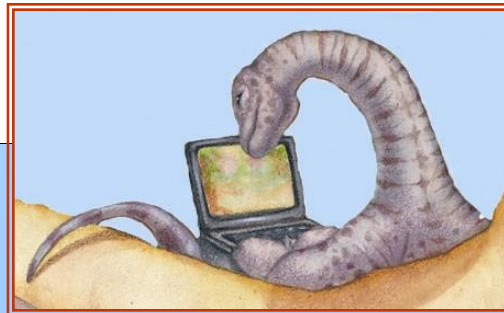


# Chapter 1: Introduction

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# Computing Environments - Traditional

- Stand-alone general purpose machines
- But blurred as most systems interconnect with others (i.e., the Internet)
- **Portals** provide web access to internal systems
- **Network computers** (**thin clients**) are like Web terminals
- Mobile computers interconnect via **wireless networks**
- Networking becoming ubiquitous – even home systems use **firewalls** to protect home computers from Internet attacks





# Computing Environments - Mobile

- Handheld smartphones, tablets, etc
- What is the functional difference between them and a “traditional” laptop?
- Extra feature – more OS features (GPS, gyroscope)
- Allows new types of apps like *augmented reality*
- Use IEEE 802.11 wireless, or cellular data networks for connectivity
- Leaders are **Apple iOS** and **Google Android**





# Computing Environments – Distributed

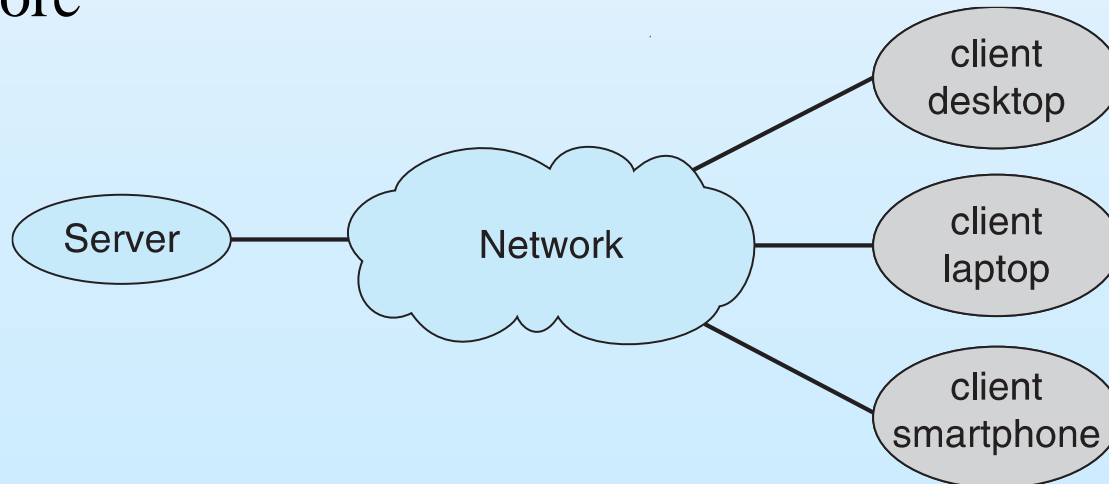
- Distributed computing
  - Collection of separate, possibly heterogeneous, systems networked together
    - ▶ **Network** is a communications path, **TCP/IP** most common
      - **Local Area Network (LAN)**
      - **Wide Area Network (WAN)**
      - **Metropolitan Area Network (MAN)**
      - **Personal Area Network (PAN)**
  - **Network Operating System** provides features between systems across network
    - ▶ Communication scheme allows systems to exchange messages
    - ▶ Illusion of a single system





# Computing Environments – Client-Server

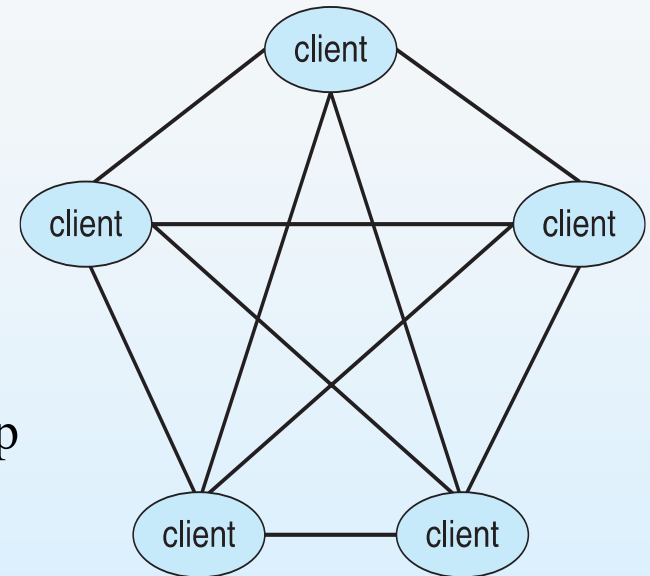
- Client-Server Computing
  - Dumb terminals supplanted by smart PCs
  - Many systems now **servers**, responding to requests generated by **clients**
    - ▶ **Compute-server system** provides an interface to client to request services (i.e., database)
    - ▶ **File-server system** provides interface for clients to store





# Computing Environments - Peer-to-Peer

- Another model of distributed system
- P2P does not distinguish clients and servers
  - Instead all nodes are considered peers
  - May each act as client, server or both
  - Node must join P2P network
    - ▶ Registers its service with central lookup service on network, or
    - ▶ Broadcast request for service and respond to requests for service via *discovery protocol*
- Examples include Napster and Gnutella, **Voice over IP (VoIP)** such as Skype





# Computing Environments - Virtualization

- Allows operating systems to run applications within other OSes
  - Vast and growing industry
- **Emulation** used when source CPU type different from target type (i.e. PowerPC to Intel x86)
  - Generally slowest method
  - When computer language not compiled to native code – **Interpretation**
- **Virtualization** – OS natively compiled for CPU, running **guest** OSes also natively compiled
  - Consider VMware running WinXP guests, each running applications, all on native WinXP **host** OS
  - **VMM** (virtual machine Manager) provides virtualization services





# Computing Environments - Virtualization

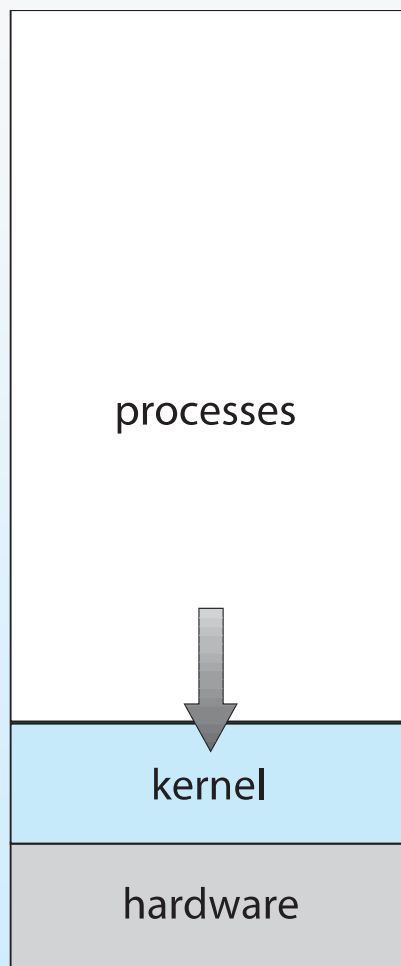
- Use cases involve laptops and desktops running multiple OSES for exploration or compatibility
  - Apple laptop running Mac OS X host, Windows as a guest
  - Developing apps for multiple OSES without having multiple systems
  - QA testing applications without having multiple systems
  - Executing and managing compute environments within data centers
- VMM can run natively, in which case they are also the host
  - There is no general purpose host then (VMware ESX and Citrix XenServer)





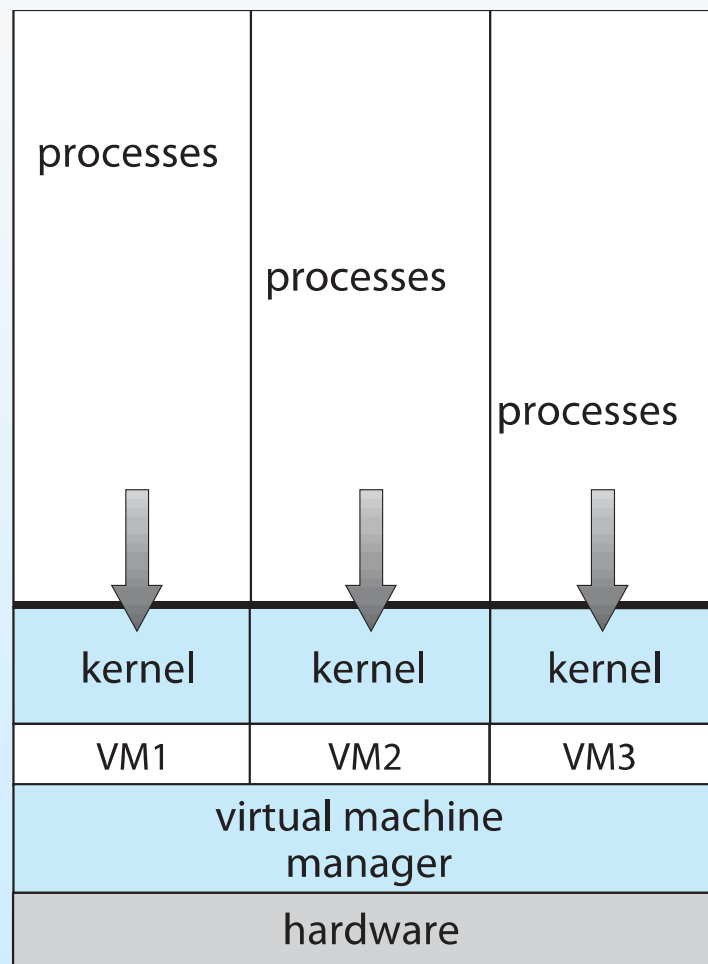


# Computing Environments - Virtualization



(a)

programming interface



(b)





# Computing Environments – Cloud Computing

- Delivers computing, storage, even apps as a service across a network
- Logical extension of virtualization because it uses virtualization as the base for its functionality.
  - Amazon **EC2** has thousands of servers, millions of virtual machines, petabytes of storage available across the Internet, pay based on usage
- **Many types:**
  - **Public cloud** – available via Internet to anyone willing to pay
  - **Private cloud** – run by a company for the company's own use
  - **Hybrid cloud** – includes both public and private cloud components





# Computing Environments – Cloud Computing

## □ Services:

- **Software as a Service (SaaS)** – one or more applications available via the Internet (i.e., word processor)
- **Platform as a Service (PaaS)** – software stack ready for application use via the Internet (i.e., a database server)
- **Infrastructure as a Service (IaaS)** – servers or storage available over Internet (i.e., storage available for backup use)





# Computing Environments – Real-Time Embedded Systems

- Real-time embedded systems most prevalent form of computers
  - Vary considerable, special purpose, limited purpose OS, **real-time OS**
  - Use expanding
- Many other special computing environments as well
  - Some have OSeS, some perform tasks without an OS
- Real-time OS has well-defined fixed time constraints
  - Processing *must* be done within constraint
  - Correct operation only if constraints met





# Open-Source Operating Systems

- ❑ Operating systems made available in source-code format rather than just binary **closed-source**
- ❑ Counter to the **copy protection** and **Digital Rights Management (DRM)** movement
- ❑ Started by **Free Software Foundation (FSF)**, which has “copyleft” **GNU Public License (GPL)**
- ❑ Examples include **GNU/Linux** and **BSD UNIX** (including core of **Mac OS X**), and many more
- ❑ Can use VMM like VMware Player (Free on Windows), Virtualbox (open source and free on many platforms - <http://www.virtualbox.com>)
  - ❑ Use to run guest operating systems for exploration



# End of Chapter 1

