

# **Linux Terminal Server Project**

## **Executive Report (public version)**

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## Introduction

The ICT-department of a schoolboard in Curaçao, Netherlands Antilles, who is responsible for the integration of ICT in the educational process, felt the need to investigate an alternative to their current ICT situation.

In the current situation, every school has a 'computer laboratory', consisting of 15 to 30 standalone Intel-based PC's, in an Ethernet network, with MS Windows 98 and various types of educational software installed. The ICT-department is in the process of connecting these networks to the Internet with 128 – 512 kb ADSL connections.

In the current situation, many computers are not functioning optimally, due to various software and hardware problems. Maintenance of the PC's takes a lot of time since most of them are quite old (sometimes more then ten years), and there is a great variety in brand and model. This leads to many hours of downtime, which in turn slows down the educational process.

Suares & Co proposed the Pilot Project 'Linux Terminal Server', in which several of the current software problems are addressed through use of the Linux Terminal Server Project. The proposal also eliminates the need for constant hardware upgrades.

This paper is the executive report of this Pilot Project. A more technical report will also be produced.



*Computer Lab powered by GNU/Linux and LTSP*

## **Purpose**

The purpose of the Pilot Project is to demonstrate that Linux Terminal Server in combination with Thin Clients is a viable alternative to a network of standalone MS Windows PC's within the educational field.

## **Starting Point**

As a starting point the ICT-department chose the Pilot School, a school with about 230 students aged 12-15. The computer laboratory consists of 27 PC's for students and one PC for the teacher. The teacher's PC functions as Windows Peer-to-Peer network Server and runs Windows ME. On the student's PC's, which are mostly Pentium 166Mhz with 64 MB of RAM, Windows 98 SE is installed, together with various types of educational software. The PC's are connected to the server through a 10Mbit Ethernet network.

This network situation is typical for 90% of all schools managed by the schoolboard. The experience gained from the Pilot Project is expected to be usable for almost the entire school system.

## **Problem Definition**

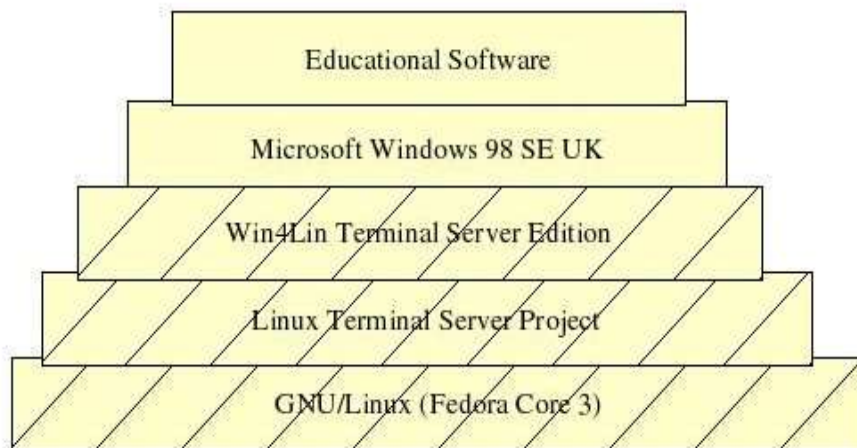
At the Pilot School, various problems have been noted:

- A number of PC's does not function optimally, if at all.
- Students can alter system configuration which leads to incomplete educational software and/or crashes, even though some measures have been taken to prevent students from altering system configuration and program files.
- The Operating System on most PC's has degraded over time.
- (Re-)installation of the Operating System, educational software and/or MS Office 2000 is time consuming.
- The computers are slow due to outdated hardware.
- As soon as the PC's will be connected to the Internet, the need for anti-virus and anti-malware software arises. This will be time consuming (installation and updates) and will slow down the PC's even more.

## Path of Action

To ease the transition, and because 100% of the educational software is Windows-based, a configuration has been chosen in which students and teachers will experience no difference in their environment. Students and teachers are shielded from the underlying GNU/Linux, LTSP and Win4Lin techniques and will only interface directly with Windows 98, Office 2000 and the various types of educational software.

In the schematic below, the structure of the installed software is shown. The bottom three layers are shielded from students and teachers.



*Students don't see the underlying system*

# Hardware

There are three essential hardware components to the Pilot Project Setup: Server, Thin Clients, and the Network.

## ***The Server***

To be able to serve 27 Thin Clients, the server must be quite powerful. Soares & Co recommended a Dual CPU machine with abundance of RAM. Experimenting with various configurations during the Pilot Project, a Dual Xeon 2.4 Ghz with 4 GB of RAM and 2 SCSI disks of 76 GB in hardware RAID-1 configuration seems sufficient for about 30 Thin Clients with room to spare.

This kind of server can be acquired for around 3000 USD.

## ***The Network***

The existing network cabling consist of CAT5 UTP which is, in most cases, sufficient for a Terminal Server configuration. The existing switches needed to be upgraded from 10 Mbit to 100 Mbit switches with one 1 Gbit port. Each of the 1 Gbit port is connected to a 10/100/1000 Intel NIC in the Server.

The network cards (NICs) in the PC's needed to be upgraded to Realtek 8139D NICs with a bootrom from DiskLessWorkstations.<sup>1</sup>

The cost of this upgrade is about 50 USD per PC.

## ***Thin Clients***

The existing PC's (mostly Pentium 166Mhz with 64 MB of RAM) can be re-used as Thin Clients.

Therefore, the cost is zero.

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<sup>1</sup> [www.disklessworkstations.com](http://www.disklessworkstations.com)

## **Software**

The software consists of 5 layers:

- Operating System (GNU/Linux Fedora Core 3)
- Linux Terminal Server Project
- Win4Lin
- Microsoft Windows 98 SE UK
- Microsoft Office 2000 + Educational Software

### ***GNU/Linux***

GNU/Linux is a free Operating System that supports multiple users and multitasking, and has proven to be stable and secure. Many large companies (IBM, Oracle), as well as city councils (Munich, Haarlem) and governments (India, The Netherlands) have applied GNU/Linux to their satisfaction. In the educational field, countries as diverse as Norway and Namibia make extensive use of this 'Open Source' Operating System.

GNU/Linux comes in many distributions, that differ not in quality but in Support and Services. To name a few: Red Hat, Novell/SuSE, Debian, Linspire and Fedora.

The costs for this Operating System is zero.

### ***Linux Terminal Server Project***

'LTSP' is a set of files and programs that turns a GNU/Linux Operating System into a GNU/Linux Terminal Server. LTSP is Open Source Software. Applying the LTSP packages to any GNU/Linux Operating System enables Thin Clients to boot from the network. Since the Linux Terminal Server Project distributes a set of 4 Cd's which combine Fedora with LTSP, the Pilot Project uses Fedora Core 3 as its GNU/Linux Operating System.

The cost for the LTSP software is zero.

### ***Win4Lin Terminal Server***

Win4Lin (formerly NetTraverse) is proprietary software (not Open Sourced) that enables Windows 95/98/ME/2000 or XP to operate under the GNU/Linux Operating System, with some restrictions. It's license model is that for every concurrent user, one license is needed (seat licensing). Soares & Co has been able to negotiate a fairly large reduction.

The costs for Win4Lin are about 50 USD per PC.

## **Microsoft Windows 98 Second Edition UK version**

Windows 98 is proprietary software (not Open Sourced) that is in widespread use. It is installed on all the schools that are managed by the schoolboard.

Windows 98 requires a license for every computer that it is used on. Since all 27 student PC's run Windows 98, one might assume that the schoolboard has those licenses readily available, and these licenses can be reused in the Pilot Project. However, when in some situations these licenses are not present, they can be bought for around 35 USD per PC.

The costs depend on the number of available licenses, but will not exceed 35 USD per PC.

## **Educational Software**

Although there are many Educational Software Packages available, the Pilot Project concentrates on two packages that are used on a daily basis at the Pilot School, and MS Office 2000.

### **Microsoft Office 2000**

Office 2000 consists of, amongst others, a Word Processor and a Spreadsheet program. Installation and Operation of MS Office 2000 on a Linux Terminal Server is flawless.

For each PC that runs Office 2000, one license is needed. The schoolboard should possess 27 licenses for the Pilot School. Since this software is already running on the standalone machines, one may assume that RKCS already possesses these licenses. In situations where this is not the case, licenses can be bought at a special educational discount.

### **Nedercom**

Nedercom is software that teaches basic language skills: grammar, spelling and formulating sentences in Dutch and English. The schoolboard has an institutional license that is valid for all schools.

Nedercom has a Student Tracking System in which the progress of each student is measured.

The installation and operation of Nedercom on Linux Terminal Server is flawless. The actual speed of the application is higher than the speed on the standalone machines.

## **Babbage 4.1**

Babbage is software for learning computer skills. It concentrates on general hardware concepts, Windows 95/98, and Office.

Babbage has a Student Tracking System in which the progress of each student is measured.

The installation of Babbage on Linux Terminal Server is flawless.

However, the operation of Babbage poses some problems. Due to the way the software is programmed, it operates perfectly on a standalone system, although it takes all system resources. In a Terminal Server environment (whether it is a Windows Terminal Server or a Linux Terminal Server) this software takes too many resources. This causes the Server to become slow. After various tests we have seen that with the current hardware, up to 15 concurrent users can use Babbage without problems. With more than 15 users, the program becomes very slow.

Suares & Co has – to great length - tried to solve this problem together with the people from Win4Lin but to no avail. Communication with the author of Babbage has not led to a possible solution.

At the moment, there is no solution for the problems Babbage on Terminal Server raises. Suares & Co recommends to search for an alternative to Babbage. The cost-savings gained from using Terminal Server could well outweigh the costs of other software, and even developing custom software should be considered. However, this issue needs more research.

## **Free Software**

As an experiment, Suares & Co installed a couple of free software packages:

- Open Office.

Open Office (formerly Sun StarOffice) is a free Word Processor, Spreadsheet and Presentation Program. It is an alternative to Microsoft Office and in widespread use. It is free, so in case there is a licensing problem with Microsoft Office, OpenOffice could be considered.

- Celestia.

Celestia is a travel among the planets and stars. It teaches students about distances between celestial bodies.

- TuxPaint

TuxPaint is a free program comparable to Microsoft Paint but with much more features. It allows for a very simple form of artistic expression.

- Sokoban

Sokoban is a logical puzzle, that starts easy but becomes more and more difficult.

- Battle of Wesnoth is a free multiplayer turn based role playing game. Apart from its recreational value, it teaches students to cooperate and to calculate their statistical chance of winning the battle.

## Training

The original project description included an on-the-job training of one system administrator and the ICT-coordinator of the Pilot School. These trainings have been given. Later, Soares & Co gave a free training/workshop to 8 other people chosen by the schoolboard.

## Documentation

Documentation, as a service, is provided by Soares & Co through a website dedicated to this subject: <http://ltsp.suares.an/>

## Costs

	USD
Dual Xeon Server with 4 GB Ram an 2 x 73 GB SCSI, including 100Mb switch, shipment and taxes	5.000
30 NIC's with bootrom from DiskLessWorkstations	900
30-user License Win4Lin Terminal Server	1.500
Consultancy Fee and Training	5.000
<b>Total:</b>	<b>12.400</b>

Omitted are the costs of licenses for Microsoft Windows 98, Microsoft Office 2000, Nedercom and Babbage.

## History of the Project

- August 2003: Soares & Co demonstrates LTSP.
- November 2003: Pilot project submitted to Management.
- June 2004: Pilot project approved by management.
- April 2005: Hardware arrived.
- July 2005: Installation, including demonstration to schoolboard
- August/September 2005: LTSP in operation.
- November 2005: End of Project.

## Conclusions and Recommendations

Linux Terminal Server, in combination with Thin Clients, and Win4Lin, is a viable alternative to a network of standalone MS Windows PC's within the educational field. Its enormous cost-savings both in hardware-upgrades as in software licensing, as well as its near-zero maintenance, pave the way for an efficient and affordable ICT-solution for educational institutions.

However, some consideration needs to be taken as to which educational software is chosen. Some software can not function properly under Terminal Server. Also, in those institutions where students need to learn specific Operating Systems, Linux Terminal Server might or might not be a viable solution. More research is needed in these areas.

For System Managers, extensive training is needed but no more than would be needed to maintain adequate knowledge of the Microsoft Windows Operating System.

The fact that the Linux Terminal Server needs practically no maintenance, and that neither students, nor viruses or spyware can break the 'Windows-part' of the Project, leads to a significant increase in availability of ICT for the primary educational process.

Ace Soares, November 2005  
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