Supporting a Windows XP/Red Hat Linux Dual Boot Environment

Bert Valenzuela
Arizona State University, East Campus
Information Technology
7001 E. Williams Field Rd.
Building 20 Room 151
(480) 727-1183
valenzuela@asu.edu

ABSTRACT
Customers of public computing sites and faculty who use the public computer classrooms to teach want diversity in computing. Inevitably, there's a group that does not want to teach exclusively using Windows, or the industry they are teaching about is not Windows based. To accommodate those customers, Information Technology at Arizona State University's (ASU) East Campus supports a Windows/Linux Dual Boot Environment in several classrooms.

This paper will examine the Linux public computing environment, how it works, how it is secured, how it utilizes the same central authentication and shared customer specific file space as the Windows and Macintosh clients, the challenges of supporting it, and what it provides that the Windows side cannot. This paper will also examine why faculty use it as a teaching tool versus using Windows exclusively.

Categories and Subject Descriptors
D.4.0 [**Operating Systems**]: General

K.3.0 [**Computers and Education**]: General.

General Terms: Documentation, Design, Security, Theory

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1. INTRODUCTION
In the fall of 1999, ASU East Information Technology (IT East) premiered a dual boot Windows/Linux environment on several computers in the main computer lab and one computer classroom due to a request from faculty teaching Environmental Resource (ERS) courses. The best description of the ERS program comes from their website where it states, "Faculty and graduate students in Environmental Resources are active in a number of research programs, including applications of geographic information systems and remote sensing to resource management, ecosystem restoration, fire ecology, monitoring of ecological change, riparian ecology, soils ecology, vegetation dynamics, and wildlife habitat ecology [1]." Most of the applications they use (Grass, ERDAS, ArcGIS) are Unix based. They made the request because they wanted to run these applications locally or use Linux's X-Windows capability to easily connect to the Unix/Solaris servers. Also, some of the faculty preferred the Linux/Unix based environment and its easy access to a Unix command prompt versus what is provided through Windows.

After the initial installation of the dual boot environment in one computer classroom and six computers in the Commons, interest grew. The Computer Engineering Technology (CET) department that teaches computer programming classes began to use the Linux environment. Soon, their students and faculty began requesting it. IT East installed the dual boot build in a couple more computer classrooms and on all the instructor's computers in their 30 mediated classrooms. Currently, the dual boot build is installed on over 100 of the 380+ computers that IT East Academic Computing supports.

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2. HOW DOES THE LINUX BUILD WORK
A computer running the dual boot Windows/Linux environment has at least a 20 GB hard drive that is split into three partitions. It uses approximately 15 GB for the Windows partition, 500 MB for the Linux Swap Partition, and 5 GB for Linux's primary partition. To facilitate the dual boot, we use GRUB (Linux's boot loader) with the default option set to boot into Windows XP.

Upon booting into Red Hat Linux, Linux boots like it would in any other environment. The only major additional daemon that starts is AFSD. The AFSD daemon/service allows IT East to map to a common Andrew File System (AFS) Server. After a successful boot, Linux displays a login prompt.

At the text-based login prompt, IT East displays instructions to log on to an account called, "generic." The "generic" account runs a Perl login script that prompts the customer to enter his/her ASURITE user ID and password. ASURITE is a Unix based computer account system that Arizona State University uses to provide computer access to the University's 100,000+ customers. The login script authenticates the customer and grabs an AFS Token to map a drive to the customer's centrally managed, private file server space. This file server space follows the customer around. It does not matter whether they log on to an IT East supported classroom/lab computer running Windows, Linux, or Macintosh.

Linux Login Process

1. Log in to account named *Generic*
2. *Generic* account initiates a Perl login script
3. Login script prompts for central account authentication credentials
4. Upon authentication, the script mounts the customer's private file server space
5. Login script sets up customer's home directory
6. Login script launches KDE and writes a couple files to the customer's file server space
7. Customer has access to use the K Desktop Environment (KDE)

Figure 1. Linux Login Process.

The customer can access his/her file space using any of the Operating Systems. Once the file space is mapped, the script sets up a user environment that includes the user's local home directory (similar to a Windows profile) that is based on a template default user home directory. As part of this profile creation, the script writes a couple files to the customer's file server space. Then, it launches KDE and provides access to a nearby network printer. For security, if any part of the login script fails, Linux immediately halts and reboots. See Figure 1 for a simplified version of the login process.

Red Hat Linux's KDE provides a Windows-like environment. Customers have a Start Menu-like way to launch their programs via the KDE Menu. Also, KDE provides an easy Unix/Linux command prompt environment. This provides easy way for those who know Unix/Linux to get around the system. Also, it allows for an easy way to spawn an X-Windows session. See Figure 2 for a screenshot of the KDE Desktop and Menu.

On the Desktop, customers have easy access to all their drives. There are icons for the floppy, CD-ROM, AFS Drive (file server space), and Zip drive. In previous versions of Linux (Red Hat 6), administrators had to run scripts to mount the disk drives when a customer clicked on one. There were separate Perl scripts that mounted each type (except for the hard drive and file server space). In the recent versions of Linux (Red Hat 8 and 9), the automounter eliminates the need for these scripts and Linux finds the drives automatically. Similar to Windows and Macintosh, there is a Trash icon to delete files. See Figure 3 for an illustration of the KDE Desktop.

For basic applications on the Linux build IT East installs Netscape and OpenOffice. This provides easy access to the Internet and to Microsoft Office like applications (Word, Excel, and PowerPoint). Also, IT East installs specialized applications per faculty request.

After a customer finishes using a system, they close their session by logging off KDE through an option on the KDE Menu. Upon logout, the system runs a logout script that cleans up the user's profile (home directory), cleanly unmounts drives, and shuts down Linux. After shutdown, the system automatically turns off the computer or reboots. If the computer reboots, it displays the GRUB boot loader prompt. If there is no direction whether to boot into Windows or Linux, the system automatically boots into Windows XP. See Figure 4 for a simplified version of the logout process.

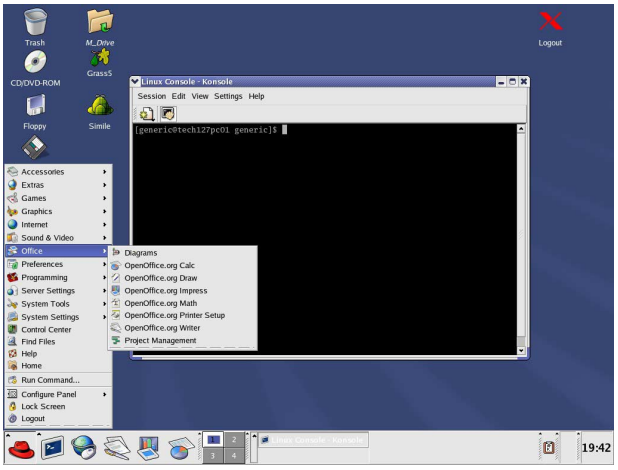

Figure 2. KDE Desktop and Menu.

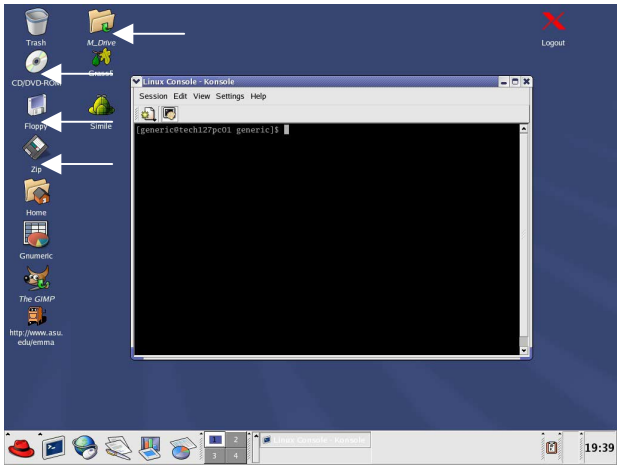

Figure 3. KDE Desktop Displaying Drives.

3. SECURITY OF THE LINUX BUILD

In the past, Linux/Unix was one of the more susceptible operating systems to hacks and other attacks. For this reason, by design, the Linux build never sits at an idle state when a customer is not using it. The computer is either rebooted into Windows, or turned off. The best security is not to have it readily available to remote attackers.

For security when operating as a lab computer, administrators turn off all services that the customer does not need. Also, the customer does not have root access. The Linux session is secured to the point

Linux Logout Process

1. Customer logs out of KDE
2. KDE closes and Perl Logout script starts
3. Logout script cleans up the files written to the customer's file server space
4. Logout script cleans up the users home directory
5. Logout script cleanly unmounts drives and file server space
6. Logout script halts Linux and turns off the computer

Figure 4. Linux Logout Process.

that a customer would have to intentionally do something to damage a system for it not to successfully load for the next customer (not including hardware failures). If they were successful, the administrators could do forensics on the computer to see who the last customer was that logged on, thus building in accountability.

In used to be much more difficult to secure incarnations of the build that ran previous versions of Linux. It was a painstaking process of going though each service and port and turning off what was not needed. Then, with Red Hat 8, administrators used ipchains and iptables. To secure a Red Hat 9 version of the Linux build, administrators simply choose "medium" security out of the box (for the most part other than a few modifications). As Red Hat Linux becomes more robust and user friendly, it takes a lot less time to set up, secure, and administer in the open lab/classroom environment.

4. TECHNICAL OBSTACLES RUNNING LINUX

The Linux build is an awesome achievement, but there were obstacles in its development. By sharing some of these, it is the author's hope that it may spare others from having to go through similar struggles when setting up Linux in a public computing environment.

In previous versions of Linux, one of the first obstacles was that it took a lot of time to secure. Upon securing, parts of the scripts, login routines, and logout routines no longer worked. IT East administrators examined each script and routine to determine which run level (level of access) it had to run at in order for the action to execute properly.

Next, administrators had to write a script that automatically configured a hostname and local printer after the Linux image was Ghosted (copied down) to the lab computers.

Also, before the automounter became available, administrators had to write scripts that automatically mounted the floppy, CD-ROM, and Zip drives when they were accessed though KDE.

Hardware is a challenge when setting up a Linux environment. Linux is not as plug and play friendly as Windows. If a computer has a non name brand, non standard or recently released piece of hardware, there may not be a Linux driver available for it. If an administrator cannot locate a driver, the component needing it will not work. Another example is that it is fairly easy to port a Windows build from one Intel chipset hardware platform to another rather than recreating the build from scratch. Linux is not as easy. With Linux, IT East administrators create a separate Linux build for each hardware platform. For example, we have separate builds that were made from scratch each for the Dell OptiPlex GX1 (Pentium II) and the Dell OptiPlex GX240 (Pentium 4). However, the most recent Linux build for the Dell OptiPlex GX240 easily ported over to the Dell OptiPlex GX260 (Pentium 4) with a few minor modifications. This may be because they are both running a similar Pentium 4 Intel Chipset and Red Hat Linux's plug and play capability is much more robust in more recent versions.

One strange issue we had with Red Hat 6 was that Linux would not get a Microsoft DHCP served IP address when ten or more Linux computers requested an IP at the same time. An ERS Faculty member found this while he tried to use Linux to administer an online quiz. About half way through his class, he asked his twenty-four students to reboot out of Windows NT4 and into Linux. After the Linux computers rebooted, only about five of the twenty-four were able to log on to KDE. It seemed Linux timed out quickly while trying to get a DHCP address and did not retry when it failed. To fix this, IT East Administrators set DHCP reservations for each of the Linux computers. Also, as a redundant measure, they increased the DHCP lease time to twenty-eight days versus the seven it was set at before. Besides this, the ultimate solution was to have the class reboot in groups of five or ten. This guaranteed that the class would be able to successfully reboot into Linux and not lose a lot of quiz time.

In previous versions of Linux, any hardware change (even as minor as a RAM upgrade) caused Linux not to boot. After upgrading the RAM in one classroom, IT East staff had to reconfigure the boot loader configuration file and rewrite the boot loader (when we used LILO instead of GRUB) before Linux would run.

On the other hand, the advantage of running Linux versus Windows when you experience hardware problems is that with Windows, once you see the blue screen of death upon boot, it is a good chance you will have to reinstall the operating system. More frequently with Linux, it is possible to recover. You may have to tinker and tinker, maybe recompile the kernel, but there's a greater chance of getting Linux back up and running.

5. WHY NOT WINDOWS EXCLUSIVELY

The ERS faculty at ASU East proposed teaching using Linux because they used applications that ran off Unix/Solaris servers. They also taught with applications that seemed to run better under the Linux environment. A couple years ago, when we compared Exceed X-Windows sessions running through Windows NT 4.0 to X-Windows sessions running through Linux, the Linux sessions performed faster and were more stable.

In Fall of 2000, the ERS faculty used Netscape on the Linux build to administer online quizzes. They preferred this to Windows because the web browsers within Windows would freeze in the middle of the quizzes.

The CET faculty uses Linux to teach diversity in computing by exposing students to a different operating system. They give programming assignments where students have to boot into Linux and complete their assignments in the Linux environment. After using Linux, some students grow to prefer Linux to Windows.

One hot debate when the implementation of Linux was first proposed was, "What could Linux do that Windows could not?" "Was it worth the time and effort to support another operating system?" In the end IT East decided it was. In some respects, Linux performed better. For example, Linux ran X-Windows applications better than Windows NT4 did using Exceed 6. Also, there were some applications that only ran under the Unix/Linux environment.

Another aspect of the debate was, "Did people prefer using Linux because they had issues with Microsoft and Windows?" Some of IT East's customers were more familiar and comfortable with Linux and Unix than Windows. IT East staff wondered, "Is the choice to use Linux based on personal preference, or is it absolutely necessary to teach the class?" IT East found it to be the latter. Although some customers were more comfortable with Linux, there were some things that they needed that Windows could not do. The licensing costs were also much cheaper.

A similar debate broke out when IT East was asked to help support a Macintosh lab. The common question asked was, "What is taught using the Macintosh that cannot be taught using Windows?" In the

case of the Macs, the faculty who teach using them, teach Print Industry classes on publishing and prepress. Macintosh is the standard in the Print and Publishing Industry. The Macs use a PostScript method of print output that the Windows counterpart does not. Thus, the Mac can provide a service that the PC cannot.

Each operating system provides a piece in the educational environment. Because no one operating system provides all the needed services at ASU East, it is necessary to support all three. By supporting all of them, the students are exposed to a diverse range of computing resources and are therefore better prepared for industry.

6. CONCLUSION

What is the future of the Linux build at ASU East? Will it be something that fades away, or will it continue to develop and flourish? Because ASU East is an academic institution and supports academic freedom, I believe the Linux build will continue to flourish. Over its future development and incarnations, it may seem like the Windows Environment will be able to compete and accomplish all the tasks that the Unix/Linux environment can. However, because of diversity in computing, application developers will inevitably come up with services that will only run in the Unix/Linux environment; services that, at first, the Windows environment cannot accommodate. I estimate/hope that the Linux environment may further flourish by there being some application that bridges Linux clients back to Windows Active Directory Services. Perhaps in years to come, Microsoft or a third party will release utilities to enable enterprise environment system administrators to administer Linux machines by using Windows Active Directory Services. As time goes on, all the operating systems seem to share more and more in common. The latest example is Macintosh OS X and its Unix based Kernel.

At ASU East, the Linux environment will be repeatedly challenged in the future. However, it is something that is here to stay as long as Linux is popular with the computing community.

7. ACKNOWLEDGMENTS

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8. REFERENCES

[1] Arizona State University East Environmental Resources. http://cactus.east.asu.edu/ersprogram/MSERS.shtml