Why GRID for e-learning?

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Abstract
Today e-learning is a mission critical role especially in higher education institutions. After examining important e-learning characteristics, author elaborates on e-learning standards providing a framework to solve current problems and meant to provide grounds for future learning technologies. Next, based on IMS and SCORM standards, learning object levels are introduced and technological premises to implement each one are presented. Analysis finalizes with investigation of highest level of distributed network learning objects (NLO), major technological requirements are formulated. Produced requirements are checked against major technology solution platforms, GRID is introduced as the best match. After leading e-learning platform and learning object support review, investigation of possible GRID integration lines is presented for summary.

Nowaday education institutions specify e-learning in their mission statement, put it as one of the top first development priorities and label it as mission critical (Stein, S., (2003)). In its' nature e-learning is less distance sensitive compared to other forms of education. For each e-learning institution this means bigger service-map coverage as well as increased competition for all market players. Consequently institutions tend to form into consortias, increase the value of the selected brand and strive for more efficiency by sharing organisational, technology and other costs (like Swiss Virtual Campus Swiss Virtual Campus (2003) or E-learning Consortium Hamburg – ELCH (2003)). This is a natural process on the way to continental and global market and getting ready for world-wide competition.

Streamlining ambiguous social learning process into e-learning education and personal development systems provides not only student-centered learning but also allows to introduce:

- well known and working learning scenarious,
- standard course design toolboxes and
- means to insure content quality and methods to facilitate it, track student progress and help in their development (socialy and in the particular study subject).

Above noted development trends result in:

- higher concentration of e-learning content,
- digital libraries initiative,
- exponential increase of electronic content usage and development of e-learning courses.

Development of e-learning courses in its' essence is similar to software production and consequently software development models are applied to e-learning course production as well. Current “network is a computer” paradigm presents two major facets of future soft- and net- anything: interoperability and reuse. Quite similarly e-learning standards since late 90' establish a growing metadata coverage for complete e-learning process description and thus enable interoperability and distributed communication of different e-learning systems.

Objectivity levels

Investigating e-learning standardization we can figure out four levels of objectivity:

1. Digital learning content,
2. Learning objects,
3. Reusable learning objects,
4. Network learning objects.

Each and every teacher starts his course by collecting data from various different sources and, unless necessary, copy machine is more than enough to replicate and distribute the resulting course to students. As institution moves towards e-learning teacher is pushed to establish his electronic presence. There is much work left for the secretary or the teacher herself to convert his course into digital learning content. This involves much scanning, text recognition as well as text typing and general reworking of the course. When course settles down it is modularized and reshaped for several target groups, constantly updated and often authored by more than one person.

Thus the course becomes a living entity assembled from changing set of smaller independent units. In order to identify each smaller unit each one is described by extra information so called metadata – version, author, last modification date, prerequisites etc. This extra information covers all possible subjects - from technologic to educational. This huge set of attributes is standardized by IEEE LOM, IMS, SCORM (IMS Standard (2003), SCORM Standard (2003)) and other standards and after content is described with this metadata it becomes a learning object.

Resulting learning objects – physically zip (or .jar, .tgz) files stored on institution's simple learning object storage (ftp server or network drive). As number of learning objects grows, the store, search and retrieve functions become a must. The benefit of institution-wide reusability is achieved only after there is an infrastructure to share and reuse various learning objects. Such infrastructure in principle is learning object repository (or a network of repositories) facilitating following functions:

- learning object upload,
- metadata retrieval and indexing,
- metadata attribute based search,
- deployment of selected learning objects to courses,
- secure, controlled, ticket-based access to each and every learning object.

As the number of courses grows there is a slight overlap of topics in the courses - learning objects can be reused across courses or even across institutions. After examined by learning object repository learning object becomes reuse-friendly and can be entitled as reusable learning object.

The e-learning grows and the course base is exceeding few hundreds, but it is still people who have got to do all the routine taks such as checking for learning object updates and updating their courses. Yet, provided there is a distributed computing architecture in place, it becomes possible not to duplicate each and every object but rather to use it directly as a network learning object and thus avoid routine updating.

Considering the fact that all e-learning standards are XML based and GRID is the single distributed computing infrastructure it is obvious that GRID is ideal candidate to serve much XML specific 3rd and 4th level learning objects.

Distributed computing is not a new area and has been around since beginning of 1980 with CORBA, DCOM etc (Foster, I., Kesselman, C., Tuecke, S., The anatomy of the GRID: enabling scallable virtual organizations (2001)). GRID in this sense did not bring much new into this area, but united those well-known technologies, extended them with a advanced XML technologies thus resulting with open infrastructure very appropriate for academic distributed computing applications. Overall for e-learning GRID provides distributed computing benefits and various related application areas, to name a few:

- calculation load-balancing and distributed processing of computing intensive requests such as 3D processing tasks, experiment data analysis and processing etc.
- unique e-learning services such as testing central etc.
- frequent updating data (economic, medical, meteorology etc) learning services.

As added value, GRID transforms e-learning by transfroming concept of e-learning content into the concept of e-learning service. This is achieved by providing means not only for storing static content, but specifically providing infrastructure for dynamic distributed learning services, real-time interaction between several integrated course management systems, adaptive game and simulation, device monitoring based learning applications etc. This promises to bridge the gap which existed between rather static technology features and adaptive social constructivist student-centered learning so much proclaimed by modern educational experts.

This transformation happens by shifting computing paradigm from container oriented stateless file to semantic dynamic state-full network service (Wilkinson, N., Next Generation Network Services (2002)). This shift happens by transforming learning through-out the objectivity levels:

1. Digital learning content.
   File – an individual content item. Directory structuring and file naming – single semantic information relationship means.
2. Learning objects,
   Set of files – a semantic group of individual items. A set of files is grouped into a learning object and metadata is used to describe its' content and its specific attributes.
3. Reusable learning objects,
   Inter-dependent set of learning objects with complex semantics. Learning repositories enables sematic dependency checks, learning object upload,

search and deploy, author metadata fields.
4. Network learning objects.
   Learning services – a continually updated the most fresh dynamic coverage of specific course topic for remote access and distributed use.

Summary

Current e-learning is yet in the state somewhere in between first and second objectivity levels. Nevertheless fast development introduces mentioned issues specific to 1st and 2nd objectivity levels and promotes GRID technology infrastructure development. Whilst GRID is not to answer digital rights, content ownership, preview, exchange etc questions – there is yet much to develop on organisational level so that the area would be attractive and safe for time and money investments, for building e-learning infrastructure on top of it. Nevertheless GRID brings lots of promises and hopes to reshape computing and e-learning possibilities into the promising richies of what Internet2 and semantic networks are to offer.

1. Stein, S., (2003) University of Alberta: eLearning: From Grass Roots to Mission-Critical, Syllabus, Internet: http://www.syllabus.com/article.asp?id=7483
2. Swiss Virtual Campus (2003), Internet: http://www.edutech.ch/edutech/institutions_e.asp
3. IMS Standard (2003), Internet: http://www.imsproject.org
4. SCORM Standard (2003), Internet: http://www.adlnet.org
5. Foster, I., Kesselman, C., Tuecke, S., The anatomy of the GRID: enabling scallable virtual organizations (2001), Internet: http://citeseer.nj.nec.com/foster01anatomy.html http://www.globus.org/research/papers/anatomy.pdf
6. Wilkinson, N., Next Generation Network Services (2002), John Wiley and Sons Ltd. ISBN: 0-471-48667-1
7. Parashar, M. et all, CORBA CoG Architecture and Implementation (2003), Internet: http://www.caip.rutgers.edu/TASSL/Projects/CorbaCoG/
8. E-learning Consortium Hamburg – ELCH (2003), Internet: http://www.estudent-hamburg.de/02_hamburg/elch.html
9. Groove networks learning service example (2003), Internet: http://www.groove.net/support/faq/gws.html