

Status of Wireless Networks in Educational Institutes in Auckland

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ABSTRACT

This research examines the status of wireless networks in seven educational institutes in Auckland, New Zealand, based on their plans for and implementation of wireless networks within the institutes, purpose of and perceived barriers for wireless networks. It also looks at what experiences the institutes had when deploying and running wireless networks, including benefits and issues encountered. The research compares the different institutes with each other and with institutes in Hong Kong (China), Victoria (Australia) and Norway. Data was gathered through interviews with employees in decision-making positions in major Auckland based institutes and through questionnaires sent out to overseas institutes.

Keywords

wireless, networks, educational, institutes.

1. INTRODUCTION

Wireless networking is becoming a popular substitute for wired networks, especially in dynamic environments. With wireless networking the need to lay wires and drill holes in the wall and other added expenses are circumvented. Although the benefits of wireless networking are many, businesses and home users have been slow in adopting it. However most tertiary institutes have acquired wireless to some extent (Moos, 2001).

Tertiary institutes have been using networks for a long time and were involved in introducing the long-range vast network known as the Internet (initially ARPAnet). Most tertiary institutes today use networks for running their business and as a teaching aid for their students. With the traditional wired networks, students are limited to classrooms and areas which connect to the network to access the information available from the institute and the Internet.

The main advantage of wireless networks is

that they allow users to access the network at any time from anywhere within an area covered by access points. With the big networks existing in tertiary institutes today, wireless seems to be a natural step to enhance the already existing networks. It allows students greater access without the expense of preparing new buildings or areas like computer laboratories and the laying of expensive wire cabling. A wireless network also provides greater flexibility for changing the network topology.

Arabasz and Pirani (2002) looked at the level of wireless networking in tertiary education in the United States of America (USA) and Canada. Their research was conducted in three stages: first an online survey of 391 EDUCAUSE member institutions, then in-depth telephone and on-site interviews at 17 of the institutes and finally case studies at six institutes to find what had worked and what had not worked in their wireless implementations.

Arabasz and Pirani showed that wireless LANs were increasingly being adopted in the USA and Canada. They found that half of the members of EDUCAUSE had implemented a wireless network, while another 42% were planning on implementing one. "The leading driver of wireless networks has been the desire to provide a greater degree of anywhere, any time network access to students". Other key drivers found were the needs to meet future computing needs and to improve wireless network access for staff. Generally the research showed that IT departments were the main advocates for wireless networks at tertiary institutes.

According to the EDUCAUSE report, wireless networking is not a substitute for wired networks, but it is a good solution for areas which



are expensive, impossible or impractical to cover. Wireless networks were found to supplement wired networks and tertiary institutes did not expect wireless to replace wired networks yet. Students were found to incorporate wireless networking easily both in their daily academic and social activities. Another big challenge for the tertiary institutes was to successfully introduce meaningful and beneficial use of wireless in the classroom curriculum. The institutes were starting to experience some success in this area, but the impacts are complex and the results are not known yet.

The EDUCAUSE research found that although laptop PCs were the most popular device for use on wireless networks, tertiary institutes were greatly increasing access for personal digital assistants (PDAs) and to a certain degree handheld PCs. These smaller devices were deemed likely to provide another layer of utility for wireless networks. The report found that security was the biggest concern for wireless networks, with “unauthorized access to information or unauthorized usurping of network resources” as two of the main problems. The technologies used for security (i.e. VPN, WEP) were found to be too costly, ineffective or inefficient. The report states that good solutions, such as Advanced Encryption Standard (AES) in VPNs and IEEE 802.1x/EAP will be available in one to two years. Another key issue is that wireless networks increase the need for support, particularly special types such as real time support in classrooms.

Institutes covered by the EDUCAUSE report have found implementing wireless networks challenging, complex and time-consuming due to many new factors and new information involved. Pilot implementations are recommended as a learning experience and using experienced wireless network contractors is considered beneficial. Another challenge mentioned in the report is the bandwidth limitations of IEEE 802.11b. Most of the institutions involved are planning new technology implementations. The report concludes that wireless networking is considered a success in higher education, that the majority of the institutes using it have found it to live up to or surpass their expectations, and that wireless networking is becoming a necessity in higher education, just like a wired network already is.

There are also a number of case studies con-

ducted in single institutions. Shirley, Pierson, Trytten, Rhoads and Court (2002) looked at how wireless laptops were introduced at the University of Oklahoma and evaluated how the institute was coping with the change, and what barriers were encountered. A similar analysis was performed at the University of Texas by Holmes and Schmidt (2002). Tang and Baker (2000) and Kotz and Essien (2002) investigated students’ usage patterns at Stanford University and Dartmouth College respectively. Gay and Hembrooke (2002) investigated how the introduction of wireless to the classroom affects the way students learn. Johnston (2003) reported research done at Swinburne University in Australia which found that the use of wireless had halved the cost of computer laboratories.

Today there are a multitude of technologies. When a tertiary institute plans to provide a particular service, careful consideration needs to be given to find out which technology will be the best long term investment. This paper will help give a view of what some other institutes have encountered with regards to wireless networks.

2. METHODOLOGY

The research used a qualitative approach to analyse the data gathered. It follows a case study design, mainly focusing on seven educational institutes in Auckland. The data was collected through a literature review, interviews, some on-site observations of the institutes and their networks, and through e-mailing a questionnaire to tertiary institutes. The interviews were conducted with the head of the IT services department at the institute or someone in a similar position, often supported by a technician. To be able to compare the data gathered in Auckland with institutes in other cities, a questionnaire addressing the same questions as the interview was sent to 50 tertiary institutes around the world, requesting information about the institute’s existing wireless networks and plans for future wireless networks. Three institutes in Hong Kong (China), two in Victoria (Australia) and seven in Norway responded with data of such a quality that it was valid for this research.

3. RESULTS

This section summarizes and discusses the data gathered from the 19 institutes.

3.1 Purpose of providing a wireless network

It was clear from the questionnaires and the interviews that the main reason for implementing wireless was to give increased access to the network, mainly for students. However the institutes had not seen a great uptake of the new technology amongst the students, except where the institute provided wireless enabled laptops (e.g. in the library) or expected the students to provide wireless capable laptops. Some of the interviewees believed that students do not find the services provided worth the expense of buying a laptop. The greater mobility or flexibility that the wireless network gave was another important factor to many of the institutes. Most of them were providing or planning to provide wireless access in outdoor areas and in cafeterias for the students to be able to work there.

Testing the technology was another major reason for implementing wireless, the institutes wanted to see how it worked. But they also needed to assess what was available and plan how they would manage wireless if they implemented it. This brought up issues such as whether the wireless network would be treated as a part of the intranet or of the external network (i.e. Internet), what security measures they would implement in regards to authentication and encryption, and what standard to go for. After initial testing, the institutes often ran a small pilot implementation in the library or similar area.

For some of the institutes the purpose of providing wireless in the library was a way of seeding the idea to the students. They bought in laptops which they made available for lending, hoping this would make the benefits of having one's own laptop apparent to the students. The same institutes often provided wireless cards for a limited group of students for the same reason. Some of the institutes were providing wireless due to demand by users, this was usually staff, but some reported that students wanted it as well. One interviewee also mentioned that although there was limited demand now, they expected a fast increase as laptop prices were going down and most laptops had wireless capabilities built in.

3.2 Barriers to implementing a wireless network

The most common issue with installing wireless was security. The interviewees gave the impression that most of the time used developing a wireless network was spent on setting up, configuring and testing security schemes, also getting it to work with the one already implemented at the institute. Of the seven institutes which were contacted in Auckland, there were only two which mentioned security as an issue, while in Norway four out of the six responding institutes mentioned that security was an issue. This was the single most mentioned factor from Norway which gives an impression of them being more concerned about intruders on their network or more aware of the need for security.

The next most common issue was cost or acquiring funding, which was mentioned by about one third of the institutes. Probably related to this was the problem of getting administrative buy-in; this was mentioned by one Auckland institute and two of the three Hong Kong institutes. Another concern expressed by four of the six Auckland institutes was the lack of demand for a wireless network. Two institutes mentioned that they had held back with wireless because it was unclear whether 802.11a or g would be the next generation after 802.11b and they did not want to invest a lot on the wrong technology.

Concerns surrounding staffing were mentioned by three institutes, they felt that one of their issues for implementing a wireless network was lack of staff resources to do the work and lack of staffing to support the students if the new technology became popular. This was mentioned by one institute in each geographical area. Other issues mentioned were the existence of ad-hoc networks installed by staff prior to the institute wide installation and that the technology was so new that there was no technical help to be had.

3.3 Stage of the wireless implementation

One of the Auckland institutes had a complete wireless network covering the entire populated part of campus and was considering going to 802.11g over the next two years depending on whether there was a need for it. All the other Auckland institutes were in the early stages of

planning or installing a wireless network. Institutes in Victoria were at a similar stage to the New Zealand institutes. All the Hong Kong institutes had fairly large wireless networks which they were either expanding to more areas or maintaining at their current levels (i.e. implementing in new buildings). The Norwegian institutes were found to have established implementations which were running well and growing fast. All five institutes which mentioned what areas they covered with wireless, named library, canteen and student areas (e.g. student rest areas, reading rooms, break-areas). Other areas mentioned were auditoriums, group rooms and meeting rooms. The two institutes which did not mention what areas they covered gave other information. One had over 100 access points, which is the biggest implementation included in this study, while the other institute had covered approximately 85% of its campus with 30 access points.

3.4 Number of wireless network users

At one Auckland institute all 1400 students were required to have a wireless enabled notebook. The other Australasian institutes indicated that there were very few users. At one Hong Kong institute 120 out of about 2,200 students had signed up for wireless access. Another Hong Kong institute estimated that they had about 2,000 wireless users out of a student population of 20,000 students. In Norway there were big differences among the number of students using wireless at the institutes: three had around 1% users, while one had 10% and another 19%. The two institutes which had a high number of users both had classes where the students were required to have wireless laptops. In addition there were two institutes which mentioned that between 1% and 2% of their students used the wireless network every day.

3.5 Who maintains the wireless networks and supports the users

In 15 of the 19 institutes the central information technology department maintained the wireless infrastructure. Only two institutes (both in Auckland) had wireless networks run by the individual departments or faculties, while two (one in Hong Kong and one in Norway) ran a combined effort between the central IT department and

faculty IT support staff. Five of the respondents said that they would not be supporting their wireless users, while ten said that their IT department would be providing support. Institutes that would be providing support did so directly through the department, their helpdesk or student helpers. One institute responded that each faculty would support their own users and another responded that support would be outsourced to an external company situated on campus.

3.6 Devices used on the wireless networks

The institutes with advanced wireless networks supported a broader range of devices. In New Zealand the institutes mainly aimed at providing access for notebooks, although most of them mentioned that some PDAs among the staff might be using wireless if the PDAs supported the necessary security schemes. In Australia they did not specify the type of device any further than what capabilities it had. One institute mentioned that any device supporting 802.11a/b/g could connect to their wireless network, while another institute said any device supporting SSID could connect. All the Hong Kong institutes mentioned that they supported notebooks and PDAs and most of them also mentioned smartphones. One even mentioned tablet PCs and generally that any device using 802.11b or g could be using their wireless network. In Norway three of the institutes said that they supported notebooks and two said that they supported any device supporting 802.11b.

3.7 Protocols and security used on the wireless network

There was a wide variety of protocols and technologies used on the wireless networks, but when looking at the standard for the wireless protocol all the institutes mentioned some form of 802.11. All but one of the institutes were using 802.11b as their wireless standard, and the remaining one (in Hong Kong) had implemented 802.11g directly. The institutes which were planning ahead all mentioned that they would be going for 802.11g if or when they upgraded. Several of the other institutes were already supporting 802.11g in parts of their campuses. As for security, VPN was used by nine institutes, WEP was used by five institutes, 802.1x with some

form of extensible authentication protocol (EAP, LEAP, PEAP) was used by four institutes, and MAC filtering was used by two institutes. Three institutes mentioned IPsec: the one in Norway currently used it as a backup solution, while the one in Auckland and the one in Hong Kong were moving to it within a year.

3.8 Applications provided over the wireless network

When asked what applications and services the institutes provided over their wireless network, the most common answer was ‘the same as their normal network’, meaning Internet and intranet access. But in some cases the wireless networks were implemented outside the firewall and services were provided through web-interfaces. When it came to printing, most of the institutes felt this would be difficult due to the need to find the geographical position of the user so what they printed came out close to them, although quite a few mentioned that a “technology savvy” user could enter the name of the printer and get it working. Printing was discouraged in five of the ten institutes which commented on printing from wireless. Generally the Auckland institutes expected to provide students with access to the Internet and to printers. Six of the institutes would be providing access to the intranet at the institute. The other institute would be providing access to necessary services through http (e.g. mail, home drive, printing, etc).

3.9 Equipment provided by the institutes

Only one of the respondents (in Auckland) required all their students to have wireless capable notebooks. Another Auckland-based institute had previously required students to have wireless capable equipment for some of their classes, but they now incorporated an equipment charge in the fees. Three of the institutes provided some staff with notebooks. Three of the institutes had wireless cards or notebooks for the students to borrow. However, apart from the institute which incorporated an equipment charge in the fees, the institutes expected the students to acquire their own notebooks or wireless cards. The lending service was only for a few and was usually part of a pilot program to show students what wireless could do. In six cases the wireless network was

implemented at the institutes for use by students, while nine supported staff as well and one only supported staff.

3.10 Perceived benefits

Flexibility and mobility were seen as benefits by 14 of the 19 institutes. The Auckland institutes did not think a wireless network would reduce the need for wired computer labs whereas eight overseas institutes did. Five institutes believed that wireless networks would reduce the cost of providing computer access – one of them specifically mentioned “less cabling”. Perceived benefits for students included “access during class” and “easier to do group work”. One Auckland institute thought that having a wireless network was important for “image”.

3.11 Implementation issues

The greatest issue that had been encountered or was anticipated was how the network would react to a heavy load. Another main challenge mentioned by the respondents was the lack of resources in the IT department to plan and implement a wireless network. This is probably related to barriers mentioned earlier such as the cost/lack of funding for wireless networks. Other issues raised were: ease of setup for users, holes in the coverage, short battery life of laptops, difficulty getting Pocket PC (the operating system) to work with PAP, 802.1x supplicant problem, finding a non-broadcast SSID, and WLAN cards not supporting European channels. Four of the institutes, one in Auckland and three in Norway, had not encountered any issues while implementing their wireless network.

3.12 Future plans for the wireless network

Institutes were asked “what are your plans for expanding your wireless network?” The general response from the New Zealand institutes was that they would respond to demand. A few of them had plans to increase their coverage a little, mainly aiming for outdoor areas, cafés and libraries. The Australian institutes had no plans to expand their networks. The Hong Kong institutes were doing minor expansions into public areas or connections to community resources. One Hong Kong institute also mentioned that they were maintaining the present level of wireless

coverage, so they would be installing it in all new buildings. In Norway four of the institutes were aiming at increasing coverage; areas mentioned included public areas, auditoriums and offices. Two of the Norwegian institutes were aiming at increasing the use of their guest accounts and at technological advances such as testing 802.11i with VPNs.

4. CONCLUSION

In Auckland two institutes had complete wireless network implementations. The remaining institutes were providing some wireless coverage, usually through pilot projects. All of the institutes except one were planning on increasing the wireless coverage on campus. The main reason for the institutes to provide wireless networks was to increase access to the campus network for students. Other reasons given were increasing access for staff, testing the wireless technology, meeting demand, and promoting the use of laptops at the institute.

The main barriers to implementing a wireless network were lack of demand from the users, cost, security, and waiting for wireless standards to settle. The institutes had experienced few issues with their wireless implementations; this was probably due to the early stage of their wireless implementations. The two institutes with complete implementations had found that the performance of the networks under heavy loads was their main issue. Other institutes mentioned lack of use and interference from ad hoc networks put up by staff as their main issues.

Compared to the three Australian institutes, Auckland institutes were a little ahead with their pilot projects and planning of their wireless networks. The institutes in Hong Kong and Norway had more advanced wireless networks than those in Auckland, with bigger implementations, more access points and greater percentage of coverage. They also had more users of their networks.

Comparison with the EDUCAUSE report (see section 1 above) shows many areas of similarity between institutes in Auckland, Australia, Canada, Hong Kong, Norway and the USA. Further research into the same topics in two to four years is recommended. This could also include educational benefits from implementation of wireless networks in tertiary institutes. Together with this research, such an analysis would give useful

information in connection with later planning and implementing upgraded wireless networks in educational institutes.

GLOSSARY

802.11a,b,g	Standards for communicating with wireless networks
EAP	Extensible Authentication Protocol
EDUCAUSE	A non-profit association whose mission is to advance higher education by promoting the intelligent use of IT
IPSec	Internet Protocol Security Protocol
IT	Information Technology
LEAP	Lightweight Extensible Authentication Protocol
MAC	Media Access Control
PAP	Password Authentication Protocol
PC	Personal Computer
PDA	Personal Digital Assistant
PEAP	Protected Extensible Authentication Protocol
SSID	Service Set Identifier
VPN	Virtual Private Networks
WEP	Wired Equivalent Privacy
WLAN	Wireless Local Area Network

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