

Building a Personalized Education Portal

Get a behind-the-scenes look at LSU's award-winning system

by **Robin R. Ethridge**, **Cynthia M. Hadden**, and **Michael P. Smith**

In 1996, Louisiana State University tapped the expertise of the Enterprise Solutions Group (ESG) and analysts from other departments within the Office of Computing Services (OCS) to build enterprise solutions that spanned the academic, research, and administrative requirements of the university. In response, OCS presented a portal application, Personal Access Web Services (PAWS), to the LSU community in September of 1997. In the year following its implementation, approximately 12,000 students, faculty, and staff requested access to this service. Today, almost three years later, more than 45,000 students, faculty, and staff are using PAWS accounts.

PAWS offers enterprise, workgroup, and personal services. Enterprise services include access to the central university directory, electronic library reserves, midterm and final grades, current and potential degree program audits, and financial aid status. In addition, students can conduct homecoming elections, register for classes, and select meal and parking plans. Workgroup applications include a course content and communication management tool, a university-

wide faculty newsletter, and the computer services help desk support center. Personal applications are e-mail, an electronic planner, and personal Web pages.

Naturally, the PAWS suite continues to evolve. We are enhancing the course management tool to allow for online assessment and soon the registration process will allow for online credit card use. Also, the requirements for a Web-based sponsored-projects management system are being defined. Using this system, faculty will be able to create proposals, route them for approval, and submit them to sponsoring agencies—all online. Once a response has been received from the agency and a proposal is funded, the budget information will be automatically loaded to the sponsored project's accounting system. The sponsored-projects management system will be the first of many workflow applications available through PAWS.

PAWS Project Planning

Before work began on the PAWS infrastructure, LSU identified several goals. From the end user's perspective, PAWS framework had to provide a user-friendly, real-time interface to data stores

previously available only through administrative offices. In addition, because of limited financial resources and personal preferences, this interface had to be accessible from a variety of platforms. From an administrative perspective, the application had to be easy to learn by analysts without experience in client-server or Web-based technologies and had to take strategic advantage of existing assets such as in-house legacy systems and existing business data. From a technical perspective, the PAWS infrastructure had to allow for upgrades of data stores without requiring major rewrites of existing applications. Also, the infrastructure had to present data without regard to how or where the data were actually stored. In other words, LSU wanted to provide to all members of the university community universal access to its existing legacy systems by leveraging its current application-development personnel resources.

These goals were accomplished. Not only does LSU have a universal interface to existing administrative systems, the interface is also specific to the individual. Each user sees only what she needs to see in a categorized manner. Yet many



resources can be accessed from a single point of service. When PAWS was initially implemented, this point of service was described as a desktop of tools for doing business with the university. Now the term portal describes this type of application.

Paws as a Portal

David Morrison defines a portal as “an application or device that provides a personalized and adaptive interface for people to discover, track, and interact with other relevant people, applications, and content.”¹ Portals have several distinguishing features that also characterize PAWS.

- *Portals facilitate the discovery of people, organizations, and content in a meaningful context.* PAWS allows users to locate and interact with other relevant individuals at LSU. A student may look up the phone number of an instructor, locate the e-mail address of a fellow classmate, or participate in an online class discussion.
- *Portals are secure, offering user authentication, credential mapping, and sensitive data encryption.* PAWS is also secure. First, accounts are only created for individuals who have a valid relationship with LSU. When a user attempts to enter the system, PAWS prompts for a logon ID and password. The personal desktop is retrieved and rendered only after authentication. Next, the data presented to the user in the various applications are mapped to the user’s credentials. The user sees only the data and applications that he is authorized to see. Finally, any sensitive data transferred from the front-end interface to legacy systems are encrypted using Secure Socket Layer (SSL) technology.
- *Portals are personalized, proactively providing customized desktops based on the user’s role in the community or enterprise.* PAWS is personalized. A person’s application suite is determined by her personal relation-

ship to LSU. For example, a student enrolled in a distance learning course will be able to access a standard suite of applications available to all students as well as the Semester Book, a course management tool, for the course in which he is enrolled. A faculty member may access a PAWS desktop with the standard suite of applications available to all faculty members as well as the Semester Book containing his courses. In addition, when a student accesses a particular application (Personal Schedule, for example), only the courses that student is enrolled in are displayed. When a faculty member accesses the Semester Book database, she has more administrative privileges and can view more information than a student enrolled in the class looking at the same database.

- *Portals are adaptive, and PAWS is adaptive.* An individual's desktop changes as her relationship to the university changes. Has the student dropped or added courses? Has he recently enrolled in an independent study course? Has she been hired as a full-time faculty member requiring an entirely new set of links? Has the faculty member been appointed to a committee that uses a specific discussion database?
- *Portals are single points of service, providing a framework for accessing multiple heterogeneous data stores including enterprise databases, e-mail, and other multimedia resources.* Portals are organized to help eliminate information overload. PAWS provides a categorized division of resources, facilitating the location of and interaction with university functions. In addition, all resources are presented in a two-window frame set, providing users with a constant navigational framework.

Portals can be general or specific. Morrison says portal content can be classified as Internet, extranet, enterprise, workgroup, and personal. PAWS is a specific portal comprising enterprise, work-

group, and personal content.

Enterprise portals organize information internal to the enterprise for administrative benefit, often providing the interface to legacy applications. The enterprise resource categories available through PAWS are Locate People, Maintain Preferences, Search Library Collections, Cast Votes, Access Faculty Resources, View Semester Materials, and Update Administrative Resources.

Workgroup portals organize information and applications relevant to the user's specific project, team, or department. The PAWS application most representative of this is Semester Book, which

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provides instructors with course content, grade management, and bulletin board tools. It provides students with up-to-date grade assessments, access to course materials, and direct communication with teachers via e-mail and discussion postings.

Personal portals organize an individual user's information and applications such as e-mail, electronic scheduling, and Web pages, which PAWS also provides.

Implementation Issues

The PAWS infrastructure organizes many different technologies and applications into a single point of service framework powered by Lotus Domino. We overcame many challenges to make the PAWS application successful. Among the

most critical were account creation, authentication, integration with backend enterprise systems, credentials mapping, transmission of sensitive information, session-based access to high-volume critical applications, and personnel.

ACCOUNT CREATION

Until recently, all requests for PAWS accounts were self-initiated. Employee requests were made through departmental channels. Student requests were initiated via a voice response unit or Web interface. Surprisingly, the challenge in creating PAWS accounts was not in determining whether an individual was a valid student or employee because Security Access Management (SAM), one of our legacy systems, could make that determination. Instead, because of the project's success, the challenge was to create large numbers of accounts quickly and on demand. The solution to this challenge was to run the performance-intensive components of the account creation process in parallel. The long-running portions of the process were executed simultaneously on several servers. Today volume is no longer the issue it once was. Accounts have now been created for all students currently enrolled and new student accounts are created prior to their arrival on campus.

AUTHENTICATION

The PAWS infrastructure is spread over many administrative and application servers. When a new server is accessed, the standard browser authentication mechanism prompts the user for a logon ID and password. The challenge was to find a solution that required the user to sign on only once per browser session.

LSU implemented a custom logon mechanism that authenticates the user for each session by logon ID and password and issues a digitally signed security ticket. The mechanism is built using Domino Release 5's Web Server Applica-

tion Programming Interface (DSAPI) and Hypertext Transfer Protocol (HTTP) cookies. The DSAPI is an application program interface for writing custom extensions to the Domino Web Server.

Users log on to a central PAWS server that authenticates them and issues a session cookie containing a digitally signed security ticket. The cookie's domain is set so it will be submitted to all PAWS servers. The DSAPI code running on each of the application servers intercepts an incoming request, examines the session cookie issued by the central logon server, and authenticates the user based on the information in the cookie rather than re-prompting the user for a logon ID and password.

LEGACY INTEGRATION

The services most in demand at LSU are implemented in the legacy systems that reside on an IBM S/390. Typically, these systems are accessed via IMS, our data communication system. In the PAWS environment, real-time communication between Domino and IMS is accomplished via MQSeries.

PAWS users submit real-time requests to view or update data stored in legacy databases. An interface program that was written in-house processes these requests, known as transactions. The program accepts the request from the Lotus Domino application and passes it to MQSeries, which is an industrial-strength, high-performance messaging product. MQSeries routes the transaction request to IMS/DC on the mainframe, where an IMS/COBOL program performs the transaction. The transaction output is routed back through MQSeries to the transaction processor, which sends the output to the waiting application. The application parses the output and displays results to the PAWS user in real time.

Integrating the PAWS framework with

Making It All Work

PAWS system services are distributed across 60 Lotus Domino servers running on IBM SP nodes, Netfinity 5500 servers, PC 330 servers, PC 300PL desktop machines, and the IBM S/390. The system includes 1 backup server, 2 administrative servers, 18 application servers, 29 messaging servers, 5 gateway servers, and 5 test servers.

The application inventory includes communications applications, library applications, and courseware. An additional nine applications—including degree audit, fee bill status, and final grade inquiry—have been offered to students. Six applications have been offered to faculty, including the class roster application, the faculty newsletter, the post-grades application, and the course tools application.

Four of the 18 application servers are PC 300PL desktop machines dedicated to the registration application. Another two PC 300PL desktop machines and a Netfinity 5500 are dedicated to the application that renders the PAWS portal. With the exception of registration-related applications, PAWS applications that provide real-time interfaces to legacy systems reside on three Netfinity 5500 servers. The remaining servers, a mixture of SP nodes and small NT servers, house applications developed strictly for the client-server and Web environments. Although the Domino server on the S/390 hosts a few small applications, its primary purpose is backup and recovery.

legacy systems at the transaction level unlocked data previously vaulted at the source, provided a more secure and robust solution than directly accessing the data in our relational database management system (IBM's DB2) through Open Database Connectivity (ODBC), and provided a means to leverage the extensive existing code base.

PAWS is unique in that it takes legacy integration one step further. The actual portal delivery application has evolved into a real-time legacy interface. In the latest version of PAWS, an individual attempting to access his Web portal issues an online transaction that immediately evaluates the user's relationships, determines the appropriate resource applications to present, creates a new portal output result, and displays it to the user. If the source system is unavailable, cached copies of the Web portal interface are presented.

MAPPING CREDENTIALS

An individual's credentials are mapped to specific applications. This means PAWS users can access only those applications for which they have authorization. There are two important aspects to credentials mapping: translating the PAWS ID to meaningful backend student and employee identification numbers and determining the content to be displayed based on the user's role as it relates to a particular application.

Under LSU's typical enterprise system security, a student's logon ID does not normally give her access to information stored in mainframe databases. Rather, security is set up so university employees access backend applications with their mainframe logon IDs to view student and administrative data. An employee may request an individual's information by entering the individual's unique identification number. In order for a student

to access her own data using PAWS, to use backend transactions already in place, and to ensure the student is receiving only her own information, it was necessary to translate PAWS account security to enterprise system security.

When PAWS users access applications integrated with these backend systems, the PAWS logon ID they enter is automatically mapped to their employee or student identification numbers in the transaction processor. Then the transaction enters the backend system under the authority of a system logon ID with restricted privileges. Therefore, when a student registers for classes through PAWS, his current schedule is automatically displayed based on the mapping of the PAWS logon ID to his identification number.

With the exception of the personalized nature of the data, the user interface and application results are displayed in an identical manner for each PAWS account holder regardless of his relationship with LSU. Some applications are tailored to the user's role in relation to the application. For example, Semester Book restricts access to class resources based on actual enrollment in the class. Not every student has access. Also, depending on the user's role when she logs on, she will see content tailored either for an instructor or a student. The term "role" rather than "relationship" is

used because someone with the correct authority can assign an application-specific role to a user, regardless of relationship. For instance, if a student not normally enrolled in a class serves as an instructor's grading assistant, the instructor may grant that student access to the database and assign him an instructor role, effectively giving him the authority to post course content and grades.

In order to protect the privacy of the users, these applications use Secure Socket Layer technology to encrypt information from the user's client to the server and vice versa.

SENSITIVE INFORMATION

Many of the applications available through PAWS require the transmission of sensitive information such as grades and academic progress. In order to protect the privacy of the users, these applications use Secure Socket Layer technology to encrypt information from the user's client to the server and vice versa.

SESSION MANAGEMENT

One critical application that allows students to register for courses on the Web presents a serious challenge. Demand for many of the courses often exceeds available space. Consequently, students are often eager to log in and enroll as soon as registration is open. The result is an extremely large volume of Web traffic within a short period of time.

Unregulated access to the Web servers running the registration application would result in long sessions with slow response times or browser timeouts and often only partial results. This would

frustrate users. The better solution is to limit the number of users who can connect to the Web servers to a small enough number with a reasonable but limited access time. While this arrangement can be frustrating to users while attempting to access the application, once they secure a session they have quality access.

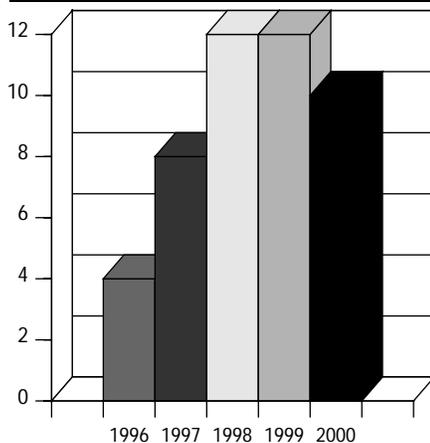
We use encrypted HTTP cookies to maintain the sessions. Users enter the registration application through a link on their PAWS desktop that takes them to a session ticket server. This server regulates the number of users by only issuing new session tickets as others expire. If the maximum number of sessions is currently in use, the ticket server informs the user and advises him to try again later. If sessions are available, the user is issued a session ticket and redirected to one of three registration servers. Currently, users get 10-minute sessions. The registration servers require that the user's client return the cookie containing the session ticket for admittance, preventing users from bookmarking the servers and bypassing the session ticket mechanism. If the user's session expires before she is done, she must revisit the ticket server to obtain a new session ticket.

PERSONNEL

The number of full-time employees assigned to developing, implementing, and maintaining PAWS for the last several years is highlighted in Figure 1. These employees include personnel required to support the infrastructure, work the help desk (Application Service Center), and develop the application. Presently, LSU has approximately 10 full-time staff members dedicated to supporting PAWS.

Two points are worth noting. First, the total number of positions assigned to applications development at LSU has not changed in 10 years. The application development staff is responsible for

Figure 1: PAWS Personnel Resources



developing, enhancing, and maintaining 10,000 legacy programs and the new Web-based applications for PAWS. Second, the number of positions assigned to technical support has also not increased dramatically. PAWS system administrators (Domino systems administrators) are also responsible for mainframe database administration. At this time, the ratio of system administrators to PAWS users is roughly 1:10,000.

PAWS Growth and Popularity

The overwhelming positive response to PAWS was confirmed in a major campus survey, in the number of requests to create new accounts, and in the use of existing accounts.

In February 1999, LSU conducted an online survey of visitors to its Web site. About 1,900 users responded to the survey. Two survey questions, illustrated in Figure 2, show the impact of PAWS and implications for its future growth.

Until recently, a new account could be created only upon the request of the student, faculty member, or staff person with whom the account would be identified. The number of PAWS accounts has increased rapidly and steadily since the application was introduced a little more than two years ago (see Figure 3). Today, there are more than 45,000 PAWS account holders.

First among those requesting accounts were the students. They recognized the

potential of PAWS early on, even before registration and grade inquiry applications were introduced. The student government passed a resolution in the fall of 1997 recommending to the provost that all freshman-level classes include an Internet assignment using PAWS. In the spring of 1998, the student government passed a second resolution endorsing PAWS as the virtual one-stop shop for the university. Both resolutions were initiated independently of the Office of Computing Services.

The next group to show interest in PAWS was the colleges. Various colleges gradually required their students to have accounts. Finally, facing record enrollment and the need to communicate up-to-the-minute details efficiently and effectively, the provost mandated that all students have PAWS accounts. Now, instead of being created on demand, accounts are created prior to spring testing, freshman orientation, and transfer student orientation and distributed to new students as they enter the university.

Not only has the number of PAWS accounts increased dramatically, but the number of transactions is also on the rise as shown in Figure 4. During a typical week the number of legacy transactions issued through PAWS represents 12 percent of all legacy transactions issued. This number is up from 4 percent last year and is expected to approach 19 percent next year. During the first week of classes in the fall 1999

semester, legacy transactions issued through PAWS accounted for 24 percent of all IMS legacy transactions issued.

The increased use of PAWS manifests not only in an increase in the total number of IMS transactions issued but also in the increased use of specific applications. Three applications that have been particularly popular are Registration, Grade Posting, and Semester Book.

Figure 2: PAWS Use Survey Results

What services/resources do you use?

Course Listings	1318
Electronic Reserves	543
Jobs Ops	233
LSU Libraries	676
None	59
Other	66
E-mail	1447
People Directory	1129
Press Releases	148
Registration Services	699

Note: All of the resources chosen, with the exception of Library services, are PAWS applications.

What services/resources would you like to see available through the LSU Web site?

Admissions requirement checker	715
Online admissions	785
Online bill payment	896
Online housing requests	624
Online parking requests	1086
Online student aid application	966
Online student aid checking	810
Other	163
Seat locator for stadiums and theaters	1049

Note: These resources will be or already have been implemented since the survey was conducted.

Figure 3: Number of PAWS Accounts

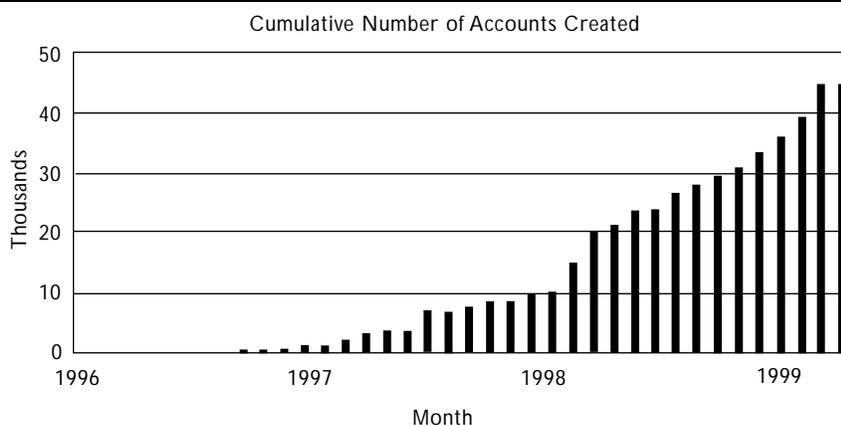
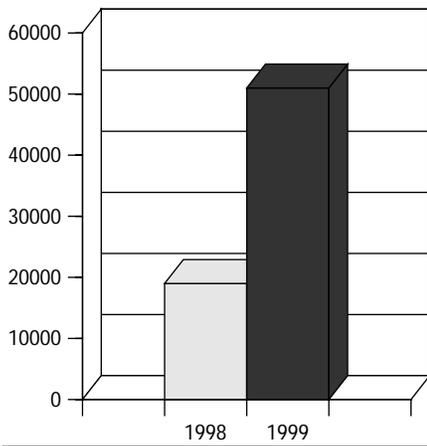


Figure 4: Number of PAWS transactions per week



Registration. The schedule-request application was the first component of the registration process made available to students through PAWS. In its first semester—fall 1998—20 percent of requests to add or drop courses were initiated through PAWS. Such requests

increased to 30 percent the following semester and to 40 percent one year after implementation. In fall 1999 students were also allowed to complete additional registration transactions, including requests for parking permits. Within two weeks, 20 percent of the requests for additional services were being initiated through PAWS.

Post Grades. This application was made available to faculty members about a year and a half ago. For the past three semesters, the number of instructors using the Post Grades application and the number of grade sheets submitted through this application have grown significantly (see Figure 5).

Semester Book. This application was made available to the entire campus in the fall of 1999 and has become a very heavily used application. Semester Book is a course-management tool that

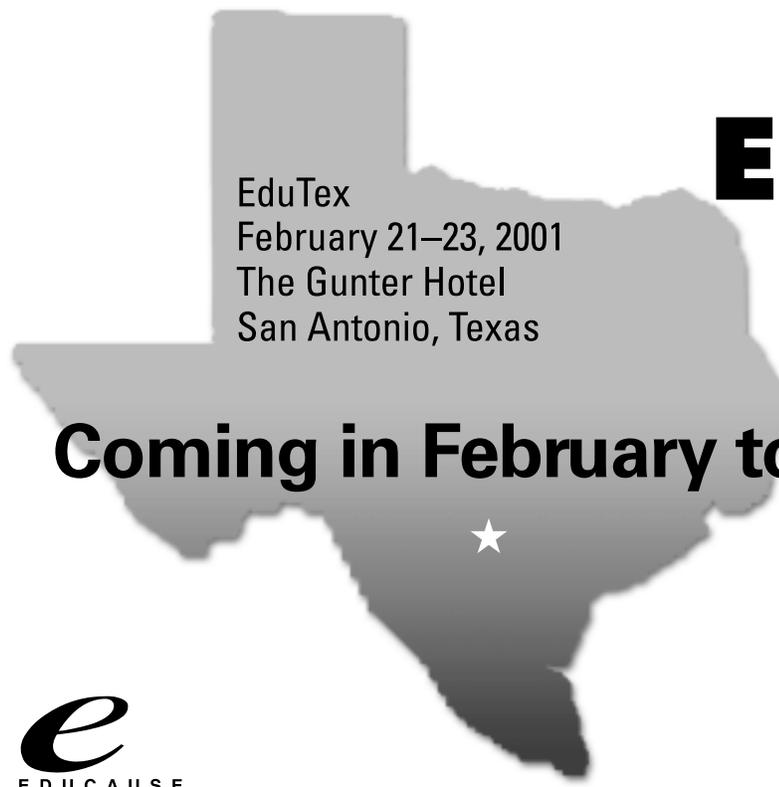
distinguishes itself from other asynchronous-learning and class-management tools in the following ways.

- The focus is on the semester rather than the course. It is called Semester Book because it was modeled on an

In 1999, LSU provided \$1,134,055 in services through PAWS that it would not have been able to provide through traditional methods.

instructor's grade book. Often, instructors use one grade book per semester rather than one grade book per class.

- It is highly integrated with our legacy applications. As students drop



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Figure 5: Grades Go Online

Semester	Teachers	Grade Sheets
Spring 1998	166	812
Fall 1998	374	1,907
Spring 1999	753	3,655

and add classes, the corresponding data in the Semester Book and links on the student desktops (PAWS) are updated accordingly.

- It is a PAWS application. The same logon ID and password that provide access to the PAWS environment provide access to Semester Book.
- Students can monitor their progress in the course and obtain class materials from any Web browser.

Return on Investment

The acceptance of PAWS as a vehicle for conducting LSU business was confirmed by a return-on-investment

study undertaken by an industry leader in technology research and analysis, International Data Corporation. IDC indicated that LSU will obtain a 78 percent ROI on PAWS in three years. In 1999, LSU provided \$1,134,055 in services through PAWS that it would not have been able to provide through traditional methods. In 2000, IDC projects that LSU will provide \$2,489,787 in services. This projection is based on an average of 50,000 PAWS transactions per week. So far this year, LSU has averaged 80,000 PAWS transactions per week. A complete report of the study can be found online (see app1004.lsu.edu/pawsinfo.nsf).

Through PAWS, LSU provides legacy systems access to all members of the university community by leveraging its current application

development personnel resources. It was designed to become the primary vehicle to carry out many university business transactions. PAWS provides members of the university community personalized access to the university any time, any place. e

Endnotes:

1. David Morrison is an International Technical Support Specialist for Lotus Development and co-author with Martin Buckley and Steve Cappo of *Building a Portal with Lotus Domino R5*. This IBM "redpaper" is online at www.redbooks.ibm.com/REDP0019/redp0019.pdf.
2. PAWS won the 2000 EDUCAUSE award for Exemplary Practices in Information Technology Solutions. See the ad on page 31.

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