Virtual Machine

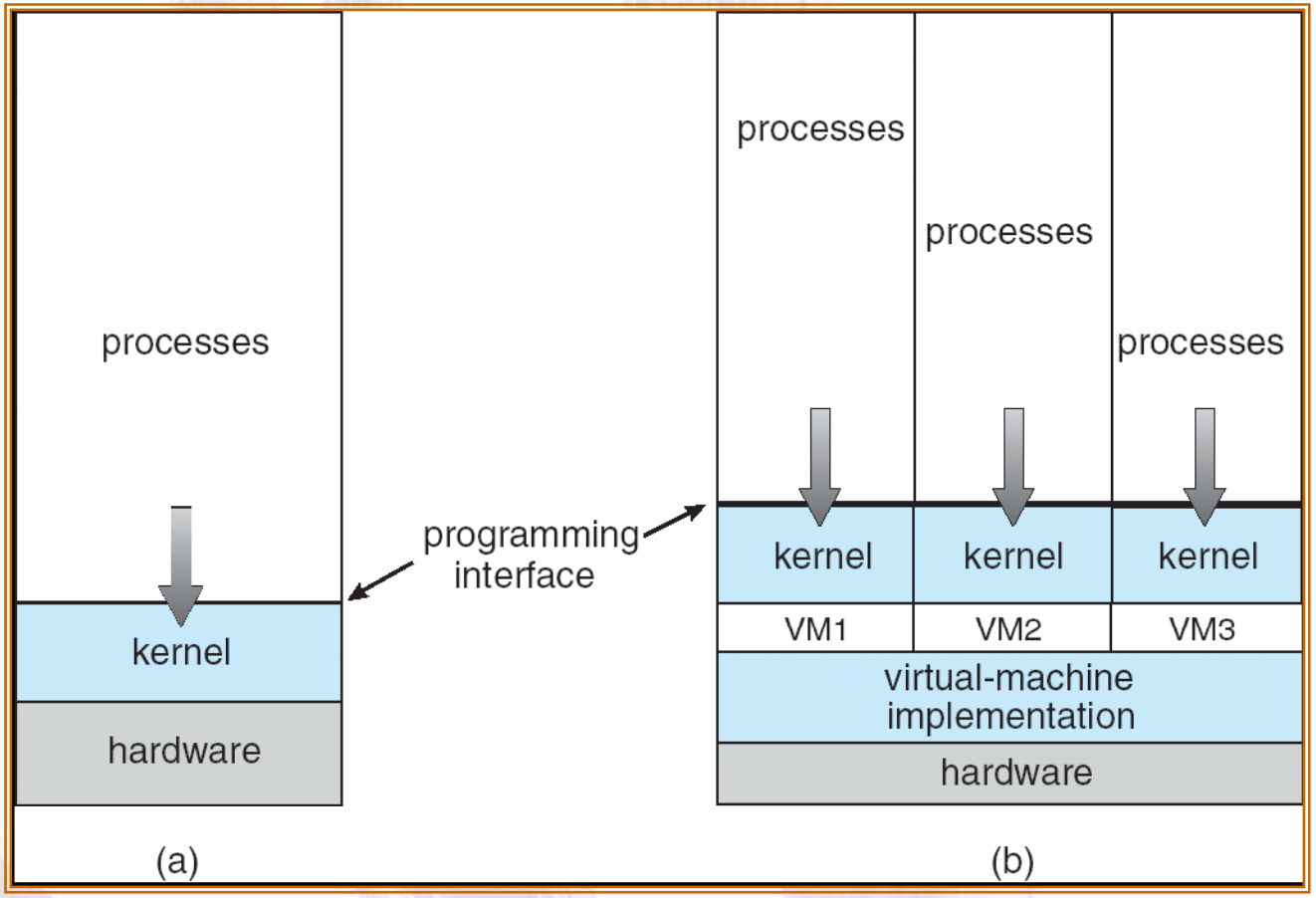
Virtual Machines

- 緣由IBM CMS (single user OS) -> Multiple users
- A *virtual machine* takes the layered approach to its logical conclusion. It treats hardware and the operating system kernel as though they were all hardware
- A virtual machine provides an interface *identical* to the underlying bare hardware
- The operating system creates the illusion of multiple processes, each executing on its own processor with its own (virtual) memory

Virtual Machines (Cont.)

- The resources of the physical computer are shared to create the virtual machines
  - CPU scheduling can create the appearance that users have their own processor
  - Spooling and a file system can provide virtual card readers and virtual line printers
  - A normal user time-sharing terminal serves as the virtual machine operator's console

Virtual Machines (Cont.)

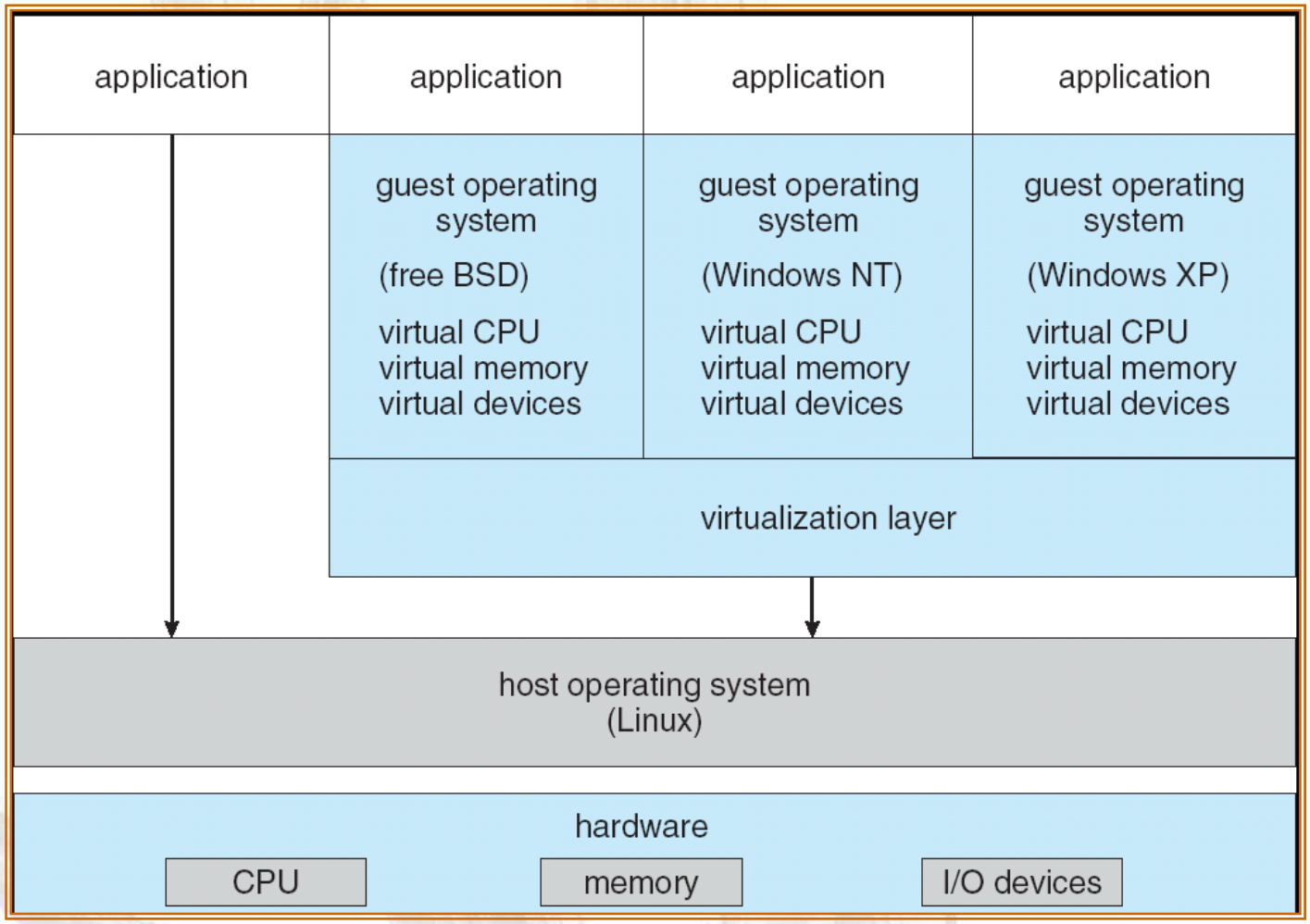


(a) Nonvirtual machine (b) virtual machine

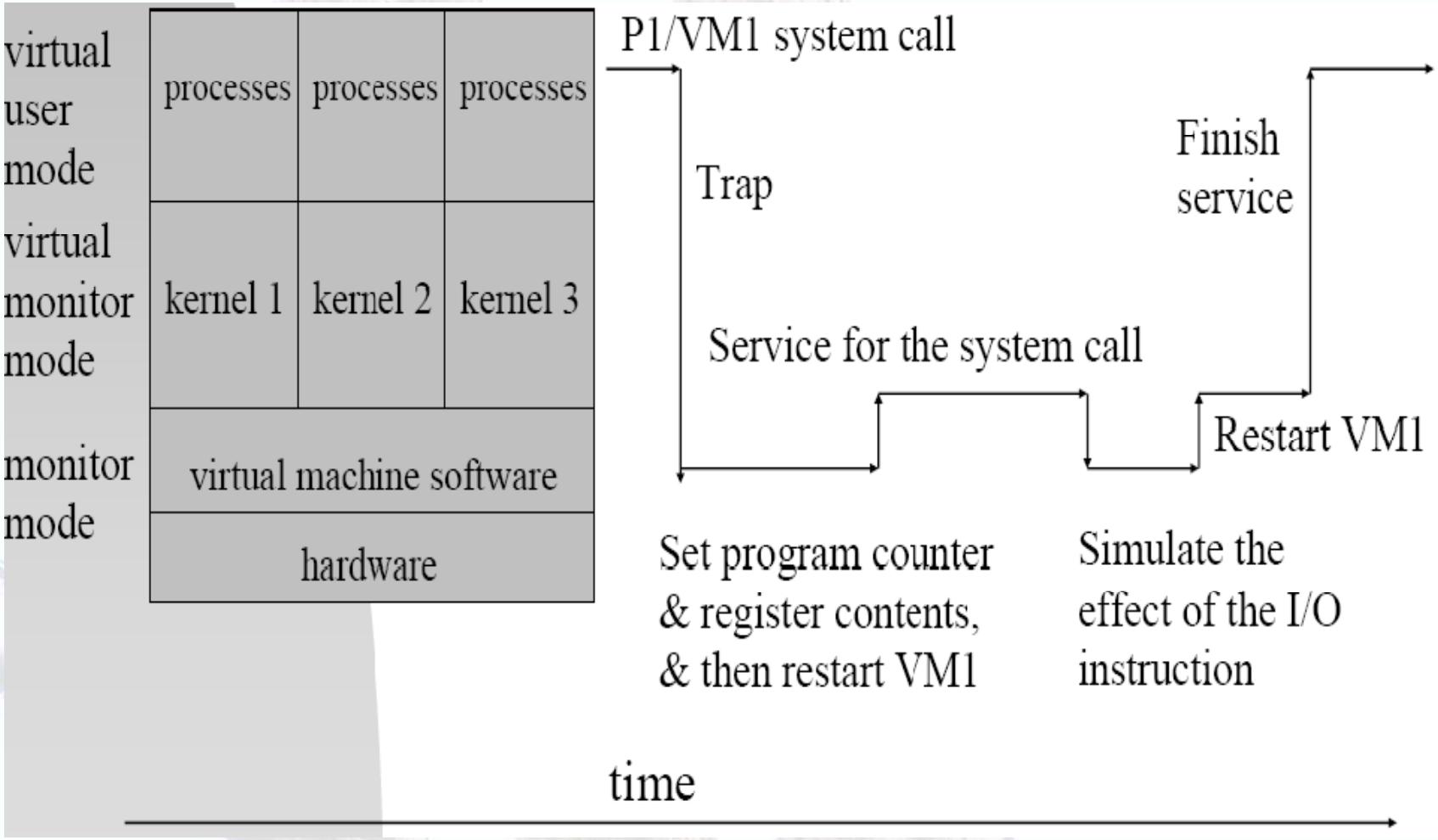
Virtual Machines (Cont.)

- The virtual-machine concept provides complete protection of system resources since each virtual machine is isolated from all other virtual machines. This isolation, however, permits no direct sharing of resources.
- A virtual-machine system is a perfect vehicle for operating-systems research and development. System development is done on the virtual machine, instead of on a physical machine and so does not disrupt normal system operation.
- The virtual machine concept is difficult to implement due to the effort required to provide an *exact* duplicate to the underlying machine

VMware Architecture

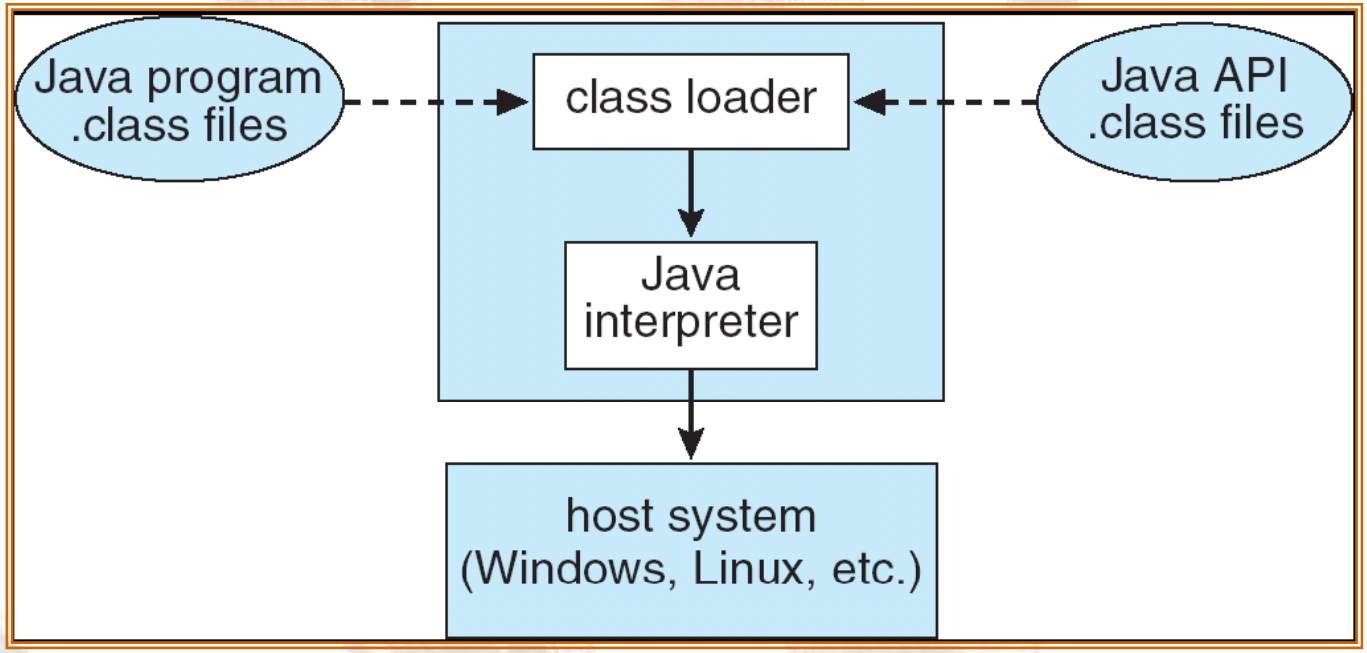


VM working

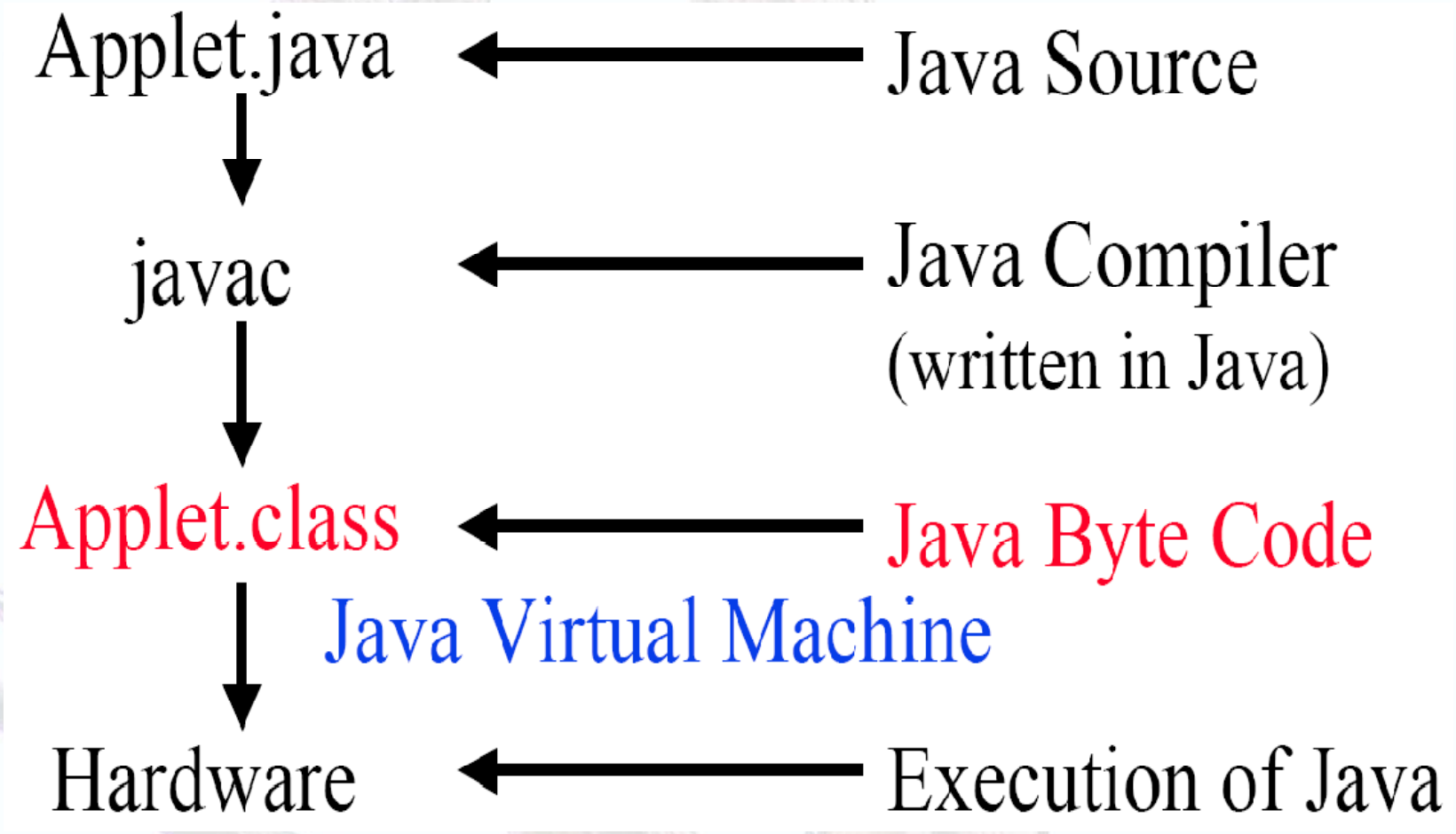

virtual user mode
processes
processes
processes
virtual monitor mode
kernel 1
kernel 2
kernel 3
monitor mode
virtual machine software
hardware
P1/VM1 system call
Trap
Finish service
Service for the system call
Restart VM1
Set program counter & register contents, & then restart VM1
Simulate the effect of the I/O instruction
time

Example 1

- Java Virtual Machine



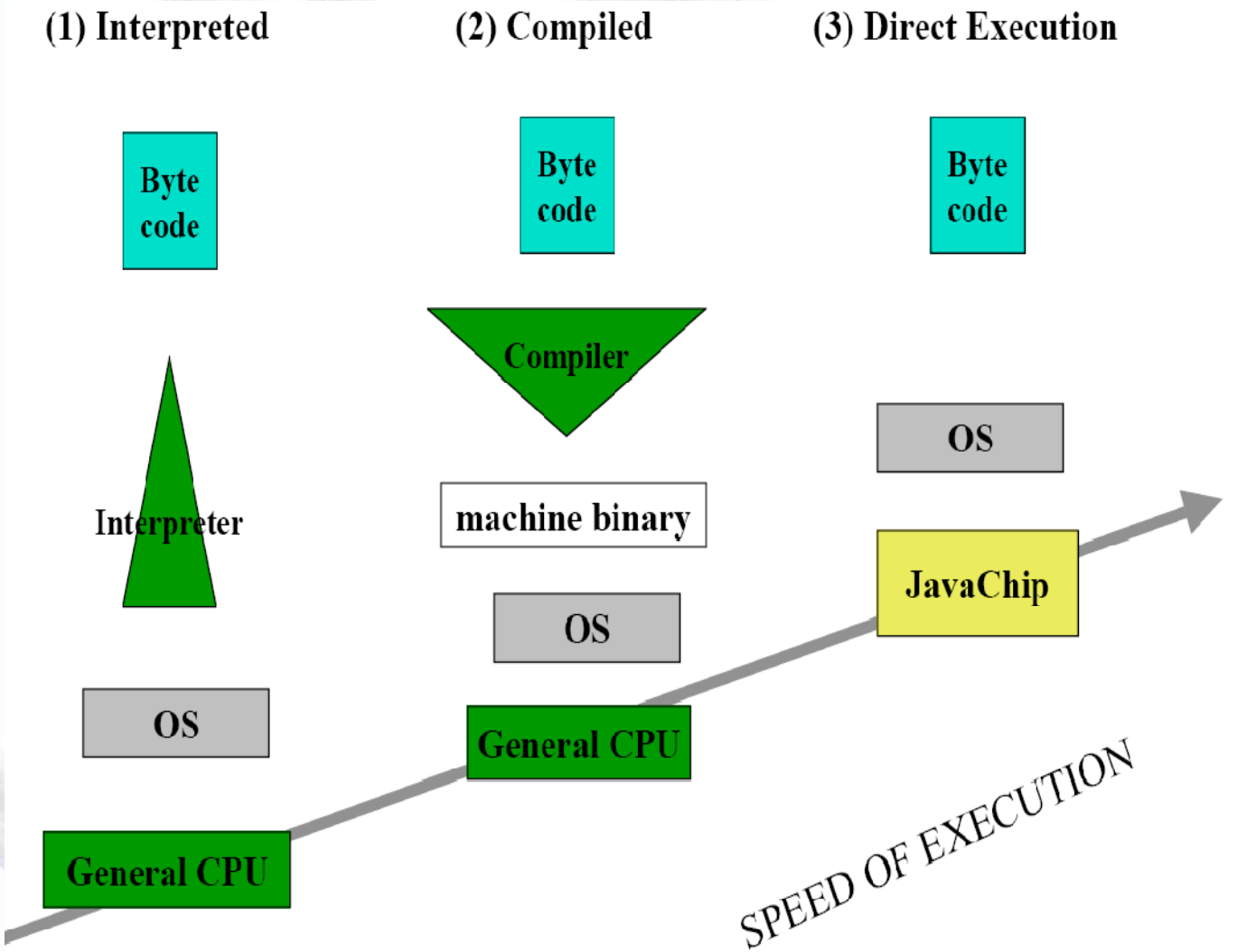
Executing Java



Java Virtual Machine

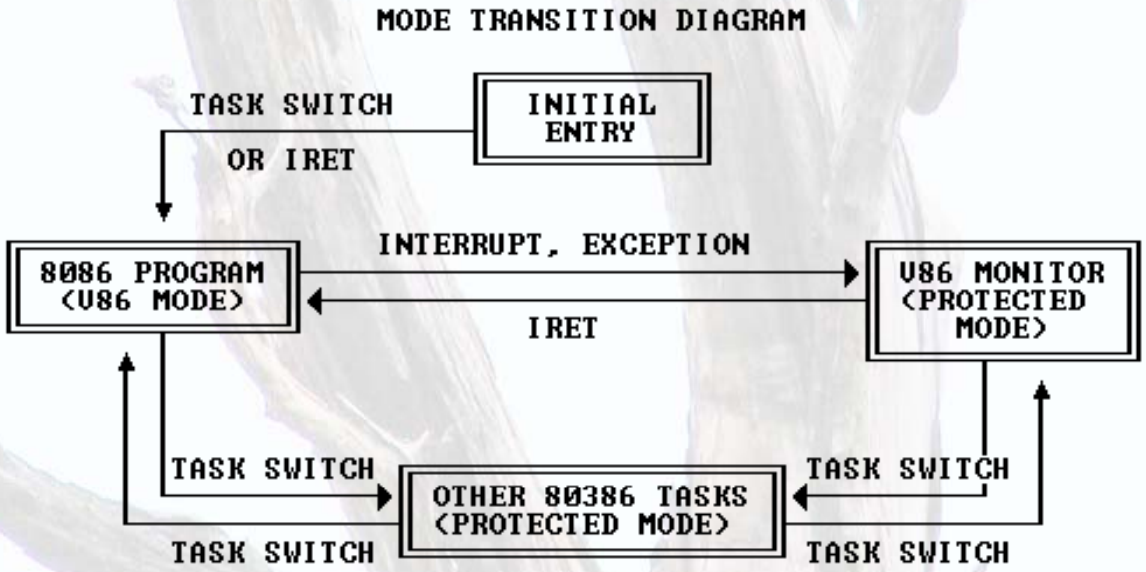
- The virtual machine specifies:
  - instruction set
  - registers
  - ……
- Stack based machine
  - operands typically accessed from the stack, stored back to the stack
- Java CPU就是把Java virtual machine直接硬體化的CPU
  - PicoJava II, CCL Java CPU, aj-100
    - best performance
    - define extended bytecode
    - tools (compiler, debugger,…)

Execution Alternatives for Java



Example 2

- X86/Pentium 之 V86 mode
- Real mode -> Virtual 8086 mode
  - The hardware provides
    - a virtual set of registers (via the TSS),
    - a virtual memory space (the first megabyte of the linear address space of the task),
    - and directly executes all instructions that deal with these registers and with this address space.



Sensitive Instructions

- CLI
  - Clear Interrupt-Enable Flag
- STI
  - Set Interrupt-Enable Flag
- LOCK
  - The LOCK prefix Assert Bus-Lock Signal during execution of the instruction
- PUSHF
  - Push Flags
- POPF
  - Pop Flags
- INT n
  - Software Interrupt
- RETI
  - Interrupt Return
- Virtualizing the sensitive instructions

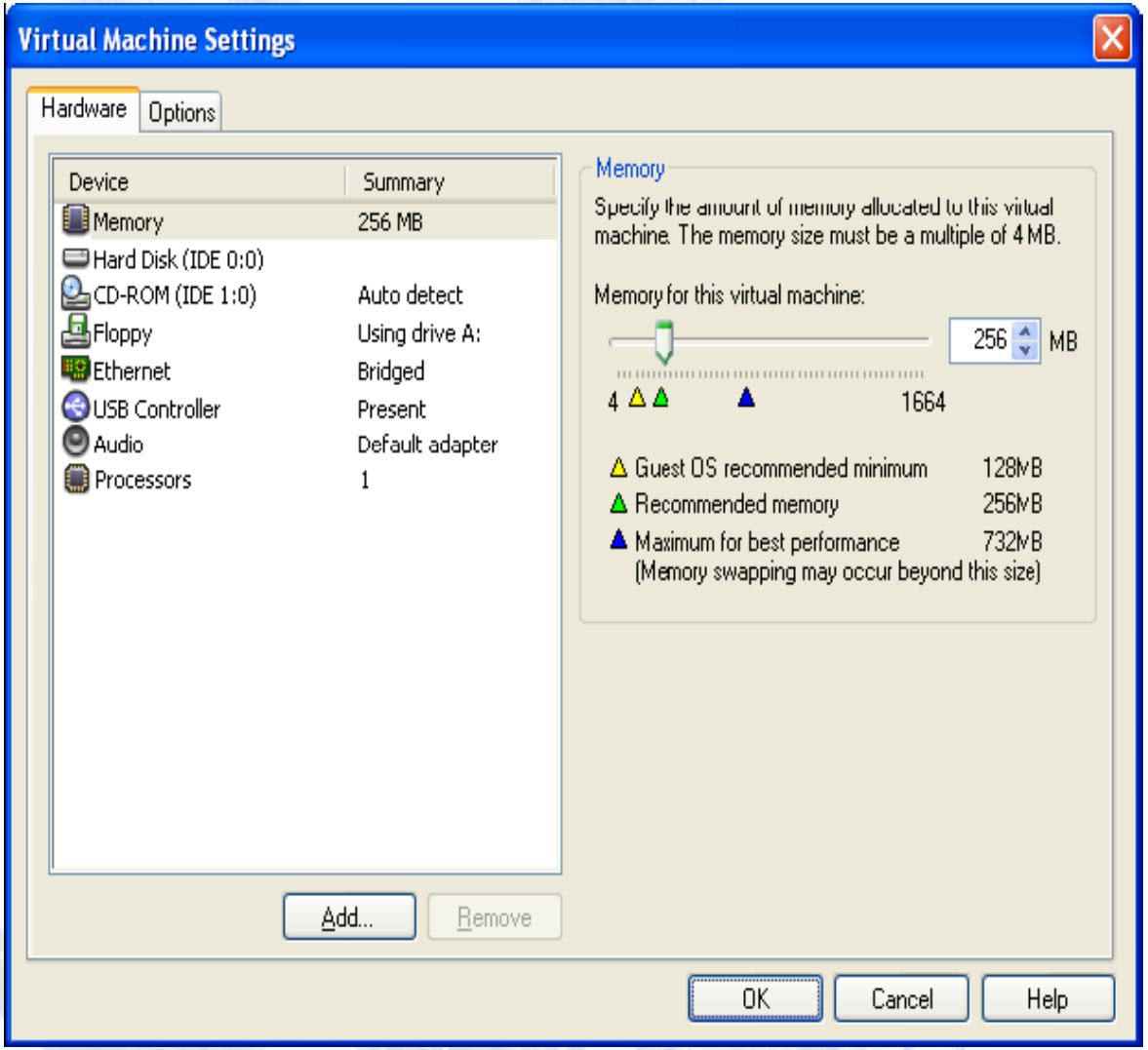
VM Advantages

- Extensions to Multiple OS, Multiple Personalities
- Emulations of Machines and Oss
  - Benefit to network development
- OS research & development
- Protection & Isolation

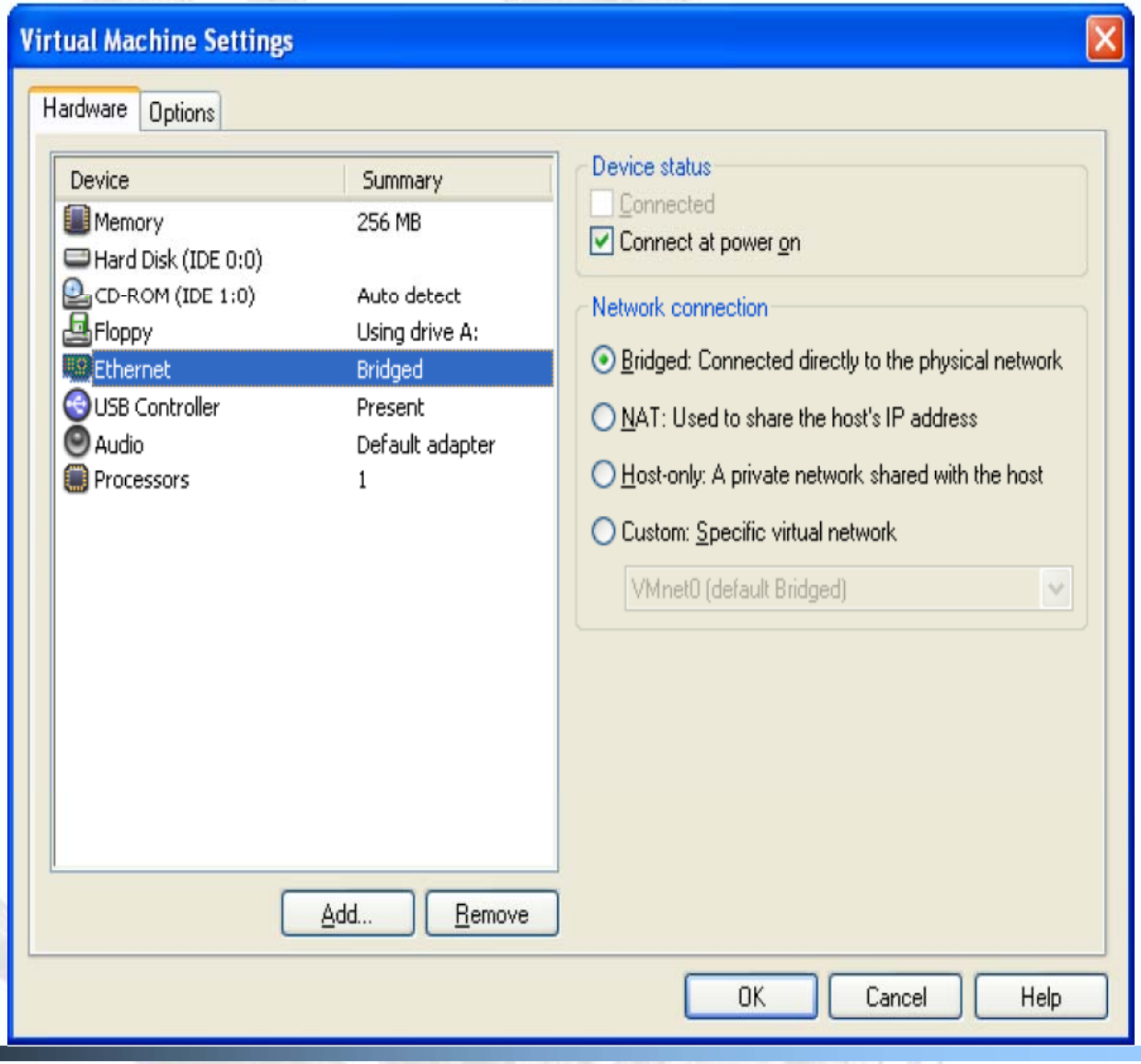
VM Disadvantages

- Slow!!
  - No direct sharing of resources

VMWare


Virtual Machine Settings
Hardware
Options
Device
Summary
Memory
256 MB
Hard Disk (IDE 0:0)
CD-ROM (IDE 1:0)
Auto detect
Floppy
Using drive A:
Ethernet
Bridged
USB Controller
Present
Audio
Default adapter
Processors
1
Memory
Specify the amount of memory allocated to this virtual machine. The memory size must be a multiple of 4 MB.
Memory for this virtual machine:
256
MB
4
1664
Guest OS recommended minimum 128MB
Recommended memory 256MB
Maximum for best performance 732MB
(Memory swapping may occur beyond this size)
Add...
Remove
OK
Cancel
Help

Virtual Network



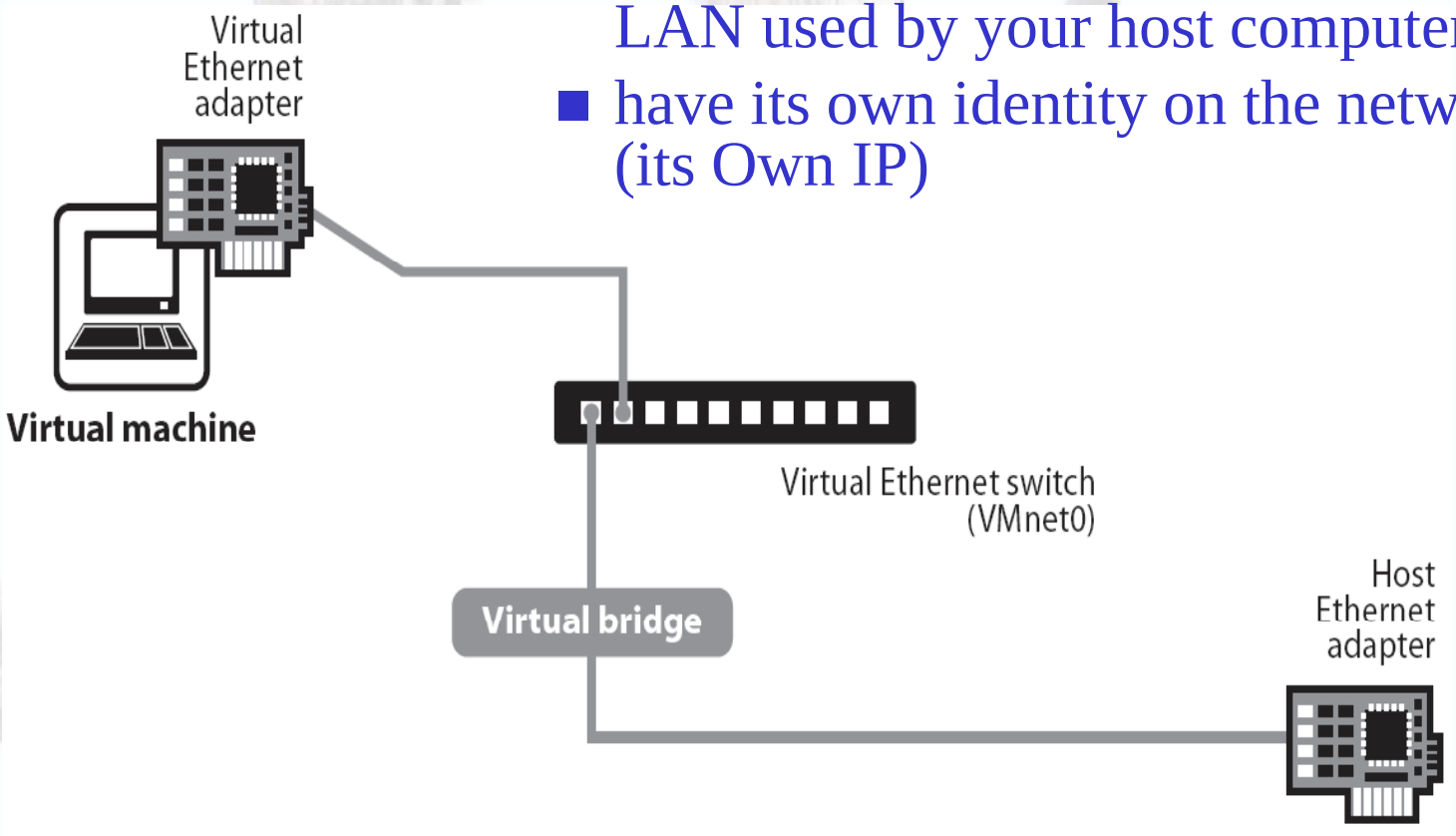
Virtual Network

- Virtual switch
  - The bridged network uses VMnet0.
  - The host-only network uses VMnet1.
  - The NAT network uses VMnet8.
- Host Virtual Adapter
  - a virtual Ethernet adapter that appears to your host operating system
  - allows you to communicate between your host computer and virtual machines on that host computer
  - used in host-only and NAT configurations.
- Virtual Network Adapter (in a Virtual Machine)
  - One virtual network adapter (AMD PCNET PCI adapter) is set up for your virtual machine.

Networking Configurations

Bridged Networking

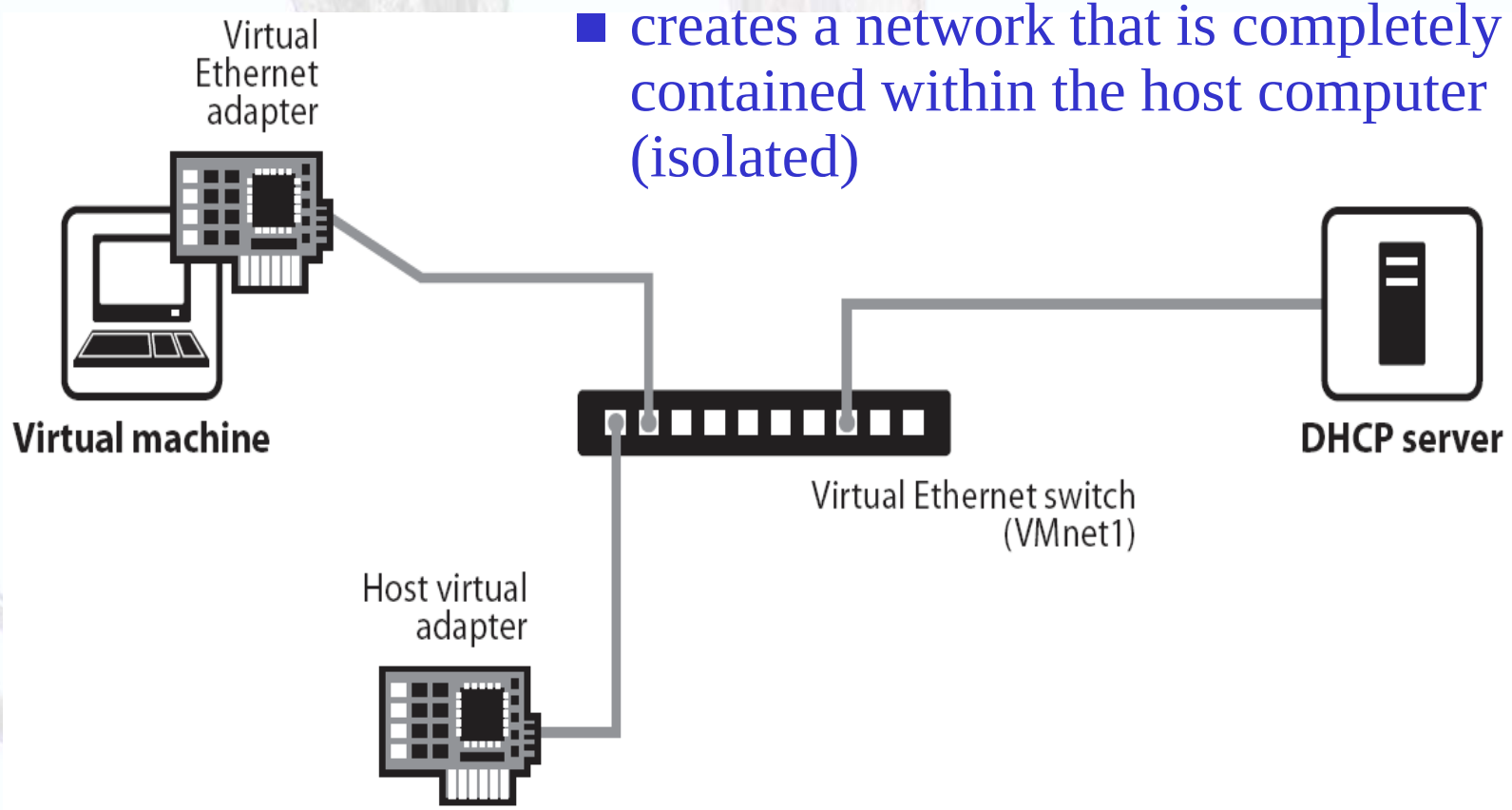
- connect your virtual machines to the LAN used by your host computer
- have its own identity on the network (its Own IP)



Networking Configurations

Host-Only Networking

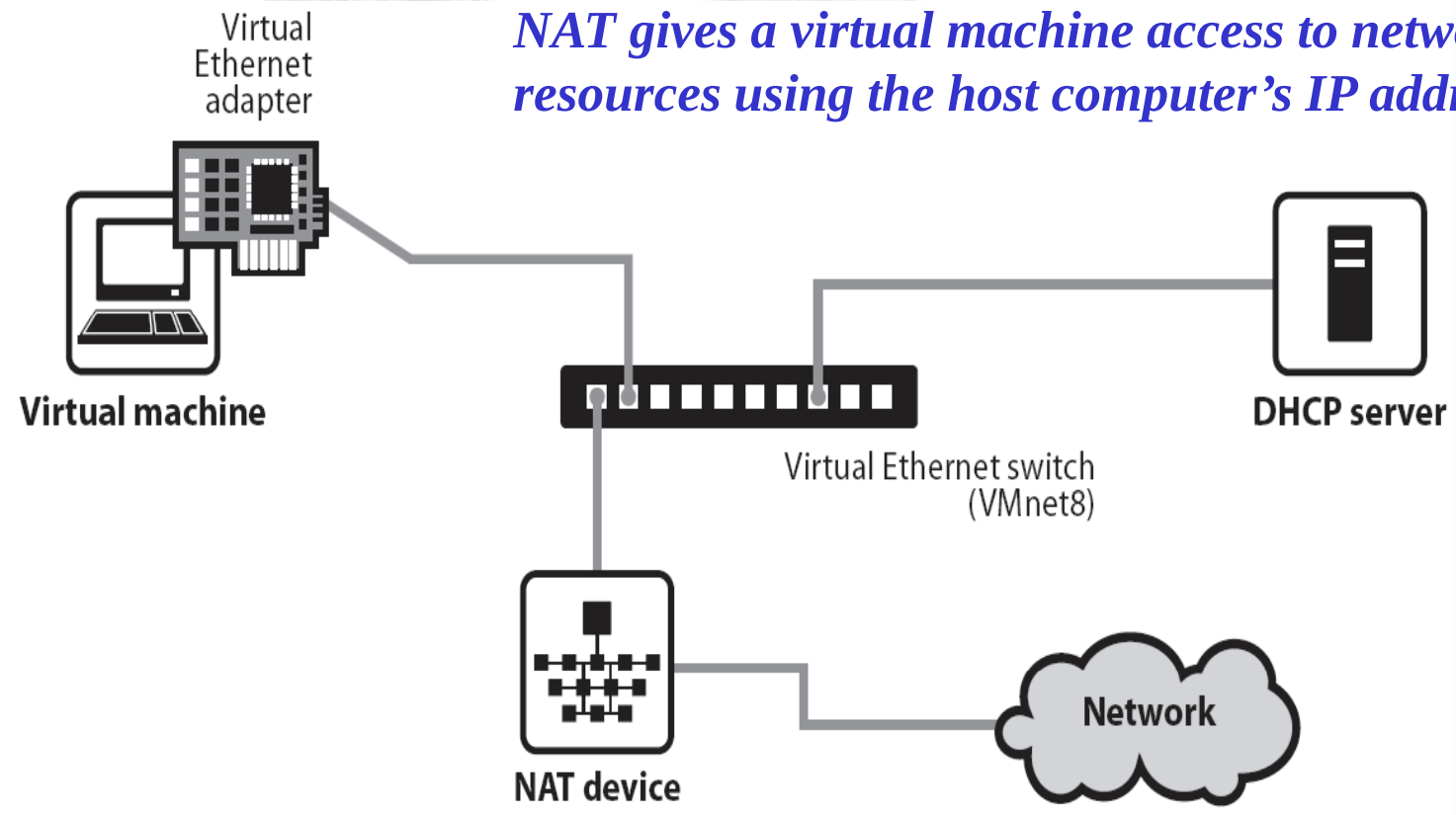
- creates a network that is completely contained within the host computer (isolated)



Networking Configurations

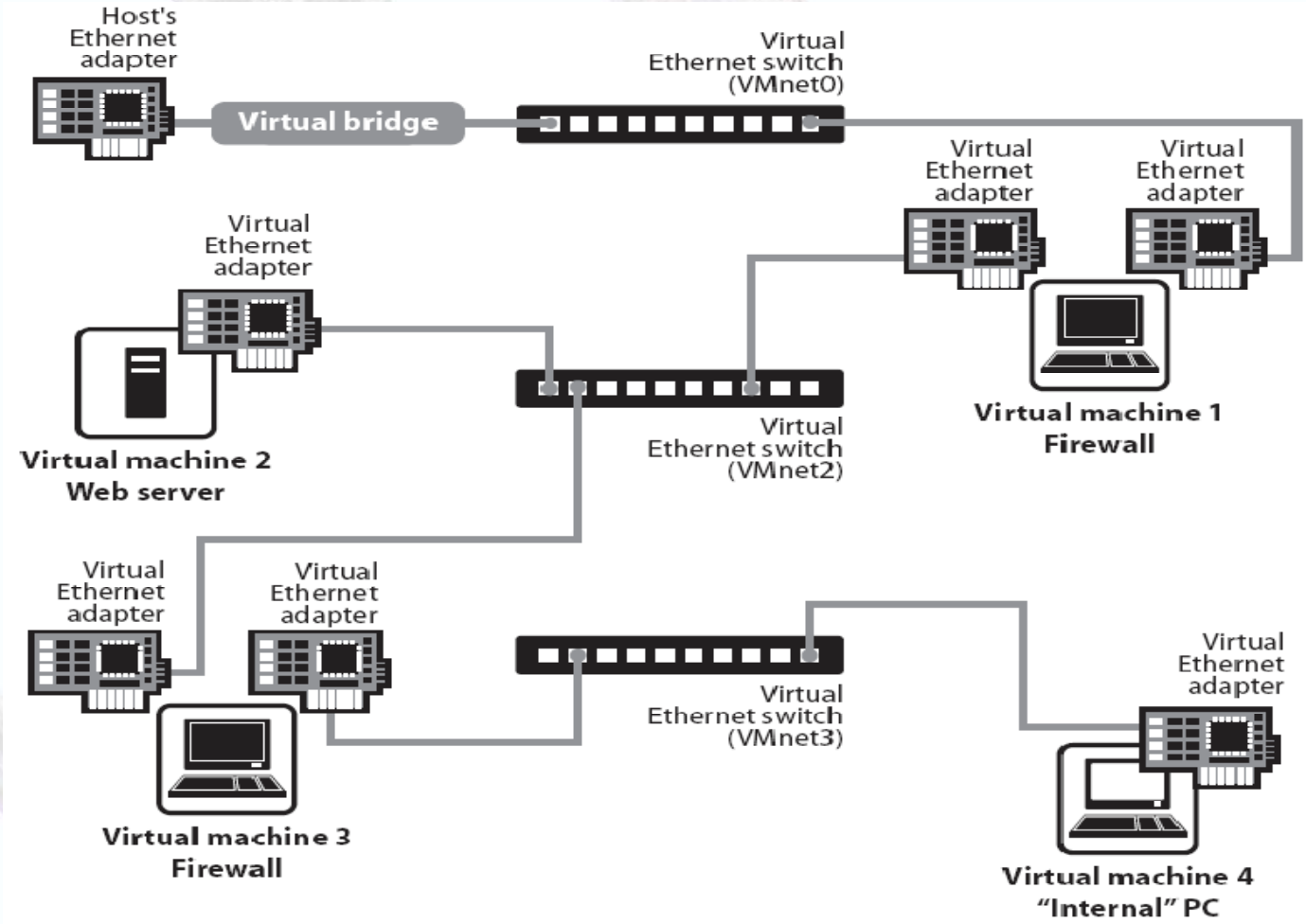
Network Address Translation (NAT)

NAT gives a virtual machine access to network resources using the host computer's IP address.



Custom Networking Configuration

- *A Web server connects through a firewall to an external network.*
- *An administrator's computer can connect to the Web server through a second firewall.*



Machine Problem 1

- Setup Development Environment
  - Domingo on Windows – (Windows)
  - Linux on the VMWare - (Linux-VMWare)
  - Linux on the ARM-9 board – (Linux-ARM9)
- NFS remote mount
  - Export a directory in PC-Linux for ARM-Linux mount remotely
- Windows and Linux-VMWare share a working directory
  - using 芳鄰 and samba