



## EDUTELLA

A P2P Networking Infrastructure  
Based on RDF

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and Stanford University

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Nilsson, Matthias Palmer, Tore Risch



## Overview

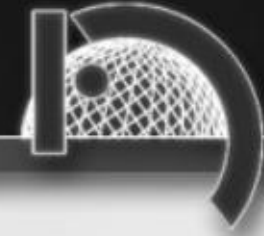
Edutella: Project Context and Motivation

Edutella: Enabling Technologies

- Peer-to-Peer (P2P)
- Resource Description Framework (RDF)
- RDF Query Exchange Language Format RDF-QEL-i

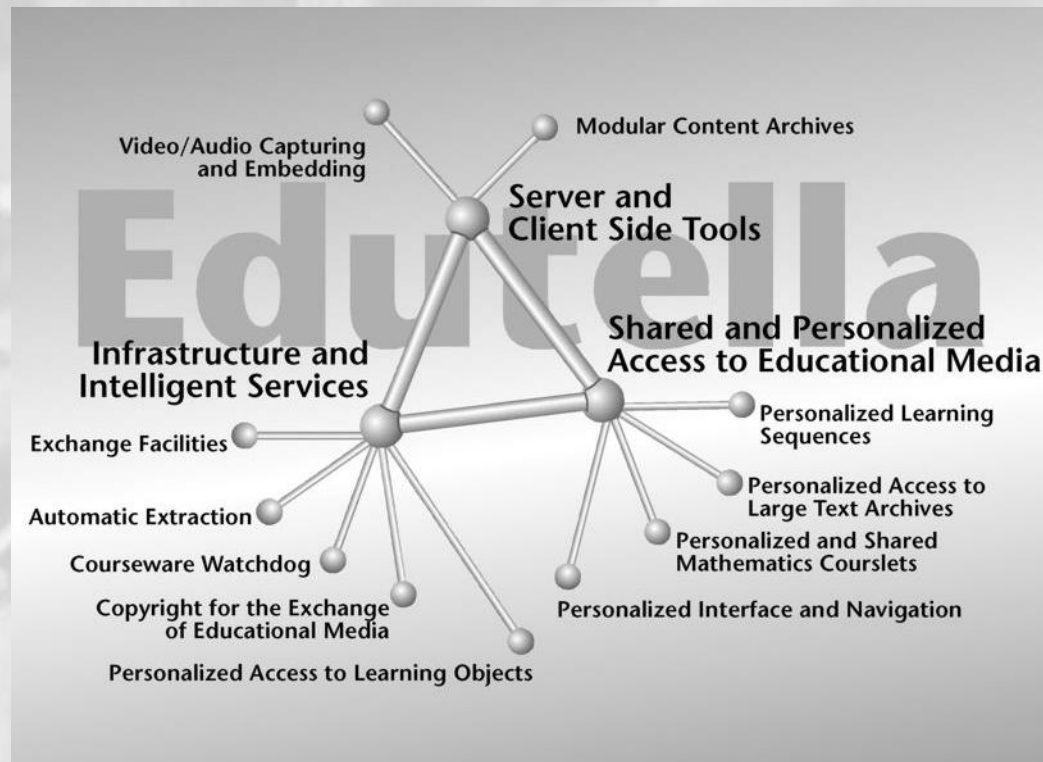
Edutella: Working Scenario & Current Status

Edutella: Current and Future Work

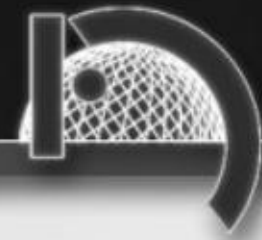


## Edutella: Project Context

Submodule of PADLR Project (Personalized Access to Distributed Learning Repositories) ([www.learninglab.de/english/projects/padlr.html](http://www.learninglab.de/english/projects/padlr.html))



Overview of PADLR Project  
(Stanford, Hannover,  
Braunschweig, Karlsruhe,  
Stockholm, Uppsala)



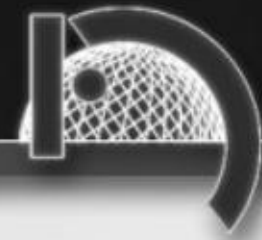
## PADLR: Basic Assumptions

Assumption 1/2: lots of learning resource repositories, which typically employ various back-ends, various meta-data schemas, and various architectures, etc., have already existed in many institutions. (trouble: isolate information islands, lack of interoperability between each other)

Assumption 2/2: Many institutions are reluctant to give up their control over learning resources, which is currently troubling many central-server based approaches to learning resource sharing, e.g., eLearning „portals“. (trouble: „portals“ are costly but unprofitable)

### Solutions:

- P2P: enable institutions to actively participate in a global sharing network without losing the control over their learning resources
- RDF: describe heterogeneous material and collections in distributed learning resource repositories to provide basic interoperability



## Edutella: Using a Peer-to-Peer Approach

Peer-to-peer computing is the sharing of computer resources and services by direct exchange between systems

Edutella connects highly heterogenous peers (heterogenous in uptime, performance, storage size, functionality, number of users...)

Goal: making distributed nature of Edutella services (e.g. repository storage) completely transparent to Edutella clients

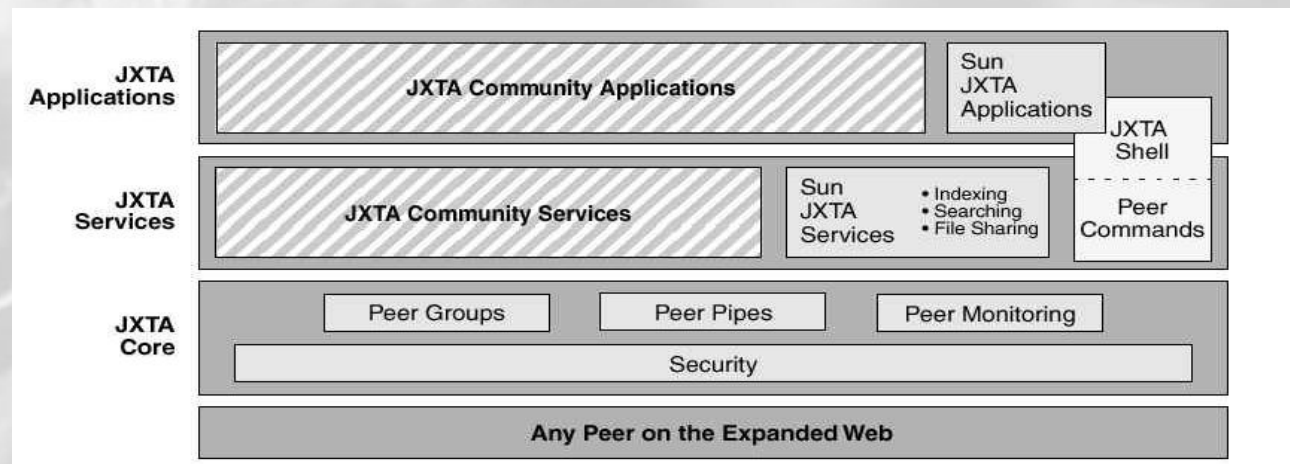
Means to get there: specification and implementation of a set of Edutella services



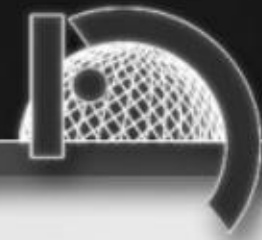


## Edutella: Enabling Technology 1/2 (JXTA)

- Project JXTA ([www.jxta.org](http://www.jxta.org))
  - An open source programming platform to enable P2P services and applications
  - Interoperability, Platform independence, Ubiquity
  - Layered approach



Source: Li Gong, Project JXTA: A Technology Overview



## Edutella: JXTA Layers

### JXTA-enabled Edutella Services



- Edutella Query Service: query Edutella provider peers and retrieve query results
- Edutella Annotation Service: annotate meta-data stored in repositories
- Edutella Update and Replication Service: update and replicate (meta-) data
- other services (mediation, mapping, etc.)

### JXTA-enabled Edutella Applications

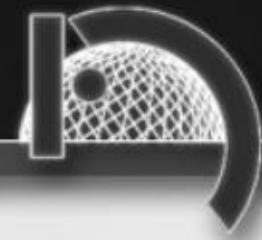


- “Provider” Applications: Edutella Provider, Edutella Hub
- “Client” Applications: Conzilla (Query GUI, KTH, Stockholm), Edutella Shell (Query GUI, L3S, Hannover), Ontomat (Annotation tool, AIFB, Karlsruhe), etc.

### JXTA Core



- Security, pipe-based communication, Rendezvous-based discovery mechanism



## Edutella: Enabling Technology 2/2 (RDF)

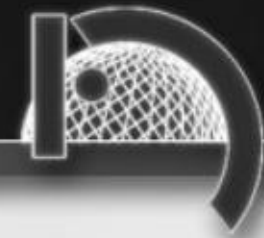
### Resource Description Framework

- Key representation language in the Semantic Web
- URI-based identifying mechanism to describe distributed resources, and state relationships between these resources
- RDF graph model makes it easy to integrate a number of other formats for recording information, e.g. tables/tuples in RDB, simple assertions in formal logic, etc.,
- RDFS offers a mechanism to define specific RDF vocabularies, enabling schema / ontology level meta-data mapping.

### RDF strength in eLearning area and P2P environment

- Availability of RDF-binding to most learning resource specifications (DC, IEEE LOM/IMS, ADL SCORM (ongoing)).
- As „distributed XML“, RDF perfectly fits into decentralized P2P environments, enabling distributed queries spanning various repositories.





## Edutella: Goal and Approach

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

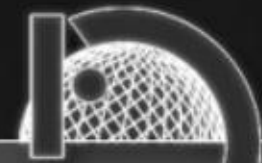
Developed as part of the  
open source peer-to-peer  
project JXTA

[edutella.jxta.org](http://edutella.jxta.org)

Contributors from various  
institutions

<b>Project JXTA</b>	
<b>Project Info</b>	<b>Project:</b> <a href="#">Project Home</a>   <a href="#">News</a>   <a href="#">Members</a>
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<a href="#">Background</a>	<b>Project:</b> edutella <span style="float: right;">If you req</span>
<a href="#">News</a>	<b>Summary:</b> RDF-based Metadata Infrastructure for P2P Applicat
<a href="#">Downloads</a>	<b>Category:</b> services
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<a href="#">Getting started</a>	This project is a multi-staged effort to scope, specify, architect
<a href="#">Tutorials</a>	infrastructure for JXTA.
<a href="#">View projects</a>	<b>Initial Services</b>
<a href="#">Join Project JXTA</a>	<ul style="list-style-type: none"><li>• Query Service: Standardized query and retrieval of RDF me</li><li>• Replication Service: Provide data persistence / availability</li><li>• Mapping Service: Translate between different metadata vo</li><li>• Annotation Service: Annotate materials stored anywhere in</li></ul>
<a href="#">Login</a>	
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Members: 7 867	

# Learning Lab Lower Saxony [L3S]



Project Member List - Netscape 6

http://edutella.jxta.org/servlets/ProjectMemberList?JServSessionId=servlets=x20dxwpu1

Suchen

## Project JXTA



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### Weekly Stats

May 4, 2002

Members	9,595
Posts	127
CVS Commits	629

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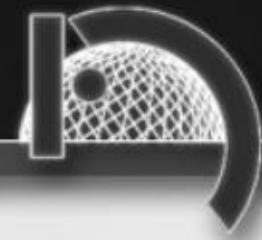
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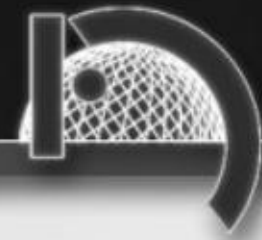


## RDF/RDFS: What is missing?

RDF/RDFS: describe distributed resources on the Web and to describe the vocabulary (properties) and constraints (classes, domain/range) for these descriptions

How do I query these distributed sources ???

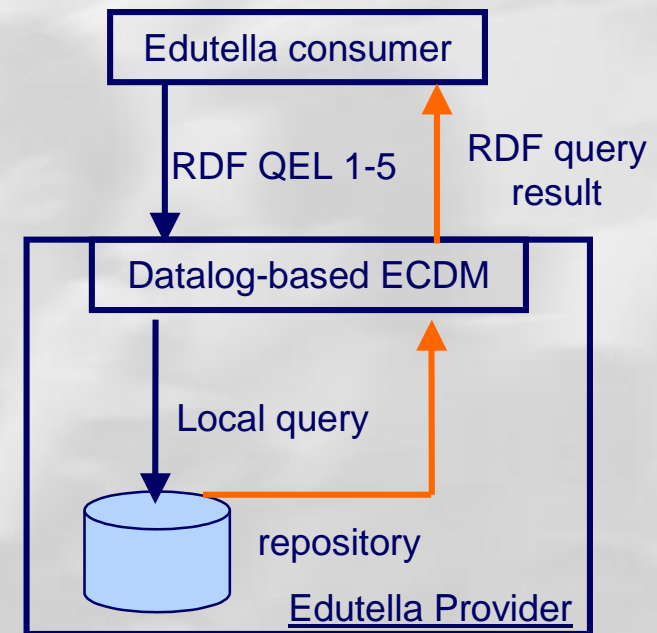
- How do my queries reach their destination?
- How do I ensure they are understood at their destination?



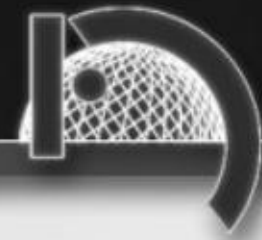
## RDF-QEL: RDF Query Exchange Language

### RDF-based Query Exchange Language (RDF-QEL)

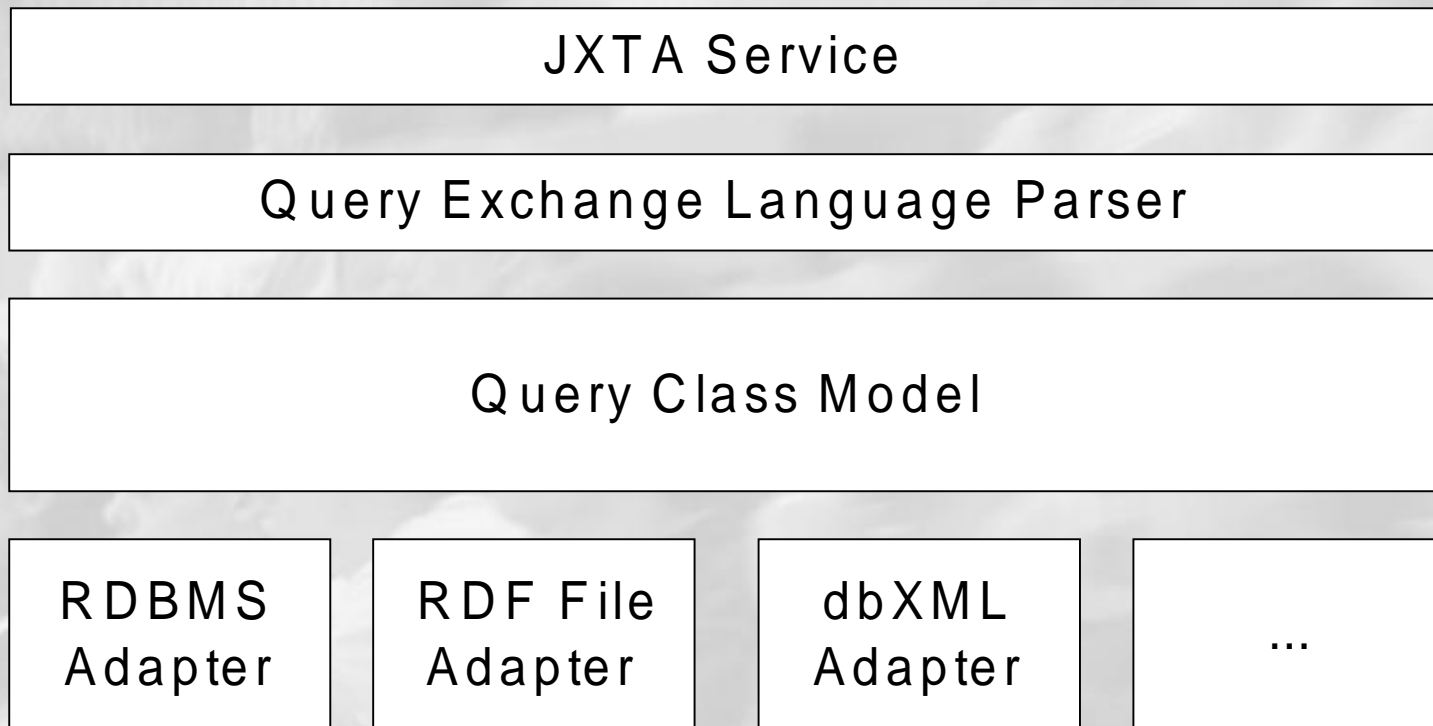
- RDF QEL1: conjunctive query
- RDF QEL2: RDF QEL1 + disjunctive query
- RDF QEL3: RDF QEL2 + negation (SQL92)
- RDF QEL4: RDF QEL3 + transitive closure (SQL3)
- RDF QEL5: RDF QEL4 + general recursion
  
- Datalog is used as the internal data model (ECDM: Edutella Common Data Model) and provided as a set of Java classes
- RDF is used to represent the queries transmitted between the peers
- Wrappers for other RDF query languages (RQL, TRIPLE, etc.) and XML query languages (like Xpath)



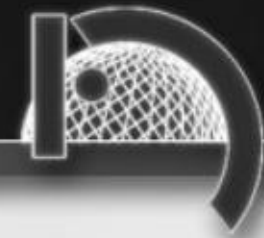
Edutella query data flow



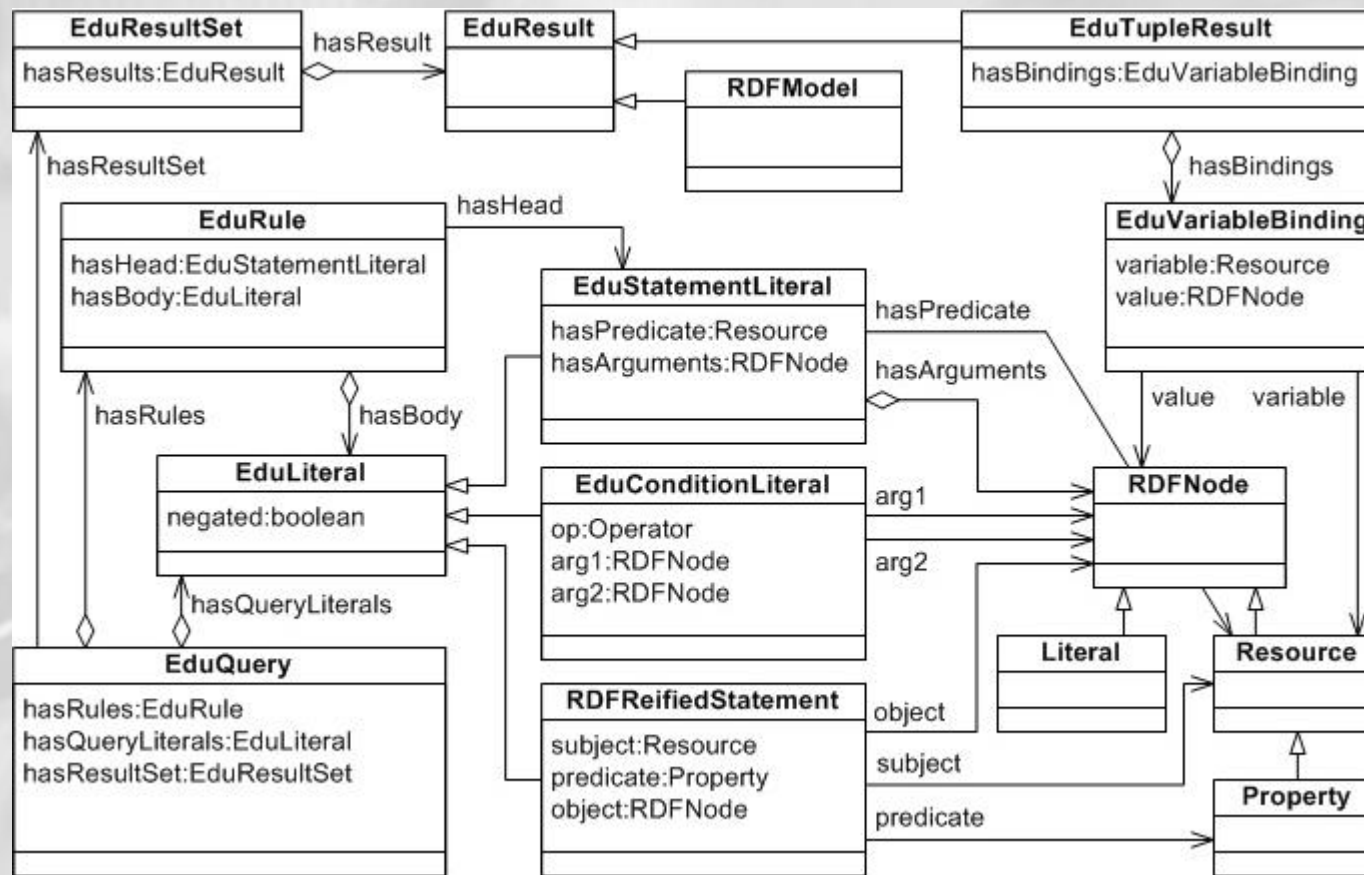
## Edutella: Query Service Architecture

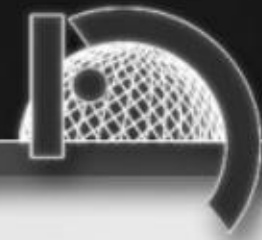




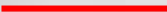


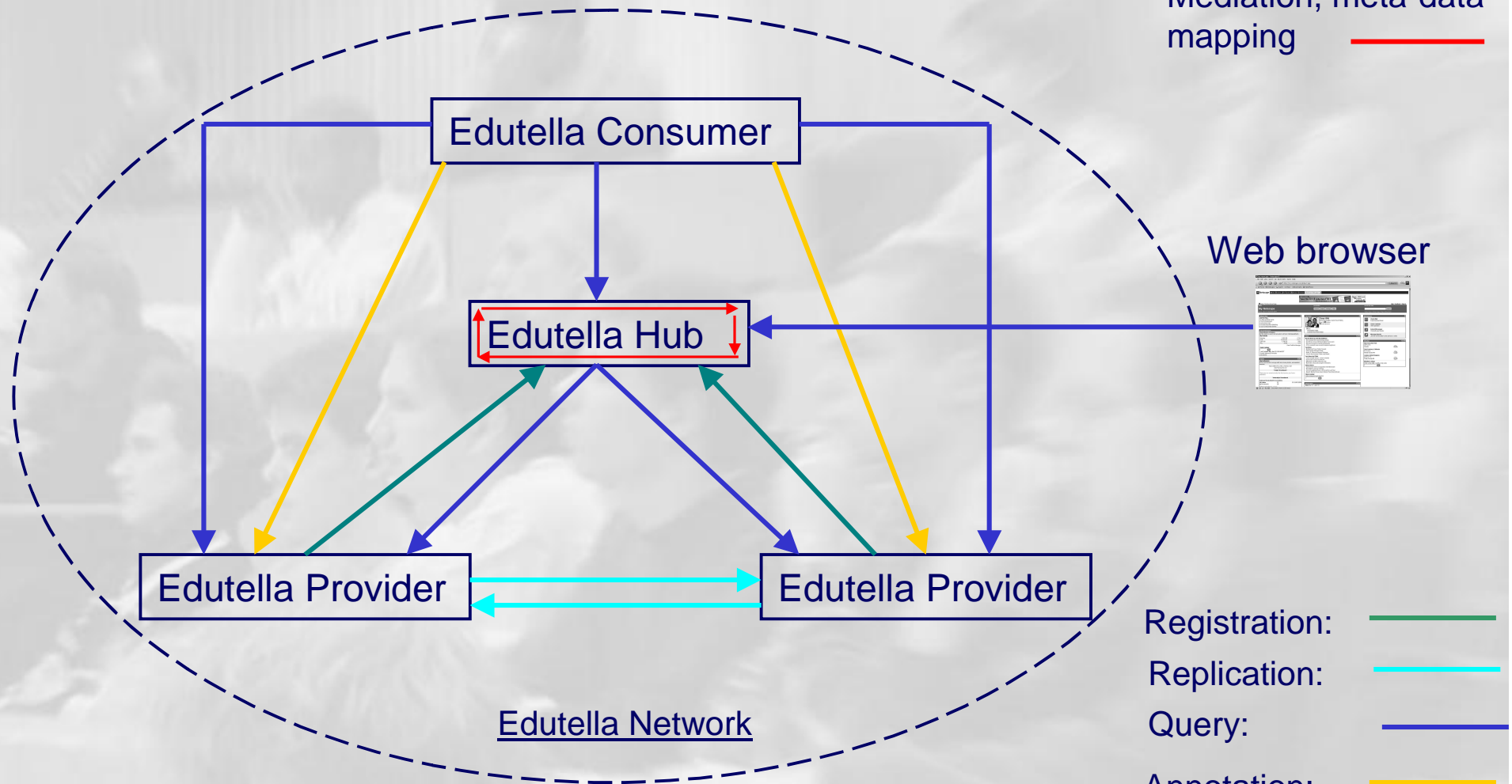
## Edutella: Query Class Model (ECMD)

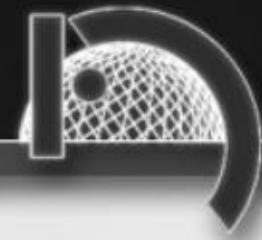




## Edutella: Working Scenario

Mediation, meta-data mapping 





## Edutella: Current Status

4 Edutella provider peers have been implemented,  
permanent peers have been running since March 7

### OLR (Open Learning Repository)

Back-end: Oracle 8i

Meta-data: RDF

Local query : SQL

Implementer: L3S, Hannover

### ConceptBase

Back-end: ConceptBase

Meta-data: RDF

Local query : O-Telos

Implementer: L3S, Hannover

### RDQL

Back-end: file system

Meta-data: RDF

Local query : Jena RDQL

Implementer: L3S, Hannover

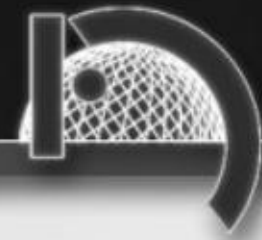
### dbXML

Back-end: Apache Xindice

Meta-data: RDF

Local query : XPath

Implementer: L3S, Hannover



## Edutella: Current Status

3 Edutella provider peers are under development

### AMOS II

Back-end: Multi data sources

Meta-data: RDF

Local query: AMOSQL

Implementer: Uni. of Uppsalla, Uppsalla

### KAON

Back-end: RDB

Meta-data: RDF

Local query: SQL

Implementer: AIFB, Karlsruhe

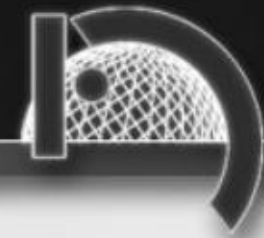
### Tamino

Back-end: Tamino

Meta-data: RDF

Local query: XQuery

Implementer: L3S, Hannover



## Edutella: Current Status

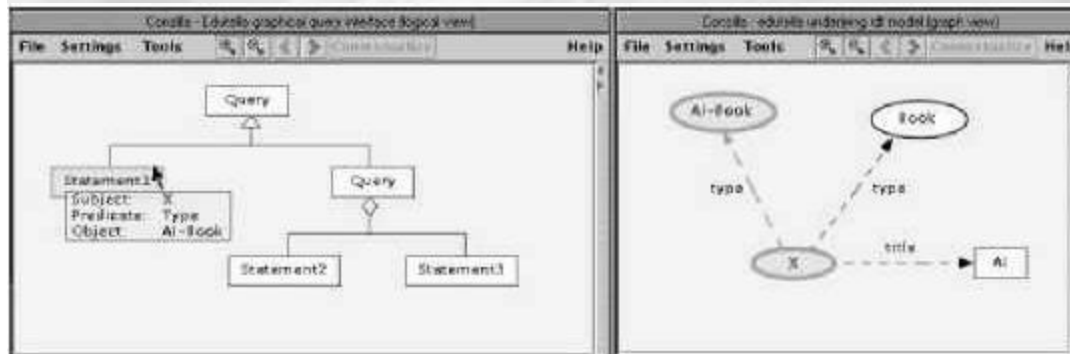
4 Edutella Consumers have been implemented

Conzilla (Query GUI)

Implementer: KTH, Stockholm

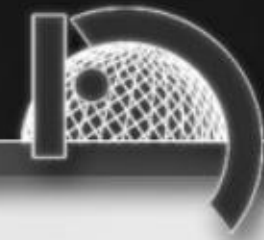
Ontology Query (Query GUI)

Implementer: Stanford



Title	Type	Topics
Musterloesung eines Lastenheftes	Lecture Notes	Software requirements, Requirements elicitation
Title	Type	Topics
Folien (Teil 1)	Document	Requirements analysis, Object-oriented design, Software requirements, Software design strategies and methods, Software design, Conceptual modelling, Software design notations, Structural descriptions (static view)
Video (Teil 2)	Video	Object-oriented design, Software design, Software requirements, Requirements definition document, Software design notations, Behavior descriptions (dynamic view)
Folien (Teil 1)	Document	Software requirements, Software engineering management, Requirements definition document



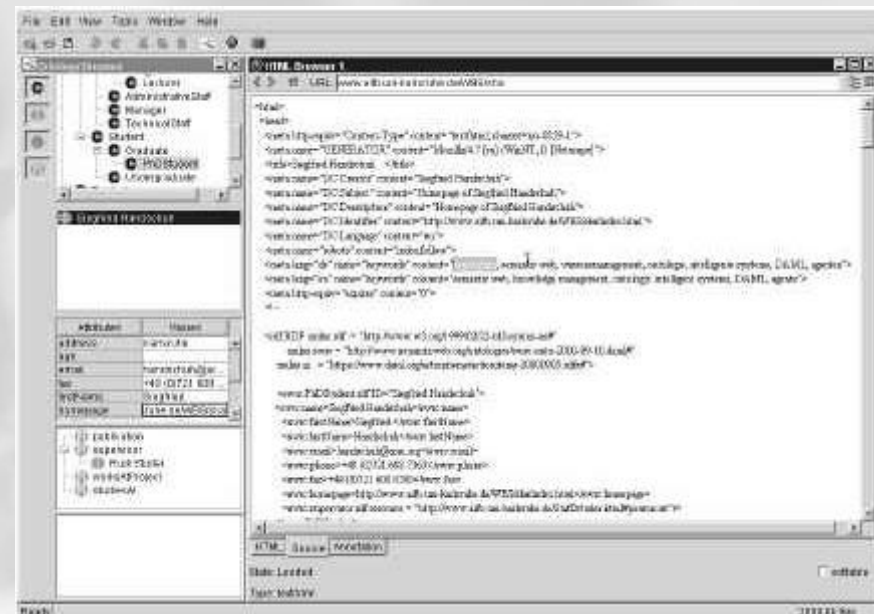
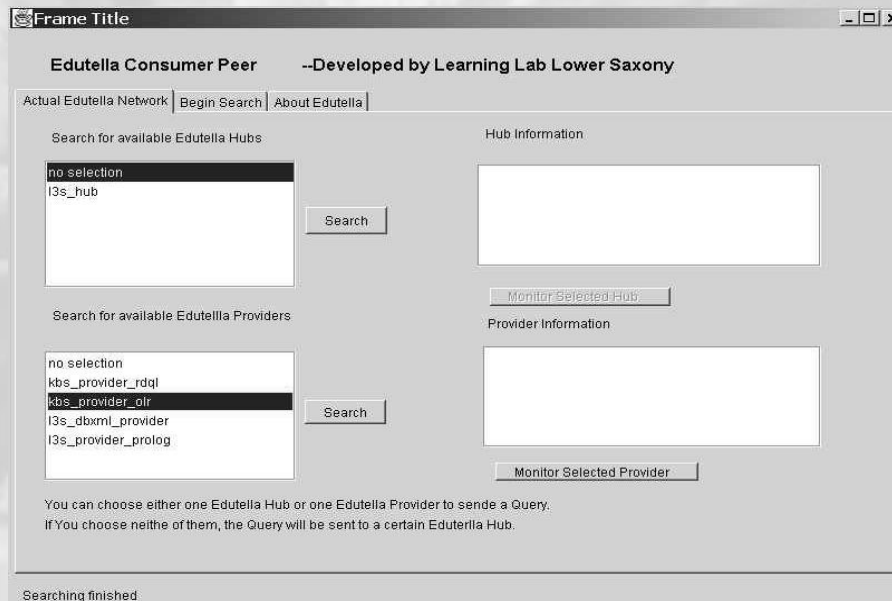


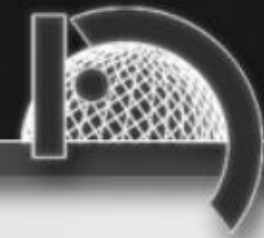
## Edutella: Current Status

4 Edutella Consumers have been implemented

Edutella shell (Query GUI)  
Implementer: L3S, Hannover

Ontomat (Annotation tool)  
Implementer: AIFB, Karlsruhe





Acrobat Reader - [p2p-06.pdf]

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## 3.2 Architecture

The Edutella annotation service is composed of the Edutella peer structure and the KAON<sup>3</sup> framework incorporating the Ont-O-Mat<sup>4</sup> plugin for annotation (cf. Figure 4).

```
graph TD
    subgraph KAON_Plugin_Structure [KAON Plugin Structure]
        Ontomat
        Peer_Config[Peer Config]
    end
    subgraph KAON_API [KAON API]
        JDBC
        RQL
        Dots[...]
    end
    subgraph Local_RDF_Repository [Local RDF Repository]
        RDF_Cylinder[(Local RDF Repository)]
    end
    K_Edutella_Wrapper[K-Edutella Wrapper]
    Globe((Globe))

    Ontomat <--> KAON_API
    Peer_Config --> K_Edutella_Wrapper
    K_Edutella_Wrapper <--> Local_RDF_Repository
    K_Edutella_Wrapper <--> Globe
```

Figure 4: Ont-O-Mat as Edutella Peer

5 von 5 215,9 x 279,4 mm



## Edutella: Current & Future Work

### RDF-based Edutella Modification Exchange Language (RDF-MEL)

- Transmit requests concerning update and replication within the Edutella network (see ISWC Paper)

### Implement more powerful Edutella Discovery

- Super-peer based indices, efficient peer-only broadcast topologies (see HyperCuP Paper) plus ontology indices

### Integrate other peers into the Edutella network

- UNIVERSAL [www.ist-universal.org](http://www.ist-universal.org)

### Implement low-end Edutella consumer peers

- PDA (Zaurus, iPAQ)

### Edutella P2P network as building block to provide ambient intelligence in a smart learning space

- European IST project ELENA

### Iron out bugs and improve ease of configuration and use



## Links

- All source code downloadable from the Edutella Homepage under [edutella.jxta.org](http://edutella.jxta.org)
- PADLR Project Homepage: [www.learninglab.de/english/projects/padlr.html](http://www.learninglab.de/english/projects/padlr.html)



New Edutella contributors are welcome!