Department of ICT
Network upgrades

Introduction

This document is intended to fuel further discussion about the ICT investments in our school. It contains information regarding many of the avenues that are open to us as we seek to develop our ICT provision for the future. References to BECTA (British Educational Communication and Technology agency) , are from their publication 'Connecting Schools, Networking People 2002' . When considering an investment in our ICT facilities it would be beneficial to have an overall and stated set of objectives that we can use as a framework to guide further development. The following are suggestions and are not meant to be prescriptive.

What should we expect from a network?

- The technology must be transparent to the user.
- The user's productivity must be enhanced by the technology.
- Use of the technology should be a pleasurable and rewarding experience.
- The user should have a roaming profile.
- Data must be easily transferable between school and home
- Use of Internet facilities should be a seamless experience.
- The network must be secure both from internal and external threats.
- It should require a minimum of technician intervention.
- It should enable the NGfl in our school by: (according to BECTA)
  - connecting people by electronic mail
  - providing access to the NGfl and the World Wide Web.
  - helping to reduce bureaucracy by combining administrative and curriculum functions across the school
  - sharing data, hardware (such as printers) and application software.
  - simplifying ICT management by, for instance, enabling files to be backed up centrally and the system to be managed remotely.

- It should not require the injection of such levels of capital as to be detrimental to the functioning or development of other parts of the curriculum. (This point rules out the use of 'Managed Services' and remote management at the LEA level as recommended by BECTA as a possible solution. We are therefore looking at an in-house managed solution.)

What constitutes a network?

1) **Hardware,** client machines, servers, printers etc. and the necessary infrastructure to connect them.
2) **Software,** this will consist of the operating system that defines the look and feel and basic functions of a computer system , and application software that adds specific functionality. BECTA include the following types of software in their recommendations to schools
    a) word processor
    b) spreadsheet
    c) database package
    d) graphics package
    e) web browser
    f) web content generator

It is significant that only generic application types are mentioned by BECTA and there are no recommendations for adherence to any proprietary standards. If a software and hardware solution can meet the requirements stated above then it must be worthy of consideration.

The total cost of ownership
'The concept of total cost of ownership (TCO) of ICT relates to the entirety of costs incurred through acquiring, deploying and using ICT equipment and services' (BECTA 2002) . Although not a new concept, TCO is becoming more important as ICT costs spiral both in industry and in education, largely by becoming locked into the upgrade cycle perpetuated by large corporations intent on maintaining profits. Breaking free of the upgrade cycle is one way to keep the TCO within manageable limits. The following is a list of factors that contribute to TCO:
- software

- installation
- network management activities
- technical support
- internet access and telecommunications
- servers and other network infrastructure
- training
  Indirect costs in an educational context include:
- the cost of downtime and its impact on the confidence and motivation of teachers and pupils
- the cost of using teachers in the classroom to provide low-level technical support
- the cost in terms of the perceived facilities to outside influences

Studies from the commercial sector state that the TCO of one computer can be as high as £5000 (The Gartner Group).

Schools must strive to drive down the TCO in any way that they can. Here are some suggestions:
- exploit economies of scale
- source competitive pricing of hardware (many school suppliers of ICT equipment charge more than high street prices which are already over-priced)
- seek to implement ICT solutions that require the minimum of technician support
- plan strategically the implementation of any solution
- break the upgrade cycle
- consider all solutions in a fair and unbiased way
- strive for consistency of technology

The position at our school

In the past, the ICT network at our school has been developed in a piece-meal fashion as and when any finance has become available. This development has usually involved buying equipment on a tight budget and has resulted in a heterogeneous and unequal distribution of hardware that requires constant maintenance and technician support. Most of our workstations are incapable of running modern operating systems at a speed that would not frustrate the user and in some cases would probably not be capable of running the necessary applications should the operating system function. The present situation, with regard to

the user, is now becoming intolerable and is a major handicap to the inclusion of ICT throughout the curriculum and is a combination of the use of this legacy hardware with an operating system and applications that are out of date and that have never been up to their intended purpose anyway. Evidently something needs to be done which will necessitate the injection of not insubstantial funding. However, things are not as bleak as they may seem from the above. We now have a network infrastructure (thanks to our Network manager) that is capable of sustaining development into the foreseeable future.

Present facilities (140 clients)

Software.   Client operating system is Windows 95
                       Network operating system is Novell Netware
        4.2
                       Office suite is MS Office 95 or 97 (25 licenses)

Hardware.   Client machines range from P100's to P400's
with   minimum of 32Mb. RAM
                       Servers are low end single or dual Pentiums
with   adequate RAM and hard disk space for file
servers.

Infrastructure.   The network backbone is 100M/bit and client
                       connections are either 100M/bit or 10M/bit

Upgrade options (costs are approximate but allow comparison of solutions)

The following suggestions should be considered in the light of the guidelines above.

1/   As mentioned before the network infrastructure gives us a head start when it comes to upgrade options. Although still adequate for its intended purpose it would be desirable to speed up network traffic by upgrading the backbone to 1000M/bit access and making sure that all clients have 100M/bit access to the backbone. This section is a necessity.

PD has included this upgrade in his proposal and costs including client upgrade to 100M/bit access are:

cost   *£6000*

2/   Software choice is where a considerable saving may be made but is the area where the lowest cost choice may also be the bravest. The following options will satisfy our guidelines:

- All machines run Windows 2000 and MS Office 97

cost   *£22050*

PD's solution would only result in 35 machines running this combination and the rest would see no change. This solution would also firmly lock us into the upgrade cycle. Although PD's solution is viable, in order to fulfill all our guidelines we would have to commit ourselves to this software solution throughout the school, with the associated extra costs. Some of our present Windows programs may not function properly with Windows 2000 and they will also need updating if we wish to continue their use. Although the extent of this problem is not yet known and indeed may not exist at all! I must stress that Windows 2000 is a sound operating system and would serve us well. However Microsoft have already announced the date at which they will cease to support the product which suggests further upgrades!

- All machines run Red Hat Linux and Staroffice 5.2 or OpenOffice or Staroffice 6 (Version 6 will incur costs as yet unknown).

cost   *£ Free*

This is the brave choice and is not without its detractors. It will fulfill all our guidelines and indeed it is now becoming the solution of choice in many Universities. The main criticism is usually the fact that it is not Microsoft, and are we going to disadvantage our pupils by not doing what everyone else does? The simple answer is no! ICT skills are not proprietary and are freely transferable amongst all the software platforms that exist today. This solution will also provide seamless transfer of data from home to school and vice versa, something the Office 97 solution will not.

There will be no further software costs incurred by the school as all future upgrades are free as is all application software. If there are indispensable Windows programs that we simply cannot do without then the solutions are as follows.

1. Run the Windows program on Linux using Wine
2. Use virtual machine technology to run Windows as a guest operating system (Win4Lin, VMware).
3. Integrate a Linux solution into our present system where the user has a choice of operating system. (see later)

- Another software solution. There are no other free operating systems that could rival commercial products. Any other commercial product would incur greater costs than those outlined above.

3/ Network operating system choices are:
- Novell Netware 6.0

cost **£4650**

- Red Hat Linux

cost **£ Free**

This Linux solution is an industry standard for Internet service providers. Linux is a fully fledged, mature and secure network operating system. Using the Samba protocol it can file serve for Windows client machines, meaning that if nothing else changed on our network we could upgrade the server operating system for free.

4/ Hardware upgrades depend on the chosen software solution.
- If we invest in a Windows 2000 solution then the hardware costs for the clients would be
  Phase one (PD's plan) **£16100**
  Phase two (rest of clients) **£48300**
- If Linux is chosen and along with this a Linux terminal server system then we would be able to utilise the present client machines as terminals. (see later) This solution would require the purchase of 17" monitors to

replace the small ones we presently have.

<p align="center">Phase one (room 21)   *£3850*</p>
<p align="center">Phase two (rest of clients) *£11550*</p>

- Server hardware costs will be about the same irrespective of the chosen solution.

<p align="center">*£4500*</p>

5/   A terminal server solution is one where all the programs are run on the servers and the client machines act as terminals which display the output from those programs. Consequently the clients need very little of their own processing power and only enough memory to run the graphical display. Because this solution relies heavily on graphical output it is essential that large, high resolution monitors are used. By choosing this route therefore, we would be able to re-use our legacy hardware and keep TCO under control. These terminals require almost no technician support and if hard drives and all moving parts are removed could last in use up to an estimated 300 years, breaking the upgrade cycle for good. Support is centred on administration at the servers and in practice is rarely required once the system is set up. There are several solutions for terminal servers and they are now becoming more popular in industry because of the reduction in TCO they offer. (it is only the recent advances in computing power that has allowed these sort of systems to become viable) . There are proprietary solutions such as Windows terminal server and Unix installations, but they all incur considerable software costs. The Linux solution is free.

Realistic courses of action and their costs

Model	Cost(£)
Windows 2000 solution as proposed by PD (room 21 only)	35677
Upgrade to Windows 2000 solution (to rest of school)	66150
Total cost of lock into proprietary solution.	101827
Linux terminal server solution (upgrade monitors to room 21 only)	14350
Linux terminal server solution all monitors upgraded	25900

Model	Cost(£)
It would be possible to integrate a Linux terminal server solution into our present system so that we do not need to lose any windows functionality. The user would then choose which server to log on to.	Same as above Linux solutions

Endnote

I have not included a Linux solution merely through some perverse hatred of Microsoft. It is here because it is a truly viable alternative. This has not always been the case, and not too long ago it would not have been possible to consider Linux. I do not advocate Linux as being any better than proprietary software, but do so because it is no worse and it is free.

References:

- Connecting Schools, Networking People 2002 (BECTA)
- Various articles in trade journals (IT week, Computing)
- Linux Terminal Server Project (www.ltsp.org)