innotek VirtualBox® User Manual

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Contents

1 Introduction

innotek VirtualBox is a family of virtual machine products targeting desktop computers, enterprise servers and embedded systems. Due to its modular architecture, VirtualBox can be deployed in any environment where x86 systems are to be virtualized on x86 systems. (With "x86", we are referring to 32-bit CPUs from AMD and Intel as well as compatible CPUs from other vendors, plus 64-bit CPUs in 32-bit mode.)

1.1 Virtualization basics

With VirtualBox, you can run unmodified operating systems – including all of the software that is installed on them – directly on top of your existing operating system, in a special environment that is called a "virtual machine". Your physical computer is then usually called the "host", while the virtual machine is often called a "guest".

The following image shows you how VirtualBox, on a Linux host, is running Windows Vista as guest operating system in a virtual machine (displayed in a window on the host):

VirtualBox allows the guest code to run unmodified, directly on the host computer, and the guest operating system "thinks" it's running on real machine. In the background, however, VirtualBox intercepts certain operations that the guest performs to make sure that the guest does not interfere with other programs on the host.

The techniques and features that VirtualBox provides are useful for several scenarios:

- **Operating system support.** With VirtualBox, one can run software written for one operating system on another (for example, Windows software on Linux) without having to reboot to use it. You can even install in a virtual machine an old operating system such as DOS or OS/2 if your real computer's hardware is no longer supported.

- **Infrastructure consolidation.** Virtualization can significantly reduce hardware and electricity costs. The full performance provided by today's powerful hardware is only rarely really needed, and typical servers have an average load of only a fraction of their theoretical power. So, instead of running many such physical computers that are only partially used, one can pack many virtual machines onto a few powerful hosts and balance the loads between them. With VirtualBox, you can even run virtual machines as mere servers for the VirtualBox Remote Desktop Protocol (VRDP), with full client USB support. This allows for consolidating the desktop machines in an enterprise on just a few RDP servers, while the actual clients will only have to be able to display VRDP data any more.

- **Testing and disaster recovery.** Once installed, a virtual box and its virtual hard disk can be considered a "container" that can be arbitrarily frozen, woken up, copied, backed up, and transported between hosts. On top of that, with the use of another VirtualBox feature called "snapshots", one can save a particular state of a virtual machine and revert back to that state, if necessary. This way, one can freely experiment with a computing environment. If something goes wrong (e.g. after installing misbehaving software or infecting the guest with a virus), one can easily switch back to a previous snapshot and avoid the need of frequent backups and restores.

When dealing with virtualization (and also for understanding the following chapters of this documentation), it helps to acquaint oneself with a bit of crucial terminology, especially the following terms:

Host operating system (host OS): the operating system of the physical computer where VirtualBox is running. Also, the host operating system determines which version of VirtualBox is required: VirtualBox for Windows, VirtualBox for Linux or VirtualBox for Mac (see chapter 1.3.1, *Supported host operating systems*, page 12 for further information).

> **Note:** Even though the various VirtualBox versions are usually discussed together in this document, there may be platform-specific differences which we will point out where appropriate.

Guest operating system (guest OS): the operating system that is running inside the virtual machine. Theoretically, VirtualBox can run any x86 operating system (DOS, Windows, OS/2, FreeBSD, OpenBSD), but to achieve near-native performance of the guest code on your machine, we had to go through a lot of optimizations that are specific to certain operating systems. So while your favorite operating system *may* run as a guest, we officially support and optimize for a select few (which, however, include the most common ones).

See chapter 1.3.2, *Supported guest operating systems*, page 12 for further information.

Virtual machine (VM). When running, a VM is the special environment that VirtualBox creates for your guest operating system. So, in other words, you run your guest operating system "in" a VM. Normally, a VM will be shown as a window on your computer's desktop, but depending on which of the various frontends of VirtualBox you use, it can be displayed in full-screen mode or remotely by use of the Remote Desktop Protocol (RDP).

Sometimes we also use the term "virtual machine" in a more abstract way. Internally, VirtualBox thinks of a VM as a set of parameters that determine its operation. These settings are mirrored in the VirtualBox graphical user interface as well as the `VBoxManage` command line program; see chapter 8, *VBoxManage reference*, page 76. They include hardware settings (how much memory the VM should have, what hard disks VirtualBox should virtualize through which container files, what CD-ROMs are mounted etc.) as well as state information (whether the VM is currently running, saved, its snapshots etc.).

In other words, a VM is also what you can see in its settings dialog.

Guest Additions. With "Guest Additions", we refer to special software packages that are shipped with VirtualBox. Even though they are part of VirtualBox, they are designed to be installed *inside* a VM to improve performance of the guest OS and to add extra features. This is described in detail in chapter 4, *The VirtualBox Guest Additions*, page 44.

1.2 Features overview

Here's a brief outline of VirtualBox's main features:

- **Clean architecture; unprecedented modularity.** VirtualBox has an extremely modular design with well-defined internal programming interfaces and a clean separation of client and server code. This makes it easy to control it from several interfaces at once: for example, you can start a VM simply by clicking on a button in the VirtualBox graphical user interface and then control that machine from the command line, or even remotely. See chapter 7, *Alternative front-ends; remote virtual machines*, page 68 for details.

Due to its modular architecture, VirtualBox can also expose its full functionality and configurability through a comprehensive **software development kit (SDK).** Based on the standard technology COM (XPCOM on Linux), this Application Programming Interface (API) offers a comfortable way of integrating VirtualBox with other software systems. Internally, VirtualBox uses its own public API, which guarantees that every aspect of the product is accessible to external customers as well and that all interfaces are well tested.

- **Easy portability.** VirtualBox runs on Windows 2000, Windows XP and Windows Server 2003 as well as on all major Linux distributions from Red Hat, Novell and others. With VirtualBox 1.4, support for 64-bit Linux and Mac OS X hosts was added. In addition, a special version for use on embedded μkernel systems is available separately.

- **Guest Additions for Windows and Linux.** The VirtualBox Guest Additions are packages which can be installed in Windows or Linux guest systems to improve their performance and to provide additional integration and communication with the host system.The Guest Additions are described in detail in chapter 4, *The VirtualBox Guest Additions*, page 44. In brief, among others, they offer the following features:

  - **Arbitrary screen resolutions (host-controlled).** In guest systems that support it (currently Windows guests), you can change the guest resolution simply by resizing the virtual machine window in the host system.
  - **Arbitrary screen resolutions (guest-controlled).** The VirtualBox Guest Additions can handle arbitrary screen resolutions. Even for guest operating systems for which no Additions have been written yet, VirtualBox will offer custom VESA resolutions.

- **XML configuration store.** VirtualBox stores all its configuration in XML files: one XML document for global settings and a XML file per virtual machine. This allows you to transport VM definitions between the different frontends and even across host computers.

  For details, please refer to chapter 9.1, *VirtualBox configuration data*, page 91.

- **Great hardware support.** Among others, VirtualBox supports:

  - **Full ACPI support.** The Advanced Configuration and Power Interface (ACPI) is fully supported by VirtualBox. This eases cloning of PC images from real machines or third-party virtual machines into VirtualBox. With its unique **ACPI power status support,** VirtualBox can even report to ACPI-aware guest operating systems the power status of the host. For mobile systems running on battery, the guest can thus enable energy saving and notify the user of the remaining power (e.g. in fullscreen modes).
  - **I/O APIC support.** VirtualBox virtualizes an Input/Output Advanced Programmable Interrupt Controller (I/O APIC) which is found in many mod-

ern PC systems. This eases cloning of PC images from real machines or 3rd party virtual machines into VirtualBox.

  - **USB device support.** VirtualBox implements a virtual USB controller and allows you to connect arbitrary USB devices to your virtual machines without having to install device-specific drivers on the host. USB support is not limited to certain device categories. For details, see chapter 3.7.6.1, *USB settings*, page 41.
  - **Multiscreen resolutions.** VirtualBox virtual machines support screen resolutions many times that of a physical screen, allowing them to be spread over a large number of screens attached to the host system.
  - **Built-in iSCSI support.** This unique feature allows you to connect a virtual machine directly to an iSCSI storage server without going through the host system. The VM accesses the iSCSI target directly without the extra overhead that is required for virtualizing hard disks in container files. For details, see chapter 5.3, *iSCSI servers*, page 53.
  - **PXE Network boot.** The integrated virtual network cards of VirtualBox fully support remote booting via the Preboot Execution Environment (PXE).

- **Multigeneration snapshots.** VirtualBox can save successive snapshots of the state of the virtual machine. You can revert the virtual machine to the state of any of the snapshots. For details, see chapter 3.4.4, *Snapshots*, page 33.

- **VRDP remote access.** You can run any virtual machine in a special VirtualBox program that acts as a server for the VirtualBox Remote Desktop Protocol (VRDP). With this unique feature, VirtualBox provides high-performance remote access to any virtual machine. A custom RDP server has been built directly into the virtualization layer and offers unprecedented performance and feature richness.

  VRDP support is described in detail in chapter 7.4, *Remote Desktop Support (VRDP)*, page 71.

  On top of this special capacity, VirtualBox offers you more unique features:

  - **Extensible RDP authentication.** VirtualBox already supports Winlogon on Windows and PAM on Linux for RDP authentication. In addition, it includes an easy-to-use SDK which allows you to create arbitrary interfaces for other methods of authentication; see chapter 9.3, *Custom external VRDP authentication*, page 93 for details.
  - **USB over RDP.** Via RDP virtual channel support, VirtualBox also allows you to connect arbitrary USB devices locally to a virtual machine which is running remotely on a VirtualBox RDP server; see chapter 7.4.3, *Remote USB*, page 74 for details.

- **Folder sharing.** VirtualBox folder sharing lets you access files from the host system inside guests. Shared folders can be set up for all virtual machines, or for

a single VM. Temporary shared folders may also be set up while a VM is running. Shared folders are described in chapter 4.4, *Folder sharing*, page 49.

1.3 Operating system support

1.3.1 Supported host operating systems

Currently, VirtualBox is available for the following **Windows** 32-bit operating systems:

- Windows 2000, service pack 3 and higher
- Windows XP, all service packs
- Windows Server 2003

and for the following **Linux** 32-bit systems:

- Debian GNU/Linux 3.1 (“sarge”) and 4.0 (“etch”)
- Fedora Core 4 to 7
- Gentoo Linux
- Redhat Enterprise Linux 3, 4 and 5
- SUSE Linux 9 and 10
- Ubuntu 5.10 (“Breezy Badger”), 6.06 (“Dapper Drake”), 6.10 (“Edgy Eft”), 7.04 (“Feisty Fawn”)

Starting with VirtualBox 1.4, the following hosts are also supported:

- 64-bit Linux
- Apple Mac OS X

It should be possible to use VirtualBox on most systems based on Linux kernel 2.4 or 2.6 using either the VirtualBox installer or by doing a manual installation; see chapter 2.2, *Installing on Linux hosts*, page 15.

1.3.2 Supported guest operating systems

While VirtualBox is designed to provide a generic virtualization environment for x86 systems, our focus is to optimize the product’s performance for a select list of guest systems. The following table provides an overview of current support:

Operating system	Support status
Windows NT 4.0	All versions/editions and service packs are fully supported (but see remark 1 below). Guest Additions are available with a limited feature set.
Windows 2000 / XP / Server 2003 / Vista	All versions/editions and service packs are fully supported. Guest Additions are available.
DOS / Windows 3.x / 95 / 98 / ME	Limited testing has been performed. Use beyond legacy installation mechanisms not recommended. No Guest Additions available.
Linux 2.4	Limited support.
Linux 2.6	All versions/editions and service packs are fully supported (but see remark 2 below). Guest Additions are available.
FreeBSD	Limited support. Guest Additions are not available yet.
OpenBSD	Versions 3.7 and 3.8 are supported. Guest Additions are not available yet.

Remarks:

1. With **Windows NT 4.0,** there are some issues with older service packs. We recommend to install service pack 6a.

2. For **Linux 2.6,** we strongly recommend using version 2.6.13 or higher for better performance. However, version 2.6.18 (and some 2.6.17 versions) introduced a race condition that can cause boot crashes in VirtualBox; if you must use a kernel >= 2.6.17, we advise to use 2.6.19 or later.

2 Installation

As installation of VirtualBox varies depending on your host operating system, we provide installation instructions in two separate chapters for Windows and Linux, respectively.

2.1 Installing on Windows hosts

2.1.1 Prerequisites

For the various versions of Windows that we support as host operating systems, please refer to chapter 1.3.1, *Supported host operating systems*, page 12.

In addition, Windows Installer 1.1 or higher must be present on your system. This should be the case if you have all recent Windows updates installed.

> **Note:** Presently VirtualBox can only be run from user accounts with administrator rights. This will be fixed in a future release.

2.1.2 Performing the installation

The VirtualBox installation can be started

- either by double-clicking on its Microsoft Installer archive (MSI file)
- or by entering

  ```
  msiexec /i VirtualBox.msi
  ```

  on the command line.

In either case, this will display the installation welcome dialog and allow you to choose where to install VirtualBox to and which components to install. In addition to the VirtualBox application, the following components are available:

USB support This package contains special drivers for your Windows host that VirtualBox requires to fully support USB devices inside your virtual machines.

Networking This package contains extra networking drivers for your Windows host that VirtualBox needs to support Host Interface Networking (to make your VM's virtual network cards accessible from other machines on your physical network).

Depending on your Windows configuration, you may see warnings about "unsigned drivers" or similar. Please select "Continue" on these warnings as otherwise VirtualBox might not function correctly after installation.

The installer will create a "VirtualBox" group in the programs startup folder which allows you to launch the application and access its documentation.

With standard settings, VirtualBox will be installed for all users on the local system. In case this is not wanted, you have to invoke the installer as follows:

```
msiexec /i VirtualBox.msi ALLUSERS=2
```

This will install VirtualBox only for the current user.

2.1.3 Uninstallation

As we use the Microsoft Installer, VirtualBox can be safely uninstalled at any time by choosing the program entry in the "Add/Remove Programs" applet in the Windows Control Panel.

2.1.4 Unattended installation

Unattended installations can be performed using the standard MSI support.

2.2 Installing on Linux hosts

2.2.1 Prerequisites

For the various versions of Linux that we support as host operating systems, please refer to chapter 1.3.1, *Supported host operating systems*, page 12.

In any case, the following packages must be installed on your Linux system:

- Qt 3.3.5 or higher;
- SDL 1.2.7 or higher (this graphics library is typically called `libsdl` or similar).

Note: To be precise, these packages are only required if you want to run the VirtualBox graphical user interfaces. In particular, `VirtualBox`, our main graphical user interface, requires both Qt and SDL; `VBoxSDL`, our simplified GUI, requires only SDL. By contrast, if you only want to run the headless VRDP server that comes with VirtualBox, neither Qt nor SDL are required.

2.2.2 Support for external kernel modules

VirtualBox uses a special kernel module to perform physical memory allocation and to gain control of the processor for guest system execution. Without this kernel module, you will still be able to work with Virtual Machines in the configuration interface, but you will not be able to start any virtual machines.

To be able to install this kernel module, you will have to prepare your system for building external kernel modules. As this process can vary from system to system, we will only describe what to do for systems we have tested

- Most Linux distributions can be set up simply by installing the right packages. Normally, these will be the GNU compiler (GCC), GNU Make (make) and packages containing header files for your kernel. *The version numbers of the header file packages must be the same as that of the kernel you are using.*
  - In newer Debian and Ubuntu releases, you must install the right version of the `linux-headers` and if it exists the `linux-kbuild` package. Current Ubuntu releases should have the right packages installed by default.
  - In older Debian and Ubuntu releases, you must install the right version of the `kernel-headers` package.
  - On Fedora and Redhat systems, the package is `kernel-devel`.
  - On SUSE and OpenSUSE Linux, you must install the right versions of the `kernel-source` and `kernel-syms` packages.
- Alternatively, if you built your own kernel `/usr/src/linux` will point to your kernel sources, and you have not removed the files created during the build process, then your system will already be correctly set up.

In order to use VirtualBox's USB support, the user account under which you intend to run VirtualBox must have read and write access to the USB filesystem (`usbfs`).

In addition, access to `/dev/net/tun` will be required if you want to use Host Interface Networking, which is described in detail in chapter 6.3, *Introduction to host interface networking*, page 56.

2.2.3 Performing the installation

VirtualBox is available as a Debian package (in fact, there are packages for Ubuntu 6.10 "Edgy", Ubuntu 6.06 "Dapper" and Debian 4.0 "Etch") or as an alternative installer (.run) which should work on most Linux distributions.

2.2.3.1 Installing VirtualBox from a Debian/Ubuntu package

First, download the appropriate package for your distribution. The following examples assume that you are installing to an Ubuntu Edgy system. Use `dpkg` to install the Debian package:

```
sudo dpkg -i VirtualBox_1.4.0_Ubuntu_edgy.deb
```

You will be asked to accept the VirtualBox Personal Use and Evaluation License. Unless you answer "yes" here, the installation will be aborted.

The group `vboxusers` will be created during installation. Note that a user who is going to run VirtualBox must be member of that group. Also note that adding an active user to that group may require a restart of the session of that user. This should be done manually after successful installation of the package.

The installer will also search for a VirtualBox kernel module suitable for your kernel. The package includes pre-compiled modules for the most common kernel configurations. If no suitable kernel module is found, the installation script tries to build a module itself. If the build process is not successful you will be shown a warning and the package will be left unconfigured. Please have a look at `/var/log/vbox-install.log` to find out why the compilation failed. You may have to install the appropriate Linux kernel headers (see chapter 2.2.2, *Support for external kernel modules*, page 16). After correcting any problems, do

```
sudo /etc/init.d/vboxdrv setup
```

This will start a second attempt to build the module.

If a suitable kernel module was found in the package or the module was successfully built, the installation script will attempt to load that module. If this fails, please see chapter 11.4.1, *Linux kernel module refuses to load*, page 107 for further information.

Once VirtualBox has been successfully installed and configured, you can start it by selecting "VirtualBox" in your start menu or from the command line (see chapter 2.2.4, *Starting VirtualBox on Linux*, page 20).

2.2.3.2 Using the alternative installer

The alternative installer performs the following steps:

- It unpacks the application files to a target directory of choice. By default, the following directory will be used:

  ```
  /opt/VirtualBox-1.4.0
  ```

- It builds the VirtualBox kernel module (`vboxdrv`) and installs it.
- It creates `/etc/init.d/vboxdrv`, an init script to start the VirtualBox kernel module.
- It creates a new system group called `vboxusers`.
- It creates symbolic links to `VirtualBox`, `VBoxSDL` and `VBoxManage` in `/usr/bin`.
- It creates `/etc/udev/60-vboxdrv.rules`, a description file for udev, if that is present, which makes the module accessible to anyone in the group `vboxusers`.

- It writes the installation directory to `/etc/vbox/vbox.cfg`.

The installer must be executed as root with either `install` or `uninstall` as the first parameter. If you do not want the installer to ask you whether you wish to accept the licence agreement (for example, for performing unattended installations), you can add the parameter `license_accepted_unconditionally`. Finally, if you want to use a directory other than the default installation directory, add the desired path as an extra parameter.

```
sudo ./VirtualBox.run install /opt/innotek/VirtualBox
```

Or if you do not have the "sudo" command available, run the following as root instead:

```
./VirtualBox.run install /opt/innotek/VirtualBox
```

If any users on your system should be able to access host USB devices from within VirtualBox guests, you should add them to the appropriate user group that your distribution uses for USB access, e.g. `usb` or `usbusers`.

2.2.3.3 Performing a manual installation

If, for any reason, you cannot use the shell script installer described previously, you can also perform a manual installation. Invoke the installer like this:

```
./VirtualBox.run --keep --noexec
```

This will unpack all the files needed for installation in the directory `install` under the current directory. The VirtualBox application files are contained in `VirtualBox.tar.bz2` which you can unpack to any directory on your system. For example:

```
sudo mkdir /opt/VirtualBox
sudo tar jxf ./install/VirtualBox.tar.bz2 -C /opt/VirtualBox
```

or as root:

```
mkdir /opt/VirtualBox
tar jxf ./install/VirtualBox.tar.bz2 -C /opt/VirtualBox
```

The sources for VirtualBox's kernel module are provided in the `src` directory. To build the module, change to the directory and issue

```
make
```

If everything builds correctly, issue the following command to install the module to the appropriate module directory:

```
sudo make install
```

In case you do not have sudo, switch the user account to root and perform

```
make install
```

The VirtualBox kernel module needs a device node to operate. The above make command will tell you how to create the device node, depending on your Linux system. The procedure is slightly different for a classical Linux setup with a `/dev` directory, a system with the now deprecated `devfs` and a modern Linux system with `udev`.

On certain Linux distributions, you might experience difficulties building the module. You will have to analyze the error messages from the build system to diagnose the cause of the problems. In general, make sure that the correct Linux kernel sources are used for the build process.

Note that the user who is going to run VirtualBox needs read and write permission on the VirtualBox kernel module device node `/dev/vboxdrv`. You can either define a `vboxusers` group by entering

```
groupadd vboxusers
chgrp vboxusers /dev/vboxdrv
chmod 660 /dev/vboxdrv
```

or, alternatively, simply give all users access (insecure, not recommended!)

```
chmod 666 /dev/vboxdrv
```

You should also add any users who will be allowed to use host USB devices in VirtualBox guests to the appropriate USB users group for your distribution. This group is often called `usb` or `usbusers`.

Next, you will have to install the system initialization script for the kernel module:

```
cp /opt/VirtualBox/vboxdrv.sh /etc/init.d/vboxdrv
```

(assuming you installed VirtualBox to the `/opt/VirtualBox` directory) and activate the initialization script using the right method for your distribution. You should create VirtualBox's configuration file:

```
mkdir /etc/vbox
echo INSTALL_DIR=/opt/VirtualBox > /etc/vbox/vbox.cfg
```

and, for convenience, create the following symbolic links:

```
ln -sf /opt/VirtualBox/VBox.sh /usr/bin/VirtualBox
ln -sf /opt/VirtualBox/VBox.sh /usr/bin/VBoxSVC
ln -sf /opt/VirtualBox/VBox.sh /usr/bin/VBoxManage
```

2.2.3.4 Updating and uninstalling VirtualBox

Before updating or uninstalling VirtualBox, you must terminate any virtual machines which are currently running and exit the VirtualBox or VBoxSVC applications. To update VirtualBox, simply run the installer of the updated version. To uninstall VirtualBox, invoke the installer like this:

```
sudo ./VirtualBox.run uninstall
```

or as root

```
./VirtualBox.run uninstall
```

To manually uninstall VirtualBox, simply undo the steps in the manual installation in reverse order.

2.2.3.5 Automatic Installation of Debian packages

The Debian packages will request some user feedback when installed for the first time. The debconf system is used to perform this task. To prevent any user interaction during installation, default values can be defined. A file `vboxconf` can contain the following debconf settings:

```
debconf virtualbox/accepted-virtualbox-puel-1-2 boolean true
debconf virtualbox/module-compilation-allowed boolean true
debconf virtualbox/delete-old-modules boolean true
```

With the first setting, the user accepts the VirtualBox Personal Use and Evaluation License. The second line allows compilation of the vboxdrv kernel module if no module was found for the current kernel. The third line allows the package to delete any old vboxdrv kernel modules compiled by previous installations.

These default settings can be applied with

```
debconf-set-selections vboxconf
```

prior to the installation of the VirtualBox Debian package.

2.2.4 Starting VirtualBox on Linux

To start the VirtualBox graphical user interface, simply start the VirtualBox program. To start the command line management interface for virtual machines, start VBoxManage. To start a single virtual machine from the command line, start VBoxSDL. The following chapters explain how to use these applications.

The following detailed instructions should only be of interest if you wish to execute VirtualBox without installing it first. You should start by compiling the `vboxdrv` kernel module (see above) and inserting it into the Linux kernel. VirtualBox consists of a service daemon (`VBoxSVC`) and several application programs. The daemon is automatically started if necessary. All VirtualBox applications will communicate with the daemon through Unix local domain sockets. There can be multiple daemon instances under different user accounts and applications can only communicate with the daemon running under the user account as the application. The local domain socket resides in a subdirectory of your system's directory for temporary files called `.vbox-<username>-ipc`. In case of communication problems or server startup problems, you may try to remove this directory.

All VirtualBox applications (`VirtualBox`, `VBoxSDL`, `VBoxManage` and `VBoxVRDP`) require the VirtualBox directory to be in the library path:

```
LD_LIBRARY_PATH=. ./VBoxManage showvminfo "Windows XP"
```

3 Starting out with VirtualBox

As already mentioned in chapter 1.1, *Virtualization basics*, page 7, VirtualBox allows you to run each of your guest operating systems on its own virtual computer system. The guest system will run in its virtual machine (VM) as if it were installed on a real computer, according to the parameters of the virtual system you have created for it. All software running on the guest system does so as it would on a real machine.

You have considerable latitude in deciding what virtual hardware will be provided to the guest. The virtual hardware can be used for communicating with the host system or with other guests. For instance, if you provide VirtualBox with the image of a CD-ROM in an ISO file, VirtualBox can present this image to a guest system as if it were a physical CD-ROM. Similarly, you can give a guest system access to the real network via its virtual network card, and, if you choose, give the host system, other guests, or computers on the internet access to the guest system.

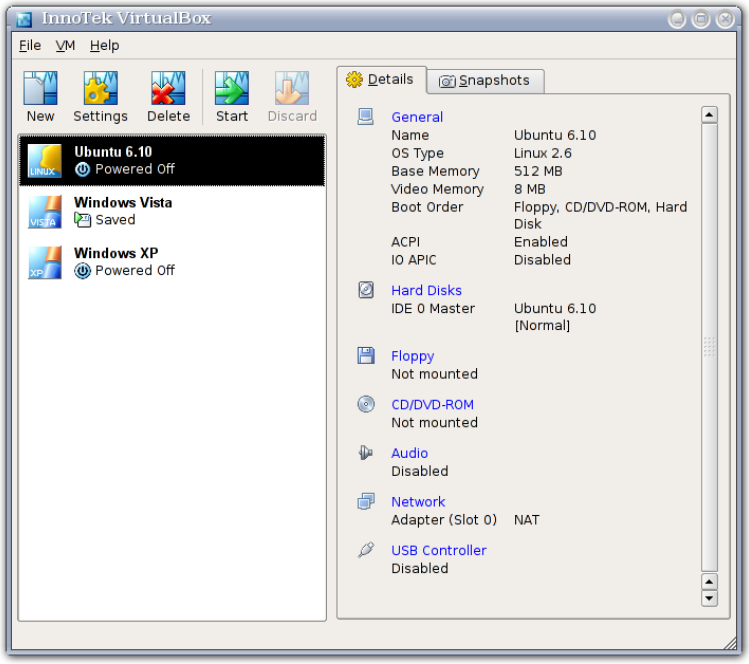
VirtualBox comes with many advanced interfaces, which will be described later in this manual:

- chapter 8, *VBoxManage reference*, page 76 explains how to use create, configure, and control virtual machines completely from the command line.
- chapter 7.3, *VBoxSDL, the simplified VM displayer*, page 70 explains how to run a single VM at a time with a reduced graphical interface.
- chapter 7.4.1, *VBoxVRDP, the headless VRDP server*, page 72 shows how to run virtual machines remotely.

The following introductory sections, however, describe `VirtualBox`, the graphical user interface, which is the simplest way to get started.

3.1 Starting the graphical user interface

After installing VirtualBox as described in chapter 2, *Installation*, page 14, on Windows, you can find the graphical user interface in the "Programs" menu (under the "VirtualBox" group); on Linux, you can type `VirtualBox` on the command line. Then, a window like the following should come up:

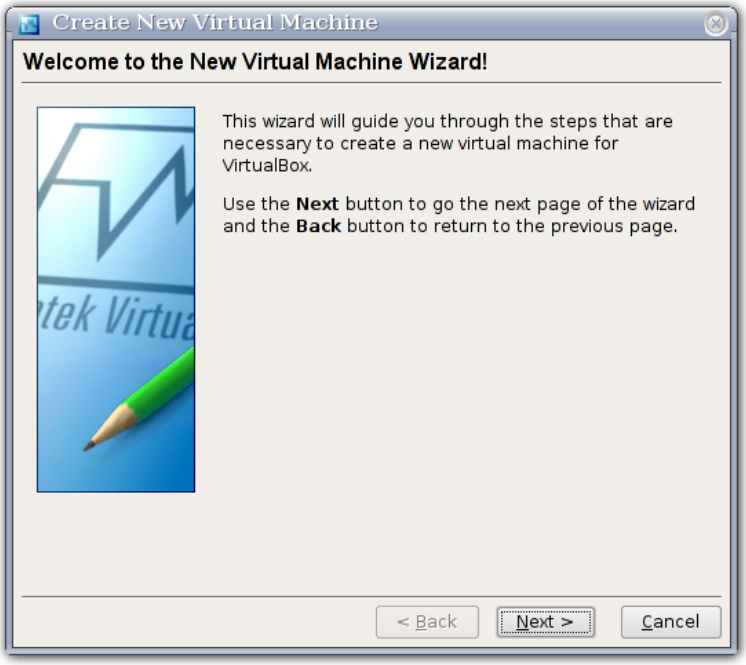


On the left, you can see a pane that lists all the virtual machines you have created so far (three in the example above). A row of buttons above it allows you to create new VMs and work on existing VMs. The pane on the right displays the properties of the virtual machine currently selected, if any.

When you start VirtualBox for the first time, as there is no virtual machine yet, everything will be empty.

3.2 Creating a virtual machine

Clicking on the “New” button in the user interface will guide you through setting up a new virtual machine (VM). A wizard will show up:



On the following pages, the wizard will ask you for the bare minimum of information that is needed to create a VM, in particular:

1. A **name** for your VM, and the **type of operating system** (OS) you want to install.

   The name is what you will later see in the VirtualBox main window, and what your settings will be stored under. It is purely informational, but once you have created a few VMs, you will appreciate if you have given your VMs informative names. "My VM" probably is therefore not as useful as "Windows XP SP2".

   For "Operating System Type", select the operating system that you want to install later. While this setting presently has no lasting effect, VirtualBox will use this setting to display an operating system accordingly and also make certain recommendations later based on your selection (such as the amount of memory and hard disk space to allocate), and future VirtualBox versions may offer certain system-specific virtualization features. It is therefore recommended to always set it to the correct value.

2. The **amount of memory (RAM)** that the virtual machine should have for itself. Every time a virtual machine is started, VirtualBox will allocate this much memory from your host machine and present it to the guest operating system, which will report this size as the (virtual) computer's installed RAM.

Note: Choose this setting carefully! The memory you give to the VM will not be available to your host OS while the VM is running, so do not specify more than you can spare. For example, if your host machine has 1 GB of RAM and you enter 512 MB as the amount of RAM for a particular virtual machine, while that VM is running, you will only have 512 MB left for all the other software on your host. If you run two VMs at the same time, even more memory will be allocated for the second VM (which may not even be able to start if that memory is not available). On the other hand, you should specify as much as your guest OS (and your applications) will require to run properly.

A Windows XP guest will require at least a few hundred MB RAM to run properly, and Windows Vista will even refuse to install with less than 512 MB. Of course, if you want to run graphics-intensive applications in your VM, you may require even more RAM.

So, as a rule of thumb, if you have 1 GB of RAM or more in your host computer, it is usually safe to allocate 512 MB to each VM. But, in any case, make sure you always have at least 256-512 MB of RAM left on your host operating system. Otherwise you may cause your host OS to excessively swap out memory to your hard disk, effectively bringing your host system to a standstill.

As with the other settings, you can change this setting later, after you have created the VM.

3. Next, you must specify a **virtual hard disk** for your VM. There are several ways in which VirtualBox can provide hard disk space to a VM, but the most common way is to use a large image file on your "real" hard disk, whose contents VirtualBox presents to your VM as if it were a complete hard disk.

   The wizard presents to you the following window:

The wizard allows you to create an image file or use an existing one. Note also that the disk images can be separated from a particular VM, so even if you delete a VM, you can keep the image, or copy it to another host and create a new VM for it there.

In the wizard, you have the following options:

- If you have previously created any virtual hard disks which have not been attached to other virtual machines, you can select those from the drop-down list in the wizard window.
- Otherwise, to create a new virtual hard disk, press the **"New"** button.
- Finally, for more complicated operations with virtual disks, the **"Existing..."** button will bring up the Virtual Disk Manager, which is described in more detail in chapter 3.5, *The Virtual Disk Manager*, page 34.

Most probably, if you are using VirtualBox for the first time, you will want to create a new disk image. Hence, press the "New" button.

This brings up another window, the **"Create New Virtual Disk Wizard".**

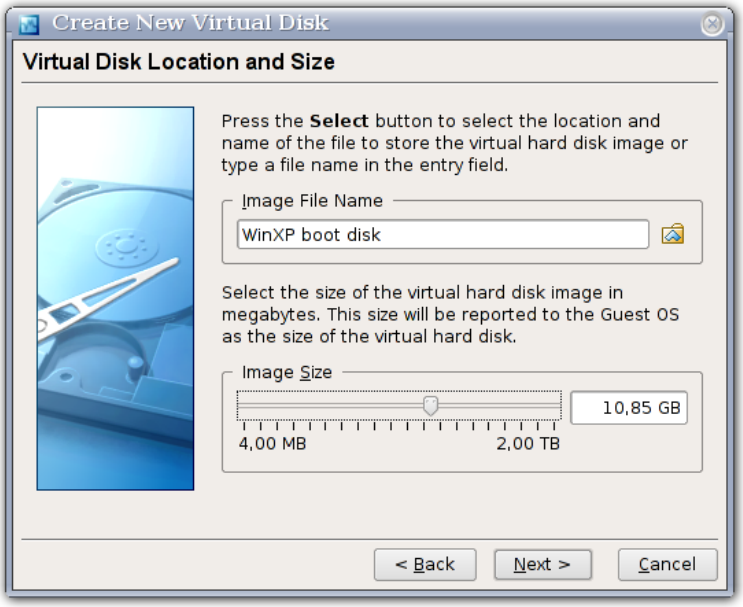
VirtualBox supports two types of image files:

- A **dynamically expanding file** will only grow in size when the guest actually stores data on its virtual hard disk. It will therefore initially be small on the host hard drive and only later grow to the size specified as it is filled with data.

- A **fixed-size file** will immediately occupy the file specified, even if only a fraction of the virtual hard disk space is actually in use. While occupying much more space, a fixed-size file incurs less overhead and is therefore slightly faster than a dynamically expanding file.

For details about the differences, please refer to chapter 5.1, *Virtual Disk Image (VDI) files*, page 51.

To prevent your physical hard disk from running full, VirtualBox limits the size of the image file. Still, it needs to be large enough to hold the contents of your operating system and the applications you want to install – for a modern Windows or Linux guest, you will probably need several gigabytes for any serious use:



After having selected or created your image file, again press **"Next"** to go to the next page.

4. After clicking on **"Finish"**, your new virtual machine will be created. You will then see it in the list on the left side of the main window, with the name you have entered.

3.3 Basics of virtual machine configuration

When you select a virtual machine from the list in the main VirtualBox window, you will see a summary of that machine's settings on the right of the window, under the "Details" tab.

Clicking on the "Settings" button in the toolbar at the top of VirtualBox main window brings up a detailed window where you can configure many of the properties of the VM that is currently selected. But be careful: even though it is possible to change all VM settings after installing a guest operating system, certain changes might prevent a guest operating system from functioning correctly if done after installation.

Note: The "Settings" button is disabled while a VM is either in the "running" or "saved" state. This is simply because the settings dialog allows you to change fundamental characteristics of the virtual computer that is created for your guest operating system, and this operating system may not take it well when, for example, half of its memory is taken away from under its feet. As a result, if the "Settings" button is disabled, shut down the current VM first.

VirtualBox provides a plethora of parameters that can be changed for a virtual machine. The various settings that can be changed in the "Settings" window are described in detail in chapter 3.7, *Virtual machine settings*, page 36. Even more parameters are available with the command line interface; see chapter 8, *VBoxManage reference*, page 76.

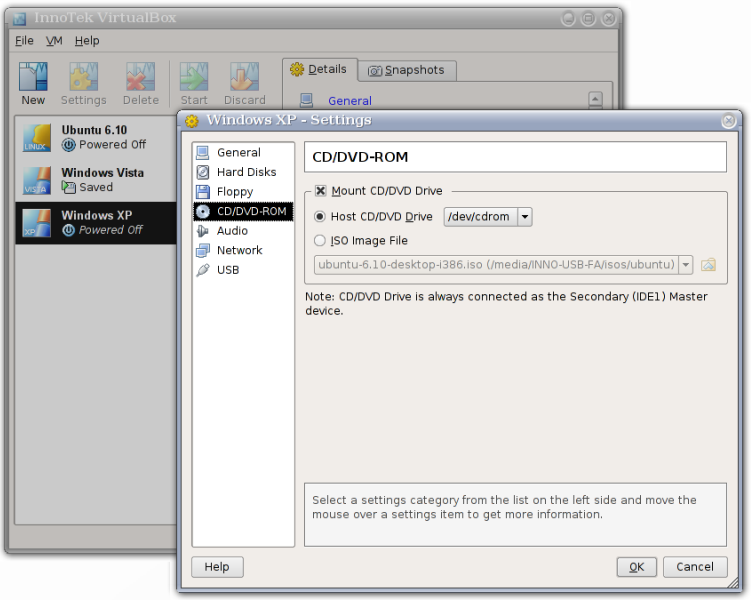
For now, if you have just created an empty VM, you will probably be most interested in the settings presented by the "CD/DVD-ROM" section if want to make a CD-ROM or a DVD-ROM available the first time you start it, in order to install your guest operating system.

For this, you have two options:

- If you have actual CD or DVD media from which you want to install your guest operating system (e.g. in the case of a Windows installation CD or DVD), put the media into your host's CD or DVD drive.

  Then, in the settings dialog, go to the "CD/DVD-ROM" section and select "Host drive" with the correct drive letter (or, in the case of a Linux host, device file).

  This will allow your VM to access the media in your host drive, and you can proceed to install from there.



- If you have downloaded installation media from the Internet in the form of an ISO image file (most probably in the case of a Linux distribution), you would normally burn this file to an empty CD or DVD and proceed as just described. With VirtualBox however, you can skip this step and mount the ISO file directly. VirtualBox will then present this file as a CD or DVD-ROM drive to the virtual machine, much like it does with virtual hard disk images.

  In this case, in the settings dialog, go to the "CD/DVD-ROM" section and select "ISO image file". This brings up the Virtual Disk Image Manager, where you perform the following steps:

  1. Press the "Add" button to add your ISO file to the list of registered images. This will present an ordinary file dialog that allows you to find your ISO file on your host machine.
  2. Back to the manager window, select the ISO file that you just added and press the "Select" button. This selects the ISO file for your VM.

  The Virtual Disk Image Manager is described in detail in chapter 3.5, *The Virtual Disk Manager*, page 34.

3.4 Running a virtual machine

The "Start" button in the main window starts the virtual machine that is currently selected.

This opens up a new window, and the virtual machine which you selected will boot up. Everything which would normally be seen on the virtual system's monitor is shown

in the window, as can be seen with the image in chapter 1.1, *Virtualization basics*, page 7.

In general, you can use the virtual machine much like you would use a real computer. There are couple of points worth mentioning however.

3.4.1 Keyboard and mouse support in virtual machines

3.4.1.1 Capturing and releasing keyboard and mouse

Since the operating system in the virtual machine does not "know" that it is not running on a real computer, it expects to have exclusive control over your keyboard and mouse. This is, however, not the case since, unless you are running the VM in full-screen mode, your VM needs to share keyboard and mouse with other applications and possibly other VMs on your host.

As a result, initially after installing a host operating system and before you install the guest additions (we will explain this in a minute), only one of the two – your VM or the rest of your computer – can "own" the keyboard and the mouse. You will see a *second* mouse pointer which will always be confined to the limits of the VM window. Basically, you activate the VM by clicking inside it.

To return ownership of keyboard and mouse to your host operating system, VirtualBox reserves a special key on your keyboard for itself: the **"host key".** By default, this is the *right Control key* on your keyboard, but you can change this default in the VirtualBox Global Settings. In any case, the current setting for the host key is always displayed *at the bottom right of your VM window,* should you have forgotten about it:

In detail, all this translates into the following:

- Your **keyboard** is owned by the VM if the VM window on your host desktop has the keyboard focus (and then, if you have many windows open in your guest operating system as well, the window that has the focus in your VM). This means that if you want to type within your VM, click on the title bar of your VM window first.

To release keyboard ownership, press the Host key (as explained above, typically the right Control key).

Note that while the VM owns the keyboard, some key sequences (like Alt-Tab for example) will no longer be seen by the host, but will go to the guest instead. After you press the host key to reenable the host keyboard, all key presses will go through the host again, so that sequences like Alt-Tab will no longer reach the guest.

- Your **mouse** is owned by the VM only after you have clicked in the VM window. The host mouse pointer will disappear, and your mouse will drive the guest's pointer instead of your normal mouse pointer.

  Note that mouse ownership is independent of that of the keyboard: even after you have clicked on a titlebar to be able to type into the VM window, your mouse is not necessarily owned by the VM yet.

  To release ownership of your mouse by the VM, also press the Host key.

As this behavior can be inconvenient, VirtualBox provides a set of tools and device drivers for guest systems called the "VirtualBox Guest Additions" which make VM keyboard and mouse operation a lot more seamless. Most importantly, the Additions will get rid of the second "guest" mouse pointer and make your host mouse pointer work directly in the guest.
This will be described later in chapter 4, *The VirtualBox Guest Additions*, page 44.

3.4.1.2 Typing special characters

Operating systems expect certain key combinations to initiate certain procedures. Some of these key combinations may be difficult to enter into a virtual machine, as there are three candidates as to who receives keyboard input: the host operating system, VirtualBox, or the guest operating system. Who of these three receives keypresses depends on a number of factors, including the key itself.

- Host operating systems reserve certain key combinations for themselves. For example, it is impossible to enter the **Ctrl+Alt+Delete** combination if you want to reboot the guest operating system in your virtual machine, because this key combination is usually hard-wired into the host OS (both Windows and Linux intercept this), and pressing this key combination will therefore reboot your *host*.

  Also, with Linux, the key combination **Ctrl+Alt+Backspace** normally resets the X server (to restart the entire graphical user interface in case it got stuck). As the X server intercepts this combination, pressing it will usually restart your *host* graphical userface (and kill all running programs, including VirtualBox, in the process).

  Third, also with Linux, the key combination Ctrl+Alt+Fx (where Fx is one of the function keys from F1 to F12) normally allows to switch between virtual

terminals. As with Ctrl+Alt+Delete, these combinations are intercepted by the host operating system and therefore always switch terminals on the *host*.

If, instead, you want to send these key combinations to the *guest* operating system in the virtual machine, you will need to use one of the following methods:

- Use the items in the "VM" menu of the virtual machine window. There you will find "Insert Ctrl+Alt+Delete" and "Ctrl+Alt+Backspace"; the latter will only have an effect with Linux guests, however.
- Press special key combinations with the Host key (normally the right Control key), which VirtualBox will then translate for the virtual machine:
  - **Host key + Del** to send Ctrl+Alt+Del (to reboot the guest);
  - **Host key + Backspace** to send Ctrl+Alt+Backspace (to restart the graphical user interface of a Linux guest);
  - **Host key + F1** (or other function keys) to simulate Ctrl+Alt+F1 (or other function keys, i.e. to switch between virtual terminals in a Linux guest).

- For some other keyboard combinations such as **Alt-Tab** (to switch between open windows), VirtualBox allows you to configure whether these combinations will affect the host or the guest, if a virtual machine currently has the focus. This is a global setting for all virtual machines and can be found under "File" -> "Global settings" -> "Input" -> "Auto-capture keyboard".

3.4.2 Changing removable media

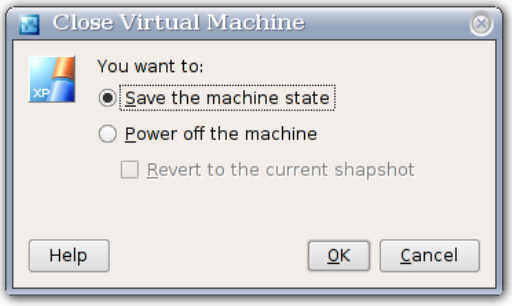
While a virtual machine is running, you can change removable media from the "Devices" menu of the VM's window. Here you can select in detail what VirtualBox presents to your VM as a CD, DVD, or floppy.

The settings are the same as would be available for the VM in the "Settings" dialog of the VirtualBox main window, but since that dialog is disabled while the VM is in "running" or "saved" state, this extra menu saves you from having to shut down and restart the VM every time you want to change media.

Hence, in the "Devices" menu, VirtualBox allows you to attach the host drive to the guest or select a floppy or DVD image using the Disk Image Manager, all as described in chapter 3.3, *Basics of virtual machine configuration*, page 27.

3.4.3 Saving the state of the machine

When you click on the "Close" button of your virtual machine window (at the top right of the window, just like you would close any other window on your system) (or press the Host key together with "Q"), VirtualBox asks you whether you want to "save" or "power off" the VM.



The difference between these two options is crucial. They mean:

- **Save the machine state:** With this option, VirtualBox "freezes" the virtual machine by completely saving its state to your local disk. When you later resume the VM (by again clicking the "Start" button in the VirtualBox main window), you will find that the VM continues exactly where it was left off. All your programs will still be open, and your computer resumes operation.

  Saving the state of a virtual machine is thus similar to suspending a laptop computer (e.g. by closing its lid).

- **Power off the machine:** With this option, VirtualBox also stops running the virtual machine, but *without* saving its state.

  This is equivalent of pulling the power plug on a real computer without shutting it down properly. If you start the machine again after powering it off, your operating system will have to reboot completely and may begin a lengthy check of its (virtual) system disks.

  As a result, this should not normally be done, since it can potentially cause data loss or an inconsistent state of the guest system on disk.

The **"Discard"** button in the main VirtualBox window discards a virtual machine's saved state. This has the same effect as powering it off, and the same warnings apply.

3.4.4 Snapshots

With VirtualBox's snapshots, you can save a particular state of a virtual machine for later use. At any later time, you can revert to that state, even though you may have changed the VM considerably since then.

This is particularly useful for making sure that a guest installation is not damaged by accidental changes, misbehaving software, or viruses.

Once you have set up the machine the way you want it, simply take a snapshot, and should anything happen to the installation, you can simply revert to its snapshot state.

To **take a snapshot** of your VM, perform the following steps:

1. If your VM is currently in either the "saved" or the "powered off" state (as displayed next to the VM in the VirtualBox main window), click on the "Snapshots" tab on the top right of the main window, and then on the small camera icon (for "Take snapshot").

   If your VM is currently running, select "Take snapshot" from the "VM" pull-down menu of the VM window.

2. A window will pop up and ask you to name the snapshot. This name is purely for reference purposes to help you remember the state of the snapshot. For example, a useful name would be "Fresh installation from scratch, no external drivers".

3. Your new snapshot will then appear in the list of snapshots under the "Snapshots" tab. Underneath, you will see an item called "Current state", signifying that the current state of your VM is a variation based on the snapshot you took earlier.

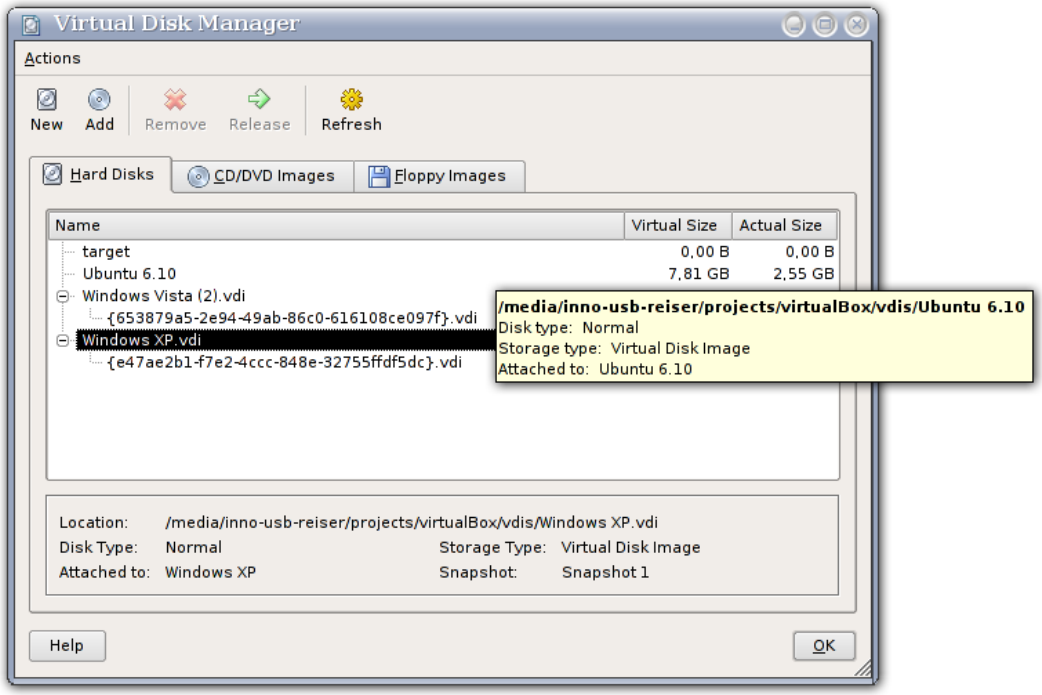
   (If you later take another snapshot, you will see that they will be displayed in sequence, and each subsequent snapshot is a derivation of the earlier one.)

To **revert to an earlier snapshot,** you click on the "Current state" item and select "Discard current state". This will bring the VM back to the state of the nearest (most recent) snapshot. In the same way, you can merge several earlier snapshots into one.

Note: The snapshot reverted to will affect the virtual hard drives that are connected to your VM, as the entire state of the virtual hard drive will be reverted as well. This means also that all files that have been created since the snapshot and all other file changes will be lost.In order to prevent such data loss while still making use of the snapshot feature, it is possible to add a second hard drive in "write-through" mode using the `VBoxManage` interface and use it to store your data. As write-through hard drives are *not* included in snapshots, they remain unaltered when a machine is reverted. See chapter 5, *Virtual storage*, page 51 for details.

3.5 The Virtual Disk Manager

VirtualBox keeps an internal registry of all available hard disk, CD/DVD-ROM and floppy disk images. This registry can be viewed and changed in the **Virtual Disk Manager**, which you can access from the "File" menu in the VirtualBox main window:



The Disk Image Manager shows you all images that are currently registered with VirtualBox, conveniently grouped in three tabs for the three possible formats. These formats are:

- Hard disk images, either in VirtualBox's own Virtual Disk Image (VDI) format or in the widely supported VMDK format;
- CD/DVD images in standard ISO format;
- floppy images in standard RAW format.

Starting with version 1.4, VirtualBox also supports the widely supported VMDK format. This means that if you have created virtual hard disks with another virtualization product that uses the VMDK format, you will not have to recreate these images with VirtualBox, but can continue to use them. See chapter 5.2, *VMDK image files*, page 53 for details.

As you can see in the screenshot above, for each image, the Virtual Disk Manager shows you the full path of the image file and other information, such as the virtual machine the image is currently attached to, if any. Also, as can be seen in the screenshot, if you have created snapshots for a virtual machine, additional "differencing" hard disk images may automatically be created; see chapter 3.4.4, *Snapshots*, page 33 for details.

The Virtual Disk Manager allows you to

- create new hard disk images using the **"New"** button; this will bring up the "Create Disk Image" wizard already described in chapter 3.2, *Creating a virtual machine*, page 23;
- import existing VDI or VMDK files from your hard drive into VirtualBox using the **"Add"** button;
- **remove** an image from the registry (and optionally delete the image file when doing so);
- **"release"** an image, that is, detach it from a virtual machine if it is currently attached to one as a virtual hard disk.

We recommend that you maintain two special folders on your system for keeping images: one for hard disk image files (which can, in the case of dynamically expanding images, grow to considerable sizes), and one for ISO files (which were probably downloaded from the Internet).

Hard disk image files can be copied onto other host systems and imported into virtual machines there, although certain guest systems (notably Windows 2000 and XP) will require that the new virtual machine be set up in a similar way to the old one.

You can also duplicate hard disk image files on the same host to quickly produce a second virtual machine with the same operating system setup. However, you should *only* make copies of virtual disk images using the utility supplied with VirtualBox; see chapter 8.14, *VBoxManage clonevdi*, page 88. This is because VirtualBox assigns a unique identity number (UUID) to each disk image, which is also stored inside the image, and will refuse to work with two images that use the same number. If you do accidentally try to reimport a disk image which you copied normally, you can make a second copy using VirtualBox's utility and import that instead.

Details about the different container formats supported by VirtualBox are described in chapter 5, *Virtual storage*, page 51.

3.6 Deleting virtual machines

The "Delete" button in the main VirtualBox window lets you remove a virtual machine which you no longer need. All settings for that machine will be lost. However, any hard disk images attached to the machine will be kept; you can delete those separately using the Disk Image Manager (described just above).

You cannot delete a machine which has snapshots or is in a saved state, so you must discard these first.

3.7 Virtual machine settings

Most of the settings described below are available in the settings window after selecting a virtual machine in the VirtualBox main window and clicking on the "Settings"

button. To keep the user interface simple, those of the following settings which are not as commonly used are not shown in that settings window. They are, however, available through `VBoxManage` and will be described in chapter 8, *VBoxManage reference*, page 76 later.

3.7.1 General settings

In the Settings window, under "General", you can configure the most fundamental aspects of the virtual machine such as memory and essential hardware. There are three tabs, "Basic", "Advanced", and "Description".

3.7.1.1 "Basic" tab

Under the "Basic" tab of the "General" settings category, you can find these settings:

Name The name under which the VM is shown in the list of VMs in the main window. Under this name, VirtualBox also saves the VM's configuration files. By changing the name, VirtualBox renames these files as well. As a result, you can only use characters which are allowed in your host operating system's file names.

Note that internally, VirtualBox uses unique identifiers (UUIDs) to identify virtual machines. You can display these with `VBoxManage`.

OS Type The type of the guest operating system that is (or will be) installed in the VM. This is the same setting that was specified in the "New Virtual Machine" wizard, as described with chapter 3.2, *Creating a virtual machine*, page 23 above.

Memory size (RAM) The amount of RAM that is allocated and given to the VM when it is running. The specified amount of memory will be allocated from the host operating system (from resident memory so it must be available or made available as free memory on the host when attempting to start the VM and will not be available to the host while the VM is running). Again, this is the same setting that was specified in the "New Virtual Machine" wizard, as described with guidelines under chapter 3.2, *Creating a virtual machine*, page 23 above.

Generally, it is possible to change the memory size after installing the guest operating system (provided you do not reduce the memory to an amount where the operating system would no longer boot).

Note: As Microsoft Windows' activation mechanism is sensitive to some hardware changes, if you are changing settings for a Windows guest, some of these changes may trigger a request for another activation with Microsoft.

Video memory size Size of the memory provided by the virtual graphics card available to the guest, in MB. As with the main memory, the specified amount will be allocated from the host's resident memory. Based on the amount of video memory, higher resolutions and color depths may be available, but for most setups, the default video memory size of 8MB should be sufficient.

3.7.1.2 "Advanced" tab

Boot order This setting determines the order in which the guest operating system will attempt to boot from the various virtual boot devices. Analogous to a real PC's BIOS setting, VirtualBox can tell a guest OS to start from the virtual floppy, the virtual CD/DVD drive, the virtual hard drive (each of these as defined by the other VM settings), or none of these.

With `VBoxManage modifyvm -boot<1-4>`, you can also configure a VM to boot from the network; see chapter 8.5, *VBoxManage modifyvm*, page 81.

Enable ACPI VirtualBox can present the Advanced Configuration and Power Interface (ACPI) to the guest operating system for configuring the virtual hardware. In addition, via ACPI, VirtualBox can present the host's power status information to the guest.

ACPI is the current industry standard to allow operating systems to recognize hardware, configure motherboards and other devices and manage power. As all modern PCs contain this feature and Windows and Linux have been supporting it for years, it is also enabled by default in VirtualBox.

Note that all Windows operating systems starting with Windows 2000 install different kernels depending on whether ACPI is available, so ACPI *must not be turned off* after installation. Turning it on after installation will have no effect however.

Enable I/O APIC Advanced Programmable Interrupt Controllers (APICs) are a newer x86 hardware feature that have replaced old-style Programmable Interrupt Controllers (PICs) in recent years. With an I/O APIC, operating systems can use more than 16 interrupt requests (IRQs) and therefore avoid IRQ sharing for improved reliability.

However, software support for I/O APICs has been unreliable with some operating systems other than Windows. Also, the use of an I/O APIC slightly increases the overhead of virtualization and therefore slows down the guest OS a little.

Note that all Windows operating systems starting with Windows 2000 install different kernels depending on whether an I/O APIC is available. As with ACPI, the I/O APIC therefore *must not be turned off after installation* of a Windows guest OS. Turning it on after installation will have no effect however.

Shared clipboard If the virtual machine has Guest Additions installed, you can select here whether the clipboard of the guest operating system should be shared with

that of your host. If you select "Bidirectional", then VirtualBox will always make sure that both clipboards contain the same data. If you select "Host to guest" or "Guest to host", then VirtualBox will only ever copy clipboard data in one direction.

Snapshot folder By default, VirtualBox saves snapshot data together with your other VirtualBox configuration data; see chapter 9.1, *VirtualBox configuration data*, page 91. With this setting, you can specify any other folder for each VM.

BIOS logo customization By default, when the virtual machine starts up, VirtualBox displays the "innotek" company logo. With `VBoxManage`, you can change this logo to one of your choice. This setting can only be customized via `VBoxManage`; see chapter 8.5, *VBoxManage modifyvm*, page 81.

3.7.2 Hard disks

In the VM Settings window, the "Hard Disks" section allows you to connect up to three virtual hard disk images to your virtual machine.

As with a real PC, VirtualBox's IDE support offers you two IDE controllers, each with a "master" and a "slave" connection. With one of these four connectors being reserved to the CD-ROM/DVD drive (see below), that leaves you with three possible hard disks, each represented by one disk image file.

The settings of the first disk ("Primary Master") are initially set by the "Create VM" wizard. Normally, you will stick with this setting for the rest of a VM's lifetime. You may, however, freely remove, add and exchange virtual hard drives after the machine has been set up. For example, if you wish to copy some files from another virtual disk that you created, you can connect that disk as a second hard disk.

To connect an additional disk, select the corresponding checkbox and click on the folder icon on the right to bring up the Virtual Disk Image Manager. To remove a virtual disk, simply uncheck the appropriate checkbox. To replace a hard drive with a different one, click on the folder icon for that drive and select or create a new one using the Virtual Disk Manager.

For more information, please see chapter 3.5, *The Virtual Disk Manager*, page 34 and chapter 5.1, *Virtual Disk Image (VDI) files*, page 51.

3.7.3 CD/DVD-ROM and floppy settings

In the VM Settings window, the settings in these two categories determine what VirtualBox provides as a floppy disk and as a CD/DVD-ROM drive to your VM's guest operating system. For both the floppy and CD/DVD-ROM categories, the following options are available:

- **Not mounted:** The virtual device is presented as empty, that is, no floppy (or no CD/DVD-ROM) is present.

- **Host drive:** The physical device of the host computer is connected to the VM, so that the guest operating system can read from and write to your physical device. This is, for instance, useful if you want to install Windows from a real installation CD. In this case, select from the drop-down list the drive letter (or, on the Linux host, the device) of your host drive.
- **Image file:** Quite similar to virtual hard disks, this presents a file on your host as a device to the guest operating system. To use an image file, you must first import it into the Virtual Disk Manager; see chapter 3.5, *The Virtual Disk Manager*, page 34. The image file format varies depending on the type of device:
  - For floppies, the file must be in raw format.
  - For CD- and DVD-ROMs, the file must be in ISO format. Most commonly, you will select this option when installing an operating system from an ISO file that you have obtained from the Internet. For example, most Linux distributions are available in this way.

All these settings can be changed while the guest is running. Since the "Settings" dialog is not available at that time, you can also access these settings from the "Devices" menu of your virtual machine window.

Note: The identification string of the drive provided to the guest (which is displayed by some configuration tools such as the Windows Device Manager) is always "VBOX CD-ROM", irrespective of the current configuration of the virtual drive. This is to prevent hardware detection from being triggered in the guest operating system every time the configuration is changed.

Using the host drive normally provides a read-only drive to the guest. As an experimental feature (which currently works for data only, audio is not supported), it is possible to give the guest access to the CD/DVD writing features of the host drive (if available):

```
VBoxManage modifyvm <vmname> -dvdpassthrough on
```

See also chapter 8.5, *VBoxManage modifyvm*, page 81.

3.7.4 Audio settings

The "Audio" section in a virtual machine's Settings window determines whether the VM will see a sound card connected, and whether the audio output should be heard on the host system.

If audio is enabled for a guest, VirtualBox simulates an Intel AC'97 controller for the virtual machine. In that case, you can select what audio driver VirtualBox will use on the host. On Linux hosts, you can select between the OSS or the ALSA subsystem.

3.7.5 Network settings

The "Network" section in a virtual machine's Settings window allows you to configure how VirtualBox presents virtual network cards to your VM, and how they operate.

VirtualBox can simulate up to four virtual network cards for a virtual machine. These cards are presented as AMD PCNet cards, which most current operating systems (as well as GNU GRUB) support out of the box, without needing extra drivers.

> **Note:** Unfortunately, Windows Vista has dropped support for this familly of network cards and requires manual driver installation; see chapter 4.2.4, *Windows Vista networking*, page 47.

When you first create a virtual machine, VirtualBox by default enables one of these four cards and selects "Network Address Translation" (NAT) for it. This way the the guest can connect to the outside world using the host's networking and the outside world can connect to services on the guest which you choose to make visible outside of the virtual machine. For a more detailed discussion of networking in virtual machines including other networking options, please see chapter 6, *Virtual networking*, page 54.

3.7.6 USB support

3.7.6.1 USB settings

The "USB" section in a virtual machine's Settings window allows you to configure VirtualBox's sophisticated USB support.

VirtualBox can allow virtual machines to access the USB devices on your host directly. To achieve this, VirtualBox presents to the guest operating system a virtual USB controller. As soon as the guest system starts using a USB device, it will appear as unavailable on the host.

> **Note:** Be careful with USB devices that are currently in use on the host! For example, if you allow your guest to connect to your USB hard disk that is currently mounted on the host, when the guest is activated, it will be disconnected from the host without a proper shutdown. This may cause data loss.

In addition to allowing a guest access to your local USB devices, VirtualBox even allows your guests to connect to remote USB devices by use of the VRDP protocol. For details about this, see chapter 7.4.3, *Remote USB*, page 74.

In the Settings dialog, you can first configure whether USB is available in the guest at all. If so, you can determine in detail which devices are available. For this, you must create so-called "filters" by specifying certain properties of the USB device.

Clicking on the "+" button to the right of the "USB Device Filters" window creates a **new filter.** You can give the filter a name (for referencing it later) and specify the filter

criteria. The more criteria you specify, the more precisely devices will be selected. For instance, if you specify only a vendor ID of 046d, all devices produced by Logitech will be available to the guest. If you fill in all fields, on the other hand, the filter will only apply to a particular device model from a particular vendor, and not even to other devices of the same type with a different revision and serial number.

In detail, the following criteria are available:

1. **Vendor and product ID.** With USB, each vendor of USB products carries an identification number that is unique world-wide, the "vendor ID". Similarly, each line of products is assigned a "product ID" number. Both numbers are commonly written in hexadecimal (that is, they are composed of the numbers 0-9 and the letters A-F), and a colon separates the vendor from the product ID. For example, `046d:c016` stands for Logitech as a vendor, and the "M-UV69a Optical Wheel Mouse" product.

   Alternatively, you can also specify **"Manufacturer"** and **"Product"** by name.

   To list all the USB devices that are connected to your host machine with their respective vendor and product IDs, you can use the following command (see chapter 8, *VBoxManage reference*, page 76):

   ```
   VBoxManage list usbhost
   ```

   On Windows, you can also see all USB devices that are attached to your system in the Device Manager. On Linux, you can use the `lsusb` command.

2. **Serial number.** While vendor and product ID are already quite specific to identify USB devices, if you have two identical devices of the same brand and product line, you will also need their serial numbers to filter them out correctly.

3. **Remote.** This setting specifies whether the device will be local only, or remote only (over VRDP), or either.

On a Windows host, you will need to unplug and reconnect a USB device to use it after creating a filter for it.

As an example, you could create a new USB filter and specify a vendor ID of 046d (Logitech, Inc), a manufacturer index of 1, and "not remote". Then any USB devices on the host system produced by Logitech, Inc with a manufacturer index of 1 will be visible to the guest system.

Several filters can select a single device – for example, a filter which selects all Logitech devices, and one which selects a particular webcam.

You can **deactivate** filters without deleting them by clicking in the checkbox next to the filter name.

3.7.6.2 Implementation notes

On Windows hosts, two kernel mode device drivers provide USB proxy support. A USB filter driver allows VirtualBox to capture devices when they are plugged in. Installing, uninstalling and updating this filter requires a system restart. A second USB

device driver then claims USB devices and makes them available to a virtual machine. After defining a USB device filter for a VM, the device needs to be replugged once for VirtualBox to claim it. Also, you might have to confirm a driver signing warning when starting a VM with assigned USB devices.

On Linux hosts, VirtualBox accesses USB devices on Linux through the `usbfs` file system. Therefore, the user executing VirtualBox needs read and write permission to the USB file system. Most distributions provide a group (e.g. `usbusers`) which the VirtualBox user needs to be added to. Also, VirtualBox can only proxy to virtual machines USB devices which are not claimed by a Linux host USB driver. Please refer to the `driver=` entry in `/proc/bus/usb/devices` to see which devices are claimed.

4 The VirtualBox Guest Additions

The previous chapter covered getting started with VirtualBox and installing operating systems. For any serious and interactive use, the VirtualBox Guest Additions will make your life much easier by providing closer integration between host and guest and improving the interactive performance of guest systems.

4.1 Introduction

As said in chapter 1.1, *Virtualization basics*, page 7, the Guest Additions are designed to be installed *inside* a virtual machine. They consist of device drivers and system applications for the guest operating system that optimize the guest for better performance and usability. To install these additions, you simply provide a special ISO file that comes with VirtualBox as a virtual CD-ROM to your guest operating system and install from there.

VirtualBox presently provides Guest Additions for Windows and Linux guests; if you need support for other operating systems, please contact innotek.

Our Guest Additions offer the following features:

Mouse pointer integration To overcome the limitations for mouse support that were described in chapter 3.4.1.1, *Capturing and releasing keyboard and mouse*, page 30, this provides you with seamless mouse support. Essentially, a special mouse driver is installed in the Windows or Linux guest that communicates with the "real" mouse driver on your host and moves the guest mouse pointer accordingly. You will only have one mouse pointer and pressing the Host key is no longer required to "free" the mouse from being captured by the guest OS.

Better video support While the virtual graphics card the VirtualBox emulates for any guest operating system provides all the basic features, the custom video drivers that are installed with the Guest Additions provide you with extra high and non-standard video modes as well as accelerated video performance. In addition, with Windows guests, when the Guest Additions are installed, you can resize the virtual machine's window, and the video resolution in the Windows guest will be automatically adjusted (as if you had manually entered an arbitrary resolution in the guest's display settings).

Time synchronization With the Guest Additions installed, VirtualBox can much better ensure that the guest's system time is better synchronized. The problem is that an operating system expects to have 100% of a computer's time for itself without interference, which is no longer the case when your VM runs together

with your host operating system and possibly other applications on your host. As a result, your guest operating system's timing will soon be off significantly. The Guest Additions will re-syncronize the time regularly.

Shared folders These provide an easy way to exchange files between the host and the guest. Much similar to ordinary Windows network shares, you can tell VirtualBox to treat a certain folder as a shared folder, and VirtualBox will make it available to the guest operating system as a network share. For details, please refer to chapter 4.4, *Folder sharing*, page 49.

Shared clipboard With the Guest Additions installed, the clipboard of the guest operating system can optionally be shared with your host operating system; see chapter 3.7.1, *General settings*, page 37.

Automated Windows logons (credentials passing; Windows guests only). For details, please see chapter 9.2, *Automated Windows guest logons (VBoxGINA)*, page 92.

4.2 Windows Guest Additions

The VirtualBox Windows Guest Additions are designed to be installed in a virtual machine running a Windows operating system. The following versions of Windows guests are supported:

- Microsoft Windows NT 4.0 (any service pack)
- Microsoft Windows 2000 (any service pack)
- Microsoft Windows XP (any service pack)
- Microsoft Windows Server 2003 (any service pack)
- Microsoft Windows Vista (all editions)

Generally, it is strongly recommend to install the Windows Guest Additions.

4.2.1 Installing the Windows Guest Additions

The VirtualBox Guest Additions are provided as a CD-ROM image file which is called `VBoxGuestAdditions.iso`. An easy-to-use installation program will guide you through the setup process. As VirtualBox can provide ISO files as virtual CD-ROM drives to the Windows guests, Windows can automatically install these additions.

4.2.1.1 Mounting the Additions ISO file

In the "Devices" menu in the virtual machine's menu bar, VirtualBox has a handy menu item named "Install guest additions", which will automatically bring up the Additions in your VM window.

If you prefer to mount the additions manually, you can perform the following steps:

1. Start the virtual machine where you have installed a Windows guest operating system.

2. Select "Mount CD/DVD-ROM" from the "Devices" menu in the virtual machine's menu bar and then "CD/DVD-ROM image". This brings up the Virtual Disk Manager described in chapter 3.5, *The Virtual Disk Manager*, page 34.

3. In the Virtual Disk Manager, press the "Add" button and browse your host file system for the `VBoxGuestAdditions.iso` file:

   - On a Windows host, you can find this file in the VirtualBox installation directory (usually under `C:\Program files\innotek VirtualBox`).
   - On a Linux host, you can find this file in the `additions` folder under where you installed VirtualBox (normally `/opt/VirtualBox-1.4.0`).

4. Back in the Virtual Disk Manager, select that ISO file and press the "Select" button. This will mount the ISO file and present it to your Windows guest as a CD-ROM.

4.2.1.2 Running the installer

Unless you have the Autostart feature disabled in your Windows guest, Windows will now autostart the VirtualBox Guest Additions installation program from the Additions ISO. If the Autostart feature has been turned off, choose `setup.exe` from the CD/DVD drive inside the guest to start the installer.

The installer will add several device drivers to the Windows driver database and then invoke the hardware detection wizard.

Depending on your configuration, it might display warnings that the drivers are not digitally signed. You must confirm these in order to continue the installation and properly install the Additions.

After installation, reboot your guest operating system to activate the Additions.

4.2.2 Updating the Windows Guest Additions

Windows Guest Additions can be updated by running the installation program again, as previously described. This will then replace the previous Additions drivers with updated versions.

Alternatively, you may also open the Windows Device Manager and select "Update driver..." for two devices:

1. the VirtualBox Graphics Adapter and
2. the VirtualBox System Device.

For each, choose to provide your own driver and use “Have Disk” to point the wizard to the CD-ROM drive with the Guest Additions.

4.2.3 Unattended Installation

In order to allow for completely unattended guest installations of Windows 2000 and XP, the Guest Additions driver files have been put separately on the Additions ISO file. Just like with other third-party drivers, the files have to be copied to the OEM directory of Windows. Using the PCI hardware detection, they will then be recognized and installed automatically.

4.2.4 Windows Vista networking

Windows Vista no longer ships a driver for the AMD PCnet Ethernet card which is what VirtualBox provides to the guest. As a result, after installation, Vista guests initially have no networking. With Windows Vista guests, you will have to install a driver for this card manually. For this reason, VirtualBox ships with such a driver, which, for simplicity, we have added to the Guest Additions ISO.

To install this driver, mount the Guest Additions ISO (as described above, select “Install guest additions” from the “Devices” menu). Then, start the Windows Hardware Wizard and direct it to the Guest Additions CD where a driver for the PCnet card can be found in the directory `AMD_PCnet`.

4.3 Linux Guest Additions

Like the Windows Guest Additions, the VirtualBox Guest Additions for Linux take the form of a set of device drivers and system applications which may be installed in the guest operating system.

The following Linux distributions are officially supported:

- Fedora Core 4 and 5
- Redhat Enterprise Linux 3 and 4
- SUSE Linux 9 and 10
- Ubuntu 5.10 and 6.06

Other distributions may work if they are based on comparable software releases. If you require such support, please contact innotek.

As with Windows guests, we recommend installation of the VirtualBox Guest Additions for Linux.

4.3.1 Installing the Linux Guest Additions

The VirtualBox Guest Additions for Linux are provided on the same ISO CD-ROM as the Additions for Windows described above. They also come with an installation program guiding you through the setup process, although, due to the significant differences between Linux distributions, installation may be slightly more complex.

Installation involves the following steps:

1. Before installing the Guest Additions, you will have to prepare your guest system for building external kernel modules. This is exactly the same process as described in chapter 2.2.2, *Support for external kernel modules*, page 16, except that this step must now be performed in your Linux *guest* instead of on a Linux host system, as described there.

2. Mount the `VBoxGuestAdditions.iso` file as your Linux guest's virtual CD-ROM drive, exactly the same way as described for a Windows guest in chapter 4.2.1.1, *Mounting the Additions ISO file*, page 46.

3. Change to the directory where your CD-ROM drive is mounted and execute as root:

   ```
   sh ./VBoxLinuxAdditions.run
   ```

The VirtualBox Guest Additions contain several different drivers. If for any reason you do not wish to install them all, you can specify the ones which you wish on the command line - for example

```
sh ./VBoxAdditions.run x11
```

to install the X Window graphic drivers. Type in the command

```
sh ./VBoxAdditions.run help
```

for more information.

4.3.2 Video acceleration and high resolution graphics modes

In Linux guests, VirtualBox video acceleration is available through the X Window System. Typically, in today's Linux distributions, this will be the X.Org server. During the installation process, X will be set up to use the VirtualBox video driver, using whatever graphics modes were set up before the installation. If these modes do not suit your requirements, you can change your setup by editing the configuration file of the X server, usually found in `/etc/X11/xorg.conf`.

VirtualBox can use any default X graphics mode which fits into the virtual video memory allocated to the virtual machine, as described in chapter 3.7.1, *General settings*, page 37. You can also add your own modes to the X server configuration file. You simply need to add them to the "Modes" list in the "Display" subsection of the "Screen" section. For example, the section shown here has a custom 2048x800 resolution mode added:

```
Section "Screen"
        Identifier    "Default Screen"
        Device        "VirtualBox graphics card"
        Monitor       "Generic Monitor"
        DefaultDepth  24
        SubSection "Display"
                Depth         24
                Modes         "2048x800" "800x600" "640x480"
        EndSubSection
EndSection
```

4.3.3 Updating the Linux Guest Additions

The Guest Additions can simply be updated by going through the installation procedure again with an updated CD-ROM image. This will replace the drivers with updated versions. You should reboot after updating the Guest Additions.

4.4 Folder sharing

Shared Folders allow you to access files of your host system from within the guest system, much like ordinary shares on Windows networks would – except that shared folders do not need a networking setup. Sharing is accomplished using a special service on the host and a file system driver for the guest, both of which are provided by VirtualBox.

In order to use this feature, the VirtualBox Guest Additions have to be installed. Currently, Shared Folders are limited to Windows XP, Windows 2000 and Linux 2.4 and 2.6 guests.

To declare a folder as shared to VirtualBox, you specify a certain path on the host (which will become the shared folder) and give it a "share name" that only VirtualBox will use. Using this share name, which the VirtualBox Shared Folders service will provide to the guest, a drive letter mapping can be performed in the guest.

There are several ways in which shared folders can be configure:

- In the graphical user interface of a running virtual machine, you can select "Shared folders" from the "Devices" menu, or click on the little folder icon in the bottom right corner.
- If a virtual machine is not currently running, you can configure shared folders in each virtual machine's "Settings" dialog.
- From the command line, you can create shared folders using the the VBoxManage command line interface; see chapter 8, *VBoxManage reference*, page 76. The command is as follows:

  ```
  VBoxManage sharedfolder add "VM name" -name "sharename"
                      -hostpath "C:\test"
  ```

There are two types of shares:

1. VM shares which are only available to the VM for which they have been defined;
2. transient VM shares, which can be added and removed at runtime and do not persist after a VM has stopped; for these, add the `--transient` option to the above command line.

Then, you can mount the shared folder from inside a VM the same way as you would mount an ordinary network share:

- In a Windows guest, use the following command:

  ```
  net use x: \\vboxsvr\sharename
  ```

  While `vboxsvr` is a fixed name, replace "x:" with the drive letter that you want to use for the share, and `sharename` with the share name specified with `VBoxManage`.

- In a Linux guest, use the following command:

  ```
  mount -t vboxsf [-o OPTIONS] sharename mountpoint
  ```

  Replace `sharename` with the share name specified with `VBoxManage`, and `mountpoint` with the path where you want the share to be mounted (e.g. `/mnt/share`). The usual mount rules apply, that is, create this directory first if it does not exist yet.

  Beyond the standard options supplied by the `mount` command, the following are available:

  ```
  iocharset CHARSET
  ```

  to set the character set used for I/O operations (utf8 by default) and

  ```
  convertcp CHARSET
  ```

  to specify the character set used for the shared folder name (utf8 by default).

5 Virtual storage

As the virtual machine will most probably expect to see a hard disk built into its virtual computer, VirtualBox must be able to present "real" storage to the guest as a virtual hard disk. There are presently three methods in which to achieve this:

1. Most commonly, VirtualBox will use large image files on a real hard disk and present them to a guest as a virtual hard disk. This is described below.

2. Alternatively, if you have iSCSI storage servers, you can attach such a server to VirtualBox as well; this is described in chapter 5.3, *iSCSI servers*, page 53.

3. Finally, as an experimental feature, you can allow a virtual machine to access one of your host disks directly; this advanced feature is described in chapter 9.8, *Using a raw host hard disk from a guest*, page 97.

5.1 Virtual Disk Image (VDI) files

By default, VirtualBox uses its own container format for guest hard disks – Virtual Disk Image (VDI) files.

The VDI files reside on the host system and are seen by the guest systems as hard disks of a certain geometry. When creating an image, its size has to be specified which determines this fixed geometry. It is therefore not possible to change the size of the virtual hard disk later.

As briefly mentioned in chapter 3.2, *Creating a virtual machine*, page 23, there are two options of how to create the image: fixed-size or dynamically expanding.

- If you create a **fixed-size image** of e.g. 10 GB, a VDI file of roughly the same size will be created immediately on your host system.

- For more flexible storage management, use a **dynamically expanding image**. This will initially be very small and not occupy any space for unused virtual disk sectors, but the image file will grow every time a disk sector is written to for the first time. While this format takes less space initially, the fact that VirtualBox needs to constantly expand the image file consumes additional computing resources, so until the disk has fully expanded, write operations are slower than with fixed size disks. However, after a dynamic disk has fully expanded, the performance penalty for read and write operations is negligible.

For either of the above two image types (that is, irrespective of whether an image is fixed-size or dynamically expanding), you can also specify whether write operations affect the image directly.

1. With **normal images** (the default setting), there are no restrictions on how guests can read from and write to the disk. Because of this, a normal hard disk can only be attached to a single virtual machine at any given time (although you can detach them from a VM and attach them to another).

   When you take a snapshot of your virtual machine as described in chapter 3.4.4, *Snapshots*, page 33, the state of such a "normal hard disk" will be recorded together with the snapshot, and when reverting to the snapshot, its state will be fully reset.

2. By contrast, **immutable images** are read-only and can be used from multiple virtual machines simultaneously. Write accesses to immutable hard disks will be directed to a special differencing disk image which VirtualBox creates automatically. However, when you shut down the VM to which the immutable disk is attached, the changes in the differencing disk will be completely discarded.

   Of course, *creating* a virtual disk image as immutable makes no sense, because then the hard disk would always be reset to an empty state when the VM is shut down to which it is attached. Hence, you will ordinarily create a "normal" virtual disk image and then, when its contents are deemed useful, then mark it immutable.

   To mark a disk image as "immutable", use the `VBoxManage modifyvdi` command; see chapter 8.13, *VBoxManage modifyvdi*, page 87.

3. Finally, **write-through hard disks** are like normal hard disks in that they fully support read and write operations also. However, their state is *not* saved when a snapshot is taken, and not restored when a VM's state is reverted.

   To *create* a disk image as "write-through", use the `VBoxManage createvdi` command; see chapter 8.12, *VBoxManage createvdi*, page 87. To mark an existing image as write-through, use `VBoxManage modifyvdi`; see chapter 8.13, *VBoxManage modifyvdi*, page 87.

To illustrate the differences between the various types with respect to snapshots: You have installed your guest operating system in your VM, and you have taken a snapshot. Imagine you have accidentally infected your VM with a virus and would like to go back to the snapshot. With a normal hard disk image, you simply revert the state of the VM, and the earlier state of your hard disk image will be restored as well (and your virus infection will be undone). With an immutable hard disk, irrespective of the snapshot, all it takes is to shut down your VM, and the virus infection will be discarded. With a write-through image however, you cannot easily undo the virus infection by means of virtualization, but will have to disinfect your virtual machine like a real computer.

Still, you might find write-though images useful if you want to preserve critical data irrespective of snapshots, and since you can attach more than one VDI to a VM, you may want to have one immutable for the operating system and one write-through for your data files.

5.2 VMDK image files

Starting with version 1.4, VirtualBox also supports the popular and open VMDK container format that is now supported by a large number of virtualization products.

This means you can import your existing VMDK files by way of the Virtual Disk Manager just like existing VDI images; see chapter 3.5, *The Virtual Disk Manager*, page 34. While VirtualBox fully supports using VMDK files in most situations, the more advanced features of virtual hard disks are presently not supported. In detail, with VMDK images,

- you presently cannot create snapshots;
- only write-through images are supported; immutable and normal hard disk are not.

These restrictions will be overcome in a future release. Creating VMDKs giving raw disk or raw partition access is already implemented; see chapter 9.8, *Using a raw host hard disk from a guest*, page 97.

5.3 iSCSI servers

iSCSI stands for "Internet SCSI" and is a standard that allows for using the SCSI[1] protocol over Internet (TCP/IP) connections. Especially with the advent of Gigabit Ethernet, it has become affordable to attach iSCSI storage servers simply as remote hard disks to a computer network. In iSCSI terminology, the server providing storage resources is called an "iSCSI target", while the client connecting to the server and accessing its resources is called "iSCSI initiator".

VirtualBox is unique on the virtualization market in that it can transparently present iSCSI remote storage to a virtual machine as a virtual hard disk. The guest operating system will not see any difference between a virtual disk image (VDI file) and an iSCSI target. To achieve this, VirtualBox has an integrated iSCSI initiator.

VirtualBox's iSCSI support has been developed according to the iSCSI standard and should work with all standard-conforming iSCSI targets. To use an iSCSi target with VirtualBox, you must first register it as a virtual hard disk with `VBoxManage`; see chapter 8.15, *VBoxManage addiscsidisk*, page 88. The target will show up in the list of disk images, as described in chapter 3.5, *The Virtual Disk Manager*, page 34, and can thus be attached to one of the VM's three hard disk slots the usual way.

> **Note:** As opposed to the VDI files described previously, the type of iSCSI targets cannot be "normal" or "immutable", but will always be set to "write through". This means that their state is not saved or reverted with snapshots.

[1] SCSI, in turn, is the "Small Computer System Interface" and is an established industry standard for data transfer between devices, notably storage devices. Established as early as 1986, SCSI is still used for connecting hard disks and tape devices even today. Especially in the PC market, however, it competed with other data transfer standards such as IDE. It is still in common use in workstations and servers.

6 Virtual networking

As briefly mentioned in chapter 3.7.5, *Network settings*, page 41, VirtualBox provides up to four virtual PCI Ethernet cards for each virtual machine.

Each of these adapters can be separately configured in one of the following four modes:

- Not attached
- Network Address Translation (NAT)
- Host Interface Networking
- Internal Networking

By default, virtual network cards are set up to use *network address translation*, which is well suited to standard networking needs (accessing the Internet from programs running in the guest and providing network services for machines in a local intranet). In particular, if all you want is to browse the Web, download files and view e-mail inside the guest then the default configuration of the NAT network should be sufficient for you, and you can safely skip the rest of this section. Please note that the `ping` utility does not work over NAT, and that there are certain limitations when using Windows file sharing.

For advanced networking needs such as network simulations, *host interface networking* can be used to set up an additional, software based network interface on the host to which the virtual machine is connected. Finally, VirtualBox *internal networking* can be used to create a virtual network which is visible to selected virtual machines, but not to applications running on the host or to the outside world. The following sections describe the available network modes in more detail.

6.1 “Not attached” mode

When a virtual network card’s mode is set to “Not attached”, VirtualBox reports to the guest that a network card is present, but that there is no connection – as if no Ethernet cable was plugged into the card. This way it is possible to “pull” the virtual Ethernet cable and disrupt the connection, which can be useful to inform a guest operating system that no network connection is available and enforce a reconfiguration.

6.2 Network Address Translation (NAT)

Network Address Translation is the simplest way of accessing an external network from a virtual machine. Usually, it does not require any configuration on the host network and guest system. For this reason, it is the default networking mode in VirtualBox.

A virtual machine with NAT networking enabled acts much like a real computer that connects to the Internet through a router. The "router", in this case, is the VirtualBox networking engine, which maps traffic from and to the virtual machine transparently. The disadvantage of NAT mode is that, much like a private network behind a router, the virtual machine is invisible and unreachable from the outside internet; you cannot run a server this way unless you set up port forwarding (described below).

The virtual machine receives its network address and configuration on the private network from a DHCP server that is integrated into VirtualBox. The address which the virtual machine receives is usually on a completely different network to the host. As more than one card of a virtual machine can be set up to use NAT networking, the first card is connected to the private network 10.0.2.0, the second card to the network 10.0.3.0 and so on.

The network frames sent out by the guest operating system are received by VirtualBox's NAT engine, which extracts the TCP/IP data, and resends it using the host operating system. To an application on the host, or to another computer on the same network as the host, it looks like the data was sent by the VirtualBox application on the host, using an IP address belonging to the host. VirtualBox listens for replies to the packages sent, and repacks and resends them to the guest machine on its private network.

As the virtual machine is connected to a private network internal to VirtualBox and invisible to the host, network services on the guest are not accessible to the host machine or to other computers on the same network. However, VirtualBox can make given services available outside of the guest by using **port forwarding.** This means that VirtualBox listens to certain ports on the host and resends all packages which arrive on them to the guest on the ports used by the services being forwarded. To an application on the host or other physical (or virtual) machines on the network, it looks as though the service being proxied is actually running on the host (note that this also means that you cannot run the same service on the same ports on the host). However, you still gain the advantages of running the service in a virtual machine – for example, services on the host machine or on other virtual machines cannot be compromised or crashed by a vulnerability or a bug in the service, and the service can run in a different operating system to the host system.

You can set up a guest service which you wish to proxy using the command line tool `VBoxManage`. You will need to know which ports on the guest the service uses and to decide which ports to use on the host (often but not always you will want to use the same ports on the guest and on the host). You can use any ports on the host which are not already in use by a service. An example of how to set up incoming NAT connections to a `ssh` server on the guest requires the following three commands:

```
VBoxManage setextradata "Linux Guest"
        "VBoxInternal/Devices/pcnet/0/LUN#0/Config/guestssh/Protocol" TCP
```

```
VBoxManage setextradata "Linux Guest"
"VBoxInternal/Devices/pcnet/0/LUN#0/Config/guestssh/GuestPort" 22
VBoxManage setextradata "Linux Guest"
"VBoxInternal/Devices/pcnet/0/LUN#0/Config/guestssh/HostPort" 2222
```

The name `guestssh` is an arbitrary one chosen for this particular forwarding configuration. With that configuration in place, all TCP connections to port 2222 on the host will be forwarded to port 22 on the guest. `Protocol` can be either of `TCP` or `UDP` (these are case insensitive). To remove a mapping again, use the same commands, but leaving out the values (in this case `TCP`, `22` and `2222`).

It is not possible to configure incoming NAT connections while the VM is running. However you can change the settings for a VM which is currently saved (or powered off at a snapshot).

Two **limitations** of NAT networking are that finding Windows shares by browsing is not possible in the default configuration (although they can still be accessed if you know the name or the IP address of the machine that is sharing them) and that the `ping` utility will not get a response from the host or other machines outside of the private network. Browsing Windows shares requires the guest to receive incoming TCP and UDP connections on ports 135, 137 and 139, so you can enable this by forwarding those ports to the guest, but this will then prevent the host from using them to browse shares. And the `ping` utility uses ICMP network packages, which can only be sent by an application with administrator privileges. Since VirtualBox runs as a user application it can not proxy these in NAT mode.

6.3 Introduction to host interface networking

With Host Interface Networking, VirtualBox creates a new networking interface in software on the host computer. When you connect a guest to it, the host can see the guest through the new network interface as though the interface were connected to the guest's network card with a network cable. As a result, the guest then behaves like a real computer connected to the network: the host can send data to the guest through that interface and receive data from it. This means that you can set up routing or bridging between the host and the guest.

You can create several VirtualBox host interfaces on the host system (see the following subsections for instructions on how to do so), but each of them can only be connected to a single virtual network card in a single guest at one time. In other words, for each virtual network card that is supposed to use Host Interface Networking, you will need to set up a new interface on the host.

> **Warning:** Please be aware that setting up host interface networking always involves making changes to your host's network configuration, which can cause the host to lose its network connection. Do not change network settings on remote or production systems unless you know what you are doing.

As there are few limits on the number of setups which can be created using host networking, we will only describe Ethernet bridging for the different host operating system that VirtualBox supports. For more advanced networking needs, we recommend that you consult general documentation about networking on your host operating system.

Ethernet bridging is a way of connecting several network devices together in software, effectively "splitting" a network card into several. With VirtualBox, you will then use the same networking card for your host operating system and your virtual machines. Other computers on your network will then see your guests as though they had their own physical network cards. You will need Ethernet hardware for this as most current wireless network devices do not support bridging.

In some network environments (often company networks), measures are taken to prevent several MAC addresses being used on a single network interface by temporarily blocking communication to that interface. This is intended to prevent certain types of network attacks, but will also prevent bridging setups from working correctly.

6.4 Host interface networking on Windows hosts

When you install VirtualBox on the Windows host, the setup program installs a special networking driver on your system. This driver, the VirtualBox Host Interface NDIS driver, can be used to create additional host interfaces. These must be created explicitly before they can be attached to a virtual machine.

Use the `VBoxManage` tool to create new host interfaces on your Windows system:

```
VBoxManage createhostif "VM1 external"
```

Alternatively you can use the network configuration in the VirtualBox GUI to create and delete host interfaces.

Each new host interface thus created appears as an additional network card in your standard "Network Connections" properties. After you have created your new host interface this way, you can select "Host Interface" as the networking mode in a virtual machine's Settings window and select the new interface in the "Interface name" drop-down list. With the above example, this drop-down list would contain "VM1 external".

If your host is running **Windows XP or newer**, you can also use the built-in bridging feature to connect your host interfaces to your physical network card. After creating the desired host interfaces, select your physical network adapter in the Network Connections folder and the desired host interface adapters and select "Bridge connections" from the popup menu. Note that you have to transfer your network configuration from your physical network adapter to the network bridge as mentioned above, because your physical network adapter will only function as a transport medium in your bridge setup. When more than one connection is active on a bridge, Windows will automatically put your physical Ethernet adapter into promiscuous mode so that it will receive network data for all bridged connections.

6.5 Host interface networking on Linux hosts

Note: There were some changes to the way dynamic host interface configuration is done in VirtualBox 1.4.0, due to changes in Linux kernel versions 2.6.18 and later. Also, this entire section of the manual was rewritten for Virtual 1.4.0. Please reread these sections if you used dynamic interfaces on earlier versions.

Since the Linux kernel has built-in support for virtual network devices (so-called TAP interfaces), VirtualBox on Linux makes use of these instead of providing custom host networking drivers. The TAP interfaces behave like physical network interfaces on your host and will work with any networking tools installed on your host system. From the point of view of the host, it looks like the guest's network card is connected to the TAP interface with a network cable. In order to use Host Interface Networking in VirtualBox, you must have access to the device `/dev/net/tun`. Check which group this device belongs to and make sure that any users who need access to VirtualBox Host Networking are members of this group. In most cases, this device will belong to the `vboxusers` group.

On Linux hosts, you have a choice of creating *permanent* networking interfaces which guests can attach to when they are created or having VirtualBox create a *dynamic* interface for a guest when the guest is started and remove it when the guest is stopped. Permanent interfaces are more suitable for hosts which run a known set of guests which does not change often (such as some server setups), and they are easier to set up. Having VirtualBox create the interfaces dynamically when a virtual machine is started provides more flexibility, but will normally require you to enter an administrator password when the interfaces are created and removed.

Since not all popular Linux distributions provide their own methods of creating permanent TAP interfaces, we provide utilities which will do this on most distributions. If your distribution does provide its own method, we recommend that you use that instead (we provide instructions below for doing this on current Debian and Ubuntu systems). We also provide instructions for setting up a network bridge on Debian, Ubuntu, openSUSE, Fedora and Redhat hosts. If you use a different distribution, please consult the documentation provided with it to find out how to do this.

6.5.1 Permanent host interfaces and bridging

On Linux hosts, setting up a permanent host interface typically consists of three steps:

1. In most cases, you will want to create a bridge for one of your physical network interfaces, e.g. `eth0`. This will allow for sharing the same physical interface between the "real" host and the "virtual" host interfaces that you will create for your virtual machines.

   The bridging step is not strictly required; you can create a host interface and make a virtual machine use it without having created a bridge (and without

having added the host interface to the bridge) first. This may be useful for testing scenarios, or if you have more complex networking setups where you would prefer routing to briding. However, in most cases, you will want to allow a virtual machine to share your physical networking interface, for which bridging is the most practical way, which is why we describe bridging in the following sections.

Also, keep in mind that briding is an Ethernet concept and therefore unrelated to TCP/IP. In physical networks, bridging is typically used to reduce collisions between many Ethernet hosts. A bridge thus connects two previously unrelated subnetworks.[1]

2. For each guest network card that uses host interface networking, you must create a new "virtual" host interface (called `tap0` or `vbox0` or something similar) and add this interface to the bridge.

3. Finally, specify the new host interface in the settings for the virtual network card of a virtual machine.

Unfortunately, Linux distributions differ substantially in their networking configuration. The exact steps how to do this therefore vary depending on the distribution of your host. Below, we will describe the setup procedures for Debian, Ubuntu, Fedora/Red Hat and openSUSE; in addition, we offer some generic instructions for advanced users.

Some distributions – such as Debian and Ubuntu – have build-in tools to create host interfaces; we recommend those built-in tools on those distributions.

For use with other distributions, VirtualBox ships with two utilities, `VBoxAddIF` and `VBoxDeleteIF`, which are explained in chapter 6.5.1.5, *The VBoxAddIF and VBoxDeleteIF utilities*, page 64. These tools allow you to create and delete host interfaces and optionally add them to an existing bridge.

Note: While we have made any attempt to ensure that the below distribution-specific instructions work, we strongly recommend that you look up your distribution's own documentation about how to set up briding in addition to the below instructions.

6.5.1.1 Debian and Ubuntu hosts

To set up a permanent host interface on a Debian or Ubuntu host, follow these steps:

1. On modern Debian and Ubuntu based hosts, you must first install the User Mode Linux utilities package (uml-utilities), which contains tools to create TAP interfaces, as well as the bridge utilities (`bridge-utils`). package. You can do this from the command line using

[1] A useful introduction to bridging can be found here: http://gentoo-wiki.com/HOWTO_setup_a_gentoo_bridge. While this is targeted at a Gentoo system, it contains some general introductions.

```
sudo apt-get install uml-utilities
sudo apt-get install bridge-utils
```

In order for VirtualBox to be able to access the interface, the user who will be running the virtual machine must be added to the group `uml-net`, for example with the following command (replace `vboxuser` with your user name):

```
sudo gpasswd -a vboxuser uml-net
```

You may have to log out and log in again for the change to take effect.

2. To describe the TAP interface to your Debian or Ubuntu system, add an entry to the file `/etc/network/interfaces`. This names the the interface and must also specify the user who will be running the virtual machine using the interface.

   The following sample entry creates the interface `tap0` for the user `vboxuser` (again, replace with your user name):

   ```
   auto tap0
   iface tap0 inet manual
       up ifconfig $IFACE 0.0.0.0 up
       down ifconfig $IFACE down
       tunctl_user vboxuser
   ```

   You will probably want to change the entry based on your networking needs. On the host, you will find more documentation in these files:

   a) `/usr/share/doc/uml-utilities/README.Debian` and

   b) `/usr/share/doc/ifupdown/examples/network-interfaces.gz`.

3. The first time it is used, activate the new interface and the bridge with these two commands:

   ```
   sudo /sbin/ifup tap0
   sudo /sbin/ifup br0
   ```

   This is only needed once, however; the next time the host is restarted, the interface and the bridge should be activated automatically.

4. Another entry must be added to the file `/etc/network/interfaces` to describe the bridge. The following sample entry creates a bridge called `br0`, adds to it all ethernet interfaces on the host as well as the TAP interface created above and tells it to obtain an IP address using DHCP so that the host remains able to access the network.

   ```
   auto br0
   iface br0 inet dhcp
       bridge_ports all tap0
   ```

   Again, you will probably want to change this to suit your own networking needs. In particular, you may want to assign a static IP address to the bridge, or if you are using TAP interfaces created by VirtualBox (these are described later), you will want to remove `tap0` from the last line. On the host, you will find more documentation in the files

a) `/usr/share/doc/bridge-utilities/README.Debian.gz` and

b) `/usr/share/doc/ifupdown/examples/network-interfaces.gz`.

5. To tell VirtualBox to use the interface, select the virtual machine which is to use it in the main window of the VirtualBox application, configure one of its network adaptors to use Host Interface Networking (using “Settings”, “Network”, “Attached to”) and enter “tap0” into the “Interface name” field.

   Alternatively, you can use the VBoxManage command line tool (in this example we are attaching the interface to the first network card of the virtual machine “My VM”):

   ```
   VBoxManage modifyvm "My VM" -hostifdev1 tap0
   ```

6.5.1.2 Bridging on openSUSE hosts

On openSUSE hosts, we recommend to use the `VBoxAddIF` utility (shipped with VirtualBox; see chapter 6.5.1.5, *The VBoxAddIF and VBoxDeleteIF utilities*, page 64) to create a TAP interface and add it to a bridge.

That leaves open the question how to create bridge on openSUSE; for this, please follow the below instructions. Note that bridging on openSUSE hosts may not work properly if you are using NetworkManager to manage your network connections. To create a bridge on a recent openSUSE host, you must first install the bridge utilities (`bridge-utils`) package. If you are working from the command line this can be done as follows:

```
sudo /sbin/yast -i bridge-utils
```

Then you must create a text file describing the bridge to be created. The name of the file must correspond to the name of the bridge you wish to create. To create the bridge `br0`, you should call the file `/etc/sysconfig/network/ifcfg-br0`. Below we have given an example of a file which creates a bridge including the network device `eth0`, obtains an IP address by DHCP (through the network device) and is started automatically when openSUSE starts. You will probably want to adjust this to match your networking requirements.

```
BOOTPROTO='dhcp'
NETMASK='255.255.255.0'
STARTMODE='auto'
USERCONTROL='no'
DHCLIENT_TIMEOUT=30
BRIDGE='yes'
BRIDGE_PORTS='eth0'
```

For this example to work, you will also need to change the configuration for the network interface `eth0` to a static IP address of 0.0.0.0, as openSUSE does not do this automatically when the interface is added to the bridge. You can do this using the graphical interface or by changing the following settings in the file `/etc/sysconfig/network/ifcfg-eth-xx:xx:xx:xx:xx:xx`, where the last part should be replaced with the hardware address of the network card.

```
BOOTPROTO='static'
IPADDR='0.0.0.0'
```

You can activate the bridge immediately after creating it with the command:

```
sudo /sbin/ifdown eth0
sudo /sbin/ifup br0
```

The bridge will be activated automatically from now on when the host is restarted.

Now, to create a permanent host interface called `vbox0` (all host interfaces created in this way must be called `vbox` followed by a number) and add it to the network bridge created above, use the following command:

```
sudo VBoxAddIF vbox0 vboxuser br0
```

Replace `vboxuser` with the name of the user who is supposed to be able to use the new interface.

To tell VirtualBox to use this interface (`vbox0`) for a virtual machine, select the VM in the main window, configure one of its network adaptors to use Host Interface Networking (using "Settings", "Network", "Attached to") and enter "vbox0" into the "Interface name" field.

Alternatively, you can use the VBoxManage command line tool (in this example we are attaching the interface to the first network card of the virtual machine "My VM":

```
VBoxManage modifyvm "My VM" -hostifdev1 vbox0
```

6.5.1.3 Bridging on Redhat and Fedora hosts

On Redhat and Fedora hosts, we recommend to use the `VBoxAddIF` utility (shipped with VirtualBox; see chapter 6.5.1.5, *The VBoxAddIF and VBoxDeleteIF utilities*, page 64) to create a TAP interface and add it to a bridge.

As with openSUSE, this leaves open the question how to create bridge on Redhat and Fedora. For this, you must first install the bridge utilities (`bridge-utils`) package. Then you must create a configuration file describing the bridge you wish to create. The following is the contents of an example configuration file `/etc/sysconfig/network-scripts/ifcfg-br0`, which sets the bridge br0 to get its IP address using DHCP and to start automatically when the system is started. You will probably want to adjust this to match your networking requirements.

```
DEVICE=br0
TYPE=Bridge
BOOTPROTO=dhcp
ONBOOT=yes
```

To add the network card `eth0` to the bridge, add the following line to the end of the file `/etc/sysconfig/network-scripts/ifcfg-eth0`:

```
BRIDGE=br0
```

You can activate the bridge immediately after creating it with the command:

```
sudo /sbin/service network restart
```

The bridge will be activated automatically from now on when the host is restarted.

Now, to create a permanent host interface called `vbox0` (all host interfaces created in this way must be called `vbox` followed by a number) and add it to the network bridge created above, use the following command:

```
sudo VBoxAddIF vbox0 vboxuser br0
```

Replace `vboxuser` with the name of the user who is supposed to be able to use the new interface.

To tell VirtualBox to use this interface (`vbox0`) for a virtual machine, select the VM in the main window, configure one of its network adaptors to use Host Interface Networking (using "Settings", "Network", "Attached to") and enter "vbox0" into the "Interface name" field.

Alternatively, you can use the VBoxManage command line tool (in this example we are attaching the interface to the first network card of the virtual machine "My VM":

```
VBoxManage modifyvm "My VM" -hostifdev1 vbox0
```

6.5.1.4 Bridging with other distributions

Most modern Linux distributions provide their own way of setting up ethernet bridges. We recommend that you follow the instructions provided by your distribution to create the bridge, and the instructions in chapter 6.5.1.5, *The VBoxAddIF and VBoxDeleteIF utilities*, page 64 to create the host interface if your distribution does not provide its own method. For distributions which do not provide their own method of creating bridges, we provide generic instructions below. Please ensure that you thoroughly understand how your distribution's networking scripts work before following these instructions, as they involve making changes to your host network configuration in ways normally only done by the networking scripts, and as such may interfere with your network setup.

First of all, you will need to install the bridge utilities (usually named `bridge-utils` or similar). Once installed, as `root`, follow these instructions to create and configure a bridge:

1. Create a new bridge with this command:

   ```
   brctl addbr br0
   ```

2. If you are not using DHCP, run `ifconfig` and note down the network configuration of your existing network interface (e.g. `eth0`), which we will need to copy to the bridge in a minute.

3. Switch your physical network adapter to "promiscuous" mode so that it will accept Ethernet frames for MAC addresses other than its own:

```
ifconfig eth0 0.0.0.0 promisc
```

Warning: You will lose network connectivity on `eth0` at this point.

4. Add your network adapter to the bridge:

   ```
   brctl addif br0 eth0
   ```

5. Transfer the network configuration previously used with your physical ethernet adapter to the new bridge. If you are using DHCP, this should work:

   ```
   dhclient br0
   ```

   Otherwise, run `ifconfig br0 x.x.x.x netmask x.x.x.x` and use the values that you noted down previously.

6. To create a permanent host interface called `vbox0` (all host interfaces created in this way must be called `vbox` followed by a number) and add it to the network bridge created above, use the following command:

   ```
   VBoxAddIF vbox0 vboxuser br0
   ```

   Replace `vboxuser` with the name of the user who is supposed to be able to use the new interface.

6.5.1.5 The VBoxAddIF and VBoxDeleteIF utilities

The `VBoxAddIF` and `VBoxDeleteIF` utilities used in the above instructions (except for Debian and Ubuntu, where we recommend to use the networking configuration that is native to those distributions) are shipped with VirtualBox to make the creation of TAP interfaces easier.

`VBoxAddIF` creates a permanent TAP interface which does not go away when the host system is restarted and, if a bridge parameter is specified, adds the new interface to the given bridge. This command replaces the `tunctl` sequences that were described in earlier versions of this manual.

To remove an interface which you have created with `VBoxCreateIF` previously (`vbox0` in the above examples), you can use the following command:

```
sudo VBoxDeleteIF vbox0
```

As an alternative to `VBoxAddIF` and `VBoxDeleteIF`, you can still use `tunctl` if you want. We now supply our own version of this command, called `VBoxTunctl`. To create a new interface, use `VBoxTunctl -t tap1 -u vboxuser` (with `vboxuser` being the user name who will be using the interface). You can then add this new interface to a bridge using `brctl addif br0 tap1`. Don't forget to bring up the new interface with `ifconfig tap1 up`.

6.5.2 Creating interfaces dynamically on VM startup

As an alternative to the permanent interfaces described previously, you can tell VirtualBox to execute commands (usually scripts) to set up your network dynamically, every time a virtual machine starts or stops. This is normally done in order to create the TAP interfaces at VM startup time, although you can also use this feature to configure existing interfaces. If you are not using permanent interfaces then the startup command should write the name of the interface which it has created, typically something like `tap0` or `tap2`, to its standard output (the `VBoxTunctl -b` command does exactly this) and the command executed when the machine stops should remove the interface again.

The commands and scripts used will depend on the networking configuration that you want to set up. Both commands are given a file descriptor to the Linux TAP device as their first argument (this is only valid if the virtual machine is using previously created interfaces) and the name of the interface, if it is known, as the second argument. In most circumstances, you will only want to use the second argument.

Here is an example of a set up script which creates a TAP interface and adds it to the network bridge `br0`.

```
#!/bin/bash

# Create an new TAP interface for the user 'vbox' and remember its name.
interface=`VBoxTunctl -b -u vbox`

# If for some reason the interface could not be created, return 1 to
# tell this to VirtualBox.
if [ -z "$interface" ]; then
exit 1
fi

# Write the name of the interface to the standard output.
echo $interface

# Bring up the interface.
/sbin/ifconfig $interface up

# And add it to the bridge.
/sbin/brctl addif br0 $interface
```

If this script is saved as `/home/vbox/setuptap.sh` and made executable, it can be used to create a TAP interface when a virtual machine is started, by configuring one of the machines network adapters to use Host Interface Networking (without specifying a device in the "Interface Name" field) and entering `gtksudo /home/vbox/setuptap.sh` into the "Setup Application" field (replace `gtksudo` by `kdesu`, or whatever is appropriate for your system). Alternatively you can use the the VBoxManage command line tool (in the following example for a machine called "Linux VM"):

```
VBoxManage modifyvm "Linux VM" -tapsetup1 "gtksudo /home/vbox/setuptap.sh"
```

An example of a matching script to remove the interface from the bridge and shut it down would be:

```
#!/bin/bash

# Remove the interface from the bridge.  The second script parameter is
# the interface name.
/sbin/brctl delif br0 $2

# And use VBoxTunctl to remove the interface.
VBoxTunctl -d $2
```

If this is saved as `/home/vbox/cleanuptap.sh` and made executable, the virtual machine can be told to execute it when it shuts down by entering `gtksudo /home/vbox/cleanuptap.sh`, into the "Termination Application" field in VirtualBox's network configuration settings, or by using VBoxManage:

```
VBoxManage modifyvm "Linux VM" -tapterminate1
"gtksudo /home/vbox/cleanuptap.sh"
```

Note: The `VBoxSDL` front end to VirtualBox (see chapter 7.3, *VBoxSDL, the simplified VM displayer*, page 70) allows for an additional way of configuring TAP interfaces if it is started from a custom parent process. This parent process can allocate the required TAP interfaces and let VirtualBox inherit the file handles. For this to work, the file descriptor has to be passed to `VBoxSDL` using the option `-tapfd<N> <fd>`. In this case, the setup and termination scripts will not be called.

6.6 Internal networking

Internal Networking is similar to host interface networking in that the VM can directly communicate with the outside world. However, the "outside world" is limited to other VMs which connect to the same internal network.

Even though technically, everything that can be done using internal networking can also be done using host interface networking, there are two good reasons why this extra mode was implemented:

1. **Security.** In host interface networking mode, all traffic goes through an interface of the host system. It is therefore possible to attach a packet sniffer (such as Ethereal) to the host interface and log all traffic that goes over a given interface. If, for any reason, you prefer two or more VMs on the same machine to communicate privately, hiding their data from both the host system and the user, Host Interface Networking therefore is not an option.

2. **Speed.** Internal networking is more efficient than host interface networking, as VirtualBox can directly transmit the data without having to send it through the host operating system's networking stack.

Internal networks are created automatically as needed, i.e. there is no central configuration. Every internal network is identified simply by its name. In order to attach a VM's network card to an internal network, set its networking mode to "internal networking" using `VBoxManage modifyvm <VM name> –nic<x> intnet` and specify a network name with the command `VBoxManage modifyvm <VM name> intnet<x> <network name>`. If you do not specify a network name, the network card will be attached to the network "intnet" by default. You will also have to manually assign an IP address to the network adaptors. Guests which need to communicate with one another should use IP addresses on the same subnet (e.g. 192.168.2.1 and 192.168.2.2). Please note that you may have to deactivate guest firewalls in order to allow guests to communicate with each other. See also chapter 8.5, *VBoxManage modifyvm*, page 81.

Once there is more than one active virtual network card with the same internal network ID, the VirtualBox support driver will automatically "wire" the cards and act as a network switch. The VirtualBox support driver implements a complete Ethernet switch and supports both broadcast/multicast frames and promiscuous mode.

As a security measure, the Linux implementation of internal networking only allows VMs running under the same user ID to establish an internal network. If you require more information on how to lift this restriction, please contact innotek.

7 Alternative front-ends; remote virtual machines

7.1 Introduction

As briefly mentioned in chapter 1.2, *Features overview*, page 9, VirtualBox has a very flexible internal design that allows you to use different front-ends to control the same virtual machines. To illustrate, you can, for example, start a virtual machine with VirtualBox's easy-to-use graphical user interface and then stop it from the command line. With VirtualBox's support for the Remote Desktop Protocol (VRDP), you can even run virtual machines remotely on a headless server and have all the graphical output redirected over the network.

In detail, the following front-ends are shipped in the standard VirtualBox package:

1. `VirtualBox` is our graphical user interface (GUI), which most of this User Manual is dedicated to describing, especially in chapter 3, *Starting out with VirtualBox*, page 22. While this is the easiest-to-use of our interfaces, it does not (yet) cover all the features that VirtualBox provides. Still, this is the best way to get to know VirtualBox initially.

2. `VBoxManage` is our command-line interface and is described in the next section.

3. `VBoxSDL` is an alternative, simple graphical front-end with an intentionally limited feature set, designed to only display virtual machines that are controlled in detail with `VBoxManage`. This is interesting for business environments where displaying all the bells and whistles of the full GUI is not feasible. `VBoxSDL` is described in chapter 7.3, *VBoxSDL, the simplified VM displayer*, page 70.

4. Finally, `VBoxVRDP` is yet another front-end that produces no visible output on the host at all, but merely acts as a VRDP server. Now, even though the other graphical front-ends (VirtualBox and VBoxSDL) also have VRDP support built-in and can act as a VRDP server, this particular front-end requires no graphics support. This is useful, for example, if you want to host your virtual machines on a headless Linux server that has no X Window system installed. For details, see chapter 7.4.1, *VBoxVRDP, the headless VRDP server*, page 72.

If the above front-ends still do not satisfy your particular needs, it is relatively painless to create yet another front-end to the complex virtualization engine that is the core of VirtualBox, as the VirtualBox core neatly exposes all of its features in a clean COM/XPCOM API.

7.2 Using VBoxManage to control virtual machines

This section will give you a brief introduction to VBoxManage and how you can use it to create and operate virtual machines.

In essence, VBoxManage supports everything that our graphical user interface allows you to do with the click of a button. VBoxManage supports a lot more than that, however. It exposes really all the features of the virtualization engine, even those that cannot (yet) be accessed from the GUI.

You will need to use the command line if you want to

- use a different user interface than the main GUI (for example, VBoxSDL or the headless VBoxVRDP server);
- control some of the more advanced and experimental configuration settings for a VM.

There are two main things to keep in mind when using `VBoxManage`: First, `VBoxManage` must always be used with a specific "subcommand", such as "list vms" or "createvm" or "startvm". All the subcommands that `VBoxManage` supports are described in detail in chapter 8, *VBoxManage reference*, page 76.

Second, most of these subcommands require that you specify a particular virtual machine after the subcommand. There are two ways you can do this:

- You can specify the VM name, as it is shown in the VirtualBox GUI. Note that if that name contains spaces, then you must enclose the entire name in double quotes (as it is always required with command line arguments that contain spaces).

  For example:

  ```
  VBoxManage startvm "Windows XP"
  ```

- You can specify the UUID, which is the internal unique identifier that VirtualBox uses to refer to the virtual machine. Assuming that the aforementioned VM called "Windows XP" has the UUID shown below, the following command has the same effect as the previous:

  ```
  VBoxManage startvm 670e746d-abea-4ba6-ad02-2a3b043810a5
  ```

You can type `VBoxManage list vms` to have all currently registered VMs listed with all their settings, including their respective names and UUIDs.

Some typical examples of how to control VirtualBox from the command line are listed below:

- To create a new virtual machine from the command line and immediately register it with VirtualBox, use `VBoxManage createvm` with the `-register` option,[1] like this:

[1] For details, see chapter 8.4, *VBoxManage createvm*, page 81.

```
$ VBoxManage createvm -name "SUSE 10.2" -register
VirtualBox Command Line Management Interface Version 1.4.0
(C) 2005-2007 innotek GmbH
All rights reserved.

Virtual machine 'SUSE 10.2' is created.
UUID: c89fc351-8ec6-4f02-a048-57f4d25288e5
Settings file: '/home/username/.VirtualBox/Machines/SUSE 10.2/SUSE 10.2.xml'
```

As can be seen from the above output, a new virtual machine has been created with a new UUID and a new XML settings file.

- To show the configuration of a particular VM, use `VBoxManage showvminfo`; see chapter 8.2, *VBoxManage showvminfo*, page 80 for details and an example.
- To change VM settings, use `VBoxManage modifyvm`, e.g. as follows:

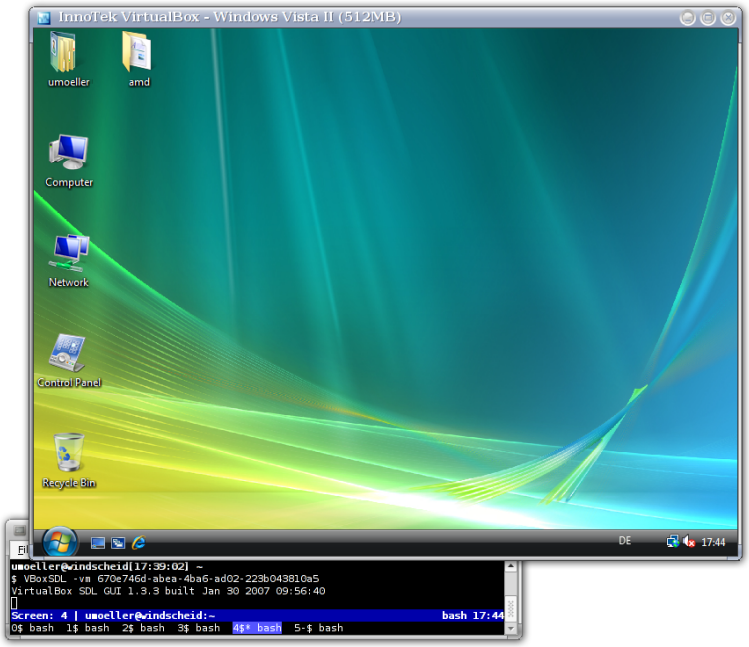
  ```
  VBoxManage modifyvm "Windows XP" -memory "512MB"
  ```

  For details, see chapter 8.5, *VBoxManage modifyvm*, page 81.
- To control VM operation, use one of the following:
  - To start a VM that is currently powered off, use `VBoxManage startvm`; see chapter 8.6, *VBoxManage startvm*, page 85 for details.
  - To pause or save a VM that is currently running, use `VBoxManage controlvm`; see chapter 8.7, *VBoxManage controlvm*, page 85 for details.

7.3 VBoxSDL, the simplified VM displayer

VBoxSDL is a simple graphical user interface (GUI) that lacks the nice point-and-click support which VirtualBox, our main GUI, provides. VBoxSDL is currently primarily used internally for debugging at innotek and therefore not officially supported. Still, you may find it useful for environments where the virtual machines are not necessarily controlled by the same person that uses the virtual machine.

As you can see in the following screenshot, VBoxSDL does indeed only provide a simple window that contains only the “pure” virtual machine, without menus or other controls to click upon and no additional indicators of virtual machine activity:



To start a virtual machine with VBoxSDL instead of the VirtualBox GUI, enter the following on a command line:

```
VBoxSDL -vm <vm>
```

where `<vm>` is, as usual with VirtualBox command line parameters, the name or UUID of an existing virtual machine.

7.4 Remote Desktop Support (VRDP)

VirtualBox, the graphical user interface, has a built-in server for the VirtualBox Remote Desktop Protocol (VRDP). This allows you to see the output of a virtual machine's window remotely on any other computer and control the virtual machine from there, as if it was running on the remote machine.

VRDP is a backwards-compatible extension to Microsoft's Remote Desktop Protocol (RDP). Typically graphics updates and audio are sent from the remote machine to the client, while keyboard and mouse events are sent back.

With `VirtualBox`, the graphical user interface, the VRDP server is disabled by default, but can easily be enabled on a per-VM basis either with the VirtualBox GUI or with `VBoxManage`:

```
VBoxManage modifyvm <vmname> -vrdp on
```

If you use VBoxVRDP (described below), VRDP support will be automatically enabled.

Additional settings for modifyvm are –vrdpport and –vrdpauthtype; see chapter 8.5, *VBoxManage modifyvm*, page 81 for details.

7.4.1 VBoxVRDP, the headless VRDP server

While the VRDP server that is built into the VirtualBox GUI is perfectly capable of running virtual machines remotely, it is not convenient to have to run VirtualBox if you never want to have VMs displayed locally in the first place. In particular, if you are running servers whose only purpose is to host VMs, and all your VMs are supposed to run remotely over VRDP, then it is pointless to have a graphical user interface on the server at all – especially since, on a Linux host, VirtualBox comes with dependencies on the Qt and SDL libraries, which is inconvenient if you would rather not have the X Window system on your server at all.

VirtualBox therefore comes with yet another front-end that produces no visible output on the host at all, but instead only delivers VRDP data. This "headless server" is called VBoxVRDP.

To start a virtual machine with VBoxVRDP, you have two options:

- You can use VBoxManage startvm <vmname> –type vrdp. The extra –type option causes the VirtualBox core to use VBoxVRDP as the front-end to the internal virtualization engine.
- The recommended way, however, is to use VBoxVRDP directly, as follows:

  ```
  VBoxVRDP –startvm <uuid|name>
  ```

  This is the recommended way, because when starting the headless interface through VBoxManage, you will not be able to view or log messages that VBoxVRDP may have output on the console. Especially in case of startup errors, such output might be desirable for problem diagnosis.

7.4.2 Step by step: creating a virtual machine on a headless server

The following instructions may give you an idea how to create a virtual machine on a headless server over a network connection. We will create a virtual machine, establish a VRDP connection and install a guest operating system – all without having to touch the headless server. All you need is the following:

1. VirtualBox on a server machine with a supported host operating system (Linux or Windows); for the following example, we will assume a Linux server;
2. an ISO file on the server, containing the installation data for the guest operating system to install (we will assume Windows XP in the following example);

3. a terminal connection to that host over which you can access a command line (e.g. via `telnet` or `ssh`);

4. an RDP viewer on the remote client; on a Linux client, you could use `rdesktop` to connect; from a Windows machine, you could use the RDP viewer that comes with Windows (usually found in "Accessories" -> "Communication" -> "Remote Desktop Connection").

Note that on the server machine, since we will only use the headless server, neither Qt nor SDL nor the X Window system will be needed.

1. On the headless server, create a new virtual machine:

   ```
   VBoxManage createvm -name "Windows XP" -register
   ```

   Note that if you do not specify `-register`, you will have to manually use the registervm command later.

2. Make sure the settings for this VM are appropriate for the guest operating system that we will install. For example:

   ```
   VBoxManage modifyvm "Windows XP" -memory "256MB" \
            -acpi on -boot1 dvd -nic1 nat
   ```

3. Create a virtual hard disk for the VM (in this case, 10GB in size) and register it with VirtualBox:

   ```
   VBoxManage createvdi -filename "WinXP.vdi" -size 10000 -register
   ```

4. Set this newly created VDI file as the first virtual hard disk of the new VM:

   ```
   VBoxManage modifyvm "Windows XP" -hda "WinXP.vdi"
   ```

5. Register the ISO file that contains the operating system installation that you want to install later:

   ```
   VBoxManage registerimage dvd /full/path/to/iso.iso
   ```

6. Attach this ISO to the virtual machine, so it can boot from it:

   ```
   VBoxManage modifyvm "Windows XP" -dvd /full/path/to/iso.iso
   ```

   (Alternatively, you can use `VBoxManage controlvm dvdattach` directly, without having to register the image first; see chapter 8.7, *VBoxManage controlvm*, page 85 for details.)

7. Start the virtual machine using VBoxVRDP:

   ```
   VBoxVRDP -startvm "Windows XP"
   ```

   If everything worked, you should see a copyright notice. If, instead, you are returned to the command line, then something went wrong.

8. On the client machine, fire up the RDP viewer and try to connect to the server. Assuming a Linux client, try the following:

```
rdesktop -a 16 my.host.address
```

(With rdesktop, the -a 16 option requests a color depth of 16 bits per pixel, which we recommend. Also, after installation, you should set the color depth of your guest operating system to the same value.)

You should now be seeing the installation routine of your guest operating system.

7.4.3 Remote USB

As a special feature on top of the VRDP support, VirtualBox supports remote USB devices over the wire as well. That is, the VirtualBox guest that runs on one computer can access the USB devices of the remote computer on which the RDP data is being displayed the same way as USB devices that are connected to the actual host. This allows for running virtual machines on a VirtualBox host that acts as a server, where a client can connect from elsewhere that needs only a network adapter and a display capable of running an RDP viewer. When USB devices are plugged into the client, the remote VirtualBox server can access them.

For these remote USB devices, the same filter rules apply as for other USB devices, as described with chapter 3.7.6.1, *USB settings*, page 41. All you have to do is specify "Remote" (or "Any") when setting up these rules.

7.4.4 RDP authentication

For each virtual machine that is remotely accessible via RDP, you can individually determine if and how RDP connections are authenticated.

For this, use `VBoxManage modifyvm` command with the `–vrdpauthtype` option; see chapter 8.5, *VBoxManage modifyvm*, page 81 for a general introduction. Three methods of authentication are available:

- The "null" method means that there is no authentication at all; any client can connect to the VRDP server and thus the virtual machine. This is, of course, very insecure and only to be recommended for private networks.
- The "external" method provides external authentication through a special authentication library.

  VirtualBox comes with two default libraries for external authentication:

  – On Linux hosts, `VRDPAuth.so` authenticates users against the host's PAM system.

  – On Windows hosts, `VRDPAuth.dll` authenticates users against the host's WinLogon system.

  In other words, the "external" method per default performs authentication with the user accounts that exist on the host system.

  However, you can replace the default "external" authentication module with any other module. For this, VirtualBox provides a well-defined interface that allows

you to write your own authentication module; see chapter 9.3, *Custom external VRDP authentication*, page 93 for details.

- Finally, the "guest" authentication method performs authentication with a special component that comes with the Guest Additions; as a result, authentication is not performed with the host users, but with the guest user accounts. This method is currently still in testing and not yet supported.

7.4.5 RDP encryption

RDP features data stream encryption, which is based on the RC4 symmetric cipher (with keys up to 128bit). The RC4 keys are being replaced in regular intervals (every 4096 packets).

RDP provides three different authentication methods:

1. Historically, RDP4 authentication was used where the RDP client does not perform any checks in order to verify the identity of the server it connects to. Using a man in the middle (MITM) attack, the user's credentials could be obtained. Therefore RDP4 authentication is insecure and should generally not be used.

2. RDP5.1 authentication employs a server certificate for which the client possesses the public key. This way, it is guaranteed that the server must possess the corresponding private key. However, this hardcoded private key became public some years ago and therefore RDP5.1 authentication must be considered to be insecure and should generally not be used.

3. RDP5.2 authentication is based on TLS 1.0 with customer supplied certificates. The server supplies a certificate to the client which must be signed by a certificate authority (CA) that the client trusts (for the Microsoft RDP Client 5.2, the CA has to be added to the Windows Trusted Root Certificate Authorities database). VirtualBox allows you to supply your own CA and server certificate and uses OpenSSL for encryption.

While VirtualBox supports all of the above, only RDP5.2 authentication should be used in environments where security is a concern. As the client that connects to the server determines what type of encryption will be used, with rdesktop, the Linux RDP viewer, use the `-4` or `-5` options.

8 VBoxManage reference

When running VBoxManage without parameters or when supplying an invalid command line, the syntax diagram will be shown. The Linux and Windows versions are slightly different, to reflect differences between these operating systems. When in doubt, check the output of `VBoxManage` for the commands available on a particular host system. The following diagram shows a superset of all commands understood by VBoxManage:

```
VirtualBox Command Line Management Interface Version 1.3.99
(C) 2005-2007 innotek GmbH
All rights reserved.

Usage:

VBoxManage list             vms|ostypes|hostdvds|hostfloppies|hostifs|
                            hdds|dvds|floppies|usbhost|usbfilters|
                            systemproperties

VBoxManage showvminfo       <uuid>|<name>
                            [-details]

VBoxManage registervm       <filename>

VBoxManage unregistervm     <uuid>|<name>
                            [-delete]

VBoxManage createvm         -name <name>
                            [-register]
                            [-basefolder <path> | -settingsfile <path>]


VBoxManage modifyvm         <uuid|name>
                            [-name <name>]
                            [-ostype <ostype>]
                            [-memory <memorysize>]
                            [-vram <vramsize>]
                            [-acpi on|off]
                            [-ioapic on|off]
                            [-hwvirtex on|off|default]
                            [-bioslogofadein on|off]
                            [-bioslogofadeout on|off]
                            [-bioslogodisplaytime <msec>]
                            [-bioslogoimagepath <imagepath>]
                            [-biosbootmenu disabled|menuonly|messageandmenu]
                            [-biossystemtimeoffset <msec>]
                            [-boot<1-4> none|floppy|dvd|disk|net>]
```

```
                          [-hd<a|b|d> none|<uuid>|<filename>]
                          [-dvd none|<uuid>|<filename>|host:<drive>]
                          [-dvdpassthrough on|off]
                          [-floppy disabled|empty|<uuid>|
                                   <filename>|host:<drive>]
                          [-nic<1-N> none|null|nat|hostif|intnet]
                          [-nictype<1-N> Am79C970A|Am79C973]
                          [-cableconnected<1-N> on|off]
                          [-nictrace<1-N> on|off]
                          [-nictracefile<1-N> <filename>]
                          [-hostifdev<1-N> none|<devicename>]
                          [-intnet<1-N> network]
                          [-macaddress<1-N> auto|<mac>
                          [-tapsetup<1-N> none|<application>]
                          [-tapterminate<1-N> none|<application>]
                          [-audio none|null|winmm|dsound|oss|alsa]
                          [-clipboard disabled|hosttoguest|guesttohost|
                                      bidirectional]
                          [-vrdp on|off]
                          [-vrdpport default|<port>]
                          [-vrdpaddress <host>]
                          [-vrdpauthtype null|external|guest]
                          [-vrdpmulticon on|off]
                          [-usb on|off]
                          [-snapshotfolder default|<path>]

VBoxManage startvm        <uuid>|<name>
                          [-type gui|vrdp]

VBoxManage controlvm      <uuid>|<name>
                          pause|resume|reset|poweroff|savestate|
                          acpipowerbutton |
                          setlinkstate<1-4> on|off |
                          usbattach <uuid>|<address> |
                          usbdetach <uuid>|<address> |
                          dvdattach none|<uuid>|<filename>|host:<drive> |
                          floppyattach none|<uuid>|<filename>|host:<drive> |
                          setvideomodehint <xres> <yres> <bpp> |
                          setcredentials <username> <password> <domain>
                                         [-allowlocallogon <yes|no>]

VBoxManage discardstate   <uuid>|<name>

VBoxManage snapshot       <uuid>|<name>
                          take <name> [-desc <desc>] |
                          discard <uuid>|<name> |
                          discardcurrent -state|-all |
                          edit <uuid>|<name>|-current
                               [-newname <name>]
                               [-newdesc <desc>] |
                          showvminfo <uuid>|<name>

VBoxManage registerimage  disk|dvd|floppy <filename>
                          [-type normal|immutable|writethrough] (disk only)

VBoxManage unregisterimage  disk|dvd|floppy <uuid>|<filename>
```

```
VBoxManage showvdiinfo      <uuid>|<filename>

VBoxManage createvdi        -filename <filename>
                            -size <megabytes>
                            [-static]
                            [-comment <comment>]
                            [-register]
                            [-type normal|writethrough] (default: normal)

VBoxManage modifyvdi        <uuid>|<filename>
                            compact

VBoxManage clonevdi         <uuid>|<filename> <outputfile>

VBoxManage convertdd        <filename> <outputfile>
VBoxManage convertdd        stdin <outputfile> <bytes>

VBoxManage addiscsidisk     -server <name>|<ip>
                            -target <target>
                            [-port <port>]
                            [-lun <lun>]
                            [-encodedlun <lun>]
                            [-username <username>]
                            [-password <password>]
                            [-comment <comment>]

VBoxManage createhostif     <name>

VBoxManage removehostif     <uuid>|<name>

VBoxManage getextradata     global|<uuid>|<name>
                            <key>|enumerate

VBoxManage setextradata     global|<uuid>|<name>
                            <key>
                            [<value>] (no value deletes key)

VBoxManage setproperty      vdifolder default|<folder> |
                            machinefolder default|<folder> |
                            vrdpauthlibrary default|<library> |
                            hwvirtexenabled yes|no

VBoxManage usbfilter        add <index,0-N>
                            -target <uuid>|<name>|global
                            -name <string>
                            -action ignore|hold (global filters only)
                            [-active yes|no] (yes)
                            [-vendorid <XXXX>] (null)
                            [-productid <XXXX>] (null)
                            [-revision <IIFF>] (null)
                            [-manufacturer <string>] (null)
                            [-product <string>] (null)
                            [-remote yes|no] (null, VM filters only)
                            [-serialnumber <string>] (null)
```

```
VBoxManage usbfilter        modify <index,0-N>
                            -target <uuid>|<name>|global
                            [-name <string>]
                            [-action ignore|hold] (global filters only)
                            [-active yes|no]
                            [-vendorid <XXXX>|""]
                            [-productid <XXXX>|""]
                            [-revision <IIFF>|""]
                            [-manufacturer <string>|""]
                            [-product <string>|""]
                            [-remote yes|no] (null, VM filters only)
                            [-serialnumber <string>|""]

VBoxManage usbfilter        remove <index,0-N>
                            -target <uuid>|<name>|global

VBoxManage sharedfolder     add <vmname>|<uuid>
                            -name <name> -hostpath <hostpath>
                            [-transient]

VBoxManage sharedfolder     remove <vmname>|<uuid>
                            -name <name> [-transient]

VBoxManage updatesettings   [<dir>|<file>] [-apply]
                            [-nobackup] [-skipinvalid]
```

Each time VBoxManage is invoked, only one command can be executed. However, a command might support several subcommands which then can be invoked in one single call. The following sections provide detailed reference information on the different commands.

8.1 VBoxManage list

The `list` command gives relevant information about your system and information about VirtualBox's current settings.

The following subcommands are available with `VBoxManage list`:

- `vms`, `hdds`, `dvds` and `floppies` all give you information about virtual machines and virtual disk images currently registered in VirtualBox, including all their settings, the unique identifiers (UUIDs) associated with them by VirtualBox and all files associated with them.
- `ostypes` lists all guest operating systems presently known to VirtualBox, along with the identifiers used to refer to them with the `modifyvm` command.
- `hostdvds`, `hostfloppies` and `hostifs`, respectively, list DVD, floppy and host networking interfaces on the host, along with the name used to access them from within VirtualBox.

- `hostusb` supplies information about USB devices attached to the host, notably information useful for constructing USB filters and whether they are currently in use by the host.
- `usbfilters` lists all global USB filters registered with VirtualBox – that is, filters for devices which are accessible to all virtual machines – and displays the filter parameters.
- `systemproperties` displays some global VirtualBox settings, such as minimum and maximum guest RAM and virtual hard disk size, folder settings and the current authentication library in use.

8.2 VBoxManage showvminfo

The `showvminfo` command shows information about a particular virtual machine. This is the same information as `VBoxManage list vms` would show for all virtual machines.

You will get information similar to the following:

```
$ VBoxManage showvminfo "Windows XP"
VirtualBox Command Line Management Interface Version 1.4.0
(C) 2005-2007 innotek GmbH
All rights reserved.

Name:            Windows XP
Guest OvS:        Other/Unknown
UUID:            1bf3464d-57c6-4d49-92a9-a5cc3816b7e7
Config file:     /home/username/.VirtualBox/Machines/Windows XP/Windows XP.xml
Memory size:     128MB
VRAM size:       8MB
Boot menu mode:  message and menu
ACPI:            on
IOAPIC:          off
Hardw. virt.ext: off
State:           powered off
Floppy:          empty
DVD:             empty
NIC 1:           disabled
NIC 2:           disabled
NIC 3:           disabled
NIC 4:           disabled
Audio:           disabled (Driver: Unknown)
VRDP:            disabled
USB:             disabled

USB Device Filters:
<none>

Shared folders:
<none>
```

8.3 VBoxManage registervm / unregistervm

The `registervm` command allows you to import a virtual machine definition in an XML file into VirtualBox. There are some restrictions here: the machine must not conflict with one already registered in VirtualBox and it may not have any hard or removable disks attached. It is advisable to place the definition file in the machines folder before registering it.

> **Note:** When creating a new virtual machine with `VBoxManage createvm` (see below), you can directly specify the `-register` option to avoid having to register it separately.

The `unregistervm` command unregisters a virtual machine. If `-delete` is also specified then the XML definition file will be deleted.

8.4 VBoxManage createvm

This command creates a new XML virtual machine definition file.

The `-name <name>` parameter is required and must specify the name of the machine. Since this name is used by default as the file name of the settings file (with the extension `.xml`) and the machine folder (a subfolder of the `.VirtualBox/Machines` folder), it must conform to your host operating system's requirements for file name specifications. If the VM is later renamed, the file and folder names will change automatically.

However, if the `-basefolder <path>` and the `-settingsfile <filename>` options are used, the XML definition file will be given the name `<filename>` and the machine folder will be named `<path>`. In this case, the names of the file and the folder will not change if the virtual machine is renamed.

By default, this command only creates the XML file without automatically registering the VM with your VirtualBox installation. To register the VM instantly, use the optional `-register` option, or run `VBoxManage registervm` separately afterwards.

8.5 VBoxManage modifyvm

This command changes the properties of a registered virtual machine. Most of the properties that this command makes available correspond to the VM settings that VirtualBox graphical user interface displays in each VM's "Settings" dialog; these were described in chapter 3.7, *Virtual machine settings*, page 36.

Some of the more advanced settings, however, are only available through the `VBoxManage` interface.

The following settings are available through `VBoxManage modifyvm`:

- `-name <name>`: This changes the VM's name and possibly renames the internal virtual machine files, as described with `VBoxManage createvm` above.

- `-ostype <ostype>`: This specifies what guest operating system is supposed to run in the VM. As mentioned at chapter 3.2, *Creating a virtual machine*, page 23, this setting is presently purely descriptive. To learn about the various identifiers that can be used here, use `VBoxManage list ostypes`.

- `-memory <memorysize>`: This sets the amount of RAM, in MB, that the virtual machine should allocate for itself from the host. Again, see the remarks in chapter 3.2, *Creating a virtual machine*, page 23 for more information.

- `-vram <vramsize>`: This sets the amount of RAM that the virtual graphics card should have. See chapter 3.7.1, *General settings*, page 37 for details.

- `-acpi on|off`; `-ioapic on|off`: These two determine whether the VM should have ACPI and I/O APIC support, respectively; again, see chapter 3.7.1, *General settings*, page 37 for details.

- `-hwvirtex on|off|default`: This enables or disables the use of virtualization extensions in the processor of your host system. This feature may still be experimental at the time you read this, and may not be enabled in your build of VirtualBox.

- You can influence the BIOS logo that is displayed when a virtual machine starts up with a number of settings. Per default, an "innotek" logo is displayed.

  With `-bioslogofadein on|off` and `-bioslogofadeout on|off`, you can determine whether the logo should fade in and out, respectively.

  With `-bioslogodisplaytime <msec>` you can set how long the logo should be visible, in milliseconds.

  With `-bioslogoimagepath <imagepath>` you can, if you are so inclined, replace the image that is shown, with your own logo. The image must be an uncompressed 256 color BMP file.

- `-biosbootmenu disabled|menuonly|messageandmenu`: This specifies whether the BIOS allows the user to select a temporary boot device. `menuonly` suppresses the message, but the user can still press F12 to select a temporary boot device.

- `-boot<1-4> none|floppy|dvd|disk|net`: This specifies the boot order for the virtual machine. There are four "slots", which the VM will try to access from 1 to 4, and for each of which you can set a device that the VM should attempt to boot from.

- `-hd<a|b|d> none|<uuid>|<filename>`: This specifies the settings for each of the three virtual hard disks that can be attached to a VM (primary master and slave, and secondary slave; the secondary master is always reserved for

the virtual CD/DVD drive). For each of these three, specify either the UUID or a filename of a virtual disk that you have

  - either registered with `VBoxManage registerimage`; see chapter 8.10, *VBoxManage registerimage / unregisterimage*, page 87;
  - or created using `VBoxManage createvdi` with the `-register` option; see chapter 8.12, *VBoxManage createvdi*, page 87;
  - alternatively, specify the UUID of an iSCSI target that you have registered with `VBoxManage addiscsidisk`; see chapter 8.15, *VBoxManage addiscsidisk*, page 88.

- `-dvd none|<uuid>|<filename>|host:<drive>`: This specifies what VirtualBox should provide to the VM as the virtual CD/DVD drive; specify either the UUID or the filename of an image file that you have registered with `VBoxManage registerimage` (see chapter 8.10, *VBoxManage registerimage / unregisterimage*, page 87). Alternatively, specify "host:" with the drive specification of your host's drive.

- `-dvdpassthrough on|off`: With this, you can enable DVD writing support (currently experimental; see chapter 3.7.3, *CD/DVD-ROM and floppy settings*, page 39).

- `-floppy disabled|empty|<uuid>|<filename>|host:<drive>`: This is the floppy equivalent to the `-dvd` option described above. `disabled` completely disables the floppy controller, whereas `empty` keeps the floppy controller enabled, but without a media inserted.

- `-nic<1-N> none|null|nat|hostif|intnet`: With this, you can set, for each of the VM's virtual network cards, what type of networking should be available. They can be not present (none), not connected to the host (null), use network address translation (nat), a host interface (hostif) or communicate with other virtual machines using internal networking (intnet). These options correspond to the modes which are described in detail in chapter 6, *Virtual networking*, page 54.

- `-nictype<1-N> Am79C970A|Am79C973`: This allows you, for each of the VM's virtual network cards, to specify whether the host will see the network adaptors as 10 Mbps AMD PCnet 79C970A cards or as 100Mbps 79C973 cards. This is in fact purely cosmetic, as both virtual cards run at full speed.

- `-cableconnected<1-N> on|off`: This allows you to temporarily disconnect a virtual network interface, as if a network cable had been pulled from a real network card. This might be useful for resetting certain software components in the VM.

- With the "nictrace" options, you can optionally trace network traffic, for debugging purposes. With -nictrace<1-N> on|off, you can enable network tracing for a particular virtual network card.

If enabled, you must specify with `-nictracefile<1-N> <filename>` what file the trace should be logged to.

- `-hostifdev<1-N> none|<devicename>`: If host interface networking has been enabled for a virtual network card (see the `-nic` option above; otherwise this setting has no effect), use this option to specify which host interface the given virtual network interface will use.

  For Windows hosts, this should be the name of a VirtualBox host interface which you have created using the `createhostif` command. For Linux hosts, this should be the name of an existing static interface or `none` if you wish to allocate an interface dynamically. In the latter case, you should also specify the creation and termination scripts for the interface with `-tapsetup<1-4>` and `-tapterminate<1-4>`. For details, please see chapter 6.3, *Introduction to host interface networking*, page 56.

- `-intnet<1-N> network`: If internal networking has been enabled for a virtual network card (see the `-nic` option above; otherwise this setting has no effect), use this option to specify the name of the internal network (see chapter 6.6, *Internal networking*, page 66).

- `-macaddress<1-N> auto|<mac>`: With this option you can set the MAC address of the virtual network card. Per default, each virtual network card is assigned a random address by VirtualBox at VM creation.

- `-audio none|null|oss`: With this option, you can set whether the VM should have audio support.

- `-clipboard -clipboard disabled|hosttoguest|guesttohost|bidirectional`: With this setting, you can select whether the guest operating system's clipboard should be shared with the host; see chapter 3.7.1, *General settings*, page 37. This requires that the Guest Additions be installed in the virtual machine.

- `-vrdp on|off`: With the VirtualBox graphical user interface, this enables or disables the built-in VRDP server. Note that if you are using `VBoxVRDP`, our headless server described in chapter 7.4.1, *VBoxVRDP, the headless VRDP server*, page 72, VRDP output is always enabled.

- `-vrdpport default|<port>`: This lets you specify which port should be used; "default" or "0" means port 3389, the standard port for RDP. Only one machine can use a given port at a time.

- `-vrdpauthtype null|external|guest`: This allows you to choose whether and how authorization will be performed; see chapter 7.4.4, *RDP authentication*, page 74 for details.

- `-usb on|off`: This option enables or disables the VM's virtual USB controller; see chapter 3.7.6.1, *USB settings*, page 41 for details.

- `-snapshotfolder default|<path>`: This allows you to specify the folder in which snapshots will be kept for a virtual machine.

8.6 VBoxManage startvm

This command starts a virtual machine that is currently in the "Powered off" or "Saved" states. This is provided for backwards compatibility only.

The optional `-type` specifier determines whether the machine will be started in a window (GUI mode, which is the default) or whether the output should go through `VBoxVRDP`, the headless VRDP server; see chapter 7.4.1, *VBoxVRDP, the headless VRDP server*, page 72 for more information.

> **Note:** We recommend to start virtual machines directly by running the respective front-end, as you might otherwise miss important error and state information that VirtualBox may display on the console. This is especially important for front-ends other than `VirtualBox`, our graphical user interface, because those cannot display error messages in a popup window. See chapter 7.4.1, *VBoxVRDP, the headless VRDP server*, page 72 for more information.

8.7 VBoxManage controlvm

The `controlvm` subcommand allows you to change the state of a virtual machine that is currently running. The following can be specified:

- `VBoxManage controlvm <vm> pause` temporarily puts a virtual machine on hold, without changing its state for good. The VM window will be painted in gray to indicate that the VM is currently paused. (This is equivalent to selecting the "Pause" item in the "VM" menu of the GUI.)

- Use `VBoxManage controlvm <vm> resume` to undo a previous `pause` command. (This is equivalent to selecting the "Resume" item in the "VM" menu of the GUI.)

- `VBoxManage controlvm <vm> reset` has the same effect on a virtual machine as pressing the "Reset" button on a real computer: a cold reboot of the virtual machine, which will restart and boot the guest operating system again immediately. The state of the VM is not saved beforehand, and data may be lost. (This is equivalent to selecting the "Reset" item in the "VM" menu of the GUI.)

- `VBoxManage controlvm <vm> poweroff` has the same effect on a virtual machine as pulling the power cable on a real computer. Again, the state of the VM is not saved beforehand, and data may be lost. (This is equivalent to

selecting the “Close” item in the “VM” menu of the GUI or pressing the window’s close button, and then selecting “Power off the machine” in the dialog.)

After this, the VM’s state will be “Powered off”. From there, it can be started again; see chapter 8.6, *VBoxManage startvm*, page 85.

- `VBoxManage controlvm <vm> savestate` will save the current state of the VM to disk and then stop the VM. (This is equivalent to selecting the “Close” item in the “VM” menu of the GUI or pressing the window’s close button, and then selecting “Save the machine state” in the dialog.)

  After this, the VM’s state will be “Saved”. From there, it can be started again; see chapter 8.6, *VBoxManage startvm*, page 85.

A few extra options are available with `controlvm` that do not directly affect the VM’s running state:

- The `setlinkstate<1-4>` operation connects or disconnects virtual network cables from their network interfaces
- `usbattach` and `usbdettach` make host USB devices visible to the virtual machine on the fly, without the need for creating filters first. The USB devices can be specified by UUID (unique identifier) or by address on the host system.

  You can use `VBoxManage list usbhost` to locate this information.
- `dvdattach` inserts a DVD image into the virtual machine or connects it to the host DVD drive. With this command (as opposed to `VBoxManage modifyvm`), the image file does not first have to be registered with VirtualBox.

  You can use `VBoxManage list hostdvds` to display all the drives found on the host and the names VirtualBox uses to access them.
- `floppyattach` works in a similar way.
- `setvideomodehint` requests that the guest system change to a particular video mode. This requires that the guest additions be installed, and will not work for all guest systems.
- The `setcredentials` operation is used for remote logons in Windows guests. For details, please refer to chapter 9.2, *Automated Windows guest logons (VBoxGINA)*, page 92.

8.8 VBoxManage discardstate

This command discards the saved state of a virtual machine which is not currently running, which will cause its operating system to restart next time you start it. This is the equivalent of pulling out the power cable on a physical machine, and should be avoided if possible.

8.9 VBoxManage snapshot

This command is used for taking snapshots of a virtual machine and for manipulating and discarding snapshots.

The `take` operation takes a snapshot of a virtual machine. You must supply a name for the snapshot and can optionally supply a description.

The `discard` operation discards a snapshot specified by name or by identifier (UUID).

The `discardcurrent` operation will either revert the current state to the most recent snapshot (if you specify the `-state` option) or discard the last snapshot and revert to the last but one (with the `-all` option).

8.10 VBoxManage registerimage / unregisterimage

These commands register or unregister hard disk, DVD or floppy images in VirtualBox. This is the command-line equivalent of the Virtual Disk Manager; see chapter 3.5, *The Virtual Disk Manager*, page 34 for more information.

Note however that when you unregister a hard disk image using VBoxManage, it will not be deleted from the host computer's hard drive.

8.11 VBoxManage showvdiinfo

This command shows information about a virtual hard disk image, notably its size, its size on disk, its type and the VM it is in use by.

8.12 VBoxManage createvdi

This command creates a new virtual hard disk image. You must specify the filename for the new image and the virtual size. If you give the `-static` option, disk space for the whole image will be allocated at once on the host. With the `-comment` option you can attach a comment to the image. The `-register` option, if given, tells VirtualBox to register the image for use with virtual machines.

You can use the `-type` option to create a disk in write-through mode, which will not be affected by snapshots; see chapter 5.1, *Virtual Disk Image (VDI) files*, page 51 for details. (As described there, you cannot *create* a VDI with the "immutable" type, as it would then always remain empty.)

8.13 VBoxManage modifyvdi

The `modifyvdi` command can be used to compact disk images, i.e. remove blocks that only contains zeroes. For this operation to be effective, it is required to zero out free space in the guest system using a suitable software tool.

8.14 VBoxManage clonevdi

This command duplicates a registered virtual hard disk image to a new image file with a new unique identifier (UUID). The new image can be transferred to another host system or imported into VirtualBox again using the Virtual Disk Manager; see chapter 3.5, *The Virtual Disk Manager*, page 34.

8.15 VBoxManage addiscsidisk

The `addiscsidisk` command attaches an iSCSI network storage unit to VirtualBox. The iSCSI target can then be made available to and used by a virtual machine as though it were a standard write-through virtual disk image.

This command has the following syntax:

```
VBoxManage addiscsidisk -server <name>|<ip>
                        -target <target>
                        [-port <port>]
                        [-lun <lun>]
                        [-username <username>]
                        [-password <password>]
                        [-comment <comment>]
```

where the parameters mean:

server The host name or IP address of the iSCSI target.

target Target name string. This is determined by the iSCSI target and used to identify the storage resource.

port TCP/IP port number of the iSCSI service on the target (optional).

lun Logical Unit Number of the target resource (optional). Often, this value is zero.

username, password Username and password for target authentication, if required (optional).

> **Note:** Currently, username and password are stored without encryption (i.e. in cleartext) in the machine configuration file.

comment Any description that you want to have stored with this item (optional; e.g. “Big storage server downstairs”). This is stored internally only and not needed for operation.

8.16 VBoxManage createhostif/removehostif

These two commands add and remove, respectively, virtual network interfaces on Windows hosts. See chapter 6.4, *Host interface networking on Windows hosts*, page 57 for details.

8.17 VBoxManage getextradata/setextradata

These commands let you attach and retrieve string data to a virtual machine or to a VirtualBox configuration (by specifying `global` instead of a virtual machine name). You must specify a key (as a text string) to associate the data with, which you can later use to retrieve it. For example:

```
VBoxManage setextradata Fedora5 installdate 2006.01.01
VBoxManage setextradata SUSE10 installdate 2006.02.02
```

would associate the string "2006.01.01" with the key installdate for the virtual machine Fedora5, and "2006.02.02" on the machine SUSE10. You could retrieve the information as follows:

```
VBoxManage getextradata Fedora5 installdate
```

which would return

```
VirtualBox Command Line Management Interface Version 1.4.0
(C) 2005-2007 innotek GmbH
All rights reserved.

Value: 2006.01.01
```

8.18 VBoxManage setproperty

This command is used to change global settings which affect the entire VirtualBox installation. Some of these correspond to the settings in the "Global settings" dialog in the graphical user interface. The following properties are available:

vdifolder This specifies the default folder that is used to keep Virtual Disk Image (VDI) files.

machinefolder This specifies the default folder in which virtual machine definitions are kept; see chapter 9.1, *VirtualBox configuration data*, page 91 for details.

vrdpauthlibrary This specifies which library to use when "external" VRDP authentication has been selected for a particular virtual machine; see chapter 7.4.4, *RDP authentication*, page 74 for details.

hwvirtexenabled This selects whether or not hardware virtualization support is enabled by default. Note: This feature may still be experimental at the time you read this.

8.19 VBoxManage usbfilter add/modify/remove

The `usbfilter` commands are used for working with USB filters in virtual machines, or global filters which affect the whole VirtualBox setup. Global filters are applied before machine-specific filters, and may be used to prevent devices from being captured by any virtual machine. Global filters are always applied in a particular order, and only the first filter which fits a device is applied. So for example, if the first global filter says to hold (make available) a particular Kingston memory stick device and the second to ignore all Kingston devices, that memory stick will be available to any machine with an appropriate filter, but no other Kingston device will.

When creating a USB filter using `usbfilter add`, you must supply three or four mandatory parameters. The index specifies the position in the list at which the filter should be placed. If there is already a filter at that position, then it and the following ones will be shifted back one place. Otherwise the new filter will be added onto the end of the list. The `target` parameter selects the virtual machine that the filter should be attached to or use "global" to apply it to all virtual machines. `name` is a name for the new filter and for global filters, `action` says whether to allow machines access to devices that fit the filter description ("hold") or not to give them access ("ignore"). In addition, you should specify parameters to filter by. You can find the parameters for devices attached to your system using `VBoxManage list usbhost`. Finally, you can specify whether the filter should be active, and for local filters, whether they are for local devices, remote (over an RDP connection) or either.

When you modify a USB filter using `usbfilter modify`, you must specify the filter by index (see the output of `VBoxManage list usbfilters` to find global filter indexes and that of `VBoxManage showvminfo` to find indexes for individual machines) and by target, which is either a virtual machine or "global". The properties which can be changed are the same as for `usbfilter add`. To remove a filter, use `usbfilter remove` and specify the index and the target.

8.20 VBoxManage sharedfolder add/remove

This command allows you to share folders on the host computer with guest operating systems. For this, the guest systems must have a version of the VirtualBox guest additions installed which supports this functionality.

Shared folders are described in detail in chapter 4.4, *Folder sharing*, page 49.

8.21 VBoxManage updatesettings

The `updatesettings` command updates all VirtualBox configuration files from an earlier to the current version. You will need this when you upgrade your version of VirtualBox, but should not need it apart from that.

9 Advanced Topics

9.1 VirtualBox configuration data

For each system user, VirtualBox stores configuration data in the user's home directory, as per the conventions of the host operating system:

- On Linux, this is `$HOME/.VirtualBox`.
- On Windows, this is `%HOMEDRIVE%%HOMEPATH%\.VirtualBox`; typically something like `C:\Documents and Settings\Username\.VirtualBox`.

VirtualBox creates this configuration directory automatically, if necessary. Optionally, you can supply an alternate configuration directory by setting the `VBOX_USER_HOME` environment variable.

VirtualBox stores all its global and machine-specific configuration data in XML documents. We intentionally do not document the specifications of these files, as we must reserve the right to modify them in the future. We therefore request that these files not be edited manually. VirtualBox provides complete access to its configuration data through its Application Programming Interface (API) and the `VBoxManage` command line tool; see chapter 8, *VBoxManage reference*, page 76.

In the configuration directory, `VirtualBox.xml` is the main configuration file. This includes global configuration options and the media and virtual machine registry. The media registry links to all CD/DVD, floppy and disk images that have been added to the Virtual Disk Manager. For each registered VM, there is one entry which points to the VM configuration file, also in XML format.

You can globally change some of the locations where VirtualBox keeps extra configuration and data by selecting "Global settings" from the "File" menu in the VirtualBox main window. Then, in the window that pops up, click on the "General" tab.

- Virtual machine settings and files are, by default, saved as XML files in a subdirectory of the `.VirtualBox/Machines` directory. You can change the location of this main "Machines" folder in the "Global settings" dialog.

  By default, for each virtual machine, VirtualBox uses another subdirectory of the "Machines" directory that carries the same name as the virtual machine. As a result, your virtual machine names must conform to the conventions of your operating system for valid file names. For example, a machine called "Fedora 6" would, by default, have its settings saved in `.VirtualBox/Machines/Fedora 6/Fedora 6.xml`. If you would like more control over the file names used, you can create the machine using

`VBoxManage createvm` with the `-settingsfile` option; see chapter 8.4, *VBoxManage createvm*, page 81.

The virtual machine directory will be renamed if you change the machine name. If you do not wish this to happen, you can create the machine using `VBoxManage createvm` with the `-basefolder` option. In this case, the folder name will never change.

- VirtualBox keeps snapshots and saved states in another special folder for each virtual machine. By default, this is a subfolder of the virtual machine folder called `Snapshots` – in our example, `.VirtualBox/Machines/Fedora 6/Snapshots`. You can change this setting for each machine using `VBoxManage` as well.
- VDI container files are, by default, created in the `.VirtualBox/VDI` directory. In particular, this directory is used when the "Create new virtual disk" wizard is started to create a new VDI file. Changing this default is probably most useful if the disk containing your home directory does not have enough room to hold your VDI files, which can grow very large.

9.2 Automated Windows guest logons (VBoxGINA)

When Windows is running in a virtual machine, it might be desirable to perform coordinated and automated logons of guest operating systems using credentials from a master logon system. (With "credentials", we are referring to logon information consisting of user name, password and domain name, where each value might be empty.) Since Windows NT, Windows has provided a modular system logon subsystem ("Winlogon") which can be customized and extended by means of so-called GINA modules (Graphical Identification and Authentication). The VirtualBox Guest Additions for Windows come with such a GINA module and therefore allow Windows guesets to perform automated logons.

To activate the GINA module, first install the Guest Additions. You will then find the GINA module – a file called `VBoxGINA.dll` – in the Additions target directory. Copy this file to the Windows `SYSTEM32` directory. Then, in the registry, create the following key:

```
HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion\
                      Winlogon\GinaDLL
```

with a value of `VBoxGINA.dll`.

Note: The VirtualBox GINA is implemented as a wrapper around the standard Windows GINA (`MSGINA.DLL`) so it will most likely not work correctly with 3rd party GINA modules.

To set credentials, use the following command on a *running* VM:

```
VBoxManage controlvm "Windows XP" \
      setcredentials "John Doe" "secretpassword" "DOMTEST"
```

While the VM is running, the credentials can be queried by the VirtualBox GINA module using the VirtualBox Guest Additions device driver. When Windows is in "logged out" mode, the GINA module will constantly poll for credentials and if they are present, a logon will be attempted. After retrieving the credentials, the GINA module will erase them so that the above command will have to be repeated for subsequent logons.

For security reasons, credentials are not stored in any persistent manner and will be lost when the VM is reset. Also, the credentials are "write-only", i.e. there is no way to retrieve the credentials from the host side. Credentials can be reset from the host side by setting empty values.

For Windows XP guests, the logon subsystem has to be configured to use the classical logon dialog as the VirtualBox GINA does not support the XP style welcome dialog.

9.3 Custom external VRDP authentication

As described in chapter 7.4.4, *RDP authentication*, page 74, VirtualBox supports arbitrary external modules to perform authentication with its VRDP servers. When the authentication method is set to "external" for a particular VM, VirtualBox calls the library that was specified with `VBoxManage setproperty vrdpauthlibrary`. This library will be loaded by the VM process on demand, i.e. when the first RDP connection is made by an external client.

External authentication is the most flexible as the external handler can both choose to grant access to everyone (like the "null" authentication method would) and delegate the request to the guest authentication component. When delegating the request to the guest component, it will still be called afterwards with the option to override the result.

A VRDP authentication library is required to implement exactly one entry point:

```
#include "VRDPAuth.h"

/**
 * Authentication library entry point. Decides whether to allow
 * a client connection.
 *
 * Parameters:
 *
 *   pUuid            Pointer to the UUID of the virtual machine
 *                    which the client connected to.
 *   guestJudgement   Result of the guest authentication.
 *   szUser           User name passed in by the client (UTF8).
 *   szPassword       Password passed in by the client (UTF8).
 *   szDomain         Domain passed in by the client (UTF8).
 *
 * Return code:
 *
```

```
 *   VRDPAuthAccessDenied    Client access has been denied.
 *   VRDPAuthAccessGranted   Client has the right to use the
 *                           virtual machine.
 *   VRDPAuthDelegateToGuest Guest operating system must
 *                           authenticate the client and the
 *                           library must be called again with
 *                           the result of the guest
 *                           authentication.
 */
VRDPAuthResult VRDPAUTHCALL VRDPAuth(
    PVRDPAUTHUUID pUuid,
    VRDPAuthGuestJudgement guestJudgement,
    const char *szUser,
    const char *szPassword
    const char *szDomain)
{
    /* process request against your authentication source of choice */
    return VRDPAuthAccessGranted;
}
```

The second arguments contains information about the guest authentication status. For the first call, it is always set to `VRDPAuthGuestNotAsked`. In case the function returns `VRDPAuthDelegateToGuest`, a guest authentication will be attempted and another call to the method is made with its result. This can be either granted / denied or no judgement (the guest component chose for whatever reason to not make a decision). In case there is a problem with the guest authentication module (e.g. the Additions are not installed or not running or the guest did not respond within a timeout), the “not reacted” status will be returned.

9.4 Secure labeling with VBoxSDL

When running guest operating systems in fullscreen mode, the guest operating system usually has control over the whole screen. This could present a security risk as the guest operating system might fool the user into thinking that it is either a different system (which might have a higher security level) or it might present messages on the screen that appear to stem from the host operating system.

In order to protect the user against the abovementioned security risks, the secure labeling feature has been developed. Secure labeling is currently available only for VBoxSDL. When enabled, a portion of the display area is reserved for a label in which a user defined message is displayed. The label height in set to 20 pixels in VBoxSDL. The label font color and background color can be optionally set as hexadecimal RBG color values. The following syntax is used to enable secure labeling:

```
VBoxSDL -securelabel -seclabelfnt ~/fonts/arial.ttf \
        -seclabelsiz 14 "Windows XP" \
        -seclabelfbcol 00FF00 -seclabelbgcol 00FFFF
```

In addition to enabling secure labeling, a TrueType font has to be supplied.

Typically, full screen resolutions are limited to certain “standard” geometries such as 1024 x 768. Adding the secure label with a height of 20 pixels would therefore require the resolution to be 1024 x 788 which is either not possible for results in suboptimal display quality. In most cases, VBoxSDL would chose the next higher resolution, e.g. 1280 x 1024 and the guest’s screen would not cover the whole display surface. If VBoxSDL is unable to choose a higher resolution, the secure label will be painted on top of the guest’s screen surface. In order to address this problem, a feature called “Y offset” has been implemented. This takes the height of the secure label and provides custom video modes to the guest that are reduced by the height of the label so that guest height + label height results in a valid native display resolution. For Windows guests, the VirtualBox Guest Additions automatically provide the reduced video modes. In addition to that, the VESA BIOS has been adjusted to duplicate its standard mode table with adjusted resolutions. The adjusted mode IDs can be calculated using the following formula:

```
reduced_modeid = modeid + 0x30
```

For example, in order to start Linux with 1024 x 748 x 16, the standard mode 0x117 (1024 x 768 x 16) is used as a base. The Linux video mode kernel parameter can then be calculated using:

```
vga = 0x200 | 0x117 + 0x30
vga = 839
```

The reason for duplicating the standard modes instead of only supplying the adjusted modes is that most guest operating systems require the standard VESA modes to be fixed and refuse to start with different modes.

When using the X.org VESA driver, custom modelines have to be calculated and added to the configuration (usually in /etc/X11/xorg.conf. A handy tool to determine modeline entries can be found at http://www.tkk.fi/Misc/Electronics/faq/vga2rgb/calc.html.

9.5 Custom VESA resolutions

Apart from the standard VESA resolutions, the VirtualBox VESA BIOS allows you to add up to 16 custom video modes which will be reported to the guest operating system. When using Windows guests with the VirtualBox Guest Additions, a custom graphics driver will be used instead of the fallback VESA solution so this information does not apply.

Additional video modes can be configured for each VM using the extra data facility. The extra data key is called CustomVideoMode<x> with x being a number from 1 to 16. Please note that modes will be read from 1 until either the following number is not defined or 16 is reached. The following example adds a video mode that corresponds to the native display resolution of many notebook computers:

```
VBoxManage setextradata "Windows XP" \
          "CustomVideoMode1" "1400x1050x16"
```

The VESA mode IDs for custom video modes start at 0x160. In order to use the above defined custom video mode, the following command line has be supplied to Linux:

```
vga = 0x200 | 0x160
vga = 864
```

For guest operating systems with VirtualBox Guest Additions, a custom video mode can be set using the video mode hint feature.

9.6 Releasing modifiers with VBoxSDL on Linux

When switching from a X virtual terminal (VT) to another VT using Ctrl-Alt-Fx while the VBoxSDL window has the input focus, the guest will receive Ctrl and Alt keypress events without receiving the corresponding key release events. This is an architectural limitation of Linux. In order to reset the modifier keys, it is possible to send `SIGUSR1` to the VBoxSDL main thread (first entry in the `ps` list). For example, when switching away to another VT and saving the virtual machine from this terminal, the following sequence can be used to make sure the VM is not saved with stuck modifiers:

```
kill -usr1 <pid>
./VBoxManage controlvm "Windows 2000" savestate
```

9.7 Using serial ports

Starting with version 1.4, VirtualBox can provide several serial ports to the guest. Up to 4 serial ports can be configured. The guest sees a standard 16450-type serial port. Both receiving and transmitting data is supported. On a Windows host, the data is sent and received through a named pipe; on a Linux host, a local domain socket is used instead. You can configure whether VirtualBox acts as a server or as a client of such a named pipe or local domain socket.

Currently, you can attach only a single host application to the named pipe or local domain socket associated with a particular serial port. The current configuration method is through the generic configuration facility of `VBoxManage`. In the future, this may be replaced with a more convenient mechanism.

To configure a serial port use the following 6 commands:

```
VBoxManage setextradata "YourVM"
   "VBoxInternal/Devices/serial/0/Config/IRQ" 4
VBoxManage setextradata "YourVM"
   "VBoxInternal/Devices/serial/0/Config/IOBase" 0x3f8
VBoxManage setextradata "YourVM"
   "VBoxInternal/Devices/serial/0/LUN#0/Driver" Char
VBoxManage setextradata "YourVM"
   "VBoxInternal/Devices/serial/0/LUN#0/AttachedDriver/Driver" NamedPipe
VBoxManage setextradata "YourVM"
   "VBoxInternal/Devices/serial/0/LUN#0/AttachedDriver/Config/Location"
```

```
   "\\.\pipe\vboxCOM1"
VBoxManage setextradata "YourVM"
   "VBoxInternal/Devices/serial/0/LUN#0/AttachedDriver/Config/IsServer"
   1
```

This example sets up a serial port in the guest with the default settings for COM1 (IRQ 4, I/O address 0x3f8) and the `Location` setting assumes that this configuration is used on a Windows host, because the Windows named pipe syntax is used. Keep in mind that on Windows hosts a named pipe must always start with `\\.\pipe\`". On Linux the same config settings apply, except that the path name for the `Location` can be chosen more freely. Local domain sockets can be placed anywhere, provided the user running VirtualBox has the permission to create a new file in the directory. The final command above defines that VirtualBox acts as a server, i.e. it creates the named pipe itself instead of connecting to an already existing one.

On Linux there are various tools which can connect to a local domain socket or create one in server mode. The most flexible tool is `socat` and is available as part of many distributions. For Windows there is a helper program called VMWare Serial Line Gateway, available for download at http://www.l4ka.org/tools/vmwaregateway.php. This tool provides a fixed server mode named pipe at `\\.\pipe\vmwaredebug` and connects incoming TCP connections on port 567 with the named pipe.

9.8 Using a raw host hard disk from a guest

Starting with version 1.4, as an alternative to using virtual disk images (as described in detail in chapter 5, *Virtual storage*, page 51), VirtualBox can also present either entire physical hard disks or selected partitions thereof as virtual disks to virtual machines.

With VirtualBox, this type of access is called "raw hard disk access"; it allows a guest operating system to access its virtual hard disk much more quickly than with disk images, since data does not have to pass through two file systems (the one in the guest and the one on the host).

> **Warning:** Raw hard disk access is for expert users only. Incorrect use or use of an outdated configuration can lead to **total loss of data** on the physical disk. Most importantly, *do not* attempt to boot the partition with the currently running host operating system in a guest. This will lead to severe data corruption.

Raw hard disk access – both for entire disks and individual partitions – is implemented as part of the VMDK image format support (see chapter 5.2, *VMDK image files*, page 53). As a result, you will need to create a special VMDK image file which defines where the data will be stored. After creating such a special VMDK image, you can use it like a regular virtual disk image. For example, you can use the Virtual Disk Manager (chapter 3.5, *The Virtual Disk Manager*, page 34) or `VBoxManage` to assign the image to a virtual machine.

9.8.1 Access to entire physical hard disk

While this variant is the simplest to set up, you must be aware that this will give a guest operating system direct and full access to an *entire physical disk*. If your *host* operating system is also booted from this disk, please take special care to not access the partition from the guest at all. On the positive side, the physical disk can be repartitioned in arbitrary ways without having to recreate the image file that gives access to the raw disk.

To create an image that represents an entire physical hard disk (which will not contain any actual data, as this will all be stored on the physical disk), on a Linux host, use the command

```
VBoxManage internalcommands createrawvmdk -filename /path/to/file.vmdk
        -rawdisk /dev/sda
```

This creates the image `/path/to/file.vmdk` (must be absolute), and all data will be read and written from `/dev/sda`.

On a Windows host, instead of the above device specification, use e.g. `\\.\PhysicalDrive0`.

Creating the image requires read/write access for the given device. Read/write access is also later needed when using the image from a virtual machine.

Just like with regular disk images, this does not automatically register the newly created image in the internal registry of hard disks. If you want this done automatically, add `-register`:

```
VBoxManage internalcommands createrawvmdk -filename /path/to/file.vmdk
        -rawdisk /dev/sda -register
```

After registering, you can assign the newly created image to a virtual machine with

```
VBoxManage modifyvm WindowsXP -hda /path/to/file.vmdk
```

When this is done the selected virtual machine will boot from the specified physical disk.

9.8.2 Access to individual physical hard disk partitions

This “raw partition support” is quite similar to the “full hard disk” access described above. However, in this case, any partitioning information will be stored inside the VMDK image, so you can e.g. install a different boot loader in the virtual hard disk without affecting the host’s partitioning information. While the guest will be able to *see* all partitions that exist on the physical disk, access will be filtered in that reading from partitions for which no access is allowed the partitions will only yield zeroes, and all writes to them are ignored.

To create a special image for raw partition support (which will contain a small amount of data, as already mentioned), on a Linux host, use the command

```
VBoxManage internalcommands createrawvmdk -filename /path/to/file.vmdk
        -rawdisk /dev/sda -partitions 1,5
```

As you can see, the command is identical to the one for "full hard disk" access, except for the additional `-partitions` parameter. This example would create the image `/path/to/file.vmdk` (which, again, must be absolute), and partitions 1 and 5 of `/dev/sda` would be made accessible to the guest.

VirtualBox uses the same partition numbering as your Linux host. As a result, the numbers given in the above example would refer to the first primary partition and the first logical drive in the extended partition, respectively.

On a Windows host, instead of the above device specification, use e.g. `\\.\PhysicalDrive0`. Partition numbers are the same on Linux and Windows hosts.

The numbers for the list of partitions can be taken from the output of

```
VBoxManage internalcommands listpartitions -rawdisk /dev/sda
```

The output lists the partition types and sizes to give the user enough information to identify the partitions necessary for the guest.

Images which give access to individual partitions are specific to a particular host disk setup. You cannot transfer these images to another host; also, whenever the host partitioning changes, the image *must be recreated*.

Creating the image requires read/write access for the given device. Read/write access is also later needed when using the image from a virtual machine. If this is not feasible, there is a special variant for raw partition access (currently only available on Linux hosts) that avoids having to give the current user access to the entire disk. To set up such an image, use

```
VBoxManage internalcommands createrawvmdk -filename /path/to/file.vmdk
        -rawdisk /dev/sda -partitions 1,5 -relative
```

When used from a virtual machine, the image will then refer not to the entire disk, but only to the individual partitions (in the example `/dev/sda1` and `/dev/sda5`). As a consequence, read/write access is only required for the affected partitions, not for the entire disk. During creation however, read-only access to the entire disk is required to obtain the partitioning information.

In some configurations it may be necessary to change the MBR code of the created image, e.g. to replace the Linux boot loader that is used on the host by another boot loader. This allows e.g. the guest to boot directly to Windows, while the host boots Linux from the "same" disk. For this purpose the `-mbr` parameter is provided. It specifies a file name from which to take the MBR code. The partition table is not modified at all, so a MBR file from a system with totally different partitioning can be used. An example of this is

```
VBoxManage internalcommands createrawvmdk -filename /path/to/file.vmdk
        -rawdisk /dev/sda -partitions 1,5 -mbr winxp.mbr
```

The modified MBR will be stored inside the image, not on the host disk.

For each of the above variants, you can register the resulting image for immediate use in VirtualBox by adding `-register` to the respective command line. The image will then immediately appear in the list of registered disk images. An example is

```
VBoxManage internalcommands createrawvmdk -filename /path/to/file.vmdk
        -rawdisk /dev/sda -partitions 1,5 -relative -register
```

which creates an image referring to individual partitions, and registers it when the image is successfully created.

10 VirtualBox Application Programming Interfaces

These are not yet documented.

11 Troubleshooting

This chapter provides answers to commonly asked questions. In order to improve your user experience with VirtualBox, it is recommended to read this section to learn more about common pitfalls and get recommendations on how to use the product.

11.1 General

11.1.1 Collecting debugging information

For problem determination, it is often important to collect debugging information which can be analyzed by VirtualBox support. This section contains information about what kind of information can be obtained.

Every time VirtualBox starts up a VM, a log file is created containing some information about the VM configuration and runtime events. The log file is called `VBox.log` and resides in the VM log file folder. Typically this will be a directory like this:

```
$HOME/.VirtualBox/Machines/{machinename}/Logs
```

When starting a VM, the configuration file of the last run will be renamed to `.1`, up to `.3`. Sometimes when there is a problem, it is useful to have a look at the logs. Also when requesting support for VirtualBox, supplying the corresponding log file is mandatory.

For convenience, for each virtual machine, the VirtualBox main window can show these logs in a window. To access it, select a virtual machine from the list on the left and select “Show logs...“ from the “Machine” window.

11.1.2 Guest shows IDE errors for VDI on slow host file system

Occasionally, some host file systems provide very poor writing performance and as a consequence cause the guest to time out IDE commands. This is normal behavior and should normally cause no real problems, as the guest should repeat commands that have timed out. However some guests (e.g. some Linux versions) have severe problems if a write to a VDI file takes longer than about 15 seconds. Some file systems however require more than a minute to complete a single write, if the host cache contains a large amount of data that needs to be written.

The symptom for this problem is that the guest can no longer access its files during large write or copying operations, usually leading to an immediate hang of the guest.

In order to work around this problem (the true fix is to use a faster file system that doesn’t exhibit such unacceptable write performance), it is possible to flush the VDI

after a certain amount of data has been written. This interval is normally infinite, but can be configured individually for each disk of a VM using the following command:

```
VBoxManage setextradata <vmname>
           "VBoxInternal/Devices/piix3ide/0/LUN#[x]/Config/FlushInterval" [b]
```

The value [x] that selects the disk is 0 for the master device on the first channel, 1 for the slave device on the first channel, 2 for the master device on the second channel or 3 for the master device on the second channel. Only disks support this configuration option. It must not be set for CD-ROM drives.

The unit of the interval [b] is the number of bytes written since the last flush. The value for it must be selected so that the occasional long write delays do not occur. Since the proper flush interval depends on the performance of the host and the host filesystem, finding the optimal value that makes the problem disappear requires some experimentation. Values between 1000000 and 10000000 (1 to 10 megabytes) are a good starting point. Decreasing the interval both decreases the probability of the problem and the write performance of the guest. Setting the value unnecessarily low will cost performance without providing any benefits. An interval of 1 will cause a flush for each write operation and should solve the problem in any case, but has a severe write performance penalty.

Providing a value of 0 for [b] is treated as an infinite flush interval, effectively disabling this workaround. Removing the extra data key by specifying no value for [b] has the same effect.

11.1.3 Responding to guest IDE flush requests

If desired, the virtual disk images (VDI) can be flushed when the guest issues the IDE FLUSH CACHE command. Normally these requests are ignored for improved performance. To enable flushing, issue the following command:

```
VBoxManage setextradata <vmname>
           "VBoxInternal/Devices/piix3ide/0/LUN#[x]/Config/IgnoreFlush" 0
```

The value [x] that selects the disk is 0 for the master device on the first channel, 1 for the slave device on the first channel, 2 for the master device on the second channel or 3 for the master device on the second channel. Only disks support this configuration option. It must not be set for CD-ROM drives.

Note that this doesn't affect the flushes performed according to the configuration described in chapter 11.1.2, *Guest shows IDE errors for VDI on slow host file system*, page 102. Restoring the default of ignoring flush commands is possible by setting the value to 1 or by removing the key.

11.2 Windows guests

11.2.1 Windows boot failures (bluescreens) after changing VM configuration

Often, customers encounter Windows startup failures (the infamous “blue screen”) after performing configuration changes to a virtual machine which are not allowed for an already installed Windows operating system. Depending on the presence of several hardware features, the Windows installation program chooses special kernel and device driver versions and will fail to startup should these hardware features be removed.

Most importantly, never disable ACPI and the I/O APIC if they were enabled at installation time. Enabling them for a Windows VM which was installed without them does not cause any harm. However, Windows will not use these features in this case.

11.2.2 Windows 2000 installation failures

When installing Windows 2000 guests, you might run into one of the following issues:

- Installation reboots, usually during component registration.
- Installation fills the whole hard disk with empty log files.
- Installation complains about a failure installing msgina.dll.

These problems are all caused by a bug in the hard disk driver of Windows 2000. After issuing a hard disk request, there is a race condition in the Windows driver code which leads to corruption if the operation completes too fast, i.e. the hardware interrupt from the IDE controller arrives too soon. With physical hardware, there is a guaranteed delay in most systems so the problem is usually hidden there (however it should be possible to reproduce it on physical hardware as well). In a virtual environment, it is possible for the operation to be done immediately (especially on very fast systems with multiple CPUs) and the interrupt is signalled sooner than on a physical system. The solution is to introduce an artificial delay before delivering such interrupts. This delay can be configured for a VM using the following command:

```
VBoxManage setextradata <vmname>
           "VBoxInternal/Devices/piix3ide/0/Config/IRQDelay" 1
```

This sets the delay to one millisecond. In case this doesn’t help, increase it to a value between 1 and 5 milliseconds. Please note that this slows down disk performance. After installation, you should be able to remove the key (or set it to 0).

11.2.3 How to record bluescreen information from Windows guests

When Windows guests run into a kernel crash, they display the infamous bluescreen. Depending on how Windows is configured, the information will remain on the screen

until the machine is restarted or it will reboot automatically. During installation, Windows is usually configured to reboot automatically. With automatic reboots, there is no chance to record the bluescreen information which might be important for problem determination.

VirtualBox provides a method of halting a guest when it wants to perform a reset. In order to enable this feature, issue the following command:

```
VBoxManage setextradata <vmname>
           "VBoxInternal/PDM/HaltOnReset" 1
```

11.2.4 No networking in Windows Vista guests

Unfortunately, with Vista, Microsoft dropped support for the virtual AMD PCnet card that we are providing to virtual machines. As a result, after installation, Vista guests initially have no networking. VirtualBox therefore ships a driver for that card with the Windows Guest Additions; see chapter 4.2.4, *Windows Vista networking*, page 47.

11.3 Windows hosts

11.3.1 VBoxSVC out-of-process COM server issues

VirtualBox makes use of the Microsoft Component Object Model (COM) for inter- and intra-process communication. This allows VirtualBox to share a common configuration among different virtual machine processes and provide several user interface options based on a common architecture. All global status information and configuration is maintained by the process `VBoxSVC.exe`, which is an out-of-process COM server. Whenever a VirtualBox process is started, it requests access to the COM server and Windows automatically starts the process. Note that it should never be started by the end user.

When the last process disconnects from the COM server, it will terminate itself after some seconds. The VirtualBox configuration (XML files) is maintained and owned by the COM server and the files are locked whenever the server runs.

In some cases - such as when a virtual machine is terminated unexpectedly - the COM server might not notice that the client is disconnected and stay active. In other rare cases the COM server might experience an internal error and subsequently other processes fail to initialize it. In these situations, it is recommended to use the Windows task manager to kill the process `VBoxSVC.exe`.

11.3.2 CD/DVD changes not recognized

In case you have assigned a phyical CD/DVD drive to a guest and the guest does not notice when the medium changes, make sure that the Windows media change notification (MCN) feature is not turned off. This is represented by the following key in the Windows registry:

```
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Cdrom\Autorun
```

Certain applications may disable this key against Microsoft's advice. If it is set to 0, change it to 1 and reboot your system. VirtualBox relies on Windows notifying it of media changes.

11.3.3 Sluggish response when using Microsoft RDP client

If connecting to a Virtual Machine via the Microsoft RDP client (called Remote Desktop Connection), there can be large delays between input (moving the mouse over a menu is the most obvious situation) and output. This is because this RDP client collects input for a certain time before sending it to the VRDP server built into VirtualBox.

The interval can be decreased by setting a Windows registry key to smaller values than the default of 100. The key does not exist initially and must be of type DWORD. The unit for its values is milliseconds. Values around 20 are suitable for low-bandwidth connections between the RDP client and server. Values around 4 can be used for a gigabit Ethernet connection. Generally values below 10 achieve a performance that is very close to that of the local input devices and screen of the host on which the Virtual Machine is running.

Depending whether the setting should be changed for an individual user or for the system, either

```
HKEY_CURRENT_USER\Software\Microsoft\Terminal Server
        Client\Min Send Interval
```

or

```
HKEY_LOCAL_MACHINE\Software\Microsoft\Terminal Server
        Client\Min Send Interval
```

can be set appropriately.

11.3.4 Running an iSCSI initiator and target on a single system

Deadlocks can occur on a Windows host when attempting to access an iSCSI target running in a guest virtual machine with an iSCSI initiator (e.g. Microsoft iSCSI Initiator) that is running on the host. This is caused by a flaw in the Windows cache manager component, and causes sluggish host system response for several minutes, followed by a "Delayed Write Failed" error message in the system tray or in a separate message window. The guest is blocked during that period and may show error messages or become unstable.

Setting the environment variable `VBOX_DISABLE_HOST_DISK_CACHE` to 1 will enable a workaround for this problem until Microsoft addresses the issue. For example, open a command prompt window and start VirtualBox like this:

```
set VBOX_DISABLE_HOST_DISK_CACHE=1
VirtualBox
```

While this will decrease guest disk performance (especially writes), it does not affect the performance of other applications running on the host.

11.4 Linux hosts

11.4.1 Linux kernel module refuses to load

If the VirtualBox kernel module (`vboxdrv`) refuses to load, i.e. you get an "Error inserting vboxdrv: Invalid argument", check (as root) the output of the `dmesg` command to find out why the load failed. The most common reasons are:

- With Linux 2.6.19 and higher, the NMI watchdog may be active. Add `nmi_watchdog=0` to the kernel command line (e.g. in your grub configuration) and reboot. With the Debian and Ubuntu installation modules, execute `sudo dpkg-reconfigure virtualbox` again.
- The kernel disagrees about the version of the gcc used to compile the module. Make sure that you use the same compiler as used to build the kernel.

11.4.2 Linux host's CD/DVD drive not found

If you have configured a virtual machine to use the host's CD/DVD drive, but this does not appear to work, make sure that the current user has permission to access the corresponding Linux device file (usually `/dev/cdrom` or similar). On most distributions, the user must be added to a corresponding group (usually called `cdrom` or `cdrw`).

Also, if your CD/DVD device has a different name, VirtualBox may be unable to find it. On Linux hosts, VirtualBox performs the following steps to locate your CD/DVD drives:

1. VirtualBox examines if the environment variable `VBOX_CDROM` is defined (see below). If so, VirtualBox omits all the following checks.
2. VirtualBox tests if `/dev/cdrom` works.
3. In addition, VirtualBox checks if any CD/DVD drives are currently mounted by checking `/etc/mtab`.
4. In addition, VirtualBox checks if any of the entries in `/etc/fstab` point to CD/DVD devices.

In other words, you can try to set VBOX_CDROM to contain a list of your CD/DVD devices, separated by colons, for example as follows:

```
export VBOX_CDROM='/dev/cdrom0:/dev/cdrom1'
```

11.4.3 Linux host's floppy not found

The previous instructions (for CD/DVD drives) apply accordingly to floppy disks, except that VirtualBox tests for `/dev/fd*` devices by default. This can be overridden with the `VBOX_FLOPPY` environment variable.

11.4.4 Strange guest IDE error messages when writing to CD/DVD

If the experimental CD/DVD writer support is enabled with an incorrect VirtualBox, host or guest configuration, it is possible that any attempt to access the CD/DVD writer fails and simply results in guest kernel error messages (for Linux guests) or application error messages (for Windows guests). VirtualBox performs the usual consistency checks when a VM is powered up (in particular it aborts with an error message if the device for the CD/DVD writer is not writable by the user starting the VM), but it cannot detect all misconfigurations. The necessary host and guest OS configuration is not specific for VirtualBox, but a few frequent problems are listed here which occurred in connection with VirtualBox.

Special care must be taken to use the correct device. The configured host CD/DVD device file name (in most cases /dev/cdrom) must point to the device that allows writing to the CD/DVD unit. For CD/DVD writer units connected to a SCSI controller or to a IDE controller that interfaces to the Linux SCSI subsystem (common for some SATA controllers), this must refer to the SCSI device node (e.g. /dev/scd0). Even for IDE CD/DVD writer units this must refer to the appropriate SCSI CD-ROM device node (e.g. /dev/scd0) if the ide-scsi kernel module is loaded. This module is required for CD/DVD writer support with all Linux 2.4 kernels and some early 2.6 kernels. Many Linux distributions load this module whenever a CD/DVD writer is detected in the system, even if the kernel would support CD/DVD writers without the module. VirtualBox supports the use of IDE device files (e.g. /dev/hdc), provided the kernel supports this and the ide-scsi module is not loaded.

Similar rules (except that within the guest the CD/DVD writer is always an IDE device) apply to the guest configuration. Since this setup is very common, it is likely that the default configuration of the guest works as expected.

11.4.5 VBoxSVC IPC issues

On Linux, VirtualBox makes use of a custom version of Mozilla XPCOM (cross platform component object model) for inter and intra process communication. The process VBoxSVC serves as a communication hub between different VirtualBox processes and maintains the global configuration, i.e. the XML database. When starting a VirtualBox component, the processes VBoxSVC and VirtualBoxXPCOMIPCD are started automatically. They are only accessible from the user account they are running under. VBoxSVC owns the VirtualBox configuration database which normally resides in ~/.VirtualBox and while it is running, the configuration files are locked. Communication between the various VirtualBox components and VBoxSVC is performed through a local domain socket residing in /tmp/.vbox-<username>-ipc. In case there are communication problems (i.e. a VirtualBox application cannot communicate with VBoxSVC), terminate the daemons and remove the local domain socket directory.

11.4.6 USB not working

If USB is not working on your Linux host, make sure that the current user has permission to access the USB filesystem (`usbfs`), which VirtualBox relies on to retrieve valid information about your host's USB devices.

As `usbfs` is a virtual filesystem, a `chmod` on `/proc/bus/usb` has no effect. The permissions for `usbfs` can therefore *only* be changed by editing the `/etc/fstab` file.

For example, most Linux distributions have a user group called `usb` or similar, of which the current user must be a member. To give all users of that group access to usbfs, make sure the following line is present:

```
# 85 is the USB group
none     /proc/bus/usb     usbfs      devgid=85,devmode=664    0    0
```

Replace 85 with the group ID that matches your system (search `/etc/group` for "usb" or similar). Alternatively, if you don't mind the security hole, give all users access to USB by changing "664" to "666".

The various distributions are very creative from which script the `usbfs` filesystem is mounted. Sometimes the command is hidden in unexpected places. For SuSE 10.0 the mount command is part of the udev configuration file `/etc/udev/rules.d/50-udev.rules`. As this distribution has no user group called `usb`, you may e.g. use the `vboxusers` group which was created by the VirtualBox installer. Since group numbers are allocated dynamically, the following example uses 85 as a placeholder. Modify the line containing (a linebreak has been inserted to improve readability)

```
DEVPATH="/module/usbcore", ACTION=="add",
    RUN+="/bin/mount -t usbfs usbfs /proc/bus/usb"
```

and add the necessary options (make sure that everything is in a single line):

```
DEVPATH="/module/usbcore", ACTION=="add",
    RUN+="/bin/mount -t usbfs usbfs /proc/bus/usb -o devgid=85,devmode=664"
```

Debian Etch has the mount command in `/etc/init.d/mountkernfs.sh`. Since that distribution has no group `usb`, it is also the easiest solution to allow all members of the group `vboxusers` to access the USB subsystem. Modify the line

```
domount usbfs usbdevfs /proc/bus/usb -onoexec,nosuid,nodev
```

so that it contains

```
domount usbfs usbdevfs /proc/bus/usb -onoexec,nosuid,nodev,devgid=85,devmode=664
```

As usual, replace the 85 with the actual group number which should get access to USB devices.

Other distributions do similar operations in scripts stored in the `/etc/init.d` directory.

11.4.7 PAX/grsec kernels

Linux kernels including the grsec patch (see http://www.grsecurity.net/) and derivates have to disable PAX_MPROTECT for the VBox binaries to be able to start a VM. The reason is that VBox has to create executable code on anonymous memory.

12 ChangeLog

This section summarizes the changes between VirtualBox versions. Note that this is not a detailed changelog and not all changes are listed. VirtualBox version numbers consist of three numbers separated by dots where the first number represents the major version, the 2nd number the minor version and the 3rd one the build number. Build numbers of official releases are always even. An odd build number represents an internal development or test build.

12.1 Version 1.4.0 (2007-06-06)

- General: added support for OS X hosts
- General: added support for AMD64 hosts
- General: signed all executables and device drivers on Windows
- GUI: added user interface for Shared Folders
- GUI: added context menu for network adapters
- GUI: added VM description field for taking notes
- GUI: always restore guest mouse pointer when entering VM window (Windows host)
- GUI: added configuration options for clipboard synchronization
- GUI: improved keyboard handling on Linux hosts
- GUI: added first run wizard
- GUI: improved boot device order dialog
- GUI: auto-resize did not work after save/restore
- GUI: restore original window size when returning from fullscreen mode
- GUI: fixed screen update when switching to fullscreen mode
- GUI: the size of the VM window was sometimes resetted to 640x480
- GUI: added localizations

- GUI: various minor improvements
- VBoxManage: added convertdd command
- API: automatically start and terminate VBoxSVC on Linux and OS X hosts
- VMM: increased startup performance due to lazy memory allocation
- VMM: significantly increased maximum guest memory size
- VMM: fixed issues with V86 mode
- VMM: support V86 extensions (VME)
- VMM: support guests with a full GDT
- VMM: fixed boot hangs for some Linux kernels
- VMM: improved FreeBSD and OpenBSD support
- VMM: improved performance of guests that aggressively patch kernel code (very recent Linux 2.6 kernels)
- VMM: added workaround for a design flaw in AMD AM2 CPUs where the timestamp counter shows large differences among CPU cores
- VMM: fixed Linux guests with grsecurity
- VMM: fixed issue on 2G/2G Linux kernels (even 1G/3G kernels should work)
- VMM: fixed Linux detection of Local APIC on non-Intel and non-AMD CPUs
- VMM: timing improvements with high host system loads (VM starvation)
- VMM: experimental AMD SVM hardware virtualization support now also handles real and protected mode without paging
- VMM: added system time offset parameter to allow for VMs to run in the past or future
- VMM: provide an MPS 1.4 table if the IOAPIC is enabled
- RDP: allow binding the RDP server to a specific interface
- RDP: added support for clipboard synchronization
- RDP: fixed problems with OS X RDP client
- RDP: added support for multiple simultaneous connections to one VM
- RDP: added support for MS RDP6 clients (Vista)

- Storage: experimental support for VMDK images (writethrough mode only, no snapshots yet)
- Storage: raw host disk support, including individual partitions
- IDE: improve CHS geometry detection
- IDE: fixed problem that only one VM could open an immutable image
- NAT: allow more than one card configured for NAT networking
- NAT: pass first entry in DNS search list (Linux host) or primary DNS suffix (Windows host) as domain name in DHCP
- NAT: support UDP broadcasts, which enables using Windows shares
- NAT: only warn if the name server could not be determined, no fatal error anymore
- NAT: fix a potential problem with incorrect memory allocation
- Internal Networking: fixed issue on Windows hosts
- Host Interface Networking: fixed sporadic crashes on interface creation/destruction (Windows host)
- Host Interface Networking: reworked TAP handling for Linux 2.6.18+ compatibility
- PXE: show error for unsupported V86 case
- PXE: small fix for parsing PXE menu entry without boot server IP
- Network: fixed network card hang after save/restore
- USB: Rewrote Windows USB handling without the need for a filter driver
- USB: Possible to steal arbitrary devices in Windows
- Serial: added serial ports with support for named pipes (local domain sockets) on the host
- Audio: fixed problem with ALSA on Linux before 2.6.18 blocking other ALSA clients on the system
- Audio: fixed problem with ALSA on AMD64 hosts
- Input: fixed PS/2 mouse detection in Win 3.x guests
- Shared Folders: fixed VM save/restore behaviour
- Shared Folders: functionality and stability fixes

- Shared Folders: allow non admin users to map folders
- Additions: added clipboard synchronization
- Windows Additions: fixed dynamic resolution changes after save/restore
- Windows Additions: added AMD PCNet driver for Windows Vista guests (with kind permission from AMD)
- Linux Additions: fixed a dependency problem which caused the vboxadd kernel module sometimes start after the X server
- Linux Additions: make VBox version visible in Linux modules with modinfo
- Linux Additions: make X11 guest video driver accept arbitrary X resolutions
- Linux Additions: make X11 setup work if /tmp uses a separate file system
- Linux Additions: better support unknown distributions
- Linux Installer: force a non-executable stack for all binaries and shared libraries
- Linux Installer: make it work on SELinux-enabled systems
- Linux Installer: ship VBoxTunctl

12.2 Version 1.3.8 (2007-03-14)

- Windows installer: fixed installation problem if UAC is active
- Linux installer: added RPM for rhel4 and Mandriva 2007.1
- Linux installer: remove any old vboxdrv modules in /lib/modules/*/misc
- Linux installer: many small improvements for .deb and .rpm packages
- Linux installer: improved setup of kernel module
- GUI: Host-Fn sends Ctrl-Alt-Fn to the guest (Linux guest VT switch)
- GUI: fixed setting for Internal Networking
- GUI: show correct audio backend on Windows (dsound)
- GUI: improved error messages if the kernel module is not accessible
- GUI: never fail to start the GUI if the kernel module is not accessible
- VMM: fixed occasional crashes when shutting down Windows TAP device
- VMM: fixed issues with IBM's 1.4.2 JVM in Linux guests

- RDP: fixed color encoding with 24bpp
- BIOS: zero main memory on reboot
- BIOS: added release logging
- USB: fixed parsing of certain devices to prevent VBoxSVC crashes
- USB: properly wakeup suspended ports
- USB: fixed a problem with unplugged USB devices during suspend
- Audio: fixed crashes on Vista hosts
- NAT: allow configuration of incoming connections (aka port mapping)
- Network: hard reset network device on reboot
- iSCSI: fixed a hang of unpaused VMs accessing unresponsive iSCSI disks
- Linux Additions: support Xorg 7.2.x
- Linux Additions: fixed default video mode if all other modes are invalid
- Linux Additions: set default DPI to 100,100
- Linux Additions: fixed initialization of video driver on X server reset

12.3 Version 1.3.6 (2007-02-20)

- Windows installer: perform installation for all users instead of just the current user (old behavior still available)
- Linux installer: fixed license display to not block installation
- Linux installer: added RPM for openSUSE 10.2
- GUI: fixed problems with several keyboard layouts on Linux hosts
- GUI: added online help on Linux hosts (using kchmviewer)
- GUI: fixed handle leak on Windows hosts
- Graphics: increased VRAM limit to 128MB
- BIOS: fixed CD/DVD-ROM detection in Windows Vista guests
- VMM: fixed incompatibility with OpenBSD 4.0
- VDI: fixed issues with snapshot merging

- Network: fixed incompatibility between Vista UAC and Host Interface Networking
- Network: fixed issues with Windows NT 4.0 guests
- Audio: fixed problem with ALSA on Linux before 2.6.18 causing system reboots
- RDP: added support for MS RDP 6.0 clients
- RDP: fixed issue with PAM authentication on certain distributions
- RDP: fixed sporadic disconnects with MS RDP clients
- iSCSI: improved behavior when pausing a VM with iSCSI connections
- iSCSI: improved read timeout handling

12.4 Version 1.3.4 (2007-02-12)

- General: fixed unresolved symbol issue on Windows 2000 hosts
- General: added warnings at VirtualBox startup when there is no valid Linux kernel module
- General: fixed problem with unrecognized host CDROM/DVD drives on Linux
- General: fixed compatibility issue with SELinux
- GUI: improved USB user interface, easier filter definitions, menu to directly attach specific devices
- GUI: added VM settings options for VRDP
- GUI: fixed GDI handle leak on Windows hosts
- GUI: worked around issue in the Metacity window manager (GNOME) leading to unmovable VM windows
- GUI: show an information dialog before entering fullscreen mode about how to get back
- GUI: several fixes and improvements
- VMM: fixed occasional crashes when shutting down a Windows guest
- VMM: fixed crash while loading Xorg on openSUSE 10.2
- VMM: fixed problems with OpenBSD 3.9 and 4.0
- VMM: fixed crash while loading XFree86 in SUSE 9.1

- VMM: fixed Debian 3.1 (Sarge) installation problem (network failure)
- VMM: fixed crash during SUSE 10.2 installation
- VMM: fixed crash during Ubuntu 7.04 RC boot
- VMM: fixed crash during ThinClientOS (Linux 2.4.33) bootup
- ATA/IDE: pause VM when host disk is full and display message
- ATA/IDE: fixed incompatibility with OpenSolaris 10
- VDI containers: do not allocate blocks when guest only writes zeros to it (size optimization when zeroing freespace prior to compacting)
- CDROM/DVD: fixed media recognition by Linux guests
- Network: corrected reporting of physical interfaces (fixes Linux guest warnings)
- Network: fixed IRQ conflict causing occassional major slowdowns with XP guests
- Network: significantly improved send performance
- Audio: added mixer support to the AC'97 codec (master volume only)
- Audio: added support for ALSA on Linux (native, no OSS emulation)
- iSCSI: improved LUN handling
- iSCSI: fixed hang due to packet overflow
- iSCSI: pause VM on iSCSI connection loss
- Linux module: never fail unloading the module (blocks Ubuntu/Debian uninstall)
- Linux module: improved compatibility with NMI watchdog enabled
- Windows Additions: fixed hardware mouse pointer with Windows 2003 Server guests
- Linux Additions: compile everything from sources instead of using precompiled objects
- Linux Additions: better compatibility with older glibc versions
- Linux Additions: when uninstalling, only delete the files we put there during installation, don't remove the directory recursively to prevent unwanted data loss
- Linux Installer: added support for Slackware
- Linux Additions: added support for Linux 2.4.28 to 2.4.34
- RDP: fixed sporadic disconnects with MS RDP clients
- RDP: fixed race condition during resolution resize leading to rare crashes

12.5 Version 1.3.2 (2007-01-15)

- General: added experimental support for Windows Vista as a host
- General: added support for Windows Vista as a guest
- GUI: numerous improvements including a redesigned media manager
- BIOS: added DMI information for recent Linux kernels
- VMM: experimental support for AMD SVM hardware virtualization extensions
- VMM: significant performance improvements for Linux 2.6 guests
- VMM: performance improvements for Windows guests
- Network: fixed issues with DOS guests
- Network: fixed creation of more than one host interface during process lifetime on Windows
- VBoxManage: added support for compacting VDI files (requires zeroing freespace in the guest)
- API: startup even when a VM configuration file is inaccessible or corrupted
- API: faster startup using lazy media access checking
- Linux Additions: fixed several installation issues and added better error checks
- Linux Additions: added support for X.org 7.1
- Installer: added packages for Ubuntu 6.10 (Edgy Eft), Ubuntu 6.06 LTS (Dapper Drake) and Debian 4.0 (Etch)

12.6 Version 1.2.4 (2006-11-16)

Several bug fixes that accidentially didn't make it into 1.2.2

12.7 Version 1.2.2 (2006-11-14)

Note: Guest Additions have to be updated for the enhanced VRDP features to work.

- Linux Additions: improved compatibility with Red Hat distributions
- Linux Additions: enhanced display performance, solved several issues
- Linux Additions: added color pointer support

- Linux Additions: added support for X.org 7.x
- VMM: fixed sporadic mouse reset problem
- VMM: fixed several issues with Linux guests
- VMM: significant performance improvements for Linux 2.6 guests
- VMM: significant general performance improvements
- VMM: fixed sporadic reboot problems (logo hang)
- VMM: added support for Intel VT-x (aka Vanderpool)
- VMM: experimental support for IBM OS/2 Warp (requires VT-x to be enabled)
- USB: added support for isochronous transfers (webcams, audio, etc.)
- USB: fixed problem with devices not showing up after a guest reboot
- USB: fixed several issues
- BIOS: fixed use of fourth boot device
- BIOS: added boot menu support
- BIOS: added support for disks up to 2 Terabytes
- VRDP: significantly enhanced performance and reduced bandwidth usage through new acceleration architecture
- VBoxManage: added support for capturing network traffic
- GUI: added fullscreen mode
- GUI: fixed several problems

12.8 Version 1.1.12 (2006-11-14)

- Additions: enabled more display modes for X.org 7.x
- VMM: stability improvements
- VMM: resolved excessive performance degradation caused by Symantec Antivirus
- iSCSI: fixed memory corruption issue
- VBoxSDL: made hostkey configurable
- VRDP: report error in case binding to the port fails

- VRDP: added mouse wheel support
- NAT: significant performance improvements
- Network: stability fixes
- Network: significant performance improvements
- ACPI: improved host power status reporting
- PXE: added support for Microsoft RIS / ProxyDHCP
- PXE: fixed several issues, added diagnostic messages

12.9 Version 1.1.10 (2006-07-28)

- IDE: added workaround for Acronis TrueImage (violates IDE specification)
- IDE: resolved issues with certain Linux guests
- ACPI: further improved host power status reporting
- API: fixed several race conditions and improved reliability
- API: increased maximum guest RAM size to 2GB (Linux host) and 1.2GB (Windows host)
- USB: added option to set the OHCI timer rate
- VMM: fixed several issues
- VRDP: fixed infinite resize loop
- GUI: changed the default host key to Right Control

12.10 Version 1.1.8 (2006-07-17)

- IDE: new ATA implementation with improved performance, reliability and better standards compliance
- IDE: added experimental support for ATAPI passthrough (to use CD/DVD burners inside VMs)
- VMM: fixed user mode IOPL handling (hwclock failure)
- VMM: fixed crashes upon termination in Linux X servers
- VMM: fixed problems with Knoppix 5.0 (and other Linux kernels 2.6.15+)
- VMM: improved handling of self modifying code (aka Linux 2.6.15+ errors)

- VMM: introduce release logging for better servicability
- VMM: significant performance improvements, especially for Linux 2.6 guests
- VRDP: several issues have been fixed
- VRDP: fixed enhanced rdesktop to build correctly under Linux 2.6.15+
- Additions: added support for SUSE 10.1 and Fedora Core 5
- NAT: improved performance and stability
- NAT: handle host IP configuration changes at runtime
- VBoxManage: made VRDP authentication configurable
- VDI: added workaround against possible Windows host deadlocks caused by a sychronisation flaw in Windows
- ACPI: improved host power status reporting

12.11 Version 1.1.6 (2006-04-18)

- ACPI: added workaround for XP SP2 crash in intelppm.sys (the real problem is a bug in this driver)
- IDE: added support for image files of up to 8 terabytes
- API: fixed several race conditions on SMP systems
- Network: significant performance improvements
- VRDP: fixed several issues with USB redirection
- IDE: added workaround for Windows 2000 installation problems due to a bug in the Windows disk driver (see troubleshooting section)
- VRDP: provide extensive connection information (also exposed through VBoxManage)
- Linux module: added support for Linux 2.6.16
- VBoxManage: improved support for immutable disk images
- iSCSI: several fixes
- USB: several fixes
- VBoxSDL: added switch for fixed video mode and guest image centering
- VMM: improved performance of Linux 2.6.x guests

12.12 Version 1.1.4 (2006-03-09)

Note: The configuration file format has been changed. After applying this update, execute "VBoxManage updatesettings" to convert your configuration to the new format.
Note: Guest Additions have to be updated.

- General: added support for multi-generation snapshots
- VMM: fixed Linux guest reboot regression
- VRDP: added client authentication through external authentication libraries (WinLogon and PAM interfaces are provided as sample code)
- VRDP: close TCP connection immediately when receiving bad data from the remote side
- VRDP: improved Microsoft RDP client support
- XPCOM: fixed race condition on SMP systems that could lead to hung client processes (Linux host)
- API: fixed race condition on SMP systems
- Network: added AMD PC-Net II 100MBit network card (Am79C973)
- Network: added PXE boot ROM for network boot
- Audio: fixed regression with Windows 2000 guests
- Audio: pause playback when VM is paused
- iSCSI: added standards compliant iSCSI initiator for transparent access of iSCSI targets
- VBoxSDL: ship on Windows as well
- VBoxManage: added command to clone a VDI file to another one having a different UUID
- Additions: added Linux additions (timesync, mouse pointer integration and graphics driver)
- Additions: added Shared Folders for Windows guests (except NT)
- Linux module: fixed compilation problem on SUSE 10 system
- Linux installer: added custom shell script installer

12.13 Version 1.1.2 (2006-02-03)

Note: Guest Additions have to be updated. The installation method has changed.

- BIOS: fixed CMOS checksum calculation (to avoid guest warnings)
- BIOS: improved APM support (to avoid guest warnings)
- IDE: Linux 2.6.14+ and OpenBSD now operate the controller in UDMA mode by default
- VMM: fixed hang when rebooting Windows 2000 guests with enabled audio adapter
- VMM: fixed random user mode crashes with OpenBSD guests
- VMM: increased timing accuracy (PIT, RTC), reduced PIT query overhead
- VMM: tamed execution thread to make GUI more responsive (esp. when executing real mode guest code such as bootloaders)
- VMM: significant performance enhancements for OpenBSD guests
- VMM: several performance enhancements
- VMM: improved memory layout on Windows hosts to allow for large amounts of guest RAM
- VMM: significantly improved VM execution state saving and restoring (at the expense of state file sizes)
- ACPI: fixed Windows bluescreen when assigning more than 512MB RAM to a guest
- ACPI: correctly report battery state when multiple batteries are present on the host (Linux hosts)
- ACPI: enabled by default for newly created VMs
- APIC: added optional I/O APIC
- Graphics: fixed distortion when changing guest color depth without changing the resolution
- VRDP: added support for remote USB (requires special rdesktop client)
- VRDP: added support for the Microsoft RDP client
- VRDP: improved audio support
- Floppy: controller can be disabled

- Floppy: fixed “no disk in drive” reporting
- Floppy: fixed writing to floppy images
- VBoxManage: restructured USB device filter syntax to make it more intuitive
- VBoxManage: added command for setting guest logon credentials
- Additions: added installer for Windows 2000/XP/2003 guests
- Additions: added custom GINA module which hooks MSGINA and can perform automatic logons using credentials retrieved from the VMM
- Documentation: added draft of VirtualBox user manual

12.14 Version 1.0.50 (2005-12-16)

Note: Guest Additions have to be updated

- VMM: added support for OpenBSD guests
- VMM: fixed a memory leak
- Network: added Internal Networking (to directly wire VMs without using host interfaces and making the traffic visible on the host)
- Network: fixed crash/hang at exit with TAP on Linux
- Graphics: added support for additional custom VESA modes
- Graphics: added support for VESA modes with y offset
- VRDP: added support for remote audio (PCM encoding)
- USB: fixed several potential crashes
- USB: fixed revision filter matching
- USB: fixed support for devices with integrated USB hubs

12.15 Version 1.0.48 (2005-11-23)

Note: The configuration has to be deleted as the format has changed. On Linux, issue rm -rf ~/.VirtualBox. On Windows, remove the directory C:\Documents and Settings\<username>\.VirtualBox. If you fail to do so, VirtualBox will not startup. Note: Guest Additions have to be updated

- VMM: fixed a Linux 2.6 guest panic on certain P4 CPUs

- VMM: performance improvements
- Graphics: fixed y offset handling in dynamic resolution mode (secure labeling support)
- VDI: added support for immutable independent images (part of the upcoming snapshot feature)
- Additions: added VBoxControl command line utility to get/set the guest video acceleration status
- Additions: video acceleration is turned off by default, use VBoxControl to enable it. It usually helps for VRDP performance.
- GUI: DirectDraw support for faster display handling on Win32.
- GUI: allow creation and assignment of disk images in the New VM wizard.
- USB: fixed high CPU load on certain Linux distributions
- VBoxSDL: fixed several secure labeling issues (crash at exit, protection against guest video modes greater than what SDL provides on the host)
- VBoxManage: convert command line parameters from the current codepage to Unicode

12.16 Version 1.0.46 (2005-11-04)

Note: Guest Additions have to be updated

- Linux: VirtualBox binaries can now be started from directories other than the installation directory
- VMM: added support for PAE guest mode
- VMM: added support for hosts running in NX (No Execute) / DEP (Data Execution Prevention) mode
- Graphics: fixes for dynamic resolution handling
- Linux module: yet another kernel panic fix due to weird patches in RedHat Enterprise Linux 4 Update 2
- VBoxSVC: if VBOX_USER_HOME is set, look for configuration in this directory (default: $HOME/.VirtualBox)

12.17 Version 1.0.44 (2005-10-25)

Note: Guest Additions have to be updated.

- Installer: greatly improved Windows installer, fixed uninstall and perform driver and COM registration through MSI
- VBoxManage: added commands to create and delete Win32 Host Interface Networking adapters
- VDI: updated virtual disk image format (for newly created images; old images continue to work) with enhanced write performance and support for the upcoming snapshot feature
- Network: performance improvements
- Graphics: added hardware acceleration to virtual graphics adapter and corresponding Guest Additions driver
- Graphics/Additions/GUI: added dynamic resizing support
- Graphics: added workaround for buggy VESA support in Windows Vista/Longhorn
- VRDP: performance and stability improvements; added support for graphics acceleration architecture
- USB: restructured USB subsystem; added support for filters to autocapture devices that meet defined criteria
- GUI: added mouse wheel support
- VMM: added support for PAE host mode

12.18 Version 1.0.42 (2005-08-30)

Note: The configuration has to be deleted as the format has changed. On Linux, issue rm -rf ~/.VirtualBox. On Windows, remove the directory C:\Documents and Settings\<username>\.VirtualBox. If you fail to do so, VirtualBox will not startup. Note: Guest Additions have to be updated.

- USB: added USB support for Windows hosts
- Network: renamed TUN to “Host Interface Networking” and TAP on Linux
- Network: added support for Host Interface Networking on Windows hosts
- Network: added “cable connected” property to the virtual network cards
- Floppy: added a virtual floppy drive to the VM and support for attaching floppy images and capturing host floppy drives

- DVD/CD: added host CD/DVD drive support
- BIOS: added boot order support
- Saved states: made location configurable (default, global setting, machine specific setting, including VBoxManage command support)
- VMM: added support for host CPUs without FXSR (e.g. Via Centaur)
- VMM: increased performance of Linux 2.6 guests
- VMM: improved timing
- VMM: fixed traps in XP guests with ACPI enabled
- VBoxManage: added remote session start function (tstHeadless has been removed from the distribution)
- VBoxManage: restructured commands, added numerous improvements
- GUI: propagate hostkey change to all running instances
- GUI: perform image access tests asynchronously
- GUI: added boot order support
- GUI: user interface redesign

12.19 Version 1.0.40 (2005-06-17)

Note: The configuration has to be deleted as the format has changed. On Linux, issue rm -rf ~/.VirtualBox. On Windows, remove the directory C:\Documents and Settings\<username>\.VirtualBox. If you fail to do so, VirtualBox will not startup. Note: Guest Additions have to be updated.

- SDK: ship VirtualBox development tools and sample program
- BIOS: made startup logo animation configurable for OEM customers
- BIOS: fixed network card detection under DOS
- Graphics: fixed VESA modes in XP and XFree86/X.org
- Network: fixed Linux guest issues
- Network: fixed NAT DHCP server to work with MS-DOS TCP/IP
- Network: fixed performance issue under heavy guest CPU load
- Network: fixed errors with more than one network card

- USB: added experimental USB support for Linux hosts
- VMM: fixed DOS A20 gate handling in real mode
- VMM: fixed TSS IO bitmap handling (crash in Debian/Knoppix hardware detection routine)
- VMM: fixed IO issue which broke VESA in X11
- VMM: performance improvements for Linux guests
- VMM: added local APIC support
- VBoxSDL: added pointer shape support and use host pointer in fullscreen mode if available
- GUI: determine system parameters (e.g. maximum VDI size) using the API
- GUI: added detailed error information dialogs
- GUI: special handling of inaccessible media
- API: better error message handling, provide system parameters, handle inaccessible media
- Guest Additions: implemented full pointer shape support for all pointer color depths including alpha channel
- VBoxManage: several command extensions

12.20 Version 1.0.39 (2005-05-05)

Note: Guest Additions have to be updated.

- Linux: converted XPCOM runtime to a single shared object
- Linux: fixed SIGALRM process crash on certain distributions
- VMM: fixed Linux guests with grsecurity (address space scrambling)
- ACPI: added experimental ACPI support
- VRDP: added shadow buffer for reduced bandwidth usage
- VRDP: added support for pointer shapes and remote pointer cache
- GUI: added support for pointer shapes
- Windows Additions: added support for high resolution video modes, including multi screen modes (2, 3 and 4 screens)
- VBoxManage: added new command line tool to automate simple administration tasks without having to write application code

12.21 Version 1.0.38 (2005-04-27)

- GUI: fixed creation of disk images larger than 4GB
- GUI: added network and audio configuration panels
- GUI: several keyboard issues fixed
- VBoxSDL: fixed -tunfd handling and added -tundev (Linux host)
- IDE: significant performance improvements in DMA modes
- Video: VRAM size is now configurable (1MB - 128MB; default 4MB)
- VMM: fixed several crashes and hangs while installing certain builds of Windows 2000 and XP
- VMM: allow guests to have more than 512MB of RAM
- VMM: resolved compatibility issues with SMP systems (Windows Host)
- VRDP: process cleanup on Linux fixed
- Linux module: fixed build error on Red Hat 2.4.21-15-EL
- NT Additions: fixed installation and a trap
- Win2k/XP Additions: fixed installation

12.22 Version 1.0.37 (2005-04-12)

Initial build with changelog.

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Glossary

A

ACPI Advanced Configuration and Power Interface, an industry specification for BIOS and hardware extensions to configure PC hardware and perform power management. Windows 2000 and higher as well as Linux 2.4 and higher support ACPI. Windows can only enable or disable ACPI support at installation time.

API Application Programming Interface.

APIC Advanced Programmable Interrupt Controller, a newer version of the original PC PIC (programmable interrupt controller). Most modern CPUs contain an on-chip APIC ("local APIC"). Many systems also contain an I/O APIC (input output APIC) as a sperate chip which provides more than 16 IRQs. Windows 2000 and higher use a different kernel if they detect an I/O APIC during installation. Therefore an I/O APIC must not be removed after installation.

C

COM Microsoft Component Object Model, a programming infrastructure for modular software. COM allows applications to provide application programming interfaces which can be accessed from various other programming languages and applications. VirtualBox makes use of COM both internally and externally to provide a comprehensive API to 3rd party developers.

D

DHCP Dynamic Host Configuration Protocol. This allows a networking device in a network to acquire its IP address (and other networking details) automatically, in order to avoid having to configure all devices in a network with fixed IP addresses. VirtualBox has a built-in DHCP server that delivers an IP addresses to a virtual machine when networking is configured to NAT; see chapter 6, *Virtual networking*, page 54.

G

GUI Graphical User Interface. Commonly used as an antonym to a "command line interface", in the context of VirtualBox, we sometimes refer to the main graphical `VirtualBox` program as the "GUI", to differentiate it from the `VBoxManage` interface.

GUID See UUID.

I

I/O APIC See APIC.

iSCSI Internet SCSI; see chapter 5.3, *iSCSI servers*, page 53.

M

MAC Media Access Control, a part of an Ethernet network card. A MAC address is a 6-byte number which identifies a network card. It is typically written in hexadecimal notation where the bytes are separated as colons, such as `00:17:3A:5E:CB:08`.

N

NAT Network Address Translation. A technique to share networking interfaces by which an interface modifies the source and/or target IP addresses of networking packages according to specific rules. Commonly employed by routers and firewalls to shield an internal network from the Internet, VirtualBox can use NAT to easily share a host's physical networking hardware with its virtual machines. See chapter 6, *Virtual networking*, page 54.

P

PIC See APIC.

PXE Preboot Execution Environment, an industry standard for booting PC systems from remote network locations. It includes DHCP for IP configuraiton and TFTP for file transfer. Using UNDI, a hardware independent driver stack for accessing the network card from bootstrap code is available.

R

RDP Remote Desktop Protocol, a protocol developed by Microsoft as an extension to the ITU T.128 and T.124 video conferencing protocol. With RDP, a PC system can be controlled from a remote location using a network connection over which data is transferred in both directions. Typically graphics updates and audio are sent from the remote machine and keyboard and mouse input events are sent from the client. VirtualBox contains an enhanced implementation of the relevant standards called "VirtualBox RDP" (VRDP), which is largely compatible with Microsoft's RDP implementation. See chapter 7.4, *Remote Desktop Support (VRDP)*, page 71 for details.

S

SCSI Small Computer System Interface. An industry standard for data transfer between devices, especially for storage. See chapter 5.3, *iSCSI servers*, page 53.

U

UUID A Universally Unique Identifier – often also called GUID (Globally Unique Identifier) – is a string of numbers and letters which can be computed dynamically and is guaranteed to be unique. Generally, it used as a global handle to identify entities. VirtualBox makes use of UUIDs to identify VMs, Virtual Disk Images (VDI files) and other entities.

V

VM Virtual Machine – a virtual computer that VirtualBox allows you to run on top of your actual hardware. See chapter 1.1, *Virtualization basics*, page 7 for details.

VRDP See RDP.

X

XPCOM Mozilla Cross Platform Component Object Model, a programming infrastructure developed by the Mozilla browser project which is similar to Microsoft COM and allows applications to provide a modular programming interface. VirtualBox makes use of XPCOM on Linux both internally and externally to provide a comprehensive API to third-party developers.