An approach to personalization in the Elena project

Peter Dolog
dolog@learninglab.de
http://www.learninglab.de/~dolog
Learning Lab Lower Saxony (L3S)
Hannover

DFKI research seminar, Kaiserslautern
12.8.2003

Learning Lab Lower Saxony [L3S]

L3S Charter:

- Competence Center for Innovative Learning Technologies
  - Members from Universities in Several German Countries
  - National and International Projects
  - Integration of Research and Application
- Location: German Pavillon (EXPO Plaza, Hannover)

L3S Members:

- HBK Braunschweig (Prof. Plank), TU Braunschweig (Profs. Floto, Reimers, Fischer, Neumann, Wolf), Uni Hannover (Profs. Nejdl, Jobmann, Pralle, Wagner), MH Hannover (Prof. Matthies), Uni Karlsruhe (Profs. Studer, Zitterbart), Uni Mannheim (Prof. Effelsberg)
- Additional associated members (ELAN, Koala, etc.)

L3S International Project Partners:

- WGLN (Karolinska Institut Stockholm, KTH Stockholm, Stanford University, Uppsala University), EU (Vienna, Amsterdam, Twente, etc.), and others

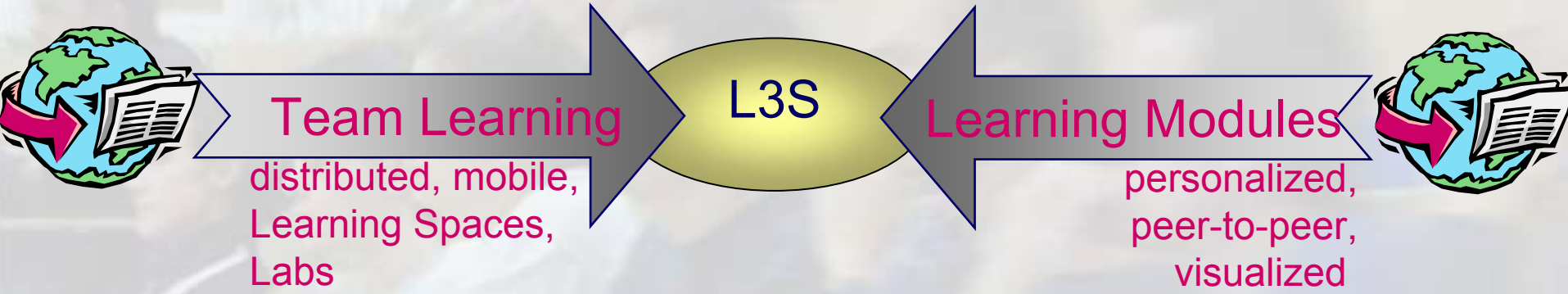
Financed by BMBF, MWK Lower Saxony, EU, ...

- About 3.5 Mill. Euro yearly budget

L3S Projects and Research Focus

L3S does research along two dimensions

- Team-Oriented Learning
- Distributed Learning & Learning Materials



Computer science, integrated with
pedagogic research aspects and evaluation, as well as other disciplines

Outline

Elena Project
Motivation
Related Work
Open RDF-Based Environment and Adaptation
Metadata Standards (Learning Objects, Learners)
Rule-Based Personalization
Conclusions and Further Work

Elena Project

Elena aims at creating smart spaces for learning **that support the "smart" mediation of learning services based on user profiling, service evaluation and reputation ratings.**

PLA, the personal learning assistant, performs the search for suitable learning services based on the learner's individual profile, processes the selected services and supports the evaluation of the learner.

Examples for a learning service **are the delivery of a course, the provision of a web-based training application or self-study material.**

Use Case Scenario

Motivation for Personalization

Educational material is distributed in the WWW

- Learning management systems
- Adaptive hypermedia
- Content providers

This material can be shared, retrieved and adapted to user needs

P2P approach allow us

- To query distributed content and link metadata which resides at different peers
- To have peers with different services distributed and thus compute adaptation not only on one machine
- ➢ And thus to provide users with more possibilities to get educational material and to choose the appropriate one for them

Outline of our Approach

Content metadata seen as some constraints on use for learning objects

Learning object metadata are retrieved according to matching between learner profile and LO metadata

Rules determine how adaptation is performed based on the matching learner profile and LO metadata

Related Work

Adaptive (Open) Web-Based Systems

- Open adaptive hypermedia (Bailey et al.)
- Open corpus adaptive hypermedia (Henze, Nejdl)

Adaptive Hypermedia Systems

- AHA! (De Bra et al.)
- Interbook (Brusilovsky et al.)
- SQL Tutor (Mitrović et al.)
- ...

➢ How to support these ideas in open network?

Open RDF-Based Environments

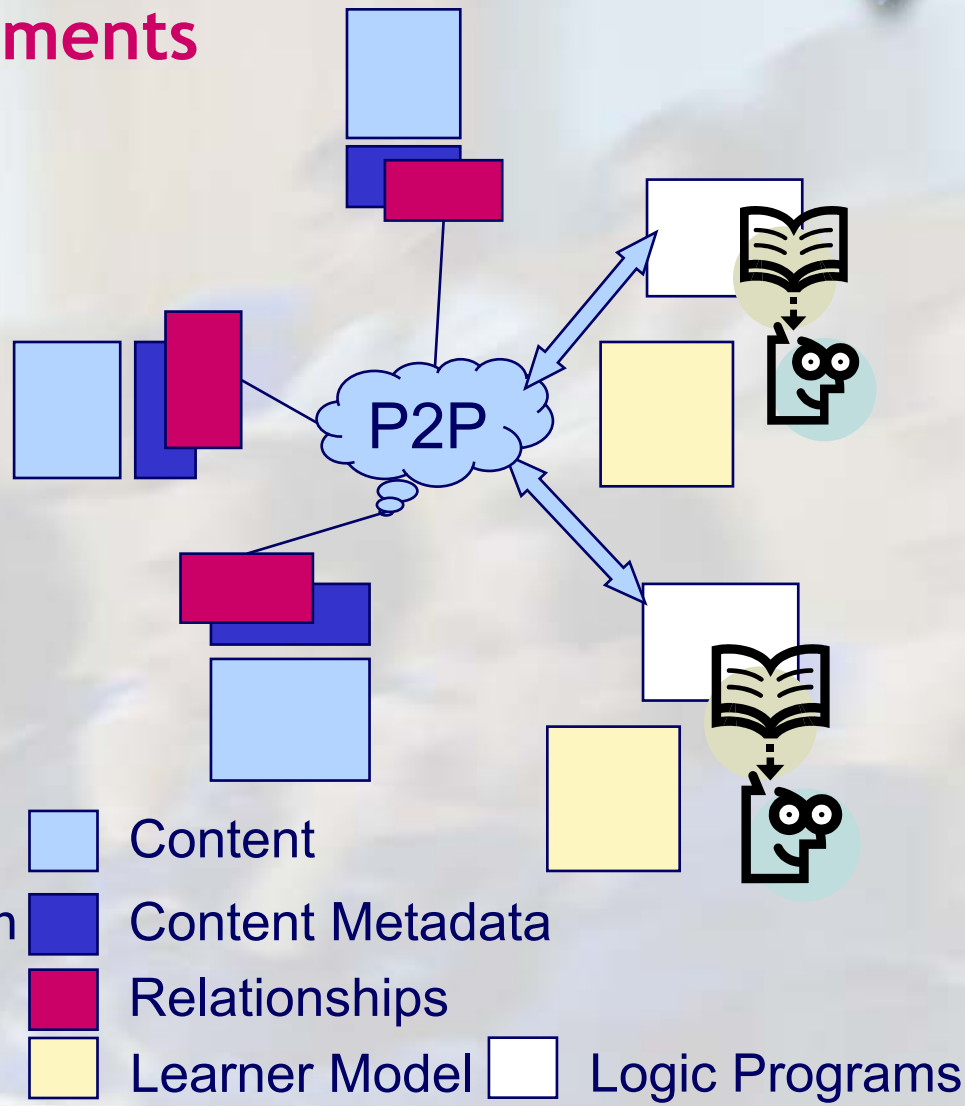
Distributed content

Distributed standard based metadata descriptions about:

- Content
- Relationships between the content
- Learner

Logic Programs

- Query and adapt content delivery and its links
- Visualize adaptive navigation support



Metadata Standards

The aim is to provide standardized descriptions to improve interoperability and to support individuals by adaptation

Standards for:

- Learning Material Descriptions
  - Learning Object Metadata (LOM) standard (IEEE LTSC P1484.12.1, 2002-6-12)
  - Simple Dublin Core (v1.1, 2003-4-2), DC Terms –formerly dublin core qualified (2003-3-4)
- Learner Descriptions
  - IEEE Public and Private Information (PAPI) for learner (IEEE P1484.2/D7, 2000-11-28)
  - IMS Learner Information Profile (v1.0, 2001-3-9)

LOM and DC

Metadata about content (learning objects):

- DC
  - Simple DC (15 attributes like title, relation, creator,...)
  - DC terms - Additional elements which refine basic elements (e.g. name, comment, definition, label refine title; isVersionOf, and so on)
- LOM
  - Attributes are grouped into categories: *general*, *life cycle*, *meta-metadata*, *technical*, *educational*, *rights*, *relation*, *classification*, *annotation*

Using RDF bindings of LOM and DC in implementation

Topic Ontologies for Content Classification

Content classified by topics (concepts) it covers

dc:subject – we assume that the topic is fully covered

(Topics can have different weights of covering – mentioned, introduced, covered)

Values from ACM CCS classification

Using *lom-cls:Taxonomy* instance in dc:subject

More on this topic:

Jan Brase, Wolfgang Nejdl: Ontologies for eLearning. In *"Handbook on Ontologies"* (Springer-Verlag 2003).

ACM CCS part Example in RDF

```
<dcterms:SubjectScheme rdf:ID=„ACM_CCS“>
  <rdfs:label>ACM Computer Classification system</rdfs:label>
</dcterms:SubjectScheme>
<lom_cls:Taxonomy>
   <lom_cls:rootTaxon>
   <ACM:ACM_CCS rdf:about=„http://www.kbs.uni-
     hannover.de/Uli/ACM_CCS.rdf#D“ >
   <rdf:value>Software</rdf:value>
      <lom_cls:taxon>
      <ACM:ACM_CCS rdf:about=„http://www.kbs.uni-
     hannover.de/Uli/ACM_CCS.rdf#D.1“>
      <rdf:value>PROGRAMMING TECHNIQUES</rdf:value>
...
      </lom_cls:taxon>
   </lom_cls:rootTaxon>
</lom_cls:Taxonomy>
```

Accessibility Requirements for LOs

Prerequisite relationship (dcterms:requires)

- Based on resource – topics have to be retrieved from metadata about the resource which is prerequisite
- Based on topics – directly storing prerequisite topics for particular resource in that resource metadata

Explicit use of learner profile in LO metadata descriptions

LOM Accessibility Constraints

Explicitly saying which learner profile is well suited to consume particular resource:

```
…
<lom-cls:accessibilityRestrictions
 rdf:resource="http://www.kbs.../S5T2.pdf"/>
  <papi:performance>
    <rdf:Description rdf:ID="performance_1">
     <papi:learning_competency rdf:resource= "http://www.kbs.uni-
hannover.de/Uli/ACM_CCS.rdf#D.1"/>
     <papi:granularity>topic</papi:granularity>
     <papi:performance_coding>number</papi:performance_coding>
     <papi:performance_metric>0-1</papi:performance_metric>

<papi:performance_value>greater_than(0.5)</papi:performance_value>
</papi:performance>
</lom-cls:accessibilityRestrictions>
…
```

Other fields

Intended user role from LOM educational category (e.g. Manager)

Context from LOM educational category (e.g. School, vocational training)

Audience from DC terms

Language from educational categories

Describing Users

Why: To be able to customize (adapt) information to specific person

Different user characteristics can support personalization

Personalization in adaptive educational hypermedia is based on learner performance mostly

- Level of knowledge
- Task solved, and so on

Learner Profile Standards

IEEE PAPI:

- Categories: personal information, relations, security, preference, performance, portfolio

IMS LIP:

- Categories: identification, QCL, accessibility, activity, goal, competency, interest, transcript, affiliation, security key, relationship

More about in:

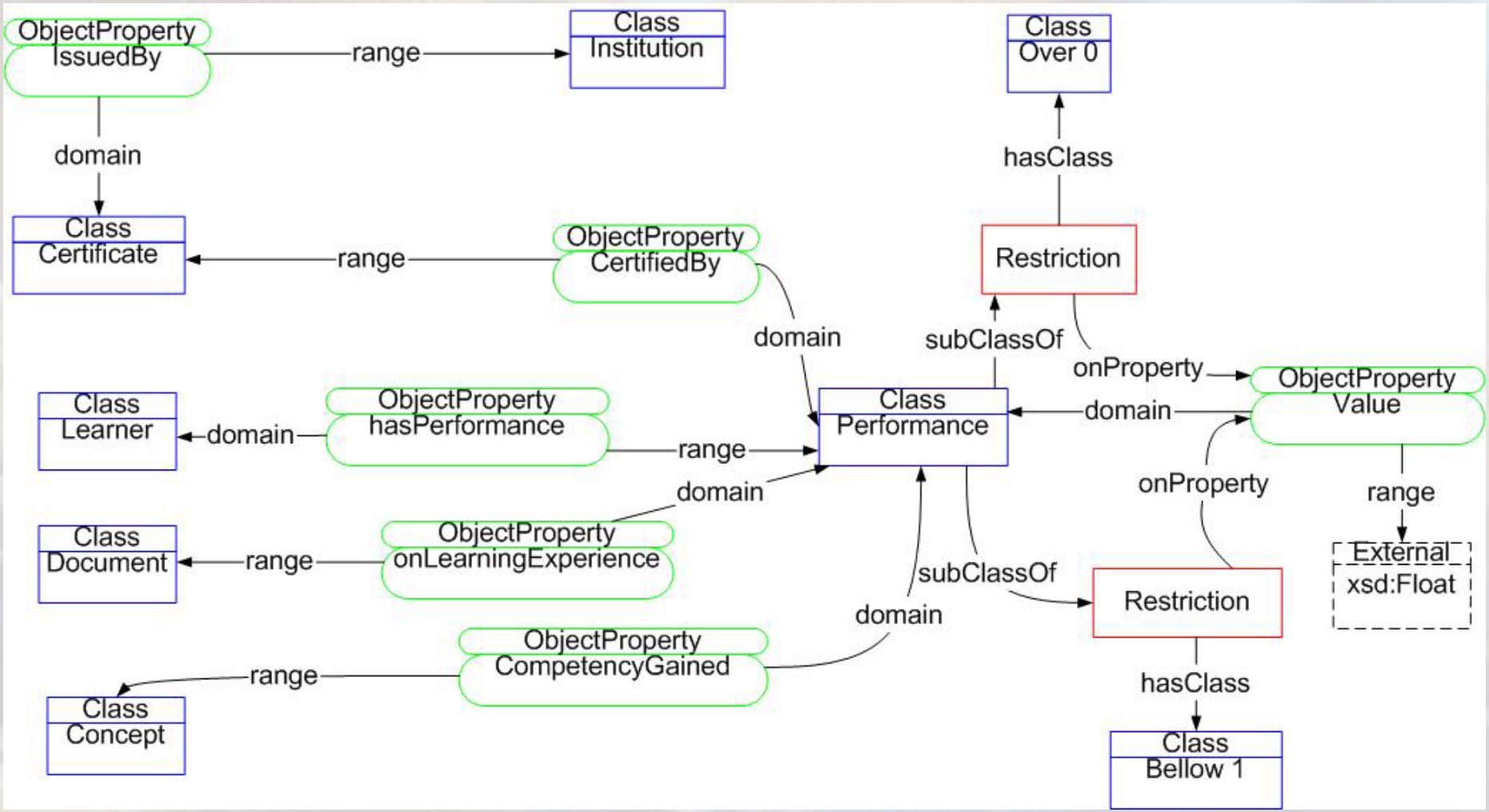
Peter Dolog and Wolfgang Nejdl:

Challenges and Benefits of the Semantic Web for User Modelling.

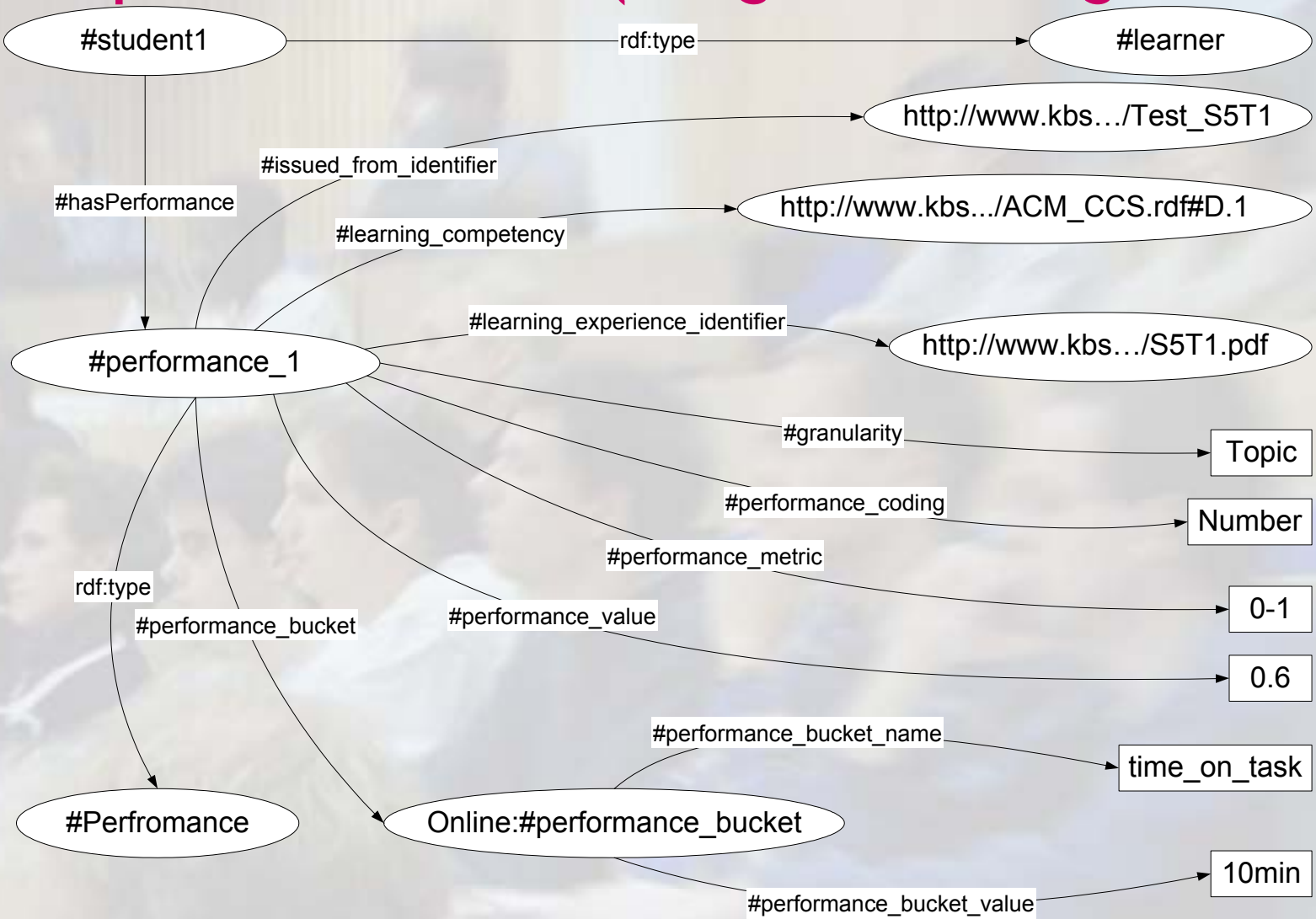
In Proc. of AH2003 workshop.

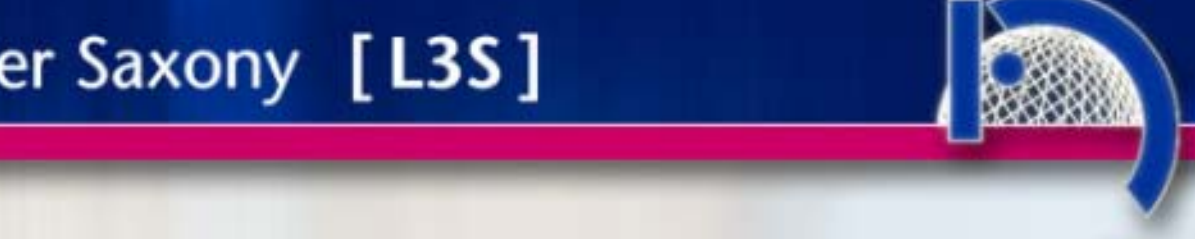
Or at http://www.learninglab.de/~dolog/learnerrdfbindings/

Schema in DAML (OWL) for performance profile

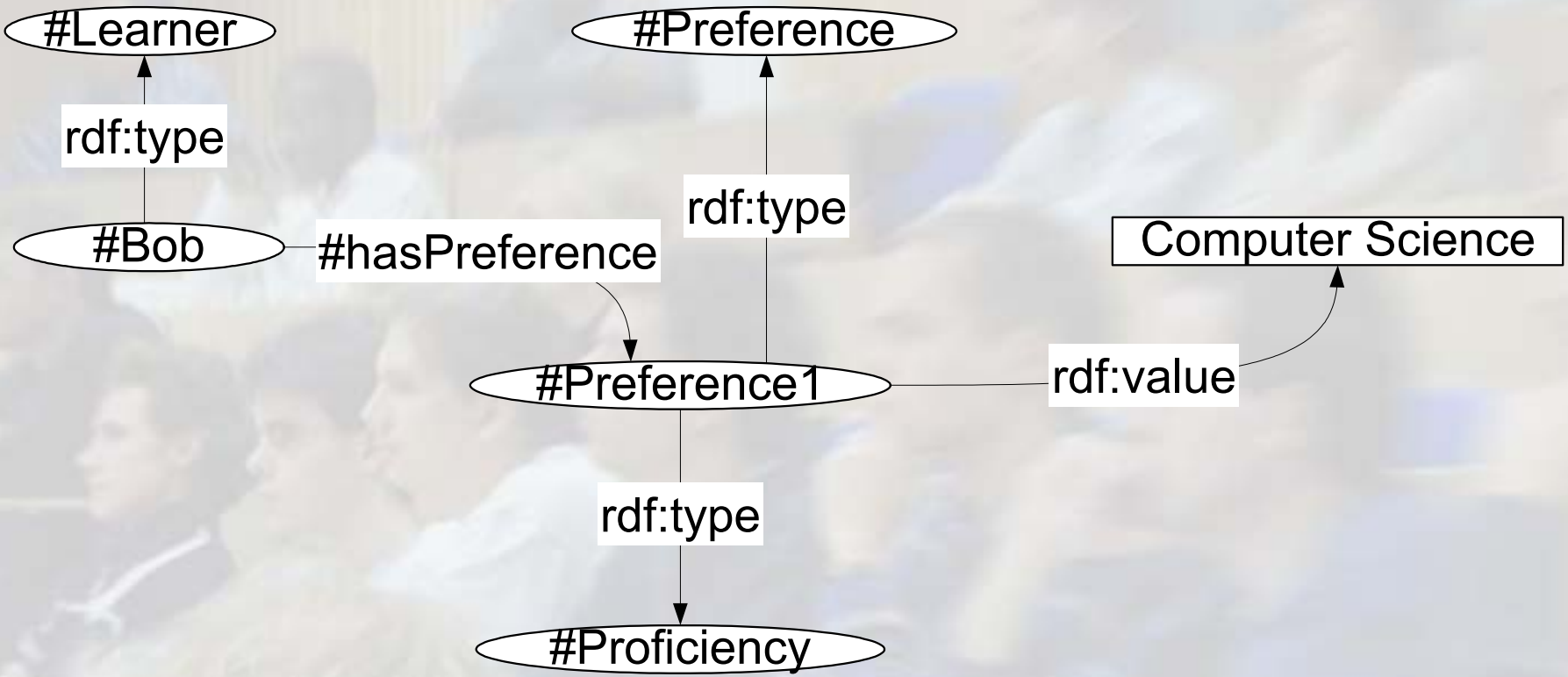


Example: Performance (using RDF bindings of PAPI)

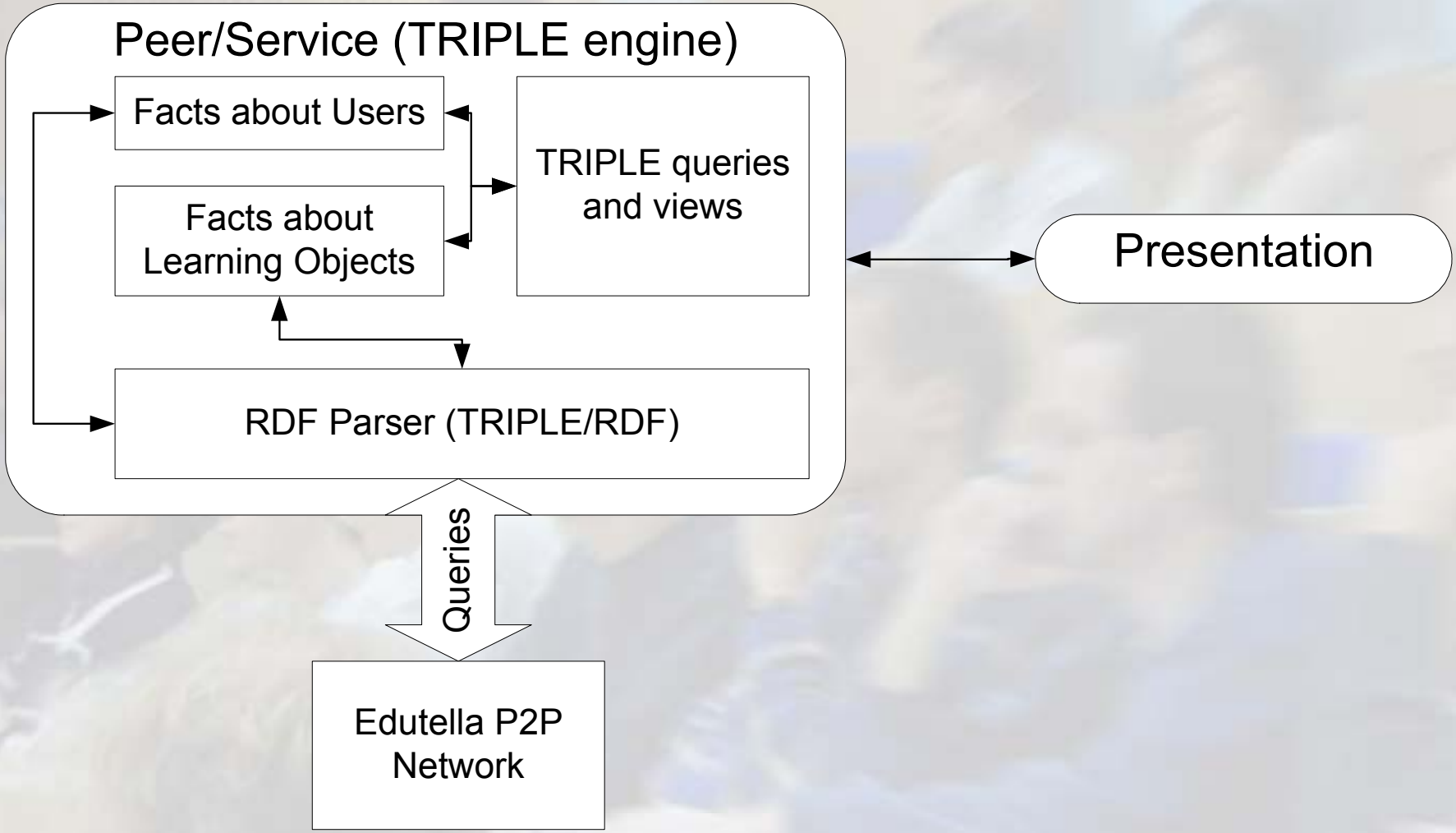




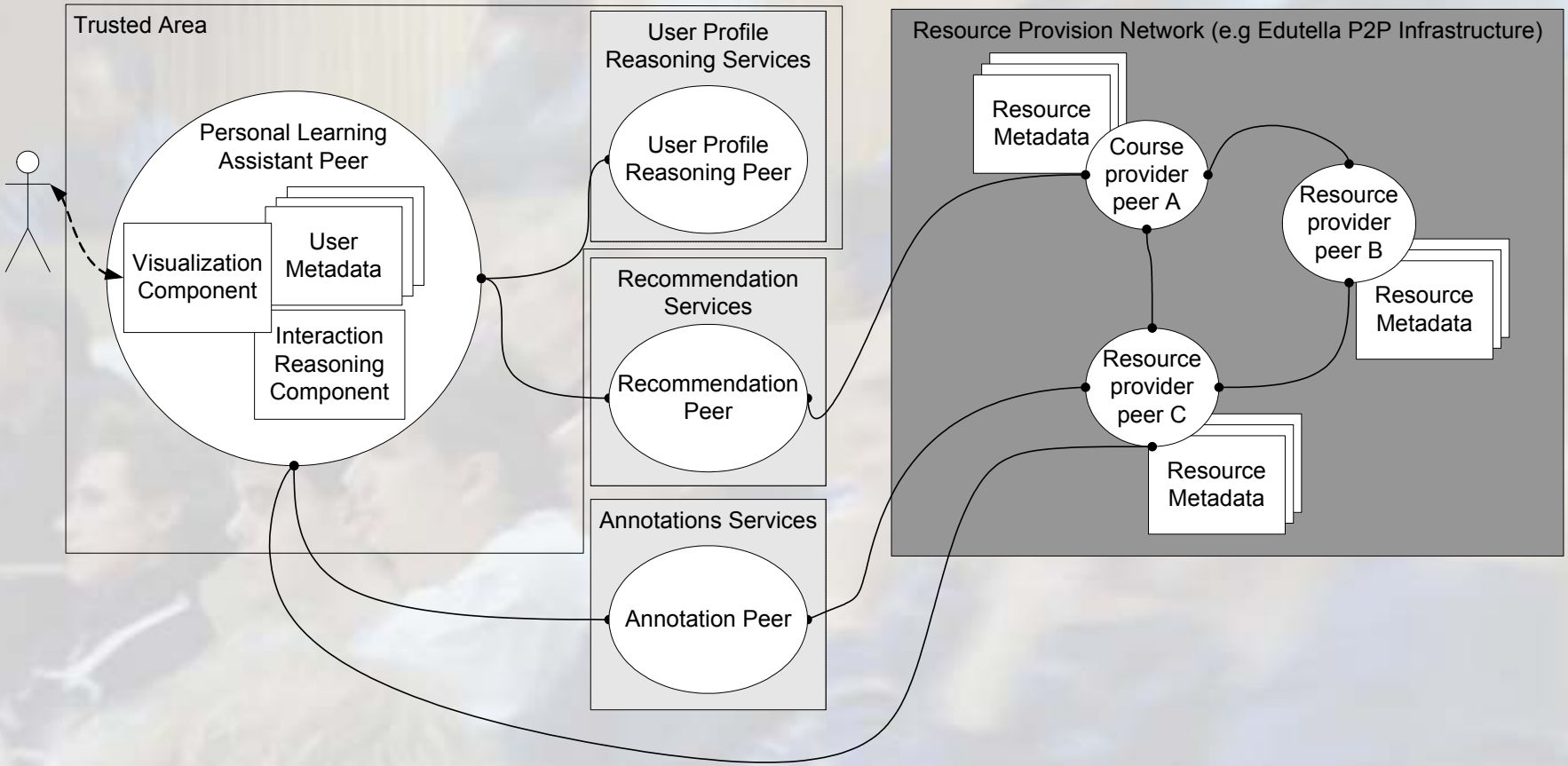
Preference Record



Peer Architecture



Architecture Focusing Personalization Services



Querying in Edutella P2P

Datalog- and RDF-Based QEL

Common internal data model for Queries

Several wrappers implemented (file based, relational database, concept base, ...) to support several metadata storage types

Two kinds of wrappers:

- Implementing provision service
- Implementing consumer (query) service

Rule-Based Personalisation using TRIPLE

Using view mechanism:

- View for transformed facts about learning objects
- View for transformed facts about learners
- View for recommendation rules

Rule for recommendation:

```
FORALL U, D recommended(U, D) <- user(U) AND document(D)
   AND
  FORALL Dl (prereq(D, Dl) ->
            (FORALL T (topic(Dl, T) -> (EXISTS P
              (U[papi:has->P]@uli:learner AND performance(P) AND
               P[papi:learning_competency->T]@uli:learner))))).
```

Conclusions and Further Work

We described:

- How to build on standards in open RDF-Based environments to support:
  - Course composed from resources distributed in the network
  - Adaptive navigation in the course

We will further investigate:

- Adaptation in heterogeneous environments
- Personalization services
- Improvements of RDF bindings for learner profiles

Thank you for your attention!!!

Visit L3S web site: http://www.learninglab.de
Elena: http://www.elena-project.org

References:

Peter Dolog, Rita Gavriloaie, Wolfgang Nejdl and Jan Brase: Integrating Adaptive Hypermedia Techniques and Open RDF-based Environments. In Proceedings of Twelfth International World Wide Web Conference. May 2003, Budapest, Hungary. ACM.

Peter Dolog and Wolfgang Nejdl: Challenges and Benefits of the Semantic Web for User Modelling. In Proc. of AH2003 workshop, May 2003

Peter Dolog and Nicola Henze: Personalization Services for Adaptive Educational Hypermedia. In Proc. of International Workshop on Adaptivity and User Modelling in Interactive Systems, LLA, Karlsruhe, Germany, October 2003.