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

- **ISPIIDER** (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 ISPIIDER 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