



Wireless Networks in the Library

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1 Introduction

Tampere University of Technology is the second largest university of technology in Finland, with a good reputation strong in research of communication technology and mobile communications.

Tampere University of Technology library has had a rapidly growing collection of networked information sources. For example there are over 3000 full-text journals available through the internet. Library started a project for wireless networks to test them in the use of students. Another perspective was to give to students a possibility to use both printed and WWW-based information sources together

2 Wireless networks

2.1 Why wireless network?

Library is open space where people move from one place to another, and use different information sources like magazines, books and networked material. If one wants to access all of them one has to have computer. And because one moves around in the library a lot, it is natural to have computer that can be carried with. That's why wireless network and a laptop computer is the best solution for places like libraries.

Different kinds of wireless data transfer technologies

- **Mobile communication networks (GSM, NMT, GPRS, etc.)**

These technologies have can be used to transfer data, and especially GSM can be used in Finland almost anywhere. But the biggest problem is data transfer rate, because normally GSM supports only 9600 kps data transfers, which is insufficient for effective network use. And GSM is quite expensive as an data transfer technology.

- **Infrared links**

Infrared links have quite high data transfer rate, but they have very limited range. Normal infrared links, that are used in office equipment have about one meter range, and they have to have direct line-of-sight so any wall will block the transmission.

- **RF technology**

Many wireless networks use radio frequencies to transfer data. It is more cost effective than for example GSM network and has much bigger range than infrared links.

There are two main ways to use RF-wireless network. First one is to use peer-to-peer technology, which means, that network interface cards communicate directly with each other. Second possibility is to use access point where network interface card roam to connect to network. Because radio frequencies are very strictly controlled due



to Finnish law, range of this kind of network can only be couple of hundred meters per access point.

This kind of wireless network is compatible with existing Internet, so when network is up and running one can only tell that it is wireless, because there is no wire to connect it to network. Otherwise it works just like wired network.

- **Wireless 11Mb networks are IEEE802.11b compatible.**

Abstract of IEEE802.11.b standard [1]: Changes and additions to IEEE Std 802.11, 1999 Edition are provided to support the higher rate physical layer (PHY) for operation in the 2.4 GHz band.

This means that network components like network interface cards can be used in any wireless network.

3 Technology used at Tampere University of Technology

3.1 Access points

Our wireless network topology is infrastructural, which means that all network traffic goes through access points. Our two access points are Wavelans (nowadays Orinoco) AP-1000 access points. We use Orinoco access point manager to manage our access points. In both of our access points there is one wireless network interface card and range extender antenna. Not just any computer can connect to access point, because access is restricted to specific network interface cards, which are identified with their MAC-addresses. Access points are connected to 100Mb Ethernet-network with twisted pair.

3.2 Network interface cards

We have two kinds of network interface cards. First ones that we purchased were Wavelan TURBO 11Mb Silver card. Two of these are in access point, and the others are used in laptops, all our loanable laptops use Wavelan cards. Silver card uses 64-bit key to encrypt network traffic. This encryption and the fact that joining the network is restricted makes this network quite safe.

Second network interface card that we use is Nokia C111 card. Nokia Card uses 128-bit encryption, so it is even safer than Wavelan card. Nokia card also has connectors for external antenna, and place for a smart card, which could be used to store profiles and WEP-keys.

Network is broadcasted on 2.422GHz frequency, and communication speed is 11Mb/s.

3.3 Laptops

We use two kinds of laptops.

Compaq 1500 series laptops with

- 64Mb RAM
- 4G hard disk

- 400MHz Intel Celeron processor.
- external Mouse
- power cord
- wireless network interface card

Compaq 1750 series laptops with

- 64Mb RAM
- 6.54G hard disk
- 333MHz Intel PentiumII processor

Operating systems and programs:

- Windows NT4.0 operating system with service pack 5/6a
- Netscape Communicator 4.7x
- Microsoft Internet explorer 5.x
- Microsoft Office97
- SSH Secure Shell client
- Microsoft Visual studio 6.0 Pro
- Adobe Acrobat 4
- Real Player
- WS-ftp
- F-secure anti-virus
- Ghostscript/Ghostview.

4 Wireless Networking project in Tampere University of Technology Library

In the year 1999 we started a Wireless network project in Tampere University of Technology Library. First we purchased 17 laptop computers 2 access points, and 12 wireless network interface cards. Later we purchased 5 more network interface cards. After installation of operating systems and programs, we started testing the environment. At first we used only one access point and couple of laptops. After successful testing period we tried to find optimal locations for our two access points. After couple of tests we found location, in which access points cover almost whole library. Because of book shelves and other obstacles like walls and staircases we still have couple of small areas in which signal is too weak to maintain network connection.

After testing period it was possible to borrow laptops. There are in total 7 laptops that can be borrowed. We had also a promotional campaign so that our customers would know about this new service. We used several different ways to promote, like Usenet newsgroups, school internal bulletins and student unions newspaper. Especially students started to borrow laptops quite soon. Library staff also uses laptops with wireless network in several occasions. Some statistics about loans and results of user questionnaire will be presented in the next paragraph



5 User experiences

User response was very positive. Main advantages were that they could do their studies in more peaceful place than computer lab and they could move around in the library where they needed. Students could choose working place which best suits their needs. They were forced to go computer laboratories, which many students considered too disturbing. Most students thought that quality of the network was good or at least sufficient though some gaps did exist in the library. Altogether students were satisfied with the project and hoped that the area should be widened outside of the library

Staff use pattern was quite similar to the one of students. Best advantages were independence of the location and still having connection to the network. Interesting use was building a mobile computer classroom with laptops for small courses.

References

- [1] IEEE 802.11b standard <http://ieeexplore.ieee.org/>

