Case Study: Undergraduate Research Office Network Redesign

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Abstract – **Fifteen years ago, the Undergraduate Research Computer Lab located in115 Lester Hall consisted of daisy chained Apple Macintosh computer network. At that time research mentors thought if students are going to work on research projects during the spring and fall semesters not just during the summer research program, specific software and hardware to support the programs goals must be acquired and implemented.**

The solution was to install SGI UNIX hosts along with a suite of UNIX and Macintosh business applications and tools that students can use to explore two and three dimensional computer based simulations when collecting research data, creating research papers, and using academic software to enhance their research skills.

Over the past fourteen years, the Undergraduate Research Computer Lab has expanded from a single LAN into three segmented TCP/IP star based LANs tied together via the ECSU backbone which consists of managed switches that extend into each campus building d-marc. Two of the LANs are located in Lester Hall room 115 and 116 and the third LAN is located in Dixon Hall in room 216. Each LAN consists of a mixture of 15 UNX, 28 Macintosh, 40 Windows PCs, eight printers, and one video teleconference host. Within Lester Hall room 116 two IBM Windows 2003 server hosts are used as web servers, nia.ecsu.edu and cerser.ecsu.edu, for the Undergraduate Research Program to communicate with its business partners, mentors, and researches. Also located within room 115 is a Macintosh G4 OS X server used as a Primary Domain Controller for 23 Macintosh G3 hosts. Also, in the third office located in Dixon Hall, room 216, is one Tera Scan UNIX server which is used to download satellite images from a NASA satellite for analysis by students in the Undergraduate Research Remote Sensing Education program. Within each office hosts communicate with one another and the public using two transmission mediums, Ethernet Category 5e and wireless 802.11b/g adapters.

I. INTRODUCTION

A. Overview

In the fourteen years that have passed, the absence of a day-to-day System Administrator at the operational and technical levels has left the Undergraduate Research Computer network in a neglected state that has been patched and added onto so many times that the network and its resources do not fully meet the research needs of the mentors and students. As a result of leaving the role of system administration up to a research student majoring in Mathematics and Computer Science during fall, spring, and some summer semesters to maintain a stable operating platform, the student administrator is not able to establish system ownership responsibility to ensure that each system meets its functional requirements, appropriately documented, is secure and controlled, has been adequately tested, and is maintainable. The student administrator becomes overwhelmed with responsibility trying to support the Undergraduate Research Program applications and any related systems despite the information the student learns in their computing courses. The student administrator inability to create and maintain end user accounts, system configurations, and Local Area Network policies, in a computing environment that consists of Windows, Macintosh, and UNIX hosts makes the Research Computer lab to difficult to manage.

B. Existing Environment

The undergraduate research lab in Lester Hall was a lab where students could do research for undergraduate programs, other tasks for computing courses and develop innovative and relevant projects. The lab consisted of eighteen computers and a printer for the students to have internet access, type word documents and print their information. There was a chalk board in the lab for the instructors to teach students at the board and a television to watch the news and others shows that could contribute to the students researching.

C. Existing System

Within the undergraduate research lab were five Sun Microsystems, or Sun blades, and thirteen SGI 02s. The Sun Microsystems computers are low cost systems which feature a 64-bit high performance, an Ultra SPARC-Iii processor and one to two 40 GB. The SGI 02 computers are able to maximize the performance of the desktop applications and uniquely integrate high-quality graphics and powerful image processing.

Sun blades *Key Benefits*:
- Provides plenty of internal disk and memory
- Has a fast PC, which delivers an acceptation performance for business, technical environments and research.
- More reliable and easier to maintain than traditional rack mount or blade servers

- Runs the most demanding enterprise applications faster and more efficiently
- Administrators can manage individual Server Modules just like a rack mount server
- Reduces the cost of integration into your existing environment and the cost of management by using highly flexible, hot pluggable, industry standard based I/O modules

Siclone Graphics 02 *Key Benefits***:**
- Innovative Unified Memory Architecture (UMA)
- Enables stunning 3D graphics
- Provides Real Time Video for processing
- Platform for scientific visualization, 2D and 3D animation
- Broadcasting, simulation defense and medical images
- Opportunity to increase swap space
- Exceptional expertise in high-performance computing, advanced visualization, and the management of complex data

This powerful, low-cost system features a 64-bit high-performance, Ultra SPARC-II processor and one or two 40GB, plenty of internal disk, memory and a fast PCI, which deliver exceptional performance for business, technical environments and research. There were also thirteen Silicon Graphics 02 computers that were able to maximize the performance of the desktop applications and uniquely integrate high-quality graphics performance and powerful image processing. Based on an innovative Unified Memory Architecture (UMA), the 02 enables stunning 3D graphics, powerful image processing and real-time video processing far beyond that of any other machine available in its class. These features make O2 the ideal platform for scientific visualization, 2D and 3D animation, broadcasting, simulation, defense, and medical imaging. Hardware Outdated

D. Existing Software

Thee existing software installed in the computers consisted of Internet Explorer, UNIX Root, Applications, Media Tools, Utilities and Windows.

II. Network Redesign

The Center of Excellence in Remote Sensing Education and Research (CERSER) on Elizabeth City State University's campus consisted of daisy chained Apple Macintosh computer network fifteen years ago. At the time, the CERSER lab was far ahead in technology but currently, the lab is becoming more outdated each and every day. The goal was to redesign the network and the computer lab. Redesigning the network means upgrading multiple computers connected together using a telecommunication system for the purpose of communicating and sharing resources. With slower internet connection and a lower amount of memory and slower hard drives, it makes it difficult for many undergraduate research students to satisfy their educational needs. It is currently the year 2007, and the CERSER lab was in a desperate need of an upgrade. They need to revamp their network and systems to handle larger amounts of research from the students. The future goal of the CERSER lab is to make the dream of a fully functional research lab in to a reality someday.

A. Prototype

The pharmacy building located near the Jenkins Science Center on campus has an excellent computer lab that was used for the basic prototype design of what the new computer lab should look like. The computer lab design was arranged so that the students could easily maneuver around the room while using laptop computers instead of desktop computers. All of the desks were pushed to the end of the walls, providing enough space in the middle for multiple faculty or students to walk around.

Although the laptop computers were more expensive, they took up less space and the students could easily use them in different parts of the building. The laptops ran on both wireless connections and Ethernet connections so that if the wireless connection was ever loss, the students could still run the laptops of off the built in connection. The software on the existing laptops and the software version currently being used is no longer supported by the manufacture. The pharmacy building was currently trying to upgrade all their systems to Windows Vistas which is a newer expansion of Windows XP. Since the computers already ran off of a VIAO system, which is currently Vistas compatible, it would make since that the computers upgraded to a more current system.

III. SYSTEM ADMINISTRATION

A. Skill Set

A System Administrator is one who is "employed to maintain, and operate a computer system or network." They must understand the behavior of software and know several programming languages used for scripting or automation of routine tasks. There is said to be different levels of system administrator and they are based upon one's skill level. There is the Novice, the Junior, the Advanced and the Senior. The Novice is considered to be not as skilled as the others, but can still get the job done. Some of the skills that the Novice has includes, being capable to explain simple procedures through writing or verbal direction, are familiar with UNIX and its commands at the user level, and are able to perform standard file processing tasks like, find, move, remove, and redirecting. The required background for a Novice is two years of college or two years of post high school education experience in the computer science field. The highest skill level which is the Senior, has all the skills of the Novice, in addition to being capable of writing proposals and papers, able to solve problems quickly and completely, has a solid understanding of Unix, is capable of programming in at least two of the following programs, shell, Perl, and Tk, and has a complete understanding of networking/distributed computing environments. A senior system administrator must have more than five years of system administration experience.

Although there are different levels of System Administrators, all of them have responsibilities that are needed to maintain and operate a computer system or network. The System Administrator installs, supports, and maintains servers or other computer systems, and makes plans to respond to service outages and other challenges that a user may face. Also, they do a little programming, some project management , and they supervise and train computer operators. In all, a System Administrator would be able to complete any tasks that a person from the technical support staff would be able to do. The skills needed to fulfill these responsibilities "entails a knowledge of operating systems and applications, as well as hardware and software troubleshooting, and also the knowledge of the purposes for which people in the organization use the computers." However, the most important skill that the System Administrator must have is the skill to problem solve. They must be capable of to quickly and efficiently find and solve a problem when they are called upon.

Thus, a System Administrator is a crucial component in making the computer system and/or network successful. They have several responsibilities that allow them to assist others when in need and make sure that the network is run properly. Their job is very demanding and takes a lot of computer knowledge, and without a System Administrator, computer systems would not be the same.

B. Technical Support

The role of a System Administrator as end-user support technician is to resolve issues of concern that impact the day-to-day functions of an organization at the administrative, technical, and operational levels.

C. Training

As the System Administrator, they are responsible to make sure that the proper training is provided to make sure that the network is able to be run as efficient as possible. They may provide training sessions or tutorials to make sure that those who are working within the system are very knowledgeable of what they are doing.

D. System Maintenance

Making sure that the system is running properly is a very important task of the System Administrator. The System Administrator "entails the knowledge of operating systems and applications, as well as hardware and software trouble shooting, as well as the knowledge of why people use computers." By understanding the purposes of computers and how it runs, the System Administrator is capable to find and solve any problem that the network may face. Therefore, the network will be run successful and the system will be run efficiently.

IV. FUTURE GOALS

A. Relocate Macintosh Computers

The vision for the project is for the network team to wipe the slate clean and redesign the Undergraduate Research Computer Lab network to make it a fully functional and secure network that meets the needs of the student as well as the instructor. Also, to create a video tutorial that will demonstrate to students how to log on to the Unix machines and how to use them properly.

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