

Low-Cost, High-Performance Computer Infrastructure for Schools

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Introduction

We served as U.S. Peace Corps Volunteers in the Philippines from 2006-2008. We were assigned to Compostela National High School (CNHS), a high school with approximately 2000 students. By the time we arrived, the principal and teachers of CNHS already had significant exposure to Information Technology (IT) through prior donations of computers as well as trainings mandated by the Department of Education in our area. Our main mission thus evolved into working with the principal, the Parent Teacher Association (PTA), and the teachers to create a distributed computer infrastructure at the school. The hope was that this infrastructure would support students learning about IT as well as students learning with IT.

A key challenge was resource limitations. First, there was the obvious limitation of funding; the school itself had very little money with which to add IT facilities. But more importantly, any computer infrastructure creates a workload demand for maintenance. CNHS has an IT coordinator, but she is also the math department head and teaches classes in addition to her IT responsibilities. We had to design a system that did not greatly increase the maintenance workload on campus.

Neal is a long-time Open Source software and Linux user, and this seemed like an obvious foundation on which to build a low-cost computer system. He was also familiar the Linux Terminal Server Project (LTSP). This is discussed more in the next section, but it allows one to connect multiple low-capability computers (known as “thin clients”) to a single power computer (typically called a “server”). The thin clients do not themselves do much other than offer a display to the user. The actual software resides on and is executed by the server for each of the thin clients that are connected. This means that the thin clients do not have to be very capable, so they can be very low cost. The CNHS project was greatly facilitated by the World Computer Exchange (WCE), a U.S. non-profit that accepts donations of used computers and then sells them at low cost to overseas agencies (see <http://worldcomputerexchange.org/>).

Since the time of the CNHS project, there have been significant advances in LTSP and in the capabilities of computers in general. The basic concepts behind the CNHS work have continued to be refined such that it is now close to a turn-key system and does not require extensive Linux knowledge. The rest of this report will describe the improved CNHS LTSP implementation for those who might be interested in replicating it. It includes hardware specifications for the server and thin clients, describes the software environment, outlines the implementation process, and discusses issues relating to on-going maintenance.

LTSP Background

Below is an extract from Wikipedia (http://en.wikipedia.org/wiki/Linux_Terminal_Server_Project) on LTSP.

“Linux Terminal Server Project (LTSP) is a free and open source terminal server for Linux that allows many people to simultaneously use the same computer. Applications run on the server with a terminal known as a thin client (also known as an X terminal) handling input and output. Generally, terminals are low-powered, lack a hard disk and are quieter than desktop computers because they do not have any moving parts.

This technology is becoming popular in schools as it allows the school to provide pupils access to computers without purchasing or upgrading expensive desktop machines. If the school does not have enough computers, new thin client machines are less costly than standard computers. If the school does have enough computers but they are a few years old, they may be able to extend the useful life of obsolescent computers by converting them into thin clients, since even a relatively slow CPU can deliver excellent performance as a thin client. In addition to the possibility of getting more

performance for less money by getting one high-end server and turning their existing computers into thin clients, an educational institution may also gain more control over how their students are using computing resources by switching to a thin client configuration. Some examples of distributions using LTSP are Edubuntu, K12LTSP and Skolelinux. LTSP is a registered trademark of DisklessWorkstations.com, LLC.

The founder and project leader of LTSP is Jim McQuillan, and LTSP is distributed under the terms of the GNU General Public License.”

Benefits of LTSP

The key driver for LTSP is minimization of life-cycle costs for the computer infrastructure at a school. This includes the initial investment for hardware and software but also costs (time and money) for on-going maintenance.

When we arrived in the Philippines in 2006, the standard paradigm for IT infrastructure for most schools was a single IT lab with 5-20 stand-alone computers with the Microsoft Windows operating system (OS) and Microsoft Office applications installed. This had to serve tens of teachers and 1000-2000 students. Often the Microsoft OS and applications were pirated, and always the computers were infested with viruses to the point that they were almost unusable. Teacher and student files were stored locally on a single machine and thus highly vulnerable to loss – not to mention the inconvenience of having to work on only that one unit to have access to one’s files. Software changes and upgrades, when they were done, had to be performed on each individual computer.

Although undesirable, this model worked when the number of computers (and computer users) on campus remained small and all computer capabilities were centralized in one place. However it was clear that this approach could not possibly be scaled, nor would one want to.

In working with the teachers at CNHS, a vision emerged of a decentralized, reliable, and capable computer infrastructure on campus, available to both teachers and students inside and outside of the classroom. A Campus Map (see figure below) was an effective tool for creating and refining the vision.

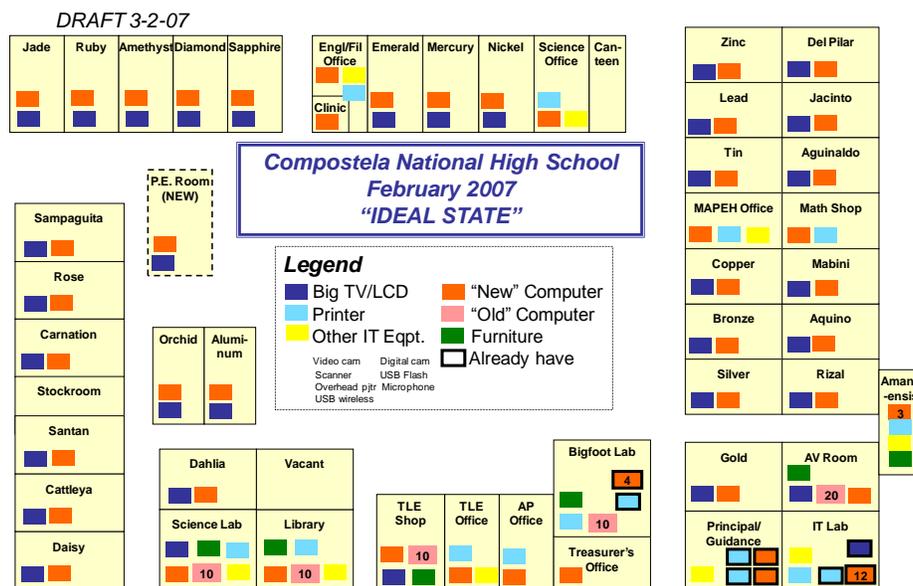


Figure 1: CNHS Campus Map

However this vision had to be realized in the context of limited financial and technical support resources for acquisition, installation, and on-going maintenance.

The solution deployed was LTSP in combination with Open Source software¹. Using LTSP meant that obsolete computers could be acquired from WCE at very low cost but could provide the power desired by the CNHS user community. The number of computers available on campus jumped by an order of magnitude as a result, with an investment of less than 10,000 \$US (including computer furniture).

In summary, the initial objectives of the CNHS IT infrastructure project were as follows:

- Low Cost
- Widely Distributed Across the Campus
- Easily Maintained

The benefits of using LTSP as implemented at CNHS include:

- Easy maintenance – OS and application software is only on the servers, so there is no need to make any changes to the thin clients
- Thin clients can be added or removed easily
- Multiple servers can be run in a large school supporting easy scalability
- Open source software is free, with no legal concerns about piracy
- No problems with viruses
- All access to Internet is controlled through a single computer to provide filtering of content
- Users can access their own files from any computer

LTSP (Server-Client) Architecture

LTSP is just one of many existing implementations of a more general concept of “server-client” architecture. Conceptually it is very straightforward, as shown in the figure below.

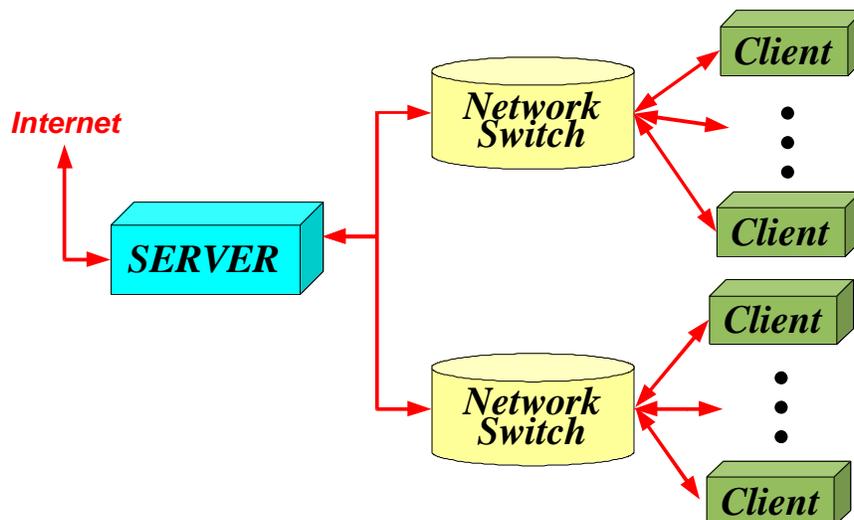


Figure 2: Basic Architecture

¹ Another key element of the CNHS project, use of wireless networking on campus, provided the desired decentralization but will not be discussed in detail in this report.

The server is a powerful computer which has the OS and the applications installed. All files are stored on the server. The server also has specialized software (e.g., LTSP) that allows it run the software for each of the thin clients that are connected to it.

Each thin client is connected through an Ethernet cable and a network switch to a network card in the server. For schools with internet, there is a second Ethernet card in the server computer that connects to the internet.

When a thin client user starts up an application, it looks to them like it is running on their computer screen and that they (and they alone) control what is done on their computer. However the application is actually being run on the server computer with the information being sent back to the thin client. The server is powerful enough to make each thin client look capable, even though it isn't. The thin client computer is really only lending its display, keyboard, mouse, and memory to the process. No hard disk is needed, and no data or software is permanently stored on the thin client. The thin client is sometimes referred to a "dumb terminal". This all means that the thin clients really need minimal capability themselves but are capable of emulating a much more powerful computer. Depending upon the server capability and the type of applications being run, servers can support 10-20 thin clients.

What the thin clients do need though is a way to be informed during their boot-up that they should serve as a thin client rather than as a stand-alone computer. For more modern computers (~1999 onward), there is a "network boot" option that can be set up in the BIOS. This is the simplest approach, since the thin client will directly start with the network connection to the server. For older computers (Pentium 1/2), the network boot option does not exist so the thin client must read and execute a very short file upon boot (the thin client network boot script) to direct them to operate as a thin client. This short file can be put on a floppy or CD, with the thin client then set up in BIOS to boot from that device. This is a little clumsier because it requires this external media and obviously requires a working floppy or CD in the thin client. Floppies in particular are very low reliability, and this has been an extra maintenance workload at CNHS to ensure that floppies are available and working for the boot. Thus if more recent machines are available at reasonable cost (e.g., Pentium 3), this is more desirable.

It should be noted that almost any computer can serve as a thin client. The huge advantage of having only one computer (the server) that has to have an OS and applications makes the server-client approach attractive for almost any hardware. In fact, even very capable computers at CNHS were used as thin clients rather than as stand-alone machines. Software upgrades could be easily added to the single server and immediately be usable on the thin clients, with no change needed to each individual thin client. **The life-cycle maintenance savings from using the server-client approach cannot be emphasized enough.** It is a huge win for already overworked teachers and IT staff. The use of Linux also means that there are no problems with viruses, a major headache and time sink for those administering Microsoft-based systems.

Note that thin clients cannot connect to the server via wireless because that would require an OS running on the thin client to support the wireless protocol. Thus all thin clients must be connected with an Ethernet cable through a network switch to the server. However if desired, one can have another OS present on the thin client for stand-alone operation.

In summary, here are the characteristics of the CNHS LTSP (server-client) architecture:

- Centralized server computer
- Thin clients are connected through Ethernet cables and network switches to the server

- Each of the thin clients looks like a capable unit but since all applications are actually running on the server, the thin clients can be low-cost
- Linux Terminal Server Project (LTSP) software to manage the server-client interactions
- Allows a school to connect many (10-20) low-cost computers to a single powerful server
- Centralized maintenance – software only needs to be upgraded on one computer, the server

Minimum specifications for the server and thin client machines will be discussed in the next two sections. Following that will be a description of other hardware that is needed for the server-client setup.

Specifications for the Server

Minimum Server Specifications:

- Dual core processor, at least 2.7GHz clock speed
- At least 4 Gbyte RAM
- At least 500 Gbyte hard drive
- Two Ethernet connections (one 100 Mbit and one 1 Gbit)
 - Add 1 Gbit connection for each additional network switch
- Means of backup (RAID disk or external computer with adequate disk space)

Server RAM is the most important factor in improving speed for most applications. Network speed is important for video.

Some means of backing up the server is required – either a RAID system within the server or a separate computer. If possible, a remote backup should also be made periodically. A backup script is included in the software to automatically run a daily incremental backup. It can be set up to run at the same time each day or when the computer is turned on.

Specifications for the Thin Clients

Minimum Thin Client Specifications:

- At least Pentium 1 with 200MHz clock, Pentium 3 is better (almost any computer can be a thin client)
- No hard disk required
- At least 128 Mbyte RAM
- Ethernet connection
- Some means of booting to the server (option for “network boot” in BIOS or set up in BIOS to boot from a working CD or floppy drive for older P1/P2 computers)
- No software installation required on clients

Thin client RAM of less than 128 Mbytes will result in slow performance. Anything less than 64 Mbytes will be unacceptably bad.

The new implementation of LTSP allows one to run video or a browser on the thin client computer. This reduces the load on the server and the network. This is the best choice if the thin clients are at least a Pentium 3 with a minimum of 192 Mbytes of RAM. For less capable thin clients, the video or browser should be run on the server. Either option can be selected with a single server on the same network on a

thin client-by-thin client basis. If there is an expectation that video streaming will be an important component of thin client use, then it is important to make sure that the optimal setting is chosen.

Other Hardware Required

Other hardware required:

- Gigabit network switch(es) to connect clients to server (8 channel switches are the least expensive and can be daisy-chained if needed)
- Ethernet cables
 - One per thin client (to connect each thin client to a network switch)
 - One per network switch (to connect each network switch to the server)
 - One for internet (to connect the internet to the server)
- Keyboards (one for server plus one for each thin client)
- Mice (one for server plus one for each thin client)
- Monitors (one for server plus one for each thin client)

In some countries, it may be advantageous to have a voltage regulator for each computer and monitor. Having an Uninterruptible Power Supply (UPS) for the server is also prudent. Most computers and monitors are capable of running either 110 or 220 volts, but computer power supplies typically must be manually switched to accommodate 220 volts. Monitors should be checked to ensure that they operate at 220 volts, if that is the local voltage.

Experience in the Philippines showed that CRT monitors had the most limited life of the used equipment that was deployed. If funding permits, spares should be purchased to account for attrition. Flat panel displays may not manifest this problem, since their heat dissipation is less.

Software Environment

In this section, the current software environment will be discussed. It has evolved considerably since the initial implementation at CNHS in 2007.

Standard Distribution Software:

- Linux Ubuntu 10.4 operating system (10.4 is a long-term support version of Ubuntu)
- Linux Gnome user interface (tailored to look like Windows)
- Open Office (word processor, spreadsheet, presentations)
 - Can save/read Microsoft Office format
- Mozilla Firefox web browser
- Adobe Reader
- Movie player (Totem)
- Photo editor (Gimp)
- Web page design (Bluefish)
- CUPS printer manager
- Educational software

Custom Software:

- School resources configured for immediate use:

- WordPress blog
- School Wiki
- Moodle
- Squid internet filtering and caching with filters already in place and set up for weekly update
- Internal Apache web server, home page with links to internal services and key external sites
- Firewall configured to protect all internal resources
- VPN for remote trouble-shooting and maintenance
- Prebuilt student and teacher accounts and file management structure
- Student accounts that can be created or replaced with a single command, to remove unwanted student changes
- Teaching and training resource repository

The entire CNHS LTSP system image can be put on a hard disk. This hard disk can then be installed in a server and set to boot automatically when the computer is turned on. A computer can also be set up to boot from a USB external disk with the system image, for demonstration purposes.

As noted earlier, there is a thin client boot script that must be read from floppy or CD for older computers if the “network boot” option is not available in BIOS.

There seems to be some degree of user phobia about the use of Linux and Open Source software, perhaps due to the early days when there was only a command line interface for Unix. However, in the same fashion as DOS gave way to Windows, so too Linux now has options for easy-to-use graphical user interfaces (GUIs). From the application perspective, Microsoft Office 2003 is more similar to Open Office than it is to Office 2007. It is just a matter of gaining familiarity with the Linux and Open Office GUIs, and it is no different than the learning curve and start-up time needed to learn any new software package or new capabilities. Our experience at CNHS bore this out. Over the course of a month or two, the teachers clustered around the virus-ridden Windows 98 computers on one side of the IT Lab began migrating over to the Linux computers on the other side of the lab as they discovered that they really were easy to use (and much faster), just a little different. Eventually the Windows 98 machines were turned into thin clients themselves. In short, the transition to Linux and Open Office for users is less painful than one might expect.

Somewhat counter-intuitively, the most experienced Microsoft users tended to find the transition harder than less experienced users. Basic operations are almost identical between Microsoft Office and Open Office, but the lesser-used, more sophisticated features were not always identically named or placed (for example, the pivot table in Microsoft Excel is called Data Pilot in Open Office Calc). Hence the Microsoft power users sometimes had to search a while to find where their favorite tricks and capabilities were located in Open Office. (The same was likely true for power users in the transition from Office 2003 to Office 2007).

Benefits of a Centralized Server

There are a number of advantages to having a centralized server. These are listed below:

- Because the internet must pass through the server, content can be filtered for appropriateness
- Websites that are used regularly can be cached for quick follow-up access
- Teachers have personalized accounts, usable anywhere on campus
 - Password-protected
 - Individual user profile information

- Personal file storage space for each account
- Shared file storage space for all teachers
- Students use generic accounts anywhere on campus
 - Common look-and-feel for all student accounts
 - Folders for each student for individual file storage

Internet filtering is an essential feature for schools, to ensure that students do not have access to inappropriate websites. In addition, streaming video sites (such as YouTube) were blocked at CNHS due to the limited internet bandwidth. A few students or teachers viewing videos slowed down all users on campus, so videos were accessible only through a single special portal in the IT Lab.

Case Study: Compostela National High School, Compostela, Cebu, Philippines

Appendix G includes a final summary report published in August of 2008 for the U.S. Peace Corps project at CNHS. However since that time, we have kept in touch with the principal and teachers at CNHS and made several return visits. This has given us the opportunity to observe the continuation of the project and note successes, concerns, and lessons learned.

Successes:

- Students in all four year levels are able to use computers in IT classes and for projects and research.
- Ever-increasing computer literacy of teachers – all teachers are using Ubuntu and Open Office for teaching and administrative tasks such as calculating grades.
- PTA commitment to maintenance – the school has two part-time computer technicians, one focused on hardware and the other on software. The software technician was one of the original Student Computer Specialists and is currently studying IT in college.
- The student blog is active.
- No viruses!

Concerns:

- Monitor attrition has been an issue – some computers are unused because there are no monitors
- Wireless speed to remote sites (not an LTSP issue)
- Use of PPT files (font incompatibilities with Draw)
- Printers
- Power outages
- Floppy reliability

Lessons Learned:

- Full disk – get bigger disk
- Disk errors/disk failures (can be mitigated with use of RAID)

Initial Installation

In this section, a short summary will be given of the installation process.

Checking Out the Equipment

At CNHS, there was an initial equipment check-out when the WCE shipment arrived. The Student Computer Specialists were an integral part of this process. The checklists that were used are included as appendices. Each piece of equipment was numbered for ease of tracking.

Appendix A: Computer Arrival Tasks

Appendix B: Pentium 1 Computer Check Procedures [also used for the Pentium 2 computers]

Appendix C: Pentium 1 Checklist [also used for the Pentium 2 computers]

Appendix D: Pentium 3/4 Checklist

Appendix E: Monitor Checklist

There were three primary issues for the Pentium 1 and Pentium 2 computers. The first was determining the best way to boot. In order of preference, network boot, CD boot, and floppy boot were all tried for each of the computers and notes made in the checklist. The second issue was determining the amount of RAM and the processor clock speed. This information was recorded on a log sheet. Significant effort was spent in swapping RAM in order to get all thin clients up to 64Mbytes of RAM. As noted earlier though, 128Mbytes results in much better performance but this was generally not possible for the older P1 computers. The final issue was installing an Ethernet card if one was not present in the computer. These cards were inexpensive and could be obtained locally.

One issue that caused considerable trouble was the wide variety video cards in the P1 and P2 computers. Some required significant research to make sure that the correct drivers were included in the LTSP software.

In general, it is much easier if all of the thin clients are the same model – once a problem is solved, it is solved for all units. The P1/2 thin clients shipped to CNHS by WCE were not homogenous, and thus it took quite a bit of effort to check out everything. Non-homogeneity also hindered salvaging of parts, which could have been combined to make addition working units.

For the Pentium 3/4 computers, the processor clock speed and amount of RAM were checked. Again, some of the memory was switched around to make sure that the Pentium 4 computers (to be used as servers) had enough RAM.

Appendix F is a summary of the computers received from WCE and what was usable for the LTSP setup.

Note that check-out should be considerably easier for modern computers, which generally have the network boot option that can be set directly in BIOS.

Set up the Server

Ensure that the server fulfills the minimum specifications. Install the LTSP hard disk, and set it to boot to “Main Server”.

Connect the System

Cable everything together. An Ethernet cable should be connected from each thin client to a network switch. Network switches can be daisy-chained, if needed.

Connect the network switch to the 1 Gbit Ethernet card in the server.

Connect the internet (if available) to the 100 Mbit Ethernet card in the server.

Setting up the Thin Clients

Turn on the server and let it get to the login screen

Turn on the thin clients – if they boot to the login screen, you don't have to do anything with the settings

If it doesn't boot, then you will need to make a small edit to a file that has the network configuration:

- Log in to the server with a user name of sysadmin (password is 1sys2admin3)
- Open the command line screen by clicking once on the icon at the bottom of your screen (the icon looks like a computer screen and is called "Terminal")
- To open the file, type \$ sudo gedit /etc/udev/rules.d/70-persistent-net.rules
- You will need to input the password again for the sysadmin account
- That will open the editor window and display the configuration file
- If it says NAME="eth0" then change it to say NAME="eth1" and if it says NAME="eth1" then change it to say NAME="eth0"
- Then go to "File" and "Save" (in the menu bar at the top of the page)
- Finally, go to "File" and "Quit editor"

Setting up the Internet

For the internet connection, the server's internet connection is set up to configure itself with DHCP automatically. Test that the internet works by open the browser and going to google.com. If it doesn't work, try to troubleshoot: confirm that internet connection is alive by another means, check cabling, check lights on modem, and check light on the server's Ethernet card. In a command line window, try typing \$ ping google.com to see if that works.

Setting up Teacher Accounts

Default teacher and student accounts are already created (teacher1 through teacher20, student1 through student20) – password for each of the student accounts is "student" – passwords for each of the teacher accounts is same as account name.

There is script available to create personal accounts for teachers.

Setting up Printers

Printer should be automatically recognized but if it isn't, use the printer setup program:

- "Applications"
- "System Administration"
- "Printing"
- This opens window to add printers.

Ongoing Maintenance

- Analog to task manager in Windows
- Empty trash
- Backup and recovery from disk failure (RAID emergency disk)
- Thin client boot floppies, CDs
- Network connectivity checks
- Internet outages – how to diagnose when it is internet and when it is school

Appendix A: Computer Arrival Tasks

Tasks:

1. Complete inventory list for Province
2. Label all 110V equipment
3. Cut off ground tabs on monitors and computers
4. Mouse check
5. Monitor check
6. Keyboard check
7. Pentium I check
8. Pentium III/IV check
9. Distribute power cables
10. Printer checks

Monitor Check-Out

1. Obtain a monitor.
2. BEFORE PLUGGING IN: Check to make sure the monitor can run on 220 V – if it does not, do not plug it in!
3. Measure the diagonal size of the monitor and record it on the log sheet.
4. Make sure that the monitor has a video cable and a power cable attached. If it doesn't, obtain them and put them with the monitor.
5. Using a computer that you know works, test each monitor by plugging it in. If it works, put a "Y" in the column on the log sheet that says "Works? (Y/N)". If it doesn't turn on at all, put "N" in that column and put a label on the monitor that says "Needs Repair".
6. Leave on for one hour. At the end of that time, write down any comments if you see problems with the picture quality or the color quality.

Keyboard Check-Out

1. Obtain a keyboard.
2. Using a computer that you know works, test the keyboard by plugging it in and trying each letter key and the Enter, Shift, and Tab keys. If the keyboard does not function at all, put a label on it that says "does not work" and put in the "Needs Repair" area. If most of the keys work, put a label on it that says "most keys work" and put in the "Needs Repair" area. If it works, put in the "Ready for Use" area.

Mouse Check-Out

1. Obtain a mouse.
2. Using a computer that you know works, test the mouse by plugging it in and trying to click, double-click, drag, and highlight. If the mouse does not function well, put a label on it that says "needs repair" and put in the "Needs Repair" area. If it works, put in the "Ready for Use" area.

Appendix B: Pentium 1 Computer Check Procedures

Introduction

The Pentium 1 computers will all be booted from the network and will not use the internal hard drive. This means that the checkout will be somewhat different from checkout of other computers. Most importantly, the only test on the hard disk need be a check on the size of the disk should it be needed for some other purpose in the future.

The network boot will be done in one of three ways:

1. Boot directly from card via “pxe boot”.
2. Boot from CD if drive is available.
3. Boot from floppy.

Computer Check

1. Obtain a computer. Place an ID tag on the computer and record the number on the log sheet.
2. Obtain a previously tested monitor, mouse, keyboard, power cable, and a working network connection to the LTSP test server.
3. Connect the keyboard, mouse, and monitor to the computer.
4. Plug in the computer and monitor and turn on the unit.
5. There are three possible outcomes that you will observe:
 - a. The computer comes on and boots to an operating system (go to Case #1)
 - b. The computer comes on but does not boot to an operating system (go to Case #2)
 - c. The computer does not come on (got to Case #3)

Case #1: The computer comes on and boots to an operating system

1. Check the keyboard and mouse. If they don't work, go to Case #3 since it may be a problem with the computer.
2. Determine type of OS. Perform a check of the floppy and CD drive – put in a floppy and a CD and make sure they are readable. If they don't work, record this on the ID tag.
3. Check computer networking. Locate ethernet connector, plug into test network using a pretested cable. Look for light by ethernet connector and note result on log. If you do not see a light try unplugging and replugging the network cable. If no ethernet connector can be found note this on tag and in logbook. Leave cable connected.
4. Go to Test With CD

Case #2: The computer comes on but does not boot to an operating system. This is not a problem for network boot but continue test merely to determine computer information.

1. Check for blinking light on front of computer that could show that the computer was checking the hard disk.
2. Check error message after computer starts. If message says “disk not found” then hard drive may be bad or unplugged.
3. Note results on logsheet.

Case #3: The computer does not come on:

Check power connection and all other cables. If this does not solve the problem just set the computer in the failed parts area for test and work after all other computers have been tested.

Later diagnostic steps:

- Check to make sure all boards are seated properly
- Try replacing the memory
- Try replacing the power supply

If we can't get the computer to work, we can salvage the parts (CD reader, floppy drive, memory, hard disk, etc.)

Test With CD

If there is a CD drive attempt to boot from it with a CD labeled "DSL 4.0 Test". There are three possible alternatives:

1. The computer reads the CD and boots from it. Continue to the section "Check With CD"
2. The computer boots from the hard drive. Turn off power and restart the computer while repeatedly pressing the "F12" key. This may give you a menu of devices to boot from. Choose CD and continue the boot. The system should boot from the CD. If you see the option "Boot From Network" or "PXE Boot" when you see the boot menu note this on the tag. This is the best case because all network boots can be done without a CD or floppy.
3. Nothing happens. The CD light does not blink and there is no sound from the CD drive to indicate that it is turning. Note this on the tag and proceed to section "Boot From Floppy"

Check With CD

Now use the DSL operating system that has booted from the CD to perform other tests and checks on the computer. All tests are performed by running programs that are started from the programs menu labeled "DSL" in the lower left corner of the screen. If the computer has very little memory the tests may be slow.

- Setup the network card. The cable should still be plugged in. Then from the menu choose "Setup" "Net Setup" netcardconfig". A window titled "DSL-Netcard Config" will appear. Select the choice "Use DHCP Broadcast" and then click the "Apply" button. Then click "Exit" to close the window.
- Now start the program "System" "System Stats". This program will be used to determine many things about the computer. The steps are:
 1. Select tab "cpu". Log "model name" and "cpu MHZ" on the logsheet.
 2. Select tab "mem" Log "MemTotal" on the logsheet.
 3. Select tab "net". It should show two major entries: "eth0" and "lo". In the fourth line of the block for eth0 you should see that the number of "RX packets" is not 0. The number in "TX Packets" on the next line should also not be 0. The numbers need not be the same. Record on the logsheet if this test is successful. You need not record the number of packets.
- Shutdown the computer from the menu by selecting "Exit" "Exit Options". A window titled "DSL Exit Options will appear. Uncheck the box "Backup" choose "Shutdown" and then OK. The CD should eject in a little while. Remove, close tray, and press enter to shutdown.

Now test network boot with a CD. Boot with the CD "Network Boot" in the same way that you did with the "DSL 4.0 Test" CD. It should look like a normal LTSP network boot. Look for the standard line of "....." very soon in the start up. Note in logbook the results, just turn off the computer. The rest of the LTSP boot will be tested later.

Test with Floppy

Now you will try network boot with a floppy. Just as you may have had to press F12 to get the computer to

boot from a CD you might have to do this with the floppy. Confirm that the light on the floppy drive lights up and that the floppy drive makes noise. The start should look like a normal LTSP boot with the line of “....” Just like the CD test you should turn off the computer if it performs this first part of the LTSP boot. Record the results on the logsheet.

Setup For Automatic Network Boot

This may be complicated. There may be several settings that will need to be changed in the computer's “BIOS”. Call Sir Neal over to check the computer and, if possible, set it up for automatic network boot.

Test LTSP

After deciding the best boot process to LTSP, try a full boot to LTSP. It should boot all the way to the login screen. Attempt login. You may get permission denied. If you do not reach the graphic login screen call Sir Neal to determine what the computer has done and what fixes might be needed.

Appendix C: Pentium 1 Checklist

Pentium 1 Computer ID:

Can set power supply voltage to 220v: Yes__ No__ *Do not test further if no switch!*

Turns on, starts to initial startup screen: Yes__ No__

External case condition:

Mouse and keyboard Work: Yes__ No__

Has CD drive: Yes__ No__ CD works: Yes__ No__

Has Floppy Drive: Yes__ No__ Floppy Drive Works: Yes__ No__

Has ethernet: Yes__ No__ Ethernet works: Yes__ No__

Has Hard Drive: Yes__ No__ Hard Drive Size: Yes__ No__

Boots with CD "DSL 4.0 Test" : Yes__ No__

CPU Type and Speed:

Memory Size:

Ethernet good with DSL test: Yes__ No__

LTSP initial boot with CD: Yes__ No__

LTSP initial boot with floppy: Yes__ No__

PXE automatic boot: Yes__ No__

LTSP full boot result:

Other Comments:

Appendix D: Pentium 3/4 Checklist

Pentium 3 or 4 Computer ID:

Can set power supply voltage to 220v: Yes__ No__ *Do not test further if no switch!*

Turns on, starts to initial startup screen: Yes__ No__

External case condition:

Mouse and keyboard Work: Yes__ No__

Has CD drive: Yes__ No__ CD works: Yes__ No__

Has Floppy Drive: Yes__ No__ Floppy Drive Works: Yes__ No__

Has ethernet: Yes__ No__ Ethernet works: Yes__ No__

Has Hard Drive: Yes__ No__ Hard Drive Size:

Boots with CD "DSL 4.0 Test" : Yes__ No__

CPU Type and Speed:

Memory Size:

Ethernet good with DSL test: Yes__ No__

Boots to OS: Yes__ No__

OS type: Win 98_ Win 2000_ Win XP Home_ Win XP Pro_

Has Windows Office: Yes__ No__ Office Version:

Has Window Office Access Database: Yes__ No__

Other Software:

Other Comments:

Appendix E: Monitor Checklist



Monitor Check-Out

←Diagonal Size

Unit Number	Diagonal Size (in inches)	Works? (Y/N)	Comments on Picture Quality (ok, distorted, blurry, shaky, doesn't fill entire screen, etc.)	Comments on Color Quality (ok, reddish, blueish, greenish, etc.)
WCM-1				
WCM-2				
WCM-3				
WCM-4				
WCM-5				
WCM-6				
WCM-7				
WCM-8				
WCM-9				
WCM-10				

Appendix F: Items Received from World Computer Exchange

Incoming Inventory of WCE Items, 2-7-08

Item	Quantity Shipped	Quantity Usable	Notes
Pentium I Computer	64	47	a
Pentium III Computer	14	14	
Pentium IV Computer	15	14	
Monitor	90	82	b
Mouse	95	85	c
Keyboard	87	82	

- a Attrition in most cases was due to inadequate clock speed and/or RAM.
- b At least two monitors were inadvertently destroyed because they did not operate on 220 volts.
- c Some of the mice had a serial interface, which did not work with LTSP at that time.

Appendix G: Improved Computer Infrastructure Project Report (August 2008)

The main focus of the computer resources at CNHS before this project was teaching students about IT. However, a key objective was to have students to also learn with IT. To achieve this, there were three main elements of the Improved Computer Infrastructure Project:

1. To provide assets for computer use in the classroom
2. To create new student labs
3. To provide computers in faculty department offices

Below are photos which show project implementation to date.

Computer Use in the Classroom

The major part of the counterpart contribution to the PCPP was the purchase of a TV for every classroom. This allows teachers to use IT in any classroom on campus by just connecting a computer to the TV. The TV purchases were coordinated by the Parent Teacher Community Association (PTCA) and were funded by a contribution from the parents of each student.

In February of 2007, CNHS was extremely fortunate and grateful to receive a donation of 19 laptop computers from the Safeway Corporation in America. This was followed by a donation of an additional 13 units. These laptops gave an immediate solution to the security concerns surrounding computers in the classroom, since they could be stored in a secure place and taken into the classroom when needed.

Below are photos taken in some of the classrooms with the TVs in use with the laptops.



*Left: A Filipino class in the 1st year Section Gold classroom
Right: A Science class in the 3rd year Section Rizal classroom*



Student Labs

One other key project goal was to give students access to computers for use in all subject areas. The original project called for creation of five new computer areas for student use: the Bigfoot Lab, the science lab, the library, the Audio Visual Room (AVR), and the Technology and Livelihood Education (TLE) workshop. The TLE workshop plan had to be changed due to acquisition of welding equipment and sewing machines which took up the planned space for the computers. The computers planned for the TLE

workshop were split thus among the other four new labs as well as adding some additional computers in the existing IT Lab.

Below are some photos of the new labs in use.



LIBRARY: These 1st year students are doing research on diseases. In the past, they would not have had access to computers at school. Our librarian, shown on the right, is teaching them how to use the Internet.



SCIENCE LAB: These computers are used during classes for lab simulations, on-line treasure hunts, worksheets and games, etc.



BIGFOOT LAB: This lab will allow the school to begin hands-on computer training to 1st and 2nd year students. It will also provide another venue for class-time computer use as well as open use by students. In these pictures, it is being used by teachers during In-Service training to do Internet searches for electronic teaching material.





AVR: This room is still being set up. Like the Bigfoot Lab, it will be available for teachers to reserve for their classes or will be open for general student use. Some of the slower hardware obtained (right) will be used for dissection, allowing the students to learn about the parts inside of the computer and how they are assembled.



Department Office Computers

Teachers at CNHS use computers both for classroom preparation and for administrative work. Formerly, they had to compete with students for the limited resources in the existing IT Lab. One of the outcomes of the project was to provide two computers for each of the seven departments that could be placed in the faculty offices for their use. Teachers could then use these conveniently placed units during their vacant time during the school day.



DEPARTMENT OFFICES: Each of the seven departments now has two computers for exclusive use by teachers. Left is English and Filipino office and right is AP (social studies).



Other Capabilities

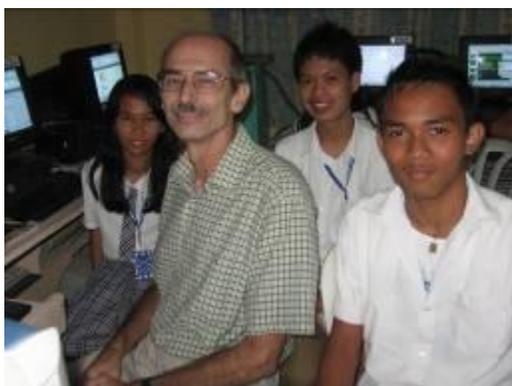
In addition to the three major goals, there were other significant improvements to the computing capabilities on campus.

1. Wireless: There are now wireless hubs in the IT Lab, library, and math department office. These allow for Internet access to all department offices, library, science lab, Bigfoot Lab, and AVR. Although it has not been tested yet, the Internet should also be accessible in some classrooms.
2. Laser Printer: A laser printer was placed in the IT Lab, and this has been a huge time-saver for teachers in printing their various reports. Formerly they used a dot matrix printer which was both slow and noisy.
3. Library Printer: This allows students, for a small fee, to print out the results of their research.
4. Computers for other campus services: A computer has been placed in the school Treasurer's office and others are being set up for the school newspaper office, the clinic, the student government office, and the property storeroom.
5. Scanner: This is for use by teachers and students. For example, teachers have used it to scan hard-copies of test materials for mimeographing, which is much cheaper than xeroxing.
6. Additional computers were added to the IT Lab. These have allowed more hands-on student use during the IT literacy classes.
7. Large TVs were added to the AVR and science lab, the former being a donation from the U.S. Embassy through the Cebu Rotary Club (see photo right).



Sustainability

The school has benefited from having two computer technicians. One is a graduate of Compostela National High School and is a college student majoring in IT. The other is a highly experienced computer hardware technician. Together they support the CNHS campus.



There were also 16 "Student Computer Specialists" on campus, 3rd and 4th year students working with Neal to assist with computer setup, cleaning, and maintenance (left). Several of the students were in this program for two years, so were able to obtain considerable knowledge of the system.

Left is a picture of PCV Rene Bierbaum with her colleagues Mrs. Nerry Bugtai (Math Department Head) and Mrs. Merlinda Lorenzana (Science Department Head). The three are conducting an Action Research approved by the Dep Ed Division Office on examining the most effective ways to use IT in the classroom that can be shared with all teachers.

