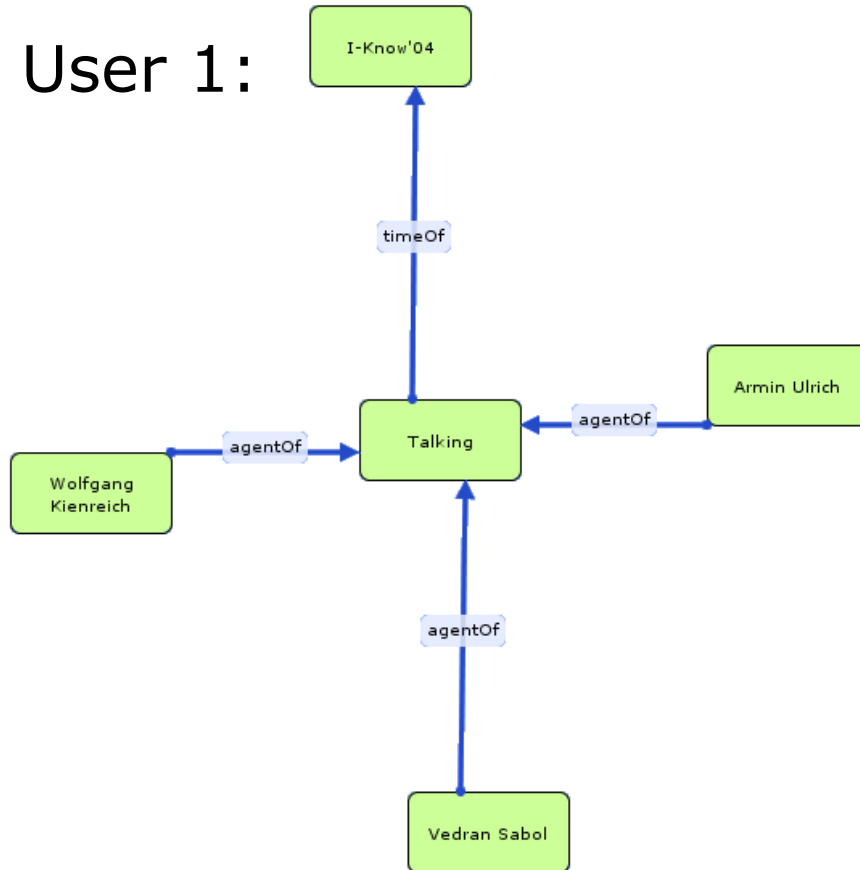
- Free text annotation:
 1. Stadthalle, Graz, Austria I-Know '04 Knowledge Managment Conference
 2. The three are sitting ...
 3. Wolfgang Kienreich, Armin Ulbrich und Vedran Sabol (v.l.n.r.) sprechen miteinander auf der I-Know. Wolfgang Kienreich, Vedran Sabol, Armin Ulbrich are at I-Know, Graz for Talking
 4. Stadthalle, Graz, Austria I-Know '04 Knowledge Managment Conference
 5. Wolfgang, Armin and Vedran talking to each other on I-Know 04 at Stadthalle Graz.

Evaluation Results: Diversity of Annotations (2nd test)

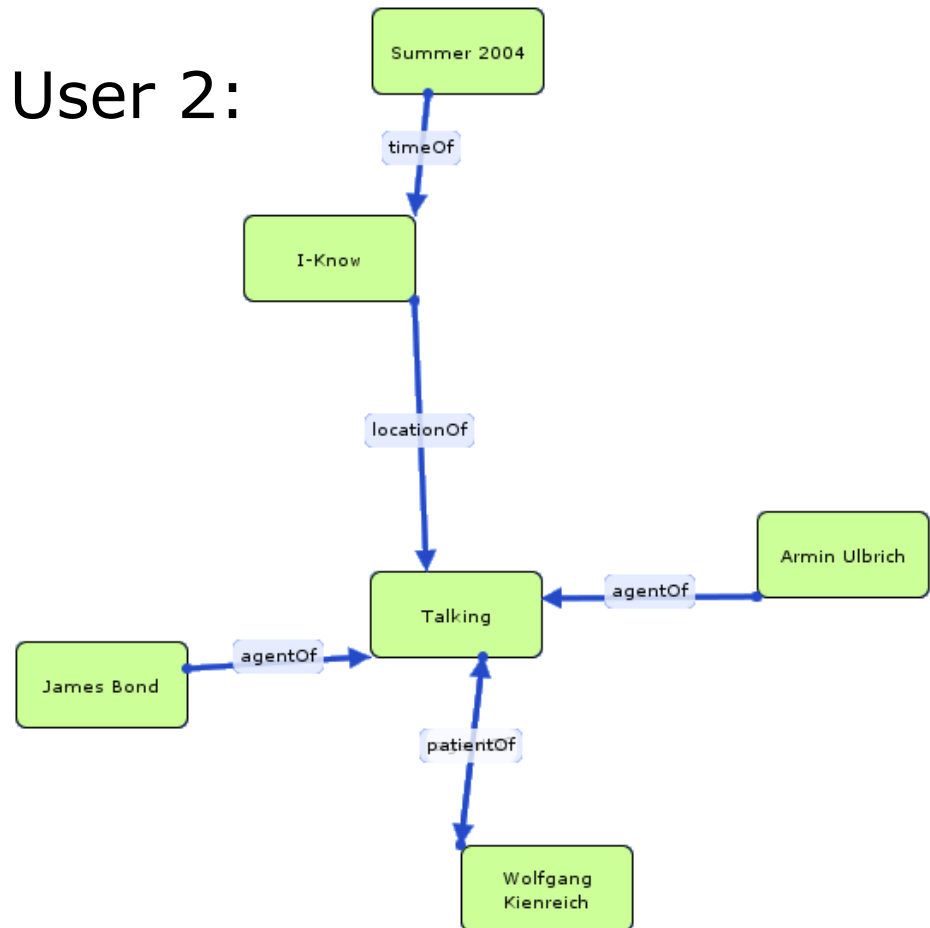


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User 1:



User 2:

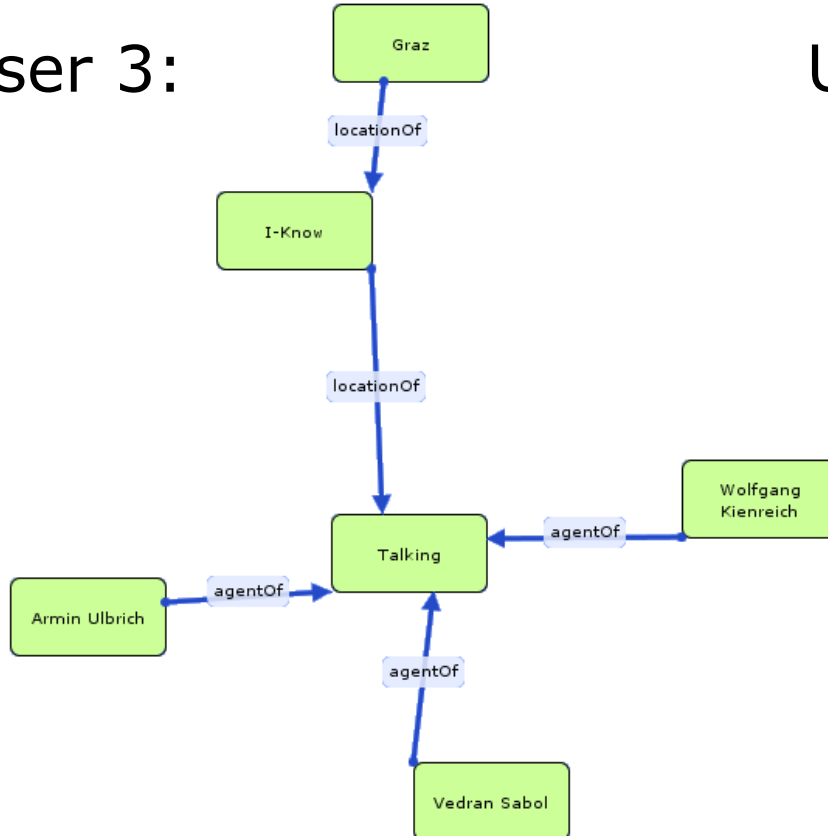


Evaluation Results: Diversity of Annotations (2nd test)

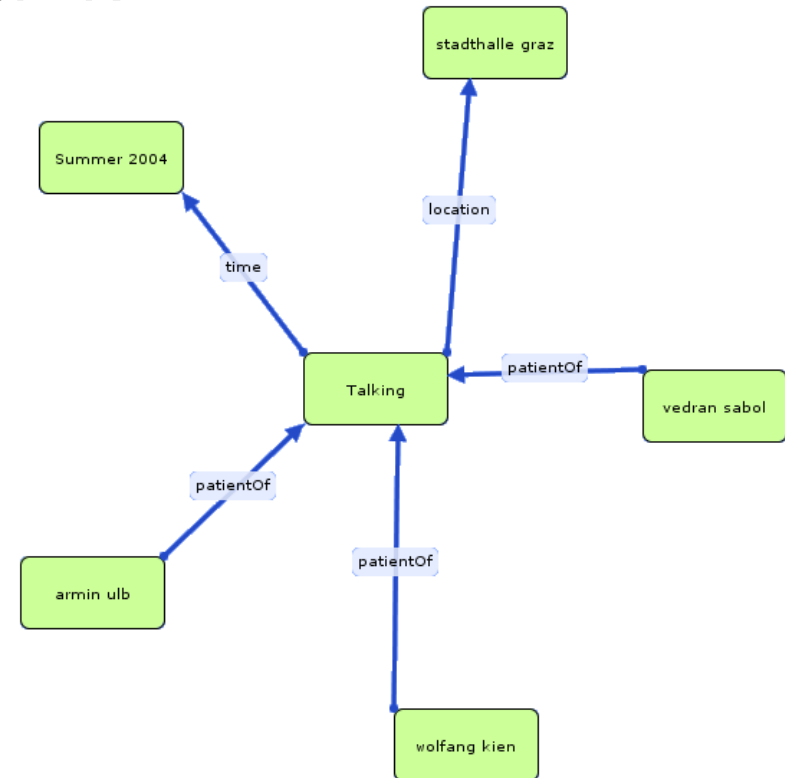


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User 3:



User 4:

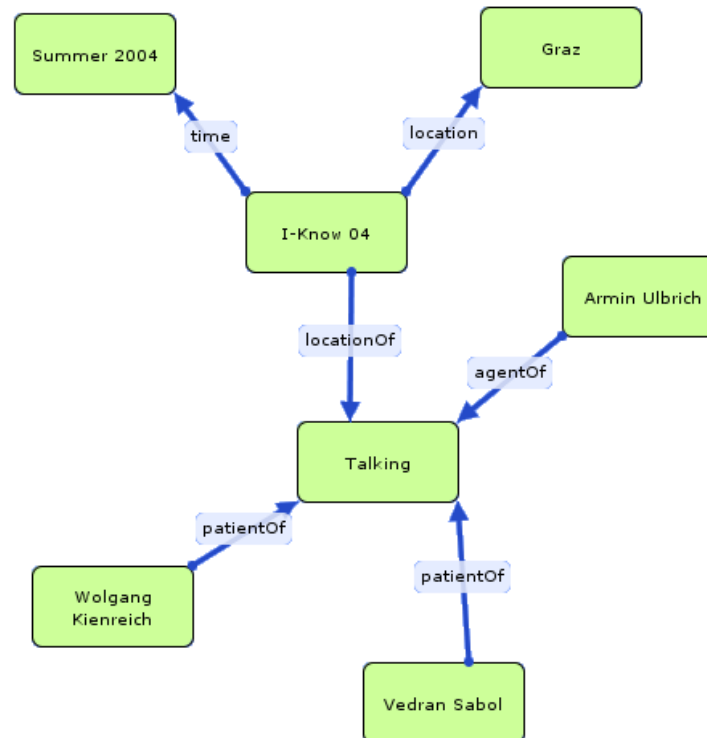


Evaluation Results: Diversity of Annotations (2nd test)



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User 5:



Lessons Learned



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- Users like the graphical annotations editor
- Users see semantic annotation in a professional (business) environment
- Semantic annotation is very time consuming
- The MPEG-7 nomenclature is not intuitive
 - Semantic agent / place / object & relations
 - Creator of image / description / quality rating
- Tagging with central tag repository ...

Demo



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