DESIGN AND LOGISTICS FOR A LAN MANAGEMENT COURSE

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ABSTRACT: This paper outlines an implementation for a hands-on Local Area Network (LAN) management course in the undergraduate curriculum of a department of Information Systems. Three major problems are addressed: faculty preparation, resource allocation, and course design/logistics. There are special difficulties in designing such a course because of the hardware preparation involved and the assignment of supervisor rights to a large number of students simultaneously for a single file server. A course outline and a sample practical exercise are given. This course has been successfully implemented and received a favorable student response.

KEYWORDS: LAN Management, Curriculum Design, Networking, Information Systems Education

INTRODUCTION

One of the most needed skills for BS-level specialists in Information Systems is a knowledge of data communications and network management. Networks have very quickly become an important platform for enterprise computing and their importance is increasing rapidly. The client-server approach to integrating platforms of all sizes in an organization will grow with the advancement of network technology. There is a relatively large demand by employers for entry-level people with network skills. Data communications theory is easily assimilated into a university curriculum, but network management skills are more difficult to offer. We address offering a LAN (Local Area Network) management course in detail in this paper. There are three major problems in the design and logistics for such a LAN management course:

1. The technology of LANs is new and very volatile. Many instructors are unfamiliar with the technology and reluctant to offer classes in areas where they do not feel confident.
2. Learning LAN management skills is very invasive to the network and difficult to implement on a production network. Special learning networks are expensive resources.
3. Designing the syllabus is difficult because in a reasonable class size (20), tasks that require access to the file server are hard to arrange without having everyone watch tasks or rotating the tasks throughout the course.

This paper describes our experience in the design and implementation of such a LAN management course. We address the above problems, the lessons learned from our experience, and make recommendations for future offerings. The LAN management course is a part of an educational philosophy in Information Systems that has been labelled "pracademics" (1). It is our belief that far from debasing a curriculum with "vocational" classes, a focus on theory and pragmatic, applied solutions fosters better, more creative, and confident students. In fact, we would make the strong claim that it is impossible to teach theory without this practical focus. The context motivates the theory. The profession needs to be much more aware of the type of individual that is produced by their curriculum. Rather than focusing entirely on credit hours and topics, there should be more awareness of intangibles like confidence, enthusiasm, and competence. This does not require invasions into people's private lives, it merely requires careful and responsible curriculum design. We have also seen too many instructors scorn such practical tasks as unimportant and mundane, but the subtext is that it is messy and bothersome and they don't want to deal with it. This paper is about the messiness.

A NEW TECHNOLOGY

Academia is a very conservative institution and it is difficult for it to maneuver in response to change. This might not be a big problem in say, Classics, where Xenophon's histories don't change much with the passing years, although interpretations do. There is more of a problem in basic sciences, but still not serious because basic science changes slowly. There *is* a serious problem in fields which are closest to technological development and organizational issues such as Information Systems. LAN technology, for example, has sprung up recently, and is changing rapidly. Furthermore, LANs have

a profound impact on how organizations do work. Academic departments related to Information Systems should be guiding and improving this process.

Most educators in Information Systems have educations that predate the proliferation of LANs and because of current responsibilities, they have difficulty retreading. The managements of academic departments can alleviate this problem by first recognizing that there is a problem and working for a solution. This solution can take two tracks. Educators can receive training from a commercial training company or they can use in-house training.

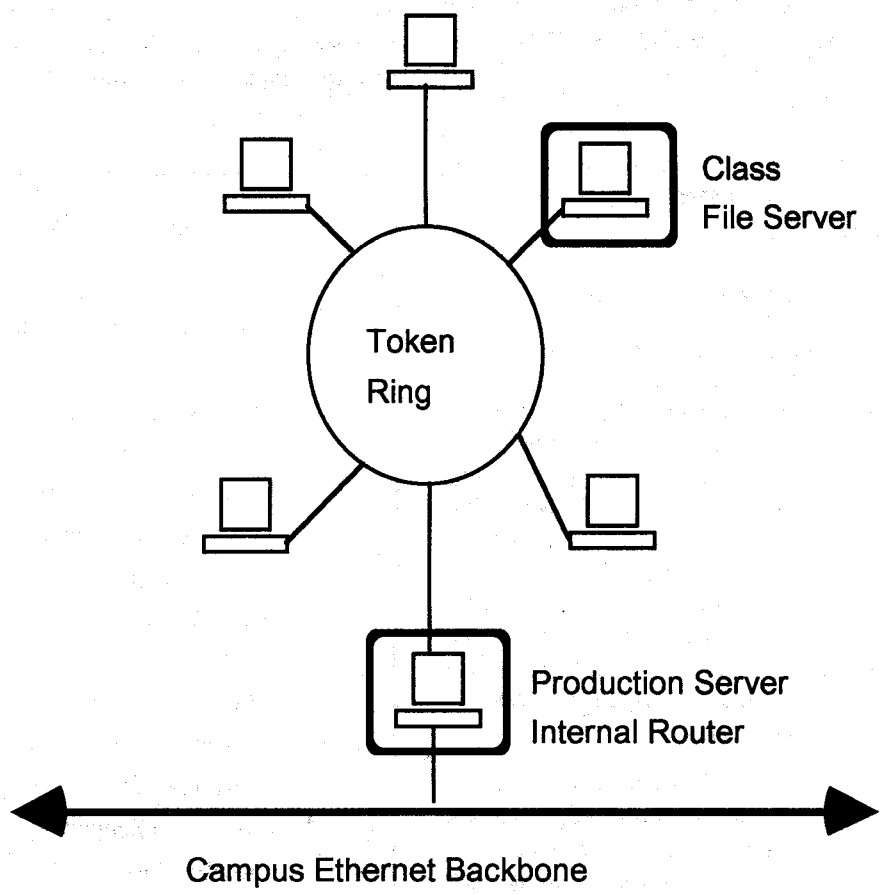
Commercial training is expensive, but may be the only alternative if there is no available expertise inside the department or school. With budgets tight in most universities now, financing this training is a problem. For example, a faculty member may desire the training and be willing to teach a class on overload or for continuing education to free up funds for the training. The first author of this paper received his commercial training in this way. The alternative of in-house training is easier to implement where internal expertise exists, although top-down pressure may be required to motivate participation. The first series of courses taught by the first author were attended by five staffers from the university Academic Computing Department. They have now become a resource for training faculty and students.

RESOURCE DILEMMAS

The second problem is that teaching such a course requires significant and sometimes redundant equipment. Lecture is an important but secondary element for a successful class. A LAN is obviously needed, but the problems exceed this requirement. The course is to be for LAN management, not LAN use. This requires invasive and potentially fatal system operations being performed by students. It is very difficult to use a production LAN for this course. Using a production LAN for the course would have demanded constant attention from the LAN Administrator, the second author. We will give some suggestions below for such an implementation, but that is not the option we chose. We set up an isolated, dedicated LAN in our regular PC lab for the use of the LAN course. One of the eight machines we segregated for the course was brought up as a file server for the duration of the course. After the course was over, the machines were integrated back into the general PC lab under the production file server. We had a natural environment for this special LAN lab because the eight machines were on an IBM Token-ring network that was connected to the production file server which is connected to the Ethernet campus-wide network. Both a Token-ring NIC (Network Interface Card) and an Ethernet NIC were put into the production file server to form an internal router. In this way, packets from the Token-ring network could get out to the campus network. The Novell Netware LAN operating system includes this router software. Figure 1 shows a schematic of the LAN used for the class.

The Token-ring connection is unplugged from the production server (disconnected from the Token-ring NIC) to isolate the campus network from the LAN class. The class file server is downed and the Token-ring connection replugged to restore the machines as a campus resource. We used Novell Netware version 3.11 (2) for the laboratory exercises. The vendor of the LAN operating system is not of great importance. Any reputable vendor's operating systems offers similar functionality that will allow the students to learn the basics of LAN management. The advantage of Novell is that they have a large market share (c. 60%) and they have aggressive educational discounts. If one does not use an isolated network for the class it is possible but dangerous to use a production server. This would involve segregating a class volume or directory subtree and giving supervisory rights only in that area. The problems with this are that

Figure 1: The Classroom LAN Topology



some supervisor tasks require access to the system directory and students get a false vision of what supervisory tasks are. We decided against such an implementation.

The separate file server approach to the LAN class requires an extra machine (that students cannot use as a workstation) and an extra license for the LAN operating system. These add to the cost of offering such a class. For Netware v3.11, the machine must be at least a 386DX PC-compatible. For our LAN class configuration, a 10-user license is required which is available for about $1000. Another option for small classes is the Computer-Based Training (CBT) offered by Novell which includes a 5-user license and all manuals. The Novell v3.11 System Manager and Advanced System Manager CBTs give 24-30 total hours of training at $595 each (retail) with a 40% discount for higher education (3).

Using the production server for the class allows you to use of all your current workstations for the class and does not require the expense of another operating system license. This option has very serious problems ,however, for a LAN manager class that are discussed in this paper. There is no need to use different protocols as we did (Token-ring and Ethernet) which requires an additional NIC for the internal router.

CURRICULUM ISSUES

The LAN management course is offered as an intensive one month winter session (the month of January) and in the regular academic semester. We use a paperback textbook Novell Netware 386: the Complete Reference by Tom Sheldon (4, see also 5) and a series of hands-on exercises developed by the first author of this paper. The textbook gives the students a fairly comprehensive reference for the Novell operating system and the exercises cover all common management tasks in a group project fashion.

Of the eight machines, seven are available as workstations to the students. We allowed three students per workstation to work as a group to a accomplish the class projects. This turned out to be too many students for the size of the room and from a group dynamics standpoint. We plan to limit the enrollment to two students per machine with an increase in the number of machines to ten workstations. Subjective evaluation of the group dynamics suggests that although three students are too many because of complexities in transfer of control (keyboard) and collaboration, two students to a machine may be superior to one student to a machine. With two students you have less of a problem with slow students and with random temporary misunderstandings (two heads are better than one).

The course is offered in radically different formats, the intensive vs. the regular semester, but this is not a major problem. The intensive session requires twelve sessions of three hours each at a rate of three days a week. The regular semester class is offered once a week as a three hour (three 50 minute sessions) class. Two extra class sessions are available in the regular semester and are used for special topics such as interoperability and specific applications. This allows easy mappings between the two course formats and enough time to complete a substantive project in one sitting. Each class consists of one hour lecture with two hours of supervised lab project. The syllabus is outlined in Figure 2 below.

The course does not presuppose user-oriented knowledge about LANs. The first class session starts out teaching user skills. The rational for teaching introductory supervisor tasks before installation is that the students will not appreciate the details of installation before they have some experience with the network operating system. The last two sessions on technical support and applications will sometimes not be offered in the intensive course depending on time constraints. In the two intensive sessions taught to date, there was time for both topics.

This course was planned as the follow-on to a three credit hour course on data communications using the textbook by Stallings (6). The students should, therefore, have the theoretical basics in hand. This one year course in data communications, split between theory and practice is seen as valuable in preparing Information Systems professionals.

Figure 3 shows a fragment of an exercise. The students need to set up an environment with users and directory

Figure 2: Class Syllabus for LAN Management

Class	Topics	Exercises
1	Introduction and Orientation	User skills
2	Startup Supervisor Tasks	Login and Directories
3	Intro Supervisor Tasks	Files, Utilities, Security, Commands
4	Intro Supervisor Tasks	Creating users
5	Intro Supervisor Tasks	Printing
6	Intermediate Supervisor Tasks	Login Scripts and Menus
7	Intermediate Supervisor Tasks	Backup and Accounting
8	Installation	Design task
9	Installation	Server and workstation install task
10	Advanced Supervisor Tasks	Advanced commands
11	Advanced Supervisor Tasks	Server console commands
12	Advanced Supervisor Tasks	Management issues and final project
13	Technical Support	Hardware concepts and tasks
14	Applications	Install mail and windows

Figure 3: Example Exercise Fragment -- Part 1: Set up your environment

1. Set up the following file structure and users.
   Replace "#" with your group number.
   This directory tree simulates your own volume.
   Items with an extension are files; all others are directories.

   sys:vol#
   users#
   joe# (grpa# and work group manager)
   eve#
   sally#
   ann# (grpb# and work group manager)
   tom#
   joan#
   public#
   edit.exe (copy from the DOS directory)
   data#
   texta#.txt (arbitrary contents in text files)
   secret#
   textb#.txt
   textc#.txt
2. **Map** drives to users# (home directories) and data#.
   Map a search drive to public#.

structure in order to do the later parts of the exercise which teach them about security and other management issues. There are 5 total parts in the exercise for the class session and Figure 3 shows Part 1.

All students are supervisor equivalents and the potential for system problems is high. For this reason, the root SUPERVISOR is un-passworded so that any student can go in and fix any errors without stopping the whole class or requiring the instructor to constantly handle errors. This is obviously not an option if one is using a production server for the class. It is also important to have the students create users and be required to periodically login as those users so that they can test their designs from a user perspective and not be fooled into thinking that everything is working because the supervisory rights are hiding a multitude of sins.

The most difficult topics to handle in the class are server installation and server console commands. The installation is difficult because the class is installing one server and 20 students have to watch with varying degrees of attentiveness to the process. It is usually impossible for students to be fully involved in a decision making process unless they have some responsibility for it or are doing it. This was considered the most unsuccessful portion of the course.

We are considering using a rotating schedule for the install task which has each group doing an install on different days. This would allow each group to do the task, but increases the logistic complexity of curriculum design significantly. The server console commands are another task that can only be done by one person at the file server machine. With Novell, there is a utility **Rconsole** which allows all groups to watch the process at their own stations, but they still are not *doing* the task.

A common aspect of these problems is that some supervisor tasks can only be done by one person since they set global parameters on the network. There is no way to completely escape this constraint. For example, there cannot be multiple system login scripts. One can evade this restriction by creating a system-style login script and then copying it to all one's group user login scripts to simulate a real system login script.

CONCLUSION

This paper presents a course design and discusses the logistics of offering a LAN management course for undergraduates. The course covers LAN design and performance, enterprise computing for organizations, and practical LAN administration skills. The practical implementation of such a course offers special problems because there are a large number of students administrating a system that is designed for only one supervisor. The course syllabus, example exercises, and lessons from experience were discussed.

This class was very popular with students. The demand exceeds our ability to offer seats in the course. This is due to two factors. First, students rightly perceive this as a class with potential for improving their job opportunities. Second, it appeals to students in an Information Systems curriculum as a systems-oriented class. Students do not have access to computer-based tools and platforms for this experience in managing (simulated) enterprise computing in many curricula. This is, of course, because it is difficult and expensive to offer such experiences.

...the goal is not just to get everything working correctly and teach students a software package, but to develop a laboratory where students can experiment with solving enterprise computing problems in a controlled environment.

In going through all this difficulty to offer such a course, it is important not to lose sight of the course goals. It is sometimes difficult to remember that the goal is not

just to get everything working correctly and teach students a software package, but to develop a laboratory where students can experiment with solving enterprise computing problems in a controlled environment. Design issues, theory of data communications, and organizational problem-solving can come alive for students in such an environment.

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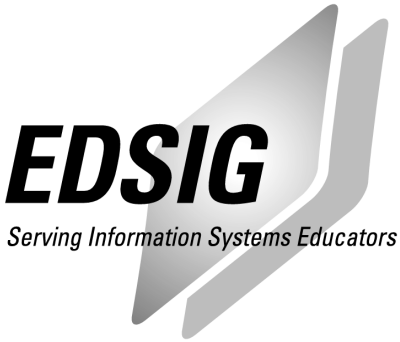

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ISSN 1055-3096