

DESIGN AND IMPLEMENTATION OF AN INTEGRATED WEB SERVICE ARCHITECTURE

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Abstract: The paper presents the design and implementation of a web service architecture for providing e-learning and dedicated information system facilities. The web portal we describe is a solution for information system integration, based on a single-sign on authentication framework and database synchronization facilities. The solution is based on MS technology and provides integrated e-learning and dedicated information systems facilities. User category permissions for accessing the portal services – both for the genuine portal functionalities and for the dedicated information system ones – are modelled based on specific groups that are retained in a global database. We consider that the solution we propose has a good generality degree and may be applied in various organization cases.

1 INTRODUCTION

Within the knowledge based society, information technologies strongly impact on the organizational management, academic institutions and learning processes (Webster et al) by means of dedicated information systems. Information system integration has been tackled in the literature especially for business and organizational processes (Hasselbring, 2000), (Hasselbring et al, 2005).

The problem of managing uniform user identities in organization is addressed in (Shaw, 2011), since different identities have to be associated to specific user roles within organizations, and the problem can become fairly complex if different information systems are used. (Shaw, 2011) presents a management access system in which for a framework with different user identities in specific information systems (Quest OneIdentity Solution). The solution relies in building a unified identity and access management system – IAM within the organization, consolidating multiple identities in one (integrated) identity.

The IAM approach simplifies identity access and management within the organization, improves security and productivity, as well as single sign on, role management, multiple authentication and

password management facilities. IAM complexity may be managed with: point solutions, which implement a password reset within a system and then synchronizes it with the others) or IAM frameworks, which implement a specific IAM solution based on already developed frameworks: IBM (Tivoli Identity Manager), Oracle, Novell, MS Forefront Identity Manager (Identity Lifecycle Manager) – approach that our paper complies.

The present paper aims at describing the design principles of a system integration framework for providing dedicated information system facilities as web services into a global portal, together with single-sign on and database synchronization facilities. Compared to our previous papers on the same topic, which were more oriented on the existing information systems, (Andreica et. al 2009; 2010), this paper focuses on general architecture principles and applicability frameworks and introduces supplemental implementation details. The web portal functionalities include content sharing and communication facilities that may be used as advanced cooperation or learning tools. The solution we present is based on MS technology and provides means of integrating various information systems, using different technologies (php / postgresql, asp / MS sql). We describe an integrated architecture

based on ILM Microsoft server, and additional interface modules, used in order to integrate dedicated information systems into a single sign-on architecture*.

The content sharing and communication facilities are provided based on SharePoint Portal functionalities; they can be customized in an advanced manner as e-learning facilities.

The solution includes synchronization tools for the information systems' databases and implements a systematic permission scheme based on user groups and categories that are retained into a global database.

Section 2 describes the system integration principles of the single sign-on architecture framework and some implementation insights. In section 3, we address the database synchronization principles, focusing on the most important implementation characteristics. Section 4 presents the web services that are available within the integrated architecture: sharing & communication / learning facilities and dedicated information facilities and the extensibility characteristics of the solution we propose. The conclusions section reveals the most important contributions of the paper.

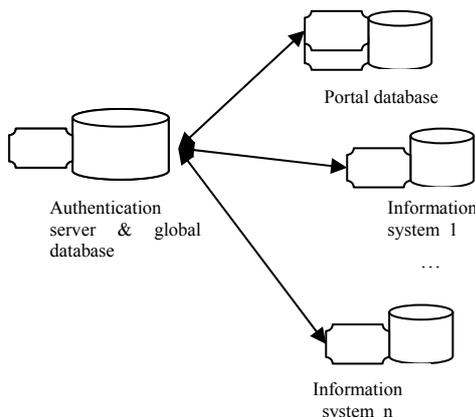


Figure 1: System integration architecture.

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2 ARCHITECTURE PRINCIPLES AND SINGLE SIGN-ON FRAMEWORK

The architecture we propose – see figure 1 – is based on MS technology; we use an ILM – Identity Lifecycle Management – type server ensuring single sign-on capabilities and uniform interface to the dedicated information systems. Therefore, these dedicated facilities will be mapped into the portal, together with supplemental web services – see 4.

In order to access the dedicated information system facilities, we selected the user categories that have specific functionalities and designed, for each, an "access point" into the portal. Authentication is performed by the same account and password into the portal and into the information systems, i.e. credentials are the same for the portal and the accessed information systems. After portal login and credentials check, the logon information is retained as current session variables and further passed on towards the information systems; access points are designed in respect with the account permissions (in our case, user categories are students, academic staff and / or research staff, managers, secretariats). Each user category may have one or more roles, based on which we define access points into the dedicated information systems. Credentials are passed on to the accessed information system as session variables and used in order to perform the authentication into the dedicated systems as well

Permissions specific to each user category are retained in a global database, created by synchronizing the information systems' databases and adding all necessary information – see (Andreica, Stuparu et al. 2010).

For example, in our case:

◇ *students* have access to their educational path (AcademicInfo system, see 4) and learning resources in view permissions (portal);

◇ *academic staff* access the disciplines they teach and student grades (AcademicInfo system, see 4) and associated learning resources in design permissions; they also access the facilities available in the Research management system (research activity upload and syntheses) and administrative facilities in ManageAsist system;

◇ *research staff* have access to facilities available in the Research management system (research activity upload and syntheses) and administrative facilities in ManageAsist system;

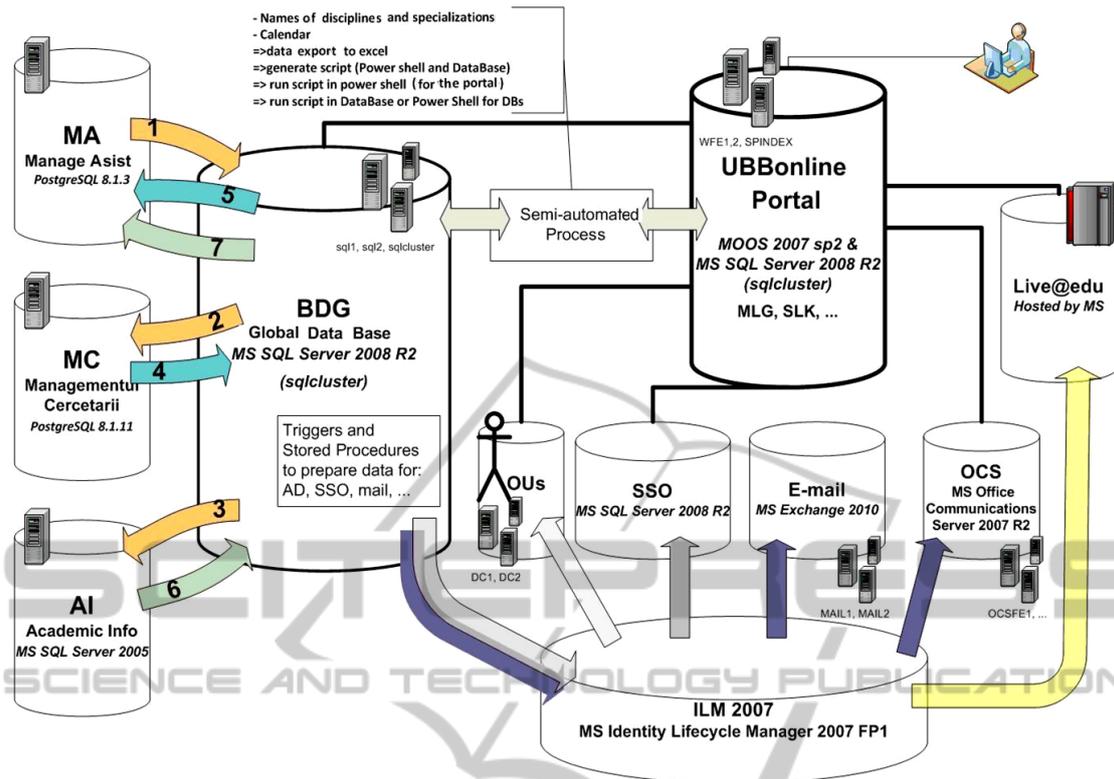


Figure 2: Portal global architecture.

◇ *managers* have access to educational syntheses (AcademicInfo system), research and financial syntheses for the chart unit they manage (chair, department, faculty, institute, university) – within Research management system, respectively ManageAsist system

The global database solves database synchronization problems (see 3) for various database management systems. The global architecture for our organization case is presented in fig. 2: ILM server is used as global authentication server and accesses information from the global database in order to perform authentication (using AD mechanisms) and to provide single sign on, e-mail and on-line communication facilities (fig 2).

Permissions within the portal (see description above) are implemented by means of dedicated groups. AD is provided the necessary information from the global database, using ILM as a synchronization interface (see 3).

3 DATABASE SYNCHRONIZATION PRINCIPLES

The correctness of the single sign-on feature is dependant of database consistency; therefore, a database synchronization is required. The synchronization process will include the information systems' databases and the portal database – figure 2

Database synchronization ensures the global database consistency and, consequently, updates access permission information both for the portal and the information systems; credentials logged in the portal will therefore be verifiable, within the global database, in respect with their permissions in the dedicated information systems.

The synchronization process is based on the dataflow sequences that occur in information processing; these sequences have to be defined in each organization case. In our case, the data workflow involves (see figure 3):

1. organization chart and user tables are replicated from ManageAsist into the global database;

2. 3. these tables are afterwards sent into Research Management and AcademicInfo databases;
4. grant tables are replicated from Research Management into the global database;
5. these tables are afterwards sent into ManageAsist database;
6. students, disciplines, educational information tables are transferred from AcademicInfo into the global database; and fee tables are transferred from AcademicInfo into the global database;
7. these tables are afterwards sent into ManageAsist database

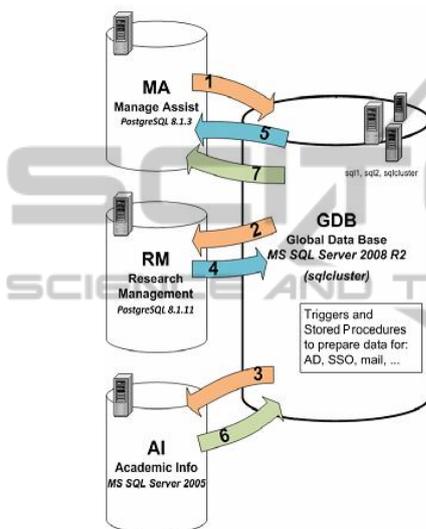


Figure 3: Database synchronization stages.

We note that a special entity case is the one of PhD students, who are both students – in doctoral schools, and academic / research staff – with research activity and sometimes also didactic activity.

Table synchronization is performed by using a dedicated field in each table, which retains if the corresponding record was synchronized, ie. transferred into the destination database: the global database for data coming from the information systems' databases or the information systems' databases for data coming from the global database.

We note that the solution which builds a global synchronized database ensures significant autonomy functional advantages for the information systems, compared to a direct Active Directory integration.

In our case, the global database synchronization is involves 2 database management systems (PostgreSQL for ManageAsist and Research Management System and MS SQL Server for AcademicInfo) – see (Andreica, Ghetie et. al, 2010) for details.

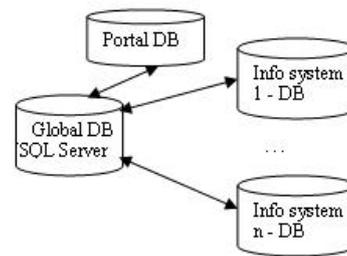


Figure 4: Database synchronization scheme.

The synchronization solution implements: replications, SQL Server Integrations Services (MS SQL web), triggers, stored procedures and jobs.

In order to perform the global authentication, we use MS Identity Lifecycle Management server, which has advanced integration facilities with our e-learning portal, and we are configuring the necessary permission mappings from the dedicated information systems into the authentication server in order to complete the integration facilities. The information system authentication is performed by dedicated interfaces which transfer credentials from the portal into each system – see section 2.

More specifically, a supplemental synchronization is performed via the ILM server (MS SQL web) between the global database - GDB and the AD information. In this respect, we use ILM's connector space (MS SQL web) and two dedicated agents which transfer information from the global database, respectively from AD into the connector space, compare it and synchronize the updated information from GDB into AD, updating therefore the necessary information in order to apply correct permissions within the portal access

4 WEB SERVICES AND EXTENSIBILITY PRINCIPLES

The web portal we describe provides various services, integrating the sharing, communication and e-learning functionalities with the ones provided by the dedicated information systems. We further describe these facilities and means of generalizing the system's architecture principles for various organization cases.

4.1 e-Learning Facilities

In order to fulfil our university's academic and learning aims, we decided to provide into the global portal specific functionalities regarding information sharing, communication and advanced e-learning

(Horton, 2003) facilities by integrating a SharePoint portal into the global architecture.

The web-based e-learning facilities provided by the described portal are therefore the SharePoint (MS Sharepoint, web) built in ones, adapted to our specific needs, and include: content management and sharing, schedule management and sharing, communication facilities (e-mail – OWA type, discussion lists, etc.), evaluation tools and feed-back facilities; task management, blog and RSS tools, survey tools, as well as other functionalities. The system is also open to adding new web-parts, services or components (Andreica et. al, 2010).

The system is also open to adding new web-parts, services or components; currently, we are working on dedicated evaluation facilities that are currently being integrated into the portal facilities. On-line evaluations may be used both as individual feed-back tests, in order to assess the students' knowledge level at a certain point in the educational path, or as final examinations. Various grading algorithms are taken into consideration in a general and customizable framework.

Our e-learning portal will also include virtual lab facilities in order to support learning in experimental sciences and sharing experimental knowledge by electronic means. Virtual lab services model processes that may be tedious to be accessed in real conditions, or are accessed remotely. Application fields include: process engineering, environmental engineering, physics, chemistry, biology.

4.2 Dedicated Services Provided by the Information Systems

Specific portal functionalities are provided by the integrated information systems implemented in our university, which are further described

AcademicInfo - <http://academicinfo.ubbcluj.ro/Info> is an integrated information system dedicated to managing educational information, with dedicated processing facilities for secretariats, specific access facilities for students (curricula and grade access, fee management, student documents and requests, on-line course evaluation), teachers (curricula and grade management (for the activities that are conducted), access to results of student evaluations) and academic management, who can access relevant synthesis regarding the educational process, including results of student evaluations at faculty or university levels. System facilities are detailed in (Andreica, Stuparu et. al 2010).

ManageAsist system is the integrated software system for administrative management that has been developed for our university. The system can be viewed as an ERP system; within its design and implementation, we integrated systematic efficiency principles in software design (Andreica et.al. 2009).

ManageAsist's principles and facilities are adapted for high education institutions; the system contains the following modules: Document management, Assets, Warehouse, Cashier, Finance, Accountancy, Grants, Human Resources and Acquisitions, and decision assistance facilities. Each module contains management reports for the corresponding compartment. Relevant synthesis from each compartment will be integrated, together with global management tools into a decision support module.

The web services <http://manageasist.ubbcluj.ro> include access to grant financial information and management of acquisition request, including specific reporting facilities for management levels.

Our **Research Management System** <http://infocercetare.ubbcluj.ro> (Andreica et. al, 2008) - is a web based system that we have developed and implemented within Babes-Bolyai University's (BBU) in order to manage research activities. The system offers, via web interfaces, accessible and user-friendly means of collecting specific information, and automatically performing quantitative analyses, syntheses and evaluations based on the collected information. The system is a tool for quantitative research evaluation, its more general aim being to ensure proficient management of the research activity within BBU and supporting the design of competitive strategies in the field.

4.3 Extensibility Principles

The solution we propose, based on MS technology and ILM authentication server, may be applied in various cases that require information system integration. Moreover, such an architecture may be enhanced with SharePoint facilities in order to provide sharing, communication and e-learning functionalities, which are often necessary within organizations.

Considering we have available n information systems, the software services that can be provided into the web portal are represented in figure 5

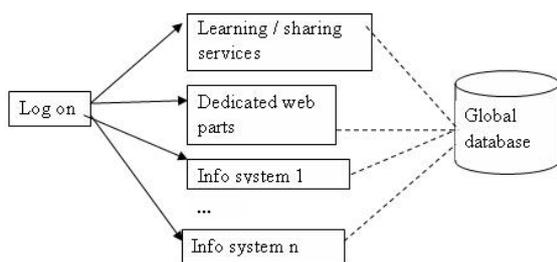


Figure 5: Web portal services.

5 CONCLUSIONS

We describe the design and implementation principles of a web portal that provides e-learning services and dedicated information systems facilities. The framework we present is an IAM framework type solution according to (Shaw, 2011) and represents an efficient integration solution for synchronizing databases and integrating dedicated information systems. The solution takes the advantage of existing technologies, in our case, MS, and provides means of integrating various information systems by using a single authentication server and mapping specific facilities from the dedicated information systems, with different database management systems, into the portal, for each user category. This architecture is based on a global integrated database and a permission mapping scheme for ensuring appropriate access into the dedicated information systems.

The system framework integrates various web services that are provided within the portal: learning facilities, virtual labs and dedicated information facilities. This integration solution has a good extensibility degree and may be applied in various cases, ie. single log-on framework for integrating dedicated information system services, as well as e-learning, facilities.

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