Adaptive Personalisation in Self e-Learning Networks

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Overview

- Background – the SeLeNe project
- Learning Object registration
- View definition over RDF metadata
- Query adaptation and trails
- Event and change notification
- Transferable outcomes of SeLeNe
- Other related projects at Birkbeck

The SeLeNe Project

- AN EU FP5 Accompanying Measure that ran from 1st November 2002 to 31st January 2004
- Project partners:
  - Birkbeck, University of London
  - Institute of Education
  - Foundation for Research and Technology Hellas
  - Laboratoire de Recherche en Informatique
  - University of Cyprus

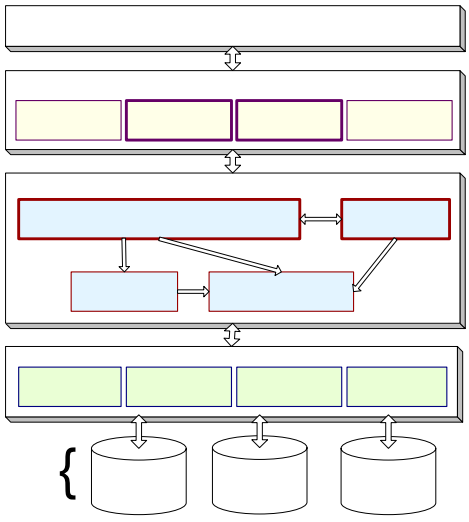
Motivation for SeLeNe

- There are a huge number of learning resources now available on the Web
- There are diverse communities of learners, geographically distributed and with a range of educational backgrounds and learning needs
- Tools are needed to allow the discovery, sharing and collaborative creation of learning resources
- Semantic metadata describing these resources can enable advanced services more powerful than traditional Web techniques

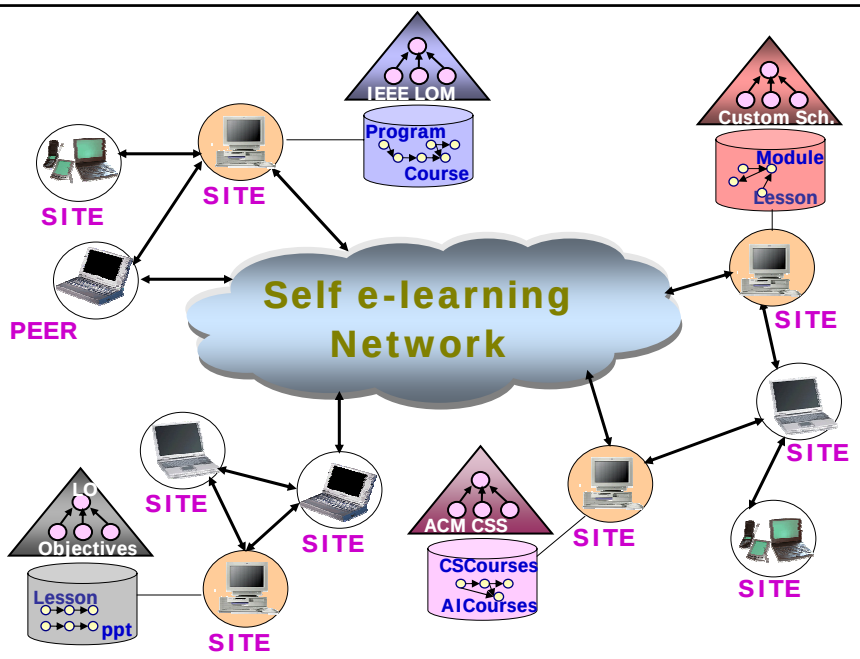
What is a Self e-Learning Network (SeLeNe)?

- Extensive user requirements specification was one of the first parts of the project, defining SeLeNe's functionality
- A SeLeNe is formed by members of a learning community
  - *instructors*, *learners* and *content providers*
- The community creates a collection of shared Learning Objects (LOs) and their RDF metadata descriptions
- Users register and share a LO by providing a metadata description of it; some parts of the metadata can be automatically generated
- The descriptions form a metadata repository – SeLeNe manages this metadata, not the LOs themselves

SeLeNe's Service Architecture



- We have defined a service-based architecture that provides the full SeLeNe functionality
- We have explored the feasibility of several deployment options: centralised, distributed and P2P



Personalisation

- There are many LOs available to users of a SeLeNe; some will be useful for them and others will not
- Personalised access to LOs provides learners with tools to aid the sharing and discovery of useful LOs:
  - **LO registration**: Descriptions of new LOs are based on the author's descriptions of their component LOs
  - **Views**: Learners can browse the LO information space according to the attributes of personal interest to them
  - **Search**: Learners are presented with LOs relevant to their current educational needs
  - **Notification**: Learners are notified of the updates and additions to the SeLeNe that are relevant to them

Learning Object Registration – LRI partner

- Registration of a LO = submission of metadata
- For *composite LOs* (made up from other LOs), the taxonomical description can be automatically derived from the descriptions of its component LOs
- Derived descriptions can use a “personal taxonomy” to classify LOs as the user would do
- Our algorithm takes the least upper bound of the Cartesian product of the individual descriptions to give a description that “summarises” the taxonomical descriptions of the parts

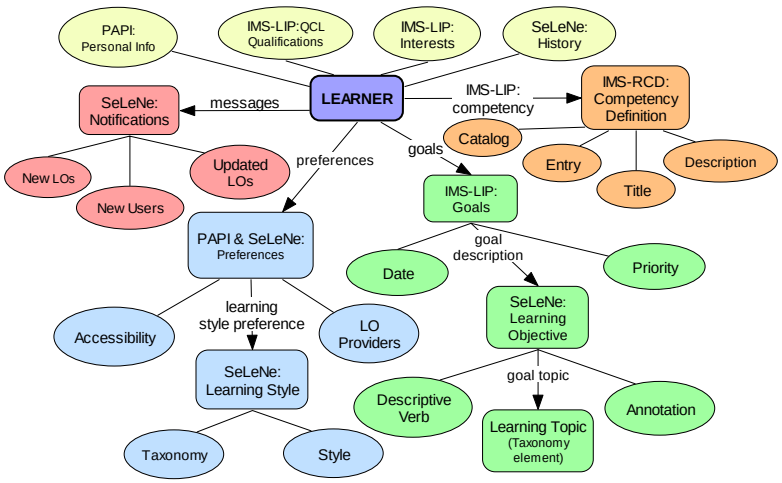
Personalised Views – FORTH partner

- The user’s view of LO descriptions and schemas can be personalised to reflect their perception of the information space
- RDF View Language (RVL) allows definition and population of virtual schemas and LO descriptions
- Personalised views can be browsed and queried directly via RQL

Personalised Query Results – BBK-IOE

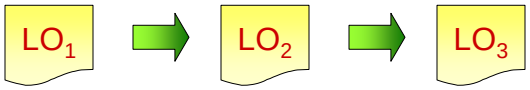
- These depend on a User Profile, which includes
  - Some PAPI-Learner elements
  - Some IMS-LIP and IMS-RCD elements
  - Additional elements to record learning goals and learning styles
- LO descriptions are queried using RQL, generated from keyword-based queries – RQL query generation takes account of the profile as well as the query
- The set of LO descriptions returned by query evaluation are ranked according to the original query and the User Profile

The SeLeNe User Profile



Trails of Learning Objects

- Personalised query results may be presented as a set of *trails* of LOs – suggested sequences of interaction



- We have defined an RDF representation of trails as a subclass of the RDF *Sequence* with additional properties
- A trail is used within the User Profile to record the user's *history* of interactions with the system
  - This is key to the dynamicity and adaptivity of the profile
  - Users' profiles are automatically updated based upon events stored in their histories (thus avoiding the need for manual updating of the profile)
  - This functionality is provided using Event-Condition-Action rules

Event and Change Notification - BBK

- SeLeNe application services may generate Event-Condition-Action (ECA) rules, which act over the RDF metadata repository like traditional database triggers
- RDFTL rules are of the form:

  on *event* **`if`** *condition* **do** *action*

- This enables notification of:
  - Registration of new LOs of interest to the user
  - Changes to descriptions of particular Los
  - Updates to user profiles

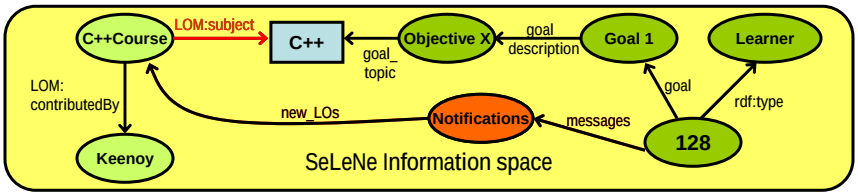
Example

```
ON INSERT resource() AS INSTANCE OF LearningObject
IF $delta/target(lom:subject)
  = resource(http://www.dcs.bbk.ac.uk/users/128)
    /target(ims-lip:goal)
    /target(ims-lip:goal_description)
    /target(selene:goal_topic)
DO LET $new_los :=
  resource(http://www.dcs.bbk.ac.uk/users/128)
  /target(selene:messages)/target(selene:new_LOs)
  IN INSERT ($new_los,seq++,$delta);;
```

→ Checks for triggering ***event*** ☑

Checks to see if the ***condition*** is met (i.e. if the inserted resource is on the topic of one of user 128's learning goals) ☑

Carries out the ***action*** associated with this rule (i.e. notifies learner 128 that there is a new LO of interest) ☑



Implementation of ECA Functionality

- Peers supporting the *Event and Change Notification* service will run an *ECA Engine*
- The ECA Engine consists of:
  - *RDFTL language interpreter* (parses rules and translates path expressions into RQL)
  - *Event detector* (detects triggering of rules using the Query service)
  - *Condition evaluator* (determines which rules should fire using the Query service)
  - *Action scheduler* (if rule condition is true, generates a set of updates to be scheduled for execution)
  - *Routing service* (maintains information about a peer's neighbours on the network)

Implementation of ECA Functionality (2)

- Service-based architecture is being developed over the Sun® JXTA Peer-to-Peer framework
- The RDF metadata are stored in a FORTH-RDFSuite repository at each peer
- We assume a peer-to-peer architecture with super peers
  - RDFTL rules are stored in a rule base at each super peer running an ECA engine
  - Event notifications are propagated from peers to their coordinating super peer
- Indexes are kept at super peers and peers facilitate event detection and rule processing
- See G.Papamarkos personal web page for relevant paper downloads

Main Transferable Outcomes of SeLeNe

- Critical *review* of existing e-learning standards
- Specification of the *functionality* of a self e-learning network
- Service-based *architecture* specification to support this functionality
- Identification of *composite LOs* as a paradigm for collaborative construction of LOs; algorithm for automatic generation of their taxonomical descriptions
- *User profile* specification, with RDF schemas
- *RVL* view definition language
- XML and RDF *event-condition-action* languages

Further details and technical reports are available from:

http://www.dcs.bbk.ac.uk/selene/



Other related projects at Birkbeck

- **ISPIDER** (BBSRC)
  - integration of heterogeneous biological resources in Grid/Web service environment
  - Using MyGrid, DQP and AutoMed as middleware
- **AutoMed** (ESPRC)
  - heterogeneous data integration toolkit
  - being applied in ISPIDER and BIOMAP
  - supports virtual/materialised, GAV/LAV/P2P integration
- **L4All Distributed e-Learning Pilot** (JISC)
  - development of pilot Web Portal and Web service-based tools to support life-long learners in London