Possibilities of Implementing Practical Teaching in Distance Education

Jiří Toman¹, Ing. Petr Michalík ²

¹Department of Computer Science and Educational Technology, University of West Bohemia in Pilsen/Academic Staff
²Univerzitní 8, 306 14 Pilsen, Czech Republic
tomanj@kvd.zcu.cz; michalik@kvd.zcu.cz

Abstract

Even in the process of distance learning it can be hard to imagine teaching without the possibility of its practical implementation. Theoretical and even practical part of teaching can be present in some subjects in the form of text, images, animations, videos. But if the process of teaching and education is to fulfill its purpose and mission, it must also include distance learning practical part of education. To meet such requirements, it is not a trivial matter and requires much more technical, program and system expertise and resources. The solution must also meet the requirements and criteria of the concept of computer network and its management in a given locality, in the Internet as well as safety and reliability of computer networks. In the implementation of practical training we start from the current situation and environment - the existence of VMware virtualization environment. The school classes are two virtual labs, each with ten virtual machines. Implementation of some practical exercises on physical machines in our conditions is not feasible. The article will show the possibilities and experiences from the implementation of practical training in the use of distance learning as well. The massive expansion of tablets, smartphones, iPads etc., and their inclusion in this environment have been mentioned.

Keywords

Distance Learning; Practical Teaching; Remote Access; Remote Access Client; VM - Virtual Machine; Virtual Lab; VMware; RDP - Remote Desktop Protokol. MSTSC – Microsoft Terminal Service Client; Tablet; ThinRDP; ThinVNC; Web Access; KVD - Department of Computer Science and Educational Technology

Introduction

For this, how to implement practical training in the some subjects, has essentially only two options. Firstly, a computer lab was prepared with physical PCs designed for this special purpose. Secondly, virtualization environment (VMware News Release, 2012) and its tools were used. Furthermore, the possibility to use standard remote access to stations already installed operating system can be accessed via a thin client or only a web access.

Ways of Dealing with Computer Labs

Computer Labs with Physical PCs

Separate computer lab with physical computers for specialized purposes requires some redundancy of computers in organization and the reality has been accepted that during the teaching dedicated stations will not be usable for other purposes. Advantage of the solution is that there are slight additional costs for administration and operation of such environment. The downside besides the already mentioned is a small computing power, because stations are not optimally utilized during the class. Otherwise, in general, the computer with an installed operating system can be fully integrated in a computer network and (see below) remote access can be utilized to these stations using a standard client-based RDP (Remote Desktop Protocol). RDP service operating both the client and on the server side, are now commonly equipped with all operating systems Microsoft Windows and Linux. This service is known as Terminal Services that can also use other services, protocols, see below chapter Terminal Service.

Virtual Computer Labs

The virtualization environment based on the ESX Server and VCS (Virtual Center Server) made by the VMware has been operated at KVD department since 2008 (Website of KVD). Our intention was to respond to practical needs of teaching in many vocational subjects. On a professional conferences, we have established cooperation with VMware, and got free academic license for the operation of ESX server as the basic building element virtualization environment within the established cooperation called the VMware Academic Program (VMAP). The VMware Academic Program is committed to strengthening VMware’s relationship with the academic and research
communities. The license for operation of VCS server we purchased from commercial firm. Virtualization environment was installed on the server with technical parameters: Dell PE2900 (2 x Quad-Core Xeon E5535 2.0GHz/2x4MB 1333FSB, OP 48 gigabytes 667MHz FBD, 2 x 80 gigabytes SATA2 involved in RAID1, 5 x 500 gigabytes SATA2 involved in RAID5, 2 x + 1 External integrated Broadcom NetXtreme II 5708 Single Port Gigabit NIC), Storage Array NetApp FAS2020. Software consists of: VMware ESX 3.5.0 SP2 – host server for virtualization, Virtual Center Server 4.0 (vCenter Server 4.0)-tools for managing virtual environments and host servers, MS Windows Srv2008 as the host server for Virtual Center Server 4.0, OS MS Windows XP SP3, Vista, Windows 7, OS Linux–operating systems for practical teaching. Virtualization environment consists of three teaching laboratories (Figure 1) for practical learning of students (A. Perilli). More information about virtualization and virtualization environment at the department KVD is available in previously published articles, see (J. Toman, P. Michalík, listopad 2008), (J. Toman, P. Michalík, květen 2009), (J. Toman, P. Michalík, O. Suchý, 2011), (J. Toman, P. Michalík, 2012). Each virtual lab is implemented on a separate virtual network segment. Some virtual machines use the method of so-called trunking. In Cisco networks, trunking is a special function that can be assigned to a port, making that port capable of carrying traffic for any or all of the VLANs accessible by a particular switch.

**Access to VMs**

First of all, virtualization environment based on VMware environments enables remote physical access to dedicated virtual machines using the thick client VMware vSphere Client. Students can access their VMs anytime and anywhere during the learning stage. Secondly, users have access to the already installed, properly configured and secure VM through terminal services. Both methods allow remote access from stations with installed clients. The solution is to replace expensive desktop workstations with OS and other software on some inexpensive desktop terminals equipped only with SSH client browser and web interface for viewing. The solution is inexpensive desktop systems with secure clients, high quality graphics interface, 10/100/1000 BASE-T Ethernet (RJ-45), Built-in smart card reader, USB keyboard, USB mouse, CD/DVD quality output, Stereo microphone input.

**Physical Access to VMs**

For the purpose of physical access to virtual machines, is available fat client, called VMware vSphere client from VMware (Fig. 2). This client is freely downloadable from both the VMware website and website of the installed VCS server. This client allows access to virtual machines as if they were physical machines.

![FIG 2 CONNECTING TO VCS SERVER](image)

**FIG. 1 VIRTUAL LABS**

**FIG. 2 CONNECTING TO VCS SERVER**

**FIG. 3 ONE VIRTUAL MACHINE REMOTE CONSOLE**
It also provides console access to virtual machines (Fig. 3). A virtual machine’s display can be viewed to run programs within it, or guest can be modified operating system settings. As well the virtual machine’s configuration can be changed, the guest operating system can be installed, or the virtual machine can be run in full screen mode. Turn off and turn on virtual machine as if it were a physical machine, install operating system from the installation media or from the installation image (Fig. 4), as well as programs, etc. The expansion option is the installation RDP Plug-in to VMware vSphere client. The Xtravirt vSphere RDP Plug-in provides integration of the Windows Remote Desktop tool with the VMware vSphere Client. Utilising Remote Desktop to connect virtual machines provides a better user experience compared to the built-in VMware console as well as performing better across WAN connections (Figure 5). Screen resolution and advanced connection options mimic the standard options available through the Microsoft® Remote Desktop Client or rather Microsoft Terminal Service Client (shortcut mstsc).

Terminal Service Access to VMs

1) From OS MS Windows to OS MS Windows

As already mentioned, current operating systems as Microsoft Windows and Linux allow remote access via terminal service. These services often use the RDP protocol. Remote Desktop Protocol (RDP) is a proprietary protocol developed by Microsoft, which provides a user with a graphical interface to another computer. The Microsoft Remote Desktop Protocol (RDP) provides remote display and input capabilities over network connections for Windows-based applications running on a server. RDP is designed to support different types of network topologies and multiple LAN protocols. This protocol must be implemented on both the client and server side. Clients exist for most versions of Microsoft Windows (including Windows Mobile), Linux, Unix, Mac OS X, Android, and other modern operating systems. By default, the server listens on TCP port 3389. Microsoft currently refers to their official RDP server software as Remote Desktop Services, formerly “Terminal Services”. Their official client software is currently referred to as Remote Desktop Connection, formerly “Terminal Services Client”. From version RDP 6.1 (Windows XP SP3 and higher) client is implemented with new functionality. RDP client allows for connection and use of local (local stations) equipment and resources (local resources) such as: mapping local resources to remote desktop, mapping local disks to remote desktop (Fig. 6), mapping plug & play.
devices to remote desktop (Fig. 7). The RDP client can set the optimal connection to the remote station. RDP uses RSA Security’s RC4 cipher, a stream cipher designed to efficiently encrypt small amounts of data. RC4 is designed for secure communications over networks.

![Mapping Plug & Play Devices to Remote Desktop](image)

**FIG. 7: MAPPING PLUG & PLAY DEVICES TO REMOTE DESKTOP.**

2) **From OS Linux to OS MS Windows**

So far, it has been discussed how to remotely connect from Windows to Windows station. The question is how to connect to a remote desktop from a Linux machine to windows XP, Windows 2003 server, Vista or Windows 7. There are many tools that make it easy to connect to a remote computer, rdesktop and Gnome-rdp is one of them, simple and easy to use. Rdesktop is an open source client for Windows NT Terminal Server and Windows 2000/2003 Terminal Services, capable of natively speaking Remote Desktop Protocol (RDP) in order to present the user’s NT desktop. We can use for example command rdesktop -u yourname 192.168.1.10 &. Rdesktop currently runs on most UNIX based platforms with the X Window System, and other ports should be fairly straightforward. Rdesktop is released under the GNU Public Licence (GPL), version 3.

3) **From OS Linux to OS Linux**

There are a wide range of remote desktop applications available that can be used to connect to Windows environment but there aren’t too many that can be used to remote desktop from Linux to Linux or Windows to Linux. With this, it means getting entire desktop of remote Linux environment on your local workstation. Most people who are used to a Unix-style environment know that a machine can be reached over the network at the shell level using utilities like telnet or ssh. And some people realize that X Windows output can be redirected back to the client workstation. But many people don’t realize that it is easy to use an entire desktop over the network. There are several open source applications that can be used to achieve this. XRDP helps Windows terminal clients connect to Linux. XRDP is an open source implementation of RDP (Remote Desktop Protocol), the protocol used with Windows Terminal Services for native Windows desktop connectivity. Once connected and authenticated to the Linux RDP server, the remote user is present to a Linux graphical desktop. The best part is that it is necessary to run an X server on your Windows computer or export your Linux display to the Windows computer. Setting up the RDP server on Linux is easy and only takes a few minutes.

Other open source applications will be briefly mentioned.

VNC (Virtual Network Computing) is a remote display system which allows the user to view the desktop of a remote machine anywhere on the internet. It can also be directed through SSH for security.

FreeNX, a system that allows you to access your desktop from another machine over the internet, can be used to login graphically to your desktop from a remote location.

2X TerminalServer for Linux is an Open Source project, licensed under the GPL and is free of charge.

The X Display Manager Control Protocol (XDMCP) uses UDP port 177. Compared to the list above, it’s not easy to setup for remote desktop but it’s the original way to do this on Linux.

CygwinX is a complete Linux emulation on Windows. You’ll find every tool and app that you have on Linux on Cygwin.

X-Win32 is top solution for Windows PCs connecting to remote Unix and Linux host systems. It works well over SSH.

And others, see (XRDP, 2012), (Linux Magazine
4) ThinRDP to Windows Desktop Remotely

RDP technology is an advanced technology that offers a wide range of applications and becomes very relevant for use in the school environment. Users can have access to all of their remote programs, documents, files, and network resources from anywhere as if they were in front of the remote machine. It doesn’t matter which device they have. It can be an iPhone, iPad, Android tablet, ChromeBook or any other device with a HTLM5 compliant browser. The application takes advantage of the HTML5 technology and interoperates with almost every platform and browsers. ThinRDP does not require Flash, Java, ActiveX, Silverlight or any other setup on the end-user side and can be used from almost any device. Furthermore, ThinRDP grants access to desktops running on Windows Terminal Services. You can even remote into RDS / VDI platforms, such as session-based applications or virtual desktops. Thanks to ThinRDP’s cross-browser, cross-platform capability, Windows, Mac OS X, Linux, Android and iOS users can remotely log in Windows desktops and work with single applications through their favorite browser. The application supports Internet Explorer 9, Firefox, Chrome, Safari, and other HTML5 capable web browsers. IE8 and earlier versions may be enhanced with HTML5 features by the addition of the Chrome Frame plug-in. ThinRDP Workstation is composed of a pure HTML5-based client that connects via HTTP(S) to the machine where ThinRDP should be installed. Convert any modern web browser into an HTML5 Remote Desktop Client, see (Cybele software, 2013), (Ericom, 2013).

Possibilities of Using Tablets in Our Education

What is the future of tablets in classroom? The tablet offers immense potential, particularly in the field of education. In fact, the iPad—the most flourishing in the touchscreen market—is now positioned as a “Learning Companion”, with the promise of changing the way things go around in the classrooms (StudyValue, 2013). A decade ago, nobody would have expected to see tablets being incorporated into one’s daily life (especially in the field of education); but now, it’s not only possible, but also a reality. Compared to this, innovative concepts of the past, like tele-education or virtual education, seem primitive. The question, however, is how tablet computers or touchscreen can penetrate the education system of the whole world and therefore also with us, if the cost of an iPad is still quite high. Before we even get close to answering this question, it is important to understand what tablets are and how they work. The PC Magazine (Cybele software, 2013) defined a tablet as “a general purpose computer contained in a single panel. Its distinguishing characteristic is the use of a touchscreen as the input device”. With the advent of the iPhone and iPad, we have witnessed the birth of apps (applications) that add value and functionality to a device. Developers across the globe are now working on developing apps for smartphones and tablets. For people who are unfamiliar with the nature of apps, they are available in different categories, including education, news, entertainment, social networking etc. Just in the education category, there are thousands of apps available. Recently, some corporations launched iBooks textbooks for students, transforming paper textbooks into multi-touch textbooks with 3D content and interactive images. Is a revolution pioneered in the field of education? The answer to that is yes. No more will students have to be weighed down by heavy backpacks and learn from textbooks containing obsolete knowledge. We live in a world which is constantly churning out information. Traditional textbooks do not contain updated information on relevant subjects. Most importantly, it is the method of learning and teaching that has undergone such a radical change. Such technologies enable students to learn in the digital age, using digital tools. And the technology that they have access to, is not absolute, but dynamic and diverse. This innovation leads to whole new education system that focuses on new technologies like tablets, and that encourages app developers to build more productive and functional apps in the field of education. This is the only way new methods of teaching will emerge. Concepts such as e-learning, distance education, and virtual learning without these new technologies can not exist. Indeed, many of our students in the classroom use tablet PCs, yet only as a multimedia device, textbook, notebook.

The tablets equipped with a standard external communication interface, with ThinRDP client based on pure HTLM5 and existence of virtualization
Teaching education through distance learning

Distance learning is becoming a necessary form of education not only in full-time study, but also in other forms such as distance learning and training of teachers and educational staff in different courses, etc. Educators must find their way corresponding to the current social, political, cultural, economic needs and global sustainability. Current research projects and distance learning teachers reflect the needs and challenges of the 21st century in our schools in all levels. Past experience tells us that it must be a combined form of contact and distance learning. The computer technology provides new interactive ways to overcome time and distance. Many global studies indicate that the education in the 21 century should prepare the students to integration in a globalized economy, based on knowledge which will be the more critical resource to the social and economic development. Our research group works explore this new techniques through the development of several on-line courses: Computer Networks and Distributed Systems, Object Oriented Programming, Installation and Administration of Operating systems, Data Processing in Spreadsheet, Data Processing in XML, Data Processing in Database, Individualized and Cooperative Learning with iPad, Computer-aided Teaching, Use of Diagnostic Tools for Creating E-learning Courses, Working with Interactive Whiteboard, Computer Technology, etc. These courses can be accessed over the Internet through the url address: https://phix.zcu.cz/moodle/course/

See illustration Fig. 8, Fig. 9, Fig. 10, Fig. 11.

Conclusions

The above mentioned environment has been operated at the Department of Computer Science and Educational Technology since 2008. Distance access to remote virtual stations is practiced also in the form of full-time and distance learning. The created environment significantly increases the flexibility of teaching and allows practical training from remote stations at anytime and anywhere. Our current and future plans consist of updating the existing environment to create the conditions for access from the tablets, etc., approach based on pure HTML5 standard.
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REFERENCES AND CITATIONS


