

# Providing Effective ICT Services using Open Source Technologies: University of the Philippines Experience

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## ABSTRACT

The University of the Philippines, comprised of seven constituent universities, is the premiere State university of the country. Providing effective information and communications technology (ICT) to its faculty, staff and students is critical in ensuring the delivery of quality education.

Established in 1966, the University Computer Center (UCC) is the unit mandated to provide ICT to the university. From mainframe-based computer services, the UCC has migrated its operations to workstations and desktop computers using Open Source technology.

The use of Open Source technology varies from simple and direct use of available applications such as web servers (Apache), electronic mail (PHP-based, imap and qmail) and authentication servers (openLDAP) to home-grown systems such as the Student Records System and Computerized Registration System (SRS/CRS), Faculty Information System (FIS), Document Tracking (DocuTrak) and the University Virtual Learning Environment (UVLE).

This paper aims to showcase the advantages of using Open Source solutions in providing information and communications technologies in a relatively small campus with 27,000 students and 5,000 faculty members and staff.

## Categories and Subject Descriptors

J.1 [Administrative Data Processing]; H.4 [Information Systems Applications]: Office automation, communication applications; H.3.5 [Online Information Services]: Web-based services

## General Terms

Performance and Standardization.

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## Keywords

University of the Philippines, Open Source, Information Technology, Information and Communications Technology

## 1. INTRODUCTION

As the premiere State university of the country, the University of the Philippines' flagship campus in Diliman is challenged to provide the same level of information and communications technology (ICT) services as its regional and global counterparts.

This paper presents a brief history of the University, concentrating on its campus in Diliman, Quezon City, Philippines. A discussion on how basic ICT services are being delivered using Open Source technology follows. Finally, the paper concludes by providing an approximate amount of money saved by using Open Source technology.

## 2. HISTORY

In 1908, an act of the First Philippine Legislature, Act No. 1870, otherwise known as the University Charter, established the University of the Philippines, with a specified function to provide advanced instruction in literature, philosophy, the sciences, and the arts, and to give professional and technical training.

The University of the Philippines System has seven constituent universities scattered all over the archipelago, namely in Baguio, Manila, Los Baños, Visayas, Mindanao, the virtual campus of the Open University, and the 493-hectare campus in Diliman, Quezon City.

The University of the Philippines–Diliman's University Computer Center (UCC), established in 1966, is tasked to provide information and communications technology (ICT) services to more than 27,000 resident students and 5,000 faculty and staff members. Sourcing its funds from the national government, the UCC is challenged to provide world-class ICT services with a developing country level funding.

### **3. INFORMATION AND COMMUNICATIONS TECHNOLOGY SERVICES**

#### **3.1 Electronic Mail**

Electronic Mail or e-mail is the most used and abused electronic service currently available. Providing e-mail to more than 30,000 subscribers is neither an easy task nor is it expensive. The UCC has employed four mail servers running RedHat Linux 6.2, qmail, courier-imap, mySQL, Apache, PHP, Imp with Horde and openSSL on Pentium III 800 Mhz with 512MB RAM and 216GB hard disk hardware. E-mail is relayed to two mail relays with virus scanning and spam filtering capabilities running on RedHat Linux 6.2 with qmail on a Pentium III 800 Mhz with 512MB RAM and 20GB hard disk server.

E-mail is retrieved both on the web and using an imap service (each one averaging 2,300 unique user connections a day), both with secure socket layer (SSL)-based encryption. Sent e-mail is routed to a simple mail transport protocol (smtp) relay server with user authentication and SSL-based encryption.

#### **3.2 Web Access**

The Internet is accessed through proxy servers to maximize the use of scarce bandwidth. Six proxy servers run on Linux, Apache, PHP, Squid and SquidGuard on Pentium III 866 Mhz and Pentium IV 2.6 Ghz servers with an average of 512MB RAM and 40GB of hard disk space. Content filtering is done by websites using SquidGuard. One of the proxy servers requires user authentication for wireless services.

University websites are hosted on a single Pentium II 400 Mhz server running Linux and Apache with virtual hosting enabled and serves more than 31,000 successful page requests daily.

#### **3.3 Public Access Computing**

Several IEEE 802.11b/g wireless hotspots are deployed all over the campus. These are connected to a central dynamic host configuration protocol (DHCP) server to provide IP addresses. However, users must have a valid university username and password before they can access remote websites via one of the proxy servers mentioned in 3.2.

Public access terminals are also provided to students who do not have portable computers. The Public E-Terminal (PET) project distributed more than twenty-five PETs to academic buildings all over the campus. The current PETs are on Microsoft Windows XP but are being migrated to Mandrake 10 Linux to reduce licensing expenses.

#### **3.4 Authentication**

User authentication is provided by a centralized lightweight directory access protocol (LDAP) server running RedHat Linux 9 and openLDAP on a Pentium IV 2.66 Ghz server with 1GB RAM and 240GB hard disk space server.

Servers are authenticated using a Certificate Authority (CA). The UP CA issues and signs digital certificates used by servers providing SSL-based connections such as https and

secure imap. the CA runs on a Pentium IV 2.6 Ghz server with 1GB RAM and 240GB hard disk. It also provides digital certificates for personal e-mail.

#### **3.5 Voice over IP**

Deployed in April 2004, the telephone system of the university runs on a hybrid proprietary and open source Voice over IP (VoIP) implementation. The system runs on two servers, a Microsoft Windows 2000 server running CISCO CallManager and a Linux-based server running Asterisk Session Initiated Protocol (SIP) server, connected to each other.

The VoIP system manages 120 digital telephone lines connected to more than 1,000 handsets and virtually unlimited number of software-based telephones or soft-phones.

#### **3.6 Firewall**

All of these services are behind a firewall running OpenBSD 4.2 on a Pentium IV 2.66 Ghz server with 1GB RAM and 240GB hard disk server. OpenBSD's built-in packet filtering (pf) is used to provide network address translation (NAT) services and to manage remote access to servers inside the campus network. This server also prevents client computers from directly accessing file-sharing services that tend to clog the limited bandwidth of the university.

#### **3.7 Remote Access**

Remote connections are provided via Virtual Private Networking (VPN) server running PoPToP on Linux and accessing a FreeRADIUS-based server for authentication. This service was introduced in April 2004. Since most of the services are web-based, the demand for VPN access is minimal.

#### **3.8 Monitoring**

The network is monitored using the Multi Router Traffic Grapher (MRTG). However, Nagios is currently being deployed to provide more detailed monitoring of the network including hosts and services.

### **4. BASIC INFORMATION SYSTEMS APPLICATIONS**

#### **4.1 Student Records System (SRS) and the Computerized Registration System (CRS)**

The Office of the University Registrar (OUR) started the full computerization of the student records and registration in 2000. The initial proof-of-concept was developed on a Microsoft Windows 2000 server with SQL Server as its back-end.

A year later, the development of the new version, based on open source technologies, started using Linux as the operating system, postgresSQL as the back-end database and Tomcat as the web and application server. Java is used to develop the web-based application.

The Student Records System and the Computerized Registration System are running on separate RedHat Linux 9 on Intel Xeon-based servers.

#### **4.2 Faculty Information System**

The Faculty Information System (FIS) keeps track of the academic, research and administrative load of each faculty

member every semester. This system also keeps track of the research output of each faculty member, e.g., book and journal article publications and conference presentations.

FIS is tightly coupled with the CRS, to determine the classes handled by the faculty. It uses the same software configuration as the SRS and CRS servers. However, a proposal is underway to use an Apple XServe G5 running Mac OS X, Tomcat and PostgreSQL.

### 4.3 Document Tracking (DocuTrak)

The Document Tracking (DocuTrak) project is the first phase of a project with an objective of having a paper-less system. This phase allows users to track their barcoded documents through a web-based interface. With more than 130 academic and administrative units connected to the system, DocuTrak has served more than 5,000 documents since its launch in August 2003.

The DocuTrak server runs RedHat Linux, Apache, PHP and MySQL on a dual Pentium III processor server with 512MB RAM.

### 4.4 University Virtual Learning Environment (UVLE)

The 2001 Asia-Pacific ICT awardee, the University Virtual Learning Environment (UVLE) is a system that enhances classroom learning with computer-based tools. Initially developed as a student project in 2000, UVLE has matured into a full-fledged system used by faculty and students.

UVLE allows students and faculty to interact and collaborate online asynchronously even outside of the normal class hours. UVLE supports lecture archives, assignment distribution, audio and video archives and links to related sites and other reference materials.

With more than 600 classes and averaging more than 4,000 pages and 7,000 hits per day, the UVLE is hosted on a Pentium III 800 Mhz server with 512MB RAM and running RedHat Linux, Apache, PHP and MySQL.

### 4.5 Others

Other information systems currently being developed using Open Source applications and tools are the Socialized Tuition Fee Assistance Program (STFAP) online application, the UP College Admission Test (UPCAT) online submission and the Human Resource Information System.

## 5. DISCUSSION

In the late 1980s, the UCC started delivering ICT services using Unix-based workstations. Migration to Linux was smooth and training requirements were minimal. Thus, Total Cost of Ownership (TCO) was based predominantly on the cost of hardware and software acquisition. The Open Source community provided the technical support in resolving application library incompatibilities and dependencies.

The cost of hardware for the setup discussed in sections 2 and 3.8 was practically the same regardless of whether we use Linux, Microsoft Windows operating systems or other commercial x86-based operating systems.

With the current software setup and configuration, the university's one-time, upfront cost is a little more than \$100, which is the cost of the CDs used to make copies of the software that were freely downloaded from the Internet. Comparing it to an all Microsoft setup, with thirty servers, it is approximated that the licensing cost will be at least around \$30,000, based on published rates for the operating system alone and not considering the per client cost and the database back-ends.

With the operating system running on Linux, the development of the various information systems mentioned in section 3.8 naturally used open source tools providing additional savings during development.

## 6. CONCLUSION

This paper has showcased how Open Source applications and tools provided the University of the Philippines–Diliman with effective and world-class information and communications technology services at minimal cost.

The Total Cost of Ownership (TCO) normally considers the upfront cost of purchasing both hardware and software, training cost (in case of migration) and the cost of vendor technical support. The University of the Philippines' savings predominantly comes from the upfront cost, i.e., cost of purchasing the hardware, the inherent availability of Linux/Unix expertise in the university from its graduates and faculty, and the availability of information from the Open Source community.

## APPENDIX

### A. WORLD WIDE WEB RESOURCES

1. Qmail, <http://www.qmail.org>
2. Courier-IMAP, <http://www.courier-mta.org>
3. MySQL, <http://www.mysql.com>
4. Apache, <http://www.apache.org>
5. PHP, <http://www.php.net>
6. IMP with Horde, <http://www.horde.org>
7. OpenSSL, <http://www.openssl.org>
8. Squid, <http://www.squid-cache.org>
9. SquidGuard, <http://www.squidguard.org>
10. openLDAP, <http://www.openldap.org>
11. Asterisk, <http://www.asterisk.org>
12. PoPToP, <http://www.poptop.org>
13. FreeRADIUS, <http://www.freeradius.org>
14. MRTG: Multi Router Traffic Grapher, <http://people.ee.ethz.ch/~oetiker/webtools/mrtg/>
15. Nagios, <http://www.nagios.org>
16. Tomcat, <http://jakarta.apache.org/tomcat>
17. PostgreSQL, <http://www.postgresql.org>