Luminance Desktop

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I. Abstract

The Luminance desktop is a amalgam of Open Source software customized for use in an K-12 educational environment. The Luminance desktop will be built upon the Debian Distribution and the Gnome desktop. The goal of this project is to create an user-friendly, appliance-like, easy to administer desktop/distribution.

Many of the world's schools do not possess the monetary resources to continually upgrade their hardware and software therefore must utilize their existing technology infrastructure to its fullest. Open Source, in conjunction with intelligent hardware purchasing techniques, can maximize the benefit of existing assets. However, Open Source's highly configurable and distributed nature has prevented it from been widespread acceptance in the common school.

In order to remedy this problem, the Luminance desktop aims to provide a simple consistent user interface (Gnome), a core set of useful applications and a simple administrative interface (The Luminance Desktop control panel).

  The Luminance desktop control panel is crucial to the proper operation of the Luminance desktop. The control panel will control all of the configurable options within the Luminance desktop and will be responsible for distributing the changes throughout the network. It will provide teachers with control over their students' machines and administrators control of the network. It will be written in C and use GTK and GNOME libraries.

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II. Introduction

Mission Statement

The luminance desktop aims to be the premier open source educational desktop. It will be comprised of many other open source projects. The luminance desktop does not aim to reinvent the wheel and rewrite every single application. Rather its goals is to create uniformity and ease of use to the a small subset of users, students and teachers. All software forming the luminance desktop will be open source, in order to promote the open source philosophy. The priorities of the project are ease of installation, ease of networking, functional for educational tasks, speed of operation and reliability. The luminance desktop is not solely software it is also hardware specifications, naming conventions, administrative conventions and networking conventions. However, the Luminance desktop does not aim to take the educational world by storm and therefore promotes interoperability and standards compliance. Luminance will adhere to already existing standards whenever possible.

Standards

The Luminance desktop project is committed to the ability to freely interchange data between clients and therefore standards. Without standards, the computing world just becomes falls further behind through wasted effort. Therefore the Luminance Desktop seeks to use standards whenever possible in order to ensure smooth inter-operation with other systems.

- SSL
- PAM
- NFS V3
- KERBEROS V5
- XML 1.0
- DHCPD
- NTP
- VNC
- SSH2
- LSB 1.0
- DocBook

III. Network

Layout

The Luminance Desktop is designed to function within a small network of computers, known as a spectrum. The idea behind using small networks (10-50 computers) is that they fit easily into a room (a computer lab) and the accommodate approximately one class of children. In addition, administrators can use physical location to define their position within the network. The workstations will run the standard applications necessary for operation. The workstations will be identical to each other except for their host name, their IP address and hardware configuration. The master of the spectrum will be different then the slaves and require more setup and high performance hardware. It will control the printers that belong within the spectrum as well as providing file sharing, authentication, monitoring and control of computers within the spectrum. The teacher should use the master machine due to its increased power, however, if a student logs in it will appear to the student just as any other computer on the network. The master machine will be able to control all the computers within its own, enabling the teachers to blank all the screens or lock Internet access if the lesson does not require it.

Overview

All networks will be in the 192.168.*.* range, the standard subnet for internally routed IP addresses. The first spectra will be 192.168.2.* with up to 254 computers on the network (including the master). The next spectra will be 192.168.3.* etc. allowing 253 spectrum. The spectra then in turn will be tied together with the 192.168.1.* spectrum. Universal Internet, authentication and file servers will reside in this spectrum and will have a higher position in the logical hierarchically of the network. The Internet gateway server will use network address translation to prevent all inbound connections other than SMTP and HTTP, HTTPS. These ports will be forwarded to the appropriate servers.

Each workstation will only have a single port, SSH, open within its own spectra. The port is used to send commands from the master to the slave. In turn each spectra master will have an NTP port open allowing all the clients to sync the time. It will also have an Apache server running for to display classroom materials, a dhcp server to delegate IP addresses to the machines within the spectra as well as a setup port used only for client setup. Each client will have a hard coded host name for the master of the spectrum, master. Allowing for presentations on the web server to be accessed by typing http://master/ in the URL field, which will be the default location for the open page of the browser unless otherwise specified during the masters setup. The data displayed at this location will either be set through the default, or the last teacher's material who logged on to the machine. This option will be setup during the installation of the master of the spectra.

IV. Hardware

Overview

The Luminance desktop is designed to run low end computers which schools are mostly like to have (The base systems used for design and testing had 133mhz processors and 32mb of ram). However if you were to purchase computers, you could maximize your budget by staying within the restraints listed below.

Workstation
- Ethernet Card: Link Sys LNE100TX >$20
- Processor/Motherboard: AMD Duron 950 $50
- Memory: 128mb   >$20
- Hard drive: 20gb ATA 100
- Other Drives: Floppy drive
- Case: ATX case
- Mouse: 3 Button Optical mouse (No balls to be stolen)
- Keyboard: Windows keyboard PS/2

Master
- Ethernet Card: Link Sys LNE100TX
- Ethernet Card: Link Sys LNE100TX
- Processor/Motherboard: 1.2ghz
- Memory: 256mb
- Hard drive: 20gb ATA 100
- Other Drives: Floppy drive, CD-ROM
- Case: ATX case
- Mouse: 3 Button Optical mouse (No balls to be stolen)
- Keyboard: Windows keyboard PS/2

File server
- Ethernet Card: Link Sys LNE100TX
- Ethernet Card: Link Sys LNE100TX
- Processor/Motherboard: 2000xp AMD
- Memory: 1024mb
- Hard drive: 3 60gb ATA 133, drives
- Other Drives: Floppy drive, CD-ROM
- Case: ATX case
- Mouse: 3 Button Optical mouse (No balls to be stolen)
- Keyboard: Windows keyboard PS/2

Internet Gateway server
- Ethernet Card: Link Sys LNE100TX
- Ethernet Card: Link Sys LNE100TX
- Processor/Motherboard: 2000xp AMD
- Memory: 1024 mb
- Hard drive: 2 40gb ATA 133, drives
- Other Drives: Floppy drive, CD-ROM
- Case: ATX case
- Mouse: 3 Button Optical mouse (No balls to be stolen)
- Keyboard: Windows keyboard PS/2

Scanners/Printers
- HP USB color scanner
- HP LaserJet BW Laser

V. Administration

Installation

The only thing required for a client installation is a boot disk. Once inserted the boot disk will attempt to detect the hardware and load a kernel to take advantage of the hardware available. It will then attempt to use the network card to listen for a broadcast packet transmitted from the server every minute. Once it has received the packet it will make a connection to the master dhcp server to receive an address. The master will then record the mac address of the network card along with the next unused host name and IP address into a database. It will also include all hardware information and setup information into a database which resides on the spectra master. The client then will receive the proper packages (as selected by the master of the spectra) and begin the installation process completely automated. When the setup has completed the new host will restart and be operational.

If for some reason the client's setup becomes corrupted all that is necessary to restore the client is the insertion of the boot disk into the malfunctioning computer. The client will again listen for the packet and start the setup process however, the master will realize that the mac address is the same and therefore reassign the same IP address and host name and verify and update hardware information. If for some reason the network card fails and requires replacement there will be a brief moment where on the boot disk where an administrator will be able to specify previous host name. The spectra master's database will be overwritten to reflect the change.

Automated tasks

The client will check time with the master on its spectrum once a day in order to keep time accurately. The master will in turn check once a day with an acknowledged standard clock. When the clients are not being used during the normal school day a distributed computing program will be run (either for profit or charity). During the master setup of each spectrum the administrator will be asked during what hours he wishes the computers to be on. If the client hardware supports wake-on-lan technology the master will turn off all the clients remotely and wake them the next day using the technology, in order to preserve electricity and prolong the life of the hardware. The individual clients will turn off their own monitors after 15 minutes of non-use in order to prolong the life of the monitor and save electricity. Each of the clients' uptime will be recorded along with login information on the spectra master, enabling administrators to identify which user was using which machine when. There will also be an automated system checking the health of the machines running on the master which will be easily accessible to teachers and administrators. All system errors will be logged on the master machine and an email will be sent to notify the administrator of the spectrum that an error has occurred.

Masters

Each master will have options to be specified during its installation. While automated, it will require a certain amount of user input. In completing an entire school conversation to Luminance it is best to install a single master that will rule all the other spectrum within the school's server domain(192.168.1.*). This machine will hold school defaults like contact information, school system customizations, default administrator contact information, and the address of default website. All settings on this system will be the defaults for all masters of spectra and in turn all their workstations. If any changes are made to this system it will be distributed on demand to all the masters and then to all the slaves. The spectra masters will have lower level options specifying what type of customizations the spectra will have. For instance if it was an art lab then it would install the art software. There will only be a few options so not as to confuse administrators. It is recommended only to install the software necessary, do not default install everything unless you are sure you want all the extra software(It creates clutter, confusion and wasted hard drive space). The last option will be concerning shares and authentication. If your system already has Windows or Novell servers luminance can handle these shares and will enable the appropriate software. If you are using a Linux file server Luminance can handle that as well. Masters will set the default language to be used with spectrum.

Documentation

Each master will host a set of standard set of documentation. There will be a short tips section which will be changeable to by the administrator describing specific nuances of the network. There will also be a set of documentation to ease the transition from Windows and then there will be a complete guide for the totally computer illiterate which will be easily referenced if users need specific help with an application. The documentation will be written in Doc Book XML enabling it to presented in a variety of forms (the standard which the Linux Documentation Project has used for some time now, with great success).

VI. Users

Overview

   Users will have unique login information and the Luminance Desktop will be able to tie personal information with their ids. Each user will only be able to change a few things about their desktop. They will be able to pick from one several themes for there desktop as specified by the administrator. They will be able to read their own email and keep their own calendars, address books and files on their accounts. They will not be able to go in and change the orders of the menus or what icons appear on their desktop. They will be able to add or remove anything from their panels. The reason for these limitations to customizations is that luminance hopes to integrate seamlessly with Microsoft Windows using schools. For instance, maybe the teachers would like to try Luminance but they do not want to change over the entire school. Luminance will thereby standalone by itself. The servers will be able to authenticate and use shares from their Microsoft Windows counterparts, however their configuration data would have to be saved to their account causing possibly confusing clutter on their accounts when they return to their Microsoft Windows accounts.

Tasks

Students

- Surf the web for research - light
- Email for group work - balsa
- Word process reports - abiword
- Calculate data -
- Graph equations -
- Create spreadsheets of data - gnumeric
- Create computer presentations - agnubis
- Computer programming - anjuta
- Create Websites - bluefish
- Graphical manipulation - gimp
- Manage files - fm
- Multimedia - gstreamer

Specialty

- Electronics - oregano
- Musical Composition
- Chemical modeling

- Astronomy
- 3D rendering - blender
- Economics - gnucash

Teachers
- Grade book - grader
- On line assessment -

Administrators
- Control panel

Internationality

The language of configuration and setup will be English. However, Luminance will offer the ability to change the language of the applications at the login screen offering foreign language students to practice their skills on the computers in addition to the class room.

VII. Software

Overview

The software will be based upon Debian packaging system and will use the Gnome 2.0 environment.   The environment will be consistent as possible (all GNOME applications). The reason for the use of Gnome 2.0. It is the most widely supported Linux desktop environment in the industry. Gnome 2.0 offers powerful libraries which enable it to be used easily by those who are disabled. Gnome 2.0 also offers powerful language display routines enabling it to display almost any language in the world (and many of the applications have been translated to other languages. This feature might be of use to high school foreign language classes).

The reason for the use of the Debian distribution is that is devoted to the Free Software ideals and is not controlled by a single entity. Effectively rendering it immune to the shifts in economic climates. The system is also well designed and tested and has one of the most sophisticated dependency resolution systems in existence (the system can be upgrade while using the same applications it is updating without a glitch).