Computer Network Components

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Outline

- Types of computer networks
- Computer network architecture
- Hierarchy of computer network protocols
- Open System Interconnection Model

TYPE OF COMPUTER NETWORKS

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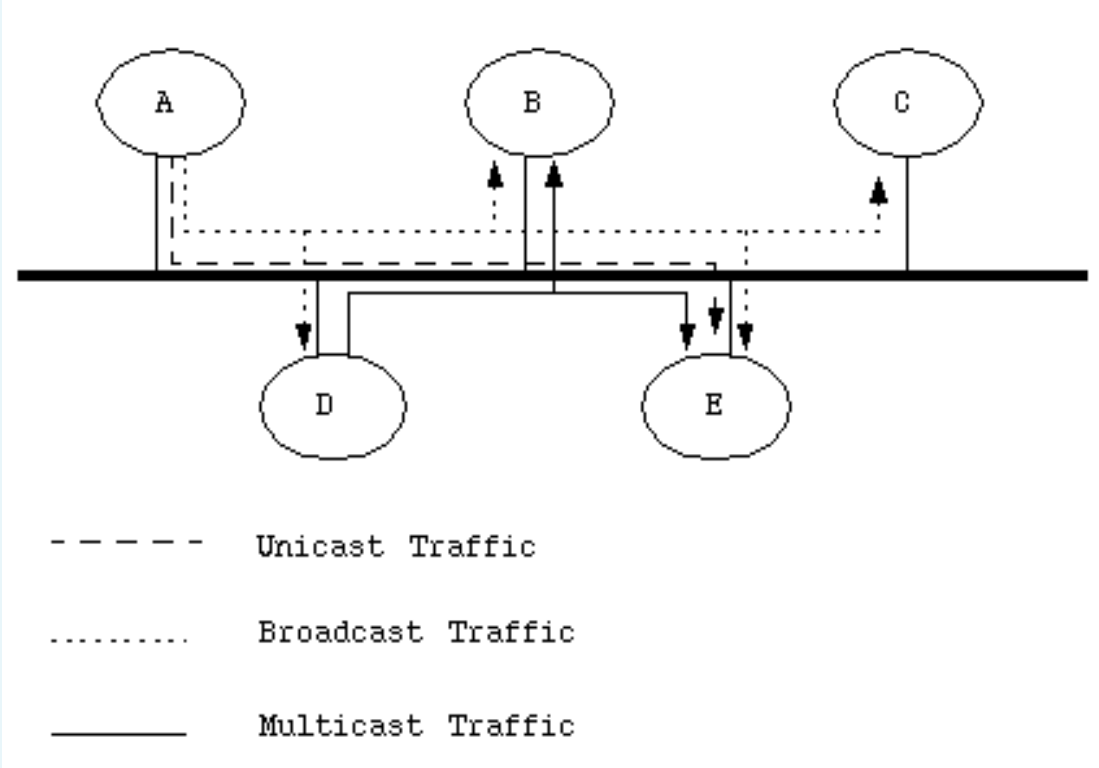
Classifying Computer networks by data transmission method

Broadcasting Network:

- All computers shared a common communication channel
- One computer transmits, all others can receive
- At any instance, only one computer can transmit



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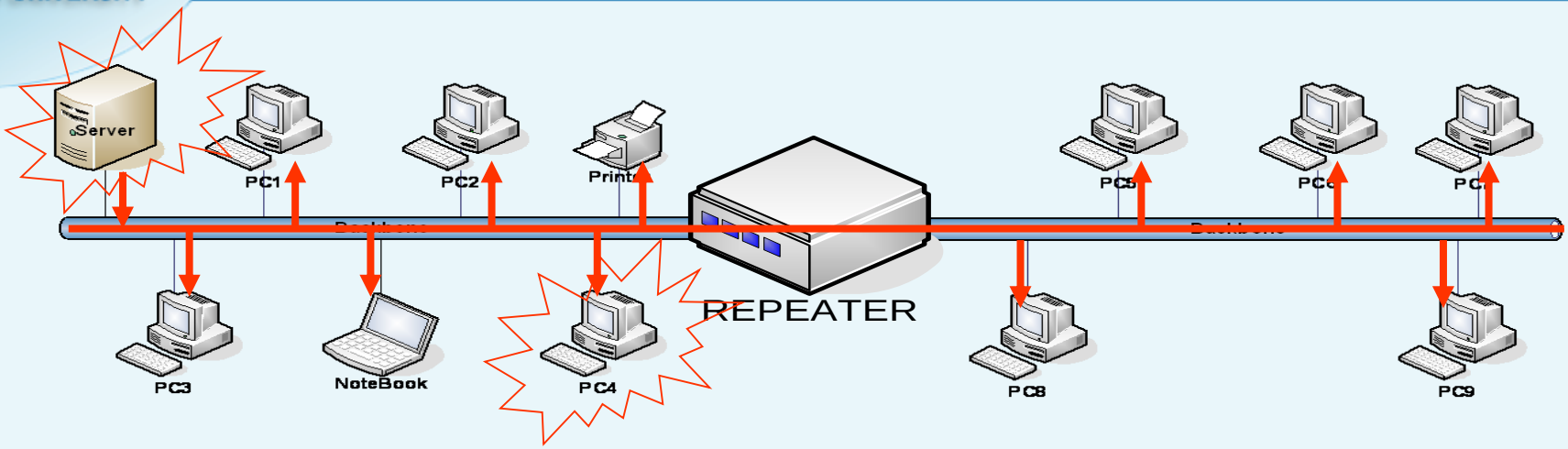
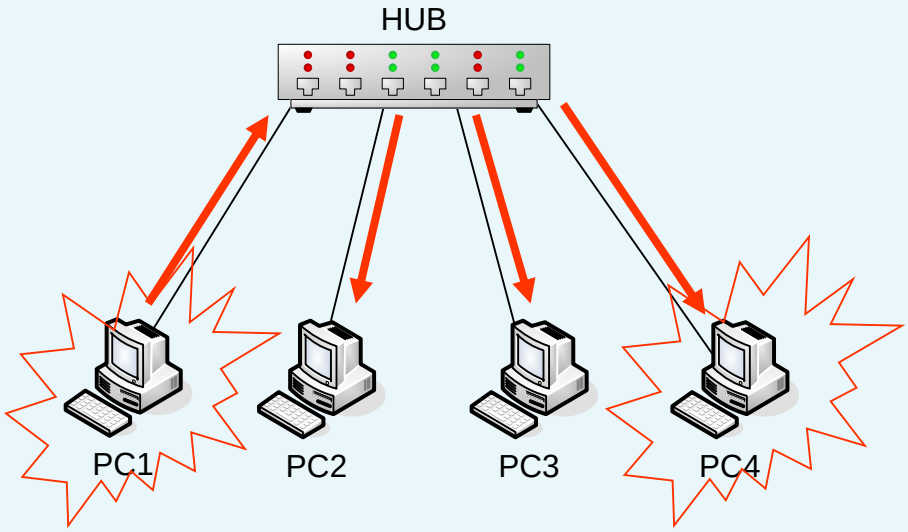
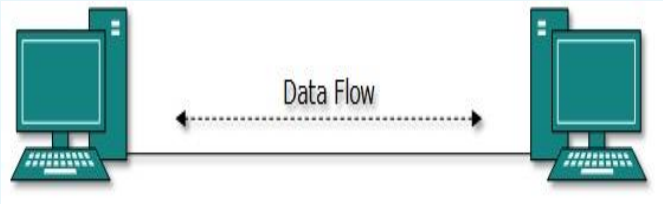
Classifying Computer networks by data transmission method





Classifying Computer networks by data transmission method

- **Point to Point (Switched Network)**



- Computers are connected toghether in pairs.
- Data are transmitted from source to destination through intermediate devices.
- Find the best path for packets.

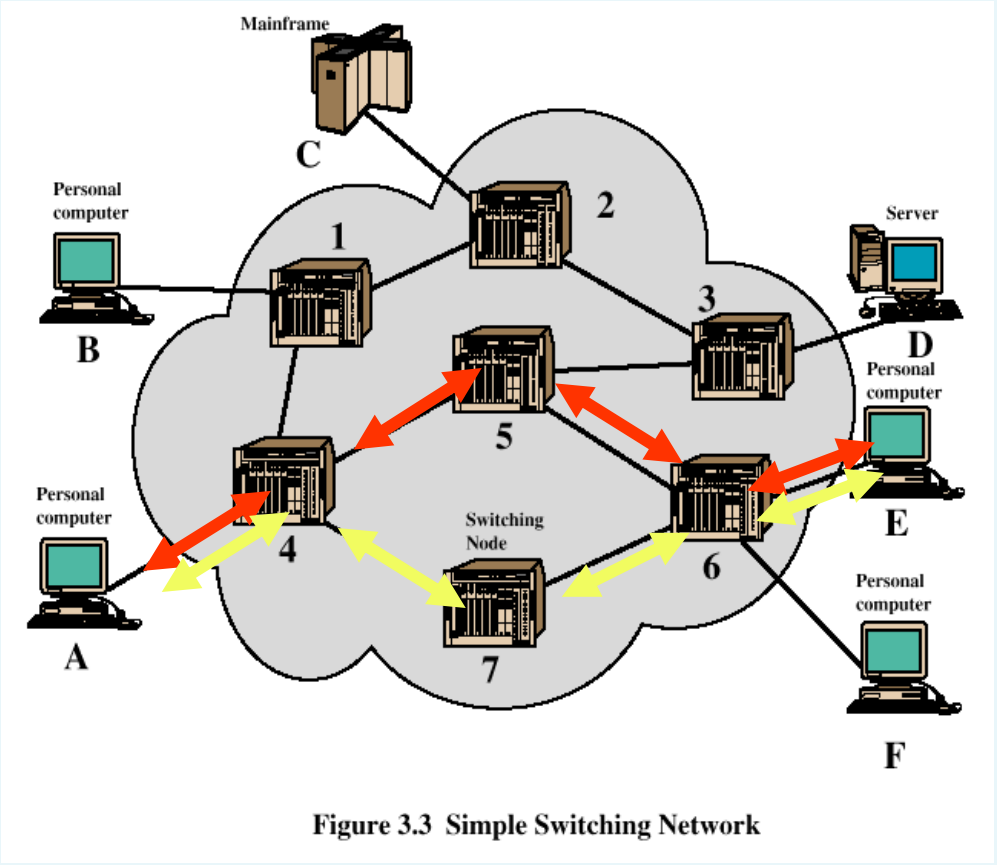


Figure 3.3 Simple Switching Network

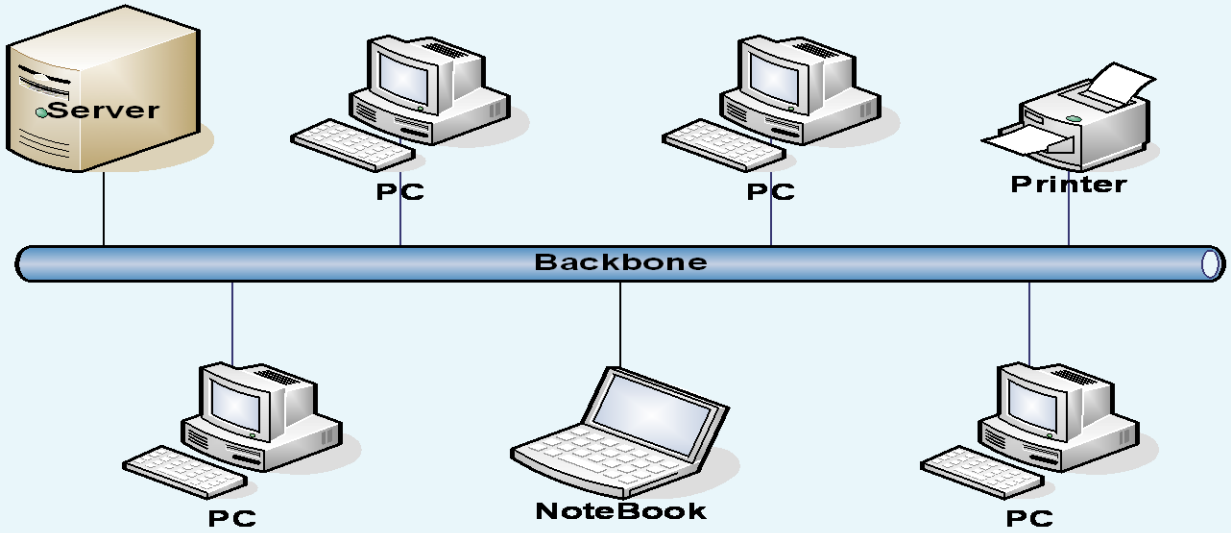
Classifying Computer networks by network diameter

Diameter	Host location	Network Types
1 m	In a square meter	PAN - Personal Area Network
10 m	In a room	LAN - Local Area Network
100 m	In a building	
1 km	PAN - Personal Area Network	
10 km	In a city	MAN - Metropolitan Area Network
100 km	In a country	WAN - Wide Area Network
1000 km	In a continent	
10000 km	Planet	

LAN-Local Area Network

- Broadcast network
- High bandwidth network
- Topology: Bus, Star, Ring

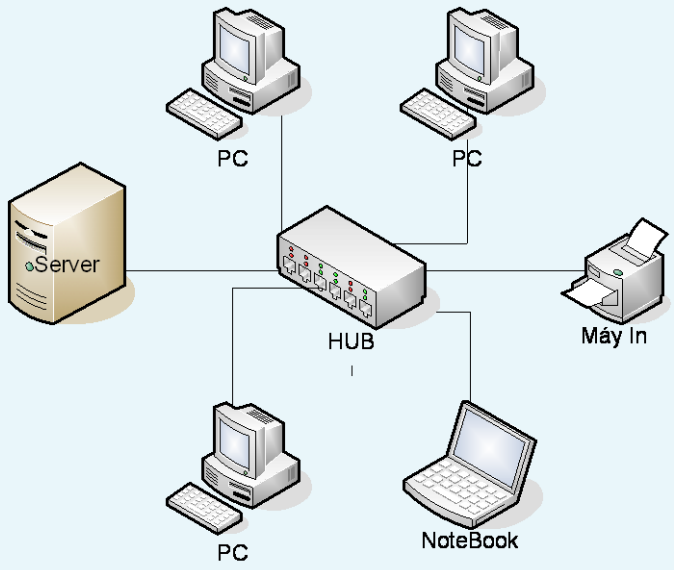
Bus topology



- All computers connected to the cable
- Advantages: cheap and easy to install
- Disadvantages: Difficult to identify the problem if the network shutdown

Star Topology

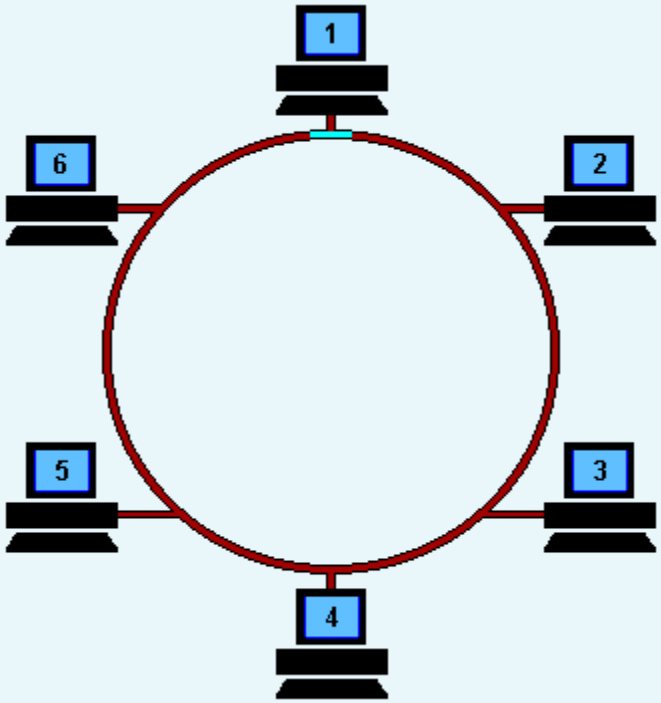
- All computers or devices connected to a central device, called hub.
- All data transferred from one computer to another passes through hub
- Advantages: Easy to install and detect problem; network continue to work when adding or remove host



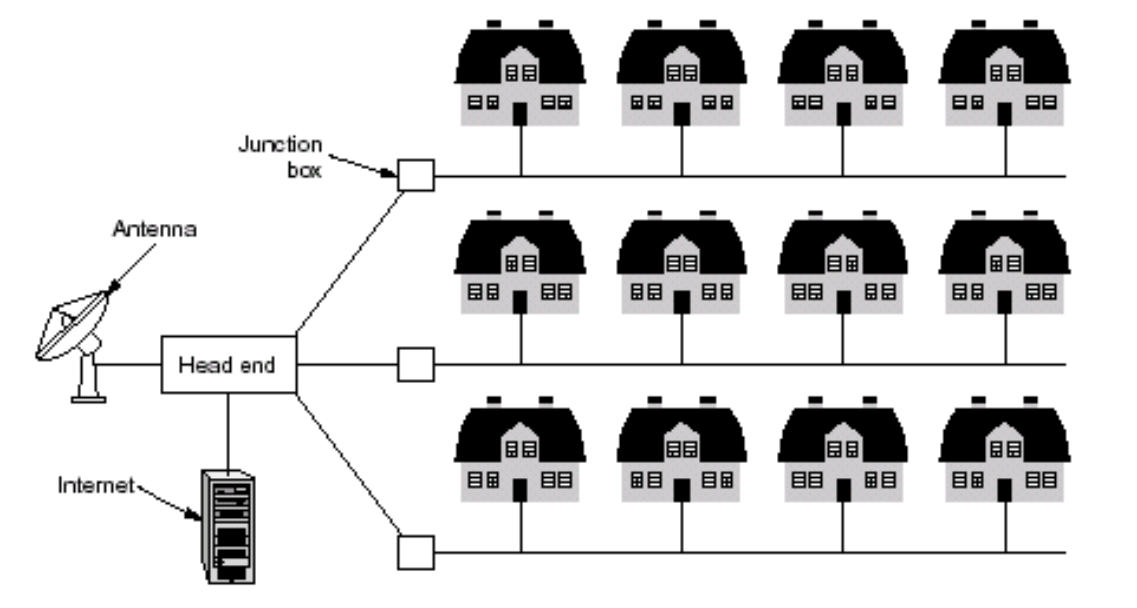
- Disadvantages: More expensive; the network stops working if the hub failed

Ring Topology

- Each node connected to two nearest nodes
- Entire network forms a circle
- One method for controlling which device can transfer is token passing
- Advantages: no collision
- Disadvantages: high cost; network stop working when the ring breaks



MAN-Metropolitan Area Network



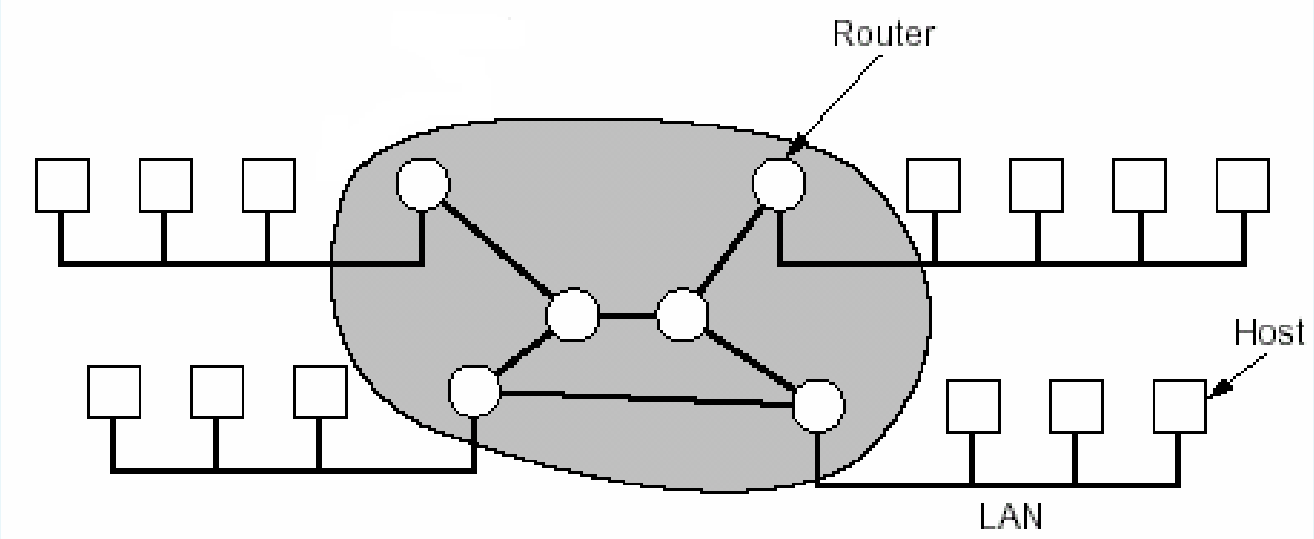
- Scope:
  - A city
  - A metropolitan area

WAN – Wide Area Network

Extend a network in:

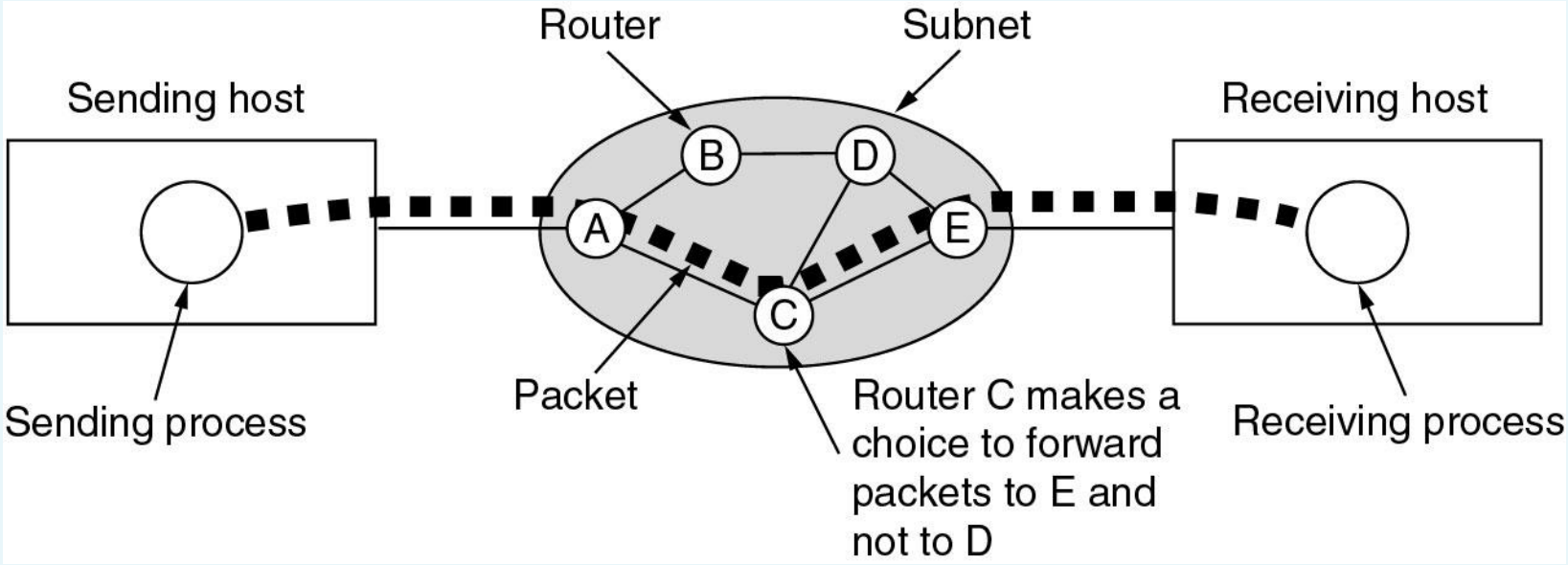
– Number of hosts

– Network diameter



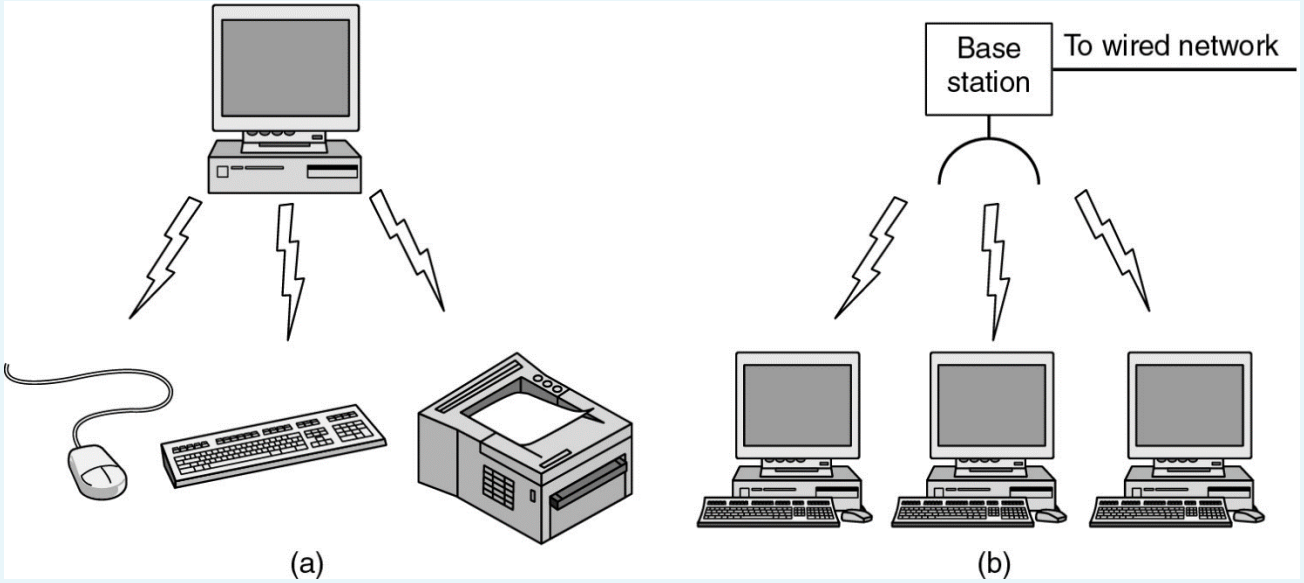
WAN – Wide Area Network

- Router: Store and Forward technique



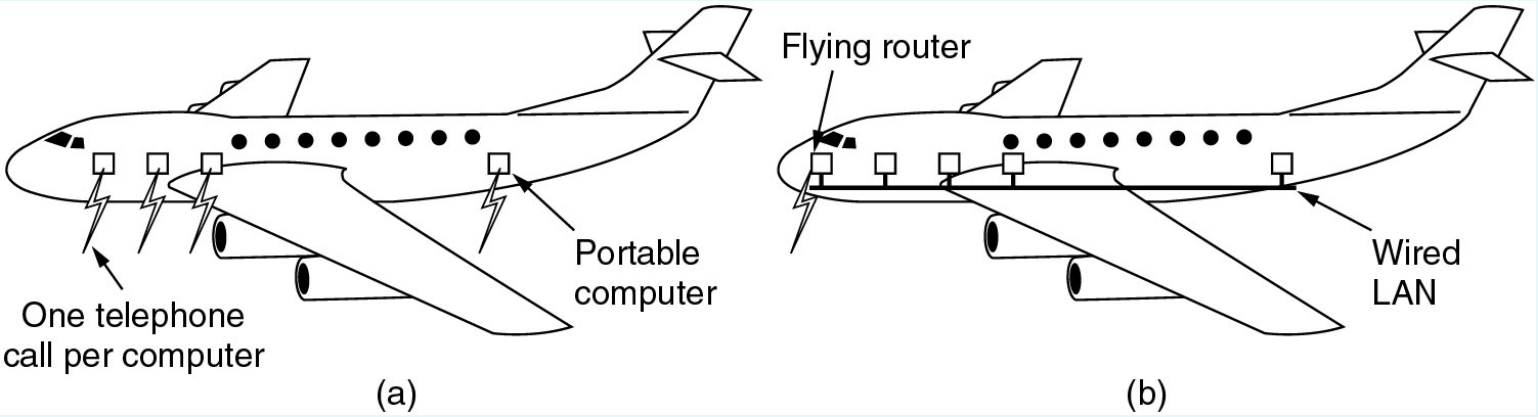
Wireless Network

- (a) Wireless devices: Replace the cabled devices
- (b) Wireless LAN



Wireless Network

- Wireless WAN



Internetwork

Internetwork

- A network formed by inter-connecting several heterogeneous (hardware, software) networks
  - LAN = LAN + LAN
  - WAN = LAN + LAN
  - WAN = WAN + WAN

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Computer Network Software

Components of computer network Software

Computer network Software is what makes computer network work. All network software implemented based on 3 core concepts:

- **Service**: What a component can provide for other components
- **Interface**: How/the way a component can access services provided by other component
- **Protocol**: a formal set of rules, conventions and data structure that governs how computers and other network devices exchange information over a network

Hierarchy of computer network protocols

To reduce the complexity in designing and implementing, the network software is organized into layers based on the principles:

- Relative services are grouped into a layer
- Each layer uses the services of the lower layer and provides services to upper layer
- Between two abjection layers exist an interface
- Two entities of two computer systems at the same layer have to use the same protocol to exchange data
- A protocol specifies rules for exchanging information: data format, handshaking, error detecting and handling, ...

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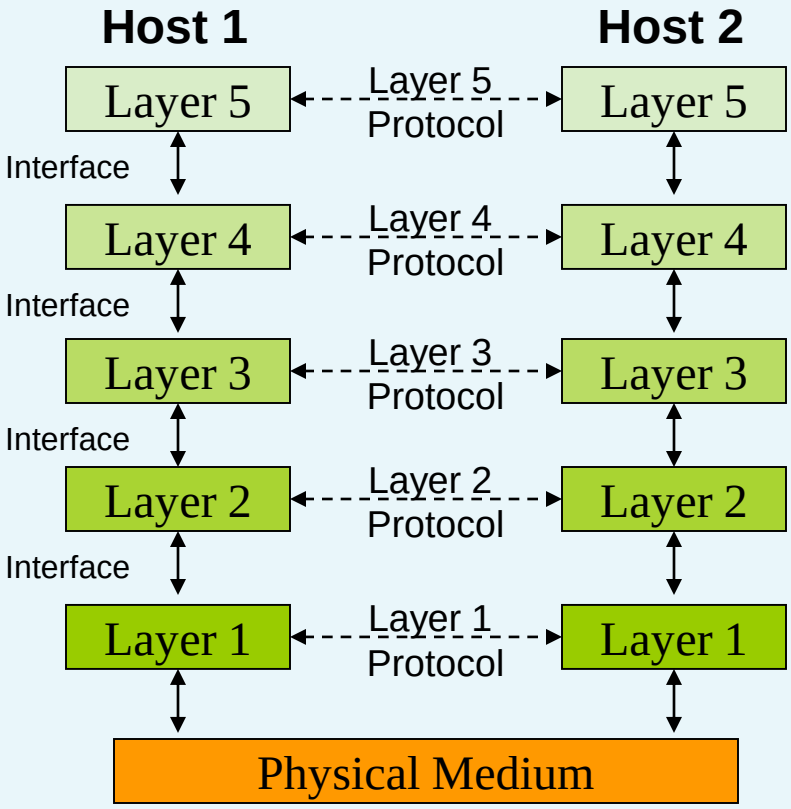
Hierarchy of computer network protocols



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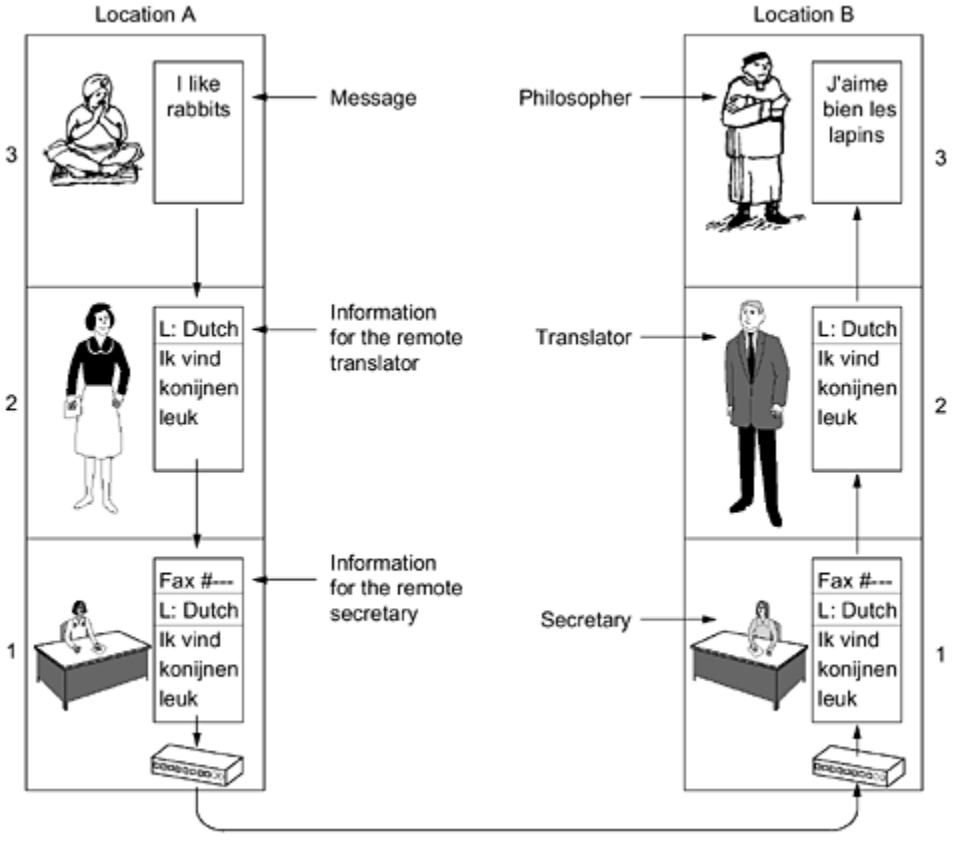
Hierarchy of computer network protocols



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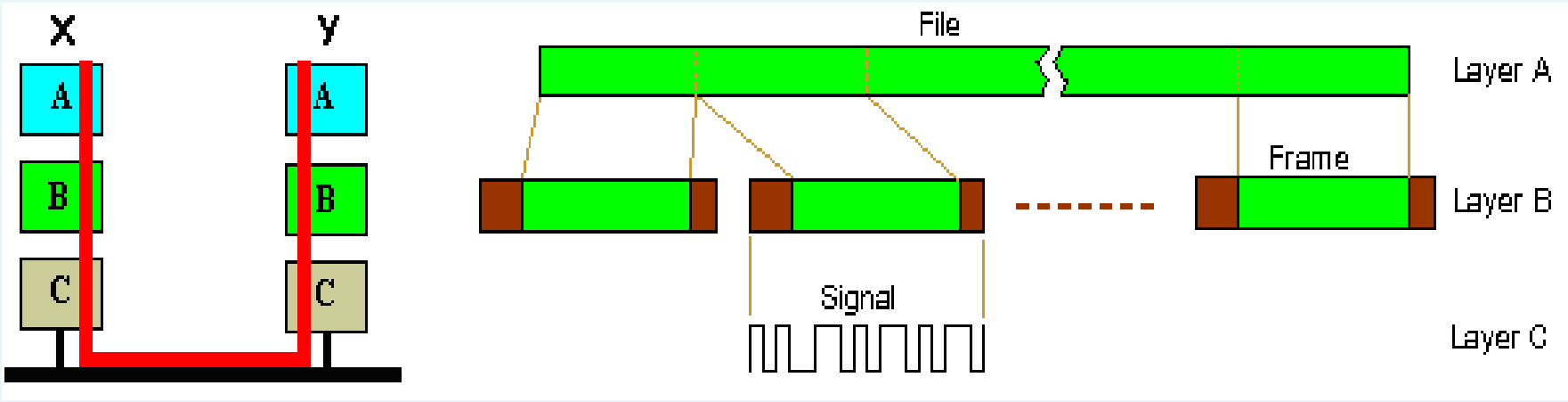
Three layer file transfer model

A : Three layer file transfer model

B : Frame Transfer Layer

C : Bit Transfer layer



Network Service Types

- **Connection-oriented services**
  - Operate using the similar model as that of telephone network
  - Establish and terminate communication Channel
- **Connectionless services**
  - Postal model
  - Data sent in packets
  - Packet header contains address of receiver

Network Services

	Service	Example
Connection-oriented	Reliable message stream	Sequence of pages
	Reliable byte stream	Movie download
	Unreliable connection	Voice over IP
Connection-less	Unreliable datagram	Electronic junk mail
	Acknowledged datagram	Text messaging
	Request-reply	Database query

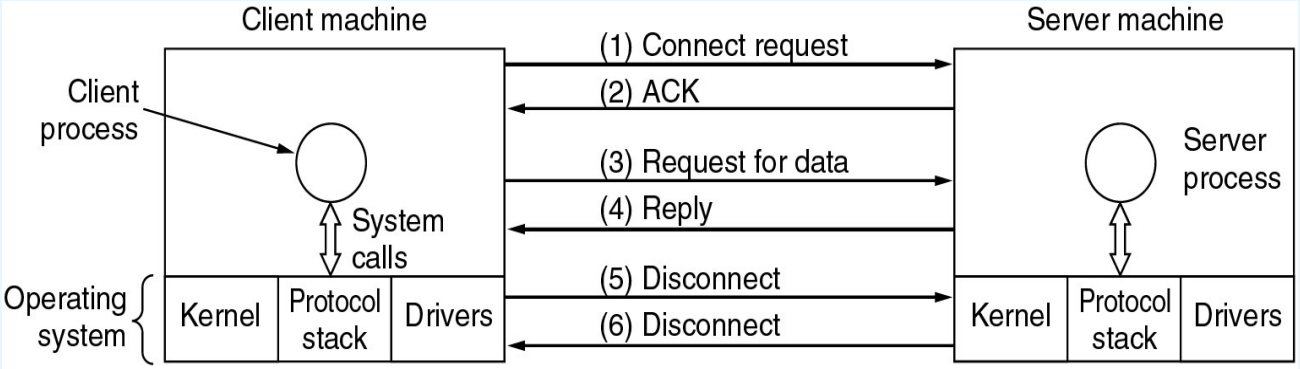
Primitives of connection oriented services

- A service is formally specified by a set of primitives (functions) to a user process to us the service.
- Following are primitives of the connection-oriented service

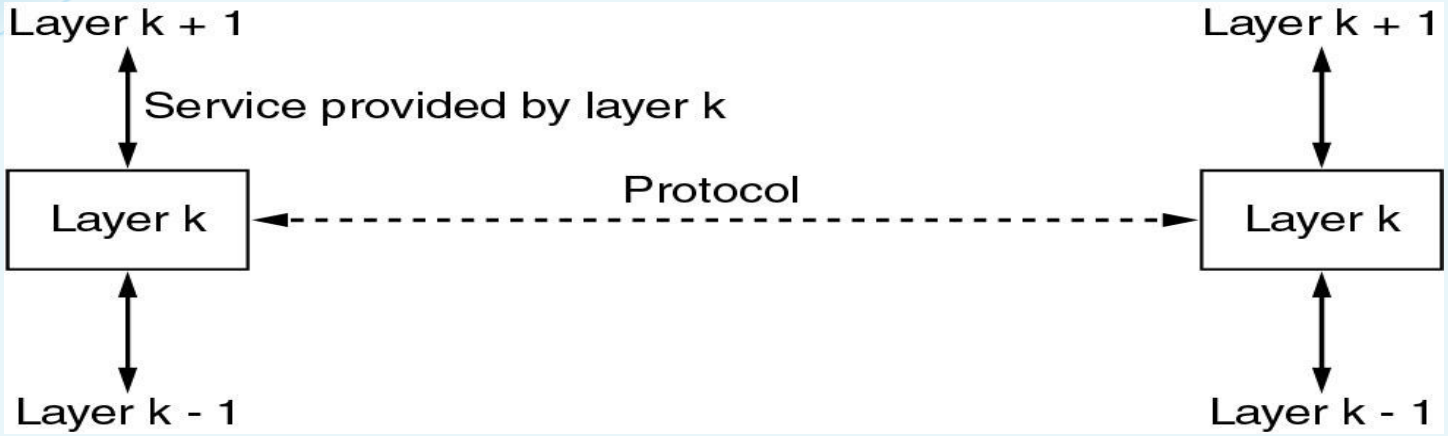
Primitive	Function
LISTEN	Block and wait for a connection request
CONNECT	Request to establish a connection
RECIEVE	Block and wait for a message arrival
SEND	Send a message
DISCONNECT	Terminate a connection

Primitives of connection oriented services

Server	Client
LISTEN	
	CONNECT
RECIEVE	SEND
SEND	RECIEVE
DISCONNECT	DISCONNECT



Service vs Protocol



- **Service**: A set of operations that a layer provides for the upper layer.
- **Protocol:** A set of rules (data format, handshaking, error detecting and handling,…) that governs the communication between two systems on the network.
- Two entities at the same layer of two computer systems must use the same protocol to exchange data

Open System Interconnection Model

Open System Interconnection Model (OSI Model)

- Standardized by ISO (International Standard Organization)
- Composed from seven layers:
  - Physical layer
  - Data link layer
  - Network layer
  - Transport layer
  - Session layer
  - Presentation
  - Application layer

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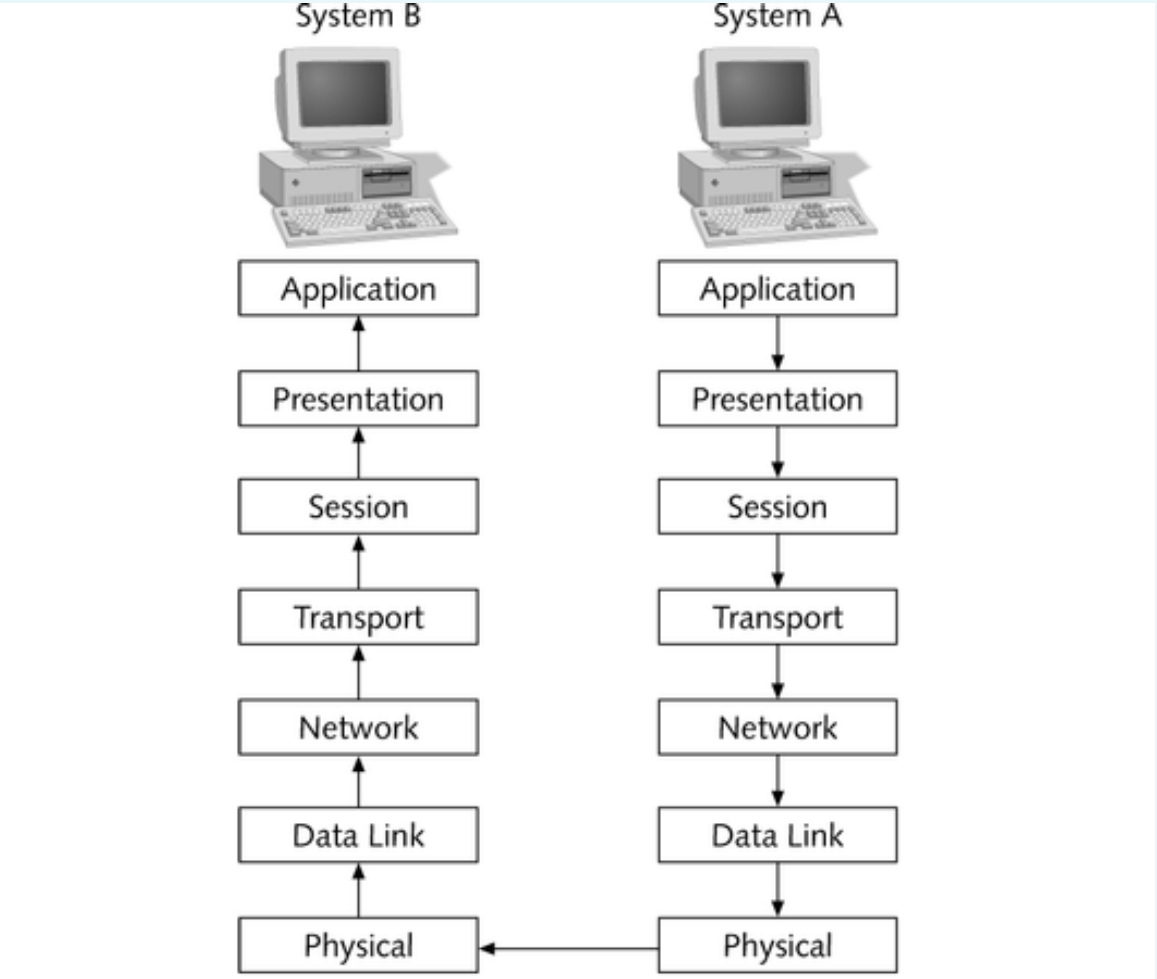
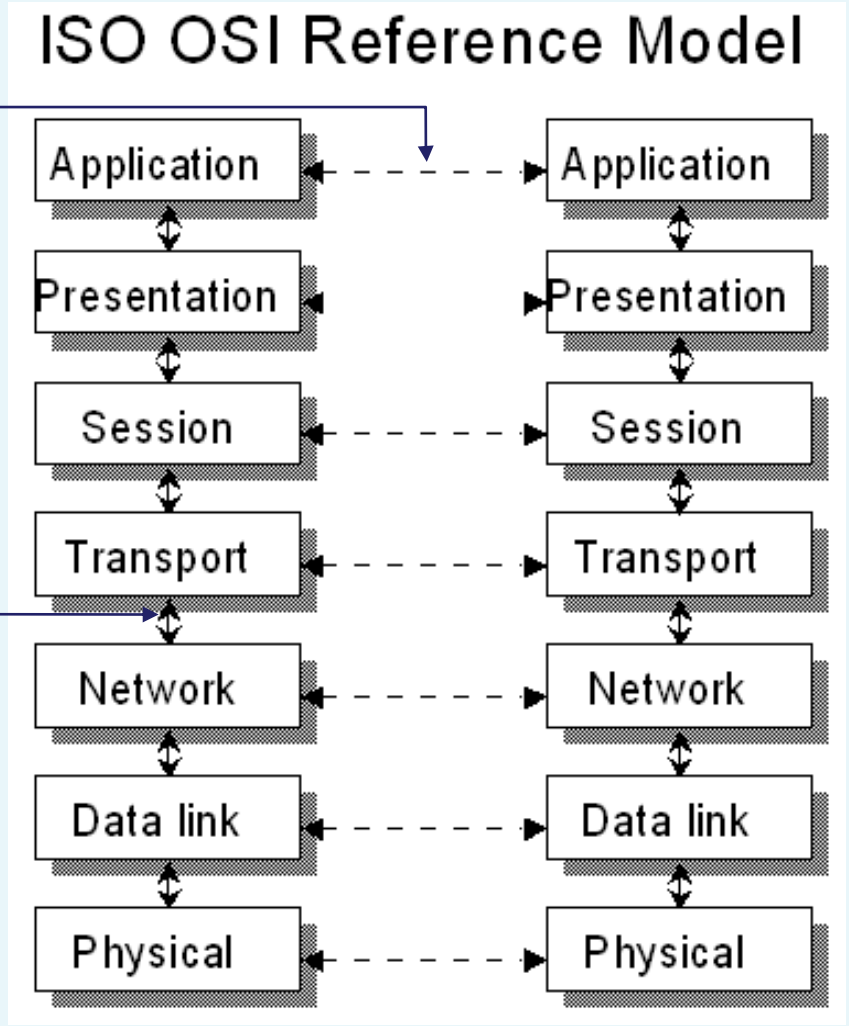
OSI Model



OSI Model

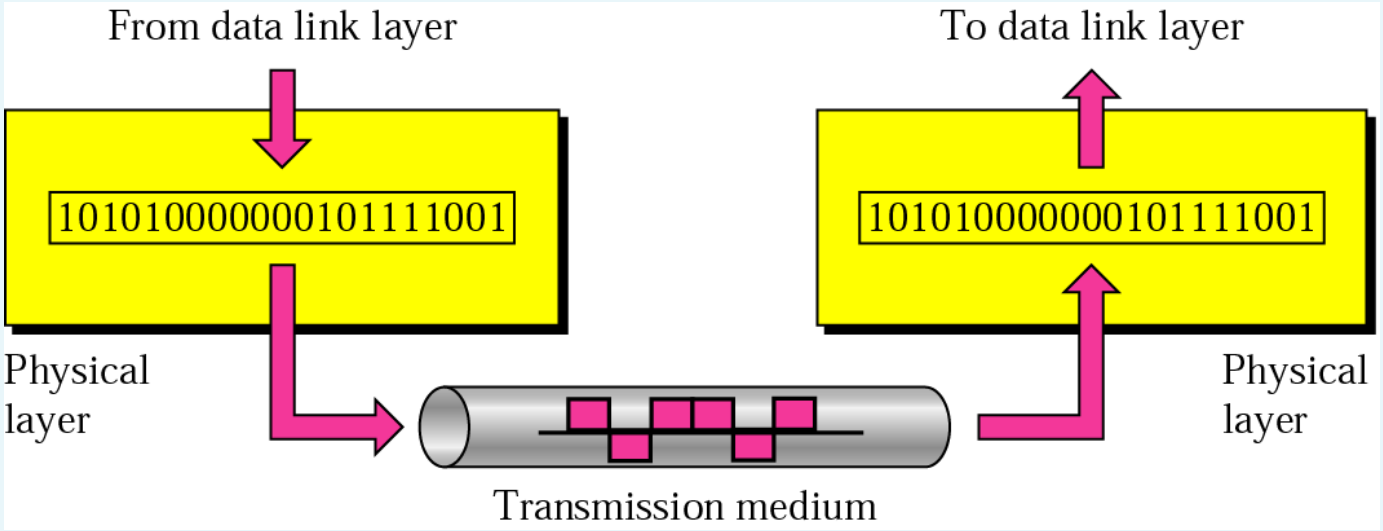
Application Protocol

Interface 4/3



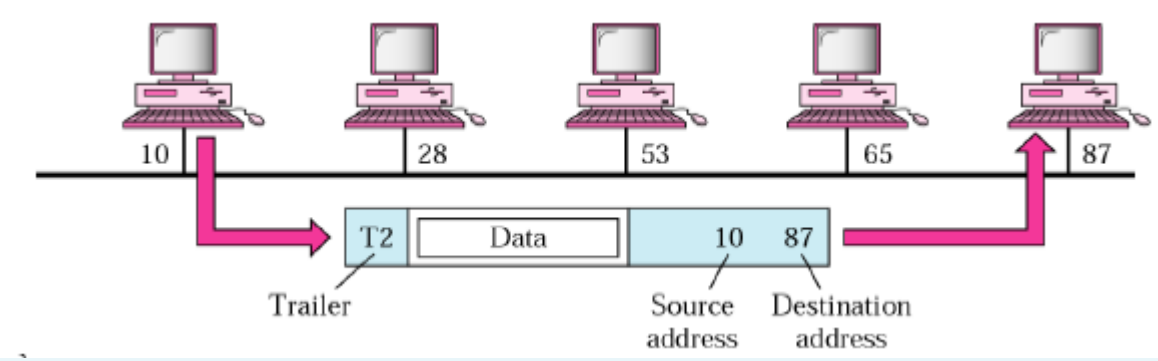
Physical layer

- Transmit raw bit on a physical link
- Define the hardware equipment, cabling, wiring, frequencies, pulses used to represent binary signals, …
- Provide services to data link layer



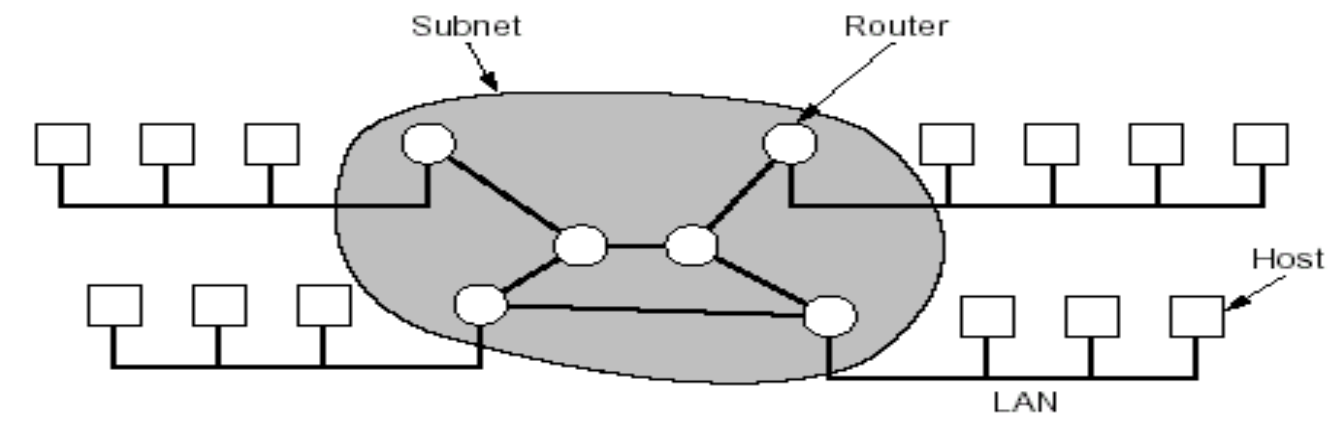
Data link layer

- Data transmission unit – Frame
- Establish mechanism for error detection and correction (0100**1** => 0101**1)**
- Establish mechanism for flow control
- Control access into shared medium
- Require direct links between sending and receiving hosts



Network layer

- Data transmission unit - Packet
- Routing and forwarding packets
- Detecting and avoiding network congestion



Transport layer

- Provide an end-to-end data transmission service
- Control packets loss and duplication
- Multiplexing / De-multiplexing

Session layer

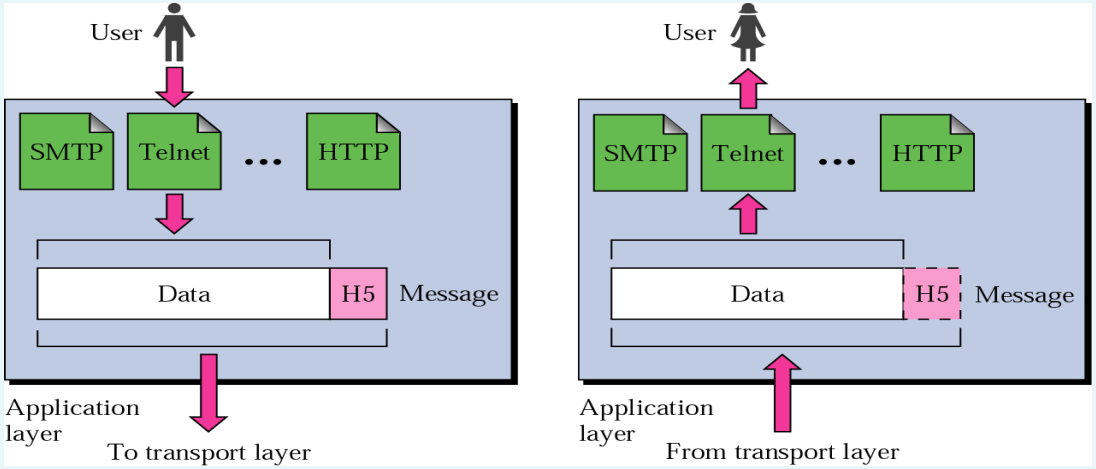
- Session management: Responsible for establish and terminating the connection
- Synchronizing transmission data
- Example: Web browser opens a web page containing text, graphics, Macromedia Flash objects and perhaps a Java applet which all stored as separate files on the web server. To access them, a separate download must be started. Your web browser opens a separate *session* to the web server to download each of the individual files. The *session* layer keeps track of which packets and data belong to which file and keeps track of where they go (in this case, to your web browser).

Presentation layer

- Standardizing data exchanged between different computer architectures: Little Endian vs Big Endian, . .
- Compressing, encoding transmission data
- Example:
  - Conversion of a Sun .RAS raster graphic to JPG.
  - Conversion of ASCII to IBM EBCDIC
  - Conversion of .PICT on a MAC to .jpg
  - Conversion of .wav to .mp3

Application layer

- Responsible for displaying data and images to the user in a human-recognizable format
- Example: Email, Web, FTP, . . .
- Application protocols: HTTP, SMTP, POP,IMAP...



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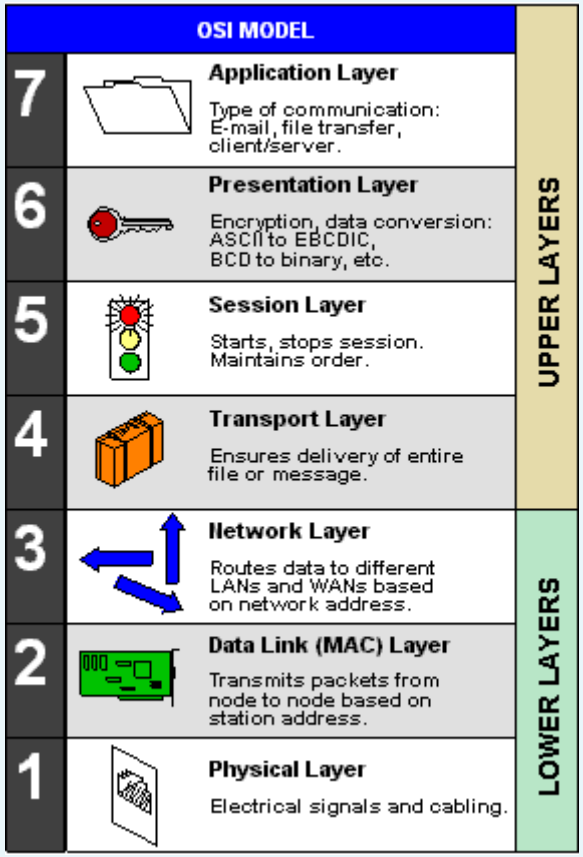
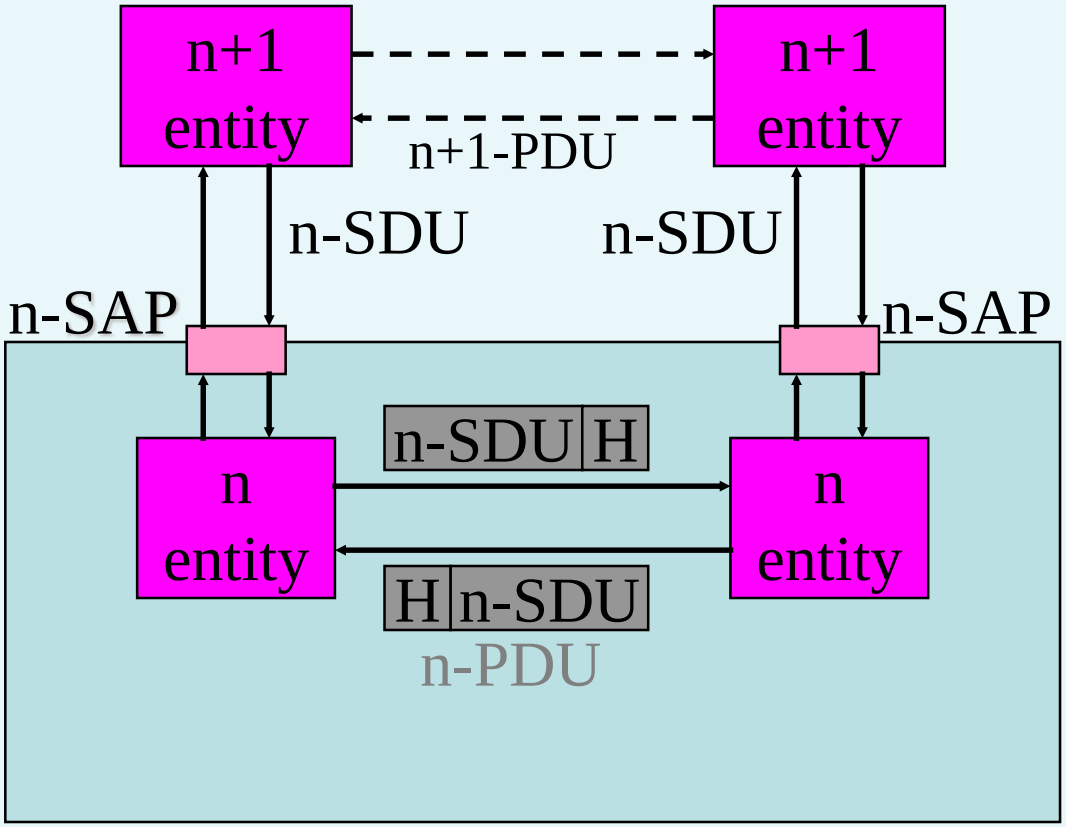
OSI MODEL



OSI Model



- n Entity (thực thể) = một tiến trình ở tầng n
- SAP = Service Access Point
- SDU = Service Data Unit
- PDU = Protocol Data Unit
- H=Header

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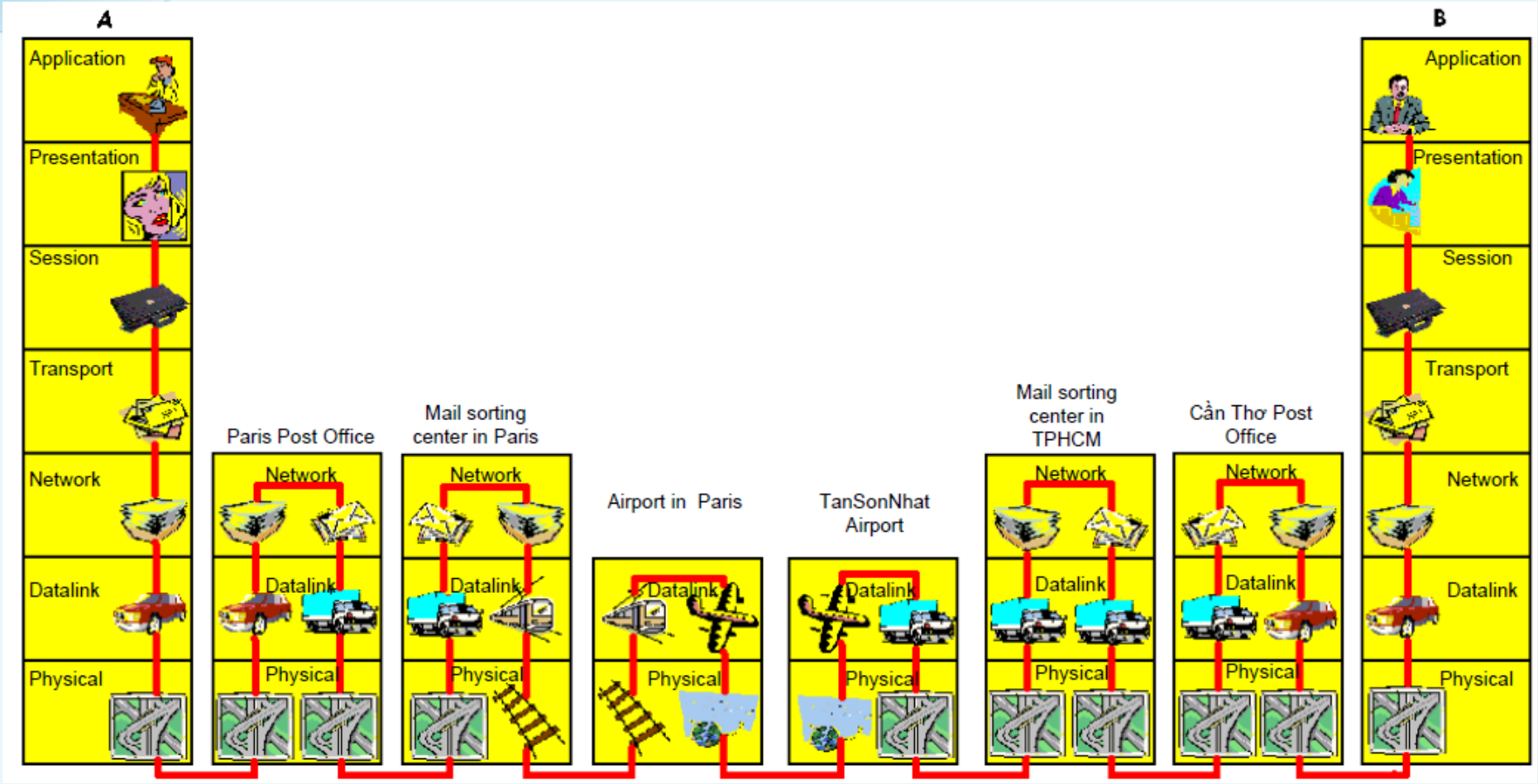
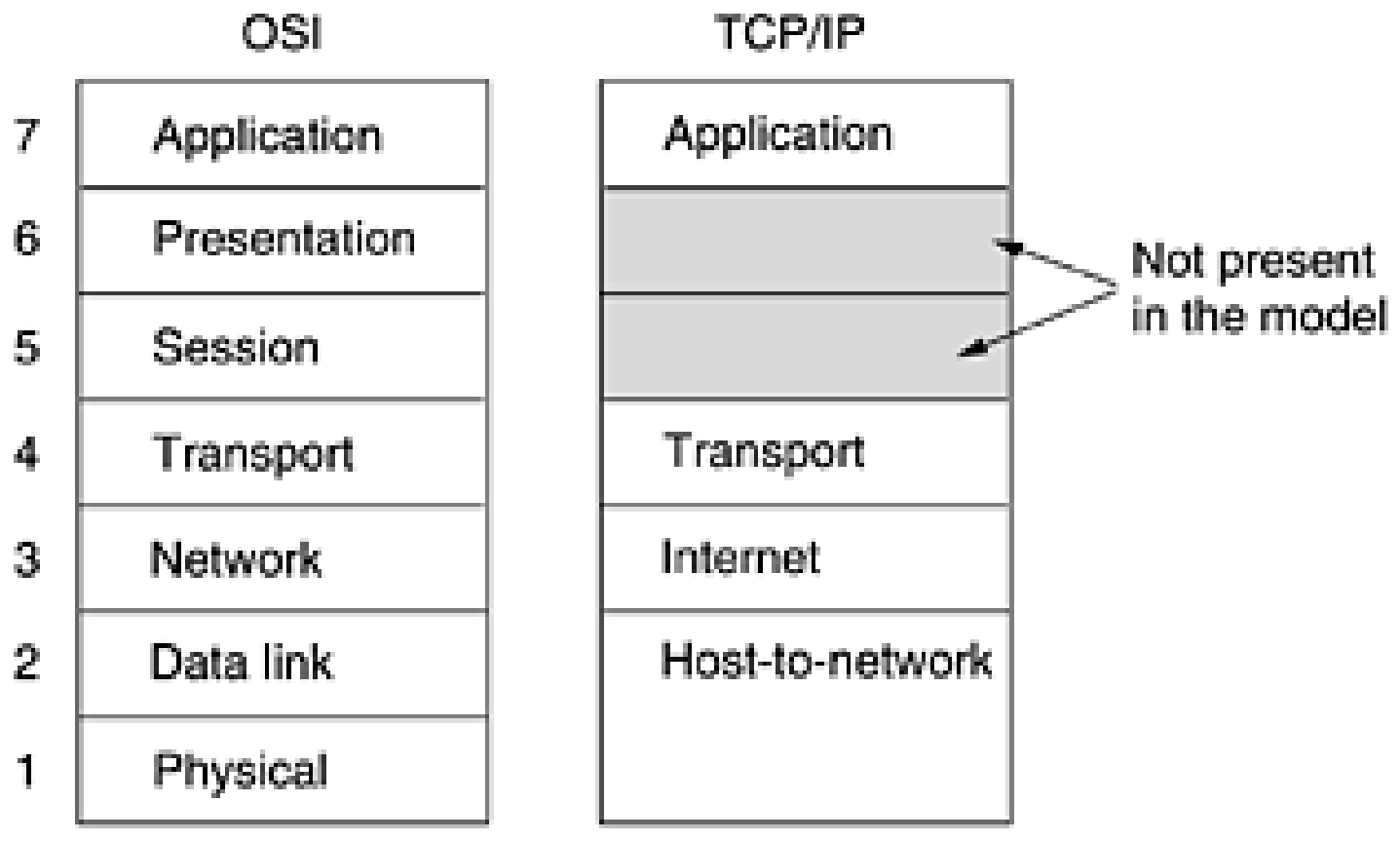
Example of layer hierarchy



Example of layer hierarchy

- Application layer: Writing/reading letter
- Presentation layer: Translating, putting letter into an envelop, open an envelop
- Session layer: Collecting/Dispatching letters of different offices
- Transport layer: Role of office agent in a company.
- Network layer: Role of post office or Mail sorting center
- Data-link layer: Transport mail between two neighborhood post office.
- Physical: Transportation methods (by car, by train, by airplane).

OSI Model vs TCP/IP



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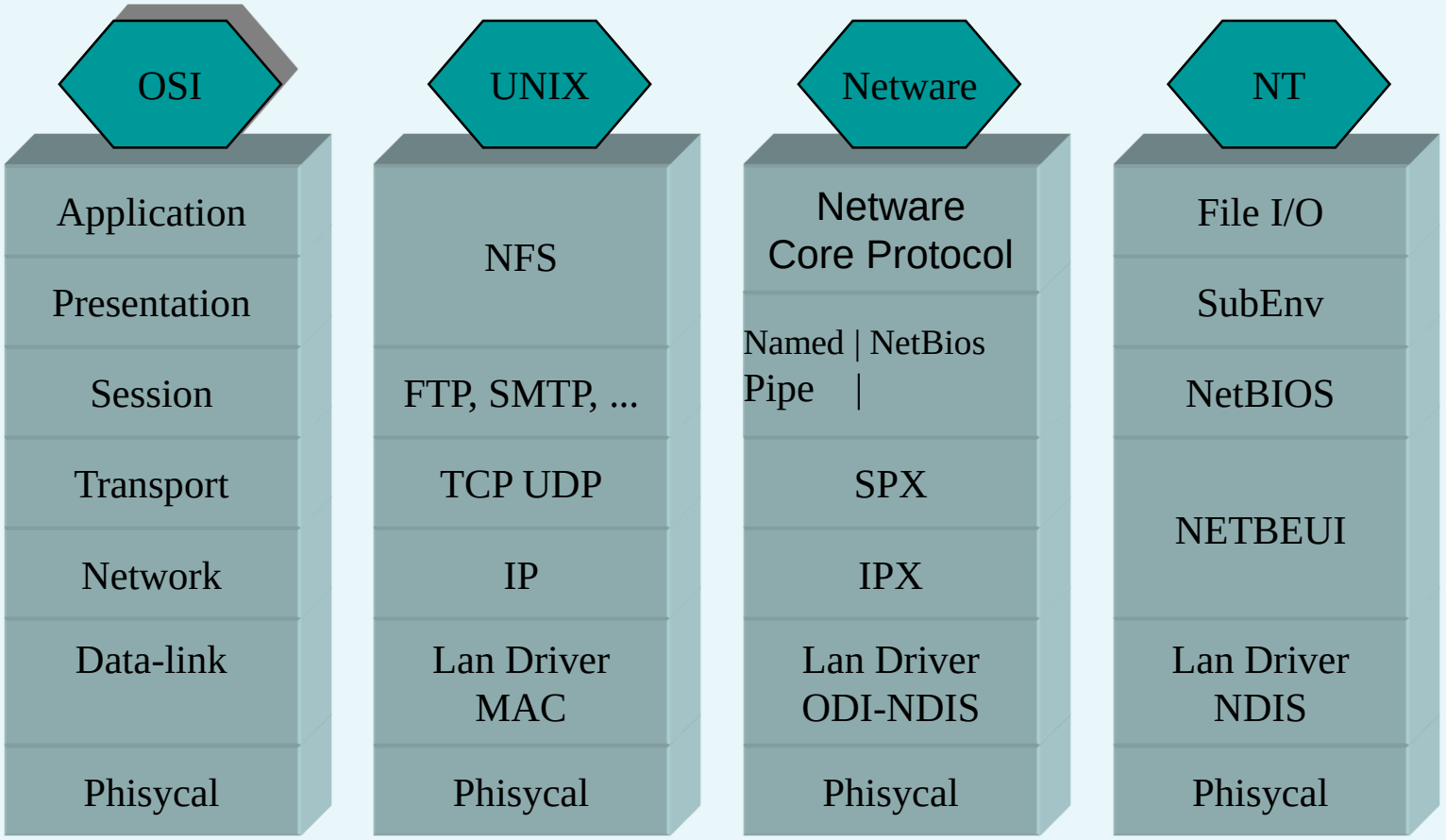
Computer Network Operating Systems



Questions