

Coping with Change: Future Proofing Networking Labs

Amy Wilson

Stefan Stasiewicz

Information Technology, School of Business Studies
Bay of Plenty Polytechnic
Tauranga, New Zealand
amy.wilson@boppoly.ac.nz

Teaching computer networking has always had its own set of challenges. The Information Communications Technology (ICT) students' need to perform administrative tasks in practical networking courses juxtaposes security issues for the institution's network. The policy is to teach networking in a lab separate from the main network.

Increased ICT student numbers and demand for networking data communications and computer hardware courses indicated it was time to re-evaluate the lab. Several options were considered with the criteria to minimise disruption to classrooms and programmes, while the chosen alternative was implemented. The other criteria were to bring best industry practice into computer education and meet Occupational Safety and Health requirements.

In planning, current research and discussion of lab layout was considered. Visits to other tertiary providers and industry input reinforced our choice for lab layout.

Positive outcomes in redesigning the lab have been observed in many areas including meeting other ad-hoc requests for its use. In order to future proof the lab several key factors were identified and planned for implementation.

Keywords

Lab layout, computer networks, computer education, practical education, future proofing

1. INTRODUCTION

As the need for practical computer courses grew at the Bay of Plenty Polytechnic, it was evident that some courses could not be run in ordinary computer labs. Many courses have special requirements, particularly those that were networking and hardware related. Generally this meant there was some component of network administration and/or computer dismantling for each group of students. With limited available classroom space and budget, the courses had to be presented within one physical classroom.

2. ORIGINAL LAB CONFIGURATION

Within the limitations of the classroom space, the room was set up as dual-purpose lab/theory classroom. The lab's dimensions were 13 metres by 9 metres, comprising three main sections.

These were:

- The wide window ledges on one side to the rear of the room, due to the unique arch in the building, were put to use as bench space for hardware courses - suitable for building/dismantling computers and setting up display machines.

- A lab work area for up to 20 computers was set up in the rear half of the room on ordinary writing desks and was used for networking and data communications. The network was wired with patch cables directly between hubs and computers with the cables running under benches and across the floor.

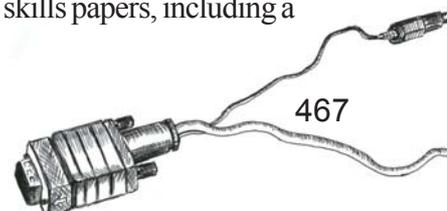
- The front half of the room was set up with 20 chairs and writing desks.

3. IMPETUS FOR CHANGE

The classroom/lab set up was becoming increasingly less viable because of the crowded working environment and the scramble of network cables and hubs around the lab, creating hazards.

In addition to needing to expand and change the layout of the lab to incorporate OSH regulations, there were other considerations including:

- The need to integrate networking, data communications and hardware skills papers, including a



number of papers being taught simultaneously due to the explosive growth of student numbers;

The change from term to semester basis. Course modules could be alternated in term structure, but the change to the semester structure meant there was a greater load as the courses modules would utilise the lab for the duration of the semester;

- The poor quality of the student learning experience, with situations occurring such as 20 students using six computers for a practical network administration course;

- Students' realistic expectation for up-to-date technology;

- The non structured cabling which meant that the lab did not emulate current workplace practice and technology and provided no provision to show students patch panels and switch racks and, further was difficult to reconfigure for different teaching situations;

- The outdated and poorly functioning data projector

As well as acquiring additional computers to give students more hands-on practical experience, it was obvious that the lab would need to be re-configured. Due to the lack of available classroom space in the Bongard Centre Campus of the Bay of Plenty Polytechnic, the only option was to remodel the existing lab. The teaching/planning team needed to acknowledge these restrictions and to identify realistic goals in order to create a new lab. The remodeling would need to incorporate best practice in industry and current and emerging technology. It was apparent that further research into networking/hardware lab layout was necessary.

4. RESEARCH

The research conducted included visits to and knowledge gained from local industry contacts, IT managers and networking specialists. Visits to other tertiary institutions assisted in defining the goals of the new lab. Articles on the Internet provided further opportunities for research. An article by Madison (2001) provided the concept of a "modular network", a grouping of client and server computers. An online discussion with Donald Joyce from Unitec (personal communication, November 11, 2001) included concepts for ordinary labs that could be integrated into the networking/hardware lab. The teaching/planning team also identified the need to

468 adapt the knowledge to the local situation.

5. PLANNING FOR CHANGE

After completing the research, specific goals were defined. The lab layout needed to incorporate:

- An area for computers which included an area for note taking.

- For the hardware courses, it was appropriate to recreate a workshop environment so that students had the space and the tools to build and test computers.

- Appropriate space for patch panels, PABX, racks of switches, demonstration computers and projectors.

- An infrastructure that allowed for current and emerging technologies.

Support from management was also crucial before change could occur, particularly in terms of the budget. The increased student demand for practical courses and the management involvement in the planning for the lab meant that support was provided to start the project.

Plans were formed. Discussions were held with OSH officials, building contractors and cabling contractors.

6. CURRENT LAB CONFIGURATION

During the Easter term break of 2002 the lab was totally reorganized providing structured network cabling and wide benches with trunking for data and power. For safety, power outlets were connected through RCD (Residual Current Device) circuits and an easily accessible main emergency cutoff switch. Positions exist for 40 stations each with 4 power outlets and two RJ45 jacks (configurable for data and/or phone).

The previous window ledge area is no longer available; instead benches run along either side of the room, providing space for 20 stations - mainly used by 10 computers - for building/dismantling in the hardware skills class.

A central bench runs down the middle of the room - 10 computers on each side, with the benches still providing enough space for students to take notes. Each pair of students would typically have 2 adja-

cent computers (eg a client and a server set up) during network classes.

A nearby office space of 4 metres by 3 metres was converted to a room that functions as a server room and also houses the patch panel and PABX.

7. NETWORKING LAB MODEL ADOPTED

Change to physical layout was only one component of future proofing. The other components were, the adoption of newer technology and the reviewing of lab procedures. A network lab model was adopted to streamline procedures for start of semester preparations and transitions to ensure students have working and tested computers.

The 30 computers used by students were purchased in groups of 10 - as budgets allowed. The 20 newest, with the highest specifications, are used for networking classes. The other, older machines are used for hardware skills. Computers within each of the 3 groups of 10 computers have identical hardware enabling the imaging process to be relatively easy. The use of imaging is crucial for the different operating systems to be installed for different courses and the ability to restore a system if the need should arise.

There are two setups for printers to provide students with the experience of LAN printing in an office situation. One printer, an HP LaserJet, has a Jetdirect card (Ethernet interface) and is connected to the LAN for setting up with print servers. Two HP DeskJets are on trolleys so they can be connected to any of the computers, as local printers and shared, as a network resource.

The patch panel, PABX, routers and ADSL connections provided for more practical exposure to remote access servers and virtual private networks. Further details of the hardware/technology used and teaching uses can be obtained from Table 1 in the Appendix.

The use of multi-partitions on hard disks and boot managers progressed to a combination of partitioning and exchangeable hard disk caddies and eventually, to exchangeable caddies only.

7.1 Benefits

Benefits of implementing the model

- Able to provide for the large number of different classes requiring use of the lab.

- Improvement of the management of the lab's resources.

- Improvement of security of student work (not sharing hard drives).

- Able to provide of one-off learning opportunities to students in all of our programmes.

8. THE FUTURE

Wireless networking hardware, (802.11g PCI adapters for each computer used in network class and wireless access points), were introduced in 2004 in line with the need to implement current technology and meet students' expectations for modern facilities and equipment. With a large investment in the current Category 5e infrastructure it is possible to extend its life from 100BaseT into 1000BaseT. This will require the move to purchase future replacement equipment with this mind (computers, network adapters, switches, routers etc).

A local Internet Service Provider has recently supplied, free of any charge, a wireless Internet link (and firewall) for the networking lab. This arrangement was mutually beneficial, as a location on the Bongard Centre Campus building was provided to them for a repeater and enabled improved coverage of outlying areas.

Other possibilities are being investigated and pursued for further industry involvement and sponsorship to assist in providing modern facilities and equipment. For example a local power company is considering an off site backup facility (communications, call centre) that can be quickly utilised in case of civil defense emergencies. In this case it is hoped that some form of mutually beneficial arrangement will be negotiated.

9. CONCLUSION

In the goal to accommodate change and allow for the future of any networking lab there are no specific rules to apply. When introducing lab changes local conditions and available budgets will greatly influence (or dictate) the optimum use and configuration of the available room space. It is prudent to adopt the latest technology in order to maximize its length of use and return on investment. In addition be aware of emerging and future technologies that will influence purchasing decisions. Combining this approach and creating procedural models assists fu-

Table 1: Timeline/Summary of Lab Changes

Year	Room Setup	LAN and Communications Technology/Hardware	Teaching Content	Classes
1998	Room Front 20 desks for theory Room Rear Rows of desk for 16 PCs (& wide window ledges)	10Mbps LAN - 10Base2 coaxial cable Two telephone extensions (Polytech PABX). Two modems (14.4Kbps). One printer (parallel port).	General Peer to Peer and Server Networks (Win 98, Novell 3.12). Dialup data communications.	NM200 NM210 HS200 DC100 HF100
1999-2001	Setup as above. PCs for students: 10 - Hardware skills 20 - Network/comms PC server for ghosting images.	10/100Mbps LAN - 10/100BaseT. Non structured cabling system used. (Cat 5 TP). Two 10Mbps hubs. Three telephone extensions (Polytech PABX). Four modems (28/33Kbps). Two printers (parallel port). Use of multiple partitions/boot managers for HDDs.	General Peer to Peer and Server Networks. (Win 98, Novell 5, Windows NT/2000, Linux). Dialup data communications. Remote Access Servers. Routing. (multihome Windows NT Servers). Terminal Services. Web, FTP Mail Servers.	NM200 NM210 IN210 HS200 DC200 DC100 HF100
2002-3	New lab layout/benches (2002). Positions for 40 stations each with 4 power outlets and two RJ45 jacks. PCs as above.	All 100BaseT NICs. Structured cabling system (Category 5e) Three 100 Mbps switches (full duplex). Three 10Mbps hubs. Separate 20-line PABX. Three telephone extensions (Polytech PABX). Ten 56Kbps modems. HP JetDirect printer – Ethernet interface. Cisco and Fresco router. Jetstream ADSL Line and ADSL modem/router. Forty swappable HDD caddies. Multiple partitions/boot managers.	General Peer to Peer and Server Networks. (Windows 2000/XP, Novell 6, Windows 2000 and 2003 Server, Linux) Full Duplex LANs using switches. Dialup data communications. Remote Access Servers. Routing. Terminal Services. Web, FTP Mail Servers. VPN networks. (Dialup to ADSL).	NM600 NM610 NM500 IN610 HS600 DC600 NE600 OS710 HF100 DC500 BCSS232 BCSS233
2004	As above.	IEEE 802.11g Wireless PCI Network Cards. (WAP and 128bit WEP security). Wireless Access Point/Router. Eighty disk caddies. No need for partition/boot management. Industry sponsored Wireless Internet connection.	Introduce wireless networks (WLAN). Ad-Hoc mode – wireless only networks. Infrastructure mode – joining wireless and cable based networks.	NM500 HS600 BCSS232 BCSS233 BCS6221 BCS6225 BCS6238
Future	Replace PCs. Air Conditioning.	With Category 5e cabling installed the option exists for future upgrade to 1000BaseT gigabit LAN. This would require replacing current network card, switches/routers. Further involvement of and sponsorship by local industry.	Use more modern/emerging technology for Data Communications and Networking classes.	Dependent on demand for ICT programmes

ture proofing and makes it possible to cope with change.

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