Report on Installation of K12LTSP in a Computer Laboratory

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Introduction

I suddenly became the computer guy at Hector Thiboutot Community School in Sandy Bay, at the end of a long road in northern Saskatchewan. The main lab was equipped with 25 Dell Optiplex GX100 which, in spite of their lengthy designation were short on power, memory and software. They ran Windows 98 on a ghosted setup that reset the hard drive on each reboot. Surfing with a compact browser like Opera was the only thing they could do well. Using larger browsers or word processing invariably resulted in crashes and freezes. Many times students' fine work was lost sometimes at the moment it was to be printed. Saving files over the network or on a partition not reset at each reboot was the only way to protect files. Even if data were not lost this characteristic failure of the software was tedious and greatly reduced confidence and enthusiasm in the users.

Existing Computers

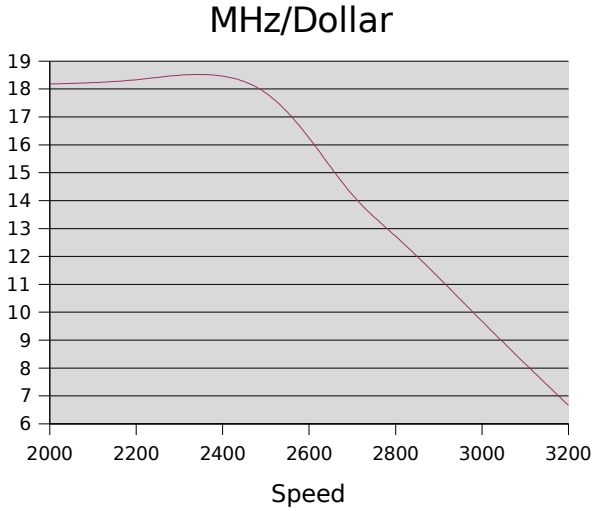
Intel 466 MHz
64 MB RAM
30 gB hard drive
100 mb/s NIC
Windows 98

If it were not that one of the programmes we needed to run for the entire grade 6 to 9 student body was a proprietary programme for Windows, I would have recommended switching to Linux to eliminate the crashing. Increasing the RAM on each machine would have been costly, but I would expect that the rate of crashing would be greatly reduced. Another solution, using Linux over the network (which was a great asset), presented itself. The K-12 Linux Terminal Server Project had documented just such a solution and provided installation CD images for download. With this system, one would need one or more very powerful machines to run software and the client PCs (the 25 Dells) would relay user input and displays over the network. Thus each user could experience the joy of Linux reliability and the

speed of a modern PC and the latest software for a similar cost to upgrading the RAM. This solution would also reduce software maintenance as only one PC would actually have any software installed on it. The clients can boot from a CD or a floppy disc in about the same time as Windows 98.

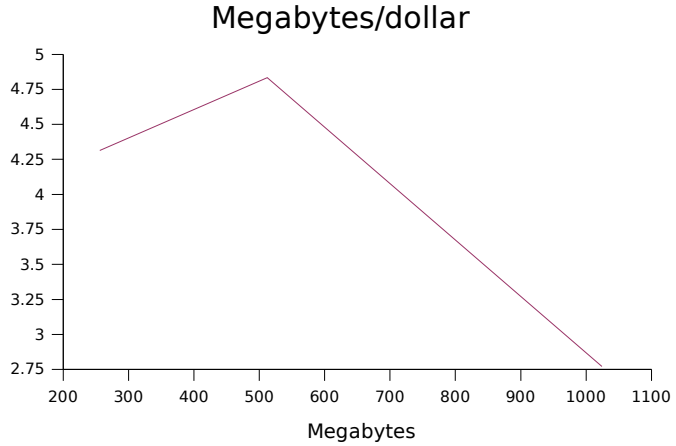
Choosing A Solution

One potential bottleneck in thin-client is that all of the network traffic would eventually pass through a single NIC to the server machine. Fortunately, the network had been upgraded with 100 mb/s switches with 1000 mb/s ports for servers, and one of the gigabit ports was unused. With this setup, ten PCs can run flat out without the server being a bottleneck. In use the network traffic is quite manageable. A survey of the hardware components needed to give near optimum performance/price was undertaken. It was decided to use an AMD XP2500 processor. Faster processors required some premium in price.



We chose a motherboard with three memory slots so we could use 1.5 gB of RAM in 512 MB sticks. This was the amount of RAM suggested by the rule of thumb: “50 MB/client”, given by http://k12ltsp.org .

Best price for RAM is at 512mB



Since we were relying on a single computer to hold all files, we needed to increase the reliability of the server. One way to do that was to use two hard drives in RAID 1 configuration. Failure of one drive should mean the other could continue. RAID (Redundant Array of Independent Discs) also has the advantage, that, for reading, the drives can read from two places at once. A good article on RAID is at http://tldp.org/HOWTO/ATA-RAID-HOWTO/index.html and at http://tldp.org/HOWTO/Software-RAID-HOWTO.html . We chose to use software RAID, because it would save a few dollars by not requiring a RAID controller (we use the ordinary double IDE controller on the motherboard). We may pay a cost in CPU utilization but the large amount of memory and Linux' penchant to store frequently used files in memory, should minimize this effect.

The heart of this server is the motherboard. We chose the SOLTEK 75FRN2-L because it is inexpensive and comes with a useful feature in a system using a lot of memory, dual channel memory access. This should give us somewhat higher data rates between the system and memory, just the trick to help a busy system. For details on the motherboard, see http://www.soltek.com.tw/English/home/01.htm

The combination of software and hardware should give us relief from many of the problems in the lab.


www.3Dnews.ru

A purchase order requisition was placed for the parts:

Nifty Server		
item	supplier	price (at writing)
Case, 9804SEL 350W 10 bays	http://ncix.com Vancouver	$46.44
Motherboard, SOLTEK 75FRN2-L NFORCE2 SOCKETA	http://ncix.com Vancouver	$105.98
CPU AMD ATHLON XP 2500+ 512K 333FSB BARTON RETAIL BOX 3YR MFR. WARRANTY	http://ncix.com Vancouver	$128.88
Hard Drives (two) SEAGATE BARRACUDA 7200.7 120GB 7200RPM IDE 9MS ATA100 OEM 1YR	http://ncix.com Vancouver	$123.98 X2 $247.96
RAM (three) INFINEON 512MB PC3200 DDR400 184PIN OEM	http://ncix.com Vancouver	$113.98 X3 $341.94
Network Interface Controller INTEL PRO1000 MT DESKTOP ADAPTER SINGLE UNIT OEM *PROMO* gigabit!	http://ncix.com Vancouver	$45.98
CDRW drive LG GCE-8520B CDRW 52X24X52 INT EIDE ATAPI OEM W/ SW	http://ncix.com Vancouver	$49.99
Video card ATI RADEON 7000LE	TOTAL	$59.34 $1026.51

INSTALLATION

This device was assembled in one hour of a grade 10 Information Processing class. Students were amused when the instructor was seen pushing on the wrong end of the clip securing the heat sink and fan to the CPU. The steps in the installation are well described in the documentation that came with the motherboard:

- Place the motherboard on the conductive foam pad that comes with the motherboard. Note that the CPU, motherboard, hard drives, RAM and NIC come in conductive plastic packages to protect from static discharges. Make sure your body is at the same potential as the parts before touching the devices. One does this by being still in the chair and touching and staying in contact with the frame or package before touching the sensitive device.
- Cut open the container of the CPU with a sharp blade like a utility knife and place the CPU into the opened socket carefully observing alignment. The CPU will drop in magically if the pins are aligned properly. The shaved corner goes toward the hinge pivot of the latch. Close the latch.
- Insert the RAM sticks vertically checking alignment keys. Close the latches.
- Mount the standoff studs on the mounting panel by the power supply. Both side panels in the standard case must be removed to do the installation. The standoffs must be placed where they will correspond to the motherboard with connectors to the rear.
- Lay the case on its side with the motherboard mounting panel down and insert the motherboard. A bezel surrounding the sockets to the rear may need to be installed in a knockout. The bezel snaps in and the motherboard slides in beside.
- Install screws and insulating washers to securely anchor the motherboard.
- Install the AGP card and NIC.
- Install cables for drives, power supplies and connections to speakers, switches and so forth.

- Install drives. The motherboard comes with a single IDE cable. You will get better performance by placing the second drive on a second cable which we borrowed from an old doorstop... Our drives are ATA100. If you get ATA133, you will need an ATA133 cable with 80 lines. Our doorstop had 40 lines but it does very well. Mark the red line and pin number one.
- Check the docs carefully and follow the wires to switches and lights to get polarity and cabling correct. It takes a few minutes to get it right sometimes.
- Connect a monitor, keyboard and mouse for initial setup. Enter BIOS setup and set system clock, CPU multiplier, booting sequence, date and so forth...
- Insert Linux CD and boot to install. You need to know the type of mouse, AGP card and monitor and display modes to minimally configure your system. You will need at least a “root” user with all powers and an “ordinary” user with ordinary powers. The k12ltsp documentation is fairly complete. We only had to do extra stuff for web proxy, apache, dhcpd, and phpBB2. The information you presently use to connect to the web will be useful...

Software was installed in a Computer Science 20 class. It took a weekend to configure the system so that Windows and Linux could exist together in the lab. The main problem was that the Linux system and the Windows system both had their own DHCP server to issue IP addresses for the network. That problem was solved by setting a requirement in the dhcpd server on the Linux box that would only be satisfied by the machines booting to Linux with a boot CD. The image for the boot CD was created at http://rom-o-matic.org .In the questioning of the form, I selected “Require an encapsulated Vendor Class Identifier of "Etherboot" . Our DHCP server could then offer service to the boot loader installing the thin-client. Unfortunately, that was insufficient, because the thin-client request DHCP service a second time when the thin-client boots. We then made use of the fact that Windows sets a bit in a message to the dhcp servers that Linux does not. The Windows server still tries to give an IP address to the Linux boxes, but because the Linux server is so much faster, it usually gets the job done first. If the Linux server detects it is a Windows machine booting, it ignores the request.

To avoid confusing the two dhcp servers, we use two subnets sharing the same physical network. One server (for Windows) serves 10.196.66.x and the other (for Linux) serves 192.168.0.x .

An additional problem is that there are a few of the machines that have different mice and display devices, so the individual serial numbers of the NICs of these machines must be identified so that the correct initializations will be done on booting. The configuration files we use are attached as APPENDIX A.

Other minutia: the server had to be set (BIOS setup) to reboot on power failure and to fix the clock rates. I found the clock rates were too low on the "auto" setting. For our CPU and motherboard we used 166 MHz and X11 multiplier giving 1837 MHz clock frequency. The front side bus runs at 333MHz DDR .

I wrote a little program to convert a class list into a set of users:

```
[pogson@nifty pogson]$ cat USERS.pas
program USERS;
uses linux;
var f,g:text;s:string;
begin
if paramcount<1 then writeln('usage: USERS file_of_userids {creates users}')
else begin
  assign(f,paramstr(1));reset(f);
  while not eof(f) do
  begin
    readln(f,s);s:=lowercase(s);
popen(g,'  /usr/sbin/useradd '+s,'W');flush(g);pclose(g);
popen(g,'  /usr/sbin/usermod -U '  +s,'W' );flush(g);pclose(g);
popen(g,'  /usr/sbin/usermod -U '  +s,'W' );flush(g);pclose(g);
  end;close(f)
     end
end.
```

This programme can be compiled with a PASCAL compiler from http://www.freepascal.org/ . Just get the RedHat packages of your choice and install them as root. If you log in as an ordinary user ($ indicates you are ordinary):

$su
$give_the_password_of_root
#rpm -Uvh whatever.rpm another.rpm
#exit
$ppc386 USERS.pas

This creates a file of users that is executable.

#./USERS file_containinglist_of_users

Will install the lot of them. If you need certain pre-installation stuff done for each user, like setting proxy addresses, menus and so forth, do it manually for one user and copy the /home/whatever directory that results to /etc/skel as root to have each user you create have the same starting directory. That saves much work if you have more than a few users....

You may need help with Linux commands. See
http://www.linuxman.com.cy/rute/rute.html
https://www.redhat.com/support/
http://k12ltsp.org/

You can find lots of places to download the CD images from http://filemirrors.com (look for k12ltsp)
or http://k12ltsp.org/download.html . The CD images can be copied to a CD with many programmes. Be careful to use the procedure for copying a CD image, not just file copying. In linux, just use cdrecord:

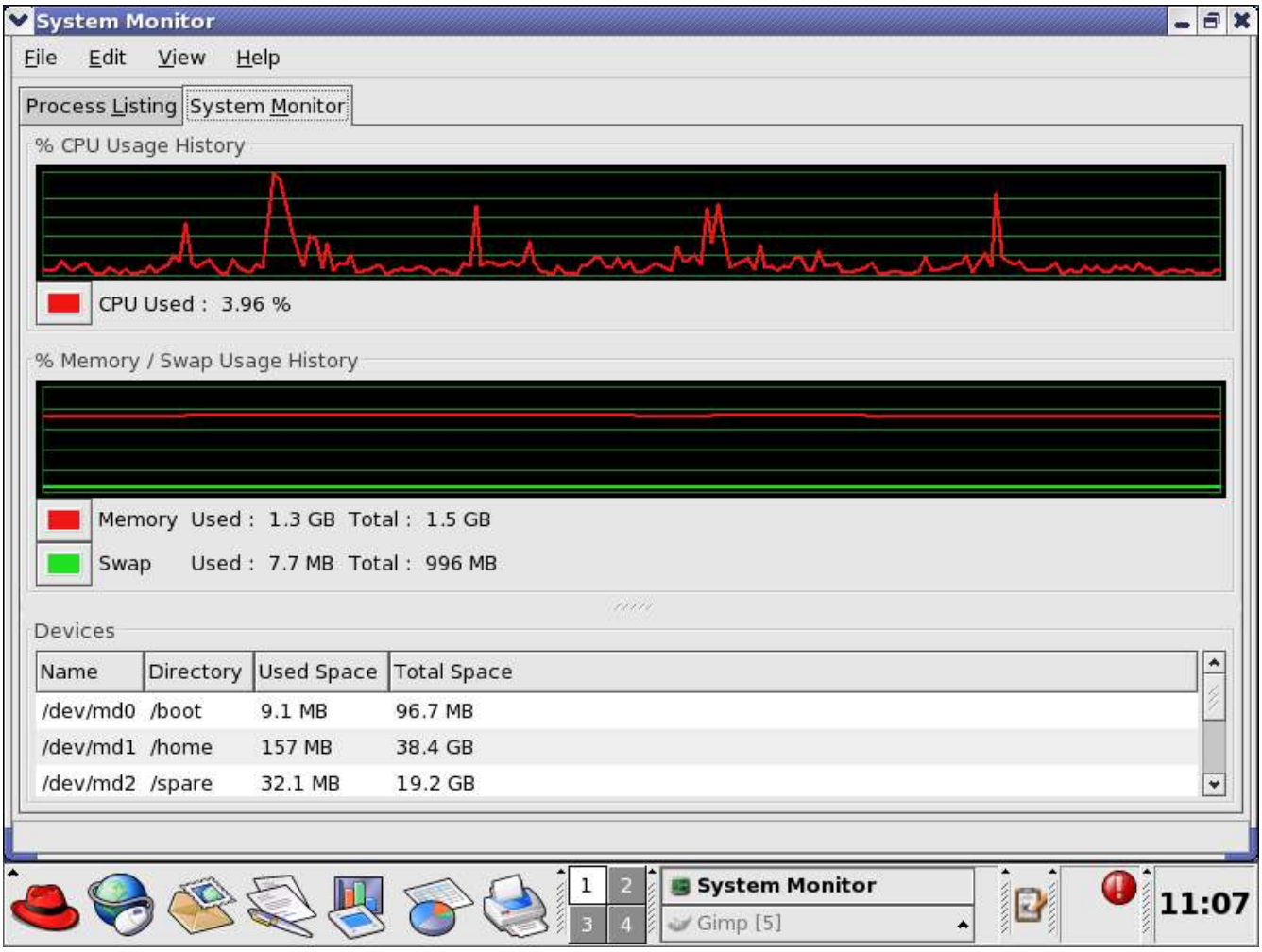
#cdrecord –scanbus
#cdrecord dev=resultsofscanbus speed=12 k12ltsp....iso

Set speed compatible with your CD writer and medium.

PERFORMANCE

Here is a snapshot of the system monitor for seven users logged on and active. We have plenty of CPU power but we will slow down with a room

full (25 users).



These are the specs of our server:

- CPU AMD Athlon 2500 (333MHz FSB)
- RAM 1.5 gB (dual channel)
- Hard drives two 120 gB Seagate Barracuda 7200 rpm RAID 1
- CD burner
- no floppy drive, monitor, keyboard or mouse in normal use.
- administration by SSH or K12LTSP thin client

Initial observations showed huge increments of memory use as students logged in. Panic subsided when it was discovered that most of this memory was used to cache files rather than to run programmes. The RAM used per user seems well under fifty megabytes.

For instance, with 22 users on Mozilla, we use all the RAM but only 145 MB of swap. 240 MB are cached

```
[root@nifty pogson]# free
             total       used       free     shared  buffers     cached
Mem:       1547996    1537620      10376          0     206848     240512
-/+ buffers/cache:    1090260     457736
Swap:      1020024     145876     874148
[root@nifty pogson]#
```

If we have 21 of those users using Mozilla also start up OpenOffice, the memory usage changes little except that we begin to have some serious use made of swap:

```
[root@nifty pogson]# #22 users on Mozilla and 21 of those on OpenOffice
[root@nifty pogson]# free
             total       used       free     shared    buffers     cached
Mem:       1547996    1537676      10320          0     146004     294468
-/+ buffers/cache:    1097204     450792
Swap:      1020024     378476     641548
```

An immediate speedup in booting and logins were seen:

	Linux	Windows98
Boot up to login screen	45s	55s
Login	4s	35s
starting OpenOffice	5s	21s
download speed OO	67KB/s	44 KB/s

Some idea of the power of software RAID in Linux can be seen from the following test:
job1 and job2 are two little one-line commands to read huge files. job 1 by itself takes 24 seconds, but the system can do job1 and job2 in 26 seconds

because both drives can be read at the same time. These drives have a sustained transfer rate of 27 to 44 MB/s depending on the radius of the tracks. job1 and job2 together are reading 1325 MB in 26 seconds for a sustained rate of 53 MB/s while job1 alone reads 27 MB/s. Clearly, we get a huge increase in read rate for multiple files with software RAID. Loading multiple files is typical of starting programmes. Most of the files we write are small, so the slower performance for writing is not an issue.

```
[root@nifty Linux_distros]# ./job1&./job2&
[1] 32538
[2] 32539
[root@nifty Linux_distros]# Sun Nov 30 20:08:58 CST 2003
Sun Nov 30 20:08:58 CST 2003
Sun Nov 30 20:09:19 CST 2003
Sun Nov 30 20:09:24 CST 2003

[1]-  Done                    ./job1
[2]+  Done                    ./job2
[root@nifty Linux_distros]# cat job2
date;cp phoebe-i386-disc2.iso /dev/null;date

[root@nifty Linux_distros]# cat job1
date;cp phoebe-i386-disc1.iso /dev/null;date

[root@nifty Linux_distros]# ls ph* -l
-rw-r--r--    1 root     root     652115968 Nov 13 15:26 phoebe-i386-disc1.iso
-rw-r--r--    1 root     root     673218560 Nov 13 15:27 phoebe-i386-disc2.iso
-rw-r--r--    1 root     root     636846080 Nov 13 15:28 phoebe-i386-disc3.iso
[root@nifty Linux_distros]# exit
exit
[pogson@nifty Linux_distros]$
```

Nifty provides several services:

0)it is a dhcp server so when booting to Linux, the clients get an IP address on a different subnet and are given information for connecting to the internet and loading Linux.
1)it is a web server for the site at http://10.196.66.10 (for ordinary folk on the network) or http://nifty (for users logged on the thin clients).
2)a bulletin board at http://nifty/phpBB2/index.php which uses a postgresql database to store user information and messages.
3)domain name service so frequently accessed sites can be connected sooner using cached IP addresses.
4)all the user files are stored on two hard drives. Mirrors are made automatically, so writing will be slower on average than reading.
5)it is a thin-client server running programmes to display with remote clients.

Setting up the postgresql database for the bulletin board takes some serious steps. These can only be done by the root user, so be careful. If the database has been lost somehow or the software is re-installed, the database must be initialized. Root must create a directory to store the database and initialize it:

#mkdir /var/db
#chmod 700 /var/db
#chown postgres:postgres /var/db
This makes the directory and sets the permissions.
#su postgres
$initdb -d /var/db -U pogson -W
will create the database structure with an owner, pogson, or whatever, with a password. Note the # prompt indicate we are root. The $ prompt means we are mortal. It is necessary to edit the file, pg_hba.conf to contain a line like:
host phpbb pogson trust
Then
#service postgresql reload or start gets the change recognized.
If restoring from a backup,
$psql -U pogson -W <backup_file_created_with_pg_dump
If creating the database through installation of phpBB, copy the files to /

var/www/html/phpBB2 and activate http://nifty/phpBB2/index.php . The installation script needs to be told the name of the database and the owner's name and password. The directory, phpBB2 must be world writable for the installation:#chmod 777 /var/www/html/phpBB2 . Afterward the ownership can be changed to apache with
#chown apache:apache /var/www/html/phpBB2/*
#chmod 700 /var/www/html/phpBB2/*
Do not forget to delete the files indicated at the end of the installation or there will be a security hole.

The owner should log in to http://nifty/phpBB2/index.php using a browser and configure the board as needed. The menu for admin is at the bottom of the page.

APPENDIX A

```
[pogson@nifty pogson]$ cat /proc/cpuinfo
processor       : 0
vendor_id       : AuthenticAMD
cpu family      : 6
model           : 10
model name      : AMD Athlon(tm) XP 2500+
stepping        : 0
cpu MHz         : 1837.518
cache size      : 512 KB
fdiv_bug        : no
hlt_bug         : no
f00f_bug        : no
coma_bug        : no
fpu             : yes
fpu_exception   : yes
cpuid level     : 1
wp              : yes
flags           : fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov
```

```
pat pse36 mmx fxsr sse syscall mmxext 3dnowext 3dnow
bogomips        : 3670.01

[pogson@nifty pogson]$
```

The “md” device is the software raid device giving us mirroring access.

```
[pogson@nifty pogson]$ df
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/md3             10079212    449288   9117920   5%    /
/dev/md0                98971      9314     84547  10%    /boot
/dev/md1             40313912   1048548  37217484   3%    /home
none                   773996         0    773996   0%    /dev/shm
/dev/md2             20158268     32828  19101444   1%    /spare
/dev/md4             10078700   4928908   4637812  52%    /usr
/dev/md5             33633304  27306140   4618660  86%    /var
[pogson@nifty pogson]$
```

The following shows memory utilization:

```
[pogson@nifty pogson]$ free
                 total       used       free     shared    buffers     cached
Mem:       1547996     512464    1035532          0      71696     265856
-/+ buffers/cache:      174912    1373084
Swap:      1020024          0    1020024
[pogson@nifty pogson]$
```

Here is the partition table specified during installation using a graphical user interface. Most of the configuration was done with a GUI. The only exception is the terminal server configuration:

```
[root@nifty pogson]# /sbin/sfdisk -l

Disk /dev/hdd: 232581 cylinders, 16 heads, 63 sectors/track
Units = cylinders of 516096 bytes, blocks of 1024 bytes, counting from 0

   Device  Boot    Start     End   #cyls    #blocks   Id  System
/dev/hdd1   *         0+     202     203-    102280+  fd  Linux raid autodetect
/dev/hdd2           203    81472   81270   40960080   fd  Linux raid autodetect
/dev/hdd3         81473   122107   40635   20480040   fd  Linux raid autodetect
/dev/hdd4        122108   232580  110473   55678392    f  Win95 Ext'd (LBA)
```

```
/dev/hdd5     122108+ 142425   20318-  10240240+  fd  Linux raid autodetect
/dev/hdd6     142426+ 162742   20317-  10239736+  fd  Linux raid autodetect
/dev/hdd7     162743+ 164774    2032-   1024096+  fd  Linux raid autodetect
/dev/hdd8     164775+ 232580   67806-  34174192+  fd  Linux raid autodetect

Disk /dev/hda: 14593 cylinders, 255 heads, 63 sectors/track
Units = cylinders of 8225280 bytes, blocks of 1024 bytes, counting from 0

   Device Boot Start     End   #cyls    #blocks   Id  System
/dev/hda1   *     0+     12     13-    104391   fd  Linux raid autodetect
/dev/hda2        13    5111    5099   40957717+  fd  Linux raid autodetect
/dev/hda3      5112    7661    2550   20482875   fd  Linux raid autodetect
/dev/hda4      7662   14592    6931   55673257+   f  Win95 Ext'd (LBA)
/dev/hda5      7662+   8936    1275-  10241406   fd  Linux raid autodetect
/dev/hda6      8937+  10211    1275-  10241406   fd  Linux raid autodetect
/dev/hda7     10212+  10338     127-   1020096   fd  Linux raid autodetect
/dev/hda8     10339+  14592    4254-  34170223+  fd  Linux raid autodetect
[root@nifty pogson]#
Here is the map of devices and the Linux filesystem:
[root@nifty pogson]# cat /etc/fstab
/dev/md3                /                       ext3    defaults        1 1
/dev/md0                /boot                   ext3    defaults        1 2
none                    /dev/pts                devpts  gid=5,mode=620  0 0
/dev/md1                /home                   ext3    defaults        1 2
none                    /proc                   proc    defaults        0 0
none                    /dev/shm                tmpfs   defaults        0 0
/dev/md2                /spare                  ext3    defaults        1 2
/dev/md4                /usr                    ext3    defaults        1 2
/dev/md5                /var                    ext3    defaults        1 2
/dev/md6                swap                    swap    defaults        0 0
/dev/cdrom      /mnt/cdrom      udf,iso9660 noauto,owner,kudzu,ro 0 0
[root@nifty pogson]#
Here is the configuration for the software raid.
[root@nifty pogson]# cat /etc/raidtab
raiddev             /dev/md3
```

```
raid-level              1
nr-raid-disks           2
chunk-size              64k
persistent-superblock   1
nr-spare-disks          0
   device       /dev/hda5
   raid-disk    0
   device       /dev/hdb5
   raid-disk    1
raiddev         /dev/md0
raid-level              1
nr-raid-disks           2
chunk-size              64k
persistent-superblock   1
nr-spare-disks          0
   device       /dev/hda1
   raid-disk    0
   device       /dev/hdb1
   raid-disk    1
raiddev         /dev/md1
raid-level              1
nr-raid-disks           2
chunk-size              64k
persistent-superblock   1
nr-spare-disks          0
   device       /dev/hda2
   raid-disk    0
   device       /dev/hdb2
   raid-disk    1
raiddev         /dev/md2
raid-level              1
nr-raid-disks           2
chunk-size              64k
persistent-superblock   1
nr-spare-disks          0
```

```
    device          /dev/hda3
    raid-disk     0
    device          /dev/hdb3
    raid-disk     1
raiddev             /dev/md4
raid-level                1
nr-raid-disks             2
chunk-size                64k
persistent-superblock     1
nr-spare-disks            0
    device          /dev/hda6
    raid-disk     0
    device          /dev/hdb6
    raid-disk     1
raiddev             /dev/md5
raid-level                1
nr-raid-disks             2
chunk-size                64k
persistent-superblock     1
nr-spare-disks            0
    device          /dev/hda8
    raid-disk     0
    device          /dev/hdb8
    raid-disk     1
raiddev             /dev/md6
raid-level                1
nr-raid-disks             2
chunk-size                64k
persistent-superblock     1
nr-spare-disks            0
    device          /dev/hda7
    raid-disk     0
    device          /dev/hdb7
    raid-disk     1
[root@nifty pogson]#
```

```
#
# Config file for the Linux Terminal Server Project (www.ltsp.org)
#
# See lts.conf.readme for a description of each configuration item
#
[Default]
        # IP address of the LTSP server
        SERVER          = 192.168.0.254

        # Video drivers for the terminals
        XSERVER         = i810
           # XFree 4 drivers: ati cirrus cyrix fbdev i128 i740 i810 mga
           #      neomagic nv r128 radeon rendition s3 s3virge savage
           #      siliconmotion sis tdfx tga trident tseng vesa vga
           # XFree 3 drivers: XF86_FBDev XF86_S3 XF86_S3V XF86_SVGA
           #      XF86_VGA16 XFree86 Xvesa

        # Mice drivers for the terminals
        X_MOUSE_PROTOCOL   = "IMPS/2"
           # Mouse protocols: ExplorerPS/2 GlidePoint GlidePointPS/2
           #      IMPS/2 IntelliMouse Microsoft MouseManPlusPS/2
           #      NetMousePS/2 NetScrollPS/2 PS/2 ThinkingMouse
           #      ThinkingMousePS/2 usb
        X_MOUSE_DEVICE     = "/dev/psaux"
        # X_MOUSE_RESOLUTION = 400
        X_MOUSE_BUTTONS    = 3
        X_USBMOUSE_PROTOCOL= "IMPS/2"
        X_USBMOUSE_DEVICE  = "/dev/input/mice"
        X_USBMOUSE_BUTTONS = 5
        # X_USBMOUSE_RESOLUTION = 400
```

```
# Keyboards
XkbSymboles       = "us(pc105)"
XkbModel          = "pc105"
XkbLayout         = "us"
   # Example of setting a different (German) keyboard mapping,
   #    XkbLayout = "de"
   # also see:
   #   http://www.xfree86.org/current/XKB-Config2.html
   #   http://www.ltsp.org/documentation/ltsp-3.0-4-en.html#AEN1213
   #   /opt/ltsp/i386/usr/X11R6/lib/X11/xkb/rules/xfree86.lst
   #   (/opt/ltsp/i386/usr/X11R6/lib/X11/xkb/symbols/)
   #   (/opt/ltsp/i386/usr/X11R6/lib/X11/xkb/keymap/xfree86)

USE_XFS           = N
LOCAL_APPS        = N
RUNLEVEL          = 5

# uncomment the following line to enable floppy support
RCFILE_01         = floppyd

# uncomment the following line to enable USB support
#RCFILE_02         = usb

# enable sound by default
SOUND             = Y

# default sound volume
VOLUME            = 75

### For ISA sound cards, you have to specify the module to use:
 SMODULE_01       = sb io=0x220 irq=5 dma=1


#-----------------------------------------------------------------------
# Below are sample mode lines for a variety of vertical refresh rates and
```

```
# resolutions.  They are used to define the default client screen resolution.
# Some lines may not work with a given monitor and video chipset.
# To avoid damaging a monitor and video card, only specify mode lines that
# your client's hardware can support.
# Uncomment only *one* of the following X_MODE_0 lines at a time, or add
one
# of your own.

# 60 Hz Resolutions
#    X_MODE_0 = 640x480    25.175    640   656   752   800    480 490 492 525
-hsync -vsync
    X_MODE_0 = 800x600    40         800   840   968 1056    600 601 605 628
+hsync +vsync
#    X_MODE_0 = 1024x768   65       1024 1048 1184 1344    768 771 777 806
-hsync -vsync

# 70 Hz Resolutions (Use instead of 72 Hz for 1024x768)
#    X_MODE_0 = 1024x768   75       1024 1048 1184 1328    768 771 777 806
-hsync -vsync

# 72 Hz Resolutions
#    X_MODE_0 = 640x480    31.5       640   664   704   832    480 489 492 520
-hsync -vsync
#    X_MODE_0 = 800x600    50         800   856   976 1040    600 637 643 666
+hsync +vsync
#    X_MODE_0 = 1024x768   75       1024 1048 1192 1296    768 771 777 806
-hsync -vsync

# 75 Hz Resolutions
#    X_MODE_0 = 800x600    49.5       800   816   896 1056    600 601 604 625
+hsync +vsync

# 85 Hz Resolutions
#    X_MODE_0 = 800x600    60.75      800   864   928 1088    600 616 621 657
-hsync -vsync
```

```
#-----------------------------------------------------------------------
#
# Example of specifying X settings for a workstation
#
[ws024]
X_MOUSE_PROTOCOL="PS/2"
[ws023]
X_MOUSE_PROTOCOL="IMPS/2"
[ws022]
X_MOUSE_PROTOCOL="PS/2"
[ws021]
X_MOUSE_PROTOCOL="PS/2"
[ws020]
X_MOUSE_PROTOCOL="PS/2"
[ws019]
X_MOUSE_PROTOCOL="PS/2"
[ws018]
X_MOUSE_PROTOCOL="PS/2"
[ws017]
X_MOUSE_PROTOCOL="IMPS/2"
[ws01]
X_MOUSE_PROTOCOL="PS/2"
[ws016]
X_MOUSE_PROTOCOL="PS/2"
[ws015]
X_MOUSE_PROTOCOL="PS/2"
[ws014]
X_MOUSE_PROTOCOL="IMPS/2"
[ws013]
X_MOUSE_PROTOCOL="IMPS/2"
[ws012]
X_MOUSE_PROTOCOL="PS/2"
[ws011]
```

```
X_MOUSE_PROTOCOL="PS/2"
[ws010]
X_MOUSE_PROTOCOL="IMPS/2"
[ws08]
X_MOUSE_PROTOCOL="IMPS/2"
[ws07]
X_MOUSE_PROTOCOL="IMPS/2"
[ws06]
X_MOUSE_PROTOCOL="PS/2"
[ws05]
X_MOUSE_PROTOCOL="PS/2"
[ws04]
X_MOUSE_PROTOCOL="PS/2"
[ws03]
X_MOUSE_PROTOCOL="IMPS/2"
[ws09]
X_MOUSE_PROTOCOL="IMPS/2"
[ws025]
X_MOUSE_PROTOCOL="PS/2"
#Here is a configuration for an old doorstop used on an AV cart to project
#in classrooms. Runs like a devil with only 32MB AND 166MHZ! The
#configuration must be a little specific because this beast is 10 years old.
#There is little apparent difference in performance except for the quality
#of the display.
[ws026]
RUNLEVEL="5"
X_MOUSE_PROTOCOL="Microsoft"
XSERVER=XF86_SVGA
X_MODE_0="800x600"
X_MODE_1="640x480"
X_MOUSE_DEVICE="/dev/ttyS0"
X_COLOR_DEPTH="8"
[ws02]
X_MOUSE_PROTOCOL="IMPS/2"
#------------------------------------------------------------------------
```

```
#
# Example of a workstation configured to load some modules
#
#[ws001]
#    MODULE_01       = agpgart.o             # This is for i810 video
#    MODULE_02       = uart401.o
#    MODULE_03       = sb.o io=0x220 irq=5 dma=1
#    MODULE_04       = opl3.o

#-------------------------------------------------------------------------
#
# Example of ws001 configured for local apps
#
#[ws001]
#    LOCAL_APPS      = Y
#    LOCAL_WM        = Y
#    NIS_DOMAIN      = ltsp
#    NIS_SERVER      = 192.168.0.254

#-------------------------------------------------------------------------
#
# Example of a serial printer attached to /dev/ttyS1 on workstation ws001
#
#[ws001]
#    PRINTER_0_DEVICE   = /dev/ttyS1
#    PRINTER_0_TYPE     = S             # P-Parallel, S-Serial
#    PRINTER_0_PORT     = 9100          # tcp/ip port: defaults to 9100
#    PRINTER_0_SPEED    = 9600          # baud rate: defaults to 9600
#      PRINTER_0_FLOWCTRL = S                    # Flow control: S-Software
(XON/XOFF),
#                                # H-Hardware (CTS/RTS)
#    PRINTER_0_PARITY   = N             # Parity: N-None, E-Even, O-Odd
#                                # (defaults to 'N')
#    PRINTER_0_DATABITS = 8             # Databits: 5,6,7,8 (defaults to 8)
```

Here is the configuration file for our dhcpd server:

```
# Sample configuration file for ISCD dhcpd
#
# Don't forget to set run_dhcpd=1 in /etc/init.d/dhcpd
# once you adjusted this file and copied it to /etc/dhcpd.conf.
#
not authoritative;
default-lease-time            21600;
max-lease-time                21600;
ddns-update-style none;
deny booting;
if substring (option vendor-class-identifier, 0, 9) = "Etherboot"
  {
      allow booting ;
    }
if substring (option dhcp-client-identifier, 0, 1)!="\001"
  {
      allow booting ;
    }
boot-unknown-clients false;
#ignore booting ;
option vendor-encapsulated-options 3c:09:45:74:68:65:72:62:6f:6f:74:ff;
option subnet-mask            255.255.255.0;
option broadcast-address      192.168.0.255;
option routers                192.168.0.254;
option domain-name-servers    192.168.0.254;
option domain-name            "ltsp";
option root-path              "192.168.0.254:/opt/ltsp/i386";
option option-128 code 128 = string;
option option-129 code 129 = text;
shared-network WORKSTATIONS {
  subnet 192.168.0.0 netmask 255.255.255.0 {     }
```

```
}
# example configurations for specifying specific kernels to specific clients
group      {
   use-host-decl-names       on;
   option log-servers        192.168.0.254;

option vendor-encapsulated-options 3c:09:45:74:68:65:72:62:6f:6f:74:ff;
host ws01 {
hardware ethernet 00:B0:D0:14:74:20;
fixed-address 192.168.0.1;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws02 {
hardware ethernet 00:B0:D0:14:6e:EF;
fixed-address 192.168.0.2;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws03 {
hardware ethernet 00:B0:D0:14:74:35;
fixed-address 192.168.0.3;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws04 {
hardware ethernet 00:B0:D0:14:73:D7;
fixed-address 192.168.0.4;
filename "/lts/vmlinuz.ltsp";
```

```
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws05 {
hardware ethernet 00:B0:D0:14:6f:31;
fixed-address 192.168.0.5;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws06 {
hardware ethernet 00:B0:D0:14:74:23;
fixed-address 192.168.0.6;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws07 {
hardware ethernet 00:B0:D0:14:74:1f;
fixed-address 192.168.0.7;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws08 {
hardware ethernet 00:B0:D0:14:6e:Fe;
fixed-address 192.168.0.8;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";
```

```
 }
host ws09 {
hardware ethernet 00:B0:D0:14:74:49;
fixed-address 192.168.0.9;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws010 {
hardware ethernet 00:B0:D0:14:73:1a;
fixed-address 192.168.0.10;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws011 {
hardware ethernet 00:B0:D0:14:A0:33;
fixed-address 192.168.0.11;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws012 {
hardware ethernet 00:B0:D0:14:74:41;
fixed-address 192.168.0.12;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws013 {
hardware ethernet 00:B0:D0:76:3d:Bf;
```

```
fixed-address 192.168.0.13;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws014 {
hardware ethernet 00:B0:D0:76:3d:C3;
fixed-address 192.168.0.14;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws015 {
hardware ethernet 00:B0:D0:76:3d:B2;
fixed-address 192.168.0.15;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws016 {
hardware ethernet 00:B0:D0:14:6f:16;
fixed-address 192.168.0.16;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws017 {
hardware ethernet 00:B0:D0:14:6f:2d;
fixed-address 192.168.0.17;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
```

```
option option-129 "NIC=3c59x";

 }
host ws018 {
hardware ethernet 00:B0:D0:14:57:C5;
fixed-address 192.168.0.18;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws019 {
hardware ethernet 00:B0:D0:14:6f:37;
fixed-address 192.168.0.19;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws020 {
hardware ethernet 00:B0:D0:14:57:C0;
fixed-address 192.168.0.20;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws021 {
hardware ethernet 00:B0:D0:14:74:1b;
fixed-address 192.168.0.21;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
```

```
host ws022 {
hardware ethernet 00:B0:D0:14:74:28;
fixed-address 192.168.0.22;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws023 {
hardware ethernet 00:B0:D0:14:57:1e;
fixed-address 192.168.0.23;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws024 {
hardware ethernet 00:B0:D0:14:57:B6;
fixed-address 192.168.0.24;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }
host ws025 {
hardware ethernet 00:B0:D0:14:57:9f;
fixed-address 192.168.0.25;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c59x";

 }

host ws026 {
hardware ethernet 00:20:AF:D1:A4:34;
```

```
fixed-address 192.168.0.26;
filename "/lts/vmlinuz.ltsp";
option option-128  e4:45:74:68:00:00;
option option-129 "NIC=3c509";

 }
```

Here is the setup for our nameserver:

```
// generated by named-bootconf.pl

options {
            directory "/var/named";
            /*
             * If there is a firewall between you and nameservers you want
             * to talk to, you might need to uncomment the query-source
             * directive below.  Previous versions of BIND always asked
             * questions using port 53, but BIND 8.1 uses an unprivileged
             * port by default.
             */
forwarders {
                        142.165.21.5;
                        10.244.0.66;
                         10.196.66.5;
         };

            // query-source address * port 53;
};

//
// a caching only nameserver config
//
controls {
            inet 127.0.0.1 allow { localhost; } keys { rndckey; };
```

```
};
zone "." IN {
        type hint;
        file "named.ca";
};

zone "localhost" IN {
        type master;
        file "localhost.zone";
        allow-update { none; };
};

zone "0.0.127.in-addr.arpa" IN {
        type master;
        file "named.local";
        allow-update { none; };
};

zone "ltsp" IN {
    type master;
    file "ltsp.zone";
    allow-update { none; };
};

zone "0.168.192.in-addr.arpa" IN {
    type master;
    file "ltsp.arpa";
    allow-update { none; };
};


include "/etc/rndc.key";
```

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