Semantic Web Metadata for e-Learning
- Some Architectural Guidelines

Mikael Nilsson, Matthias Palmér, Ambjörn Naeve
{mini,matthias,amb}@nada.kth.se

The Knowledge Management Research Group
Centre for user oriented IT design
Royal Institute of Technology, Stockholm

http://kmr.nada.kth.se
Metadata everywhere

- Rapid increase in popularity of e-learning standards (within IEEE, IMS, ADL, etc.)
- Metadata forms the basis of all efforts, but:
  - Still much confusion about how metadata should be implemented.
  - The W3C standard for metadata (RDF) is not widely supported.
  - Very little of the potential in the metadata concept has been realized.
The KMR group and metadata

- Initiated and lead development of **RDF bindings** for IEEE LOM and IMS CP
- Implemented metadata-based systems include:
  - **SCAM**: RDF-based content archive & digital portfolio
  - **Edutella**: RDF-based **P2P network** (within WGLN)
  - **Conzilla**: RDF-based **concept browser**
Guiding principles for a metadata architecture

• The **Knowledge Manifold** is our philosophical and pedagogical framework. Metadata needs to support:
  > Human to human via machine
  > Subjective expression
  > Connecting distributed knowledge patches
  > Building knowledge communities

• The following slides will discuss problems with current meta-data standards/implementations
Subjectivity of metadata

- Most current metadata is authoritative
- No room for interpretations / annotations
- No real support for meta-metadata
- No support for trust and the consensus building process

⇒ We need to support non-authoritative metadata!
Evolving descriptions

• Authoritative metadata is designed for “produce once – use everywhere”
• Does not allow for adaption to changing needs and uses
• Does not allow for context-dependence

⇒ We need an architecture supporting a metadata eco-system!
Extensions – syntax and semantics

- Current metadata standards extremely monolithic
- Extensions, while allowed, must be crafted with minute syntactic care
- Semantic interoperability is a mess (e.g. DC & LOM)
- Still, most deployments need to mix vocabularies, syntactically and semantically

⇒ We need a common model & syntax supporting semantic/syntactic extensions!
Combining descriptions

• Metadata standards build on the metadata instance metaphor
• In a metadata eco-system, metadata will be distributed
• Metadata must be processable even if combined from several sources

⇒ We need to support distributed metadata descriptions!
Beyond resources

- Most metadata implementations focus on resources
- Resources without a conceptual context lack meaning
- **Contextual information** will provide a key to handling information overflow

⇒ We need to use **conceptual metadata**, focusing on **contextual information**!
Summary

• We need metadata that is:
  - subjective and non-authoritarian
  - evolving
  - extensible in syntax and meaning
  - distributed
  - conceptual

• **RDF** is the key
  - Combined with **P2P technology**...
Metadata Management: Explorative vs. Search-Oriented

- Explorative
  * browse existing structures with little or no adaption
  * no need to know beforehand what to explore, you may choose if you want to follow prepared paths
  * things beyond the current endeavor may be discovered
  + associative process
    - the associations are somebody's

- Search-Oriented

Metadata Management: Centralized vs. Distributed

- Centralized
  * central metadata-server needs responsible maintainer
  * in many cases this results in a authoritative bottleneck
  * collected metadata results in duplication

- Distributed

Metadata Management: Resource-Centric vs. Context-Centric

- Resource-Centric
  * hedgehog metadata such as dc:title, dc:description, etc.
  * classification may provide a context for the resource
  * for a resource a tag-value list is often a sufficient presentation

- Context-Centric

Supporting Tools:
- SCAM: Standardised Content Archiving Management
- RDF-based content archive & digital portfolio
- based on IMS Content Packaging
- Edutella
- Conzilla

Create

Publicize

Find / Fetch

Metadata Management: A Low Level View/Division

Supported by Tool
find / fetch

explorative
- query, filter and sort are similar processes
- questions should be possible to reuse, combined, visualize, annotated etc.
- queries are metadata and should be searchable
  + to formulate questions is a part of the creative process
  - good questions is hard to formulate

publicize

centralized

create

resource-centric

distributed
- RDF allows anyone to say anything but not anywhere, hence metadata kept locally may be more subjective
- metadata is pulled from you instead of pushed by you. Hopefully lowers the psychological threshold for publication

metadata management

supported by

Tool

SCAM
- RDF-based P2P network
- peer to peer for metadata
- both for publication and search
- allows translations between semantically similar expressions

Edutella

Conzilla
**Metadata Management Inquiry**

**Find/Fetch**
- Explore existing structures with little or no adaptation.
- No need to know beforehand what to explore; you may choose if you want to follow prepared paths.
- Things beyond the current endeavor may be discovered.
- Associative process: the associations are somebodyselves.

**Publicize**

**Create**
- A low level view/division.

**Metadata Management**

**Centralized**
- Central metadata-server needs responsible maintainer; in many cases this results in an authoritative bottleneck.
- Collected metadata results in duplication.

**Distributed**

**Resource-Centric**

**Context-Centric**
- Metadata describing relations between resources, e.g., associations, dependencies, etc.
- Such relational metadata forms a graph, describing ontologies, organization structures, associative nets, etc.
- Whatever appropriate.
- The graph might be very large; hence presenting only selected parts, 'contexts', is preferable.

**Explorative**
- Browse existing structures with little or no adaptation.
- No need to know beforehand what to explore; you may choose if you want to follow prepared paths.
- Things beyond the current endeavor may be discovered.
- Associative process: the associations are somebodyselves.

**Search-Oriented**

**Tool**

**Supported by**

**SCAM**

**Edutella**

**Conzilla**
- RDF-based concept browser.
- Similar to topicmaps.
- Full fledged graphical RDF editor with layout and styling possibilities.
- A very general modeling tool, e.g.: course and LO design, organizational modeling, ontologies, etc.