Web-Based Virtual Research Environments (VRE): Support Collaboration in e-Science

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Abstract

Interdisciplinary challenges in research today require increasingly cooperation among researchers. The demand for building up Virtual Research Environments (VRE) becomes more and more urgent than ever before. Built on top of web, VRE systems aim at supporting research activities with much more efficient methods for sharing data and knowledge bases. In this paper, we present our recent work on development of a general-purpose VRE system by extending Sakai, an advanced collaboration and learning platform, with tools for accessing Microsoft Exchange Server through WebDAV, integrating existing grid tools to access remote computing and data grid resources via Web Services for Remote Portlets (WSRP), and managing documents to help organising workshops and conferences.

1 Introduction

The UK e-Science activities are now evolving in many research areas ranging from engineering to science. A lot of research projects are today trying to tackle interdisciplinary challenges which naturally include researchers from multidiscipline backgrounds. Furthermore many research projects are now at university, national or international levels which automatically evolve researchers from geographically distributed research groups. The demand for building up Virtual Research Environments (VRE) becomes increasingly urgent than ever before. A VRE provides a platform so that different kinds of tools, services and resources can be integrated. The key concept of a VRE resides its ability of supporting collaborative activities. Through such a VRE, researchers from different locations are able to work much more cooperatively then ever before by using tools for sharing data, knowledge bases, etc. As web is now ubiquitous today, it becomes an ideal payload for holding VRE systems.

The Sakai VRE Demonstration Project is a UK JISC (Joint Information Systems Committee) supported project aiming at providing "hard science" such a VRE by extending Sakai (*http://sakaiproject.org/*), an advanced collaboration and learning platform, with a suite of collaborative tools so that researchers can cooperate easily. This project is a joint project led by the University of Lancaster, with three other partners being the CCLRC e-Science Centre (Daresbury Laboratory), the universities of Oxford and Reading (previously Portsmouth). This makes the project itself a good example showing how such a VRE is required and utilised to help research activities.

At University of Lancaster, tools are under development to enhance Sakai with functions like many-to-many drawing (whiteboard), one-to-many application sharing (shared display), blogging (Blogger), and audio and video conferencing. In Portsmouth, chat and video system has been developed as JSR 168 portlets using NaradaBroker and Java Media Framework. In Oxford, researchers are currently focusing on security concerns such as single sign-on (SSO) among several VRE systems.

In this paper, we provide our experience at the CCLRC e-Science Centre (Daresbury Laboratory) for development of a generic web-based VRE for supporting collaboration in e-Science project, the Sakai VRE Demonstration Project. It will cover three major aspects: a) groupware integration for communication, b) integrations of existing grid tools (JSR 168 portlets) through Web Services for Remote Portlets (WSRP), and c) document management system (DMS) for management of documents for research groups and arrangement of workshops and conferences. The rest of the paper is organised as below. Section 2 will describe some relative work in the VRE area. The aforementioned three aspects of our development of collaborative tools for Sakai are then followed. Conclusion remarks and future work will be presented in the last section.

2 Related work

The growth of the web is the basis for construction of web-based VRE systems. Today the web is beyond a massive "library", recent development of the web such as data

mining and knowledge management is focusing on how to effectively retrieve, understand and share information provided by the web to support different kinds of activities. Web-based VRE systems are focusing on making use of the web together with emerging technologies like grid to support research.

In [7, 8], a web-based research support systems (WRSS) was proposed and discussed. Based on assembling, integration, and adaptation of existing computer technology and information systems, a WRSS focuses on a more systematic and coherent treatment of existing isolated studies of research support.

In [6], the concept of web-based information retrieval support systems (WIRSS) was introduced with a detailed case study of existing research article indexing and citation analysis systems. WIRSS aims at improving research productivity and quality.

In [3], a prototype WRSS system, CUPTRSS, has been presented and discussed focusing on management support, CUPTRSS provides support of research management, information support, and collaborative work support.

Recently in UK, some JISC funded projects are aiming at building up VRE systems to provide support of research activities in biology, art & humanities, etc. As indicated on the JISC web site at *http://www.jisc.ac.uk/programme_vre.html*, *"A VRE will add value to the research process across all disciplines by complementing and inter-working with existing resources and by being flexible and adaptable to changing requirements"*. Furthermore, with the emergence of grid, a computing and data resource layer is now able to be extracted from VRE systems to simplify the VRE development while at the same time to make full use of cutting-edge grid technology.

An example here is NEESit (*http://it.nees.org/*) which links earthquake researchers together across USA by providing them a virtual research laboratory. Such a virtual lab makes use of the grid to integrate computing resources and engineering facilities for supporting collaborative research activities.

3 Construction of a VRE system on top of Sakai

In Fig. 1, we describe VRE as service-based systems for supporting research and related management activities. All functionalities listed in Fig. 1 are viewed as services such as chat and email. Service-based VRE systems enable the maximum re-usage of their components to other information systems. In this section, we describe our extensions to Sakai, the basis of our Sakai VRE Demonstration Project. For more information about Sakai itself, please refer to its web site at *http://sakaiproject.org/*.

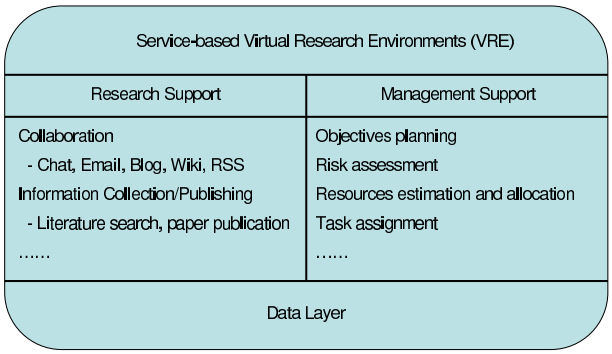

Figure 1. Service-based VRE.

3.1 Groupware integration: accessing Microsoft Exchange server through WebDAV

Calendars are widely utilised to arrange events for example to book meetings. Sakai has its own calendar built-in. One of the useful features is that an administrator can book events for people who are members of a particular worksite, i.e., each worksite inside Sakai can have its own community-style calendar for subscribers of this worksite. Also Sakai provides the function for importing calendar events from external resources like Microsoft Outlook and Meeting Maker. Unfortunately sometimes users are not able to stay with only the Sakai calendar due to various reasons, for example, a user is in a department where Microsoft Outlook is the only officially supported email client. Therefore synchronisation of calendar events between Sakai and external calendar services is useful since it removes the potential miss of meetings or appointments.

iCalendar (RFC 2445) is an IETF (Internet Engineering Task Force) standard which aims at allowing users to send meeting/task requests to other users through emails. It has been widely adopted and implemented by products like Lotus Notes and Microsoft Outlook. Besides iCalendar, there exists a proposed standard protocol, CalDAV, which tries to enable calendar access via WebDAV. The benefit of using CalDAV is that events expressed in the standard iCalendar format are stored as HTTP resources through WebDAV. This makes it an ideal candidate for sharing calendar events within groups or organisations.

Microsoft Exchange Servers have been widely deployed acting as messaging and collaboration servers that provide email together with calendar services. The native way for accessing the Microsoft Exchange Server is normally through CDO (Collaboration Data Objects) for Exchange Server. In order to make use the Exchange Server in Java programs, a practical issue is that there lacks of component like CDO. There are several approaches to work around this

issue: 1) to configure Exchange Server to provide POP3 and IMAP4 services so that they are accessible through JavaMail; 2) to use (commercial) Java-COM bridges like the one provided by J-Integra (*http://j-integra.intrinsyc.com*); 3) to enable WebDAV on Exchange Server then WebDAV clients can access it. Option 1) provides email access without calendar support. Option 2) does provide all sorts of capabilities but there lacks of open-source software for executing the same task. Therefore we select the last option for accessing Microsoft Exchange Server through WebDAV within Sakai calendar.

As stated on *http://www.webdav.org/*, WebDAV includes *"a set of extensions to the HTTP protocol which allows users to collaboratively edit and manage files on remote web servers"*. If a Microsoft Exchange Server is configured to support WebDAV, then its resources including emails and calendar events will be available to WebDAV clients. Based on this point, Sakai calendar has been extended using Jakarta Slide (*http://jakarta.apache.org/slide/*) so that it can import calendar events from Exchange Server. Furthermore, event booking within Sakai calendar can be synchronised to Exchange Server and vice verse.

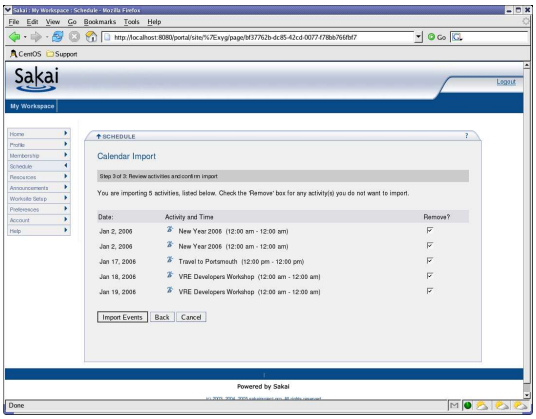

Figure 2. Calendar events retrieved from Microsoft Exchange Server to be imported in Sakai calendar.

3.2 Grid tools integration through WSRP

Based on the Spring framework, Sakai can be easily extended to support new standards to enhance its capability. In this section, we present our work on extending Sakai to support the Java Portlet Specification 1.0, JSR 168 [1], via WSRP (Web Services for Remote Portlets) 1.0 [2] by providing Sakai a WSRP consumer. In general, portlets are web components to be used by a portal for building up integrated full web pages. JSR 168 standardises the communications between a portlet and its container by defining a set of APIs. WSRP 1.0 brings presentation-oriented web services so that output of portlets (markup fragments) can be exchanged in SOAP messages. For more details about JSR 168 and WSRP 1.0, see [4].

Currently Sakai does not support JSR168, i.e., it is not possible to deploy JSR 168 compliant portlets in Sakai. While portals today are prevailing, they are keeping on gaining attentions from both industry and academia. For example, enterprise portals have been built up to provide new interfaces for managing enterprise resources. And grid portals are constructed to provide easy access of grid resources in many e-Science research projects.

The motivation of this work is how to make use of existing grid tools developed as JSR 168 portlets inside Sakai. If Sakai can make use of markup fragments generated by the grid portlets to build up web pages, end-users will experience the same feeling that these portlets are running inside Sakai. The idea can be achieved through presentation-oriented web services. Different from the traditional data-centric web services, presentation-oriented web services are focusing on transferring markups generated by portlets from services (WSRP producers) to service clients (WSRP consumers). Information such as end-user actions are collected by consumers and then forwarded to producers which in turn forward to portlet containers and portlets. Markup fragments generated by portlets will then be sent back to consumers accordingly.

A servlet based WSRP consumer built on top of ProxyPortlet (a WSRP consumer from WSRP4J, *http://portals.apache.org/wsrp4j/*) has been successfully tested with UDDI. In practice, portal administrator can browse the UDDI registry to look for portlets he is interested in. Producer information can then be retrieved from such a registry so that remote portlets can be subscribed for construction of integrated portal pages. The consumer has been migrated to Sakai (without UDDI support which can be plugged-in without much work) and a set of grid portlets developed for the UK NGS (National Grid Service) Portal has been consumed successfully. For more details, see [5].

3.3 Document Management System (DMS)

The idea of this system comes from the experience when a workshop was organised. Because Sakai has already got some collaborative tools included such as announcement and calendar, it is a good candidate for constructing a document management system (DMS) within which documents and authors are managed. DMS can be treated as a data/metadata management system which is tailored for workshops/conferences.

The basic tasks of DMS include administrative work such as user and document management, paper submission and review. Various tasks such as email notification of announcement, review result can be plugged in as optional

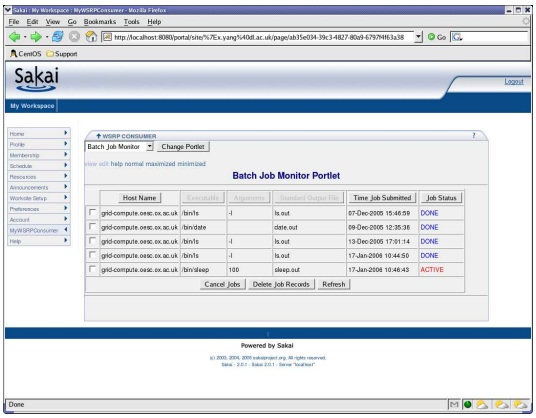

Figure 3. Monitoring remote job status in a remote JSR 168 portlet inside Sakai via WSRP.

functions. This tool is currently under development with a prototype set up for testing purpose.

The DMS tool can be used in conjunction with other Sakai tools like announcement, calendar and wiki to provide a full functional document management system for organising workshops and conferences. More advanced features are to be added such as reviewer/paper auto-matching.

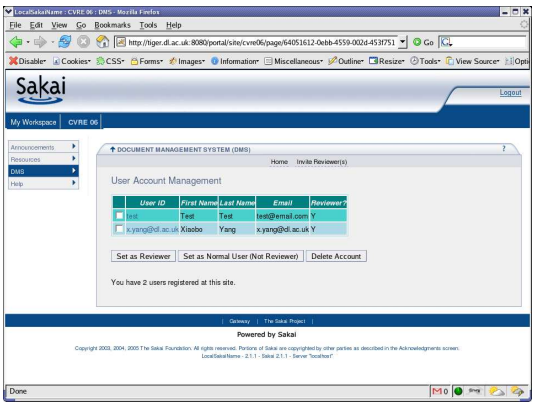

Figure 4. User account management inside DMS.

4 Conclusions and future work

The demand of Virtual Research Environments (VRE) is now increasing for researchers to tackle more and more complex challenges in different kinds of research areas. By providing collaborative tools like instance messaging and wiki, users are able to communicate more effectively during their research activities. In this paper, we describe our experience of building up a general-purpose VRE system based on Sakai. With tools we developed plugged in Sakai, its functionalities have been successfully extended to: 1) access Microsoft Exchange Server through WebDAV, 2) consume JSR 168 portlets through WSRP, and 3) manage documents for workshops and conferences. These tools are focusing on providing better communication method, integrating existing assets and fulfilling new capability into Sakai. As proven in this paper, a flexible framework of VRE is the basis because user requirements are always changing. In order to meet future requirements, VRE should be easily extended.

As you can see from this paper, VRE systems do not live in isolation but having a lot of communications with other software agents like external groupware information systems. More investigations are to be executed to look for how to assemble heterogeneous tools to meet new requirements. Furthermore, credential delegation is an interesting area for VRE systems to act as delegates for end-users to access remote services/resources.

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