Interoperability for Peer-to-Peer Networks: Opening P2P to the rest of the World

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Outline

- Motivation
- Providing Interoperability
  - Edutella Proxies
  - Semantic Mappings
- Whole Picture
- Conclusions & Further Work
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Motivation
P2P Networks

Advantages:
- High flexibility for peers to join and leave the network dynamically
- Scalability
- Autonomy
- High resilience against peer failures (no single point of failure)

Disadvantages:
- Peers must implement the P2P specific interface in order to make use of the network
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Requirements for Interoperability

- Common Communication Protocol and Interface
  - Web Services, RPC, HTTP forms ...
  - We use SQL (Web Service binding) as interface

- Common Query Language
  - SQL, XQuery, QEL, CQL ...
  - We use QEL as main query language

- Common Schema
  - Dublin Core, LOM ...
  - No assumption at the schema level
Databases & Semantic Web: Edutella

Specify and implement a RDF-based meta-data infrastructure for P2P networks

Developed as part of the open source peer-to-peer project JXTA
edutella.jxta.org

60+ contributors from various institutions

Building block for the EU/IST ELENA smart learning space

Project JXTA

Project Info
- Home
- Background
- News
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- FAQ
- Help

Developer Resources
- Getting started
- Tutorials
- View projects
- Join Project JXTA
- Login
- Mailing lists
- Report bugs

Documentation
- Project JXTA docs
- Protocol Spec
- License
- Governance

Project: edutella

Resources: Mailing Lists | Source Code | Issue Tracking

Summary: RDF-based Metadata Infrastructure for P2P Applications

Category: services

License: The Sun Project JXTA Software License

Overview

This project is a multi-staged effort to scope, specify, architect infrastructure for JXTA.

Initial Services

- Query Service: Standardized query and retrieval of RDF metadata
- Replication Service: Provide data persistence / availability and consistency
- Mapping Service: Translates between different metadata vocabularies in between different peers
- Annotation Service: Annotate materials stored anywhere in the network

Vision

Provide the metadata services needed to enable interoperability between applications.
Simple Query Interface

Open and collaborative effort to achieve interoperability between (learning objects) repositories

- Simple and Easy to implement
- No assumptions on query language, schema or results format
- Supports synchronous and asynchronous scenarios

http://www.prolearn-project.org/lori/

Contributions from, among others, the following initiatives:
Ariadne, Educanext, Celebrate, Edutella, Elena, EduSource, ProLearn, Universal, Zing
Query Language

- QEL (Query Exchange Language) - based on Datalog
- Edutella provides wrappers for repositories based on query languages like
  - SQL
  - RQL and RDQL
  - TRIPLE
  - Xpath
  - ...
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Proxying Edutella (I)

Consumer Proxy

Provider Proxy
Proxying Edutella (& II)
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Data Integration

Global as View

Local As View

Unified Schema (attr1, attr2, attr3, attr4)

```
SELECT * FROM S1
UNION
SELECT S2.attr1, S2.attr2, S3.attr3, S4.attr4
FROM S2, S3 WHERE S2.attr1 = S3.attr1
```

S1(attr1, attr2, attr3, attr4) → S2(attr1, attr2) → S3(attr1, attr3, attr4)

Unified Schema (attr1, attr2, attr3, attr4)

```
SELECT attr1, attr2, attr3, attr4
FROM S1
UNION
SELECT attr1, attr2
FROM S2
UNION
SELECT attr1, attr2, attr3, attr4
FROM S3
```

S1(attr1, attr2, attr3, attr4) → S2(attr1, attr2) → S3(attr1, attr3, attr4)
GAV vs LAV

Given a query reformulating it in terms of the sources
- Is easier in GAV (just needs unfolding of the query)
- Is harder in LaV

Adding a new source
- Supposedly easier in LaV (just need to express the new source as a view of the global schema)
- Harder in GaV (as the global schema needs to be revised)
Edutella mappings

- Single property mappings
  - Property
    system1:s(X, dc:contributor, Y) ← system2:s(X, dc:creator, Y)
  - Property + Value
    system1:s(X, dc:language, ”de”) ← system2:s(X, dc:language, ”ger”)

- Double mappings
  system1.s(X, dc:creator, Y), system1.s(Y, vcard:FN, Z) ← system1.s(X, dc:creator, Y)

- Default values
  lom:cost = ”No”
Property Mapping

- HCD Suite Schema: Title, Language, Contributor
- ULI Schema: Title, Language, Creator
- Mapping Needed: (R, dc:contributor, X) ← (R, dc:creator, X)
Default values

- HCD Suite Schema: Title, Language, Cost
- ULI Schema: Title, Language
- Default value needed: (lom:cost = ‘No’)

HCD Suite

Title = X?
Cost = Y?

X = ‘Java’
Y = ‘No’

Mediator

Title = X?

X = ‘Java’

ULI
Mappings Configuration File

<rdf:Seq rdf:about="#Mappings">
</rdf:Seq>

<rdf:Seq rdf:about="#DefaultValues">
</rdf:Seq>
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Conclusions

- Solution for interoperability of P2P networks based on:
  - Proxies
  - Repository wrappers
  - Semantic Mappings

Further Work

- Distributed Ranking algorithms
- How to extend mappings to Edutella Retrieval Service
References

- Edutella Project
  http://edutella.jxta.org/

- Working with Edutella
  http://www.l3s.de/~olmedilla/projects/edutella/edutella.pdf

- LORInteroperability site
  http://www.prolearn-project.org/lori/

- SQI Implementation Registry
  http://ariadne.cs.kuleuven.ac.be/vqwiki-2.5.5/jsp/Wiki?SQIImplementationsRegistry
Questions?