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While we all know computers cannot teach, they are excellent tools for conveying information of many kinds in the educational community and give good value for money and effort spent to place them in schools. Most schools use computer labs and a minimal number of computers in the classroom. I believe the time has come to increase use of computers in classrooms and I believe it can be done much more economically.

There are three key elements to these changes:

- we must use more free software
 - operating systems, Linux and FreeBSD, for example
 - applications, FOSS (Free Open Source Software), such as OpenOffice, GIMP, Mozilla FireFox
 - we can free ourselves from the cost and liability of dealing with a demonstrably unethical corporation, Microsoft
- we must use thin client/terminal server networks
 - K12LTSP has been very successful
 - Debian GNU/Linux + LTSP has a very large collection of software
 - thin clients are inexpensive to buy and operate
 - one terminal server costs about the same as a PC and can run applications and services for many clients
- we must do more to train teachers how to use PCs and networks in a teaching environment
 - I have offered to share at the next NATA convention
 - PD, demonstrations and literature should be distributed

I have written an article following this which goes into more detail and provides literature on this better way of providing computing technology in schools.

Economical Computer Technology in Schools

Robert Pogson 2005 La Loche

Following Moore's Law, the power of computer technology has grown exponentially. Educators need to harness this power efficiently for the benefit of students, teachers and society. Only ten years ago, a typical computer in school may have had 32 mb of memory, a 1 gb hard drive, a 200 MHz processor and no network access. Today all these numbers would be increased by large factors. Ten years ago, the cost of software was about 15% of the cost of a computer but today it is closer to 50%. The monopoly position of Microsoft Corporation has permitted it to make exorbitant profits at the expense of our taxpayers and students. At the same time, the quality of the software from Microsoft that we use in schools has not evolved dramatically. It requires great expense and effort to keep it from crashing and being taken over by malware.

To find the cause of these problems, read Cyberinsecurity - The Cost of Monopoly

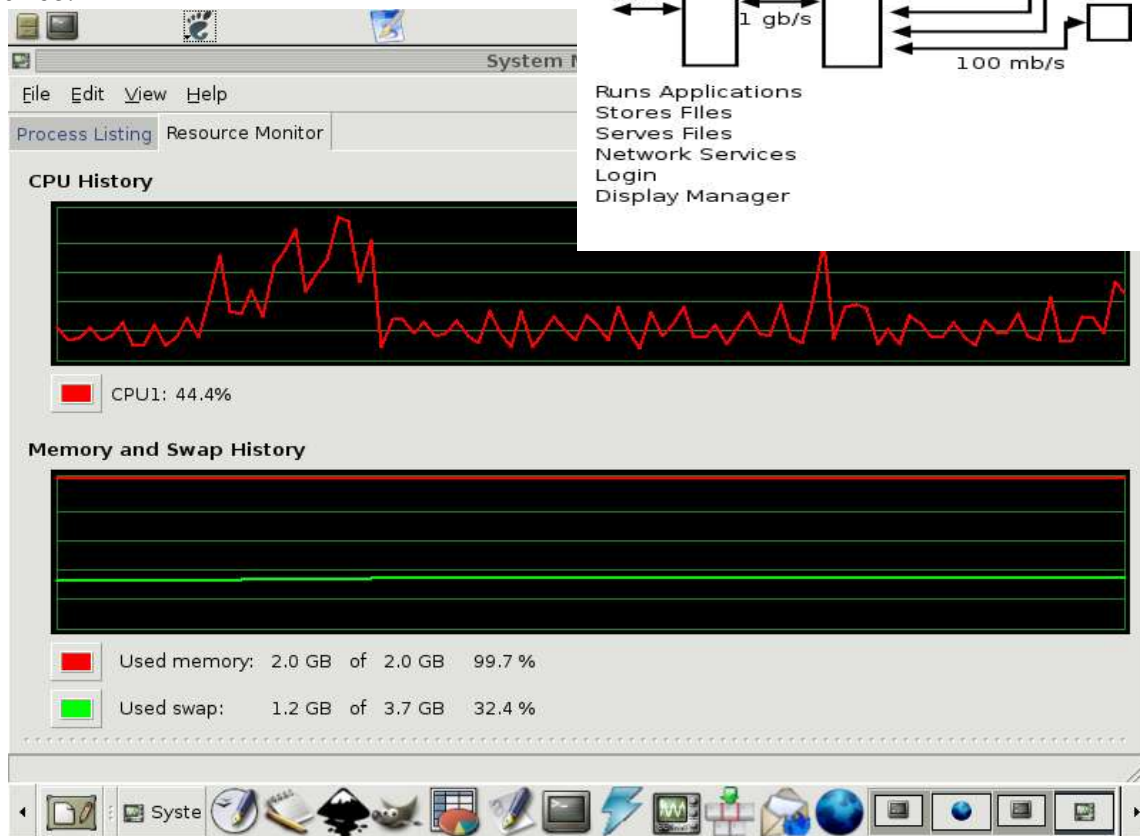
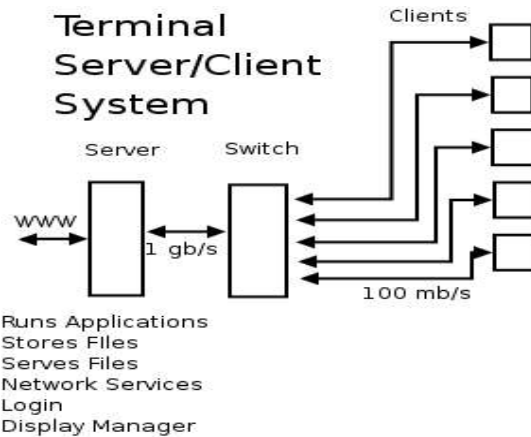
(<http://www.ccianet.org/papers/cyberinsecurity.pdf>)

In the past, Microsoft ruthlessly eliminated competition by illegal means and has been convicted in courts around the world but persists to the detriment of our students and our economy. This has been going on for a decade and Microsoft has been paying its fines and settling law suits out of court using the billions of excess profits its monopoly allows. The situation is now changing and it is in our power to help break the cycle of dependence on Microsoft.

Linux, an operating system with none of these ethical, technical and economic disadvantages, has matured to the point where it is feasible to use in schools. The Linux operating system has proven itself to be reliable and economical in education, business and personal use and a large body of software has been developed cooperatively around the world. Saskatchewan has been a place of cooperation so it is very appropriate to use software generated by users who wanted good software free of restrictive licences and fees. Most software for Linux is distributed under the GPL (GNU Public Licence) which authorizes use, copying and distribution under the same terms as the software was obtained. This body of work is copyright by the authors and the GPL is the explicit permission to use and copy.

Linux has been used successfully at the Battlefords, Sandy Bay and La Loche. Rather than the usual desktop installation where software is installed on the hard drive of each computer, these installations have used a client/server approach where the applications run on the server, a powerful, resourceful machine of moderate cost, and the user interacts with a client PC of modest power connected to the server by a 100 megabits/s network.

The power of the modern CPU can easily support many users as shown here. Seventeen users were running desktop applications on the server at once.



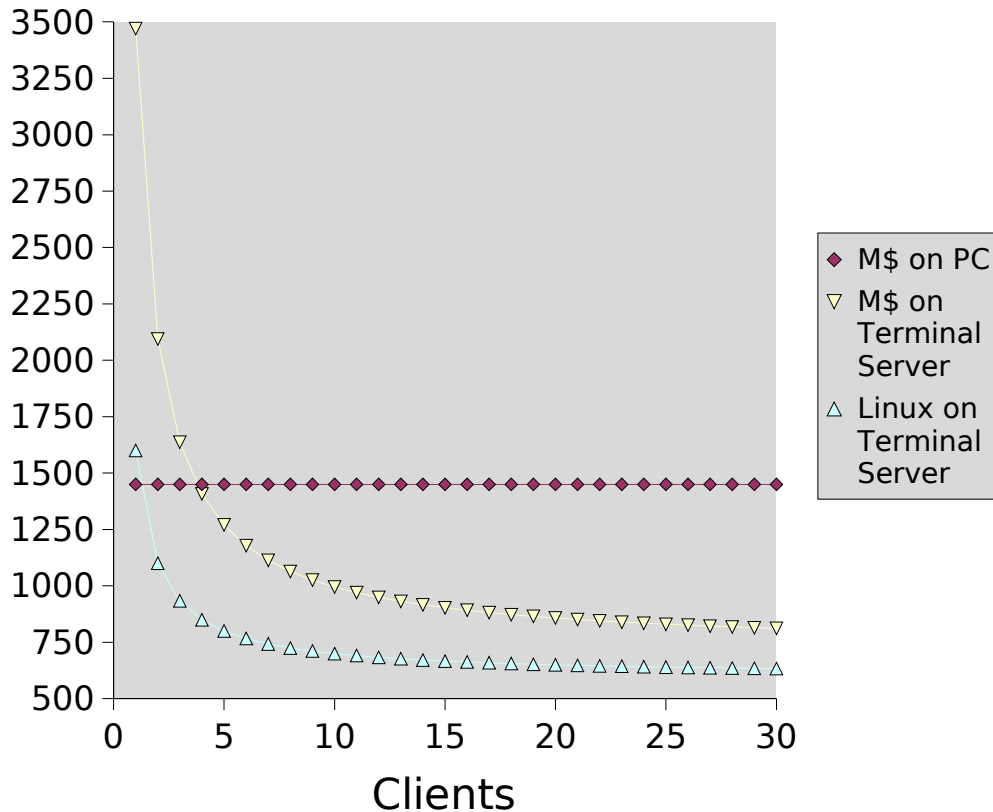
The network infrastructure is already in place for normal network and internet access. It can be used to connect the client PC to the Linux terminal server. Even a ten year old PC will do for clients.

The numbers are startling. Instead of spending \$1000 or more on each machine, schools can use new clients costing \$500 or old machines costing much less and spend about \$1000 for a server adequate to run 30 machines. This is beautiful for a laboratory where the teacher can control every process

by every student from one machine, and with a few such servers or with a server costing a few thousand dollars, a whole school can run. The cost of equipment per machine can be as little as \$533 using new clients or \$33 using available older machines. The software costs nothing but a little time to install. The savings are hundreds of dollars per machine and can be used to increase the number of PCs in a school. The cost of operation is lower as one never needs to replace a hard drive or the software on the clients. All the software except a boot loader is installed on the server and less effort is required because there are many fewer servers than clients.

We can choose to be practical, ethical or both when we select computer systems. It is interesting that we can do both by using smaller, less expensive, easier to maintain, less power-consuming thin clients instead of the usual PC. These cost less and are less damaging to the environment while they give all the benefits of a full computer. A thin client without monitor may cost \$200 and weigh a pound or so. An LCD monitor, keyboard and mouse may add another \$200 so we can have a thin client for \$400 or so. Compare that with PCs costing hundreds more in a system of hundreds of PCs and we can have huge savings. The reduced maintenance costs, and long lifespan (no moving parts, little heat) mean these machines cost little or nothing over their lifetime. A typical PC can use 200 W of power. This adds noise and heat to the environment. The thin client may use 20 W and has no fan. The difference, 180 W, over ten years of use @ 8 cents/kw-h comes to $180 \times 24 \times 365.25 \times .00008 = \126 , almost paying for itself. If you value the reduction in resource usage through using smaller computers longer, and the corresponding reduction in garbage production, it is a simple choice with no downside. Use Thin clients + Terminal Servers. It is a better way and the right way.

Cost per Client



The availability of Linux has spawned a huge effort to produce software for it. There are thousands of packages of software available freely under the GPL:

- Word processors - OpenOffice, AbiWord, KWord, Scribus
- Web Browsers - Mozilla, Netscape, Opera, Mozilla-firefox
- Spreadsheets - OpenOffice, Gnumeric, KSpread
- Image processing - GIMP, Blender, Cinepaint, Inkscape
- Scanning software - SANE
- Drawing software - OpenOffice, Inkscape, Dia, Blender
- Audio processors - Ardour, Audacity
- Audio/video players - XMMS, Totem
- Video processors - Cinepaint, cinelerra
- Educational games (youngsters) - GCompris, Kalkul, Neverending Tale and many others
- Library software - Koha, Emilda

There are repositories of free, open-source software on the web for Linux at

<http://Sourceforge.org> and distributions such as Debian. Sourceforge has over 100000 packages. Debian takes 8 CDs to hold the binary form of their software. With Microsoft, we usually get one CD for the operating system and one for Office, for a much greater cost.

While providing terminal services to the clients, Linux can also provide web services to browsers running on and off the server. This is much faster than using the web through a slow connection and web applications are easily installed. Recent research emphasizes the importance of web applications in education. See

http://www.sasked.gov.sk.ca/branches/institutions/rc_review/TEL.htm

We serve our own students a web page filled with local and web links to static and dynamic pages:

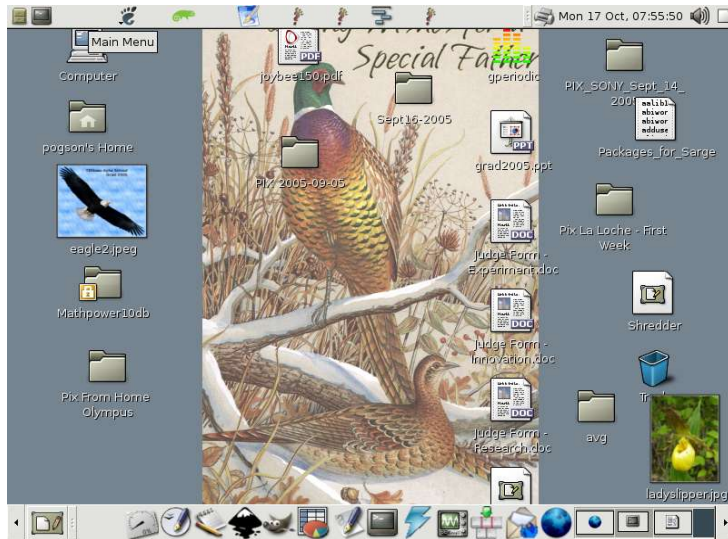


Examples of web applications that can be used in schools are Moodle course management system, bulletin boards, e-commerce sites, encyclopaedia like wikipedia.org, image galleries, and searchable databases. Having the sites in the schools allows teachers to have complete control of content and students can have personal experience with the latest technology through their web browsers.

There are particular advantages to using Linux for Information Processing and Computer Science. Students use software designed from the beginning for multiple users instead of Windows which was designed for ease of use in homes and offices of single users. In businesses and schools, the multi-user environment makes communication and sharing within the group much more natural and secure. The information processing cycle and open-source software development naturally thrive in the Linux environment. Software development on Linux is very simple and students have many programming languages available at no cost. Pascal, Python, Perl, Java, C and PHP are widely used for teaching.

I have introduced hundreds of students to Linux and, with the graphical user interface, they have no difficulty switching to Linux. The change from one version of Windows to another is a similar effort. Most features use the same point-and-click style used on Windows, and MacOS.

In Linux, the desktop is very configurable so the appearance is different. On my (rather cluttered) desktop I have placed two panels holding icons for commonly used applications, workspace changers (for multiple desktops), menu buttons, and all the folders I use frequently. Each user can have his own desktop and browser preferences available no matter which client he uses. In fact,



students can log into two or more clients at the same time if more screens are useful. The user can place icons and menus wherever he chooses with GNOME window manager. There are about a dozen window managers available.

The flexibility and savings Linux gives to educators is remarkable. We can control our computers instead of having Microsoft control us. I have offered to present this system at the next convention. It is time school divisions examined other options.

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Articles:

Battlefords Catholic School Board

<http://www.canopener.ca/article.php?story=20041011101716787>

Linux in Government: An Interview with Les Richardson, Author of Open Admin

<http://www.linuxjournal.com/node/7906>

Open Admin - Linux software for school administration

<http://linux.softpedia.com/get/Education/Open-Administration-for-Schools-2873.shtml>

Linux Case Study: Battlefords School Division

<http://casestudy.seul.org/cgi-bin/caseview1.pl?recnum=24>

Setting up my first Linux Terminal Server:

<http://www.skyweb.ca/~alicia/report.pdf>

Chinese Schools go with Linux

<http://www.informationweek.com/showArticle.jhtml?articleID=171203429&tid=16018>

South African Schools go with Linux

<http://www.tectonic.co.za/view.php?id=467>

Brazil adopts Open Source Software

<http://news.bbc.co.uk/2/hi/business/4602325.stm>

Large project in Saskatchewan

http://www.sun.com/products-n-solutions/edu/success/pdf/saskatchewan_casestudy.pdf

Sun's report on North Battleford's results:

<http://tapor.ualberta.ca/Res/Documents/SunRay02.pdf>

Computer Lab Without Windows - C.T.Leung, Sisler High School, Winnipeg

<http://www.linuxjournal.com/article/7418> Part I

<http://www.linuxjournal.com/article/7419> Part II