Operating System

Nguyen Tri Thanh
ntthanh@vnu.edu.vn

Introduction

Objectives

- Why do we need Operating Systems?
- What is an OS?
- What does an OS do?
- Classification of Operating Systems
- Disambiguation of some concepts

Reference

- Chapter 1,2 of Operating System Concepts

Why do we need OSes?

- What does a computer can do?
- What language does it “speak”?
- What does a computer have?
- Can we “use” the computer and its resources directly?

Quiz

Select the best description of what a pure computer can do?

A. Do calculation, string manipulation and communicate with other devices
B. Provide graphical interface for users
C. Provide applications for users
D. Provide applications and an Internet connection

Quiz

Select the code that a pure computer can do

A. a=a+b
B. 0110010110
C. c.open();
D. add AX, BX

Quiz

Select the language a pure computer can understand

A. Binary code (0110010110)
B. C
C. C++
D. Assembly

Quiz

Select the best description of resources a pure computer may have

A. CPU, RAM, Disks
B. CPU, RAM and anything that can connect to the computer, such as CD, network card, …
C. CPU, RAM, Disk, printer
D. CPU, RAM, Disk, printer, monitor

Quiz

Can we use a pure computer and its resources directly?

A. Yes, only some system programmers can
B. Any normal user can
C. Normal software developers can
D. Computer providers can

⇨ Why do we need an OS?

Operating System definition

Can you
drive a bus?

Have you ever gone by bus?

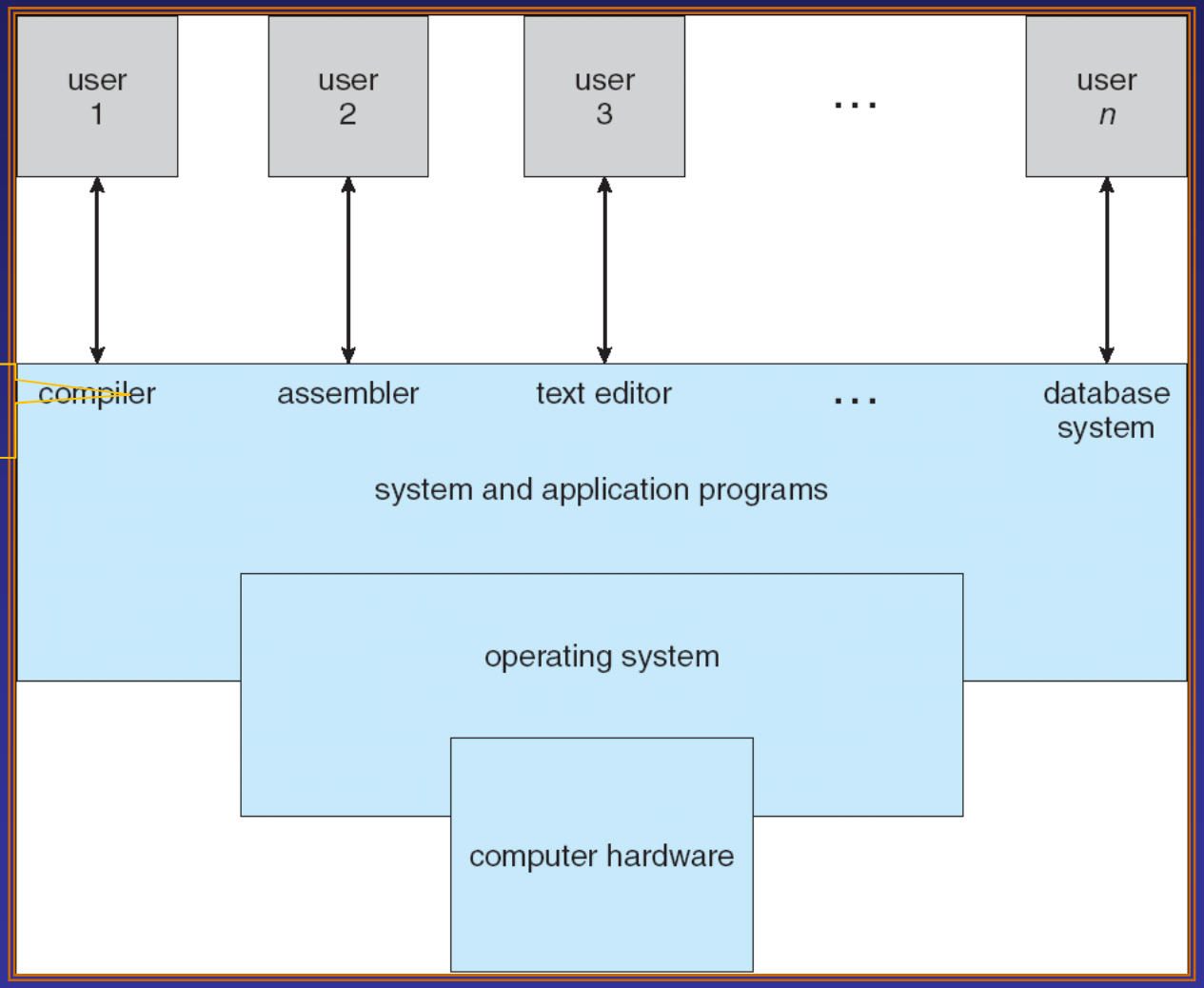
How did you go?

Who helped you to go?

What is an Operating System?

- A program that acts as an intermediary between a user of a computer and the computer hardware (only for computer).
- Operating system goals:
  - Execute user programs and make solving user problems easier.
  - Make the computer system convenient to use.
  - Use the computer hardware (resources) in an efficient manner.

Position of an Operating System



Applications

Typical Operating Systems

Quiz

What is incorrect about the main purposes of Operating Systems

A. resource allocator (manages all resources for requests/applications)
B. control program (controls execution of programs to prevent errors and improper use of the computer
C. database management (database management system)
D. provide system calls (API) for programming

List of operating systems

- http://en.wikipedia.org/wiki/List_of_operating_systems
- http://en.wikipedia.org/wiki/List_of_Linux_distributions
- http://en.wikipedia.org/wiki/Mobile_operating_system

Quiz

Which is NOT true about an application?

A. Does a certain task/purpose
B. Database Management System (DBMS) is an example
C. Manages IO operations, such as disk IO operations
D. May consist of several files on storage devices

Main tasks of an OS

- Process Management
- Memory Management (RAM)
- Storage Management
  - File/directory
  - Disks
- Protection and Security
- Networking

- Main tasks are usually implemented in kernel (core)

OS classification

- Batch processing
  - very early OS's
- Uniprogramming
  - less powerful (weak) machines
- Multiprogramming (powerful machines)
  - Timesharing/multitasking
  - Multi-user system
- Parallel processing (PC-cluster) (highly computational application)
  - search engines, e.g., google, yahoo,..

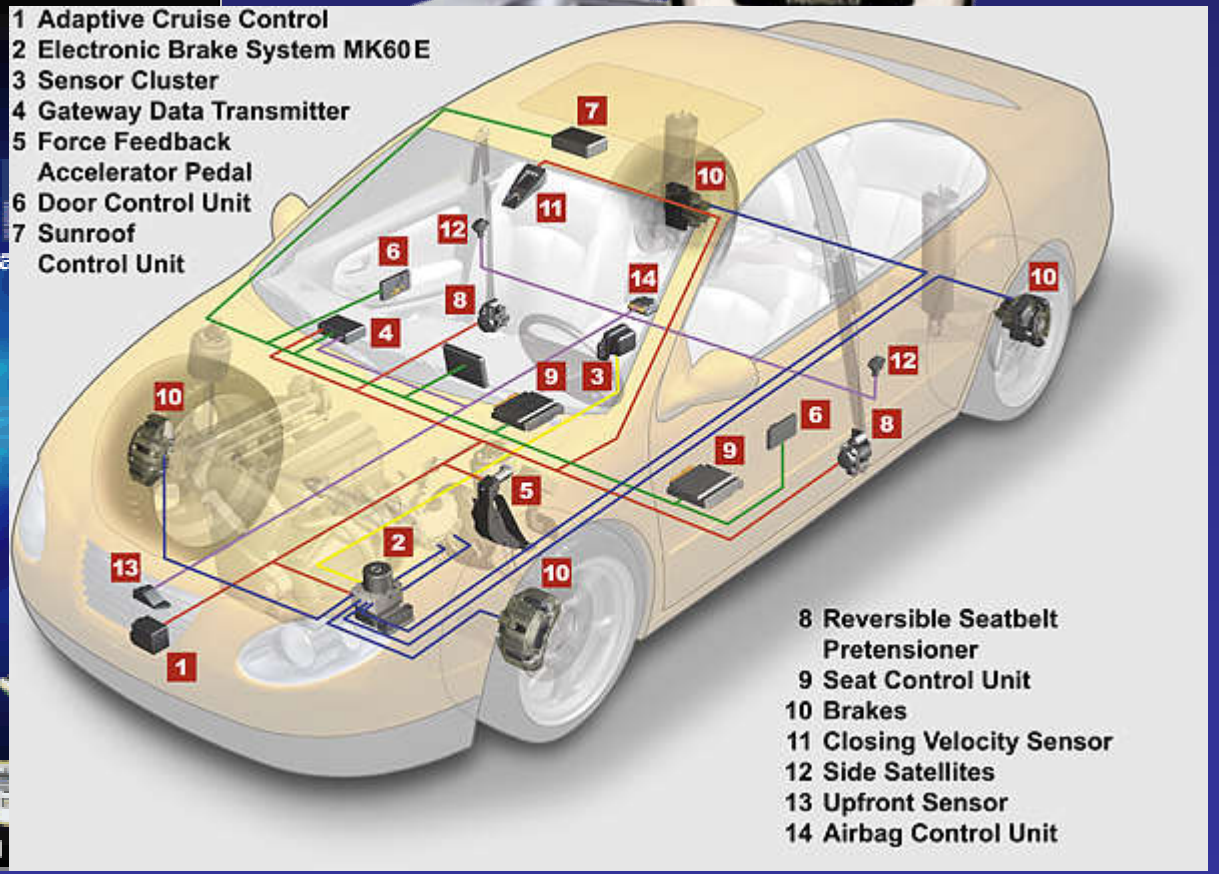
OS classification (cont'd)

- Embedded (embedded into devices to do a specific task)
  - the task has limited (few) functions
  - usually is made as a firmware (NOT as software)
  - Calculator, game players, digital camera, mp3 player, ...
- Special-purpose systems
  - designed to perform a specific task
    - Factory's control system
    - GPS receiver

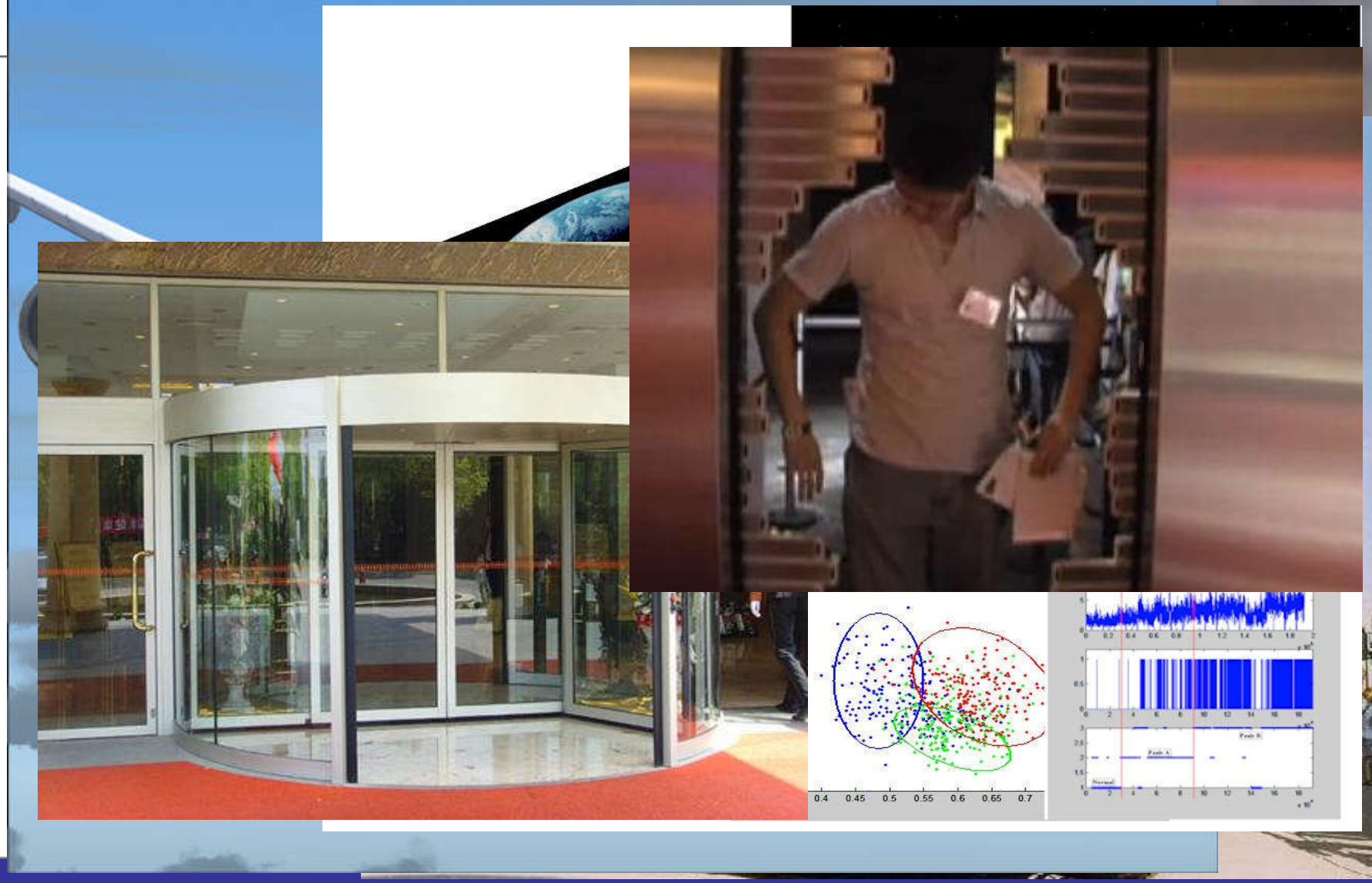
OS classification (cont'd)

- Real-time systems
  - Do a task with a time constraint (produce output when the input comes before it is too late)
    - NASA's control system
    - missile defense systems
    - earth-quake detection systems
    - robot control systems
    - Boeing automatic flying systems
- Boundaries among OS types are not clear
  - one OS can have characteristics of many types

Special purpose – Embedded Systems



Real-time Systems



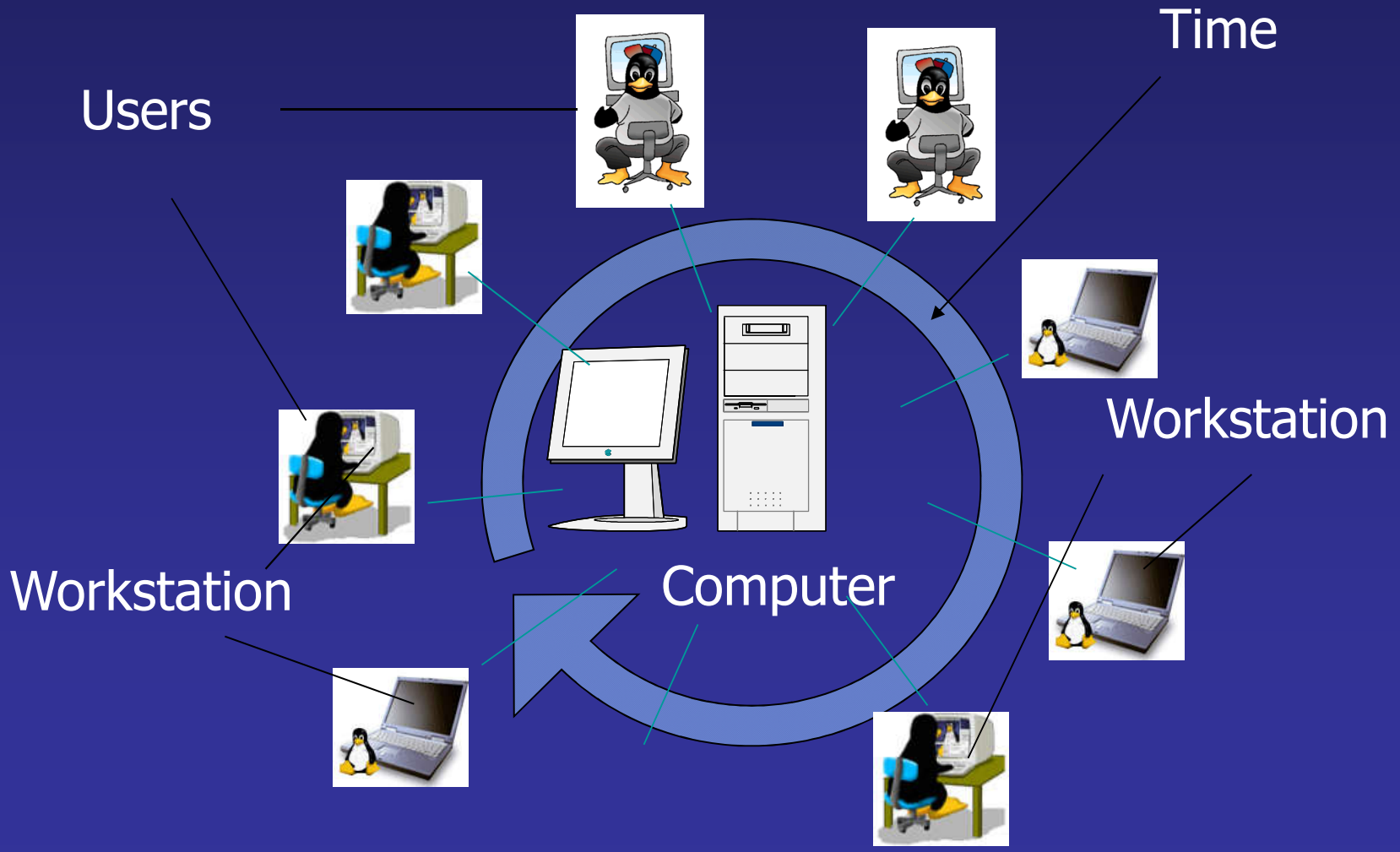
OS classification (cont'd)

- you're a perfect real-time system when
  - drive a car
  - play a game
  - play sports
  - …

Why multiprogramming?

- **Multiprogramming** needed for efficiency
  - Single user cannot keep CPU and I/O devices busy at all times
  - Multiprogramming organizes jobs (code and data) so CPU always has one to execute
  - A subset of total jobs in system is kept in memory
- **Timesharing (multitasking)** is logical extension in which CPU switches jobs so frequently that users can interact with each job while it is running, creating **interactive** computing
  - Each user has at least one program executing in memory ⇨**process**
  - If several jobs ready to run at the same time ⇨ **CPU scheduling**

Timesharing system



Quiz

What is the correct class of Windows XP?

A. Uniprogramming
B. Multiprogramming
C. Embedded
D. Special-purpose

Quiz

What is correct about a program?

A. A process
B. A compiled application (in machine code)
C. A part of Operating Systems
D. A library

Quiz

What is correct about a process?

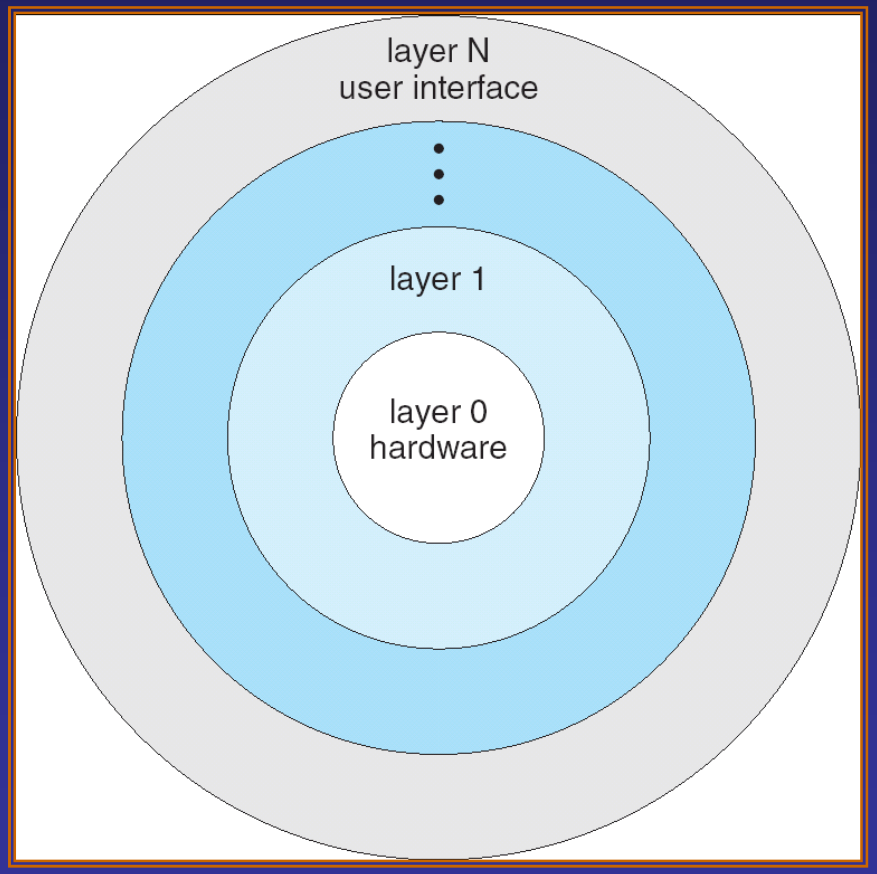
A. A file on disk
B. An application
C. A program running on the system
D. A library

Operating System Structure

OS structure

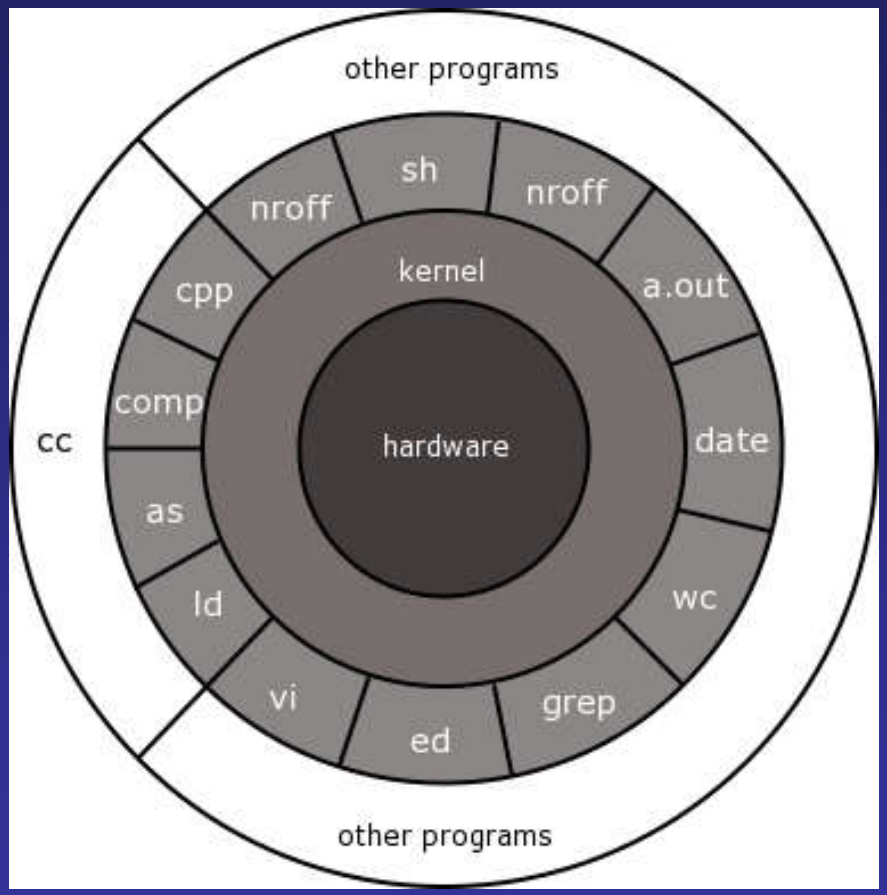
Layered approach

- OS is divided into several levels
- A higher level can only access/use its direct lower level
  - level 3 can access level 2
  - level 4 cannot access level 2
- Why? Motivation?



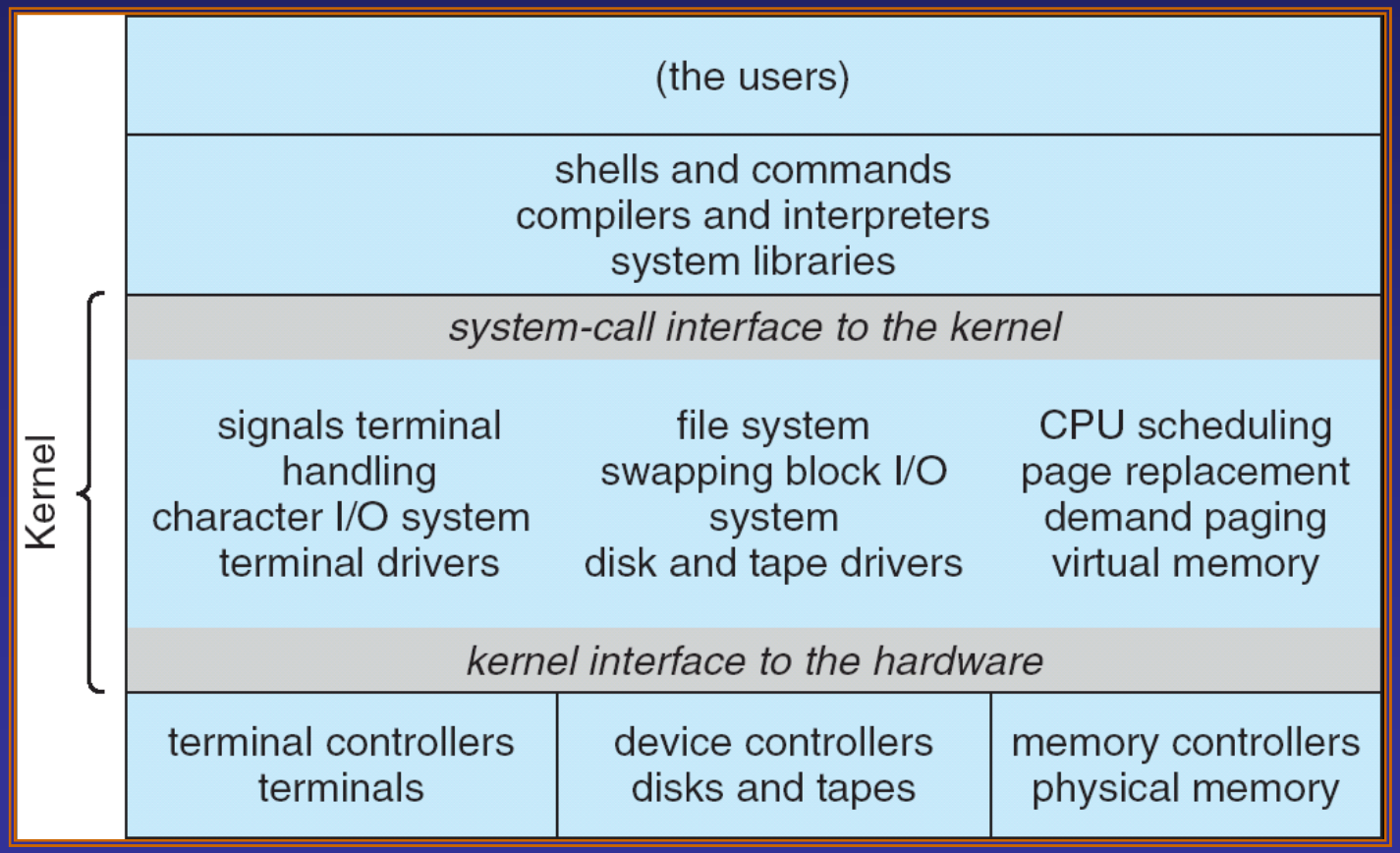
Layered approach example

- UNIX, LINUX
- How many levels are there?
  - A. 1
  - B. 2
  - C. 3
  - D. 4



UNIX another view

- How many levels are there?
  - A. 1
  - B. 2
  - C. 3
  - D. 4



Microkernel

- Keep minimum/essential functions in kernel
- Others are built as libraries/applications
- Examples
  - Mach, Tru64 UNIX, QNX
  - http://en.wikipedia.org/wiki/Mach_(kernel)

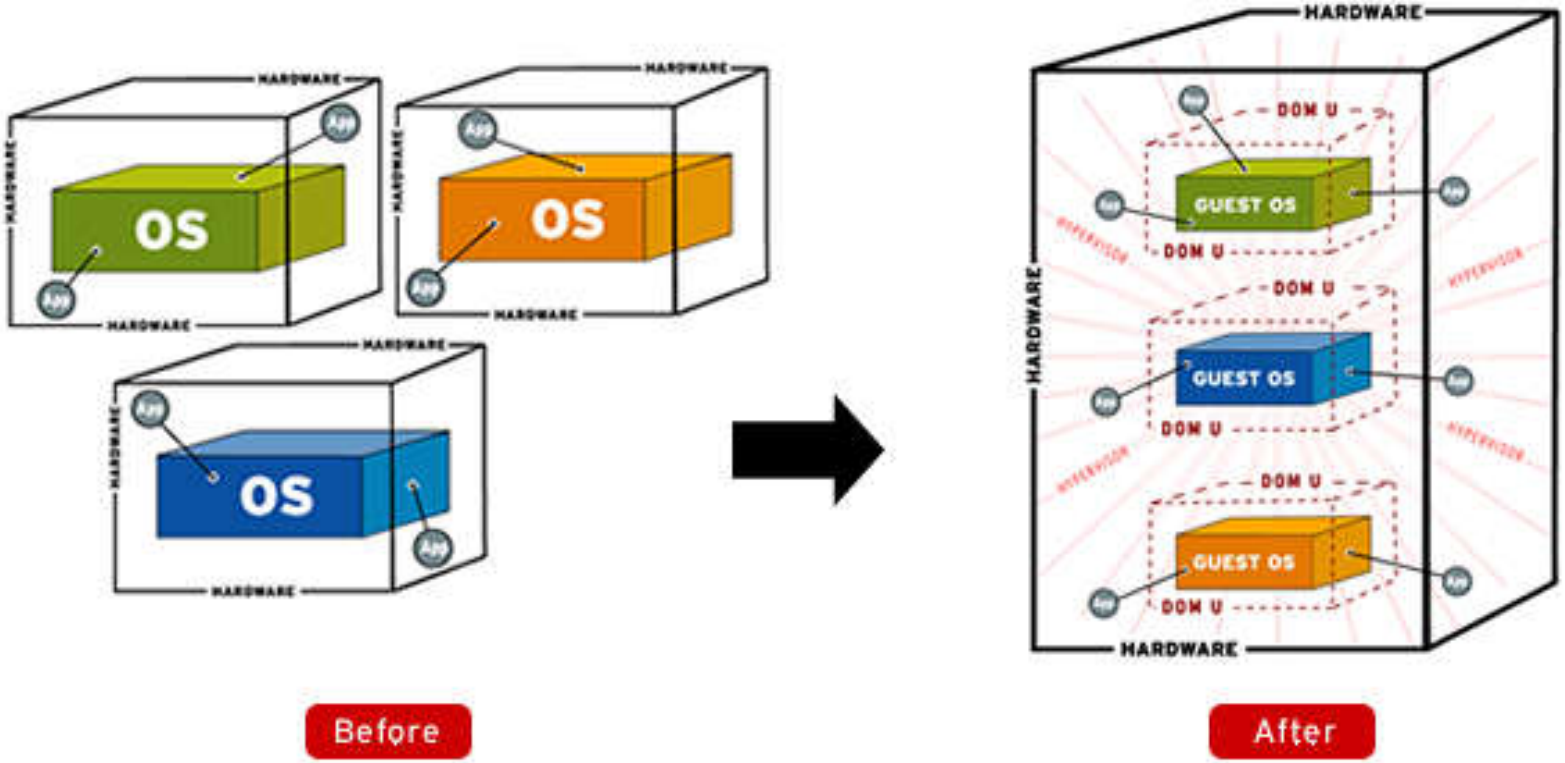
Module approach

- Considered as most effective approach
  - Inherits OOP paradigm
  - Sun Solaris is an example
  - http://en.wikipedia.org/wiki/Solaris_(operating_system)

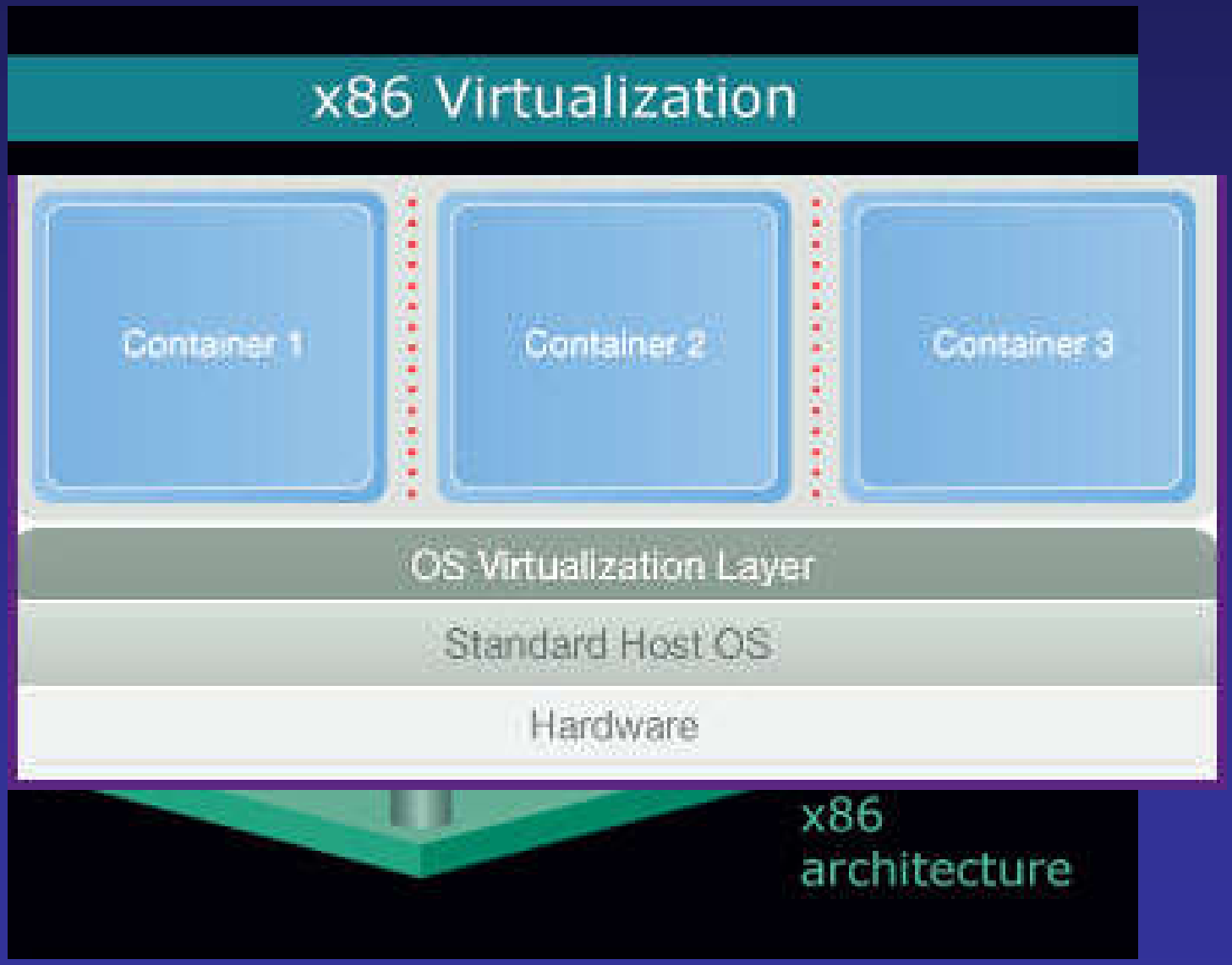
Virtual Machine

Virtual machine

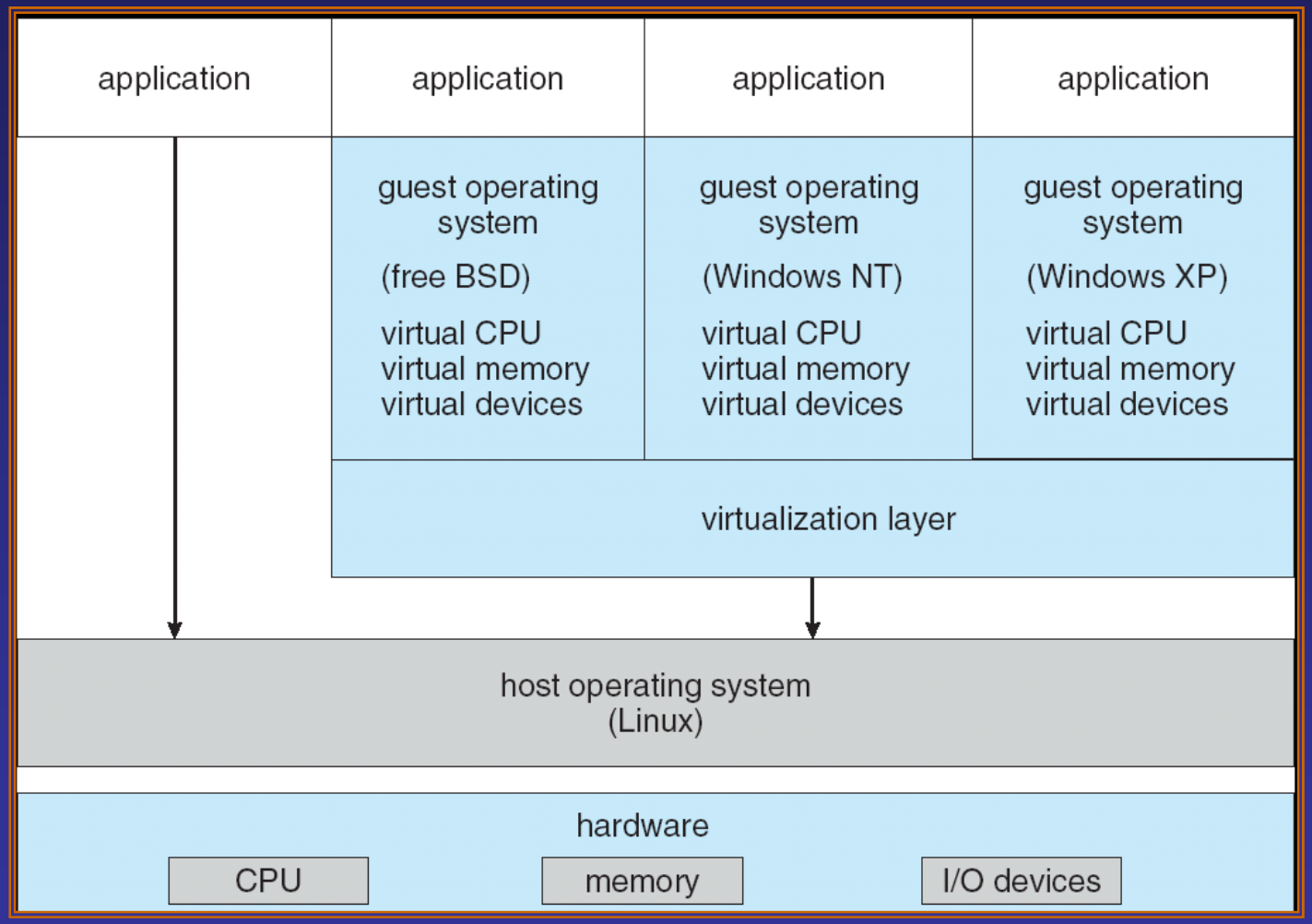
- A concept refers to the abstraction of computer resources



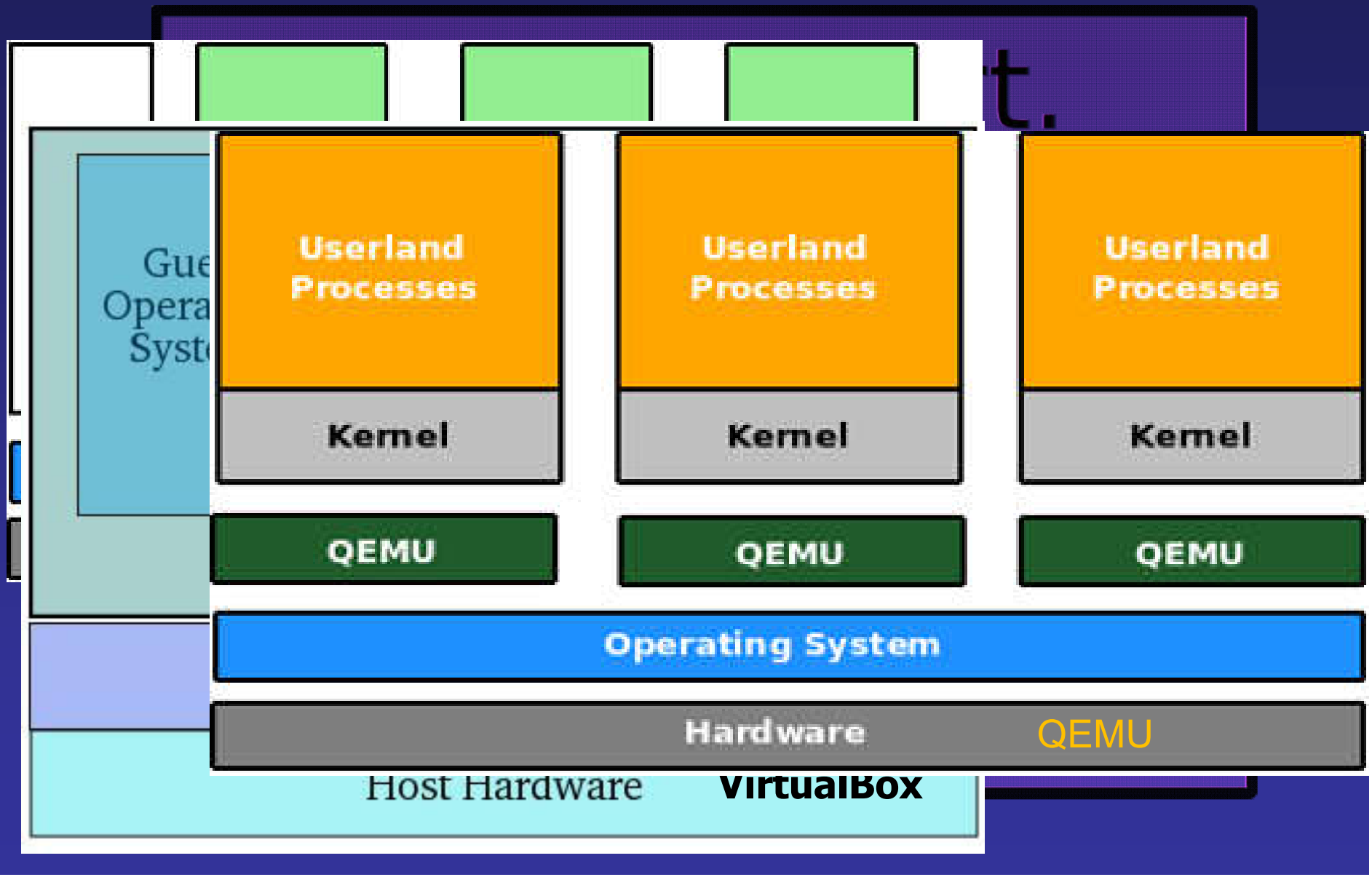
Virtual machine



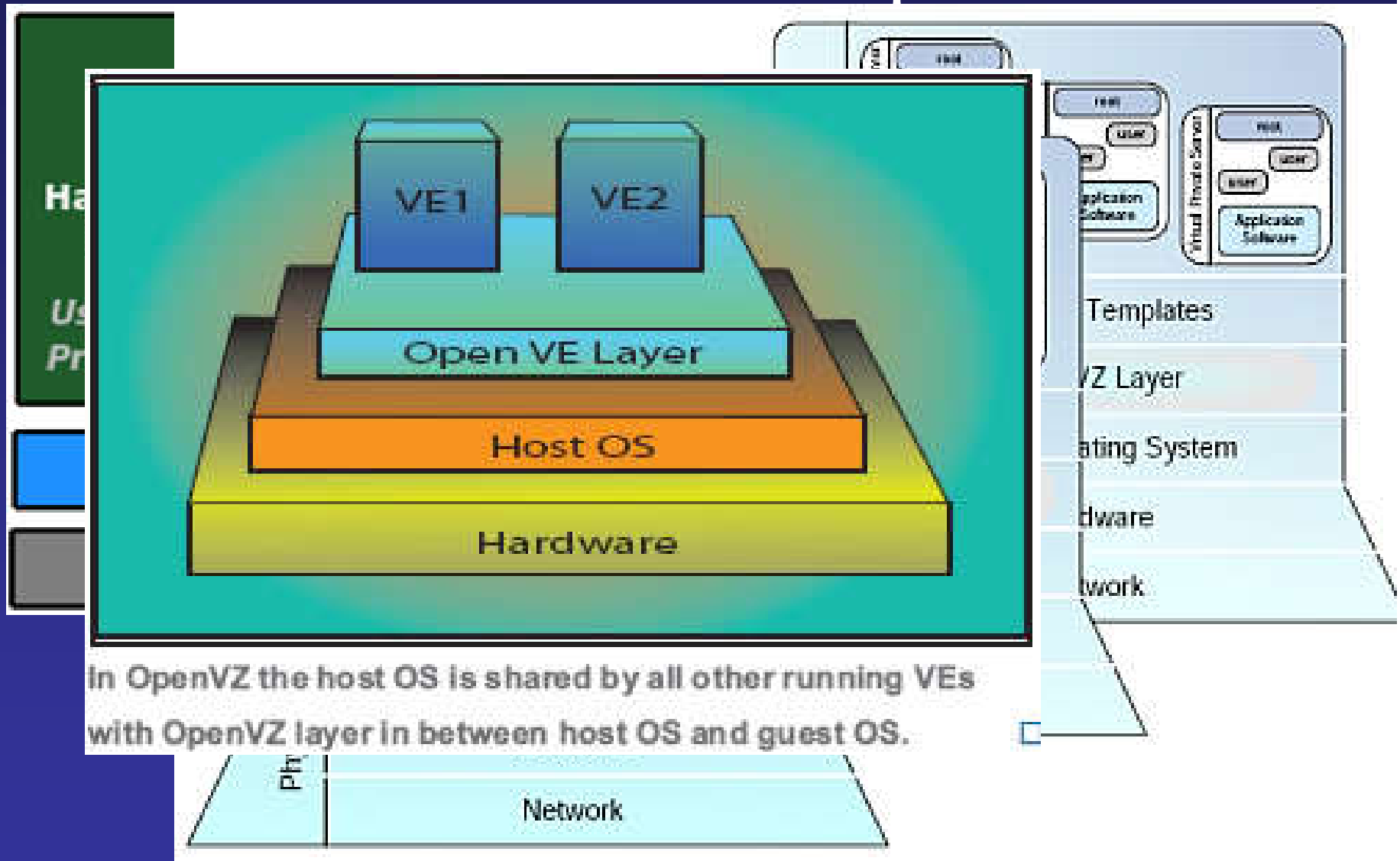
Virtual machine - VMWare



Virtual machine



Virtual machine - OpenVZ



Quiz

Which is NOT the main purposes of Virtual machines?

A. Creates more processes

B. Utilizes RAM, CPU more effectively

C. Allows multiple independent Operating Systems to run on the same machine

D. Allows multiple independent Operating Systems to run with separated resources (e.g. IP address, Ports, Domain names, …)

Any question?