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Screenshot of VirtualBox v4.1.8 running a copy of Ubuntu 11.04 on Windows 7. The window to the left is VirtualBox virtual machine manager and the one to the right is the desktop of Ubuntu

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<b><u>Developer(s)</u></b>	<a href="#">Oracle Corporation</a>
<b>Initial release</b>	January 15, 2007; 5 years ago
<b><u>Stable release</u></b>	<a href="#">4.1.18</a> (June 20, 2012; 15 days ago) <small>[±]</small>
<b><u>Preview release</u></b>	<small>[±]</small>
<b><u>Operating system</u></b>	<a href="#">Microsoft Windows</a> , <a href="#">Mac OS X</a> , <a href="#">Linux</a> and <a href="#">Solaris</a> <sup>[1]</sup>
<b><u>Size</u></b>	40 – 90 <a href="#">MB</a> depending on platform <sup>[2]</sup>
<b><u>Type</u></b>	<a href="#">Virtual machine</a>
<b><u>License</u></b>	Base Package: <a href="#">GNU General Public License</a> version 2 (Optionally <a href="#">CDDL</a> for most files of the source distribution), "Extension Pack": <a href="#">PUEL</a>
<b>Website</b>	<a href="http://www.virtualbox.org">www.virtualbox.org</a>

# Oracle VM VirtualBox

- **Oracle VM VirtualBox** (formerly **Sun VirtualBox**, **Sun xVM VirtualBox** and **innotek VirtualBox**) is an x86 virtualization software package, created by software company Innotek GmbH, purchased by Sun Microsystems, and now developed by Oracle Corporation as part of its family of virtualization products.
- Oracle VM VirtualBox is installed on an existing host operating system as an application; this host application allows additional guest operating systems, each known as a *Guest OS*, to be loaded and run, each with its own virtual environment.
- **Supported host operating systems** include Linux, Mac OS X, Windows XP, Windows Vista, Windows 7, Windows 8, Solaris, and OpenSolaris; there is also a port to FreeBSD.
- **Supported guest operating systems** include versions and derivations of Windows, Linux, BSD, OS/2, Solaris and others.
- Since release 3.2.0, VirtualBox also allows limited virtualization of Mac OS X guests on Apple hardware, though OSX86 can also be installed using VirtualBox

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- According to 2010 surveys by LinuxJournal.com, and LifeHacker.com, VirtualBox was the most popular virtualization product with over 50% of the vote.
- Since version 4.1, Windows guests on supported hardware can take advantage of the recently **implemented WDDM** driver included in the guest additions; this allows **Windows Aero** to be enabled along with **Direct3D support**.

# Logo of VirtualBox OSE, 2007



# History

- Innotek initially offered the application under a proprietary software license. One version of the product was available at no cost for personal or evaluation use, subject to the **VirtualBox Personal Use and Evaluation License (PUEL)**.
- **In January 2007, VirtualBox Open Source Edition (OSE) was released as free software**, subject to the requirements of the GNU General Public License (GPL), version 2.
- The original developer, **Innotek**, also contributed to the development of OS/2 and Linux support in virtualization and OS/2 ports of products from Connectix which were later acquired by Microsoft. Specifically, Innotek developed the “additions” code in both Microsoft Virtual PC and Microsoft Virtual Server, which enables various host-guest OS interactions like shared clipboards or dynamic viewport resizing.
- **Sun Microsystems acquired Innotek** in February 2008.
- **Oracle Corporation acquired Sun** in January 2010 and re-branded the product as "Oracle VM VirtualBox".

# Licensing

- With version 4 of Virtualbox, released in Dec. 2010, the **core package** is free software released under GNU General Public License version 2 (GPLv2).
- This is the fully featured package, **excluding some proprietary components not available under GPLv2**. These components provide support for USB 2.0 devices, RDP and PXE boot for Intel cards and are released as a separate "VirtualBox Oracle VM VirtualBox extension pack" under a proprietary **Personal Use and Evaluation License (PUEL)**, which permits use of the software for personal use, educational use, or evaluation, free of charge
- **Prior to version 4**, there were **two different packages** of the VirtualBox software. The **full package was offered free under the PUEL**, with licenses for other commercial deployment purchasable from Oracle. A second package called the **VirtualBox Open Source Edition (OSE)** was released under GPLv2. This removed the same proprietary components not available under GPLv2
- Although VirtualBox has experimental support for Mac OS X guests, the **end user license agreement of Mac OS X does not permit the operating system to run on non-Apple hardware**, enforced within the operating system by calls to the Apple System Management Controller (**SMC**) in all Apple machines, which verifies the authenticity of the hardware

# Emulated environment

- **Multiple guest OSs** can be loaded under the host operating system (host OS). Each guest can be started, paused and stopped independently within its own virtual machine (VM)
- The user can independently configure each VM and run it under a choice of software-based virtualization or hardware assisted virtualization if the underlying host hardware supports this
- The **host OS and guest OSs and applications can communicate with each other through a number of mechanisms** including a common clipboard and a virtualized network facility provided. Guest VMs can also directly communicate with each other if configured to do so

# Software-based virtualization

- In the absence of hardware-assisted virtualization, VirtualBox adopts a **standard software-based virtualization approach**. This mode supports 32-bit guest OSs which run in rings 0 and 3 of the Intel ring architecture.
- The guest OS code, running in ring 0, is reconfigured to execute in ring 1 on the host hardware.
- Because this code contains many privileged instructions **which cannot run natively in ring 1**, VirtualBox employs a **Code Scanning and Analysis Manager (CSAM)** to scan the ring 0 code recursively before its first execution to identify problematic instructions and then calls the **Patch Manager (PATM)** to perform in-situ patching.
- **This replaces the instruction with a jump to a VM-safe** equivalent compiled code fragment in hypervisor memory.
- The guest user-mode code, running in the ring 3, is generally run directly on the host hardware at ring 3.

# Software-based virtualization

- In both cases, VirtualBox uses CSAM and PATM to inspect and patch the offending instructions whenever a fault occurs.
- VirtualBox also contains a dynamic recompiler, based on QEMU to recompile any real mode or protected mode code entirely
- (e.g. BIOS code, a DOS guest, or any operating system startup)
- Using these techniques, VirtualBox can achieve a performance that is comparable to that of VMware.

# Hardware-assisted virtualization

- VirtualBox supports both Intel's VT-x and AMD's AMD-V hardware virtualization.
- Making use of these facilities, VirtualBox can run each guest VM in its own separate address space; the guest OS ring 0 code runs on the host at ring 0 in VMX non-root mode rather than in ring 1.
- Some guests, including 64-bit guests, SMP guests and certain proprietary OSs, are only supported by VirtualBox on hosts with hardware-assisted virtualization.

# Device virtualization

- Hard disks are emulated in one of **three disk image formats**:
  - ◆ VirtualBox-specific container format, called "Virtual Disk Image" (VDI), which are stored as files (with a .vdi suffix) on the host operating system
  - ◆ VMware Virtual Machine Disk Format (VMDK)
  - ◆ Microsoft Virtual PC VHD format
- A **VirtualBox virtual machine can, therefore, use disks that were created in VMware or Microsoft Virtual PC**, as well as its own native format. VirtualBox can also connect to **iSCSI targets** and to raw partitions on the host, using either as virtual hard disks.
- VirtualBox **emulates IDE** (PIIX4 and ICH6 controllers), **SCSI, SATA** (ICH8M controller) and **SAS controllers** to which hard drives can be attached
- **Both ISO images and host-connected physical devices can be mounted as CD/DVD drives**. For example, the DVD image of a Linux distribution can be downloaded and used directly by VirtualBox
- By default VirtualBox provides **graphics support through a custom virtual graphics card that is VESA compatible**. The Guest Additions for Windows, Linux, Solaris, OpenSolaris, or OS/2 guests include a special video driver that increases video performance and includes additional features, such as automatically adjusting the guest resolution when resizing the VM window, or desktop composition via virtualized WDDM drivers

# Device virtualization

- **For an Ethernet network adapter, VirtualBox virtualizes these Network Interface Cards:** AMD PCnet PCI II (Am79C970A), AMD PCnet-Fast III (Am79C973), Intel Pro/1000 MT Desktop (82540EM), Intel Pro/1000 MT Server (82545EM), and Intel Pro/1000 T Server (82543GC). The emulated network cards allow most guest OSs to run without the need to find and install drivers for networking hardware as they are shipped as part of the guest OS. By default, VirtualBox uses NAT through which Internet software for end users such as Firefox or ssh can operate. Bridged networking via a host network adapter or virtual networks between guests can also be configured. Up to eight network adapters can be attached simultaneously, but only four are configurable through the graphical interface
- **For a sound card, VirtualBox virtualizes** Intel HD Audio, Intel ICH AC'97 device and SoundBlaster 16 cards
- **A USB 1.1 controller** is emulated so that any USB devices attached to the host can be seen in the guest. The **closed source extension pack adds a USB 2.0 controller** and, if VirtualBox acts as an RDP server, it can also use USB devices on the remote RDP client as if they were connected to the host, although only if the client supports this VirtualBox-specific extension (Oracle provides clients for Solaris, Linux and Sun Ray thin clients that can do this, and have promised support for other platforms in future versions)

# Feature set

- This section **is in a list format that may be better presented using prose**
  - ◆ 64-bit guests (hardware virtualization only)
  - ◆ NCQ support for SATA, SCSI and SAS raw disks and partitions
  - ◆ Snapshots
  - ◆ Seamless mode
  - ◆ Clipboard
  - ◆ Shared folders
  - ◆ Special drivers and utilities to facilitate switching between systems
  - ◆ Command line interaction (in addition to the GUI)
  - ◆ Public API (Java, Python, SOAP, XPCOM) to control VM configuration and execution
  - ◆ Nested paging for AMD-V and Intel VT (only for processors supporting SLAT and with SLAT enabled)
  - ◆ Raw hard disk access – allows physical hard disk partitions on the host system to appear in the guest system
  - ◆ VMware Virtual Machine Disk (VMDK) format support – allows VirtualBox to exchange disk images with VMware
  - ◆ Microsoft VHD support
  - ◆ 3D virtualization (Limited support for OpenGL was added to v2.1, more support was added to v2.2, OpenGL 2.0 and Direct3D support was added in VirtualBox 3.0)
  - ◆ SMP support (up to 32 virtual CPUs per virtual machine), since version 3.0
  - ◆ Teleportation (aka Live Migration), since version 3.1
  - ◆ 2D video acceleration, since version 3.1

# Feature set

## ■ Since version 3.2

- ❖ Mac OS X Server guest support – experimental
- ❖ Memory ballooning
- ❖ RAM deduplication (Page Fusion) for Windows guests on 64-bit hosts
- ❖ CPU hot-plugging for Linux (hot-add and hot-remove) and certain Windows guests (hot-add only)
- ❖ Deleting snapshots while the VM is running
- ❖ Multi-monitor guest setups in the GUI, for Windows guests
- ❖ LSI Logic SAS controller emulation
- ❖ Remote Desktop Protocol (RDP) video acceleration
- ❖ Run and control guest applications from the host – for automated software deployments

# Feature set

## ■ Since version 4.0

- ❖ The PUEL/OSE separation was given up in favor of an open source base product and a closed source extension pack that can be installed on top of the base product.
  - As part of this change, additional components of VirtualBox were made open source (installers, documentation, device drivers)
- ❖ Intel HD audio emulation
- ❖ Intel ICH9 chipset emulation
- ❖ A new VM storage scheme where all VM data is stored in one single folder to improve VM portability
- ❖ Several UI enhancements including a new look with VM preview and scale mode
- ❖ On 32-bit hosts, VMs can each use more than 1.5 GB of RAM
- ❖ In addition to OVF, the single file OVA format is supported
- ❖ CPU use and I/O bandwidth can be limited per VM
- ❖ Support for Apple DMG images (DVD)
- ❖ Multi-monitor guest setups for Linux/Solaris guests (previously Windows only)
- ❖ Resizing of VDI and **VHD images**

## ■ Since version 4.1

- ❖ Windows Aero support (experimental)
- ❖ Guest virtual machine cloning

# The extension pack

- Some features require the installation of the closed-source "VirtualBox Extension Pack":
  - Support for a virtual USB 2.0 controller (EHCI)
  - VirtualBox RDP: support for proprietary remote connection protocol developed by Microsoft and Citrix.
  - PXE boot for Intel cards

# Virtual Disk Image

- VirtualBox uses its own format for storage containers – **Virtual Disk Image (VDI)**. VirtualBox also supports other well-known storage formats such as **VMDK** (used in particular by VMware) as well as the **VHD** format used by Microsoft
- VirtualBox's command-line utility VBoxManage includes options for **cloning disks and importing and exporting file systems**, however, it does not include a tool for increasing the size of the filesystem within a **VDI container: this can be achieved in many ways with third-party tools** (e.g. CloneVDI provides a GUI for cloning and increasing the size) or in the guest OS itself.
- VirtualBox has supported **Open Virtualization Format (OVF)** since version 2.2.0 (April 2009)