Introduction to Desktop Virtualization

– Get Started with Virtual Machines (VMs)

Saturday 2012-10-20 – *For Review*

Johan Sarkinen

M.Sc. Computer Science

COMGT

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1 Objectives

There are two objectives with this document: to introduce general concepts around desktop virtualization (1) and walk the reader through the whole process of getting a virtual machine up and running (2).

2 Executive Summary

Virtualization is among the hotter topics in information technology today - from enabling more energy efficient operations in data centers to enabling advanced capabilities on personal computers.

Through desktop virtualization, a user can easily:

- Run the best applications out there, on any desktop computer, independently if applications are Mac-, Windows-, or Linux-based.[1]
- Have a complete network of “computers” on one single machine, for development or test.
- Use specific applications in *sandboxes*, for information security reasons.

Starting costs are low – from zero with the free and open source software (FOSS) *VirtualBox* and any reasonably modern and powerful computer will do just fine. Everything you need can be downloaded from the Internet.

3 About the Author

Johan Sarkinen has been working with virtualization and related technologies (e.g. emulators) since the 1980s. In the earlier days using emulators in development of embedded monitoring solutions and the first use of personal computer virtualization was Connectix’ Virtual PC[2] on Mac in the late 1990s.

Today, essentially every personal computer used by Johan – Mac or Win – includes a *hypervisor* and a few virtual machines. A Linux environment is always useful…

Johan holds a M.Sc. in Computer Science, he is a Project Management Professional (PMP) certified by Project Management Institute (PMI), and is a Senior IEEE Member and a proud member of FBI’s InfraGard program.

[1] Some restrictions may exist depending on licenses (more in section 8, pg. 11).
[2] Sold to Microsoft in 2003.

4 Introduction

This document focuses on what is called *desktop virtualization* and especially the capability to run multiple operating systems simultaneously. For instance using Mac OS X, Windows 7, Windows XP, a complete Linux-based VoIP phone system (*Asterisk*), checking out a customer relations management (CRM) system, and using advanced tools for digital forensics and information security (e.g. *BackTrack*) – all at the same time, on one single personal computer.

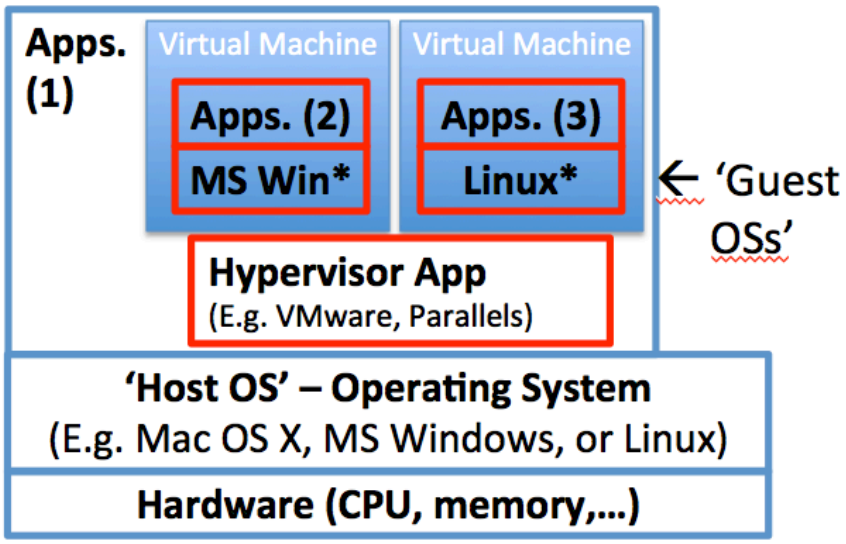

Figure 1: Hardware, Host OS, and Guest OSs

Some key concepts include (Figure 1):

- *Host OS*: the operating system you're running on your personal computer. We are using *host* to separate this OS from the *guest* OS(s).
- *Hypervisor*, or *virtual machine manager* (VMM[1]): special application that executes on your host OS and runs your virtual machines.
- *Virtual Machine* (VM): all the files that compromises a virtual environment that can be executed by a hypervisor.
- *Guest OS(s)*: the operating system(s) you're running inside your virtual machine(s), via the *hypervisor* of your choice.

Note that there are many flavors of virtualization – bare-metal ('type 1'), hosted ('type 2'), desktop, virtual desktop infrastructure (VDI), server, storage, network, and memory to mention a few – but the focus in this document is solely on *hosted* (type 2) *desktops*.

[1] Sometime also called *virtual machine monitor*.

5 Why Use, or Learn

- Run applications **not available** on your OS. Mac or Linux users using Windows applications, Windows users using free open source software created for Linux. Or simply be able to use the **best applications** out there, independently of what OS they run on. (Indicated with 'Apps. (1)', 'Apps. (2)', and 'Apps. (3)' in Figure 1 on previous page.)
- **Development**: for web deployment or embedded systems, including mobile devices. Have complete development environment ready for some specific hardware; have an Android OS running directly on your desktop; run multiple Internet Explorer web browsers simultaneously (IE 6, 7, 8, 9…).
- **Digital forensics**: easy access to older platforms (e.g. Windows 98) and special tools.
- **Information security**: use virtual machines as 'sand boxes' try out tools, explore malware, run intrusion detection system (IDS), network monitors, etc.
- **Learn** a very **hot and useful topic**: virtualization is various forms are directly or indirectly (e.g. in cloud computing) mentioned in many job ads (2011). Or to have an environment to learn something running inside a VM, like Linux.

Figure 2 shows a Macintosh computer simultaneously enabling use of Mac OS X, MS Windows (XP) and Linux. With graphical user interface (GUI) and command line interface (CLI) interfaces.

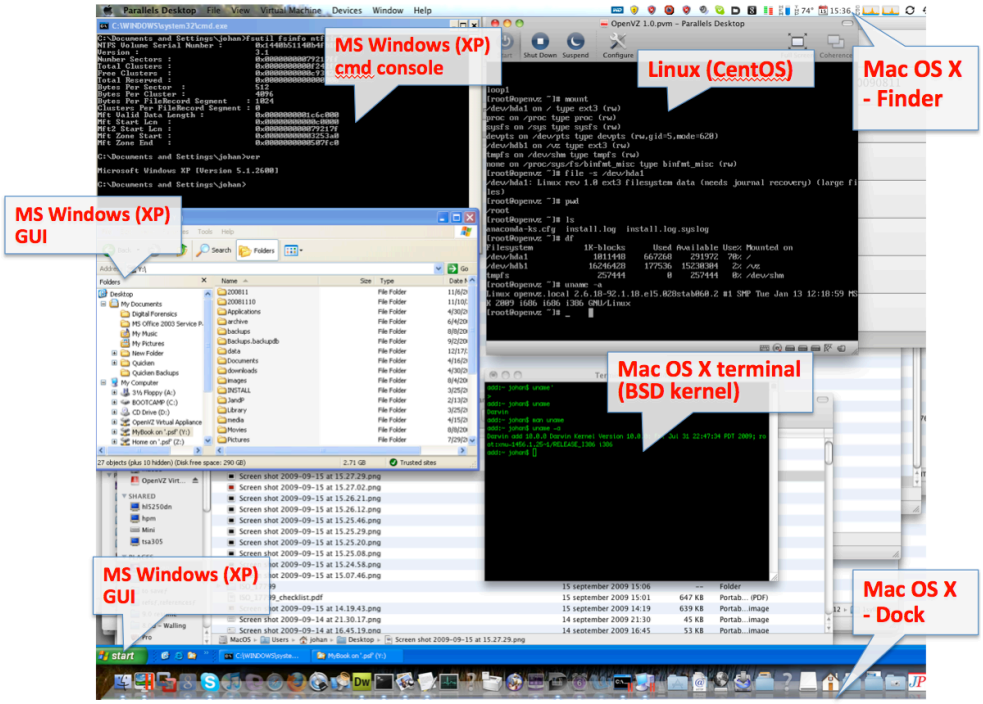

Figure 2: Mac OS X, Windows, and Linux at the Same Time

6 What You Need

Personal skills: Know how to install software.

Internet Access: A decent-speed broadband connection, or it can take days to download certain appliances…

Hardware: A reasonably modern computer with at least a couple of gigabyte of RAM memory and some 20-50 GB of free hard disk space. See also Appendix A System Requirements on page 15.

You must have administrative privileges, to install software.

Software: At a minimum (more in section 11.1 Preparations, pg. 14):

1. Hypervisor – more in chapter 7 on next page.
2. Possibly a separate license for operating system (if creating VM with Windows or Mac OS X) – more in chapter 8 Licenses on page 11.

6.1 32- or 64-bit Versions of Operating Systems?

For **Host OS**: 64-bit, for ability to use more than 4 GB of memory.

- My personal preferences are Mac OS X for Mac-based systems and Windows XP 64-bit for Windows-based systems.

  Note that I prefer XP to Windows 7, as XP is "good enough" and requires far less resources of the host – which means more resources available to guest operating systems.

For **Guest OS(s)**: 32-bit, for most desktop-use applications – you won't allocate too much memory to individual VMs anyway.

(Learn more on 32- vs 64-bit at http://www.techsupportalert.com/content/32-bit-and-64-bit-explained.htm.)

7 Hypervisors

For our purposes – hosted desktop virtualization, and with capability to run our most common desktop operating systems (both on host OS and as guest OSs)[1] – there are three major manufacturers of hypervisors:

1. Parallels – started for Mac but has ventured into also Windows and Linux
2. VMware – among the biggest player in the industry of virtualization, for both desktop and servers.
3. VirtualBox (owned by Oracle) – free and open-source software (FOSS). (GPL license – more in 8.4 GPL and Other Open Source Licenses, pg. 11)

Table 1 summarizes hypervisors for desktop virtualization based on host operating system.

Table 1: Hypervisors from VirtualBox, VMware, and Parallels

Host OS:	**Mac OS X**	**MS Windows**	**Linux**
Free:	• VirtualBox	• VirtualBox • VMware Player	• VirtualBox
For pay:	• Parallels Desktop ($$) – free trial • VMware Fusion ($$) – free trial	• Parallels Desktop ($$) - • VMware Workstation ($$$)	• Parallels Desktop ($$) • VMware Workstation ($$$)

See also http://comgt.com/virtual/#ProductsHypervisors for more on products including links to where to buy and/or download.

7.1 Which to Choose

For Mac-users: I strongly recommend spending $$ to buy either Parallels Desktop or VMware Fusion. The free VirtualBox (VB) is of course not a bad alternative especially for the cost-continuous individuals (e.g. students) but VB also requires more work to use. See 7.5 VirtualBox for more.

For Windows-users: easy choice – see 7.3 VMware Player (Windows Only).

For Linux-users: as for Mac, spending $$-$$$ will save you time.

[1] There is no shortage of different variants of virtualization products – see (e.g.) http://en.wikipedia.org/wiki/Comparison_of_platform_virtual_machines. Many however are more specialized than the three mentioned above.

7.2 Parallels or VMware

I've been – and am – using both Parallels and VMware (Fusion) on Mac and these are very similar and either one is a good choice.

For people working in multiple environments, VMware has an advantage of easier move of appliances between systems (Mac, Win, and even VMware-based servers).

7.3 VMware Player (Windows Only)

Windows users have a great choice – the VMware Player is free and has become quite capable over the years. (Early versions only allowed running ready-made appliances but since v3, you can also create new machines in Player.)

Note the there are still useful features that are missing in Player (Table 2) and professionals should consider the Workstation ($$$), or Parallels Desktop ($$).

Table 2: VMware Player vs. Workstation

Host OS	VMware Player (v4)	VMware Workstation (v8)
Cost	Free	$$$
# VMs/host	1-2	< 10
Snapshots	No	Yes
Record – Replay	No	Yes
Headless operation	No	Yes
Support available	No	Yes

(Player (v4) and Workstation (v8) requires a 64-bit host OS.)

See (e.g.) *What is the difference between Workstation, Player and Server?* - http://vmfaq.com/entry/5/ (updated 2011-10-03) for more.

7.4 Note on Windows XP Mode

Windows 7 **Pro** and higher variants (not *Home Premium*) has capability to run a Windows XP Mode. This however is a bit cumbersome to setup – requires multiple downloads and the only benefit – if any – is that a license to run XP is included.

Reasons to stay away of XP Mode include: compatibility issues, performance, and flexibility (https://google.com/search?q=windows+7+xp+mode+vs+vmware for more)

7.5 VirtualBox

The big advantage with this is of course low initial cost – free. Though, if you value your time, you need to consider the extra work with setting up machines.

Using VirtualBox (After downloaded a VDI file)	Using (e.g.) VMware Player (free; Win) (After downloaded an appliance)
Create a New Virtual Machine in VirtualBox using the uncompressed VDI file as the Hard Drive 1. Run VirtualBox 2. Click the "New" button 3. Click "Next" 4. Enter the name "My Puppy"; 5. Select "Linux 2.6" with the OS Type dropdown 6. Select "Next" 7. On the "Memory" panel select "Next" 8. On the Virtual Hard Disk" panel select "Existing" This opens the VirtualBox Virtual Disk Manager" 9. Select the "Add" button. 10. Select the "puppy-4.00-k2.6.21.7-seamonkey.vdi" file that was extracted in the previous steps 11. Click "Select" 12. Click "Next" 13. Click "Finished" • Optional: *(Configure VirtualBox General settings to match the site settings.)*	No need to create VM. 1. Double-click on .vmx (or possibly a .vmware - file on Mac). That's it. (And the same is applicable for Parallels – another hypervisor product – simply download appliance and open to run.) Nor any need to know details otherwise required creating a virtual machine. Like: • What operating system • 32-bit or 64-bit • Version of kernel • RAM size, Disk size, ...

Figure 3: Use of VirtualBox vs. VMware Player (or Parallels Fusion)

(Steps for VirtualBox from http://virtualboximages.com/GettingStarted 2011-12-09, and numbered here instead of bullets. For easier counting of how much work with different products.)

8 Licenses

For many users this is a boring topic and users often quickly accept any license terms – without reading them – when installing new software.

Below are a few notes to at least highlight the most important things to know. And indirectly explains why you can't find free ready-to-use appliances with Mac or Windows operating systems (as you have to buy another license to use).

8.1 Mac OS X

Apple has traditionally been very restrictive with how their Mac OS X operating system could be used. For natural reasons – they sell computers, not in business of selling operating systems per se.

- 10.6 Snow Leopard: only Server-variant is allowed in VM environments
- 10.7 Lion: both Server and Desktop are now allowed.

→ The general rule is you have to buy a license for each VM you run.

8.2 MS Windows

Microsoft – as in business of selling operating systems – does not have the same restrictions as Apple (at least traditionally has had).

→ The general rule is you must buy a license for each VM you run.

(Windows 7, *Pro* and higher, does include a license for Windows XP Mode.)

8.3 Linux

To some, the licensing of Linux is among the bigger benefits – not hassles, get and run as many copies you want, at no special costs or issues.

Linux is licensed under a license called GNU Public License (GPL) – next.

8.4 GPL and Other Open Source Licenses

GNU Public License (GPL) and other free and open source software (FOSS) licenses allow you to basically use software in any way you like. The only restriction is that you have to keep this openness - i.e. you **cannot** take open sources and make them proprietary (as is the case with GPL). And you must also make any changes you make available to anyone asking for these. This is informally called *copyleft* (compare to *copyright*) requirement.

Note that there are some FOSS licenses (e.g. LGPL and BSD) that **do** allow "safe" use in also proprietary settings, where you do not want to give up your changes or extensions.

9 Virtual Machines

You have basically two different ways of getting your virtual machines:

1) Create your own
2) Get a ready-to-use virtual machine, also known as an *appliance*.

9.1 Linux Distributions ('Distros') vs. Appliances

Note that a distro is not the same as an appliance, per se.

"Linux" when discussed in terms of operating systems exist in a rather huge number of flavors (e.g. Android, Debian, Fedora, RedHat, SUSE, and Ubuntu).

A distro consists of the Linux kernel (core OS, in some specific version) plus some number of specific applications, graphical desktop environment (most popular and common are GNOME and KDE), and can be slimmed down to run on a small USB stick, or to run on a huge IBM mainframe computer.

See http://comgt.com/lib/linux/ for more on some popular Linux distros.

An appliance is a ready-to-use virtual machine including OS and all other files part of a VM, which allows this to be executed by a hypervisor.

Some Linux distributions exist as appliances, which makes it much easier to check out a specific distro.

9.2 Create Your Own Virtual Machine (Appliance)

This is like installing an operating system on any other computer, including installing and configuring applications, etc. The process is rather simple but outside the scope of this document. See instructions for the hypervisor of your choice for more.

9.3 Download Ready-to-Use

There are many sources for downloading appliances, including sites for specific distros (like *BackTrack*, see chapter 10.1 on page 13). The three main vendors of hypervisors also maintain directories for easier finding appliances:

- Parallels Virtual Appliances Directory - parallels.com/ptn/download/va/ (98 appliances per 2011-12-26, and still 98 per 2012-10-20…!?)
- VMware Virtual Appliances Marketplace - vmware.com/appliances/ (938 per 2012-10-20)
- VirtualBox Virtual Appliances - virtualboximages.com (>400 2012-10-20)

(Number of appliances is only provided as indication and includes many similar variants, like different versions of operating systems, included applications, etc.)

10 Two Linux Distros

As example of a couple of Linux distributions that also exist in form of ready-to-use, downloadable, appliances:

10.1 BackTrack (BT) – Larger

BackTrack (http://www.backtrack-linux.org/) is a popular digital forensics and information security distro.

This is a larger distribution and can take a bit of time to download if you have a slower Internet connection.

Table 3: Download Sizes – BackTrack 5 R1 and 4 R2 (older)

Release	File	Size
BackTrack 5 R1 (2011)	BT5R1-GNOME-VM-32.7z • Gnome windows manager • 32 bit architecture • VMware image	1.64 GB
BackTrack 4 R2 (2010)	bt4-r2-vm.tar.bz2	2.39 GB

Additional resources:

1) *BackTrack in 30 Minutes* – a two-page guide to start with BT: http://comgt.com/download/BackTrack4in30minutes.pdf
2) http://www.backtrack-linux.org/wiki/index.php/Basic_Usage

10.2 Damn Small Linux (DSL) – Smaller

DSL (http://www.damnsmalllinux.org/) is on the other side of the spectrum in terms of size. From http://www.vmware.com/appliances/directory/54320:

> Damn Small Linux has a nearly complete desktop, including XMMS (MP3, and MPEG), FTP client, links-hacked web browser, spreadsheet, email, spellcheck (US English), a word-processor, three editors (Nedit, nVi, Zile [emacs clone]), Xpdf, Worker (file manager), Naim (AIM, ICQ, IRC), VNCviwer, SSH/SCP server and client, DHCP client, PPP, PPPoE, a web server, calculator, Fluxbox window manager, system monitoring apps, USB support, and soon it will have PCMCIA support as well. If you like Damn Small Linux you can install it on your hard drive. Because all the applications are small and light it makes a very good choice for older hardware.

Download size around 50 MB (!), and runs fine in only 128 MB of RAM.

11 Procedure

11.1 Preparations

Tools – What You Need

1. Computer with web browser
2. Internet connection
3. Hypervisor – download one of your choice
4. Unzip / archive tool – to unpack downloaded hypervisor and appliances
5. Possibly: A Bit Torrent client – some appliances are distributed via torrents.
6. Hashing tool (MD5) – to ensure downloads are good

Planning

1. Hard disk: Make sure you have enough hard disk space – these things tend to eat up some space… -
2. Time: calculate with half-hour or more to get thing set up, aside time for downloads…
3. Where to keep appliances
4. Consider what appliance(s) you want to use to decide which hypervisor platform to start with.

11.2 Process

1. Download hypervisor application
2. Download appliance(s)
3. Verify downloads using MD5 hashes.
4. Unpack and install hypervisor
5. Unpack appliance
6. Create VM or immediately start using – see Figure 3: Use of VirtualBox vs. VMware Player (or Parallels Fusion) on page 10 for steps.

11.3 Learn More

Go to http://comgt.com/virtual/ for more information and tips.

Appendix A System Requirements

You can get started as long as you have a fairly modern computer but as you will be running multiple operating systems (and applications) simultaneously, the more powerful computer the better.

Minimum recommended systems is a personal computer (Mac OS X, MS Windows, or Linux - based desktop or laptop) with 2 GB of RAM and enough free hard disk space to install another operating system (from 10 GB and up is appropriate depending on which guest OS). More in Table 5 on next page.

Note that 2 GB RAM really is on the low side when using virtual machines and 3 GB or more is strongly recommended. As professionals at COMGT, we always load machines with 8 to 16 GB of RAM.

As one example, the recommendations for VirtualBox hypervisor product are shown in Figure 4:

This page is for end users who are looking for information about how to download and run VirtualBox.

In order to run VirtualBox on your machine, you need:

- Reasonably powerful **x86[5] hardware.** Any recent Intel or AMD processor should do.
- **Memory.** Depending on what guest operating systems you want to run, you will need at least 512 MB of RAM (but probably more, and the more the better). Basically, you will need whatever your host operating system needs to run comfortably, plus the amount that the guest operating system needs. So, if you want to run Windows XP on Windows XP, you probably won't enjoy the experience much with less than 1 GB of RAM. If you want to try out Windows Vista in a guest, it will refuse to install if it is given less than 512 MB RAM, so you'll need that for the guest alone, plus the memory your operating system normally needs.
- **Hard disk space.** While VirtualBox itself is very lean (a typical installation will only need about 30 MB of hard disk space), the virtual machines will require fairly huge files on disk to represent their own hard disk storage. So, to install Windows XP, for example, you will need a file that will easily grow to several GB in size.

- A supported **host operating system.** Presently, we support Windows (XP and later), many Linux distributions, Mac OS X, Solaris and OpenSolaris.
  - A supported **guest operating system.** Besides the user manual (see below), up-to-date information is available at "Status: Guest OSes".

Figure 4: Requirements (from VirtualBox)

(https://www.virtualbox.org/wiki/End-user_documentation, retrieved 2011-12-26)

[5] In this case, x86 refer to both 32 and 64 bit (aka x86-32 and x86-64, or x64) (note added in this document).

A.1 Combined Requirements – Host and Guest(s)

Running VMs can quickly eat up both RAM and hard disk space, especially if running a heavy-weigh OS like Windows 7. Table 4 below shows combined requirements for some combinations of more common OSs.

Table 4: System Requirements – Example Configurations

Host:	**Mac OS X – based**						**MS Windows – based**						**Linux – based**	
Host OS	10.6 Snow Leopard[1]		10.7 Lion[2]				Windows XP 64-bit[4]				Windows 7 64-bit[5]		'Some Linux' 64-bit[6]	
	RAM	HD	RAM	HD	RAM	HD	RAM	HD	RAM	HD	RAM	HD	RAM	HD
	1 GiB	5 GiB	2 GiB	7 GiB	2 GiB	7 GiB	1 GiB	15 GiB	1 GiB	15 GiB	2 GiB	20 GiB	1 GB	15 GiB
Guest OS	Windows XP 32-bit[3]				'Some Linux 32-bit[6]		Windows 7 32-bit[5]		'Some Linux 32-bit[6]		Windows XP Mode[5]		Windows XP 32-bit[3]	
	RAM	HD	RAM	HD	RAM	HD	RAM	HD	RAM	HD	RAM	HD	RAM	HD
	64 MiB	1.5 GiB	64 MiB	1.5 GiB	0.5 GiB	5 GiB	1 GiB	16 GiB	0.5 GiB	5 GiB	1 GiB	15 GiB	64 MiB	1.5 GiB
Tot	1.1 GiB	6.5 GiB	2.1 GiB	8.5 GiB	2.5 GiB	12 GiB	2 GiB	31 GiB	1.5 GiB	20 GiB	3 GiB	45 GiB	1.1 GiB	16.5 GiB

All host operating systems in 64-bit variant (when exist in both 32 and 64 bits).

[1] http://en.wikipedia.org/wiki/Mac_OS_X_Snow_Leopard
[2] *OS X Lion Technical Specification* – http://www.apple.com/macosx/specs.html
[3] *System requirements for Windows XP operating system* - http://support.microsoft.com/kb/314865
[4] Microsoft Windows XP 64-bit Edition – http://technet.microsoft.com/en-us/library/bb457053.aspx
[5] *Windows 7 system requirements* - http://windows.microsoft.com/en-US/windows7/products/system-requirements
[6] Linux exist in a multitude of flavors for different use (e.g. desktop, server, embedded, for main frames, mobile devices, etc) but in general is a quite lean operating system with relatively low requirements on both RAM and hard drive space.

Linux Hardware Requirements, 2011-03-03
http://www.brighthub.com/computing/linux/articles/37725.aspx

A.2 A Little Bit of History

It's easy to forget how quickly information technology has evolved and having thoughts like 'No, is that really true? Can I really run Windows XP on 64 MiB of memory…?'

As a brief reminder, Table 5 shows *minimum* requirements for all OSs from Apple and Microsoft, plus a few releases of Ubuntu – one of the current more popular Linux distributions.

Table 5: Requirements Operating Systems 2001-2011

Released	OS	RAM	Disk	Comments
2001 Mar	OS X 10.0	128 MiB	1.5 GiB	800 MiB for minimal install
2001 Aug	Windows XP	64 MiB	1.5 GiB	3.2 GiB for SP2, 4.1 GiB for SP3
2001 Sep	OS X 10.1	128 MiB	1.5 GiB	
2002 May	OS X 10.2	128 MiB	?	No disk space req. in [W] article
2003 Oct	OS X 10.3	128 MiB	1.5 GiB	
2004 Oct	Ubuntu 4.10	64 MiB	1 GiB	'With Desktop' version. Yes – 4.10 was the first release of Ubuntu
2005 Apr	OS X 10.4	256 MiB	3 GiB	
2006 Jun	OS X 10.5	512 MiB	9 GiB	
2006 Nov	Vista	512 MiB	20 GiB	For *Vista Capable*; 1 GiB / 40 GiB for *Vista Premium Ready*.
2008 Apr	Ubuntu 8.04	64 MiB	5 GiB	Min; 512 MiB rec. (With Desktop)
2009 Jul	Windows 7	1 GiB	16 GiB	32-bit; 64-bit: 2 GiB / 20 GiB
2009 Aug	OS X 10.6	1 GiB	5 GiB	[W]
2011 Jul	OS X 10.7	2 GiB	7 GiB	[W]
2011 Oct	Ubuntu 11.10	384 MiB	5 GB	(Desktop; Server: 128 MiB / 1 GiB)

Color-coded origin:

Apple – bluish	Microsoft – pinkish	Linux – greenish

Sources:

- http://en.wikipedia.org/wiki/Mac_OS_X and wikipedia's Mac_OS_X_v10.[x] - for example: http://en.wikipedia.org/wiki/Mac_OS_X_v10.2
- http://en.wikipedia.org/wiki/Windows_xp
- http://en.wikipedia.org/wiki/Windows_Vista
- http://en.wikipedia.org/wiki/Windows_7
- Ubuntu 4.10: http://old-releases.ubuntu.com/ubuntu/dists/warty/main/installer-i386/20040801ubuntu20/doc/manual/en/ch03s04.html
- Ubuntu 8.04: https://help.ubuntu.com/8.04/installation-guide/i386/minimum-hardware-reqts.html
- Ubuntu 11.10 (current): https://help.ubuntu.com/community/Installation/SystemRequirements

Appendix B Windows 7 and XP Mode

Does "Windows XP Mode" REALLY work? - http://us.generation-nt.com/answer/does-windows-xp-mode-really-work-help-204823131.html?page=4

Question:

> Does "Windows XP Mode" REALLY work?
> September 18th, 2011 - 05:56 pm ET by PDFrank | Report spam
> Help Create a new topic
> Running Windows 7 Home Premium SP1
> I have a few good legacy programs that don't run right under Windows 7, even under "compatibility mode."
> They ran fine under XP.
> The software companies that wrote the programs went bye-bye.
> $89.95 is the price to upgrade to 7 Professional.
> Is it possible that they still might not run right even in "XP Mode"?

Answer:

> I went with VMWare Player instead of XP Mode, basically for two reasons: (1) to save the cost and possible problems of upgrading my Win 7 Home Premium to Professional, and (2) the ability to run other OSes like Ubuntu in the VM. It's interesting to see that even from a strict technical viewpoint XP mode would not be the best choice.

Appendix C More Readings

General

- http://en.wikipedia.org/wiki/Virtualization - general overview and introduction
- http://en.wikipedia.org/wiki/Emulation_%28computing%29 - more technical

News

- http://www.virtualization.net/ - Virtualization.net | Cloud Computing Technology - News - Forums - Videos - Support
- http://www.networkworld.com/topics/virtualization.html

Microsoft

- http://www.microsoft.com/virtualization/ - primary focus on data centers and servers
- Windows XP Mode in Windows 7: http://windows.microsoft.com/en-us/windows7/products/features/windows-xp-mode

VMware

- VMware Player Documentation - http://www.vmware.com/support/pubs/player_pubs.html
- VMware Workstation Documentation https://www.vmware.com/support/pubs/ws_pubs.html
- What is the difference between Workstation, Player and Server? http://vmfaq.com/entry/5/

Acronyms

CLI	Command Line Interface (terminal interface)
FOSS	Free and Open Source Software
GPL	GNU Public License
GUI	Graphical User Interface (req. mouse, touch screen, similar)
IA-32	Intel Architecture, 32-bit (aka x86, x86-32)
IA-64	Intel Architecture, 64-bit (aka x64, x86-64)
VDI	Virtual Desktop Infrastructure, Virtual Desktop Interface
VM	Virtual Machine
VMM	Virtual Machine Manager, Virtual Machine Monitor

https://www.google.com/search?q=vdi

References

[1] *None at this point*

Document History

This document uses ISO-8601 international standard for time information (YYYY-MM-DD, and 24 hours HH:MM:SS, as applicable).

Date	User	Notes
2012-01-20	JS	First release for review (started 2011-12-18 Sun)
2012-05-26	JS	Started cleanups of language, content
2012-10-20	JS	Second release for review