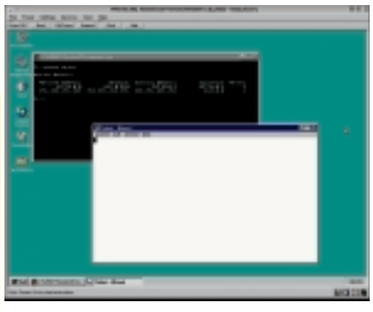
PC emulation

VIRTUAL COMPUTER

HANS-GEORG EßER



Possibly the most popular product among Windows emulators is VMware, a commercial program from the US-based company of the same name. But VMware is more than a Windows emulator: It actually emulates an entire PC.

Seeing a freshly-installed and appropriately configured VMware installation start for the first time is a sensation in itself. In a black window, the BIOS start-up message of an ordinary PC appears, the memory is counted up and you have the option of calling up the BIOS set-up, just like on a real PC.

Installing VMware

Two steps are necessary to get the benefit of Windows emulation. Firstly, the VMware software itself has to be installed. A licence is required to be able to use VMware. You can obtain a free 30-day evaluation license from VMware's home page, or you can buy a long-term VMware licence. The price starts at $99 US for personal, non-commercial use. Whatever you do, the licence must be stored in the *.vmware* directory in your home directory under the name *license*.

The performance of VMware is unaffected by the type of licence obtained. In most cases you will install an *rpm* package – in the case of SuSE Linux 7.0 it is the file *vmware-2.0-55.i386.rpm*. You install this as usual as administrator *root* using the command

```
rpm -i vmware-xxx.i386.rpm
```

This does not mean VMware is ready to use. A few special kernel modules are required. These are included in the VMware package for various kernel versions: if you are running a distribution for which precompiled modules are not supplied, the installation script will compile them.

To install – and if necessary, create – the kernel modules, call up the program *vmware-config.pl* (again as *root*). A longish question and answer game then begins. This will install the kernel modules and, if required, add a DHCP server from which the operating system running on the virtual PC (known as the *guest* operating system) can automatically obtain its own IP address. Your Linux computer will receive a second IP address at this point via which it can be contacted from the guest system.

You will find a sample installation with explanations in the box "Installation with vmware-config.pl".

Preparing VMware for Windows installation

When starting VMware for the first time (by entering *vmware* as a normal user (not as *root*) you can call up the VMware Configuration Wizard, with which you can prepare VMware for a Windows installation. To do this, first select the guest operating system. In VMware 2.0.x the systems on offer are MS-DOS, Windows 3.1, 95, 98, NT 4.0 and 2000 as well as Linux (yes, you can run Linux in a virtual machine under Linux!) and FreeBSD. You can also experiment with other operating systems, such as BeOS. Here, we are only looking at the installation of Windows, since our focus is on Windows emulation.

In the first dialog box of the Configuration Wizard, select the Windows version you wish to install on the virtual machine (Fig. 1).

Next, select the directory into which VMware Windows is to be installed. Note: this will not contain a directory structure in which Windows files accessible directly from Linux will be stored. Instead, VMware will create a single file there which contains a virtual hard disk. This will later become a perfectly normal-looking (at first unpartitioned) disk. The disk will then be partitioned and formatted as usual by Windows. A good location for this directory is */home/user/vmware/windows/*. VMware will suggest an appropriate directory. What is important is that there is sufficient free space in this directory.

In the next dialog box you have to specify how large the virtual hard disk is to be. Obviously, this needs to be large enough to hold the version of Windows you are installing, the applications and files you will use under it, plus the swap file. Windows 2000 alone demands about 900 M, though older Windows versions can get by with less space.

Fig. 1: The Configuration Wizard is ready for the installation of a range of operating systems

Next you must state whether the CD-ROM drive and the diskette drive are to be available for the guest operating system when VMware starts up in future. A positive answer to this question will not, incidentally, prevent you also mounting a CD or diskette under Linux.

Network

The next item concerns the network connection between the virtual PC and your Linux machine: At this point you can choose between *No networking*, ***Bridged networking*** and ***Host-only networking*** (and a combination of the last two variants).

If you don't need any connection between the virtual Windows system and any other computer you can also select **No networking**.

VMware makes a recommendation for the available main memory which the emulated PC is to have, and which cannot be altered at this point. (You can, however, correct the RAM size later on via the VMware configuration menus.) There now appears a summary of the options with which VMware will start in future and in which directory which files were created. (Fig. 2) Confirm this with *Done*, in order to finish with the Configuration Wizard.

Installation with vmware-config.pl

```
[root@dual esser]# vmware-config.pl
Making sure VMware's services are stopped.
....

Trying to find a suitable vmmon module for your running kernel.

None of VMware's pre-built vmmon modules is suitable for your running
kernel.

Do you want this script to try to build the vmmon module for
your system (you need to have a C compiler installed on your system)?
[yes] [Return]

What is the location of the directory of C header files that match
your running kernel? [/usr/src/linux/include] [Return]
```

If the header files of the kernel are located elsewhere, specify the correct path: /usr/src/linux/include/ should usually be correct.

```
Extracting the sources of the vmmon module.
....
The module loads perfectly in the running kernel.

Making sure that both the parport and parport_pc kernel services are
available.

Trying to find a suitable vmppuser module for your running kernel.

None of VMware's pre-built vmppuser modules is suitable for your
running kernel.

Do you want this script to try to build the vmppuser module for your
system (you need to have a C compiler installed on your system)? [yes]
[Return]
```

The same procedure follows for a kernel module, which later permits direct access to the printer port, so that (for example) parallel port scanners can be addressed directly under Windows.

```
Extracting the sources of the vmppuser module.
....
The module loads perfectly in the running kernel.

Do you want this script to automatically configure your system to
allow your Virtual Machines to access the host filesystem?
(yes/no/help) [yes] [Return]

The version of Samba used in this version of VMware is licensed as
described in the "/usr/share/doc/packages/vmware/SAMBA-LICENSE" file.

Hit enter to continue. [Return]

Enabling networking (this is required to share the host filesystem).

Trying to find a suitable vmnet module for your running kernel.

None of VMware's pre-built vmnet modules is suitable for your running
kernel. Do you want this script to try to build the vmnet module for
your system (you need to have a C compiler installed on your system)?
[yes] [Return]
```

And so it goes on. The vmnet module will be needed later for the network connection between Linux and the guest system.

```
Extracting the sources of the vmnet module.
....
The module loads perfectly in the running kernel.

Enabling host-only networking (this is required to share the host
filesystem).

Do you want this script to probe for an unused private subnet?
(yes/no/help) [yes] [Return]
```

Under some circumstances VMware can itself find a free subnet, i.e. a collection of IP addresses which is not yet in use. This is important, to avoid any conflicts. In this case, it has not worked:

```
Probing for an unused private subnet (this can take some time).

Unable to sendto: network is unreachable

 We were unable to locate an unused Class C subnet in the range of
private network numbers because we did not manage to send ICMP ping
packets on the network (which is normal if your host is not connected
to an IP network).

You will need to explicitly specify a network number.
```

At this point, enter the IP address which your Linux computer is to have later when seen by the VMware computer, thus from Windows. As a rule, an address in the form of 192.168.x.y is suitable. The associated netmask for this is 255.255.255.0.

```
What will be the IP address of your host on the private network?
[192.168.2.1] 192.168.2.1 [Return]

What will be the netmask of your private network?
[255.255.255.0] [Return]

This system appears to have a CIFS/SMB server (Samba) configured for
normal use.

If this server is intended to run, you need to make sure that it will
not conflict with the Samba server set-up on the private network (the
one that we use to share the host filesystem). Please check your
/etc/smb.conf file so that:

.. The "interfaces" line does not contain "192.168.2.1/255.255.255.0"
.. There is a "socket address" line that contains only your real host
IP address
```

If you are using a Samba server this has to be reconfigured so that it allows accesses from the virtual PC. Then you can assign your Linux home directory under Windows to a drive letter and access your private files.

```
Hit enter to continue.

Starting VMware services:
   Virtual machine monitor                 [  OK  ]
   Virtual bidirectional parallel port       [  OK  ]
   Virtual ethernet                        [  OK  ]
   Bridged networking                      [  OK  ]
   Host-only and samba networking (background) [  OK  ]

You have successfully configured VMware to allow your Virtual Machines
to access the host filesystem.  Your system appears to already be set
up with usernames and passwords for accessing the host filesystem.

Would you like to add another username and password at this time?
(yes/no/help) [no] yes
```

The following dialog only appears if a running Samba server has been found. You can then add a new username under which you can log onto the Samba server from Windows:

```
Please specify a username that is known to your host: esser

New SMB password:
Retype new SMB password:
Added user esser.
Password changed for user esser.

You have successfully configured VMware to allow your Virtual Machines
to access the host filesystem.  Your system appears to already be set
up with usernames and passwords for accessing the host filesystem.
Would you like to add another username and password at this time?
(yes/no/help) [no] [Return]
```

(One new account is enough...)

```
...
The configuration of VMware 2.0 build-476 for Linux for this running
kernel completed successfully.

You can now run VMware by invoking the following command:
"/usr/bin/vmware".

Enjoy,

the VMware team

[root@dual esser]#
```

With this, vmware-config.pl has completed its task.

Fig. 2: To end, the Installation Wizard summarises everything once more

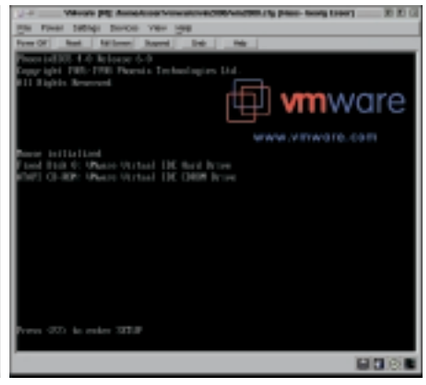


Fig. 3: The virtual PC is equipped with a Phoenix BIOS

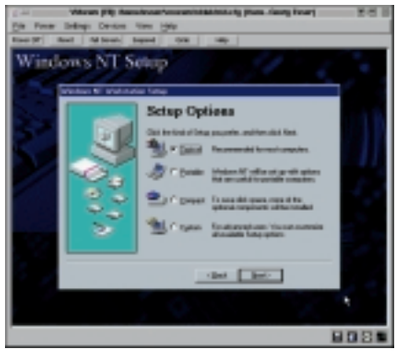


Fig. 4: Configuration of the Windows components to be installed (here: NT 4.0)

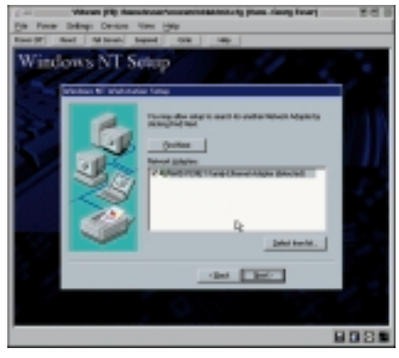


Fig. 5: NT 4.0 recognises an AMD PCNET network card

Windows Installation

The next step is the installation of the guest operating system – in this case, Windows in one of the versions 95, 98, Millennium Edition, NT 4.0 or 2000. All are supported in principle by VMware and co-operate with varying degrees of success with the virtual PC.

For this article we performed tests with Windows 98, NT 4.0 and Windows 2000. The test computer was a dual Pentium III 500 with 256 MB RAM and a fast SCSI hard disk. In all cases the installation ran exactly as it would in a normal PC. You insert the Windows installation CD in the CD-ROM drive and click on the *Power On* button, this switches on the virtual PC. It's most impressive when the usual BIOS start-up messages appear and the (virtual) main memory is counted down, just as a normal PC would do. By pressing [F2] at this point you could call up the BIOS set-up, in which the usual things (including among others the boot sequence) can be adjusted. (Fig. 3)

Since the newly-installed virtual hard disk is still unpartitioned, VMware won't find an operating system there. You will only notice this if you have *not* inserted the Windows CD, because in the standard configuration the virtual PC first attempts to boot up from the diskette or CD.

What happens next is the completely normal installation procedure of the version of Windows you selected. You will be guided through the partitioning and selection of the Windows components to be installed, and from time to time the virtual PC will reboot, a habit Microsoft operating systems seem unable to give up. You can make the usual adjustments (time zone, name of the Windows directory etc.). Since VMware assumes the Linux system time is the hardware time for the emulated PC you should select "no automatic change to winter/summer time" or the summer time adjustment will be doubly applied.

Automatic hardware recognition by Windows should find, among other things, an AMD PCNET card. This virtual network card will be used later for the network connection to the guest computer. If you chose bridged networking as well, a second virtual network card will be created for connection to the local network. (Fig. 5)

Once installation is completed, the virtual PC will reboot. Take the Windows CD out of the drive so as not to initiate the installation program again. Now VMware should boot up from the virtual disk and ultimately present the Windows log-in screen (Fig. 6).

Graphics driver

Only a standard VGA graphics card is recognised when VMware is installed. Consequently, Windows presents itself at the start in an unsatisfactory 640x480 16 colour resolution. This mode has other disadvantages apart from the interface being much too small. As soon as you click for the first time in the VMware window, the mouse remains trapped there. You can still move the Windows mouse cursor, but in order to leave the window you must "release" the mouse with the key combination [Ctrl+Alt+Esc].

However, VMware has special drivers for Windows 95/98/NT 4.0/2000 which are much easier to work with. They are installed from a virtual diskette which is provided on request by VMware. To install them, select the menu item *Settings/VMware Tools Install* (see Fig. 7). After a warning notice, all subsequent accesses to the A:

Bridged networking: *In bridged networking the virtual machine obtains transparent network access to the entire network on which your Linux computer is located (including the Internet, if your network is connected to it.) This enables, for example, a web server which has been installed on Windows NT running under VMware to be accessed from any other computer. You can use VMware Windows to access other computers in the local network via a web browser or Telnet. Your virtual Windows box will have exactly the same accessibility as a real Windows box connected to your network.*

Host-only networking: *In this variant only a (virtual) network connection between the Linux system (Host) and the virtual computer (Guest) is made. The virtual machine will be invisible to any other computer on the network. The purpose of this option is to allow you to access your Linux files from Windows (with assistance from a Samba server.)*

drive no longer lead to any diskette which may have been inserted, but to a virtual driver diskette. Now go through the usual procedure for the chosen Windows version for the installation of a new graphics card and select the appropriate driver from the diskette. After restarting the VMware PC you can then set a higher resolution.

Installation of the VMware tools under Windows adds an icon in the Windows StartUp list, which creates an icon in the Windows system tray. You can use this icon to permit or deny VMware access to the CD and diskette drives.

Network

VMware automatically starts a DHCP server under Linux if at the start of the VMware configuration (*vmware-config.pl*) you selected one of the options *Host-only networking* or *Bridged networking*. From this, the installed Windows can automatically obtain an IP address. To do this, you must of course tell Windows that it should search in the "local network" for such a server. This works brilliantly under Windows 95/98 and NT 4.0 too.

In the test configuration with NT 4.0 the Linux PC had the IP address 192.168.0.4 (in the local network 192.168.0.*) and also the address configured especially for VMware 192.168.2.1; in the emulation NT was assigned the address 192.168.2.128 by the DHCP server, and immediately a Telnet (for example) was possible on the Linux computer; via a WWW proxy running under Linux (e.g. *wwwoffle* or *squid*) it was also possible to surf the Internet. Only Windows 2000 refused to co-operate in our tests and obviously could not find the DHCP server.

It is easy at this point to determine whether the DHCP server has actually been contacted and has issued an IP address. In the file */etc/vmware/vmnet1/dhcpd/dhcpd.leases* you will find for each IP address issued an entry in the form

```
lease 192.168.2.128 {
    starts 0 2000/09/03 23:25:18;
    ends 0 2000/09/03 23:55:18;
    hardware ethernet 00:50:56:c0:67:33;
    uid 01:00:50:56:c0:67:33;
    client-hostname "VMWARE";
}
```

If on the other hand the file (apart from a few comment lines beginning with "#") is empty, no address has been issued. Under most Windows versions you can also determine, in a *COMMAND.COM* window using the command:

```
C:\> route print
```

whether an IP address has been issued. If only the standard IP address 127.0.0.1 (*localhost*) pops up there, it hasn't worked. If correct, it should look like Fig. 8.

[left] Fig. 6: Log-in screen for NT 4.0
[right] Fig. 9: At last, with the aid of VMware tools Word and Excel from the Office 2000 package are available under Linux in a usable resolution (Linux: 1280x1024, Windows: 1152x864).

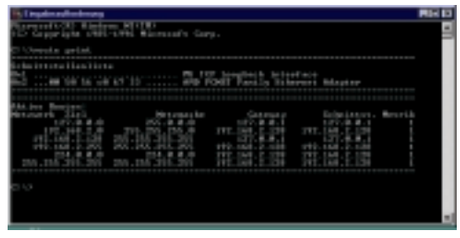


Fig. 8: Here "route print" also shows the IP address 192.168.2.128 issued by the DHCP server

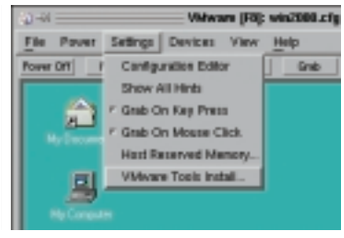


Fig. 7: Insert the VMware tools diskette...

The world of Windows programs

There is now nothing to stop you from installing any preferred Windows program. Install Microsoft Office 2000, for example, (see Fig. 9) and free yourself from the problems of trying to exchange files with other people who run it. You do of course need a licence for both the operating system and all programs installed under it. If you need to buy a Windows licence especially for your virtual PC, VMware will even sell you a package containing both VMware and a Windows licence. ■

Info

VMWare
http://www.vmware.com/

■

Suspend and Resume

One especially useful feature of VMware (from Version 2.0) is the option of freezing the current state of the emulated PC at any time by using the Suspend button. VMware then stores the entire main memory and some other data in a file named vmware/nt4/nt4.std (for example) and then stops the PC. After this you can close down VMware. When you next start it, reload this state information by using the Resume button. You can then carry on working from where you left off. The advantage of this method is that you save yourself the bother of the lengthy Windows boot procedure and having to open all the applications again. But a great deal of disk space is needed to store the status.

VMware files

Each virtual machine configured by you has its own directory (usually $HOME/vmware/os/, where "os" stands for the name of the operating system, e.g. nt4 or win2000). There you will find, respectively, a configuration file (nt4.cfg), the virtual hard disk (nt4.dsk), a log file (nt4.log), the BIOS configuration (nt4.nvram) and (if applicable) the most recent status stored using Suspend (nt4.std).

■