System Booting

Sunbeam Infotech

Bootable device

- The procedure of starting a computer system by loading the kernel is known as booting the system.

- The first sector of any storage device is known as boot sector.

- If boot sector of any storage device contains a special program called bootstrap program, then that device is said to be a bootable device.

- Similarly if boot sector of the partition of any disk contains this program, partition is said to be a boot partition.

bootstrap program

- Bootstrap program locates the kernel, loads it into main memory and starts its execution.

- Sometimes two-step process where boot block at fixed location loads complex bootstrap program.

- There is a separate bootstrap program for each operating system.

- If multiple operating systems are installed on the computer, the boot loader encompasses the bootstrap/boot loader for other operating systems.

- NTLDR, GRUB, LILO, etc are few examples of boot loaders.

grub

Boot loaders
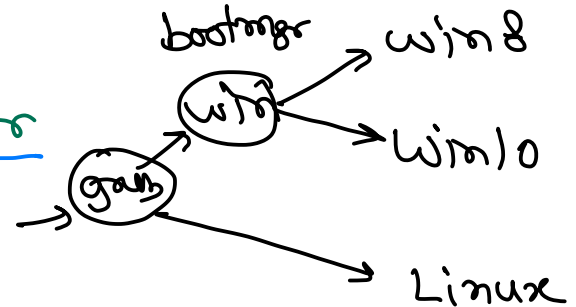
Windows (before vista): ntldr

windows (vista +): bootmgr

Linux: LiLo, GrUB

BSD UNIX: BTX

Solaris: SILo

Mac OSX: Boot Camp (Darwin)

Booting process

- When computer is started, the instruction pointer (program counter) is loaded with a predefined memory location and execution starts there.

- The initial boot program is kept here in ROM, as RAM is in an unknown state at system startup.

- The bootstrap program run diagnostics to determine the state of machine (hardware). → POST / BIST → Bootstrap loader

- It also initialize CPU registers, device controllers and such things so that basic system is initialized. → BL → BS

- It loads kernel of OS from the disk/device to the memory and starts the first process of that kernel.

- Finally one or more system processes are created which functions as an operating system.

Power on
↓
BaseRom programs
↓
RAM

firmware

BIOS → Set of of programs

Base Rom
(motherboard)

① POST   ② Bootstrap loader - to find bootable device.

Bootloader - to show options of OS to load.

/user select

Bootstrap ⟶ Load the kernel.

hardware → PCB, wires, electronic cct, ...

firmware → Programs fixed/burned in ROM.
Cannot easily add toemove.
PC → IBM + MS → firmware = BIOS
Intel + HP → firmware = EFI

software → programs installed in OS.
they can be easily added toemoved.

Virtual Machine
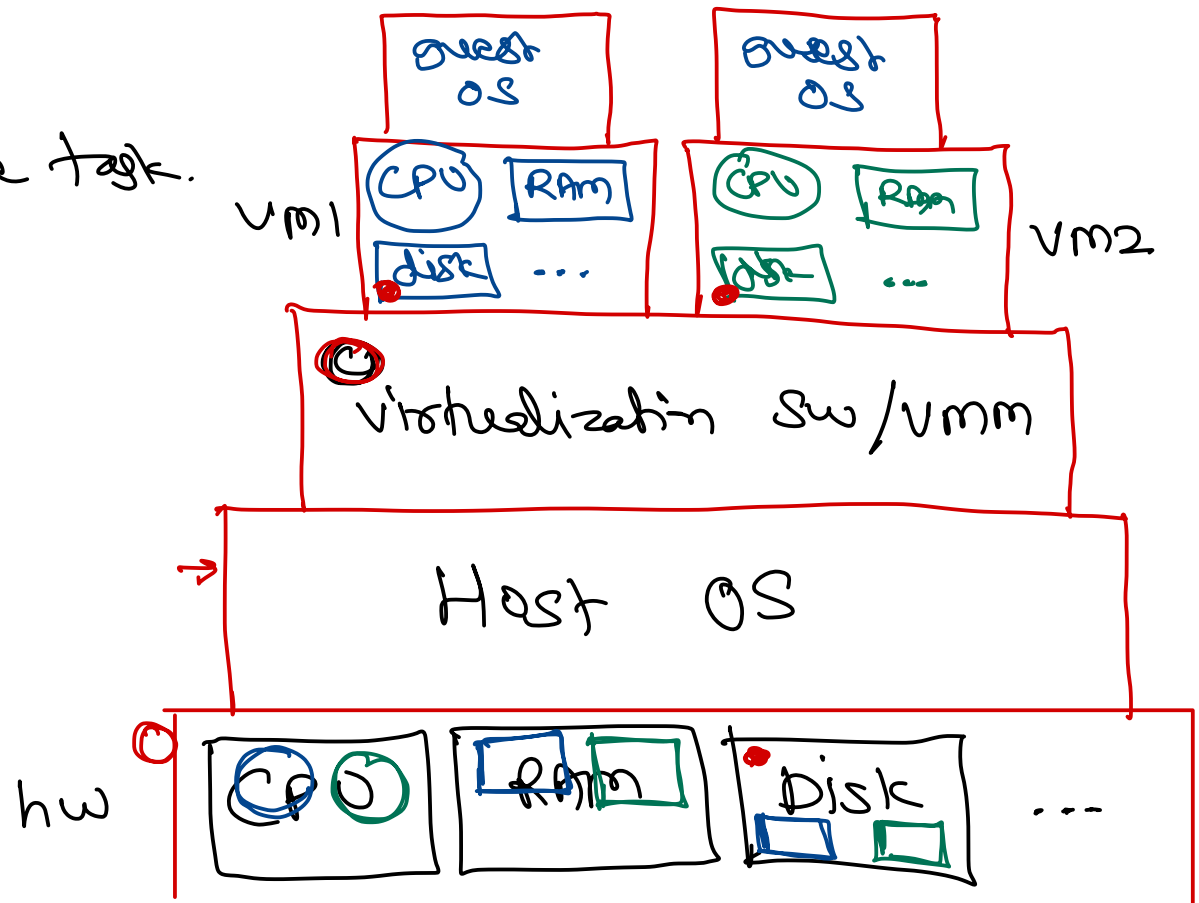
apptns of virtualization

(OS virtualization)

① testing/dev sw on multiple platform.

② learning networking.

limitations

① no Cpu intensive task.

virtualization sw

① vmware

② virtualbox

③ Hyper-V

④ Parallels

(lscpu)

VM1 — guest OS — CPU, RAM, disk ...

VM2 — guest OS — CPU, RAM, disk ...

virtualization sw/vmm

Host OS

hw — CPU, RAM, Disk ...

← emulator: qemu [18]

Virtual Machines

- Virtual machine takes layered approach for 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
- 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
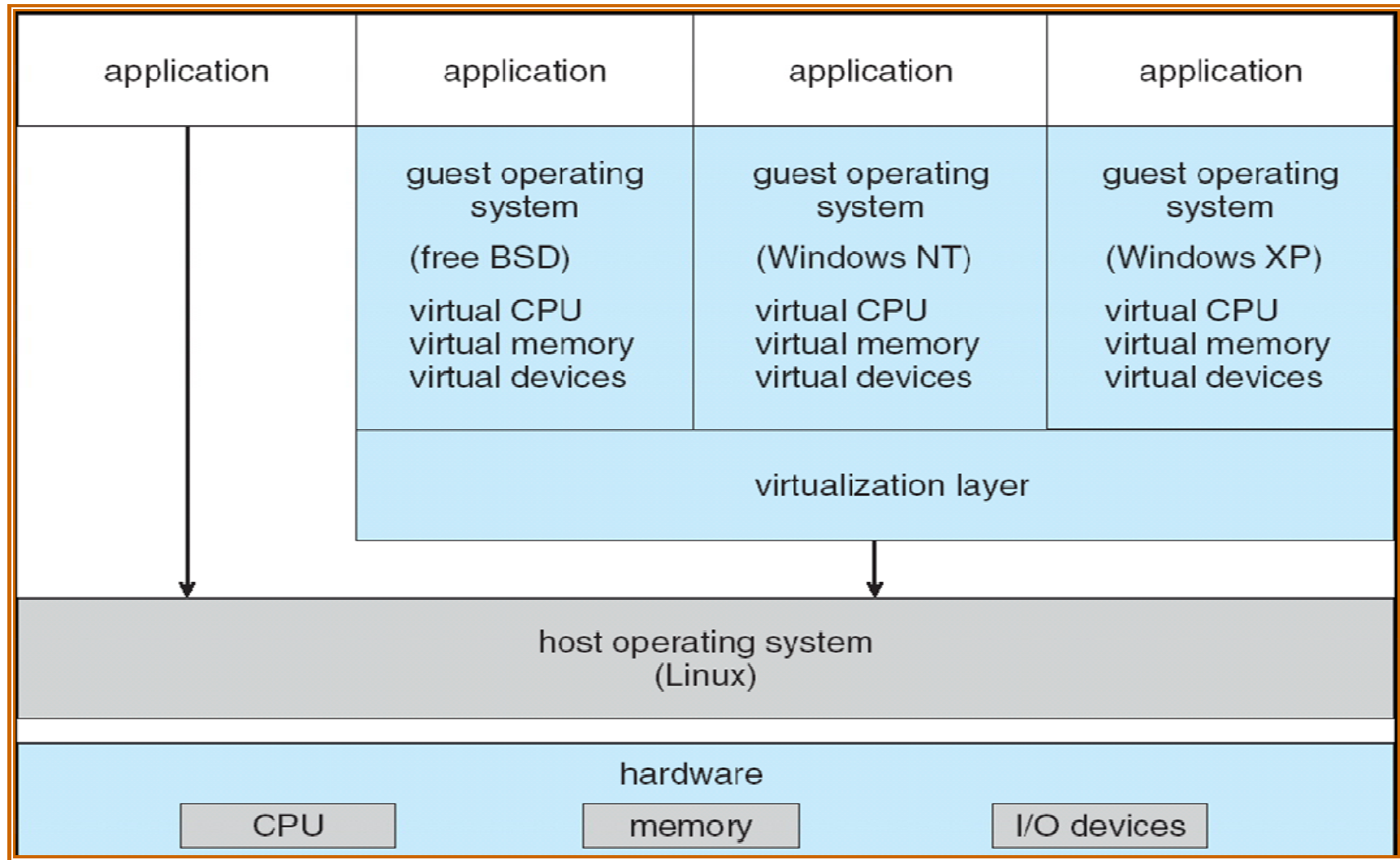
Virtual Machine (cont'd)
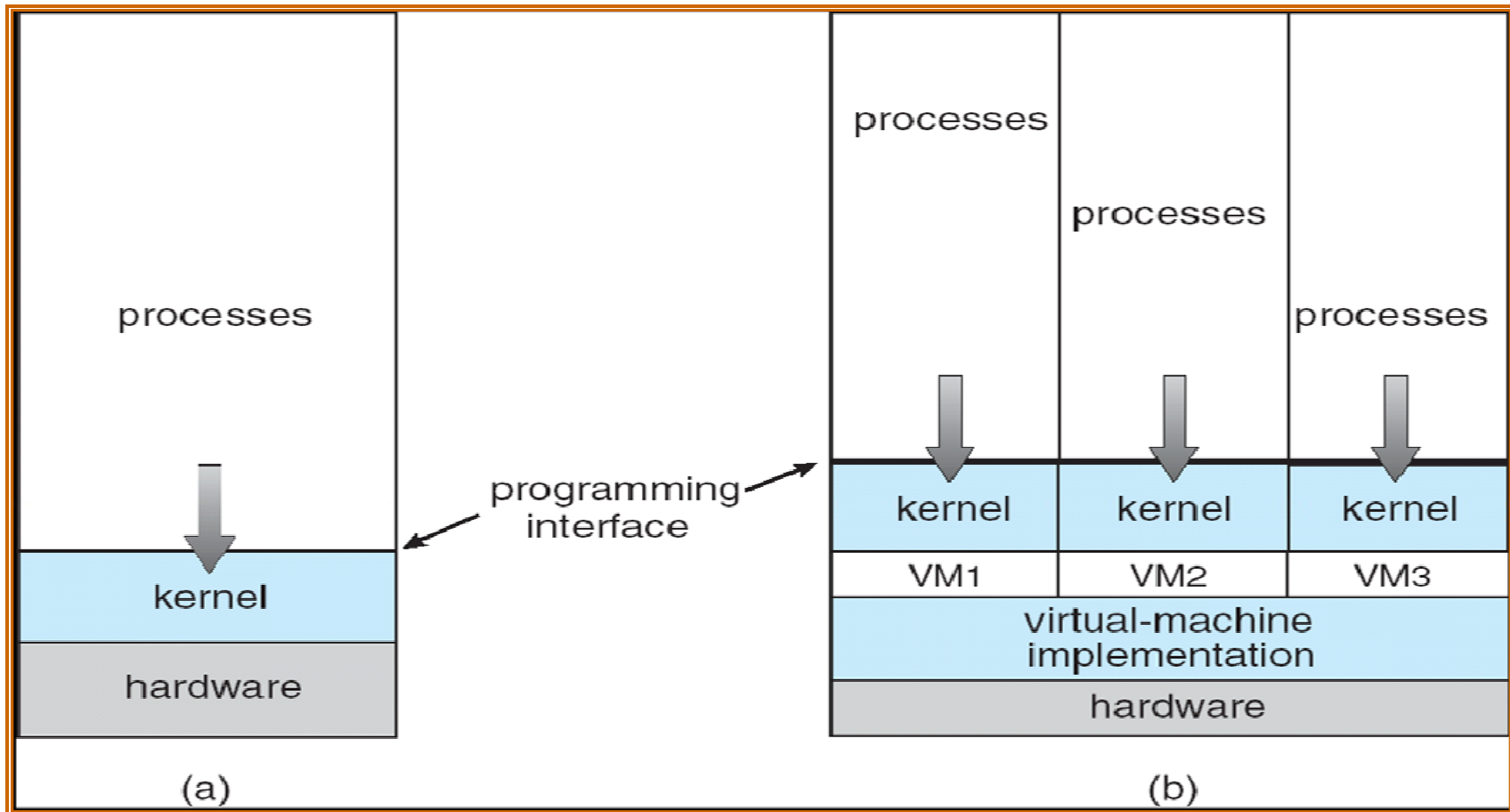
(a) Non-Virtual Machine   AND   (b) Virtual Machine

Virtual Machine (cont'd)

- 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

application	application	application	application
	guest operating system (free BSD) virtual CPU virtual memory virtual devices	guest operating system (Windows NT) virtual CPU virtual memory virtual devices	guest operating system (Windows XP) virtual CPU virtual memory virtual devices

virtualization layer

host operating system (Linux)

hardware

| CPU | memory | I/O devices |

Thank you!

Source: Galvin OS books/slides

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