

A Low-cost Heterogeneous Computer Network

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Abstract

A low-cost computer network where users can have access to facilities under two operating systems simultaneously is proposed. The multi-user network is implemented with the available resources in the laboratories, the only running cost being telephone charges for the dial-up connection with LEARN for e-mail services. Two servers, one under Windows NT and the other, Linux operating system, host the network. The former is used as the primary domain of the students and also for file storage and web page hosting while the latter is mainly used for e-mail facilities to all the staff members in the university.

Introduction

A computer network offering facilities such as file backup, resource sharing and e-mail services under several operating systems would be of immense assistance to both students and staff members [Topol, 1992]. Due to limited financial resources available to purchase new equipment, a method has been explored to make the maximum usage of the present resources to offer the services mentioned above efficiently. Since, the primary use of this network is e-mail services and data storage, the bandwidth possible over the connections and the speed of data transfer between the servers and the nodes are not taken into account [Berket et al., 1997].

At present, the staff strength of the university at Belihuloya is around a hundred (100) and the total number of students is about a thousand (1000). The Center for Computer Studies (CCS), with its two laboratories, offers lectures and practical sessions in computer applications for students in the faculties of Social Sciences & Languages and Management Studies.

Resources Available

1. Computers for the use of university staff and students :
 - Intel 486 and Pentium machinesThese computers consist of 16 MB RAM and ample hard disk space
2. Computers to be used as servers:
 - A Pentium(II) with 64 MB RAM, 4.3 GB hard disk and modem
 - A Pentium with 32 MB RAM and 2.1 GB hard disk
3. Network cards, cables and other peripheral devices are available to connect all of the above computers together.
4. Laser, Inkjet and dot matrix printers

Network Setup

Table 1 illustrates the disk space requirements for the staff members and students:

Number of staff members = 100

Number of students = 200 (network services are offered only to 3rd year students)

Table 1: Disk space requirements for staff and students

User Category		Disk usage by one user	Disk space required
Staff	Minimum	7 MB	7x100 = 700 MB
	Maximum	10 MB	10x100 = 1 GB
Students	Minimum	3 MB	3x200 = 600 MB
	Maximum	5 MB	5x200 = 1 GB

Therefore, the total minimum and maximum disk space requirement for the users are around 1.3 GB and 2.0 GB respectively.

The two computers that can be used as servers are allocated for the staff and students as follows:

a). Pentium(II) machine:

The hard disk is partitioned into two, one with Windows 98 (1.3 GB) and the other (3 GB) with Linux. The latter partition is used as the e-mail server and data storage for both staff and students (3rd Year) of the two faculties.

b). Pentium machine:

This computer, running under Windows NT, acts as a storage device and also as a print server for both staff and students.

Network Configuration

The network is configured to accommodate any future expansion of the services. A Class C addressing scheme is used for the Linux server and the Windows clients who are dynamically assigned an IP address through the Dynamic Host Configuration Protocol (DHCP) [Comer et al., 1991]. The addresses assigned are as follows:

Network address: 192.168.10.0
Host address : 192.168.1
Domain : belihul.sab.ac.lk
Subnet Mask : 255.255.255.0
DHCP addressing range: 192.168.10.5 - 192.168.10.100

The clients could *telnet* to the server and use e-mail services over the TCP/IP [LeBond et al., 1990]. Also, the users are allowed to transfer their files through *ftp*. The following steps have also been taken to maximize the network security [Hacking Information Page, 2000].

1. Login for 'root' allowed only from the console.
2. Only local users can use *telnet* and *ftp*.
3. Machine hardware and operating system identifications are removed from the login banner.
4. *Finger* daemon is disabled for users.

According to Table 2, the advantage of this option is that the discounted period for the telephone charges has been made use of to connect with LEARN. Also, e-mail services can be used 24 hours a day including weekends and university holidays. In the event of a hard disk crash on a Friday evening, however, the services would be unavailable until Monday afternoon.

Option 2: The server is switched only on working days (Monday - Friday)

Table 3: Connecting times during working hours

Connecting Times of the Day	
Minimum	Maximum
8.00 - 8.05	8.00 - 8.15
12.30 - 12.35	12.30 - 12.45
15.30 - 15.35	15.30 - 15.45

This option would facilitate reduced electricity and maintenance costs. The main disadvantage of this method is the high cost of telephone bills since the connecting times are during peak hours as shown in Table 3. In addition, e-mail facilities cannot be used on weekends and holidays.

Cost Estimation:-

a) Connectivity Charges

As highlighted in Table 4, option 1 accounts for the lowest cost for telephone charges although the server is switched on at all times. These figures are calculated according to telecommunication rates as of 16th February 2000 [SLT Telephone Directory, 2000].

Table 4: Cost estimation for the dial-up connection

Options	Cost per month (Rs.)		
	Minimum	Maximum	Average
Option 1	208.32	624.96	416.64
Option 2	550.00	1650.00	1100.00

b). Capital Charges

Table 5: Cost estimation for Liner bus topology network

Item	Price pre Item	Quantity	Total Price
BNC Cable	Rs. 110 m	25	2750
BNC Connector	Rs. 75	20	1500
T Connector	Rs. 55	20	1100
Cost of Linux CD			500
Total Cost for the Network			5850

Conclusions and Recommendations

From the above facts, it can be seen that, with regard to telephone charges, the first option would be the best for this network with e-mail services. However, it is important to note that this option carries additional hidden costs such as electricity charges and maintenance costs. The second option does not carry any additional costs since the server is used only on working hours with facilities already provided by LEARN are used as buffer storage. Also, with this option, immediate remedial measures could be undertaken in the event of a possible server or hard disk crash. Therefore, it is evident that a heterogeneous computer network under the second option for the dial-up connection is sufficient for the efficient use of the services offered.

Additional peripheral devices are needed to give the network services to the whole campus including Department of Surveying Sciences, administration buildings, VC's office and Dean's offices. Also, it is imperative that a backup facility be integrated to the system to store user files at the end of each day.

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