# ASSIS -FACILITATING NEXT GENERATION LEARNING EXPERIENCES

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## Abstract

The recent eLearning developments from the JISC have considered the provision of a Service Oriented Architecture (SOA), with the vision of enabling the aggregation of a number of discrete services in to a coherent whole for the end user. The Assis project, funded by the JISC and completed in March 2005, looked technically and pedagogically at how learning materials including formative assessment could be delivered by integrating simple sequencing and assessment. It is envisaged that the approach developed by the project can be used as the first steps in a move towards explorative and games-based learning.

In order to translate this technical architecture into a concept both teachers and learners can engage with, it has become apparent that a higher level design paradigm is required. Assis explored the creation and development of a Floor-Corridor-Room model.

The generation of such learning experiences also requires an interface allowing the searching, previewing and downloading of assessment items from a question bank. Assis created a common interface to Web Services based search services for two different assessment systems with item banks (TOIA and Samigo).

At the core of Assis technical developments is the Player, a micro integration of discrete services to produce a service oriented tool. By communicating with a number of external services, the Player delivers structured dynamic packages of content to the user by the rendering and response processing of assessment items, processing the sequencing rules and providing additional, context sensitive resources.

The presentation will include a demonstration of a simple adaptive sequence of content using the Player tool in conjunction with sequencing and assessment services. An intended future demonstrator in the field of archaeology, more closely aligned with the intention to create more explorative environments, will also be presented.

To conclude, an examination of the effectiveness of the SOA approach will be considered, both in terms of creating and developing tools and the implications for potential future work by the JISC and others in the community.

## Introduction

Much has been made in recent years of the use of both Web Services and Service Oriented Architectures (SOA) designed to enable the use, re-use and recombination of services according to systems and user requirements. The JISC position on the use of SOA and Web Services was outlined in the publication of "A Technical Framework to Support e-Learning" paper in February 2004 [1]. This included a service diagram, based outlining the services required to build the Technical Framework, shortened to the E-Learning Framework (ELF). Through a funding programme for the ELF, started in Spring 2004, it was intended to produce a number of the services identified in the diagram as a first step towards the development of the full ELF.

In the first round of ELF funding, the University of Hull in partnership with lcodeon Ltd. and Newark and Sherwood College, submitted a successful bid for the ISIS project [2]. ISIS, completed in September 2004, developed a sequencing service. The IMS Simple Sequencing (SS) specification allows for the creation of complex learning experiences based on the generation of sequencing rules associated with learning content. Using SS a sequencing service was produced allowing independent components to communicate with the engine using Web Services technologies - Web Services Definition Language (WSDL) and Simple Object Access Protocol (SOAP). This removed the need for component software to understand the SS standard, it just needed to know how to communicate with the service.

Also successful in the first round was the APIS project [3] based at the University of Strathclyde. Taking the same approach ISIS had taken with SS, APIS looked to deal with the complexity of items coded as IMS Question and Test Interoperability (QTI) version 2.0, allowing external components to pass to the service QTI conformant questions. APIS deals with both the rendering of the question, the processing of the response from the learner and the provision of any specified feedback.

The development of individual services is an important first step in the realization of the vision of the ELF. Many of the services are developed with machine-to-machine interfaces. However, for these services to be of use to end users, whether teachers or learners, there is a need to be able to coordinate a number of these services into a component or tool providing a seamless user interface.

An opportunity to explore this scenario arose through a related JISC programme, Distributed eLearning (DEL). Hull led a bid including, Icodeon Ltd., Strathclyde University, Stanford University, Newark and Sherwood College and Loughborough University for the Assis project [4]. Assis had a broad scope, dealing with both pedagogic and technical issues, but central to the project was the development of a tool to address the coordination, or orchestration, of services, specifically the sequencing service from ISIS and the assessment service from APIS. These two services were chosen following

the experiences at Hull with the ISIS project and the realisation that most rules used in sequencing are triggered by results from assessments.

# Pedagogy

When a teacher starts to design a learning experience using sequencing, it is difficult to understand how the rules used for sequencing can be applied to teaching content in such a way that a number of pre-planned paths can be constructed for learners, depending on their interactions with the materials.

Assis started to address this issue by suggesting a Floor-Corridor-Room (F-C-R) paradigm for organising both the content and the rules that control access to that content. Activity generally takes place in a Room, with sequencing objectives determining when a Room has been successfully 'completed' and additionally, when the rules have been satisfied for a Floor, allowing progress to other Floors. This model also works well when the visible attribute of sequencing is used, potentially allowing students to explore and discover in a similar way to games, as they complete activities and open other Rooms and/or Floors. His model can be seen to be supporting the view of Laurillard on active learning [5].

The design considerations of the F-C-R model are reflected by a prototype demonstrator showing how an authoring tool for teachers, could be developed in the future. The tool uses the F-C-R and a number of identified sequencing patterns that can be dragged and dropped onto individual Rooms.

# Technology

The most important aim of Assis was the production of the Player tool that demonstrated the integration of services. Using Web Services technologies and standards, the Player has demonstrated the possibility of realising a Service Oriented Architecture, such as the JISC ELF, via the integration and orchestration of a number, in this case three, discrete, independent, Web Services based services. The Player uses Business Process Execution Language for Web Services (BPEL), WSDL and SOAP to present sequences of content to learners by communicating with the Content Package service for the structure and material, the Simple Sequencing service for decision making and the QTI service for the rendering and response processing of assessment items.

The work for Assis was divided between the four main partners drawing on their strengths and building on their previous experiences. Where possible dependencies between workpackages were limited, not only by sharing the work but also by the nature of the deliverables, discrete solutions that can be used independently. The project addressed issues of interoperability by working to international standards and specifications from the IMS (QTI, Content Packaging and Simple Sequencing), W3C (SOAP, WSDL) and OASIS (BPEL). Where possible, 'de facto' standard technologies were used to ensure the deliverables worked on the most popular platforms, specifically Apache Axis for SOAP and Jakarta Tomcat as the Java application server. For BPEL, the open source ActiveBPEL engine and the ActiveWebflow editing tool from Active Endpoints were used.

All the services software and the Player were produced in the cross-platform Java programming language using the open source eclipse and Borland JBuilder development environments. The user interfaces to the search functionality and the authoring demonstrator were created in Macromedia Flash. The latest version of which, MX 2004 Professional, includes the ability to communicate directly with any WSDL conformant services.

The generation of new learning experiences requires an interface allowing the searching, previewing and downloading of assessment items from question banks. Assis created such an interface to two different systems with item bank functionality (TOIA and Samigo). The machine-to-machine interface was originally intended to be the same across the two systems. However, in collaboration with the TIP project at Oxford University, the searching for TOIA was extended to use the SRW standard. In partnership with Loughborough University, a number of assessment items including the HELM question bank were used to test the TOIA search functionality. An interface was developed in Flash, communicating with the appropriate WSDL for searching across the two sources of questions.

## Conclusion

Because of the distributed nature of Assis, with four main development partners, the structuring of the workpackages and the project deliverables was critical to its success. The project structure also reflects some of the underlying ideas behind Service Oriented Architectures such as the ELF. Developers can independently create services conforming to standards that can subsequently be used by other tools, often being developed at the same time by other project partners. This development work can take place in parallel with different teams working independently but to the same service definitions, for example, programmers at Stanford wrote a Web Services search interface to the Samigo assessment tool at the same time as developers at Hull were writing the user interface for the search functionality.

It was apparent from the release of QTI 2.0 that the integration of Simple Sequencing and this latest version of QTI was important and necessary work. This section in the draft of the QTI specification had two words "in progress". The project has consulted with the IMS QTI lead developer and the CETIS Assessment SIG to ensure our work was coordinated with the expectations of the community. This work did not just replicate the model recommended for the integration of Learning Design but extended it to enable looser integration via a two level web service execution model.

The loose coupling allows the author of the QTI item and the user of the item to have autonomy in determining, for example, the name of the result. The question author could call it Result whilst the sequence author might call it SSresult5. Because of the loose coupling the value will be transferred from one service to the other without either service having to consider the mismatched names. The Web Services execution layer, using BPEL, deals internally with the recognition and relationship between the parameter names from different services.

Assis has demonstrated seminal progress towards the practical realisation of the service oriented ELF framework, using a flexible, generic model, by showing how a group of services can be orchestrated using BPEL and suggested the first steps towards a reference implementation for such orchestration. The integration is independent of the technologies used to create individual services, provided their interfaces can be exposed via the WSDL standard. This has proved the effectiveness of Web Services as a backbone for prototype systems allowing the development and integration of a number of service producers and service consumers, such as the Player.

The project has confirmed that the available technology is mature, robust and appropriate for the development of projects such as the ELF framework. This is further highlighted by an announcement from Oracle in April 2005 which stated that their middleware offering will be based around the BPEL standard.

Simple Sequencing has now been shown to be of practical use, now, within learning and teaching. The project has shown ways that potential obstacles to the use of Simple Sequencing can be overcome, through the use of higher level design paradigms such as the F-C-R, and the future generation of tools to support this.

The work of Assis and ISIS continues to be developed through two new JISC funded projects. MakingTracks will produce two demonstrators of the ELF technology, providing Maths students with learning trails centred on highly interactive learning objects. The second project, RepoMan will look to develop the Assis player into a more generic tool to enable the creation of a customised workflow tool for an institutional repository.

## References

[1]

http://www.jisc.ac.uk/uploaded\_documents/Technical%20Framework%20feb0 4.doc

[2] ISIS project site - http://www.hull.ac.uk/esig/assis.html

[3] APIS project site - http://sourceforge.net/projects/apis/

[4] Assis project site - http://www.hull.ac.uk/esig/assis.html

[5]Laurillard, D, 1993, Rethinking University Thinking