

Decreasing Information Technology expenses by using emulators on Windows and Linux platforms

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Abstract – The two most popular operating systems (continues: OS) nowadays are Windows (wide range of products) and Linux (various distributions). Every OS has different development history, aimed application and different hardware implementation. The popularity of Windows operating systems is on a very high level but, today, Linux has proved that high quality software doesn't necessarily have to be commercial software. Linux and Windows operating systems and their applications are not compatible because of kernel and file systems differences and program code execution. That means that the users have to decide which OS they will use depending on economical and financial possibilities. The problem of using applications under different operating systems can be solved by emulator programs on both of Windows and Linux platforms. Most widely used emulators today are Wine (on Linux platforms) and VMware (on both platforms). Emulators offer the possibility to execute different applications (even installation of operating systems) on a platform that they were not previously written for. By choosing less expensive (or free) operating systems and appropriate emulators the overall information technology expenses can be significantly decreased.

I. INTRODUCTION

The dominance of Windows family of operating systems is slowly decreasing with the rise of popularity of various Linux distributions built for both server and personal PC usage. These OSs are incompatible due to major kernel, file system and code execution differences. The problem of running applications built for one OS on another can be solved by using emulators. Emulators enable otherwise incompatible application to run on different OSs seamlessly. By running Windows applications on Linux distributions using emulators we can achieve significant savings in software license costs. When using emulators, it is important to consider their advantages and constraints as well as technical support availability. Through careful selection of best emulators for a specific application domain we can achieve overall IT budget savings while maintaining the required quality of service from these applications.

Chapter 2. describes the basic functions of the OS and the kernel. Chapter 3. defines the role the emulators have and describes most popular Windows and Linux based emulators. In Chapter 4. we compare the Windows and Linux OS software license and tech support prices and

give arguments for emulator implementation. Our final thoughts about IT expense decreasing by using emulators are given in the conclusion.

II. OPERATING SYSTEMS AND KERNEL

The operating system [1,2] provides a platform that facilitates computer systems usage and programming. It manages the CPU(s), memory, storage devices and enables communication with various input/output devices.

Although the Windows family of OSs is dominant on the market and has much wider application support the Linux distributions have, in some cases, proven that high quality software does not necessarily have to be expensive, but in fact – free. The term “Linux” has more than one meaning:

- specifically, it denotes the core (kernel) of the OS,
- in broader sense it denotes the OS and the collection of applications that are usually packed in a so called distribution [3].

In this paper we will focus on Linux distributions because the prices of licensing some applications can have great effect on the overall IT budget expenses.

Operating systems differ in structure and built in functions. The relationship between the OS and its kernel can be defined by the differences in the tasks they perform.

The most important tasks of the operating system are [1,2]:

- process management,
- memory management,
- secondary memory management,
- input/output management,
- file management,
- access protection,
- instruction interpretation,
- network management.

The kernel (or “core”) is the base of any operating system that performs the following tasks:

- process management,
- memory management,
- secondary memory management,
- input/output management,
- file management,
- exception management
- enabling inter-process communication

The Windows and Linux OS have different so the applications developed for Windows are incompatible with Linux and *vice versa*. The most important differences between Windows and Linux regarding compatibility are related to:

- kernel differences
- file system differences

The kernel manages the computer hardware and provides service for applications that are being executed on the OS platform. In this way the kernel can be described as a lower layer between the hardware and the applications as displayed in Figure 1. In this way an application can be executed on various hardware platforms.

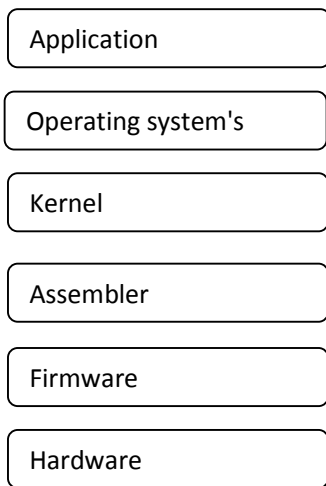


Figure 1. Hierarchical model of the layers of a computer system

The Linux kernel interprets the instructions differently from the Windows OS and therefore the applications developed for Windows cannot be executed on Linux and *vice versa*. When needed, we can install emulator software to be able to execute such applications on both OSs.

The file system is used to store all the required data in the specified format as well as provide access to data on disks or other storage devices. The data is then used by various applications. Windows and Linux OSs support different file formats but neither support all known

formats (see Table 1). They can read stored data from storage units formatted using another file system but only for file and folder manipulation and not for running applications.

TABLE I. SUPPORTED FILE SYSTEMS FOR WINDOWS AND LINUX OSs [3]

<i>Windows</i>	<i>Linux</i>	<i>Comment</i>
NTFS FAT ISO 9660 UDF	Ext2 Ext3 Ext4 ReiserFS ISO 9660 UDF JFS XF	Windows OS can read and write to Ext2 i Ext3 file systems with 3 rd party drivers (FS-driver or ext2fsd). Linux can read or write to FAT and NTFS by using additional services (Samba).

The most commonly used file systems on OS installations are:

- FAT32 / NTFS (Windows)
- Ext2, Ext3, Ext4, RaiserFS (Linux)

III. EMULATORS AND VIRTUAL MACHINES

Some of the most popular emulators are: Wine and VMware. Wine functions as a middle layer between the OS and the application built for another OS that we wish to run on our OS by translating Windows API calls to Linux OS commands. VMware uses the virtual machine concept. When started, VMware enables the user to create a virtual PC on the current OS, and install any OS and its applications on it. By using emulators we can make significant savings on software licenses.

A. WINE EMULATOR

Wine enables the user to run Windows application on the Linux OS. Wine is a free product with a goal to be able to run all Windows based application on the Linux platform. The list of applications it supports is already very large although it does not support custom developed applications. Wine is based on a set of alternative DLL libraries that implement Windows API. In this way Wine translates the system calls a Windows application makes to the Linux kernel. This concept is also called a compatibility layer.

Wine has support for:

- Optional using of original Windows DLL files
- DirectX
- GDI (fully supported)
- Winsock networking with TCP/IP
- Various printers and scanners

- ASPI interface (SCSI) support for CD, DVD writers
- Multilingual support

B. VMWARE EMULATOR

VMware is a commercial product that uses the concept of a “virtual machine” (VM). After installation on a PC (it is available for both Windows and Linux OS) it enables the user to create a virtual PC (based on the real PC hardware) with a limited amount of RAM that it can use for its operation. After the virtual PC has been created the user can install any OS and its application on it. Other user can access this PC both local and remotely (via network) and interact with just as it was a real PC (see Figure 2.). A VMware workstation also enables the

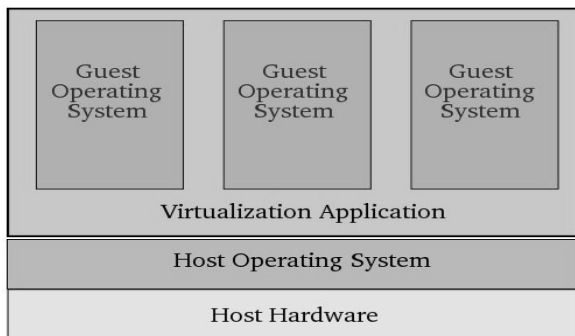


Figure 2. Layered model of the VMware virtual machine [3]

creation of multiple virtual machines on one computer which is especially useful for testing in a client-server environment.

IV. FINANCIAL BENEFITS FROM USING EMULATORS

The price of an operating system can vary greatly depending on the type and intended application (client or server OS). The TCO also includes technical support rates, license renewal, hardware and installation and maintenance costs. By using emulators like Wine it is possible to make saving in software licensing of client applications, while using VMware can save in hardware and OS licensing costs (by running more virtual servers on one real machine).

When choosing an OS the users must take into consideration:

- Various Windows and Linux OS properties important for compatibility and application support [4] (see Table 2).
- Application compatibility and emulator supported application lists [5]
- technical support availability

The implementation and support expenses are lower compared to Windows based platforms [6]. Furthermore, most Linux distributions include an Office application

package (OpenOffice, LibreOffice), and image manipulation applications (Gimp, Inkscape) which can also decrease the overall IT expenses of a company or institution.

Technical support for Linux OS also has lower prices/rates than Windows based OSs. For example, a Novel Linux OpenSuse software package version 11.0 is priced at \$60 and it includes a 90-day install support while the SuSE Linux Enterprise Desktop is priced at \$50 and includes 1 year of technical support. Support availability and quality (in respect to request reaction time) is on the side of Windows based OSs but it comes at a much higher cost.

TABLE II. PRESENTATION OF CHARACTERISTIC FOR WINDOWS AND LINUX SYSTEMS

<i>Property</i>	<i>Windows</i>	<i>Linux</i>
Networking support	+ built in - possible limitations of number of network connections	+ built in - no limitations
File sharing	+ built in	- not built in
Large scale information systems	+ professional technical support available -high cost of 24/7 technical support	- insufficient levels of professional technical support especially for highly specialized applications and information systems + low cost of technical support
Office applications	+ professional technical support available	+ professional technical support available
General application availability	+ high	+ medium
User interface	+ excellent - OS cannot be used without UI	+ very good + multiple UIs available + OS can be used without UI
File system	- small number of fully supported FSs (FAT16, FAT32, NTFS)	+ large number of supported FSs (FAT16, FAT32, NTFS, EXT2, EXT3, HFS, HFS+, JFS)

A comparison of implementation price calculation is displayed in Table III. This comparison has been made for 15 PCs (1 server and 14 client computers). We calculated prices for different Windows OS versions (Windows 2008 R2 Standard and Windows 7 Professional [7,8]), and different Linux OS versions (OpenSuse11, Linux SuSE Enterprise Desktop). The Linux OS showed considerable savings in software

licenses (\$5808-\$5858). The savings can vary in respect to the selected OS version. Evidently, by selecting a Linux based OS we will see a decrease in IT expenses regarding software licensing and technical support [9].

The decision on whether we will use emulators cannot be based solely on the implementation price. Other important factors are: application and emulator compatibility, application performance on emulator, etc. Emulators can decrease the expenses of IT solutions (mainly through using free OS) although it can also generate expenses (implementation, user education, etc.). All the mentioned aspects must be taken into account

TABLE III. COMPARISON OF OPERATING SYSTEM'S IMPLEMENTATION EXPENSES

OS	Price	Support	No of PCs	Total
Windows 2008 R2 Standard (server)	1408 \$	1000 \$	1	2408 \$
Windows 7 professional	300 \$	0 \$	14	4200 \$
Linux Open SuSE 11	60 \$	90 day support included	15	900 \$
Linux SuSE Enterprise Desktop	50 \$	1 year support included	15	750 \$

when making a decision on using emulators.

V. CONCLUSION

The Windows and Linux OS and their applications are incompatible because of the structural differences of their kernels and their file systems. Emulators can be used to execute applications built for one of these OSs on another. After reviewing both advantages and disadvantages of both OS's we concluded that Linux is the better choice for server installations while Windows is the better choice for user PC's. The main advantages of Linux OS are its price, high configurability, security and stability, while lower number of available high quality applications and technical support availability can be seen as its main disadvantages. Linux OS has proven itself as a high quality and low price solution for running certain Windows applications using emulators. This approach is being used in practice and it has shown that Windows applications running on emulators can have very good performance and stability levels.

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