

Remote Real Laboratory: Linux installation and configuration

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Abstract :

Remote real laboratories deal with performing real lab experiments remotely via Internet. Recent advances in Internet/web technologies and computer-controlled instrumentation allow net-based techniques to be used for setting up remote real laboratory access.

The goal of our project VITELS¹ (Virtual Internet Telecommunications Laboratory of Switzerland) is to develop a course that provides practical exercises in the area of telecommunications and computer networks to the students. The exercises shall be performed by students remotely and students do not need to be present in particular laboratory rooms.

As regards communication between machines, several levels of complexity must be differentiated. The management and total handling become more complicated according to the kind of desired networks functionality and data exchange. This differentiation is often based on the following functions networks: File transfer (File transfer), Execution of programs on other machines (remote execution), virtual Terminals (Network File System).

In our paper, we present a remote laboratory which consists to learn how to install and configure Linux on a real remote machine using a simple Internet connection. Three approaches have been studied and have been implemented. First approach is the installation of Linux Mandrake distribution by simulation. The second approach, more interesting, consists in using VNC² (Virtual Network Computing) to really install Linux on a remote machine just using a navigator and our environment. The third approach which consists in combining the two approaches to obtain an optimal result. The distant user would gain in time and would profit from an interaction of the assistance coming from the server. This system is based on a client-server concept with a deployment by levels of the installation on the remote machine. Our environment allows several users to make the virtual installation on the same machine at the same time and the real deployment of the user's parameters is done once the virtual installation is finished.

Keywords : *Remote real laboratory, VITELS, Practical exercises.*

¹ Virtual Internet Telecommunications Laboratory of Switzerland, <http://www.vitels.ch>

² VNC stands for Virtual Network Computing. It is, in essence, a remote display system which allows you to view a computing 'desktop' environment not only on the machine where it is running, but from anywhere on the Internet and from a wide variety of machine architectures.

1. Introduction

During the past few years, many institutions of higher education have successfully established Web-based environments where learners can pursue their higher education via the Internet or other alternative distance education modalities. Most of the tools employed to train students over the Internet are primarily simulation software that is also known as *Virtual Experimenters*. In these types of environments the knowledge gained by the student depends primarily upon the authenticity, constraints, and capabilities of the simulation software. A review of literature, existing web sites, and surveys indicate that students are only free to perform experiments in a Restricted Environment. These restrictions that are imposed by limited pre-designed inputs and predicted outputs restrain an individual's creativity to experiment in natural settings without pre-designed software limitations.

Instead of simulated laboratories, VITELS (Virtual Internet and Telecommunications Laboratory of Switzerland) project proposes an unrestricted environment where real lab experiments can take place via the Internet through remote scenarios. Each partner of the VITELS project - four universities (Bern, Fribourg, Geneva, Neuchatel), one engineering school (Fribourg) is currently developing modules in the field of computer sciences and telecommunications based on the own competence and equipment.

The seven modules focus on Linux System Installation and Configuration, IP Network Simulation, Configuration and Performance Evaluation of a Real IP Network, Client/Server Programming, Protocol Analysis, IP Security and Firewall Management. Each participating university develops and maintains its modules within its own laboratory environment, but allows remote students to access and use the laboratory infrastructure via Internet technology. The entire course must appear to the user as being homogeneous, although it is distributed over several locations in Switzerland. A web-learning environment called WebCT³ is used to lead through the course modules.

2. Remote Lab: Linux Installation and Configuration

2.1 The Model

The team at University of Geneva CUI⁴ had in charge to develop two modules for VITELS project:

- Linux System Installation and Configuration;
- Configuration and Performance Evaluation of a Real IP Network.

Given the innovation nature of the project, the team in Geneva decided to use the Linux System Installation and Configuration module as an “apprenticeship”. In this paper, we present the remote laboratory with practical exercises for Linux System Installation and Configuration. The development of the remote lab is based on the complete architecture shown in FIGURE 1 and the software tools described below.

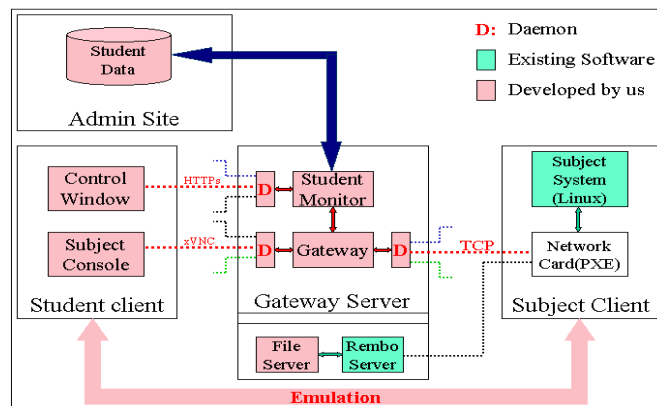


FIGURE 1

³ WebCT is the world's leading provider of e-learning solutions to higher education.

⁴ CUI: The Computer Science Department (Centre Universitaire d'Informatique) groups together the different teaching and research activities in computer science at the University of Geneva, <http://cui.unige.ch>

2.2 Content

Now it's possible to install and configure a Linux computer from scratch, booting from virgin machine, learn standard activities for Linux kernel installation and sub-systems. The student can access to subject machine via a remote bootstrapping machine. Subject machine is initially totally emptied. Student will do all necessary steps for preparing the file system and installing the kernel & subsystems. Student will find and personalize the necessary components locally and from remote servers.

The laboratory is composed by 6 dedicated PCs, one Server, Rembo⁵ remote boot and configuration support. The remote practical exercises are similar to exercises done in a physical laboratory context. Interesting scheduling and management tasks are used to optimise the use of machines. At the moment we use Linux Mandrake 9.0.

3. Diagram of the Data Base

The physical model of data is made up of 3 tables. The "ETUDIANT" table which makes it possible to store all information concerning the students, this information is used to identify the student at the time of the phase of authentication. The "CLIENTVIR" table makes it possible to keep all information concerning the computer where the operating system is installed by the student: creation date, name given to the computer and the identifier of the student who did the installation. The "CONFIG" table makes it possible to store the configuration made on the computer. This information is represented as a file which is the image of the installation made by the student on the computer. The model is represented in the following way (FIGURE 2).

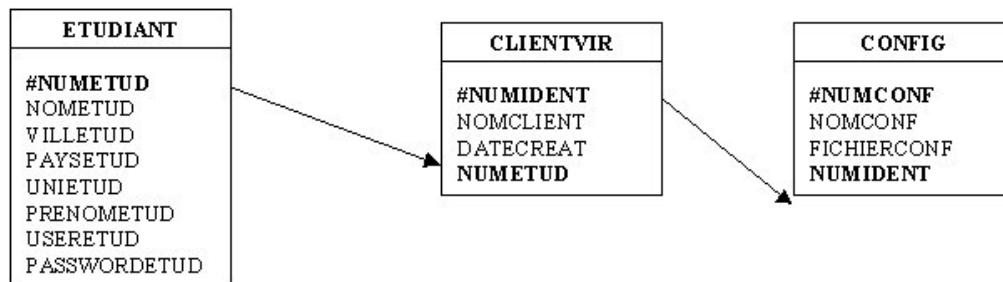


Figure 2

4. Management Rules

- a virtual machine belongs to only one student
- a student can have several virtual machines
- an image is only for one virtual machine
- a virtual machine can have several images

5. Proposal for a scenario

- Connection, Authentication and Authorization Identification (AAI)
- Looking for available remote computer of the student
- Choice of a virtual machine (If the student does not have any virtual computer, the system creates a virtual empties computer)
- Looking for of the various images of the selected virtual computer
- Choice of an image
- Restitution of the image on the level of the virtual computer
- Emulation of the computer

⁵ Rembo Toolkit includes all the software you need to implement personalized, fast and robust OS management solutions.

6. Conclusion

The model suggested makes it possible to optimise the number of computer and to increase the number of users in the network. The user has also possibilities of configuring several kind of computer and to keep all already made information. Instead of several computers, the student only needs 2 remotes computers to make a network configuration. A first computer for the server and the second computer for the real terminal. This method of remote installation allows users to be initiated with the installation and configuration of Linux. Now, the installation and initial configuration step is finished and the users will be able to use the computer to make other kind of practical exercise (Router configuration, Network performance evaluation...) using telnet or SSH via the WebCT environment. A concrete example based on VITELS modules was tested and evaluated by students of several Universities and schools in different countries.

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