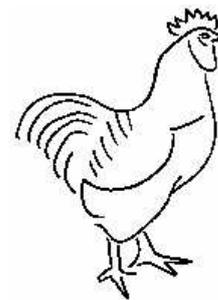


CLTC Documentation Sheet 0/B:

Designing the Community-Linux Training Centre System



Developed by The 'Free Range' Community-Linux Training Centre Project -
Version 1.0, January 2003. <http://www.fraw.org.uk/cltc/>

*"once you embrace unpleasant news not as a negative but as evidence
of a need for change, you aren't defeated by it"*

Bill Gates (not learning from his own words) in *Business @ The Speed Of Thought*

This section outlines the technical criteria behind the development of the CLTC system. In particular, it looks at the importance of specifying the design of the local area network in advance of setting-up/installing the hardware.

General design criteria

Put simply, the aim of the project is to provide a highly portable computer network that can be used to teach active members of a community how to use a computer and computer networks. The main design criteria for the network was that it be portable within specific limits. The choice of hardware was therefore restricted.

The overall design parameters were:

1. Portability, defined in the terms that the equipment should fit into a single large rucksack and be portable on public transport (basically, total volume no more than 75 litres, total weight no more than 30 kilos);
2. Dispense with the need for an Internet connection, enabling unrestricted portability, by running the equivalent network services from a local server;
3. Reduce the need for equipment by having one portable networked printer, and, if a phone line or other network connection is available, running the connection from the server so that all clients share the same line;
4. Provide access to the server/network, and provide facilities for each user to work, by plugging four or more laptops into the

network.

Point 1 prohibits the use of any desktop equipment. This is why the whole system has been constructed around five laptop computers. Implementing 2 to 4 is simple - one of the laptops becomes the server. In fact, it would be possible to double-up by having one laptop perform the functions of both client and server at the same time. This reduces costs, weight and volume. However, the machines we are using are of a relatively low spec., and therefore running client applications on the server would detrimentally affect both roles.

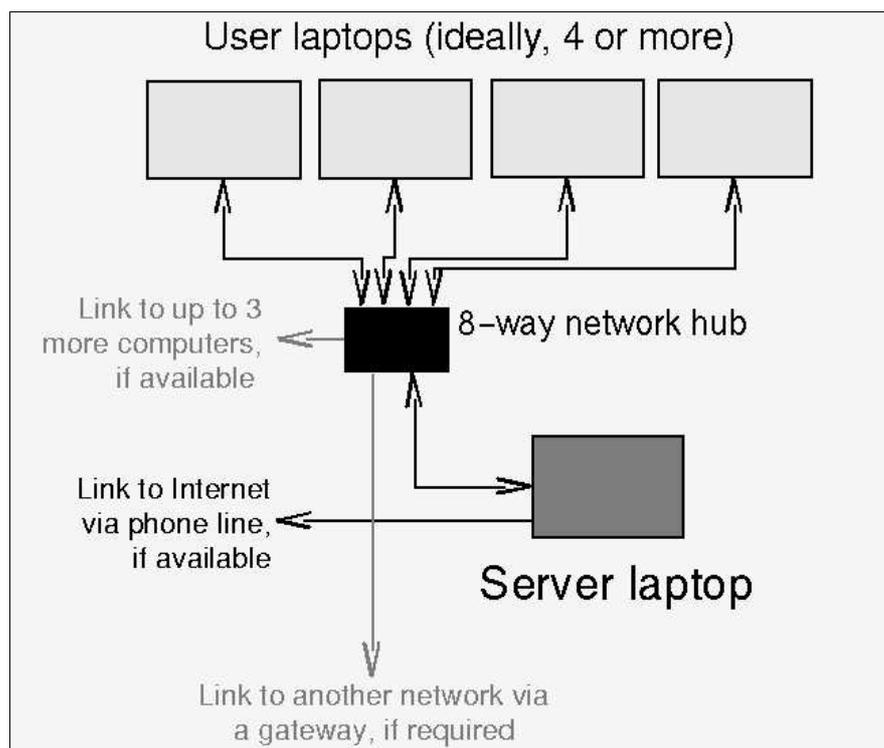
Note that, after some experimentation, it was found that carrying the CLTC in a rucksack was not always practical. For this reason point (1) was amended somewhat, and the system now travels in a wheelie chest (see later) that serves as a handy seat when there are no seats left on public transport.

After considering various options the following structure was settled upon:

- Five laptops - one server and four clients - as this would provide the most user terminals within the restrictions of weight and volume - each with a PCMCIA 100 Base-T Ethernet card (only recent laptops have Ethernet as standard);

- A fast 3Com 100 Base-T Ethernet hub to maximise the speed of the client systems, five UTP-5 (100 Base-T) Ethernet cables, an HP Deskjet-340 printer and a parallel printer cable;
- Using a single Linux distribution, rather than a range of distributions, to simplify use/maintenance;
- Use identical laptops, rather than having a more powerful server, to provide system redundancy in the case of damage/failure;
- Using combined network cards and modems in each laptop so that, if required, the whole system could be split up to provide four/five independently usable laptop systems.

A Schematic Diagram of the Community-Linux Training Centre



Linux is the ideal operating system for this system because on an ordinary computer it is possible to configure the major Internet services – such as email, web, news and FTP – for use over a local network. Therefore, even without a connection to the Internet, users can experience the use of networked services. In fact, they will access the same programs over the network that they would normally access over the Internet.

The computers will also run the office-related software for word processing, spreadsheets, databases, etc. The combination of a highly portable network, and Linux, produces an extremely versatile training facility.

Hardware and software

The members of the Free Range Network have had some experience setting up Linux systems and networks. This experience encompasses all the major distributions – *Red Hat*, *SuSE*, *Mandrake*, *Debian*, and *Caldera*. There are

various views as to what distribution is best for what type of application. However, the key issue within the CLTC system is the ability to run on low spec. laptop systems.

Linux distributions are compatible, but not identical. They are all configured slightly differently. For example, Red Hat is configured using well established programs and libraries, making it a lightweight and powerful system. SuSE on the other hand is configured to use far more programs and libraries, making it slightly more bloated (slower) than Red Hat, but giving it better multimedia capabilities 'straight out of the box' (you can configure Red Hat for this, but you have to do it yourself). Another difference is in the range of drivers provided. SuSE has more drivers for more hardware, but some of them are better than others.

For this project we have to install on laptop computers. This is one of the hardest ways to install Linux. Laptop computers are short lived, use specialised electronics, and their internal design is upgraded regularly even though the laptop model may appear to be the same. For this reason, installing on laptops requires previous Linux systems experience.

The Fully-Portable CLTC System



A wheelie-chest, 60 litres in volume, 35 kilos in weight.



Opens to give cabling/power supplies storage in the top...



...and the 5 laptops, network hub and printer in the base.



It then unpacks to create the training centre.

For example, we couldn't easily install SuSE 7.2 on the laptops we used because the interchangeable CD-ROM/floppy disk drive was not 'hot swappable' under the installation program. That meant that we couldn't boot the CD, then remove the CD-ROM drive and insert the floppy drive to load the laptop driver modules disk. But there is usually a solution to most of these problems, albeit it requires a little more knowledge to implement. Later, as an experiment, we installed the system over a 'networked file system' (NFS) using the DVD drive of another laptop to provide the required files over the network. When we later upgraded to SuSE 8.1, the problem disappeared.

The first 'alpha' version of the CLTC used Red Hat 7.1 as the operating system for all machines. This provided a good range of office and networking software for the clients, as well as being a good server distribution. We tried upgrading the server to Red Hat 7.3, but there was a problem with the IRC server. This was very problematic because the Internet chat capability had proved very important for teaching people to interact online.

The *ircd* RPM package that we had (version 2.10.3) would not run on Red Hat 7.3 because it had not been created for later editions of the Linux kernel. We kept getting a 'segmentation error'. It would have been a simple matter to compile *ircd* from its source code for use with the new kernel. However, we decided that we didn't want to get that technical. We wanted to keep things as simple as possible for Linux 'newbies' to be able to replicate our work. For this reason we stuck with Red Hat 7.1 on the server. If we find a new RPM of *ircd* that works, we can upgrade.

Later some of the clients were variously upgraded with Red Hat 7.3, SuSE 7.3/8.1, and Mandrake 8.2. This gave some benefits, but there were still problems with audio drivers. After testing each we settle for SuSE 8.1 on all the client systems - allowing the identical configuration of each client.

We could install the latest versions of all

the Linux distributions. The reason that we use older distributions for the laptops is simple – they're cast off's. They are older distributions that, because the users have upgraded, we've had donated.

The main problem in developing the system was getting hold of five laptops for a reasonable price. Yes, you can buy five laptops. But this is a very expensive option if you have to pay the full price for each. Instead we sought to get a 'bulk purchase' deal. Very few companies who sell 2nd user equipment direct to the public are willing to do this.

After a few months of searching we found a company in Scotland, DWA Computers (www.thelaptop.co.uk) who routinely offered bulk deals on quality 2nd user equipment. We were also able to purchase all the network cards required at the same time as part of the order and negotiate a better price.

The problem with buying 2nd user laptops is that they may have taken quite a battering in their previous usage. But when using Linux, the bigger problem is that you don't always have precise control over the model/version of laptop that you buy. As noted above, even the same make of laptop can have a slightly different internal configuration.

In the end, we settled for five Dell *Latitude CPi* machines. The specification of the models we purchased was:

- A Pentium-II 266MHz processor with 512k external cache;
- 128MB RAM, with roughly a 4GB ATA66 hard disks;
- A 13.3" TFT screen and UK keyboard;
- An interchangeable CD-ROM and floppy drives.
- The power requirement of 16V to 18V DC at an average 0.8A (specs. state 20V at 3.5A) meant that we could efficiently power the laptops from batteries.

We hoped that this would provide an acceptable platform to operate the training centre. In the end, apart from the fact that they seemed a little 'slow' because Network members ordinarily use 700MHz to 1.2GHz systems, they provided very good performance. The clients ran even the large

office suites, such as Star Office, well (if a little slow when launching the application). The server was also able to handle a large amount of traffic, even though we were using a high-speed network (our test was running *webget*, a chat session, and email simultaneously on all four client machines).

Finally, the quality of second user equipment does vary. Slight adjustments had to be made to most of the laptops, as well as giving them a thorough clean. One laptop had a fault on the spacebar of the keyboard. Although this was easily fixed, it wasn't perfect. Therefore this machine was the natural candidate to be the network server (the keyboard isn't well used on the server).

Planning the CLTC network configuration and services

The last stage in the system design was deciding what, from the huge range of software that ships in a Linux distribution, to install and run. 4 gigabytes sounds like a lot of hard disk. But it isn't. Given the size of most programs today careful attention had to be paid to how the server system would be installed and configured.

Server disk space is critical. Not only because we want to install all the CLTC documentation and learning materials on the server, but also because the server does produce large amounts of log files. These can quickly fill a small hard disk. Therefore, even with minimal usage, regular maintenance of the server's file system will still be required to keep the 'kipple' from mounting up.

The most crucial aspect is planning the layout of the network. If you rush ahead to network the computers you'll almost certainly generate more work for yourself at a later date. This is because networks, and the services you use over them, require careful setting up; to avoid conflicts; and to ensure that the various machines have the appropriate information located on them.

Local networks under Linux work under a similar system as the Internet. They use similar

'IP' numbering. However, there is a slot allocated within the Transmission Control Protocol/Internet Protocol (TCP/IP, or just 'IP') numbering system at 192.168.X.X for 'Class C' local networks ('Class C' are small networks). Therefore you should use this as the base for your network numbering, unless you have a good reason not to. You need to sort out the numbering before you begin to install the computers because you'll need to enter these numbers at install time. But you can reconfigure everything later if you like playing with configuration files for no reason.

To begin with, on the 'alpha' version, we used 192.168.1.X. Problem was, just about everyone else uses this numbering system too. Therefore, when we wanted to jack-in to people's local networks we caused numbering conflicts. For this reason the numbering on the final system was changed to 192.168.66.X. What this means is that we can then jack-in to another network via a gateway computer.

From the outset, part of the design of the system assumed that certain network services had to be available. This has implications for how the network was set up – particularly the naming system. The network services that we decided had to be made operational on the system were:

- DHCP and DNS (see below).
- A web (HTTP) server.
- A Networked File System (NFS).
- A File Transfer Protocol (FTP) server.
- An email transport (SMTP) system.
- An email delivery system (POP3).
- An Internet chat (IRC) server.
- An Internet news server.
- A telnet/remote login system.
- A Window compatible network protocol (Samba server).
- A networked printing system.

The CLTC network, for the personal benefit of the developers, must also dock into other networks that the developers run at home. The reason for this is that tools or information can be developed on a network of desktop computers, using the substantial information and processing power they contain, and then transferred to the machines on the CLTC

network. Therefore number clashes have to be managed not only within the CLTC network, but within the other networks the CLTC network docks into.

It's also necessary to plan name spaces. People find names far easier to use than IP addresses. There are two ways to run the domain name system (DNS) under Linux:

You can hard-code the names, and the IP numbers the names correspond to, using the `/etc/hosts` files on each machine. The machines then refer to their own table of information to handle domain names.

The problem with this is that modifications must be made to every machine when you wish to change something. All the machines have to have fixed IP addresses. It also means that non-Linux machines have problems accessing the network, and generally can't use DNS.

The CLTC network therefore uses the other option for controlling the naming system – a 'name server'. This runs on the CLTC network server, and supplies DNS information to all the machines on the network.

A single server can run many services from the same IP address. This can simplify configuration. In addition, the CLTC server will run IP-based virtual web servers. This means that the the client machines can be used to train people in web-site development, including security precautions, using unique addresses for each. We also run name-based virtual servers from the same IP number. This enables us to demonstrate the way in which many web sites can be configured from a single IP address.

For the client systems, naming is not essential. So to ease the burden of configuring machines on the network all the clients are connected to the network using the Dynamic Host Configuration Protocol (DHCP). Most people who use their laptops in offices have their systems configured using DHCP. The benefit of this system is that not only will the CLTC clients work more easily, but at any time you can add other people's systems to the CLTC network without worrying about configuration – you just plug them into the network hub and DHCP takes care of the configuration.

Configuring DHCP requires that you plan the IP addresses for the different services you will use on the network. It also requires that you provide sufficient number spaces within the allocation of IP addresses. Every client computers to be logged onto the network by DHCP needs one spare number.

Finally, various services require that you have a user account on the server. For email, user accounts provide identity verification to relay the mail. For FTP, they provide passwords and locations where files can be uploaded/downloaded. Therefore, once you've planned your network layout, you need to consider the user accounts you require. This is not as critical as network planning. But if you set up the user accounts when initially configuring the server you can save time later.

So, for the IP numbering system, this is what was planned for the CLTC was:

Number(s)	Service
192.168.66.0	CLTC network address
192.168.66.1	CLTC server
192.168.66.2-9	Unused
192.168.66.10-20	CLTC virtual server IP addresses
192.168.66.21-99	Unused
192.168.66.100-199	DHCP client address block (i.e., 100 possible clients)
192.168.66.200-254	Unused
192.168.66.255	CLTC broadcast address

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Note: This report has been produced entirely using open source/free software using the Linux OS.

The CLTC naming system was planned as follows (all working from the IP address of the server, 192.168.66.1):

cltc.lan/epsilon.cltc.lan	general system domain/alias
www.cltc.lan	web server
smtp.cltc.lan	mail transport server
mail.cltc.lan	mail delivery server
ftp.cltc.lan	file transfer protocol
telnet.cltc.lan	telnet login
irc.cltc.lan	Internet chat server
news.cltc.lan	Internet news server
dns.cltc.lan	DNS server

In addition, the following are used for the CLTC's four virtual web servers:

www.alphaweb.lan	192.168.66.10
www.betaweb.lan	192.168.66.11
www.gammaweb.lan	192.168.66.12
www.deltaweb.lan	192.168.66.13
(name based URLs)	192.168.66.14

By mapping out all these details at the initial stage it is far easier to configure the systems. Making changes half way through installation can create a lot of extra work. By mapping the system first it also makes it possible to divide the work of system development between a number of different people. For example, one person installs the server, whilst another installs the clients. Also, where one network must routinely dock with another, you are less likely to get numbering/name clashes because people know the limits they have to work within.