UDBL

Tore Risch
Johan Petrini
Uppsala DataBase Laboratory
Dept. of Information Technology
Uppsala University, Sweden
http://user.it.uu.se/~udbl

PSELO
Personalized
SEmantic queries
of Learning Objects

New book:

•P.Gray, L.Kerschberg, P.King, and A.Poulovassilis (eds.): *FunctionalApproach to Data Management - Modeling, Analyzing and Integrating Heterogeneous Data*, Springer, ISBN 3-540-00375-4, 2003, http://www.springer.de/cgi/svcat/search_book.pl?isbn=3-540-00375-4

3 chapters about group's technology, incl. PSELO

Talk overview

- Describe principles of PSELO system
- Short intro. to RDF and Edutella
- Overview how PSELO is integrated with Edutella P2P infrastructure for learning objects

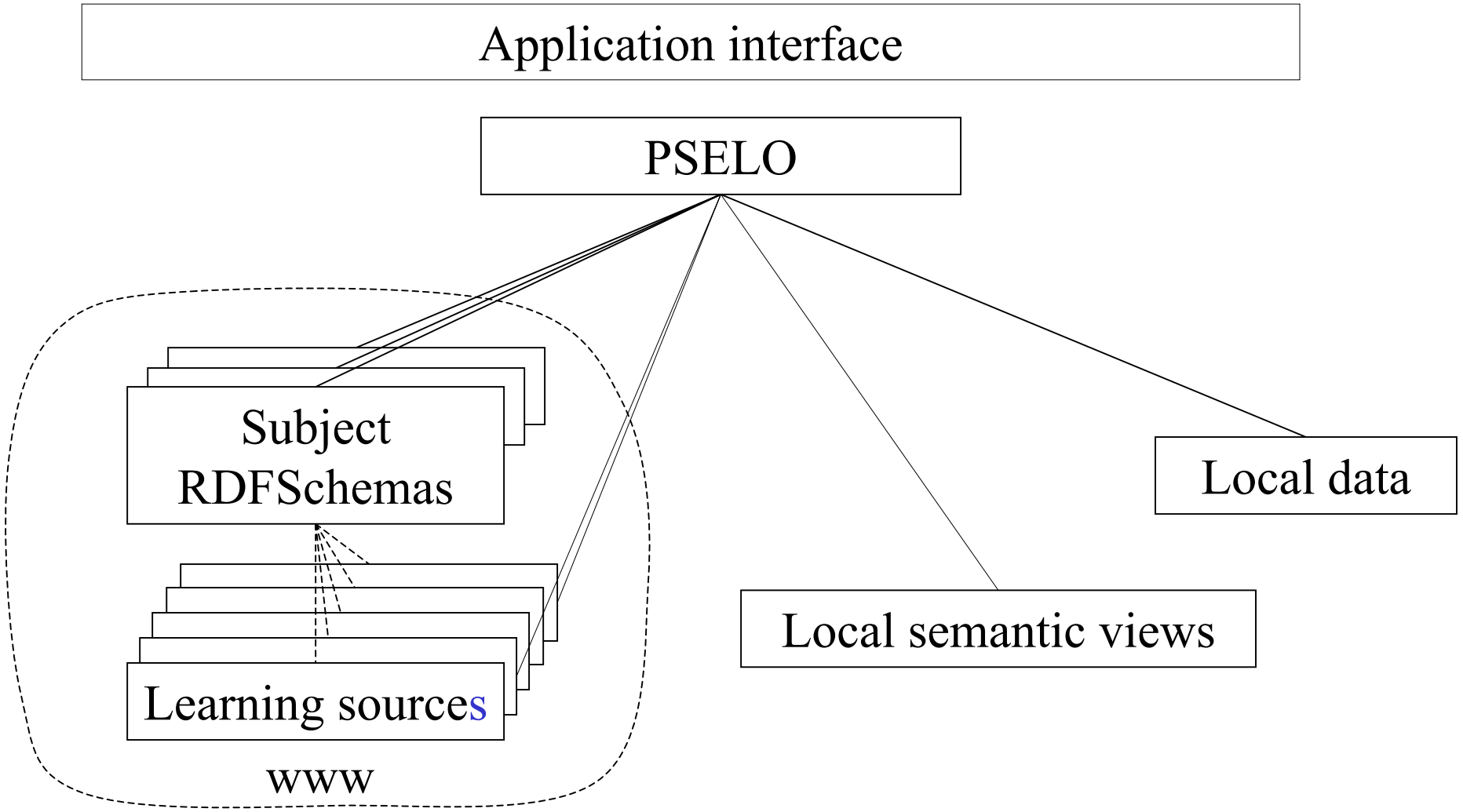
Problem Area

- Learning material, *Learning Objects*, are stored in several different data sources, e.g. web pages, databases, servers, etc.
- *Student* should be able to query teaching material on subject on his own.
- *Tutor* should be able to focus student on learning objects and terminology relevant for the subject.
- *Student* should be able to change focus as the learning progresses.

Approach

- Student explores material through middleware, PSELO.
- Learning objects described though semantic web *meta-data descriptions*, using *RDF* and *RDF-Schema* meta-data description languages.
- PSELO provides functionality for high-level ‘semantic’ queries and personal views in terms of taught subject
- Both tutor and student can define, modify, and extend semantic views

Personalized Search Engine for Learning Objects



RDFAmos semantic web mediator

•RDFAmos =
Amos II http://user.it.uu.se/~torer/publ/FuncMedPaper.pdf
+ wrappers for RDF and RDF-Schema.

•RDFAmos can:
- Access any RDF(S) data on web
-Automatically generate semantic views of RDF-Schema meta-data descriptions
- Process semantic queries over accessed data
- Manage local user views and tables
- Define mediating views combining RDF(S) sources with other kinds of data (e.g. relational databases)

PSELO semantic web mediator

•PSELO subsystems:

- RDFAmos

- Interfaces to Edutella P2P infrastructure for web-based learning material

RDF

•RDF describes web resources (URIs) using set of *statement* triples (in XML syntax):

<*subject*,*predicate*,*object*>

where *subject* is a URI to be annotated.

predicate is an annotation property

object is value of property as URI or *literal*(string)

•NB: This is a *binary relational model*. Schema is ONE relation:

statement(subject,predicate,object)

•Querying => Graph traversal through self joins, RQL

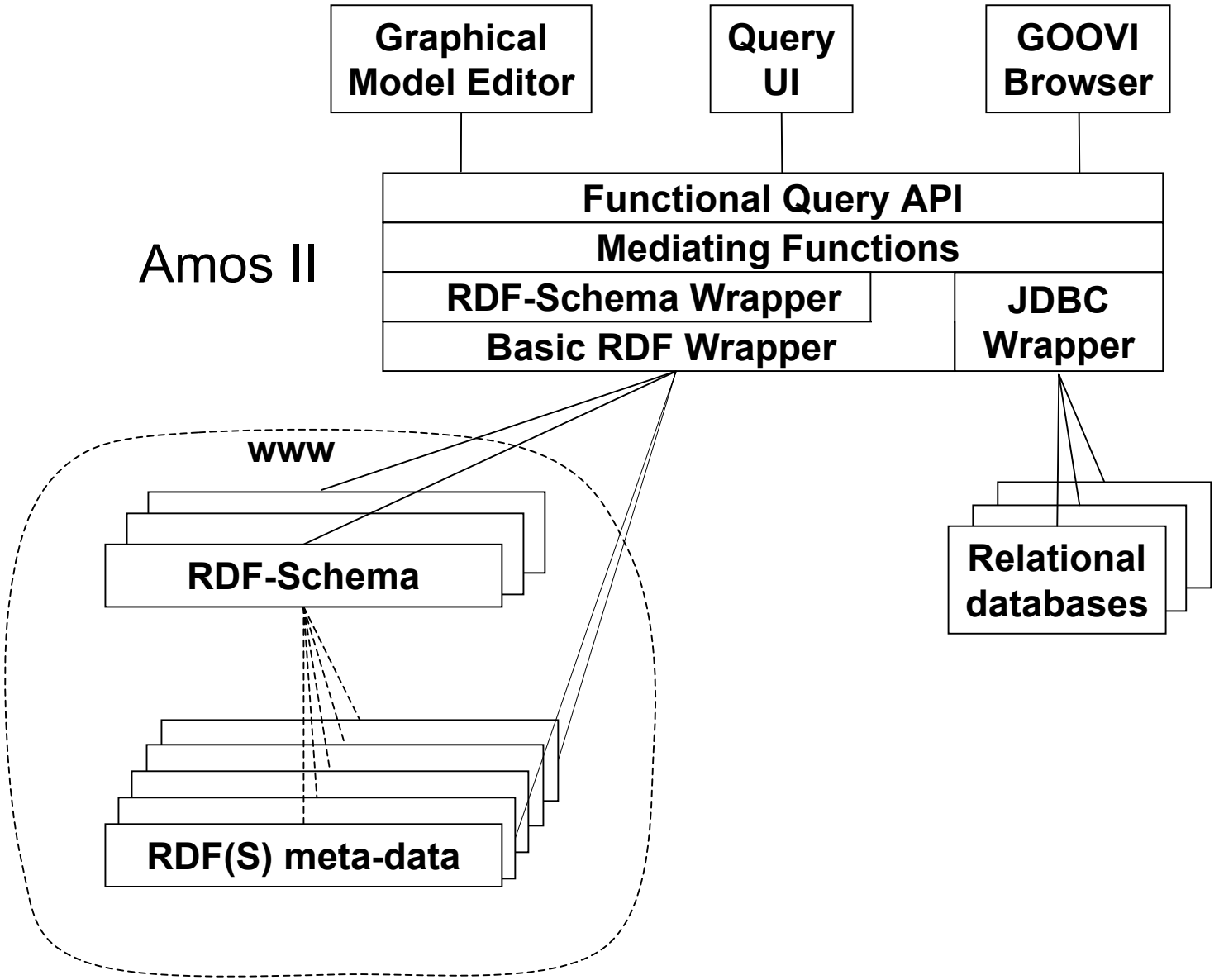
RDF-Schema

•Problem with RDF:
- Properties not predefined.
- Difficult to query and understand.

•RDF-Schema:
- Classification of resources
- Each class of resource has predefined properties
- Defined using RDF
- Data may be *mix* of RDF and RDF-Schema

•RDFAmos allows *semantic* queries:
- Queries expressed in terms of schema, not data.
- Over classes (types) and functions (properties)

RDFAmos System



RDF Wrapper

- General Amos II wrapper from RDF to functional data model (FDM)
- Basic Functional RDF Representation (BFRR) can represent *any* accessed RDF meta-data description
- HP'sARP2 RDF(S) parser used

RDFS Wrapper

- Each *RDF Schema* represented as **automatically generated** *functional views* over BFRR.
- *Functional queries* over **both** RDFS and semantically poorer RDF simultanously supported.

RDF Schema Example

In http://user.it.uu.se/~udbl/RDFAmos/Schema/schema:

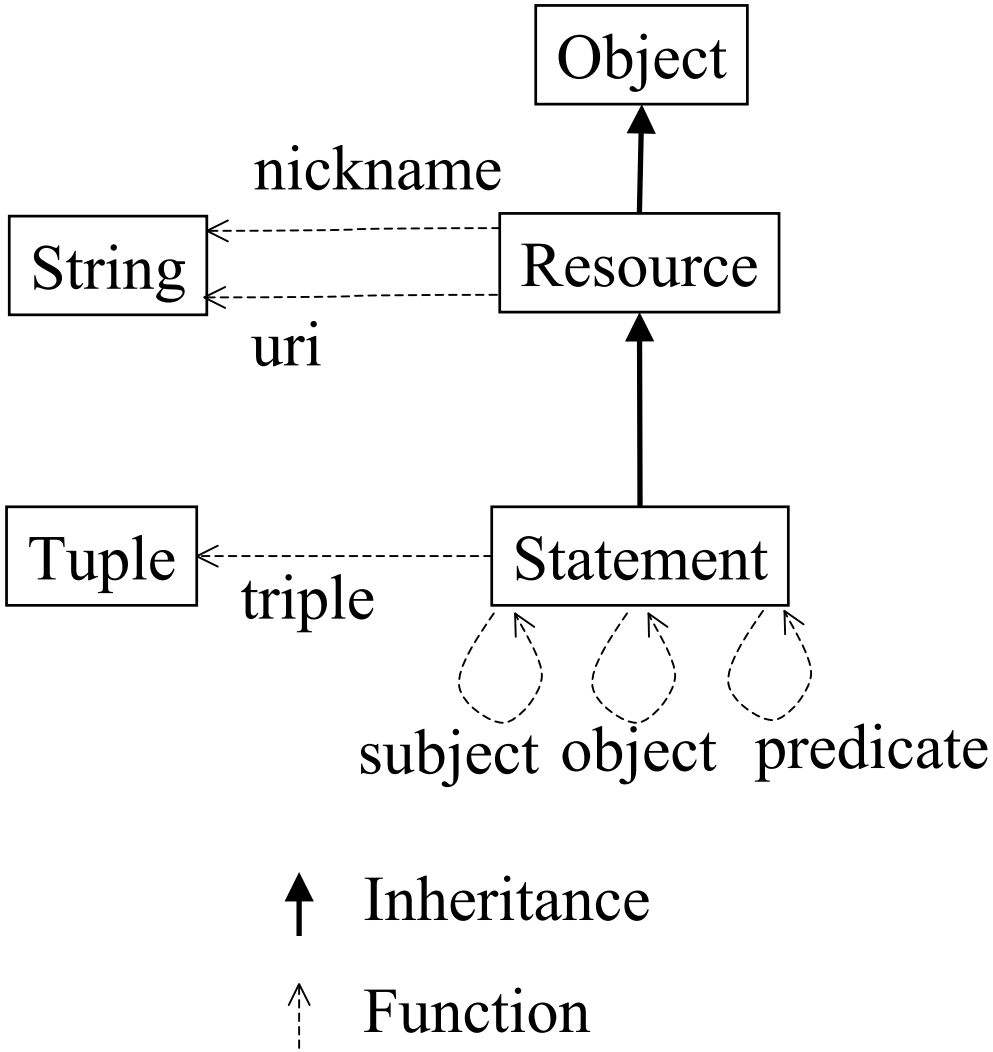
```
<rdf:RDF xml:lang="en"
         xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         mlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
<rdf:Description ID="Book">
  <rdf:type resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
  <rdfs:subClassOf rdf:resource="http://www.w3.org/2000/01/rdfschema#Resource"/>
</rdf:Description>
<rdf:Description ID="Title">
  <rdf:type resource="http://www.w3.org/2000/01/rdf-schema#Property"/>
  <rdfs:domain rdf:resource="#Book"/>
  <rdfs:range rdf:resource="http://www.w3.org/2000/01/rdf-schema#Literal"/>
</rdf:Description>
<rdf:Description ID="AI_Book">
  <rdf:type resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
  <rdfs:subClassOf rdf:resource="#Book"/>
</rdf:Description>
</rdf:RDF>
```

Basic Relational RDF representation

Statement

Subject	**Predicate**	**Object**
http:../#Book	http:../#type	http:.../#Class
http:.../#AI-Book	http:.../#type	http:.../#Class
http:.../#AI-book	http:.../#subClassOf	http:.../#Book
http:.../#Title	http:.../#type	http:.../#Property
http:.../#Title	http:.../#domain	http:.../#Book
http:.../#Title	http:.../#range	http:.../#literal

RDFAmos basic functional RDF representation BFRR



RDFS Data

http://user.it.uu.se/~udbl/RDFAmos/Schema/data:

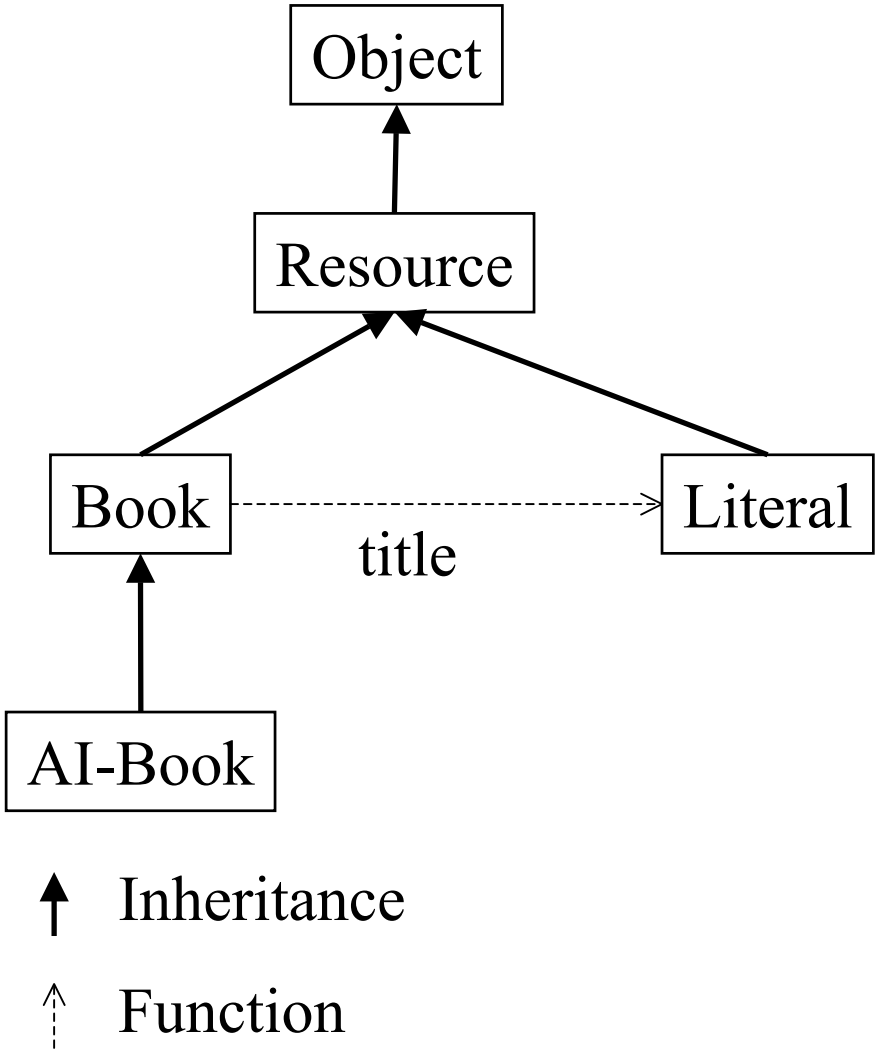
```
<rdf:RDF xml:lang="en"
   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#”
   xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
   xmlns:sch="http://user.it.uu.se/~udbl/RDFAmos/Schema/schema#" >
<sch:Book about="http://www.xyz.com/sw.html">
   <sch:Title>Software Engineering</sch:Title>
</sch:Book>
<sch:AI_Book about="http://www.xyz.com/ai.html">
    <sch:Title>Artificial Intelligence</sch:Title>
</sch:AI_Book>
<sch:Book about="http://www.xyz.com/pl.html">
    <sch:Title>Prolog</sch:Title>
</sch:Book>
</rdf:RDF>
```

Basic Relational RDF representation

Statement

Subject	**Predicate**	**Object**
http:../#Book	http:../#type	http:.../#Class
http:.../#AI-Book	http:../#type	http:.../#Class
http:.../#AI-book	http:.../#subClassOf	http:.../#Book
http:.../#Title	http:.../#type	http:.../#Property
http:.../#Title	http:.../#domain	http:.../#Book
http:.../#Title	http:.../#range	http:.../#literal
http:.../sw.html	http:.../#type	http:.../#Book
http:.../sw.html	http:.../#title	Software Engineering
http:.../ai.html	http:.../#type	http:.../#AI-Book
http:.../ai.html	http:.../#title	Artificial Intelligennce
http:.../pl.html	http:.../#type	http:.../#Book
http:.../pl.html	http:.../#title	Prolog

RDFAmos functional schema for a RDF Schema



Example Semantic Query

```
select distinct X
from Book X, AI_Book Y
where title(X) = 'Artificial Intelligence’
      or X = Y;
```

Edutella

- Infrastructure for peer-to-peer distribution of learning material
- Uses an RDF-Schema for description of learning material
- Application for SUN's JXTA environment for P2P systems
- Uses RDF based query language QEL3
- Can hook up Edutella *providers* which are peers that answer QEL3 queries

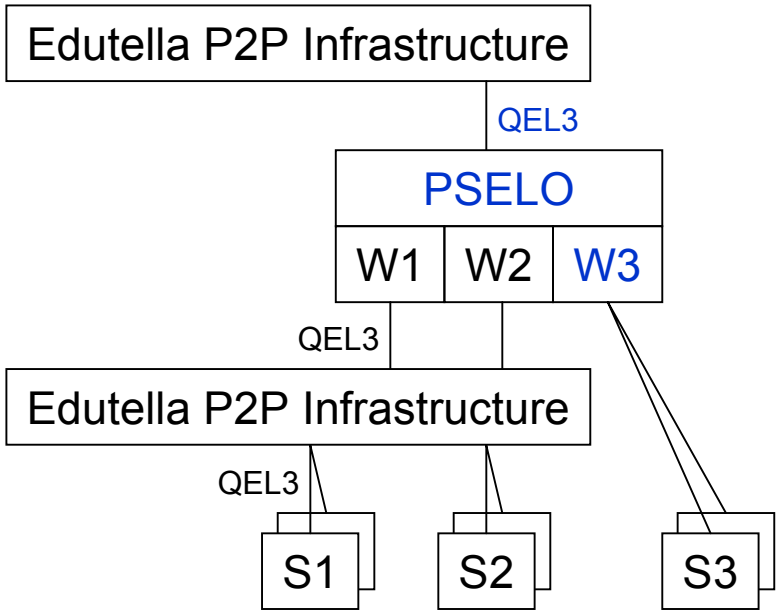
PSELO as Edutella provider

- PSELO is RDFAmos hooked up as Edutella provider
- PSELO delivers result through Edutella infrastructure

$\Rightarrow$PSELO becomes QEL3 Edutella peer that can mediate many kinds of data sources

- Also developing PSELO wrapper for Edutella sources

Edutella integration



Edutella Queries

- *QEL3* queries are data too.
- *QEL3* queries instances of *QEL3 meta-schema*
- *QEL3 meta-schema* imported as any other RDFS schema
  => Become type and function definitions in PSELO
- *QEL3 queries* imported as any other instances
  => Data describing queries in PSELO
- QEL3 queries are *objects* in mediator

QEL3 Query Translation

- Declarative PSELO function constructs PSELO query string from QEL3 query object:

```
query_string(QEL3Query)->Charstring
```

- PSELO function **`eval`** executes query string

Publications:

•T.Risch: Functional Queries to Wrapped Educational Semantic Web Meta-data, in P.Gray, L.Kerschberg, P.King, and A.Poulovassilis (eds.): *FunctionalApproach to Data Management - Modeling, Analyzing and Integrating Heterogeneous Data*, Springer, ISBN 3-540-00375-4, 2003, http://user.it.uu.se/~torer/publ/semfdm.pdf

•W.Neidl, B.Wolf, W.Siberski, C.Qu, S.Decker, M.Sintek, A.Naeve, M.Nilsson, M.Palmer, and T.Risch: EDUTELLA: P2P Networking for the Semantic Web, to be published in *Computer Networks Journal* (special issue on semantic web), 2003

•W.Neidl, B.Wolf, C.Qu, S.Decker, M.Sinek, A.Naeve, M.Nilsson, M.Palmér, and T.Risch: EDUTELLA: A P2P Networking Infrastructure Based on RDF. Presented at *11th Intl. World Wide Web Conference,* Honolulu, Hawaii, USA, May 2002, http://user.it.uu.se/~torer/publ/WWW-Edutella.pdf

Sponsorship

PSELO is part of PADLR project

- Sponsored by Wallenberg Global Learning Lab.
- Cooperation Uppsala, KTH, Hannover, Karlsruhe, Stanford