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TRANSFORMING INFORMATION & LEARNING CONFERENCE

Making and Keeping Connections Life, Learning and Information Networks

School of Computer and Information Science

Proceedings of the

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Making and Keeping Connections: Life, Learning and Information Networks

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TRANSFORMING INFORMATION & LEARNING CONFERENCE

Refereed Paper

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Biography
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Use of bootable Linux CDs for the delivery of educational course content

Abstract

This paper outlines the processes involved in creating and using bootable Linux/Knoppix compact discs (CDs) as a means of delivering course content to students. An outline of experiences in using these CDs to deliver courses in totally on-line mode is also given.

Introduction

Knoppix (2006) or bootable Linux CDs now provide a complete operating environment for the deployment of computer applications in an educational environment. These bootable CDs are able to be used across a wide variety of computer systems ranging from Intel 486 systems to the latest dual core 64 bit computer systems. Knoppix uses a compressed file system that allows up 3 gigabytes of binaries to be accessed from a CDROM disc and up to 12 gigabytes from a DVD drive. This allows for the production of comprehensive CDs as well as discipline or task specific CDs as small as 44 megabytes in size. Unlike the current Windows based offerings such as BartsPE (Lagerweij 2006) these CDs allow the deployment of a fully functioning operating system. The CDs are in the main copyright free and hence incur no licensing fees and are able to be used by anyone.

But it's Linux!

There is a common misconception that Linux users have to be conversant command line connoisseurs to use a Linux system effectively. This may have had some resonance in the past. However, since 2003 many Knoppix distributions have booted directly into a windowed environment by default, enabling users of these systems to utilize them in the same manner as conventional PC based operating systems such as Windows or Macintosh. It does not preclude the use of command lines, as terminals to enable this are in-built into the Knoppix systems.

One of the other major bonuses that these distributions have is that they can leave the underlying operating systems forensically intact, i.e. no alteration of any part of the underlying file system will occur. You can, if you like, also copy the entire CD contents to RAM and have the system eject the CD allowing use of the CD elsewhere if necessary. However the need for this in most classroom situations would not be warranted. In addition, most distributions can intelligently detect and use any swap spaces, should they exist, which aids in the performance of the system. This high portability and cleanliness allows the ad-hoc use of a system at any time on any suitable PC with the added bonus of the system presenting a consistent interface to the user.

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Educational merits of using this technology

One of the biggest educational advantages is the presentation of consistent operating environments to learners. Students can use the distributions in a variety of locations and each time be guaranteed the same interface to applications, menus, desktops and devices. This is in direct contrast with a conventional IT learning experience where desktops may vary greatly, even within the same educational venue or system. Students may focus on understanding the theory of what they are attempting to do and not have learning opportunities obfuscated by inconsistent user interfaces or menuing systems. As an example, take something as simple as the use of a word processor in an instructional setting.

Unless there is extensive and often problematic locking of the application features in a conventional computer system there is the ability to modify most attributes of the word processing program. However, beyond this there is little control afforded, for example, of template changes or customization of features such as AutoCorrect. Locking of these features creates a nexus. Typically the features that are locked need to be used in learning processes to enable the efficient use of the technology. Therefore, in most learning institutions these features are left unencumbered and consequently open to modification by students. Students legitimately modify these features as per instruction conducted in class, or in some cases maliciously, for example replacing a common word like *THE* with an expletive, in AutoCorrect. Unaware of the changes, a new student or instructor uses the installed conventional word processing system, thus making for some interesting educational experiences for instructor and student alike each time they type *THE.* In addition, the second or subsequent person who may be using the system will potentially not have to interact in an educational sense as they may merely follow the changes already input by the previous user.

In a Knoppix usage scenario templates and other features are locked. Students can customise at will but must save these customizations to a network drive or memory stick for later reuse as a reboot reinstitutes the templates from the CD. This restriction then personalizes the data and makes its “ownership” that of the students. Furthermore, it also confines the personalisation to the individual, rather than inflicting the previous person’s good or bad habits on the learning community. Educationally it also makes it difficult for the student to mimic or benefit from the previous user’s efforts, whether they are right or wrong. The user can also load from a memory device their personalized learning experience at any other time or location, for example their shared home computer, without affecting the underlying machine or setting.

Some may argue that the advance of virtualization technology now allows for the use of tools such as VMware player (VMware 2006) to play snapshots of other people’s complete operating systems should the need arise in the classroom. However, where is the true educational need for this beyond the requirement to use a specific package to demonstrate a particular concept? Education should be about generic principles and theories of operation, not about specific packages, commands or program methods: this is training. The author harks back almost 20 years when WordStar (Barnaby and Fox 1978)

was the undisputed leader of word processors literally because it was one of the few available. As a student of computing, the author suffered two distinct approaches to WordStar from two different lecturers, one of training and one of education. My education in the use of a word processor allows me to type this document to a required standard: my training on WordStar is now useless as the sequence control-K-S does not seem to save my document anymore.

“Industry standard” is another argument that monotheist computer users will use as a taunt. One fact about the computer industry is that industry standards litter the landscape: WordPerfect, Multiplan, WordStar, CP/M to name a few. What does hold are transferable skills and theories of operation. Furthermore, the high level of obsolescence in the computer industry would see a matriculating student in 2006 having used at least 6 different operating system versions from Microsoft. It is doubtful that the student will need to use their hard earned DOS 6.2 skills in university or a chosen vocation in 2007. They will, however, use their understanding of operating system skills to work with their operating system whatever it is to delete, organise, save, print or transmit their data.

Pick from the plethora or cut your own

There are literally several hundred customized ready to go distributions from which to choose. You can also remaster or customise your own CD or DVD using an existing distribution as the base. Some knowledge of application installation using Linux is needed. However this skill can be readily acquired with the wide range of HOWTO and FAQ available. A CD or DVD burner is needed and at least 5Gbytes of free space, preferably on fast access disk such as SATA or SCSI mechanism.

One of the major benefits of using Knoppix is that you can create highly customized CD/DVDs for use in the classroom. There are many good distributions out there that can be used automatically for many classroom situations. Occasionally there is a need to generate a specific targeted CD for use: this is called remastering.

Remastering of Knoppix CDs is relatively simple. You need some skills in following directions and some knowledge of how to install applications using Linux tools. These days much of the installation knowledge, such as dependencies and requirements for applications, is now managed using in-built intelligence or decision making within the installation application. Further to this you need a Linux partition with ~ 5GB of free space: this is used to store the source distribution and create the master copy which uses the compressed file system. Access to a CD/DVD burner is also required!

The initial steps involve the creation of a series of directories, the first of which is a source directory. This directory should contain a copy of the uncompressed file system which is simply copied from a booted Knoppix distribution of your choice. Then other directories are created to store the master copy i.e. the one you create. All of these details are easy to follow in HOWTOs and FAQs (2006).

Once the copy of the Knoppix is complete, you reboot the system and use a disk that has remastering capability. A safe disk to use for this purpose is the original Knoppix distribution itself. It is best to boot these in command line mode: this is achieved by typing `knoppix 2 dma` at the boot prompt. Once you have entered the command line environment, you need to perform what is called a changed root or chroot. This is achieved by changing directory to the source directory and entering the command chroot KNOPPIX. You then need to mount a proc file system which you must also dismount at the end of the session. You do this by mount –t proc /proc proc at the command prompt. You can now modify, delete, add or change the distribution to suit your requirements. This is done through the use of the apt program which is also extensively covered in the HOWTOs and FAQs (2006).

At the end of your session run the command apt-get clean. This removes all program archives from the system that you may have used to install the modified system, saving considerable space. Next you have to run a command that generates the compressed file system that you store in the `/master/KNOPPIX` directory normally as a file called `KNOPPIX`. Depending on the size of your distribution, speed, memory and disk type, this operation can take several minutes to several hours to compress all of the files in your source directory. The general rule for the creation of the compressed file system is that there is no such thing as too much CPU or memory.

You then produce the ISO9660 image file for burning to CDROM or DVD. Finally, you burn your new distribution to the desired media and then test. C*eteris paribus,* it should work: otherwise restart the cycle. It normally takes several iterations of the remastering process to get a customisation correct. The read-only features of the CD or DVD can be quite annoying at this stage of the process. Then once it is all tested and complete it is simply a matter of distributing the burned CD/DVD media or disc images via a file server.

Experience in using bootable CD environments

Over the last four years, the computer security group at Edith Cowan University has been running totally online university units within several coursework Masters degrees and, more recently, an undergraduate minor. The degree programs are running well with students using these CD and DVDs in a variety of situations to complete course requirements. Positive feedback from students indicates they are able to use the CD anywhere, anytime, anyplace. This allows busy professionals to use time efficiently in the pursuit of their degree. Several students have used these distributions to complete course requirements in rural and remote locations such as a gold mine in Yellowknife, Canada just below the Arctic circle, or in actual theatres of war such as Iraq.

The use of commercial CD/DVD duplicating systems has significantly improved timelines and they are definitely worth the purchase price. As mentioned previously, one issue is the need for rigorous testing as a mistake or omission can mean significant problems and may even require a remaster of the CD and redistribution. In a traditional networked environment, this type of change management is effected by applying a patch or re-imaging the standard operating environment (SOE) computers with the updated image.

There is the odd new device that does not work well with these CDs. However over 4 years of extensive use, we have been able to overcome such problems in all except one case. This type of trouble normally requires some expertise in Linux, though our experience has shown that in most cases it is that the computer's power management features that are to blame for 80 per cent of trouble. These may be disabled on boot command prompt with either `knoppix noacpi` or `knoppix noapm` depending on the power management systems that the equipment uses. The other problem is that of a new esoteric or "enhanced" piece of video hardware. Similarly these video issues may sometimes be overcome with the use of boot command line switches. A case from our laboratories established that we needed to specify the actual video card chipset to use for the x windows driver (an Intel810), because the new card (Intel845) was a newer child of the existing and well known Intel810. This was found out through an inquiry to the hardware supplier and some good Internet searching and feedback from user forums.

Production issues aside, the distribution of the media or images is an issue that needs to be examined. The distribution of CD/DVDs to a local population is a simple matter of handing them out in class. On-line storage and delivery of the image is also advantageous for a number of reasons. Firstly the externally located student can access the images for replication/burning on their equipment. This is handy when conventional mail may take 8 weeks. Secondly, local students who misplace their copies can burn one at their own expense in time, effort and media. Finally, it allows for the rapid deployment of a patch or replacement copy should the need arise.

Conclusion

Knoppix technology has allowed ECU to develop and deliver highly technical on-line courses in computer security and computer forensics that would not otherwise have been possible. The technology has allowed synergies in development of curriculum and student learning through the strict enforcement of a go anywhere standard operating/learning environment. This has allowed students to focus on the often complex concepts and theories that they have to master in the course content. The use of this approach has contributed to student satisfaction; many students comment that they find the use of this technology beneficial when undertaking the courses.

This technology is proven and provides educators with a cheap, go anywhere solution that is able to be readily tailored to individual IT infrastructure deployment or specific educational needs. Students also like the technology due to the presentation of a consistent learning environment and its high degree of portability. Our approach can be readily adapted to libraries, school and other places where there is a need for targeted, niche learning objects.

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