

**Running VMware
or
Running Multiple Operating Systems,
Virtual Systems, Virtual Networks and
Virtual Disks**

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Special Thanks to Collective Technologies
as a former employer of mine.

This is for the special project time they allowed me to
develop and research additional methods and
techniques that are being presented along with the time
to help build the systems now in use in IC1108

Overview

- " Driving force in the search
- " Methods tried
- " Other options
- " Use of Vmware

Issues That Needed Solving

- " Survey says ...
- " Students could not be an administrator
- " Students could not do networking
- " Students could not do network administration

Problems in Teaching System and Networking Admin

- " Budget
- " Network security concerns
- " Lack of equipment
- " Lack of classroom space
- " Only one or a few sections
- " Limited open lab time

Problems in Developing in a Heterogeneous Environment

- " Budget
- " Network security concerns
- " Lack of equipment to do development
- " Lack of lab, computer room or other space
- " Only a few machines available
- " Restricted schedules to test ideas on an available box
- " Development using traditional methods

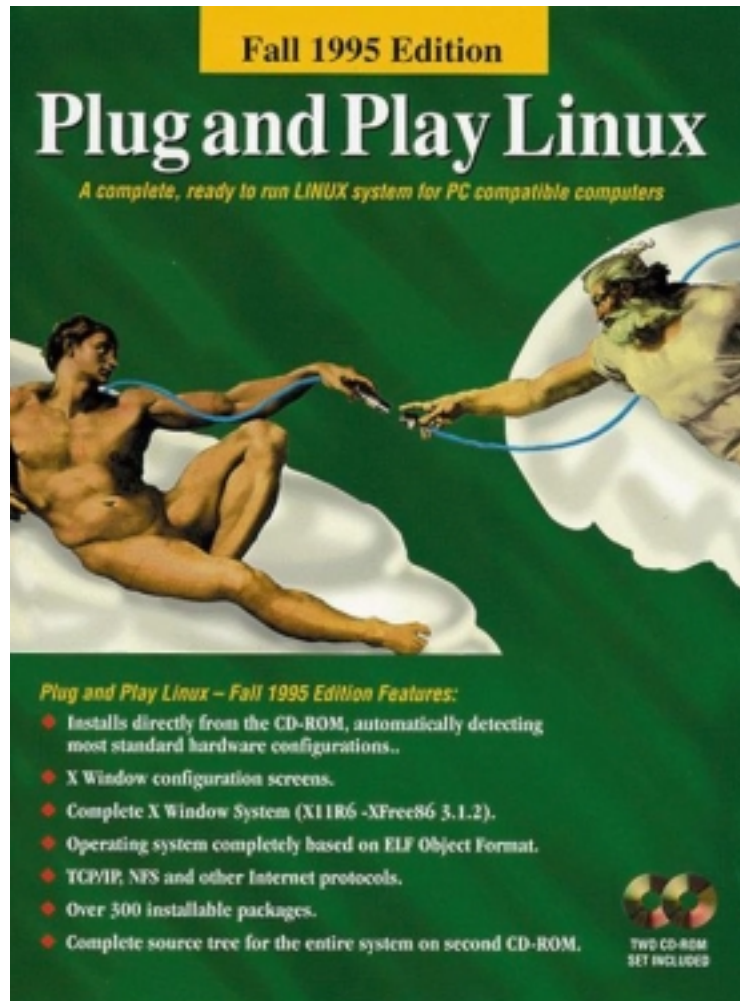
Where to Run An Operating System

- „ CD-ROM
- „ Diskette
- „ Hard disk
- „ Network card

Running Off The CD-ROM

- „ Uses RAM disks for temporary and writeable files
- „ Presents a new totally clean environment on bootup
- „ Customized files can be loaded from a diskette
- „ Device support may be limited and is not easily customizable on the CD-ROM

CD-ROM Options – Yggdrasil Linux



Characteristics

- Students can run Linux from diskette and CD-ROM only
- Does not require a hard disk
- Files can be saved to diskette and hard disk
- Last version was Fall 1995
- Supports only older networking cards
- Some programs are not standard Linux or UNIX
- New features are found in DemoLinux

CD-ROM Options - DemoLinux

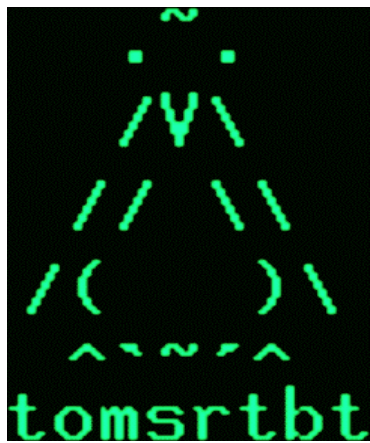


- A No hard disk is needed
- A Uses diskette, bootable CD-ROM and memory (diskette may not be needed)
- A Has over 1 Gig of programs on a standard CD-ROM
- A Information can be saved to diskette, harddisk, network
- A Network support includes NFS, current ethernet cards, Samba, etc.
- A Can also be fully installed or used with a link from Windows to run the CD-ROM
- A Is volative (It loses its information on shutdown)
- A Must be configured after each reboot either manually or with a batch program

Using Diskette

- " Run the operating system off the diskette. i.e. DOS
- " Operating system can be loaded into RAM and run as RAM disks, i.e. Trinux, Tomsrtbt
- " Filesystems can be mounted remotely to run the operating system, i.e. Novell
- " Networking protocols and device support is limited due to low diskette space
- " Expensive, limited or no MS support of Windows GUI

Diskette-Based Linux Options



Uses one or several diskettes for

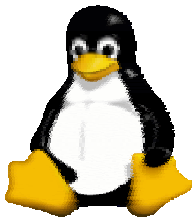
- Web-server
- Router
- Troubleshooting
- Network analysis
- X-windows
- Simple to understand and teach
- Customizable
- Limited in capabilities
- Limited commands

Dual/Multi Boot

- " The most common method of doing multiple operating systems
- " Boots off a Master Boot Record
- " Then accesses individual partition boot records each of which can run a totally independent operating system
- " Can run single or multiple operating systems, individually (by default) or simultaneously (with virtual operating system support)
- " Is supported for all PC-based operating systems as well as free managers on other processor versions of Linux
- " Requires a boot manager such as the Linux lilo, System Commander, Boot Magic, NT Boot manager, etc.

Some Boot Managers

Free



LILO –
Linux Loader

- " In Master Boot Record or partition
- " Supports Windows, Linux, OS/2, etc
- " Other free versions include X-windows based boot manager



Partition Magic
Boot Magic

Commercial Packages

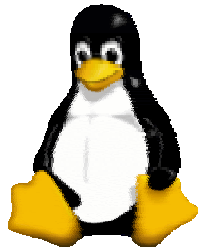
- " Easily Available in computer stores
- " Supports Windows, Linux, etc
- " Some versions converts filesystem types
- " Up to 100 Operating Systems at one time.



System
Commander

Running Linux from Windows

Free



Loadlin

- „ Runs Linux partition from Windows
- „ Does not allow access to live Windows operating system



Mandrake Linux for Windows

Commercial

- „ Usually install a small file with variable values
- „ Runs remainder off CD-ROM



SuSE Live Eval

- „ Other manufactures also can run mostly off the CD-ROM

Running off a Network Card

- " Uses a special ROM memory chip added to the network card or computer motherboard
- " Doesn't require a hard disk
- " Can require a lot of network bandwidth due to everything being loaded off a remote box
- " Has been used in Netware, UNIX and Linux

Emulator

- .. Runs software that was not originally design for the hardware and software running it
- .. The emulated machines functionality, hardware and software is duplicated in software
- .. Is often limited because either all the system parameters are not known or too complex to build
- .. Handles a limited number of software apps
- .. Requires large amounts of memory and CPU power

Simulator

- „ Is a special class of emulator
- „ Is less CPU and memory intensive
- „ Can duplicate a particular function or series of functions
- „ Can emulate parts of hardware, software or apps
- „ Is often used in early development of new processors and their software before creating an emulator

Virtual Machine

Does not have a CPU emulation component

Directly uses the system's CPU

Only runs operating systems and apps for that CPU

Is theoretically faster than an emulator

Requires an emulation layer for Input/Output devices

Requires additional memory

Is not as CPU intensive as an emulator

Examples include VMware, DOSEMU, VM

The Virtual Network

A network that doesn't really exist

Assumes the characteristics of a real network

Emulates an standard ethernet card

- „ Doesn't use the standard network components
- „ Can be used to prototype new network ideas
- „ Can be used to teach networking and operating systems

VMware

- .. Allows:
 - / Virtual Machines
 - / Virtual networks (Up to 3)
 - / Virtual disks (Up to 4 IDE and 7 SCSI)
- .. Supports Microsoft SMB networking with a SAMBA server and client capability
- .. Includes a DHCP server for the virtual network only

VMware Terms

- " **Virtual Network** - Confined inside the Host. Up to 3 virtual networks can be defined per Host and Guest
- " **Host** - the operating system running the VMware. Can be Linux or Windows NT/2000
- " **Guest** - the operating system that runs from VMware
- " **Host-only** - virtual networking confined to the Host
- " **Bridged** - virtual networking the Guest uses to access the LAN.

VMware Guest Operating Systems

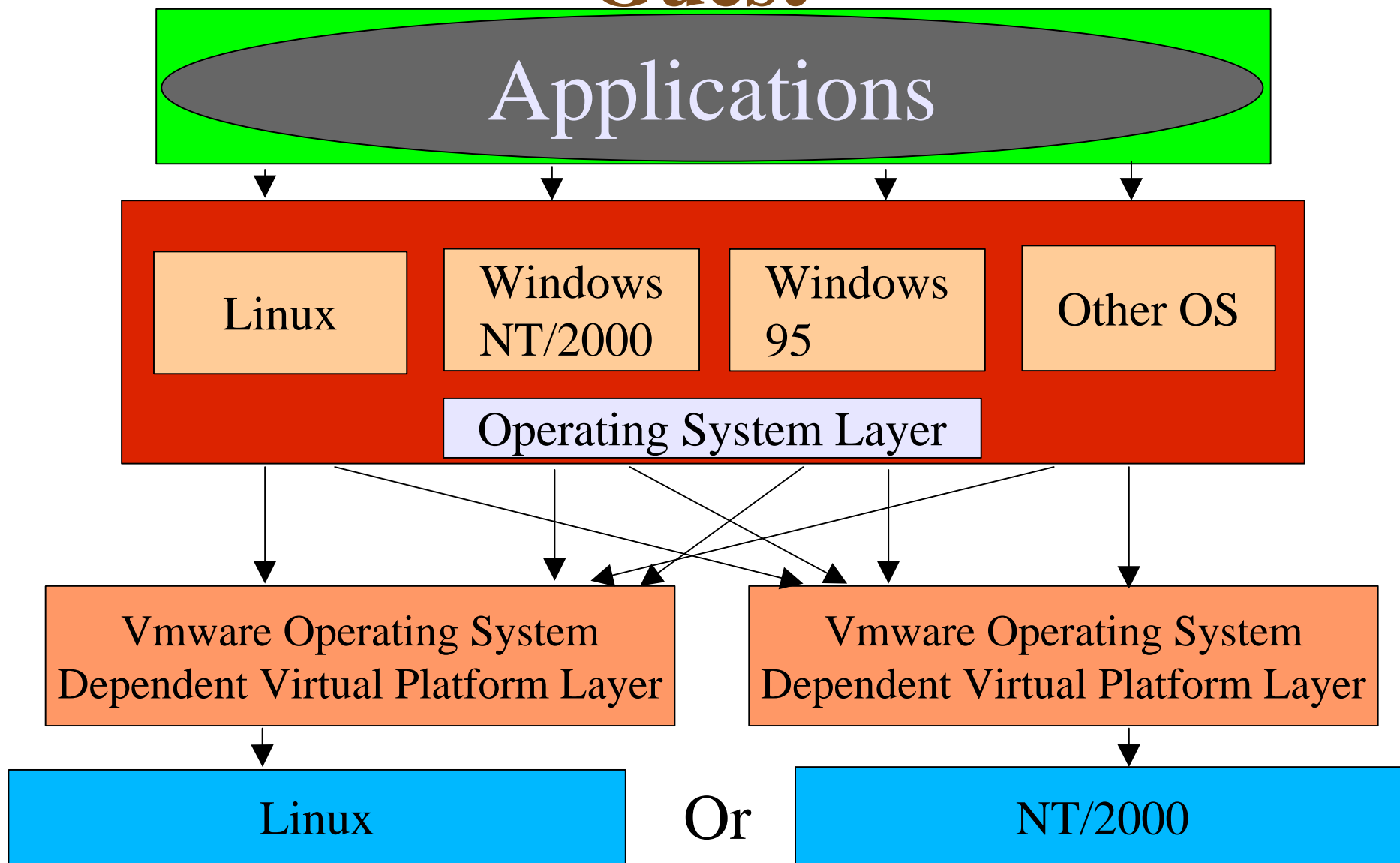
Supported

- "Linux – Most current versions
- "NT3.5/NT4.0/2000
- "DOS
- "Windows 3.1/95/98
- "FreeBSD
- "Other

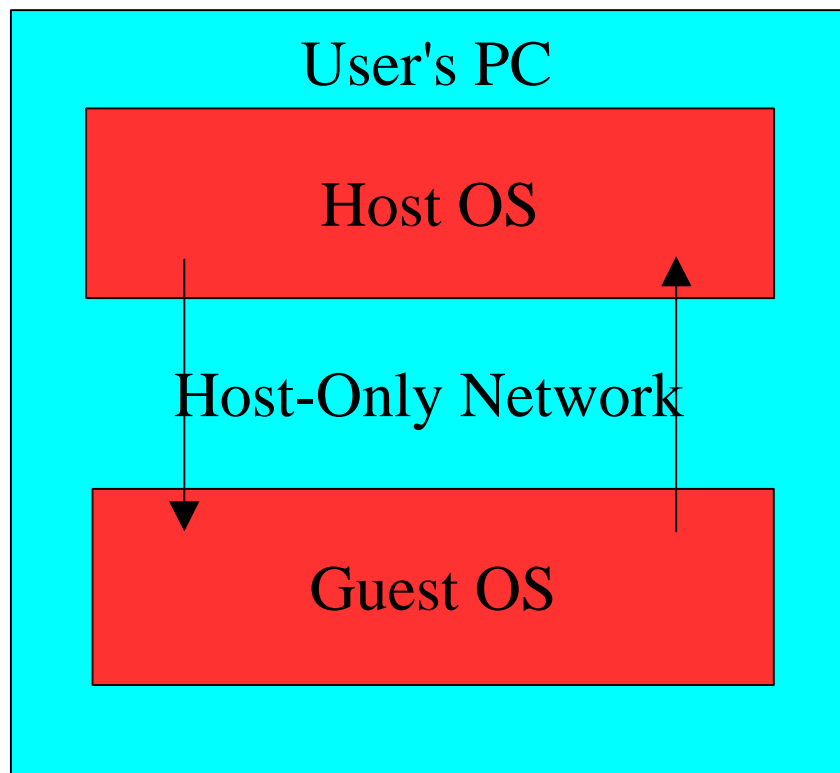
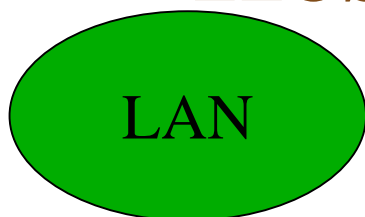
Partially or Un-Supported

- "Novell 4.0/5.0
- "OS/2 and OS/2 Warp
- "NetBSD, OpenBSD
- "Windows/ME
- "Other

Topology of VMware Host and Guest



Host-Only Networking

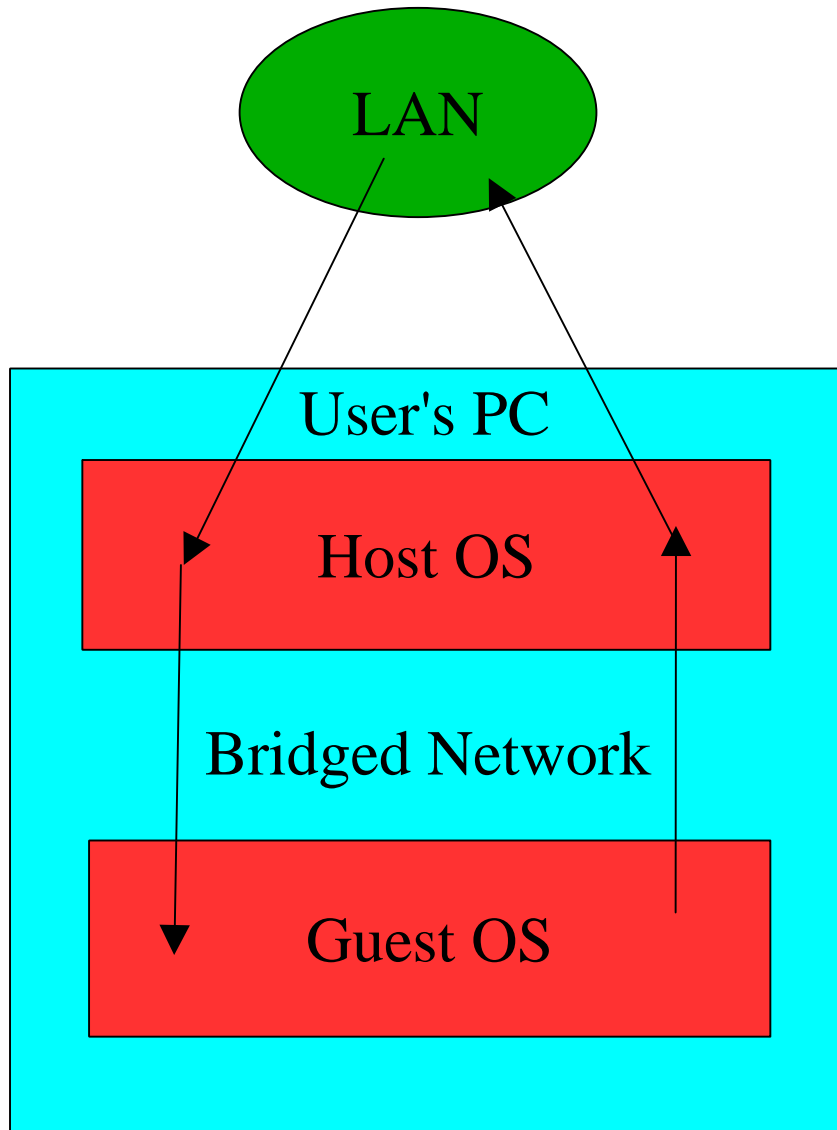


- Virtual networking that is totally confined inside the box
- Reduces security concerns
- Reduces Network costs
- Routing concepts and rules can be safely tested and developed

Host-Only Networking Continued

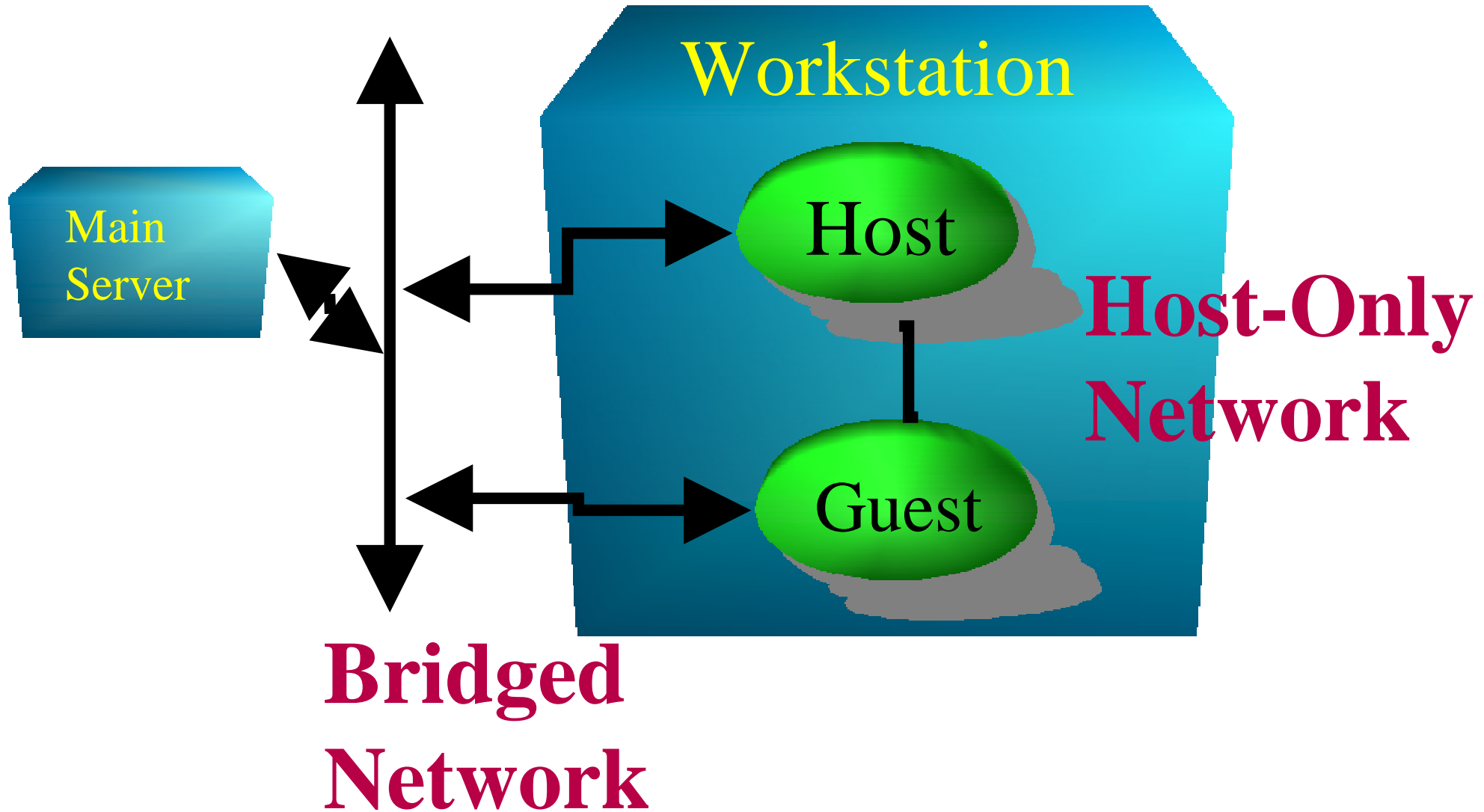
- " Students can safely experiment with different network types including Microsoft, Novell, TCP/IP
- " Allows users to prototype new ideas in isolation
- " Up to 3 virtual host-only networks can exist per Guest and Host

Bridged Networking



The Host acts like a network bridge
Virtual networking that allows the Guest operating system direct access to the local LAN via the host
Allows the LAN to directly access the Guest
Up to 3 bridged networks can exist per Guest and Host

Vmware System Layout



Virtual Filesystem Types

- " **Persistent** - Works like a regular hard disk
- " **Nonpersistent** - Changes to the drive are made to a temporary redo log file. When VMware is shutdown the changes are lost
- " **Undoable** - Gives you the choice of saving the changes at the end of the session

Virtual IDE and SCSI Disks

- " A virtual drive can be either SCSI or IDE regardless of what type of disk stores the info
- " An IDE disk drive or CD-ROM can be made to look like it's a SCSI device
- " A SCSI disk drive or CD-ROM can be made to look like it's an IDE device
- " SCSI CD-ROMS, either emulated or real, cannot be bootable by the Guest

Virtual SCSI and IDE Disks Cont.

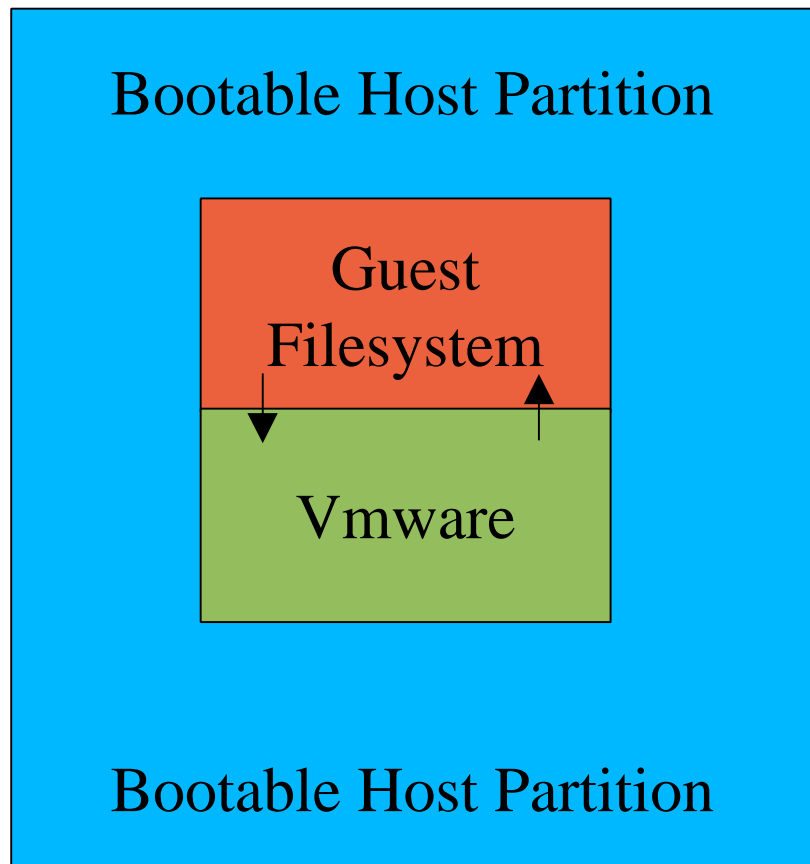
- " Up to 7 SCSI virtual disks can be created
- " Up to 4 IDE virtual disks can be created
- " Each Virtual Disk can be defined with a size up to 2 Gigabytes
- " Each disk only takes up the amount of space used by data. No matter how big it is defined.
- " Can be used to setup RAID devices.

Virtual Hard Disk Types

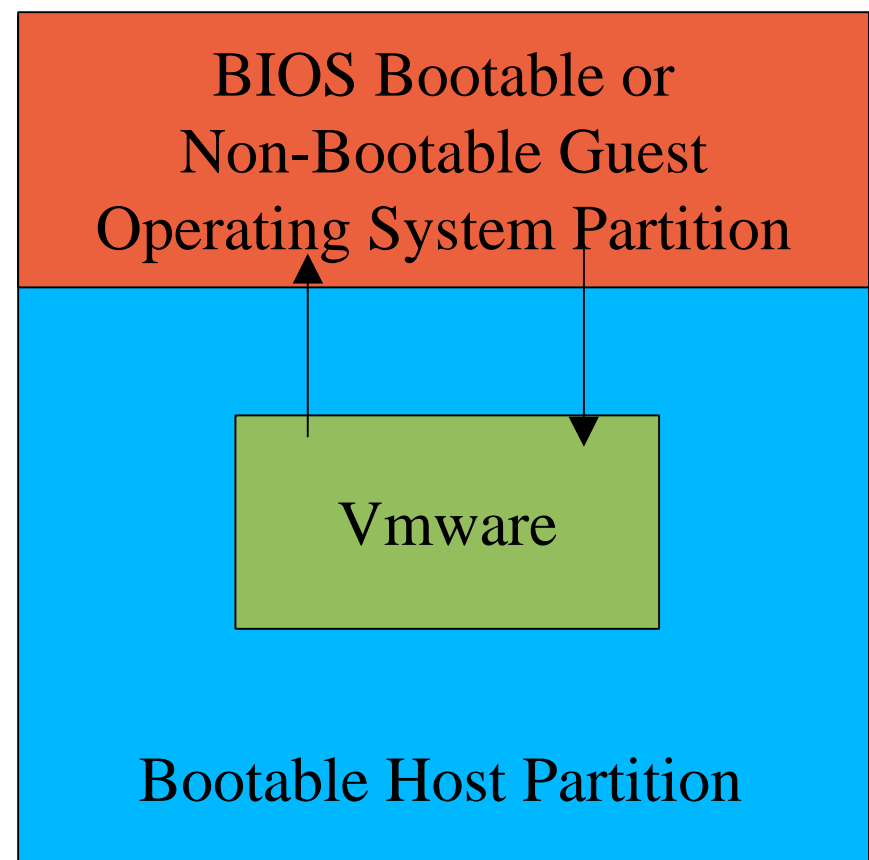
- " **Disk File** - a regular file that has all the characteristics of a hard disk. Only uses space taken by the data up to 2 Gigs
- " **Raw Disk** -a regular disk partition
- " **Plain Disk** - combines several disk files into a fixed size usually greater than 2 Gigs

Virtual vs Raw Filesystems and Partitions

Running off a Disk File

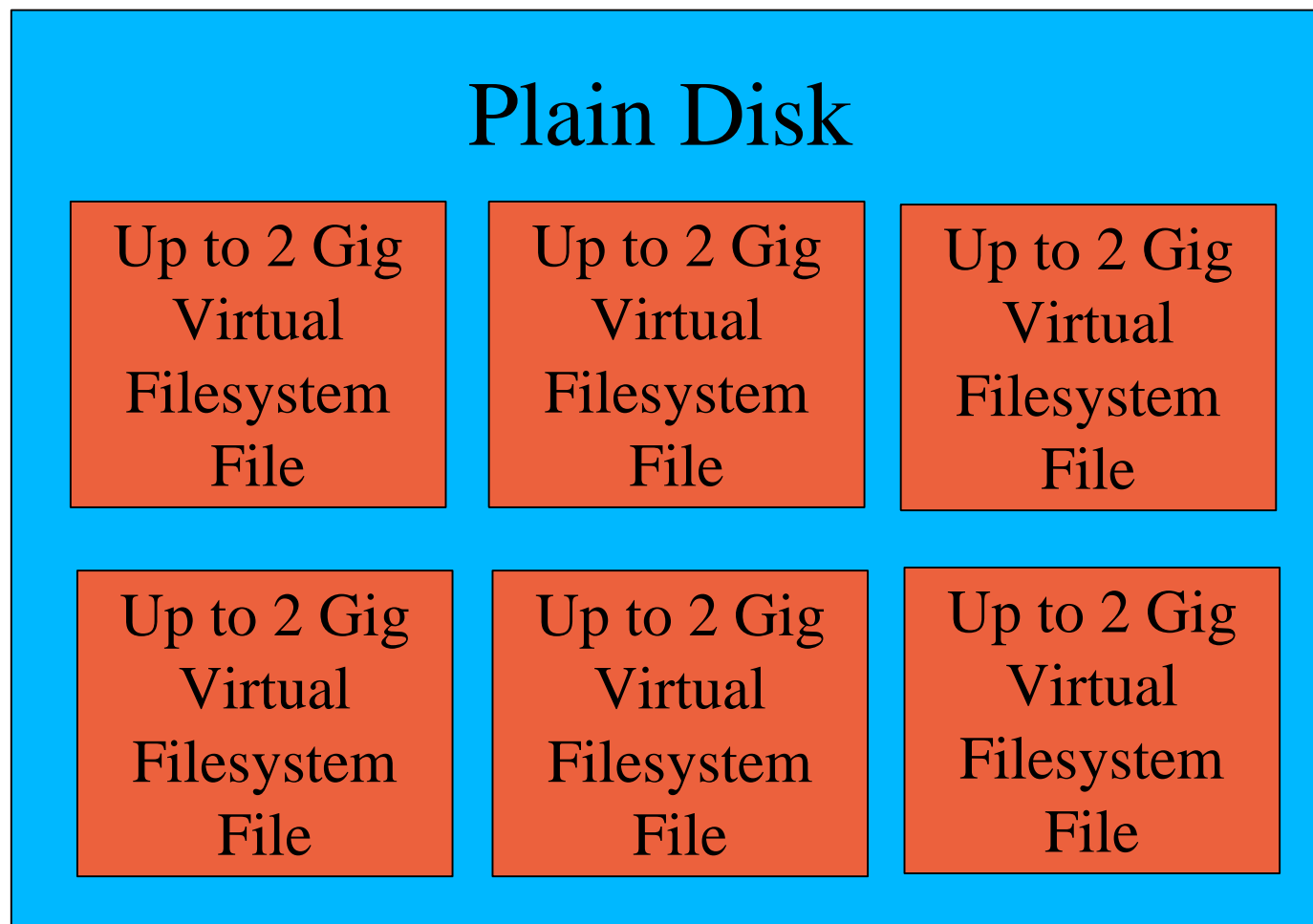


Running off a Raw Partition

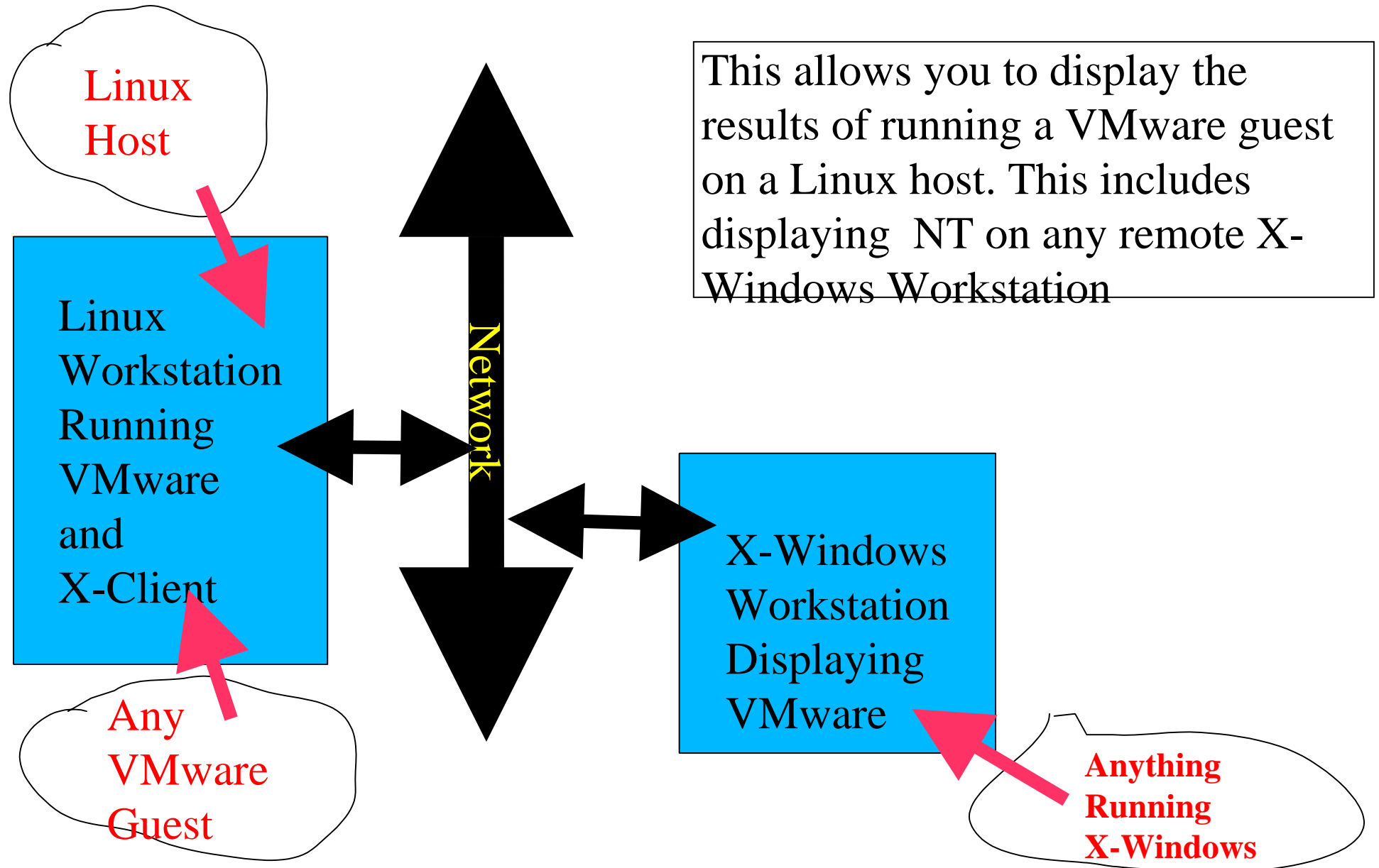


Plain Disk

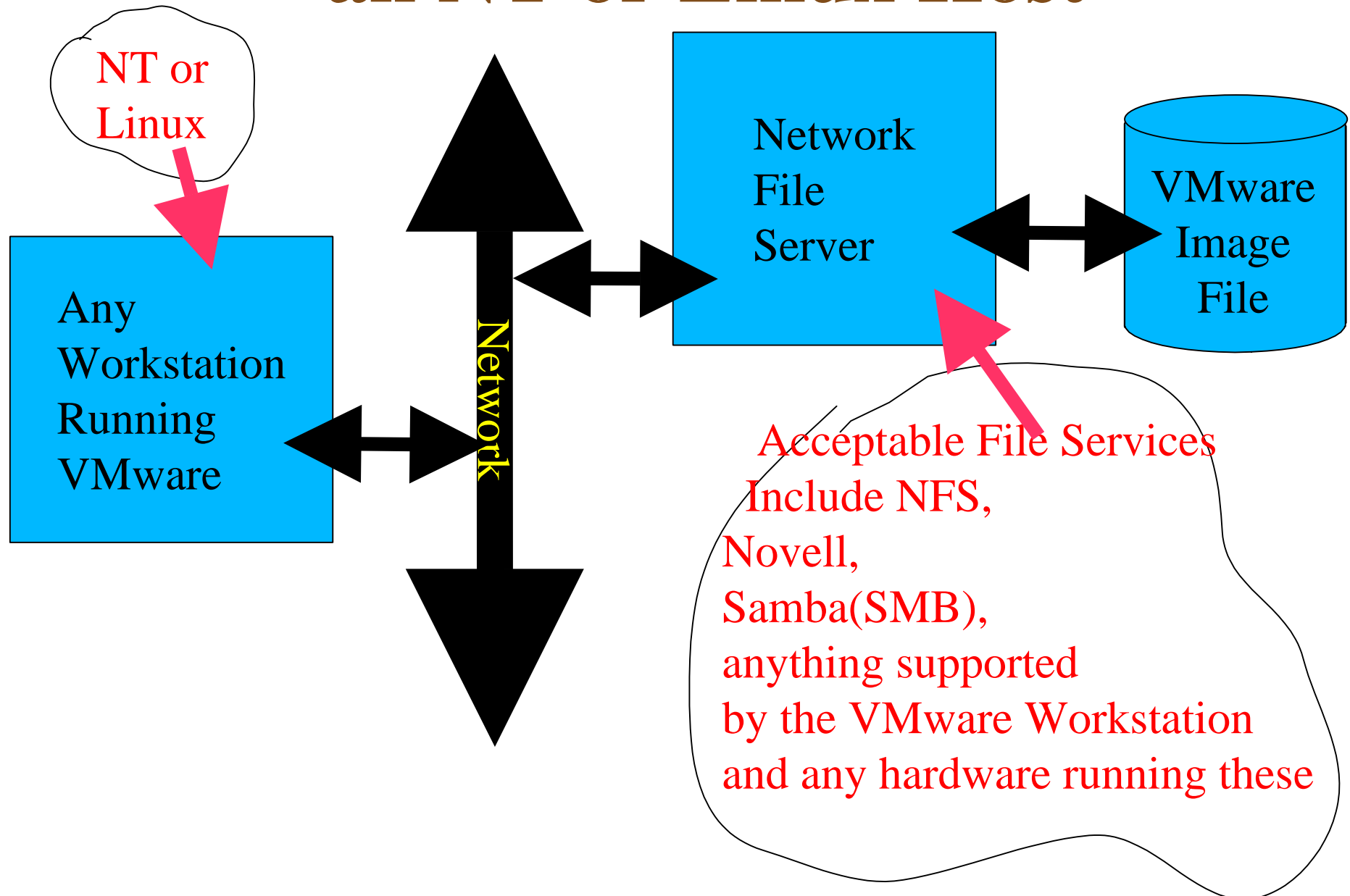
- " Combines Several Files into one larger virtual file



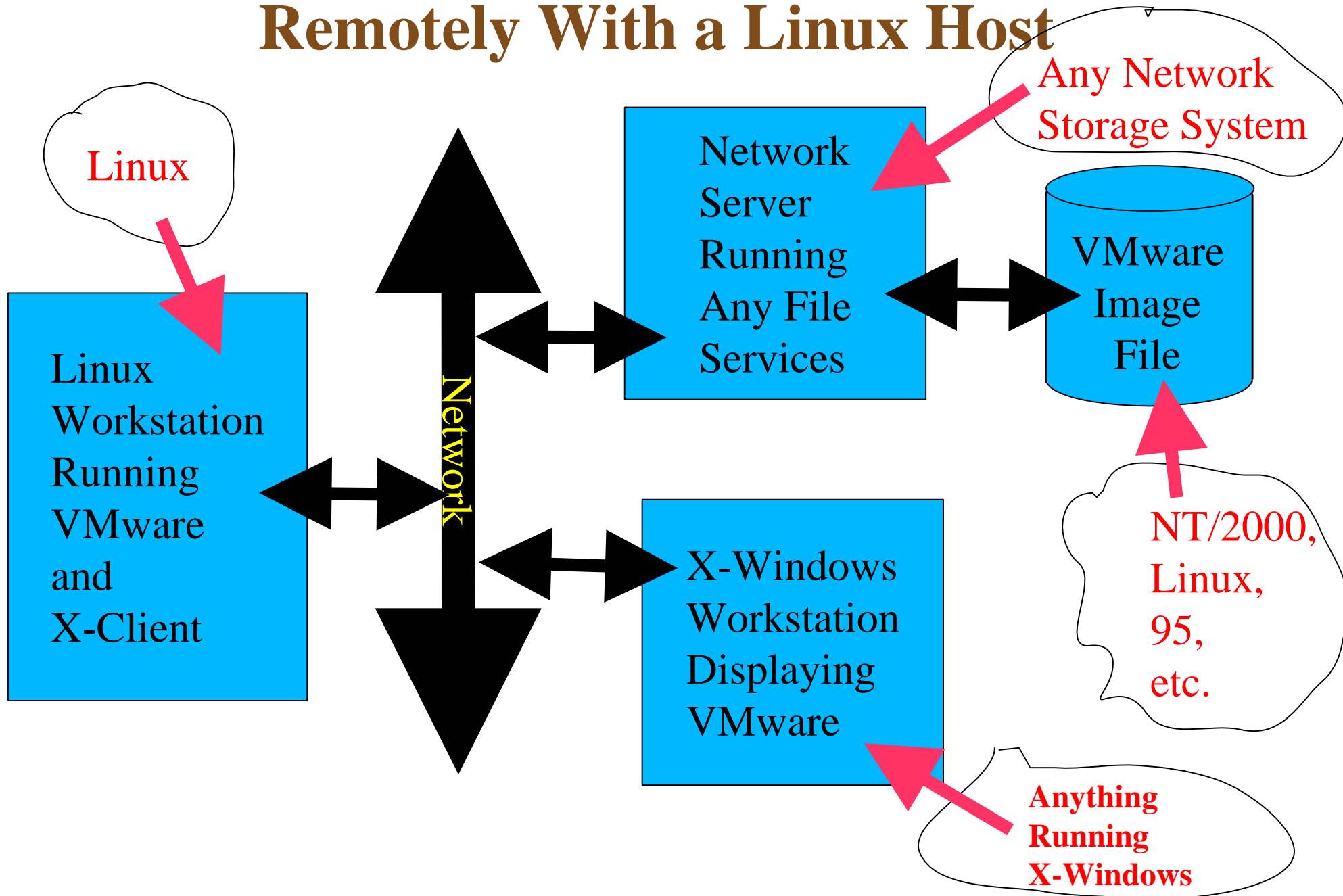
Displaying and Running VMware Remotely Using a Linux Host



Running off a Network Disk With an NT or Linux Host



Storing, Displaying and Running VMware Remotely With a Linux Host



Other Virtual System Options

- " Sun E1000 (E10K) allows the partitioning of the system with multiple operating systems each having one or several CPUs and memory boards
- " HP SuperDome – No information at this time on how it uses the system layout
- " Linux Plex86 – a virtual system package that runs on Linux. The source code is freely available

IBM Virtual System Options

- " The pSeries - RS/6000 with AIX 5.1L will simultaneously run PowerPC Linux using system partitioning like VM
- " The iSeries – AS/400 will run Linux simultaneously with other operating systems using partitioning
- " The xSeries – Netfinity Intel-based server series which runs VMware and later releases of AIX5L – Redbooks
- " The zSeries – S/390 mainframe system run thousands of Linux instances on VM and other managers. Linux versions include Red Hat, SuSE and TurboLinux

Student and Developer Advantages

Virtual Systems, Runnable CD-ROMS and diskettes allow the user to:

Install the operating system without needing to be an network or system administrator

Run the operating system without interacting with the campus or office environment

Administer their own operating system

Experiment with different configurations w/o making permanent changes

Student and Developer Advantages Cont.

The student can access multiple operating systems without needing multiple PCs

Routing and network concepts can be experimented with

All the network changes are isolated within the PC when using the virtual networking

Users can clone a network or operating system and be destructive without changing the original

Instructor Advantages

It is possible to demonstrate different configuration and install procedures without getting involved in hardware setup

The VMware display in Linux is run on X-Windows allowing a demonstration across the network

The virtual machine only takes up the disk storage space that is actually needed. Empty file space is not allocated

IT Staff Advantages

By using host-only mode the networking is isolated within the PC

Any access to the main network must be done by configuring the host as a router. This can be restricted to only allowing changes by the admin

It is not necessary for the IT staff to constantly rebuild the system after each term. It is only necessary to delete extra files or partitions

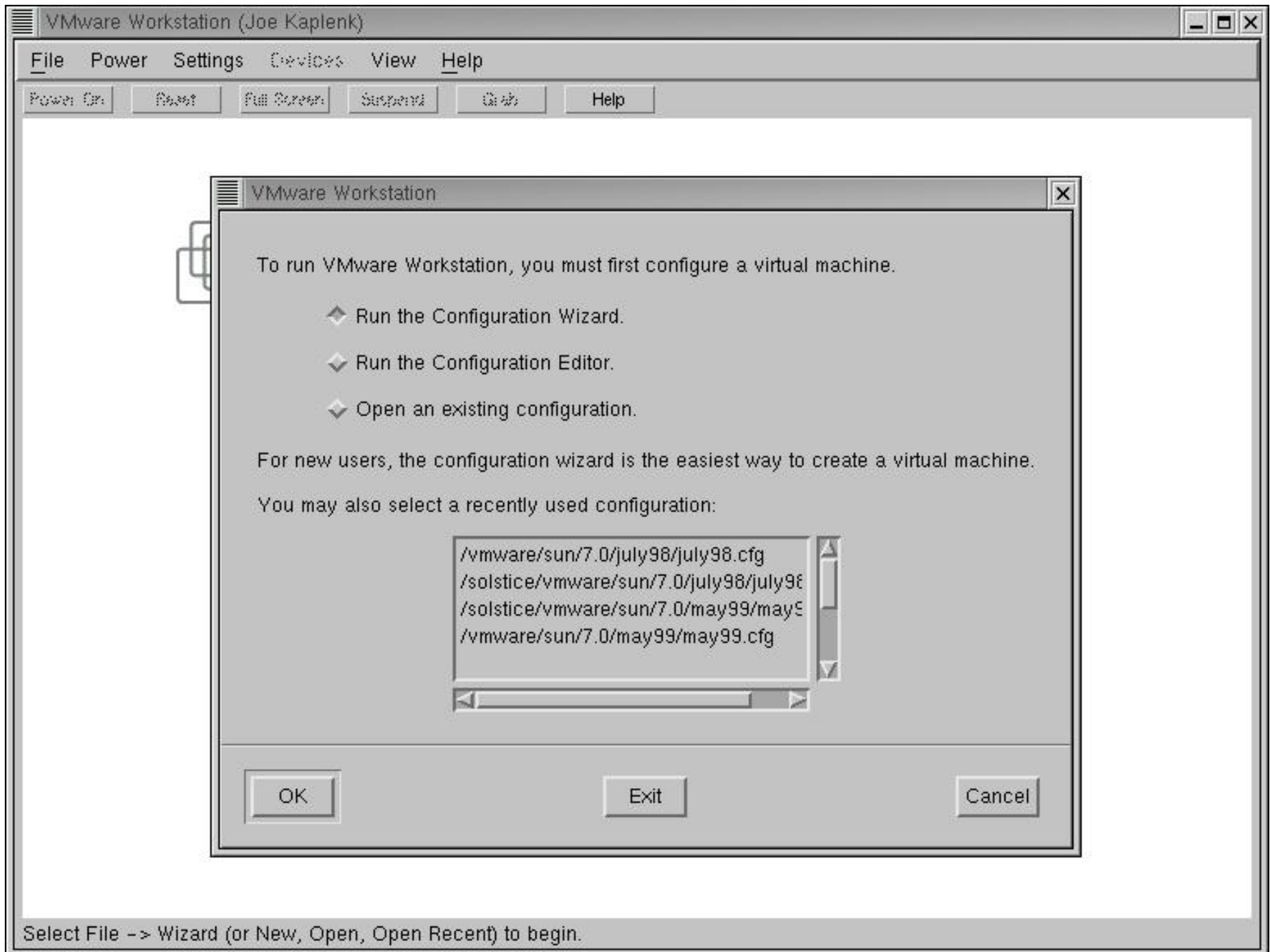
Weaknesses or Realities of VMware

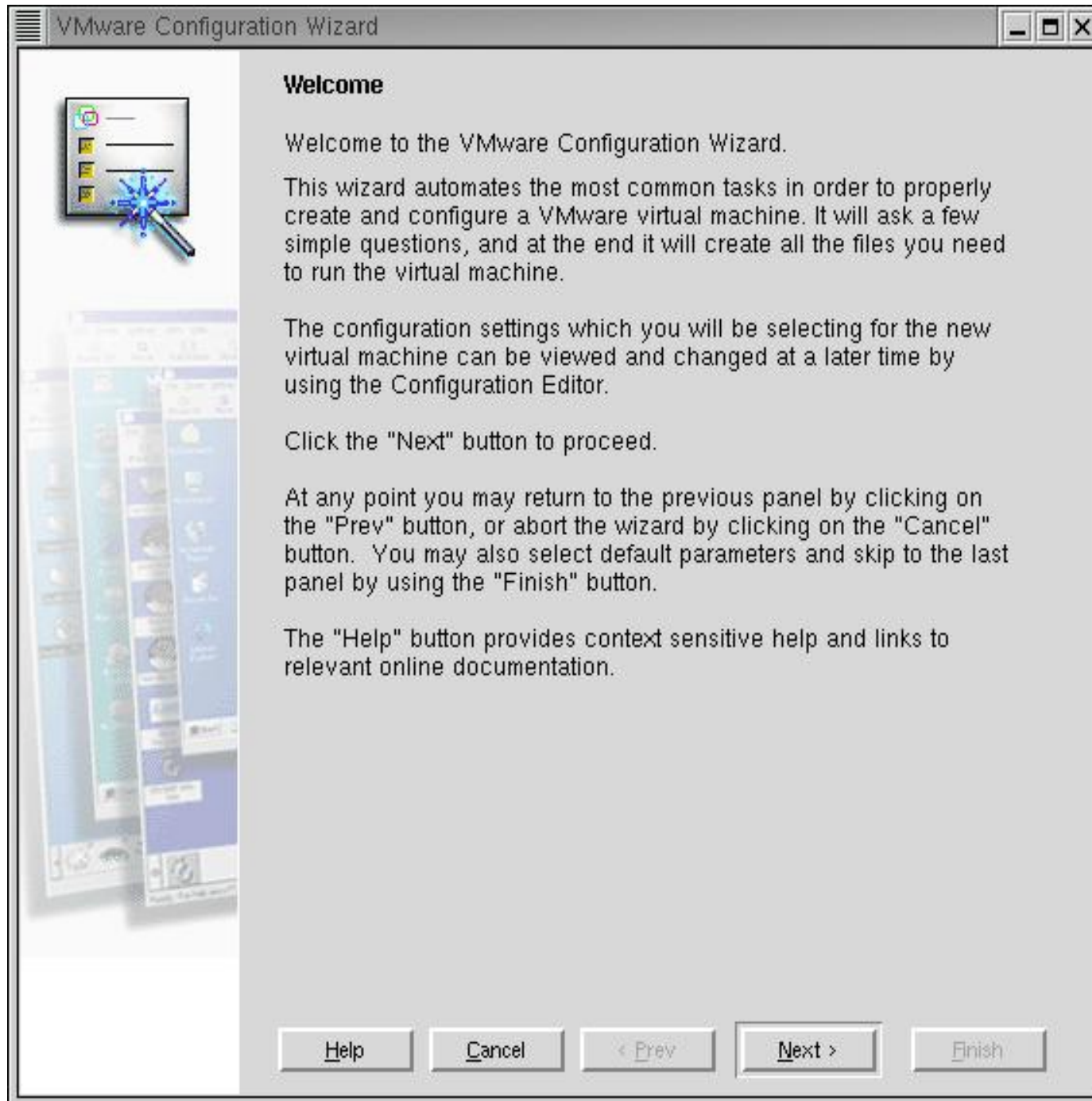
There is a per workstation cost for a license

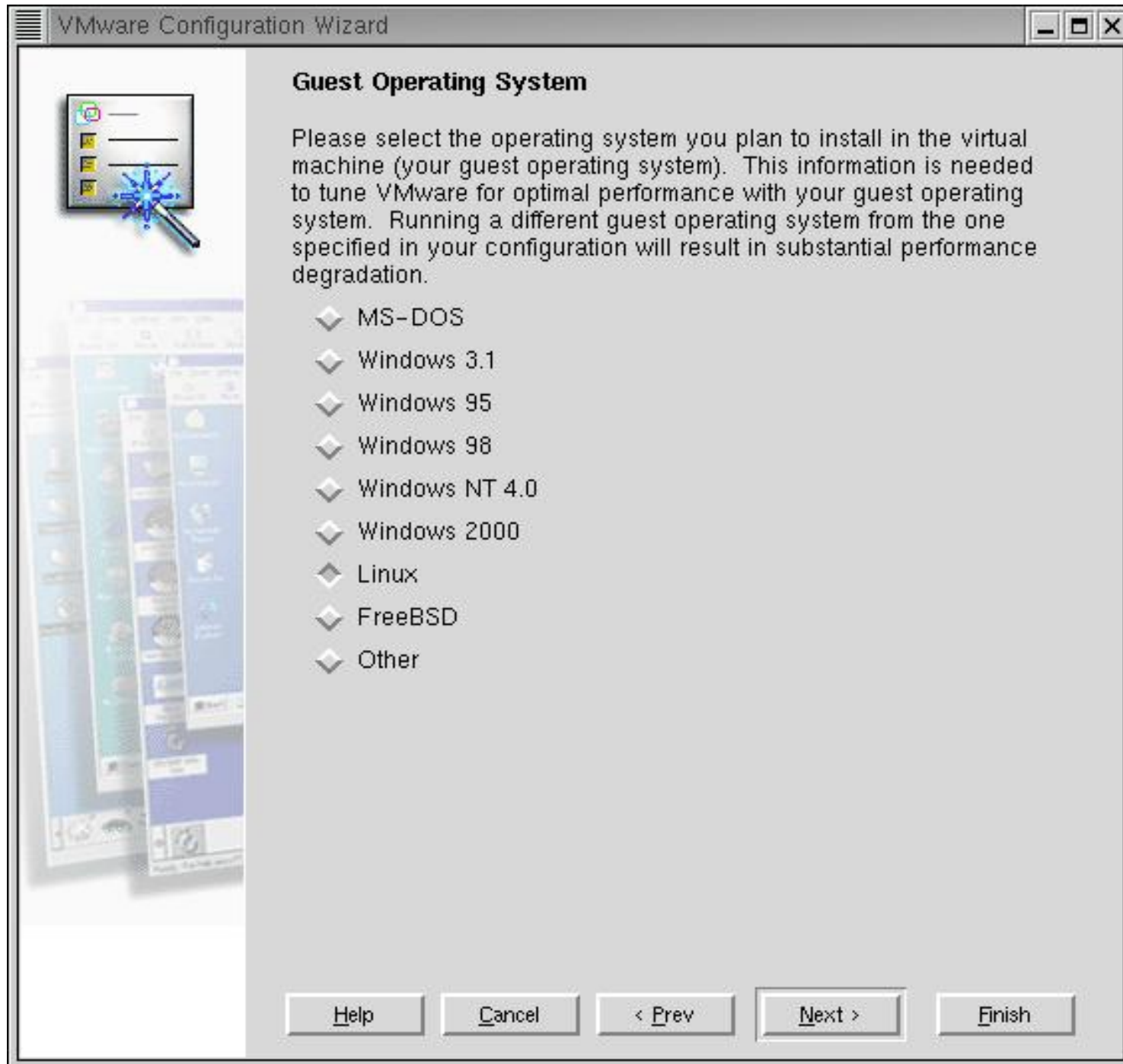
You need to allow the normal amount of memory for each running virtual operating system plus a little extra to avoid swapping

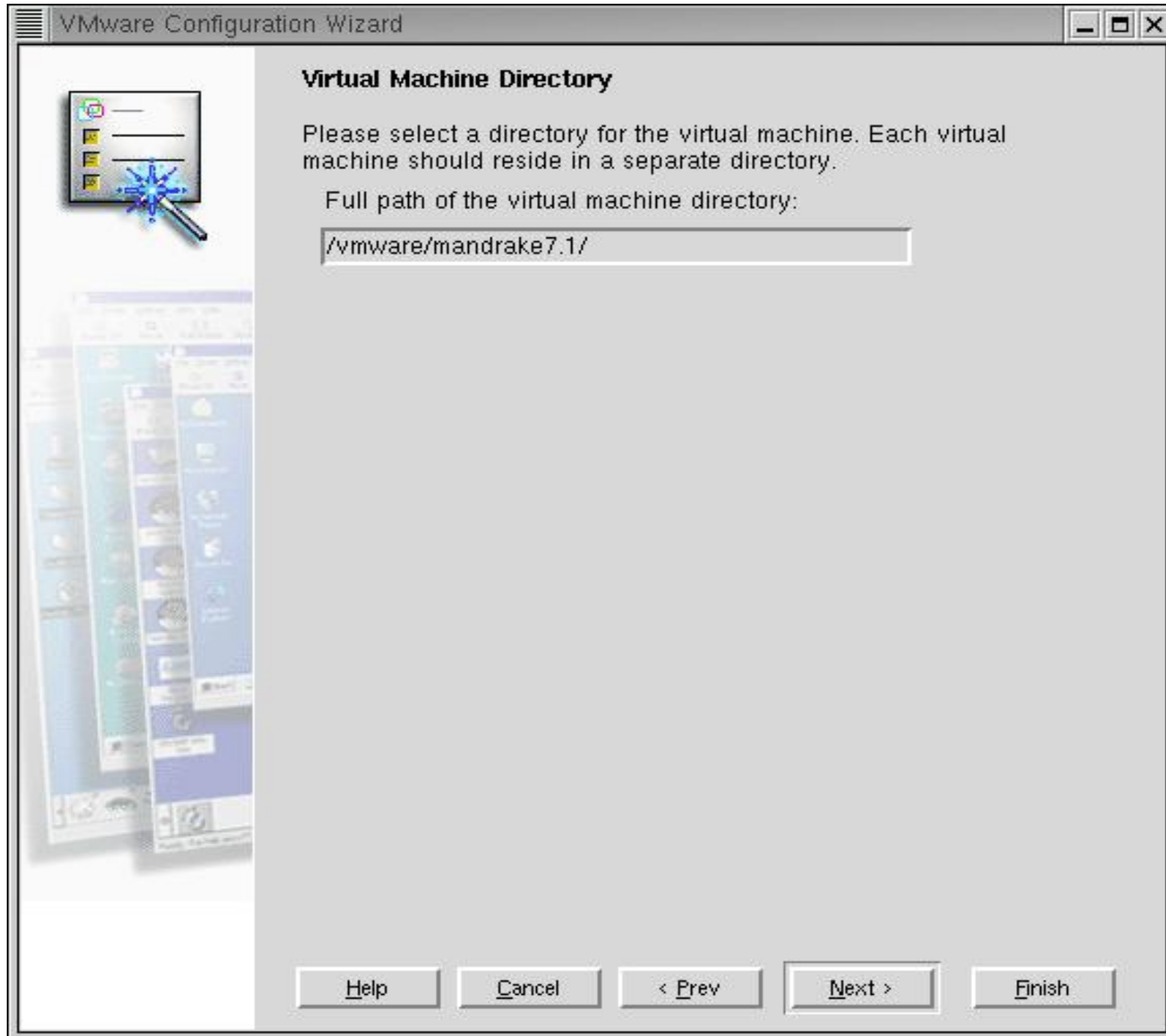
Graphics support is more limited

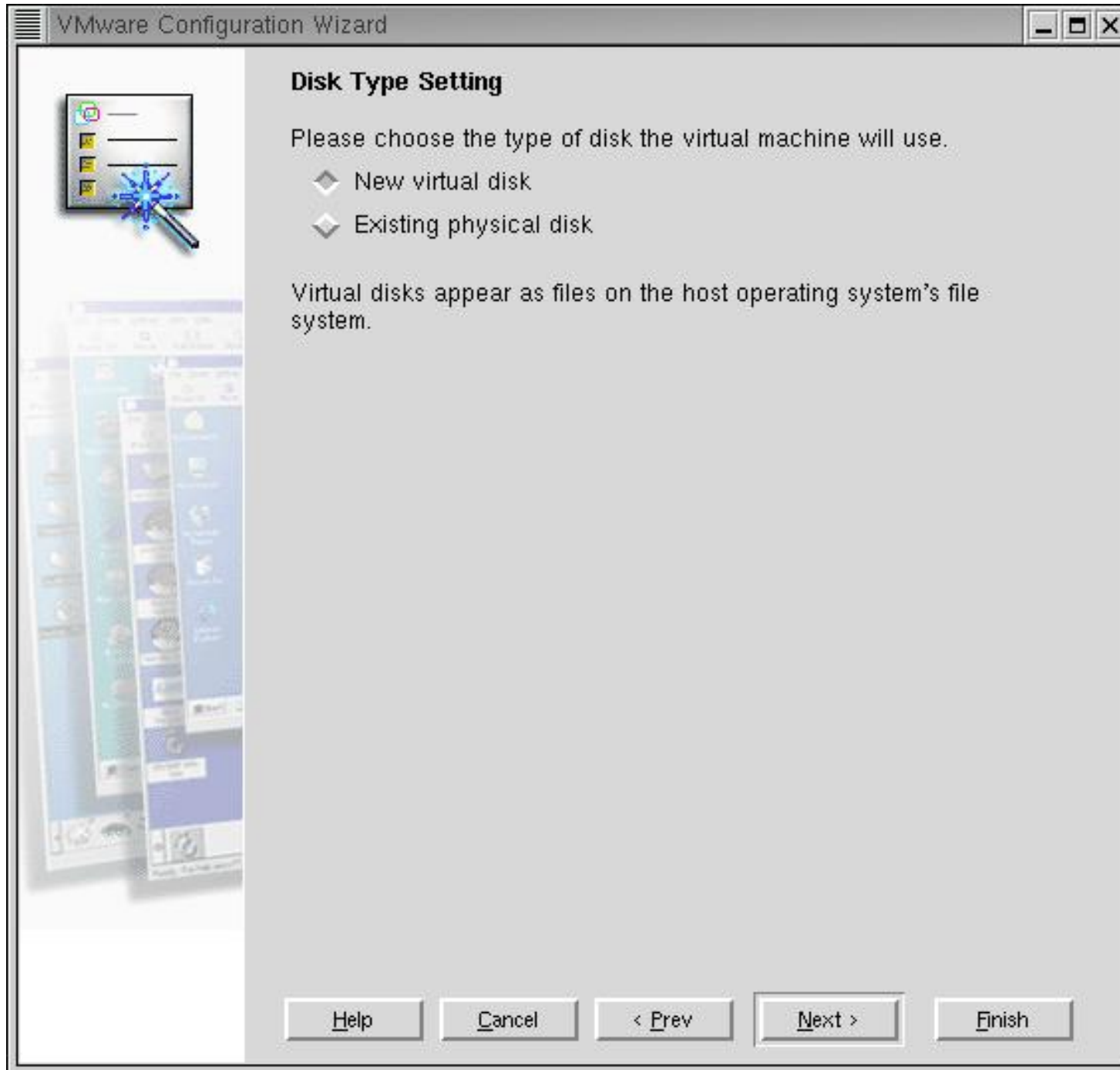
Device support for the guest is limited to those devices supported by the host



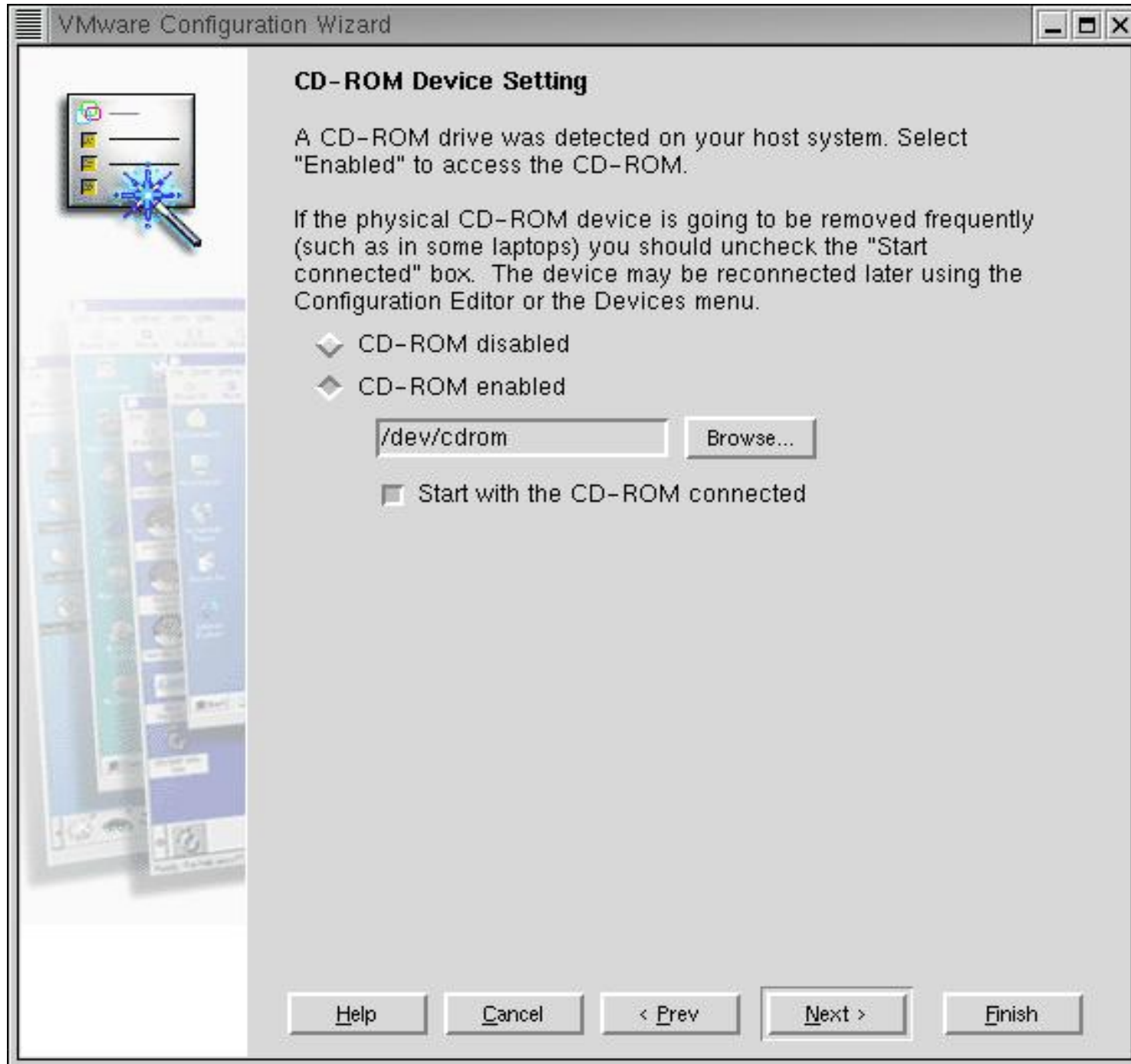


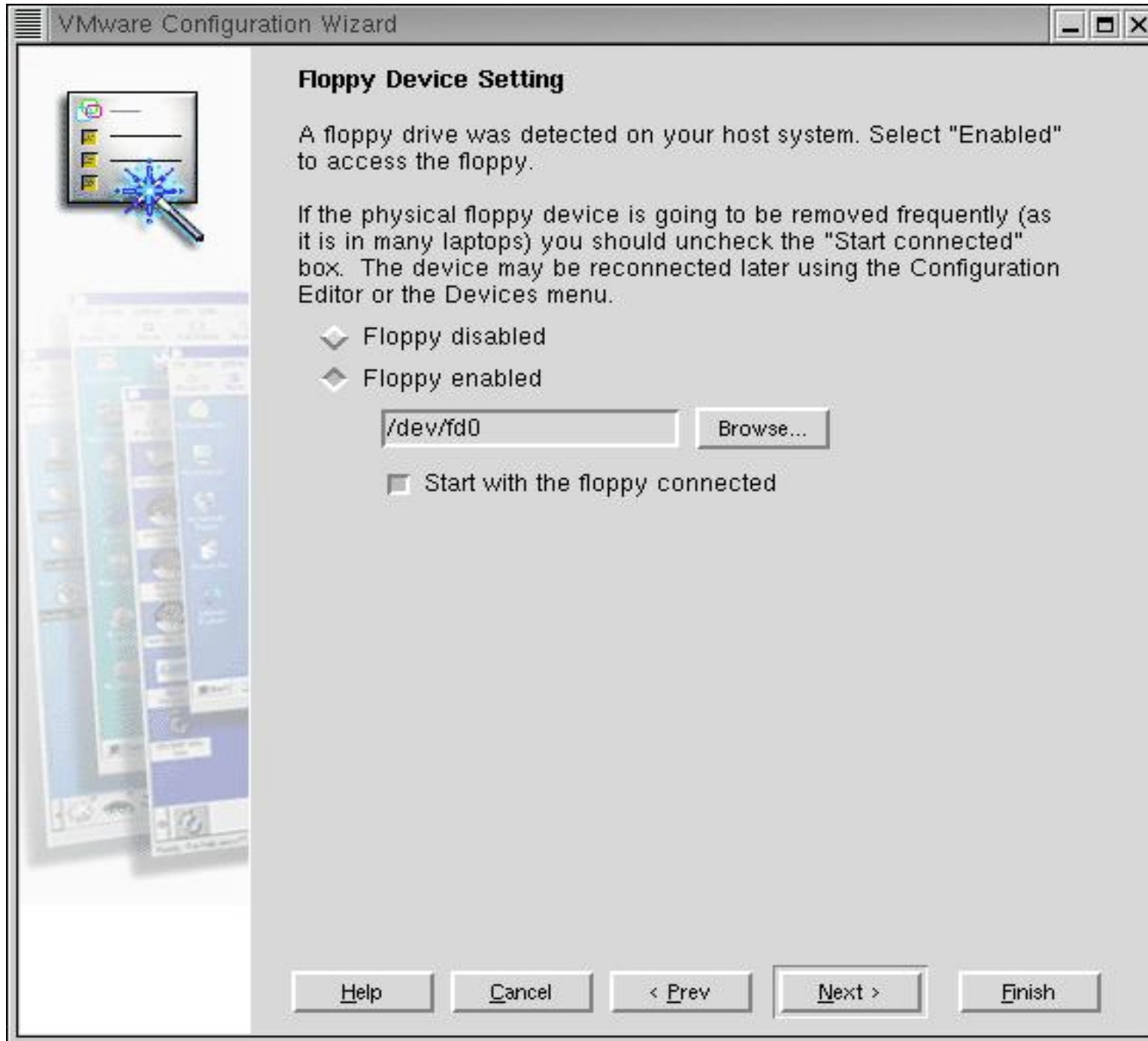


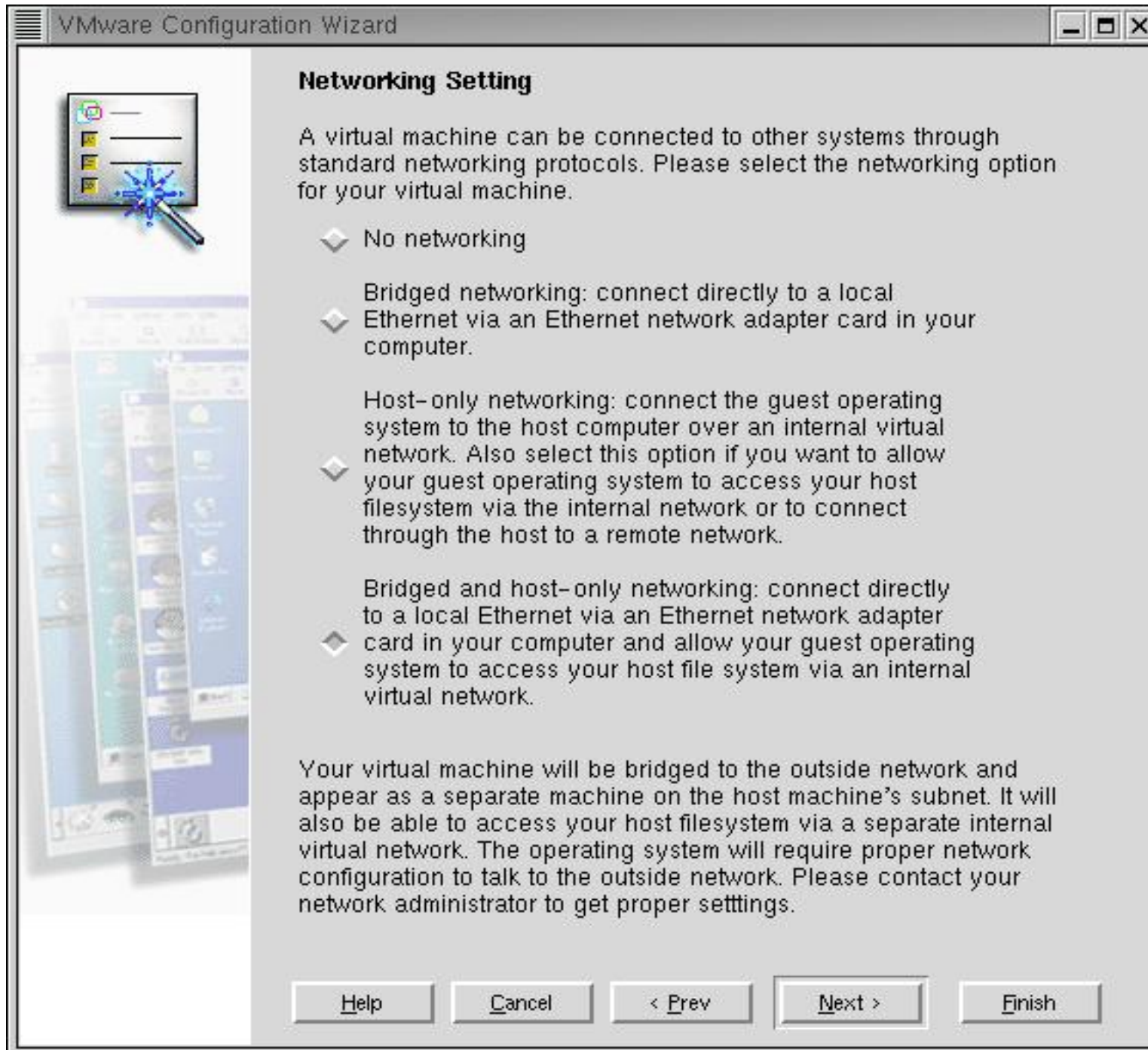


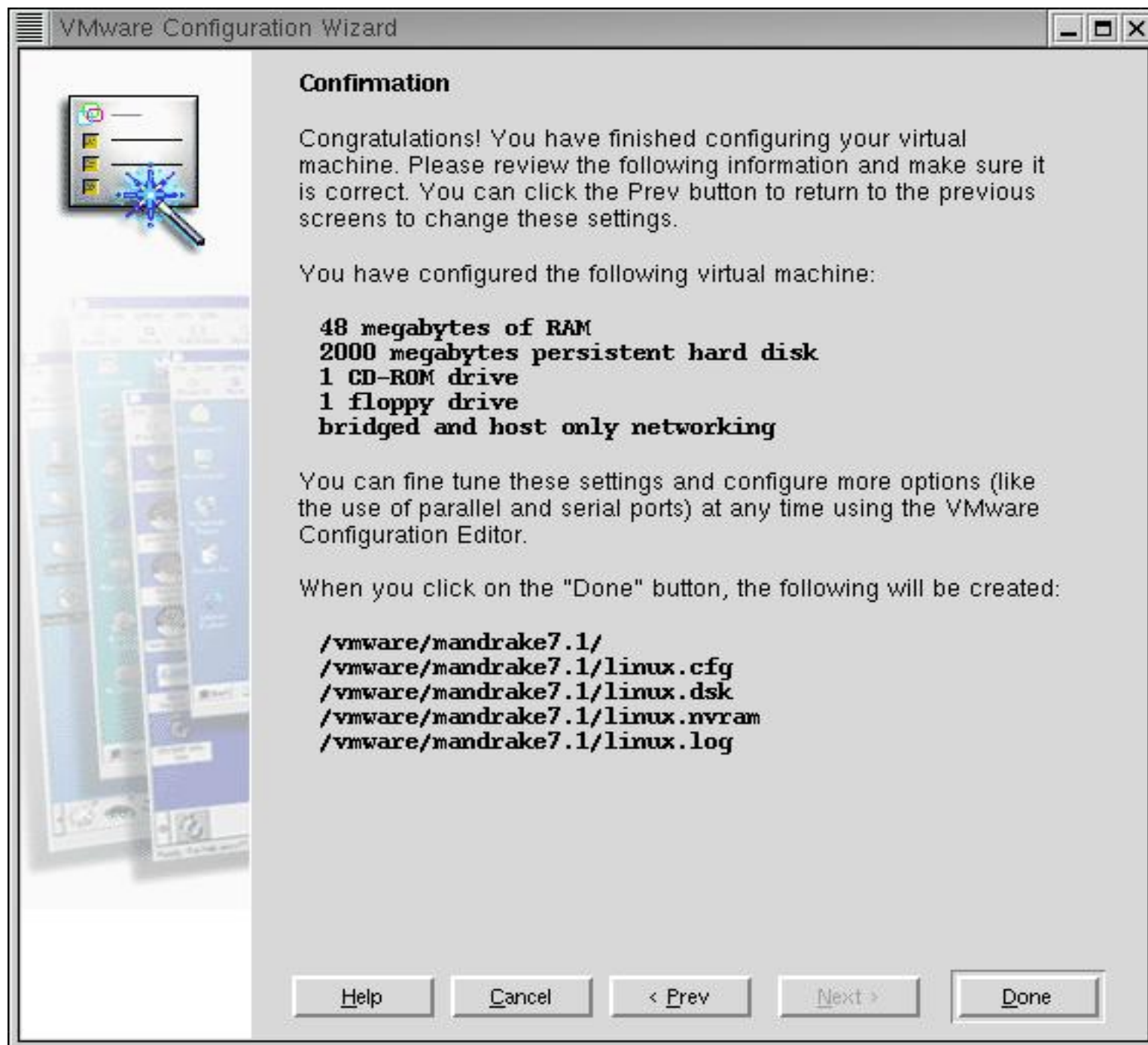












VMware Workstation: /vmware/mandrake7.1/linux.cfg (Joe Kaplenk)

File Power Settings Devices View Help

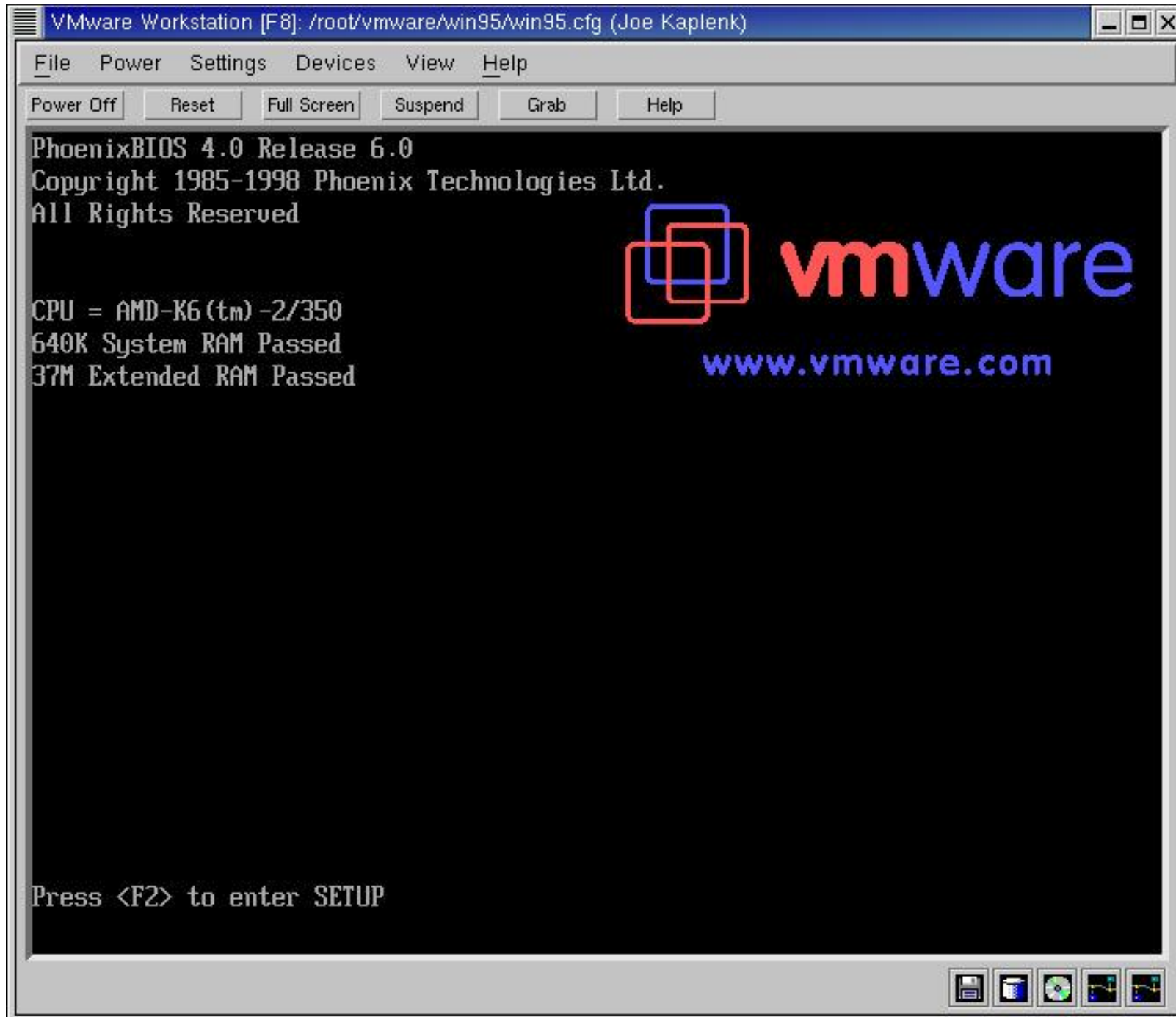
Power On Reset Full Screen Suspend Grab Help



www.vmware.com

Copyright © 1998-2000 VMware, Inc. All rights reserved.
This program is protected by U.S. and international copyright laws.

Click Power On to start execution.




```

Konsole <4>
File Sessions Options Help
[root@wheels /root]# vmware &
[1] 1163
[root@wheels /root]# vmware &
[2] 1167
[root@wheels /root]# X connection to :0.0 broken (exp
wn).

[2]+ Exit 1 vmware
[root@wheels /root]# vmware &
[2] 1173
[root@wheels /root]# gimp

```

File Power Settings Devices View Help

Gnome Help Browser

File Window Settings Help

Back Forward Reload Index History BMarks Help

Location: toc:

...e Help

als

all Guide | [Red Hat Linux Reference Guide](#)

...ale

Taskbar icons: Help, Network, Internet Explorer, Start menu.

File Xtns

Toolbar icons: Selection tools, Copy, Paste, Undo, Redo, Erase, Fill, Text, etc.

References

- " VMware website: www.vmware.com
- " Book: VMware 2 for Linux by Jason Compton, publ by Prima Tech
- " Article: Using Linux to Teach UNIX System Administration by Joe Kaplenk - w2.linuxjournal.com/cgi-bin/frames.pl/lj-issues/issue44/2348.html
- " My email: jkaplenk@aol.com
- " y website: users.aol.com/jkaplenk

My Computer/Scientific Background

B.S. Physics – University of Utah

Collective Technologies (Current)

IBM Global Services

Loyola University Chicago

University of Illinois at Chicago Physics Dept.

Argonne National Labs

Fermi National Labs

Motorola

R.R. Donnelley

Comdisco

My Publishing Background

Author of:

UNIX System Administrator's Interactive Workbook

Linux Network Administrator's Interactive Work Book

Co-Author of:

IBM Redbooks on:

Turbo Linux

Red Hat Linux

Caldera Linux

SuSE Linux

My Training Background

Current and Past Instructor for:

- „ College of DuPage CIS Department (Current)
- „ New Horizons Computer Learning Center
- „ Loyola University Mathematics Dept.
- „ Westwood College of Technology