A Web-based Interoperable Method for accessing e-learning Remote Repositories using directed XML-based Remote Procedure Calls

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Abstract: - The objective of this paper is to present a commune standard web-based interface that allows different content owners to be networked through one single engine provided by an e-learning platform, that was developed in our laboratory [2], [3]. Each content owner keeps locally the contents of the platform and manages owned data without external interferences. The end user can make queries from a single access interface and transparently gather the results that are collected from different sources.

Key-Words: - e-learning, interoperability, matlab, java, XML, RPC, web-based IS

1. Introduction
The term interoperability has widespread currency because it is used to encapsulate the various levels of connectivity necessary to create end-to-end infrastructure linking systems and services in a meaningful way for the user [1], [6]. The development of standards [7], [9], [10], [12], [13], [14] is seen as the principal means of achieving widespread interoperability hence the interdependence of the two terms.

In an attempt to put structure around the required levels of interoperability there is a significant investment in the e-learning community in developing frameworks and architectures that provide an overall model of the infrastructure required to support e-learning. To a large extent these models are strategic rather than technical, and are used to make sense of a complex world of standards, their application in the enterprise, communicate to a constituency of stakeholders, identify gaps and prioritise engagement.

2. E-learning and Interoperability
The proliferation of interoperability e-learning specifications raises the need of extending existing e-learning platforms so that they can be used efficiently in a distributed environment where material producers, service providers and users (either learners or teachers) exchange information using standard models. This extension is essential to preserve digital learning material and retain the user groups and learning communities already set up.

E-learning interoperability is expressed by various interoperability standards. Standards for e-learning will give us new and improved ways of training and education in both an individual and organisational perspective. An important aspect of e-learning is that it depends upon technology for implementation. New and improved information technologies like databases, learning management systems (LMS), learning content management systems (LCMS), search engines etc. are giving new possibilities for storing, retrieving and reusing information objects across systems, time and geography.

The standardisation initiatives focus on how to make e-learning even more flexible, through making the different new technologies more compatible with each other. An enhanced e-learning IT interoperability framework will provide users and teachers with many effective tools for exporting or importing various learning objects to the existing platform and realise inter-communication mechanisms between platforms.

3. Interoperability Definition
The terms ‘framework’ and ‘architecture’ are used by different communities to describe a view (typically a high-level overview) of the range of functions or
facets of an e-learning system or infrastructure. As such, the terms are used in both general and technical contexts. In some cases the terms have a technical meaning (though not a consistent technical interpretation) and apply to an implementation, in other cases describe a conceptual organisation of components, whilst in others define an action plan.

There is a variety of approaches to infrastructure modelling which illustrate a strong community need to have clear models for a number of purposes including: defining a clear overview of the e-learning space as it applies to a community; defining a map for implementation of standards and specifications; supporting strategic decisions relating to infrastructure and standardization; documenting an agreed implementation set of technologies; providing an implementation and development environment, etc.

3.1 Interoperability barriers
The interoperability framework can provide a very effective base mechanism of converting and transferring various Learning Objects between different platforms. However the various conversion mechanisms require efficient technical knowledge and technology adoption to a very high level.

This technology adoption must often meet different standards that are applied to the same Learning Object. Due to the fact that various e-learning standards have been created and adopted at the same time and without any specific synchronisation, many of them are not compatible and create difficulties by imposing specific barriers to the interoperability procedure. Standards must support the development of e-learning capability across entire sectors, rather than encouraging piecemeal and isolated initiatives. Some observations on present or future barriers and constraints to interoperability can be:

- Some of these standards and the resulting technical implementations are consistent with each other, whilst others result in implementations that will not be interoperable outside the immediately implementing community or region. There is a question as to whether there can or should be convergence between all these approaches into a single unified realisation.

- The trend towards transactional approaches is driven by the growing acceptance of service oriented architectures and the development of Web Services standards based on XML (e.g., SOAP, WSDL, and UDDI). However, there is still much to be done in the area of Web Services standardisation and the best practices for developing domain specific specifications bound to Web Services.

- The technical expertise that is sometimes needed in order to understand the standard’s mechanisms and functions is often demanding, especially when knowledge of XML is required.

Solutions to these issues exist already but poor integration or alternatively high levels of inter-component coupling mean that these solutions are not available in all situations. The early phase of ‘e-learning standards’ development has been focused on remote data interchange associated with content and its management.

4. Remote Content Repositories
Our approach to interoperability is well structured and defined, based on the modern need for interoperable content. The enabler for content linking, are XML [6] and future Web Services. The platform is based on traditional well-accepted J2EE specifications together with an integrated Matlab Server that is connected to the J2EE framework through Matlab Server Pages calls.

Our test platform [3] can and has already supported customized XML generation and manipulation so that any client can connect to and be connected from our platform in order to have access to any content. XML (Extended Markup Language), which is a de facto standard format for Internet/intranet data information exchange.

4.1 Background Technical Architecture
The initial problem and the solution that had to be found was about a commune standard interface that allows different content owners to be networked through one single web-based engine provided by our platform. Each content owner will keep locally its contents and can manage owned data without external interferences.

The end user can make queries from a single access interface and transparently will gather the results that are collected from different sources. The images could be mapped to the external Internet by means of links. The content provider allows the interaction to the database by means of XML standard. The methodology followed was to send the query in xml and obtain xml results. This can help to have independent web interface development from the search tools by creating an intermediate layer that sends requests from remote servers.

The XML standard for the exchange of information was used to set up a flexible and scalable
interface to query the local DBs. This interface does not change any local record/data: it only collects the agreed metadata and images.

The local query and results collection is executed by means of the XML standard interface. This procedure guarantees to maintain the web interface, the query and the results of the different content owners separated. The application is able to retrieve images and metadata from one or more external Content Owner platforms.

The so called Content Search Platform (now onwards we will call it CSP), could be by instance the local platform.

The two different environments that were involved in the development of the web-based linking tool interface are: HyperText Markup Language (HTML) standards with the addition of some Java Server Pages (JSP) under J2EE specifications, and advanced Matlab code [4]. The Matlab web server toolbox [4], [5] was effectively used by combining Java language, to produce dynamic Matlab Server Pages (MSP). Matlab Server Pages, permit the direct execution of Matlab functions directly from the JSP source code, by using specific tags, identical to the JSP Tags.

The communication was preserved, through internal Java objects, which are incorporated in the Apache Tomcat server. Remote Matlab Method Invocation (RMMI) was achieved by this way and by combining CGI-based POST methods to the Matlab Web Server; a very powerful Matlab Application Server (MAS) was produced. The developed system (fig. 1) allowed the creation of compact programs, called Matlab Beans (MB) and the execution of those beans (interconnected m-files) under HTML and JSP pages, located inside the Apache Tomcat Server. The application, using web GUI facilities sends data, through java calls and post methods to the matlab beans and vice versa.
Student log data received from the MySQL database through Open Data Base Connectivity (ODBC), are processed inside the core matlab engine located on a clustered 2nd tier application server. The results are returned and presented on the Apache Tomcat web browser window at the client computer (evaluation statistical graphs and tables).

With this configuration the client computer only needs to run the web Apache browser to access to the HTML and JSP document, since the matlab server and the web server run on different remote server stations. Therefore the process is transparent to the user who does not need to know matlab scripting to generate and have access to the available content and the statistical results.

The front-tier is based on the Apache-Tomcat web server (fig. 2).

4.2 Results of the XML-RPC Topology
The system was tested in our e-learning server at Medialab [3]. The results were presented by using specific XSL transformation and filters, in order to transform the XML-envelope to an appropriate HTML-based file.

5. Conclusions and Future Work
The next step will be to implement SOAP envelopes and Web services in conjunction with Remote Procedure Calls. The power of Web Services will improve the remote interoperability of the framework and by using J2EE architecture and Matlab Server Pages, statistical servlet function could be incorporated to the above functionalities.

References