



CALA Occasional Paper Series

From the Ground to the Cloud: A Practice at California State University, East Bay

By

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Cloud computing has been actively discussed in recent years, and is making its way into the library field. It has advantages when libraries work with constrained financial resources. This article describes the procedures that the University Libraries at California State University, East Bay (CSUEB) took in 2010-2011 to migrate their major IT infrastructure from the ground to the cloud. It discusses the circumstances under which each decision was made, and the problems that the libraries encountered during and after the migration. It shows the benefits that the libraries gained and the lessons learned from these practices.

Keywords: cloud computing, library information technology, library system migration

Introduction

According to National Institute of Standards and Technology (NIST), cloud computing refers to “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” (Mell & Grance, 2011). In the library field, it means that libraries use external expertise and resources to deliver IT-related services for public users and internal employees.

Cloud computing services can be divided into three categories: 1) Infrastructure as a Service (IaaS), 2) Platform as a Service (PaaS), and 3) Software as a Service (SaaS). A cloud infrastructure offers virtualized resources on demand. It is considered to be the bottom layer of cloud computing systems. A typical example of this model is Amazon’s EC2 (Elastic Computing Cloud) service. A cloud platform offers an environment on which developers create and deploy applications and do not necessarily need to know how many processors or how much memory that applications will be using. The well-known Google AppEngine is an example of PaaS. At SaaS level, applications reside on the top of the cloud stack. Services provided by this layer can be accessed by end users through web portals. Examples of this model include SerialsSolutions and LibGuides.

Regardless of its service category, a cloud can be classified as public, private, community, or hybrid. While a public cloud is for open use by the general public, a private cloud is an internal data center for a business or an organization

which is not available to the general public. A community cloud is shared by several organizations; a hybrid cloud is a composition of two or more cloud infrastructures discussed above.

Cloud computing benefits libraries by removing the need to invest in physical server infrastructure, lowering the cost through elastic computing resources, and reducing employee hours on server maintenance, systems upgrades, data backups, troubleshooting, etc. Such advantages are attractive when libraries must cope with budget cuts or need to work with constrained financial resources.

Depending on the library’s IT needs and the resources available, a library can take different paths to migrate its IT infrastructure from the ground to the cloud. Marshall Breeding (2009) points out that on the way from the ground to the cloud, it is common to see a library use several options to provide their IT services, with each option supporting one or several services. Han Yan (2011) conducted a review on the current state of cloud computing in libraries with a focus on cost analysis. In recent years, many libraries have attempted using cloud computing as a way of delivering their core IT applications. In early 2009, University of Arizona Libraries examined running their Integrated Library System (ILS), content management system, and repository software on the cloud (Han, 2010). In 2010, Erik Mitchell discussed their experience of migrating the core IT infrastructure to a cloud environment at the Z. Smith Reynolds Library, Wake Forest University. At CSUEB, the University Libraries’ migration projects involved the ILS, the Inter-Library Loan (ILL) system, the web system and

the EZProxy system. The ILS was migrated from locally-managed to vendor-hosted (Innovative Interfaces, Inc.) environment. The ILL system was initially moved to the University's virtual server platform and later moved to a remote server hosted by OCLC, taking it one step further away from the ground. Both the web and EZProxy systems were moved from locally-managed to the virtual environment built and supported by the campus IT team. The clouds discussed in this article include both cloud-based (or hosted) environment and internally virtualized (e.g. a private cloud) environment, and are at IaaS level.

The plan for the migration projects was developed in fall 2010 and the implementations were completed in summer 2011. The next section discusses the library IT background and the circumstances under which the above decisions were made.

Background

Before the implementation of the migration project, all servers supporting the major library IT services were located in the IT server room. These servers included the ILS server, the ILL server, the web server and the proxy server. Members of the library IT group, a branch of the campus IT team, were responsible for the server maintenance, and library faculty for updating the library web content on WordPress on the server.

Several reasons contributed to our migration decisions. First, the California State University (CSU) system experienced a series of budget cuts in recent years. These cuts prompted CSUEB's IT team to conduct reorganization, resulting in the formation of a centralized computing model. The direct impact on the University Libraries was that members of the library IT group assumed more responsibilities for serving IT needs across the University, including all colleges and departments. Although library personnel could continue to request IT services by opening Service Desk tickets as needed, and the library IT staff could still help with a few general computing tasks, there was a big gap between the services that the centralized campus IT team could provide and the IT needs of the libraries. This kind of situation has been described by Dian Schaffhauser (2010) in her study on the relationship between

library and campus IT after the consolidation of IT operations.

Server maintenance is critical among all the issues resulting from the centralized computing. Initially the libraries were willing to maintain all servers locally because this gave the libraries maximum control over the various systems located on those servers; however, after the technology experts left the library IT group, parts of the server maintenance work were abandoned. Although the Windows operating system updates and data backups continued running normally, other jobs such as server upgrade and patch installations were dropped. Hence, moving the library IT services from locally-managed model to the cloud became a serious consideration for the libraries.

After the IT consolidation, although the libraries still had staff and student assistants monitoring the automatic data backup procedures on all servers, it was difficult for them to perform troubleshooting tasks when an issue occurred during or after the backup. In addition, the libraries had to handle cases when systems staff members were on vacation; for example, when a tape was wrongly used, or a UPS needed changing.

Another consideration for the move to cloud computing was the condition of the server room. The library main building, which housed the server room, was built in the early 1960s and lacked a fire suppression system. The room designated as the computer server room did not meet the necessary standards. When the room temperature rose, high-powered fans were needed to cool both the servers and the computers in the room in order to enable them to continue running normally. There were several server malfunctions for this reason in the past.

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Before the libraries finalized the decision to migrate the servers, similar discussions had already been underway in the university. In 2010, the campus IT conducted server consolidation projects in different colleges and departments throughout the University. Along with these

projects, the team set up a virtual server environment for the library EZProxy and Inter-library Loan systems in summer and fall 2010, respectively. The two servers were not put into production until the libraries made the final migration decisions in spring 2011. The following section discusses how the library IT services were migrated.

ILS Server

At CSUEB, the libraries use Millennium (Innovative Interfaces, Inc.) as their ILS. This dedicated server was provided by the vendor with Solaris 9 operating system installed. The CPU model was Sunfire V240 and the memory size was 2GB.

Before the migration, problems with the Millennium server were mainly centered on the system's backup jobs. Although it was automatically set to run a daily full back-up onto tape, problems occurred when the systems staff forgot to initialize a tape, or when a student assistant forgot to change a daily tape located in the server room. Another issue that grew in importance was whether a student assistant should be given access to the library server room for security reasons. The idea of moving the ILS server to a vendor-hosted system was generated after the campus IT consolidations; however, the decision was not finalized until after the 2011 Innovative Users Group Annual Conference. During that conference, the newly-developed platform, Sierra, was widely introduced and drew a good deal of attention from the library attendees. With support from the University Librarian, the Systems Librarian initiated discussions with Innovative Interfaces regarding Sierra implementation, with a focus on questions such as the hardware and software requirements for Sierra, the timeline for its implementation, and the price for the new system platform. Among the three choices offered by the vendor, the University Librarian adopted the option of first hosting the server at Innovative and then allowing the vendor's staff to perform the platform conversion. The ILS server migration became a prerequisite for later system implementation in the libraries.

Before the migration, the Systems Librarian discussed the date of migration with library

faculty and staff in access services. The migration was conducted during the week of spring break in 2011. The Systems Librarian sent out two email reminders to the entire libraries: one was sent two weeks before the migration, and the other was sent the day before the migration. After the second notice, the Systems Librarian performed a final full data backup. On the day of migration, the Systems Librarian worked remotely with the technician at Innovative Interfaces and kept the entire library faculty and staff informed about the process. The whole migration process was completed in about four hours, but a number of problems occurred after the migration.

The first major issue to be noticed was the network printing. The circulation staff found out that the host system did not print to the library network printers, which functioned correctly before the migration. After a number of communications with Innovative Interfaces, the problem was temporarily resolved by setting all default printers to the local printers; however, this did not help in cases when certain jobs need be printed from a network printer rather than a local printer. In addition, library staff had been used to printing to network printers for years and it was difficult for them to change the Millennium default settings to print from a different printer. As a result, the Systems Librarian opened a new service ticket with Innovative Interfaces to discuss possible solutions for this issue. Following the advice from Innovative Interfaces, the Systems Librarian sent the IP addresses of the library network printers to people on the server side and asked the campus IT to reset the firewall settings in order to enable print commands to be sent from the host server to the library network printers. This finally resolved the printing problem. Another print related issue was the format settings. All printing formats were changed to the system's default. Some library staff complained because they had to change the settings back to their preferred formats.

The second major issue was frozen screens. The library cataloging staff reported that their computer screens froze intermittently, resulting in their inability to use Millennium unless they forced the computer to end the task and waited for several minutes to log in again. When one user's screen froze, other users could not login to the

system. After the issue was reported to Innovative Interfaces, the remote server was rebooted several times and the problem disappeared. The same problem recurred two months later, but this time the cause was busy network transactions, which had nothing to do with the hosting services.

Other issues reported by the cataloging department included lost FTP connection to the Marcive site (a source for cataloging records) and a lost Z39.50 connection to the California Government Publications (CGP). Both issues were resolved after service tickets were opened with Innovative Interfaces.

Another problem reported after the migration related to the Inn-Reach software. Similar to the use of the inter-library loan service, the libraries use the Inn-Reach service to lend and request books from participating libraries in California and Nevada through a consortium borrowing service called LINK+. This software malfunctioned because the central coordinator of the Inn-Reach system was not informed of the new server's host name and IP address to make necessary changes when the migration occurred. The same issue occurred with the Books & Articles search page on the library website. This function is an interface that enables patrons to search books and journal articles at the same time. It was developed and maintained by the systems group in the CSU Chancellor's Office. After informing them about the ILS change, the problem was resolved. Both issues could have been avoided if the libraries had been able to convey the new server information earlier and send it to related parties in time.

Problems due to lack of communication among staff within Innovative Interfaces resulted in a security certificate error and a web management report error. The security certificate error occurred on the login page when a patron tried to renew a book. The error indicated that the security certificate was not issued to the new site, and suggested that patrons not continue using the page to renew books. Although patrons could choose to proceed anyway, whether they realized it or not, the issue became troublesome when more patrons reported the same issue. Initially,

the libraries were unaware that a new certificate would be issued by Innovative Interfaces, and the Systems Librarian planned to purchase a new security certificate from a different vendor; however, when waiting for a reply from Innovative Interfaces in order to activate the new certificate, the Systems Librarian was told that a new certificate would be provided by Innovative Interfaces. It took several days for this to be generated and properly installed on the host system. The web management report error occurred one and a half months after the migration. When staff in the Access Services area tried to extract their monthly statistics, they found the web management report page was missing. It was recovered instantly after a service ticket was opened with Innovative.

At this time, the system is running properly and it has been reported that the new host system responds faster than the local server to various commands.

ILL Server

The library ILL system was originally set up by the technology expert in the library IT group. The system was running on Windows Server 2003 operating system. Migrating this system consists of two steps: initially, it was moved onto the campus' virtual server environment, which was a temporary solution to a hardware failure occurred in spring 2011; later it was hosted by OCLC.

The virtual environment for the ILL system was set up in fall 2010 by the campus IT. However, it was not activated until the local server crashed one day in spring 2011 due to a hardware failure during a scheduled installation of a Windows system update. It became clear that it would take less time and effort to move the system data onto the already existing server environment than to purchase a new server and build it from scratch. The ILL migration was more challenging than other migration processes in that it involved a lot of configuration changes in the Illiad Customization Manager and SQL Alias Manager, which were new to the Systems Librarian, and could not be completed by members in campus IT because the person who had managed the system left the university. The problems related to the settings in Customization

Manager included missing PDF documents, a printing issue, an email problem, and an error with the patron home address. Although most of the problems could be resolved by simply changing a link or a file path in a module in the Customization Manager, it was challenging for the Systems Librarian, who was new to the Illiad system and had to teach herself how to manage the system. When the project was implemented, both the SQL Alias Manager and BDE interfaces had to be used, resulting in an error message for database connection. The problem was resolved after a dbc file was created. Throughout the migration process, the Systems Librarian found that the Illiad Installation Guide on the Illiad documentation site was helpful in troubleshooting the database connection issue.

The campus-based virtual ILL environment solved the system reliability issue. The Illiad coordinator no longer needed to worry about system crashes; however, this did not solve the systems maintenance issues. Because of the special features of the system in configuring the Illiad Customization Manager and the SQL Alias Manager, no one on the campus IT team was willing to assume the responsibilities for systems upgrade, data backup, new instance installations, and other maintenance requirements. The ILL server had to be taken down whenever campus-wide systems maintenance was scheduled. For these reasons, the Systems Librarian decided to ask OCLC to host the system with the support of the University Librarian.

After discussions with the library ILL coordinator and the Access Services manager, the Systems Librarian initiated the talk with OCLC, filled out the migration form to request the hosting service, and completed a questionnaire including detailed information about the Illiad settings in the libraries. Based on these settings, the campus was required to open outbound SQL traffic and FTP for the newly hosted web server and SQL server. This was a key step before the server migration. After the migration date was determined through communications with the library staff and OCLC, the Systems Librarian sent out reminders twice to the entire libraries. On the day before the actual migration, the systems librarian shut down the Illiad service on the local server and transferred the specified data sets to OCLC, which then built

the host server and verified its operation. With the support from the campus IT security analyst in testing the server connections, the migration was successfully completed in August 2011. The Systems Librarian updated the SQL Alias Manager with the new server IP address and database name. The library Illiad coordinator updated the external links.

After the ILL server migration, the only difference for the Illiad coordinator was the location of the PDF files, which were moved to the host server from the local network drive. The Illiad coordinator welcomed the change and had no problems using the FTP client to locate the PDF documents. Later, the Systems Librarian upgraded the Illiad Client from Version 7.4 to Version 8.1.

Web Server

As mentioned in the background section, CSUEB libraries use WordPress as their web content management system, which employed Apache web server and MySQL database management system. The system was running on Windows Server 2003 operating system.

Moving the library web system onto the virtual environment was completely driven by the security issues with the local server. The local web server was built in 2006 and had barely been maintained due to a lack of systems personnel in the libraries. In summer 2011 the campus IT received several reports about a virus spreading campus-wide and they quickly discovered that the virus was generated from the library web server. After scanning the files and the operating system, the web security specialist found several lines of compromised code on a few index files on the library web server.

After cleaning the local server's file system and blocking all users from gaining access to the server, the campus web team held several meetings with the library web team to discuss solutions to the server security problems. The libraries decided to move the web contents to the campus virtual environment. Although migrating to the campus virtual server would decrease the level of the library control, it would definitely ease the library's ability to manage their web contents, rather than having to manage them in the

University's content management system, which is completely different from the library system and based on an entirely different vendor's product. When building the new system, the campus IT originally used IIS (Internet Information Services) as the web server, and installed PHP and WordPress on top of it. Although the same combination had been used to support other departments' web sites, the library web team found that it would conflict with the WordPress multi-user system, which was used by library faculty to manage their individual subject guide pages. Later online research showed examples of such conflicts in other similar settings. The system was then rebuilt using an Apache server and data was transferred to the new system. After a one-week test period, the virtual server went live.

Having the library web content on the virtual server has greatly reduced the library workload in system maintenance and the website's security level has been raised to a new level; however the libraries have lost control over the management of the website to some extent. For example, since all systems patches and updates are scheduled by central IT, the libraries cannot determine when to update or install a WordPress plugin.

EZProxy server

The library EZproxy server was located in the server room. It was set up in 2007, and had been in use to substitute the Web Access Management (WAM) service offered by Innovative Interfaces. The server had Windows server 2003 operating system running on it.

The procedure for this migration was easier than other system migrations for two reasons. The virtual server environment had already been built, and was ready for use a quarter term in advance of when it was required for this purpose. As a result, no extra configurations were needed before it was put into production mode. Secondly, managing the EZProxy system is not as complicated as managing other library IT systems. The transfer process was implemented without any issues.

Before putting the server into production mode, the Systems Librarian discussed with the

campus IT specialist in detail about the maintenance work, and subsequently worked with the library bibliographic control coordinator to make changes to the library e-resource management system, SFX. A list of system changes, including the new IP address and the server host name, was also sent to the systems group at the CSU Chancellor's Office in order to make the necessary changes in the systems.

Because of the simplicity of this migration, the Systems Librarian reported to the University Librarian only once before initiating the project, and informed the entire libraries on the date when the new system was put in use.

Upon finishing all systems configurations on the new server, the local server ran in parallel with the virtual server for two weeks before it was decommissioned. During the two-week testing period, a couple of databases with newly-changed URLs were reported as "unproxied" because the proxy file located on the virtual server had been taken from a former backup of the local server system and was not fully up-to-date with the most current information in time for the changeover. The problem disappeared after the servers' synchronizations.

Discussion

This article discusses the background and procedures that the CSUEB University Libraries undertook to move major IT services from the ground to the cloud, along with the problems, issues and solutions that resulted after the migration. Most of the issues that the libraries encountered focused on the ILS and ILL migrations, which include:

- Printing, including changed printing format issue after ILS migration;
- Lost FTP and Z39.50 connections after ILS migration;
- Malfunctioned Link+ service and Books & Articles search after ILS migration;
- Security Certificate and Web Management Report errors after ILS migration;
- Missing PDF documents after ILL migration;
- Lost database connection after ILL migration.

Some of the problems could have been avoided if more communication had been conducted among the libraries, the vendor, and other organizations prior to the migrations. Other problems could not be anticipated and required more work after the migration.

During these times when libraries have to cope with constrained budgets, moving major library IT services onto either vendor-hosted or campus IT-hosted servers are attractive options. For libraries that are planning migrations similar to those that have been completed at CSUEB, it is important to be mindful of the following:

- Obtaining the new IP address and ensuring connectivity is central to successful cloud migration;
- Sharing the migration messages in advance with related parties and ensuring all external links are updated greatly help avoid future problems after migration;
- Good communication with all stakeholders (library staff, campus IT, University Librarian, etc.) is always important and necessary.

After the CSUEB library procedures were completed, two key problems evaporated, namely, the server room problem and the security concerns about student assistants in the server room. Equally important have been the resolutions to the server maintenance issues. The expense for hosting services is a small price to pay compared with the cost for a dedicated person working on server maintenance in the libraries. With the expertise provided by the vendors and server support from the campus IT, the time and effort library staff spend on systems troubleshooting has been greatly reduced.

While CSUEB libraries benefit from cloud computing, it is worthwhile to note that issues common to cloud computing also showed up after these implementations. For example, although the libraries have not experienced a “frozen screen” problem since it last occurred in September 2011, whether it will reoccur in the Millennium system remains uncertain to the libraries. Moreover, faculty discussion on the level of library control over the website has been continuous since the first day it was hosted on the campus-based virtual environment.

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