The Planet Project: Collaborative Educational Content Repositories on Structured Peer-to-Peer Grids

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Introduction: The Planet Project

- Ubiquity of computing networks is making distance learning and accessibility to high quality materials possible.

- Appearance of different standards for interoperability between organizations.
  - Content labelling – LOM
  - Packaging and browsing of contents – SCORM
  - Remote search and content gathering – IMS Digital Repositories

- Main problem is content accessibility
  - Need for an open worldwide platform – Global educational content repository
  - POOL or Edutella are first approaches
    - Missing directory service for searching contents hierarchically.
Introduction: The Planet Project (2)

• The **decentralization** pattern is being followed
  – **Content servers** are “fixed elements” in the network
  – **Clients** are “dynamic elements” in the network
• This philosophy matches those of **Peer-to-Peer Grids**
  – Provide services typically found in Grids and p2p networks
• In such context, the **Planet Project** is framed
  – Merge these previously isolated worlds
    • Structured p2p Grids + educational content repositories
• Planet Project’s objectives
  – Develop a **decoupled and open architecture** based on **Grid/p2p** and federation/replication for educational content **access and distribution**
  – **Integrate collaboration and interaction tools** in content access and interaction
  – **Promote content reusability and interoperability** between multiple platforms by splitting content descriptions from their instantiation
  – And many others, ...
Introduction (4): The Planet Project

- Planet Project’s layered architecture
Related Work

- **Wide-Area Middleware Platforms**
  - JxTA
  - OMNIX
  - LaColla

- **Content Repositories Interoperability Standards**
  - IMS Digital Repository Interoperability (DRI)
  - Learning Object Resources Interoperability (LORI)
  - ProLearn
p2p Grid Middleware Layer: Dermi

• **Dermi** is a structured p2p Grid object-based middleware

• It provides interesting services on top of a decentralized overlay network:
  - P2P Invocation Abstractions
  - Decentralized Object Location
  - Distributed Interception
p2p Grid Middleware Layer – Dermi Architecture
p2p Grid Middleware Layer – Dermi Services

• p2p Invocation Abstractions
  – **Direct calls** (Sync / Async)
    • A direct call from one object to another (1:1)
  – **Multicalls** (Sync / Async)
    • A call from one object to many (1:N)
  – **Anycalls**
    • The call is made to the client’s nearest object, as dictated by the network’s proximity metric
  – **Manycalls**
    • Similar to *anycall*, but in this case, the call must be satisfied by several group members
Content Repositories Layer

- We have implemented our own educational content repository: **Planet Digital Repositories (PlanetDR)**
- Interoperability in mind:
  - Implementation of the **ECL protocol** using Web Services
  - It follows the **IMS DRI** interoperability standard
Content Repositories Layer – IMS DRI & ECL

- **IMS DRI** provides **recommendations** for interoperating between the most common repository functions.

- **ECL** (eduSource Communication Language) is an **implementation** of IMS DRI
  - Provided by means of an **eduSource connector**
  - It provides a **standard API** to connect an existing repository to the eduSource network.
• **IMS DRI Core functions** defined as web services:
  
  – **Search/Expose**: search contents through their metadata (using the XQuery protocol)
  
  – **Submit/Store**: how to “upload” contents to an educational content server. Try not to use FTP transport protocol!
  
  – **Request/Deliver**: access a determinate resource described by its metadata.
  
  – **Gather/Expose**: defines repository-exposed meta-data requests, and aggregation for use in subsequent searches, or for creating a new meta-data repository.
PlanetDR includes the following services

- **Search service**
  - *Quick search*
    - Keyword found in *any* metadata field
  - *Advanced search*
    - *Search by main meta-data category*: any LOM meta-data field can be specified.
    - *Accumulated search*: searching for any field, linking together *conditions* of different LOM categories.
- **Federated search**
  - Results are gathered from all active content servers in the eduSource network (it acts as a simulated Gather service).
Content Repositories Layer – PlanetDR (2)

- PlanetDR includes the following services (cont’d)
  - Request Service
  - Submit Service
  - Federation Mode
    - Decentralized management of PlanetDR compatible servers
    - New PlanetDR active instances in the network are automatically detected and inserted into each node’s local list of available servers
    - Provides “awareness” of which content servers are available on the network.
• Development of **wide-area collaborative tools**
  
  – Developed on top of **p2pCM** (a structured p2p Grid Component Model) or **Dermi**.
  
  – Programmers **can focus** on interesting aspects of the application (forgetting caching, replication, object location, etc.)
  
  – The underlying middleware can be used to develop wide-area applications.
  
  – We focus on **wide-area collaboration** tools and applications.
Collaboration Layer (2)

- **Getting the best of it** (a collaborative perspective)
  - State propagation (**multicall**)
  - Collaborative components location (**decentralized location service**)
  - State persistence (**stored and replicated in the DHT**, thus providing fault tolerance)
  - Collaborative voting scenario (**manycall**)

- **Example: decentralized messenger-like application**
  - Contact information stored in the **naming service**
  - Multicall used to disseminate messages 1:N
  - **Offline message delivery system**
    - Messages are **restored from the DHT** once the contact becomes online
Planet Communities

- **Link** both the repository and the collaborative layers to create collaborative communities around educational contents.
- PlanetDR allows individuals from the same common or other collaborative areas to **make contact** and find each other.
- **PlanetDR’s Community Service**
  - Users join the service (@, username, phone number, …)
  - Keyword search: “p2p dht middleware”
  - Dermi’s naming service extended to support semantic queries.
- This is a **first step** in creating communities around contents in PlanetDR. Future works include:
  - Content evaluation tools
  - Content annotation tools
Conclusions

• We have presented the Planet Project
  – Middleware layer
  – Wide-area educational content repository: PlanetDR
  – Collaborative layer
  – PlanetDR communities

• Federation service on top of a structured p2p grid
  – Interconnects PlanetDR and ECL compatible content repositories

• Fully downloadable source code (LGPL License)
  – http://ants.etse.urv.es/planetdr

• Interested parties
  – eduSource Canada
  – UCAM
Future Work

- We have the **technology**, but this kind of platforms maybe lack **quorum**.
- PlanetDR is being utilized in Canada and Mexico, **but**…
- it is very difficult to **attract users** unless these networks offer some more **added values**.
- We are **seeking new ways** of offering additional services which attract potential users to use our infrastructure…
Future Work (2)

• **Next step** towards wide area application deployment
• **SNAP (Structured overlay Networks Application Platform)**
  – J2EE web application deployment in a *worldwide network*
  – Surely these webapps can be **collaborative ! ;-)**
  – It will offer many services like
    • Security
    • Persistence
    • Load balancing
    • Transparent failover and recovery
• Some enterprises are interested in providing new wide-area applications for Snap.
Thank you very much!

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