



北京邮电大学

# Computer Networks

## Review of Chapter 1 to 4

Apr. 2020

# Chapter1 Introduction(1)

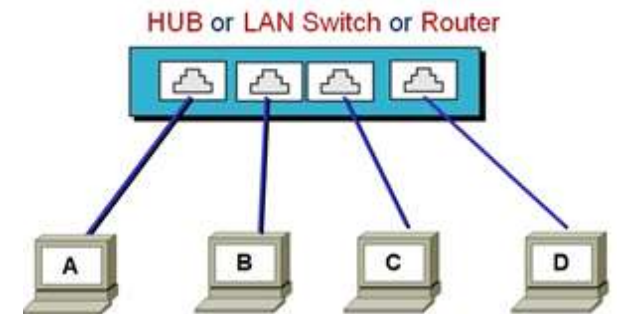
## ■ What is a computer network?

- ◆ A set of independent and interconnected computers
- ◆ Computer networks vs. communication networks
  - user-oriented vs. communication-oriented
  - Host/End system vs. Interconnection devices
  - 5 layers vs. 3 layers
- ◆ Computer networks vs. distributed systems
  - Whether transparent to users
  - distributed system is a software system over a computer network

## ■ Uses of computer networks

## ■ Hardware composition

- ◆ Host/end system, network node, links(wired or wireless)



# Chapter1 Introduction(2)

## ■ Categories of computer networks

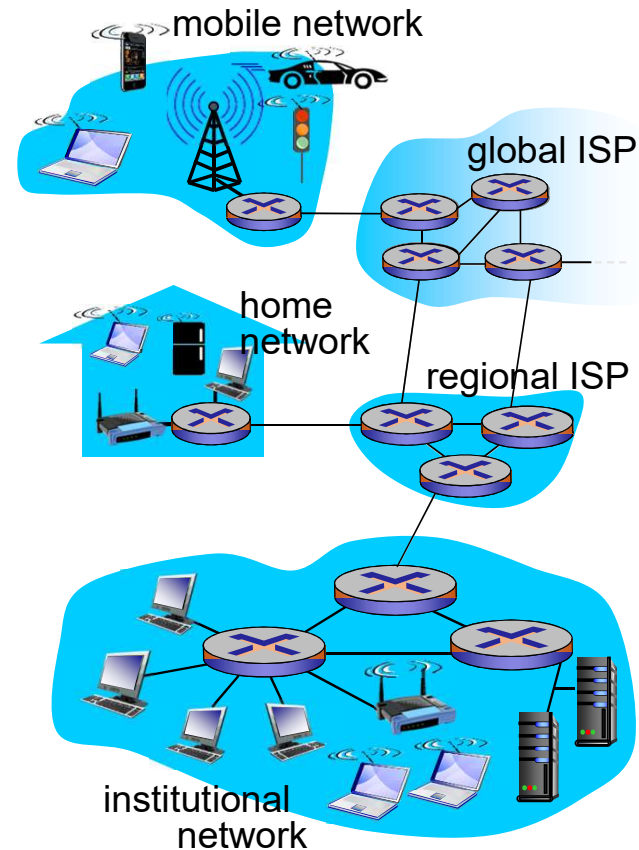
### ◆ On transmission technology:

- Broadcast link vs. point-to-point link
- Shared channel vs. dedicated channel
- Supporting multicast/broadcast or not
- LAN vs. WAN

### ◆ On scale: PAN, LAN, MAN, WAN, Internet

### ◆ On position in Internet:

- access network vs. core networks
- Edge, connecting end systems vs. connection of routers



# Chapter1 Introduction(3)

## ■ Network architecture

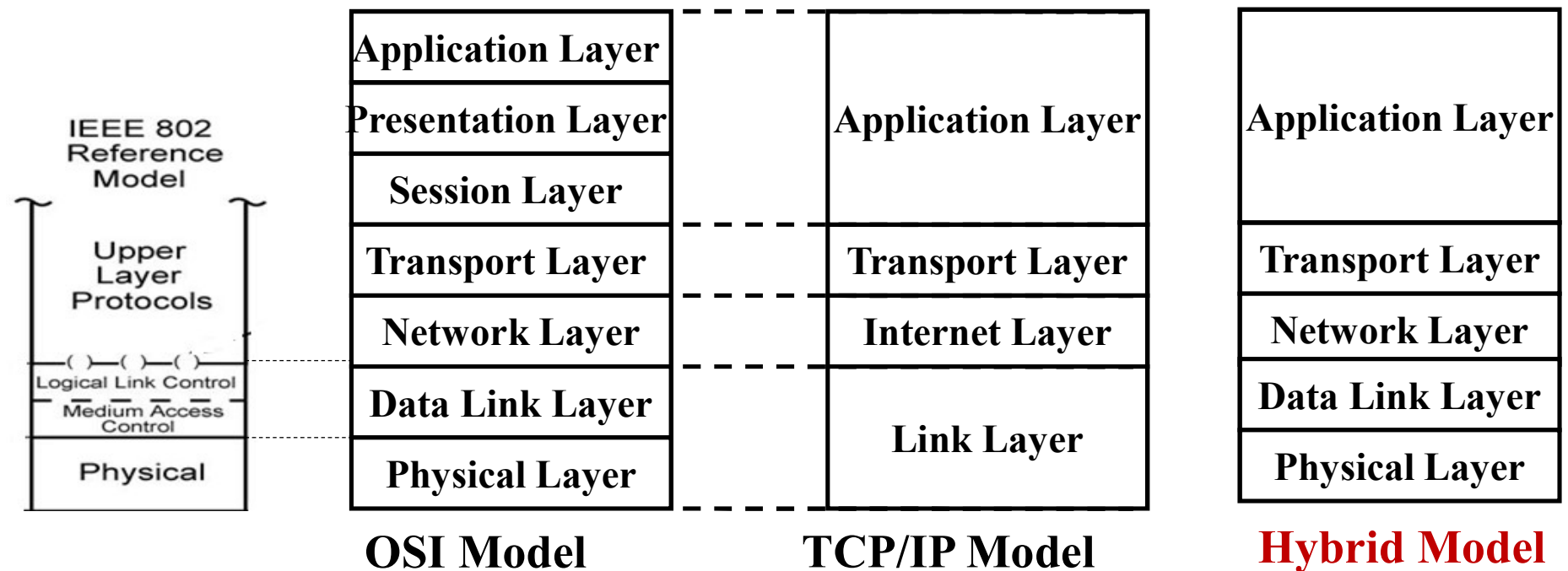
- ◆ Idea of Layer: well-defined function, offering certain service to upper layer, minimum information across interfaces
- ◆ Information flow: U-shape
- ◆ Encapsulation

## ■ Protocol: an agreement between peers on communication

- ◆ Packet format(PDU), meaning of fields, message flow

## ■ Services: connection-oriented vs. connectionless

# Chapter1 Introduction(4): Reference Models



# Chapter2 Physical Layer(1)

## ■ Position, function and service

- ◆ Position: bottom layer, real communication
- ◆ Function:
  - sending signal to and receiving signal from transmission media
  - Bit-signal transformation
  - defining electrical, timing and other interfaces with transmission media
- ◆ Service: transmission of bit stream
- ◆ Performance parameters
  - Bandwidth/maximum data rate/channel capacity
  - Bit error rate
  - Delay(transmission delay, propagation delay)

# Chapter2 Physical Layer(2)

- Theorem of maximum data rate
  - ◆ Nyquist theorem and Shannon theorem
- Transmission media
  - ◆ Wired: twisted pair, coaxial cable, fiber
  - ◆ Wireless: radio, satellite
- Data vs. Signal(digital vs. analog)
  - ◆ Modulation (QPSK & QAM)
  - ◆ Line encoding (Manchester)
  - ◆ PCM
- Accessing to Internet
  - ◆ Dial-up, ADSL, FTTH, Cable TV

# Chapter2 Physical Layer(3)

## ■ Multiplexing

- ◆FDM, WDM, TDM(Synchronous TDM vs. Statistical TDM), CDMA

## ■ Circuit Switching vs. Packet Switching

- ◆call setup, resource reservation, path of data, order of arrival, bandwidth available, timing, ...

## ■ Connection devices

- ◆Repeater, Hub (1 collision domain)

## ■ Example protocol

- ◆10BaseT



# Chapter3 Data Link Layer(1)

## ■ Position, function and service

- ◆ Position: on top of physical layer, under network layer

- ◆ Function:

- Transmission of frames(reliably) between adjacent devices
- Hiding physical network details

- ◆ Service:

- Connection-oriented: HDLC
- Connectionless: PPPoE

## ■ Design issues

- ◆ Framing

- Byte stuffing
- Bit stuffing
- Physical layer coding violations

# Chapter3 Data Link Layer(2)

## ■ Design issues

### ◆ Error Control

- Correcting Code: Hamming code
- Error Detecting Code: CRC

### ◆ Flow Control (+Error Control): reliable transmission

- ◆ ARQ: checksum, ACK(ACK frame or piggybacking), retransmission on timeout, sequence number

- Stop-and-wait:  $W_T=W_R=1$ ,  $U=1/(1+2a)$

- Go-back-N:  $1 < W_T < 2^m$ ,  $W_R=1$

- Selective Repeat:  $W_T=W_R=2^{m-1}$

$$\longrightarrow U = \begin{cases} 1 & W \geq 2a+1 \\ \frac{W}{2a+1} & W < 2a+1 \end{cases}$$

## ■ Example protocol

### ◆ HDLC, PPP

# Chapter4 MAC Sublayer(1)

## ■ Position, function and service

- ◆ Position: on top of physical layer, under LLC sublayer
- ◆ Function: accessing a shared medium(broadcast link)
- ◆ Service:

- Connectionless: Ethernet
- Connectionless with ACK: wifi

## ■ Multiple Access method

- ◆ CSMA/CD
  - carrier sense, collision detection, jam, binary exponential backoff
- ◆ CSMA/CA
  - carrier sense, RTS/CTS to avoid collision(MACA)

# Chapter4 MAC Sublayer(2)

## ■ Connection devices

### ◆ Bridge, LAN switch

- A collision domain for each port
- Forwarding frame on destination MAC address
- Reverse learning to build forwarding table
- VLAN: solve problem of broadcast storm

## ■ Example networks

### ◆ Ethernet

- Classical Ethernet(10Mbps): CSMA/CD, maximum and minimum frame length, Manchester encoding
- Fast Ethernet(100Mbps)
- Gigabit Ethernet(1000Mbps)

### ◆ Wifi

- NAV(Virtual channel sensing) to solve hidden station problem
- Different IFS to support priority