

# **A Review of Key Networking Concepts**

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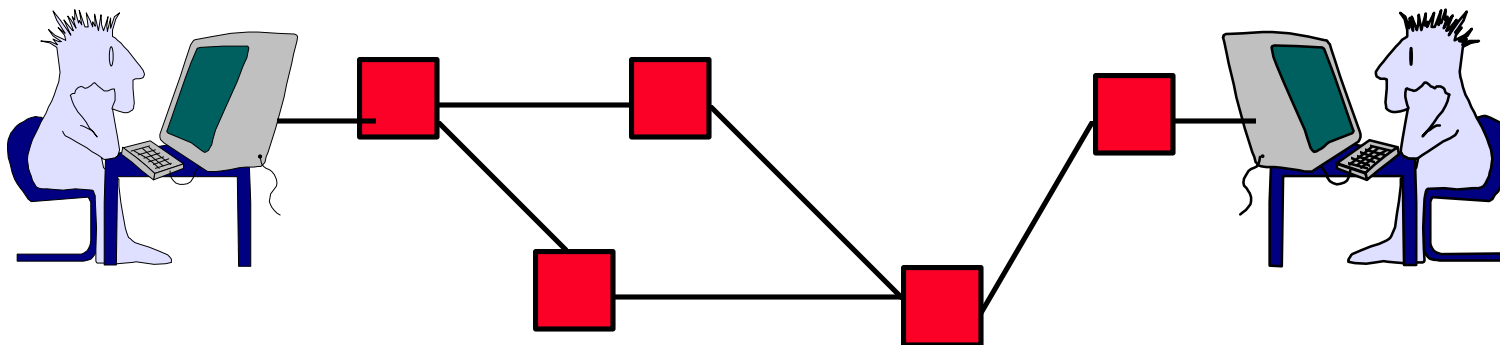
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- ❑ ISO/OSI Reference Model
  - ❑ TCP/IP Reference Model
  - ❑ Differences between ISO and TCP
  - ❑ Ethernet/IEEE 802.3 LANs
  - ❑ Interconnecting Devices
- All these concepts are taught in CIS677.

# ISO/OSI Reference Model

4	Application	File transfer, Email, Remote Login
	Presentation	ASCII Text, Sound
	Session	Establish/manage connection
3	Transport	End-to-end communication: TCP
2	Network	Routing, Addressing: IP
1	Datalink	Media Sharing: Ethernet
	Physical	How to transmit signal: Coding



# Layering

FTP	Telnet	Web	Email
TCP		UDP	
IP		IPX	
Ethernet		Token Ring	
Twisted Pair		Fiber	

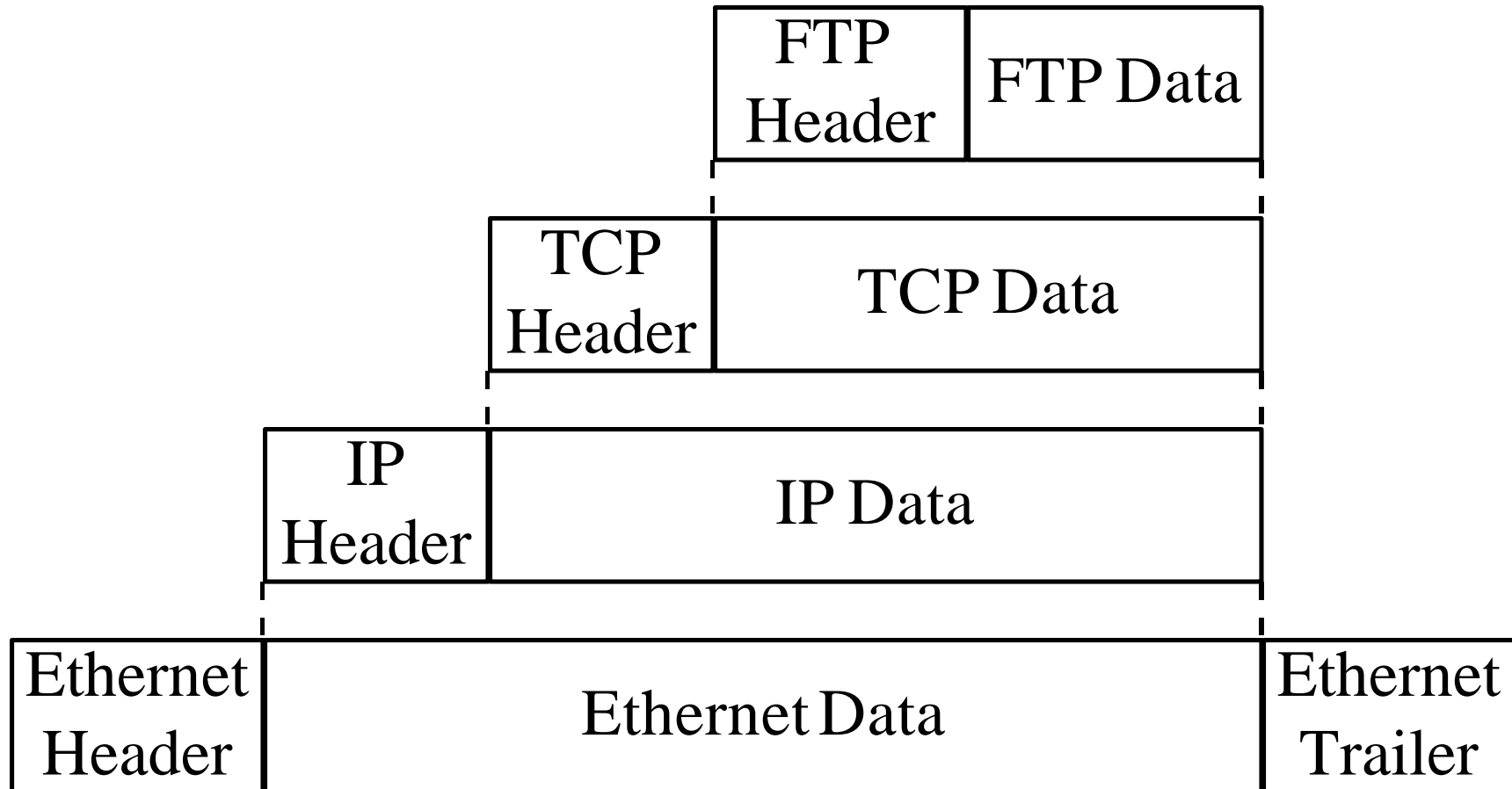
← Same Interfaces

- ❑ Protocols of each layer perform a set of functions
- ❑ All alternatives for a row have the same interfaces
- ❑ Choice of protocols at each layer is independent of those of at other layers.

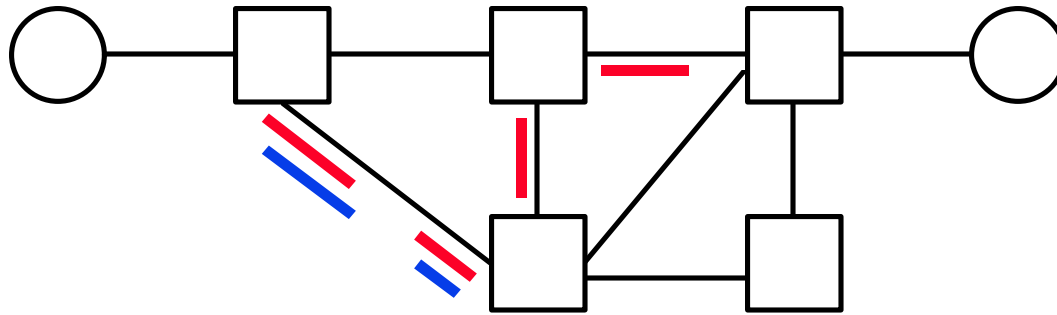
UDP = User Data Protocol, TCP = Transport Control Protocol, IPX = Internetwork Packet Exchange

# Layered Packet Format

- Nth layer control info is passed as N-1th layer data.



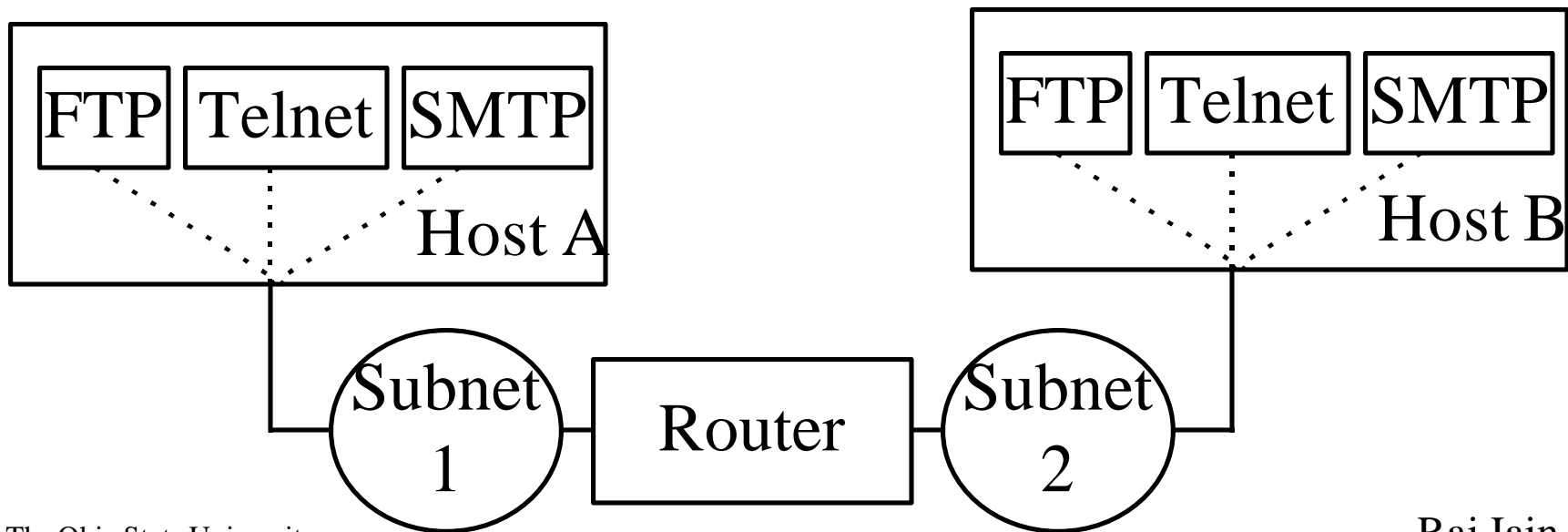
# Connection-Oriented vs Connectionless



- ❑ Connection-Oriented: Telephone System
  - ❑ Path setup before data is sent
  - ❑ Data need not have address. Circuit number is sufficient.
- ❑ Connectionless: Postal System.
  - ❑ Complete address on each packet
  - ❑ The address decides the next hop at each router

# Internetworking Terms

- ❑ End-system: Host
- ❑ Network: Provides data transfer between end-systems
- ❑ Internet: A collection of networks
- ❑ Subnetwork: Each component of an internet.  
Usually one LAN



# TCP/IP Reference Model

- TCP = Transport Control Protocol
- IP = Internet Protocol (Routing)

TCP/IP Ref Model TCP/IP Protocols

OSI Ref Model

Application	FTP	Telnet	HTTP	Application
Transport	TCP		UDP	Presentation
Internetwork	IP			Session
Host to Network	Ethernet	Packet Radio	Point-to-Point	Transport
				Network
				Datalink
				Physical

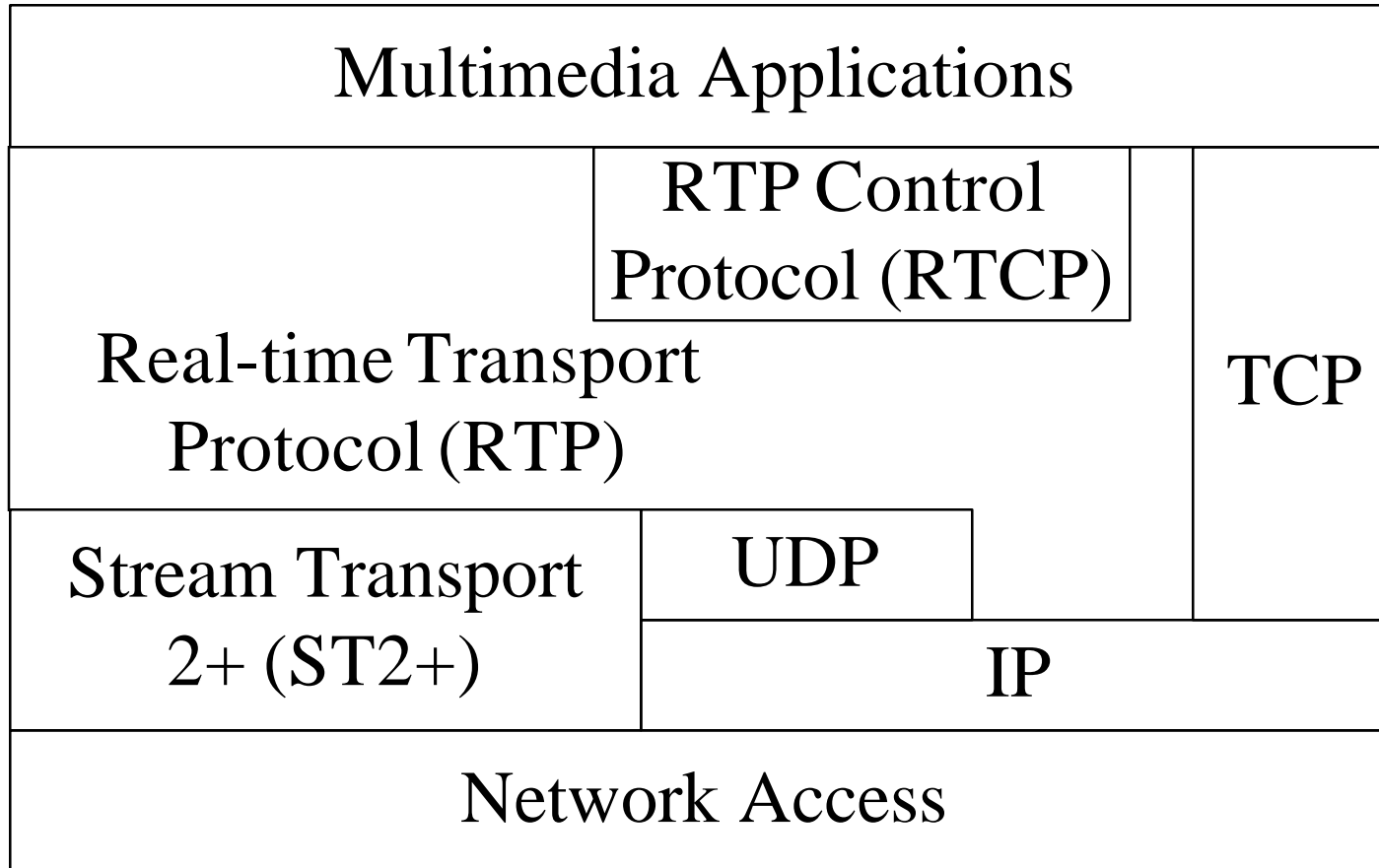
# OSI vs TCP Reference Models

- ❑ OSI introduced concept of services, interface, protocols, layers. These were force-fitted to TCP later  
⇒ It is not easy to replace protocols in TCP.
- ❑ In OSI, reference model was done before protocols.  
In TCP, protocols were done before the model
- ❑ OSI: Standardize first, build later  
TCP: Build first, standardize later
- ❑ OSI took too long to standardize.  
TCP/IP was already in wide use by the time.
- ❑ OSI became too complex.  
TCP/IP is not general. Ad hoc.

# Hierarchy

- ❑ Can directly use the services of a lower entity even if it is not in an adjacent layer
- ❑ Control and data can be separate connections. Control connections may have different reliability requirements than data.
- ❑ Lower layer control information can be used for higher layer control, e.g., lower layer close may close all higher layers

# Internet Integrated Services Protocols

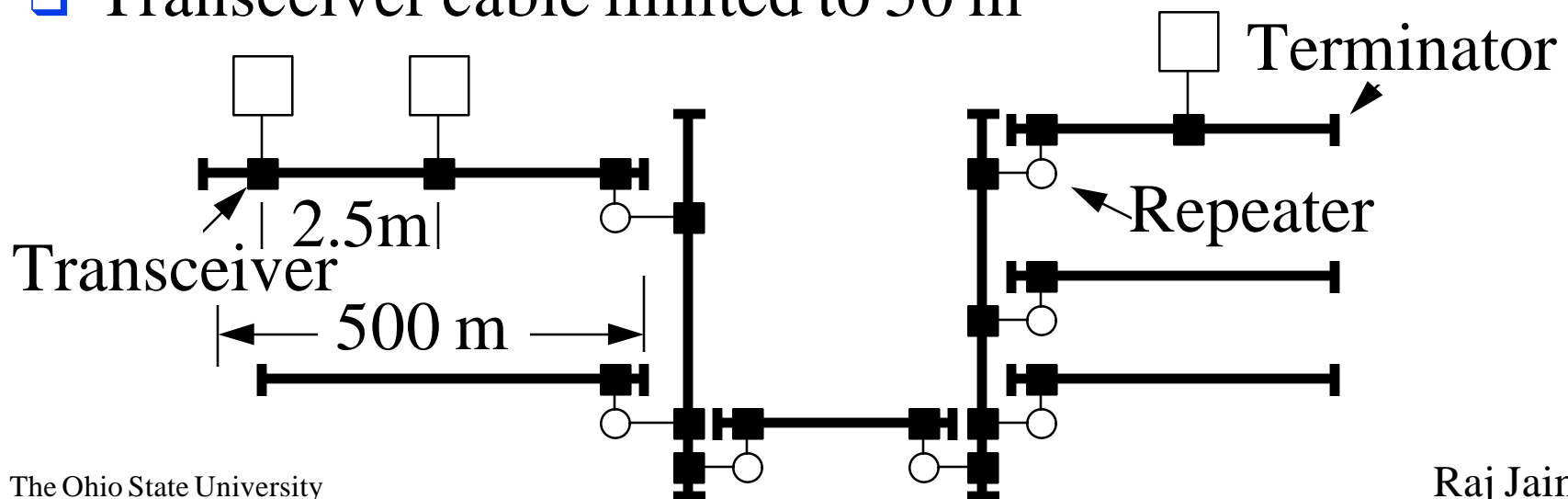


# Multiple Access Protocols

- ❑ Aloha at University of Hawaii:  
Transmit whenever you like  
Worst case utilization =  $1/(2e) = 18\%$
- ❑ CSMA: Carrier Sense Multiple Access  
Listen before you transmit
- ❑ CSMA/CD: CSMA with Collision Detection  
Listen while transmitting.  
Stop if you hear someone else.
- ❑ Ethernet uses CSMA/CD.  
Standardized by IEEE 802.3 committee.

# Original Ethernet Cabling Rules

- ❑ Thick coax
- ❑ Length of the cable is limited to 2.5 km, no more than 4 repeaters between stations
- ❑ No more than 500 m per segment  $\Rightarrow$  10Base5
- ❑ No more than 2.5 m between stations
- ❑ Transceiver cable limited to 50 m

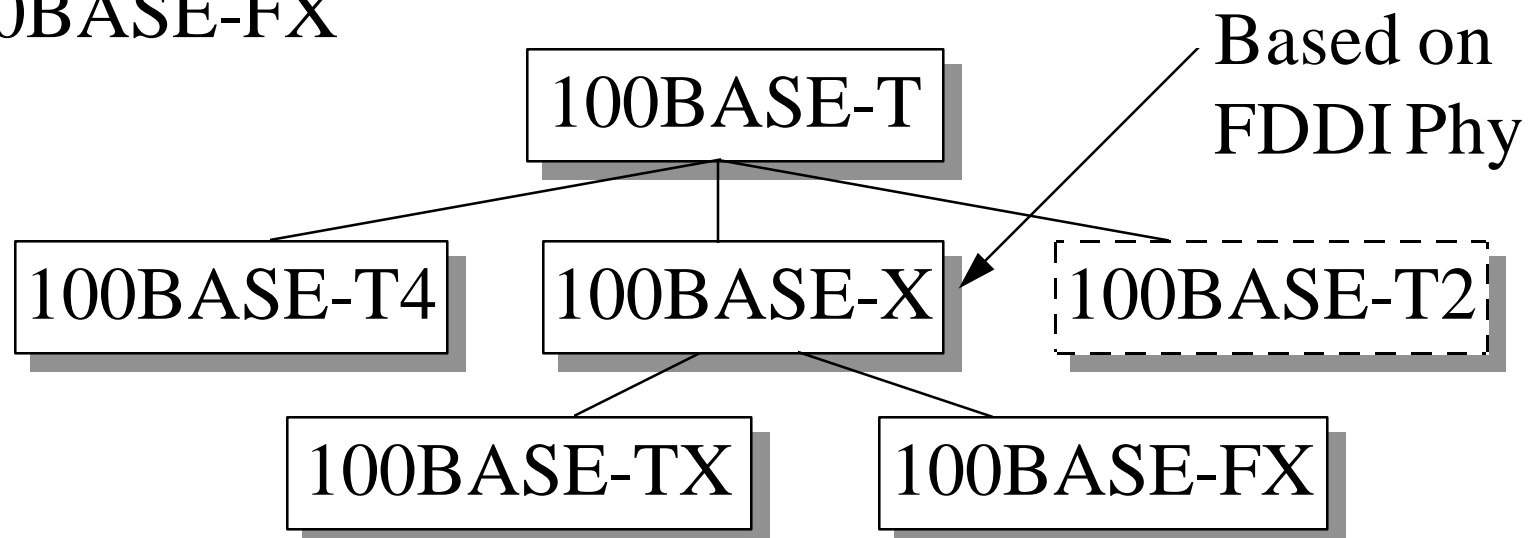


## 802.3 PHY Standards

- ❑ **10BASE5:** 10 Mb/s over coaxial cable (Thick Wire)
- ❑ **10BROAD36:** 10 Mb/s over broadband cable, 3600 m max segments
- ❑ **10BASE2:** 10 Mb/s over thin RG58 coaxial cable (Thin Wire), 185 m max segments
- ❑ **1BASE5:** 1 Mb/s over 2 pairs of UTP
- ❑ **10BASE-T:** 10 Mb/s over 2 pairs of UTP
- ❑ **10BASE-F:** Fiber Optic inter-repeater link (FOIRL), 10BASE-FL (link), 10BASE-FB (backbone), or 10BASE-FP (Passive)

# Fast Ethernet Standards

- ❑ **100BASE-T4:** 100 Mb/s over 4 pairs of CAT-3, 4, 5
- ❑ **100BASE-TX:** 100 Mb/s over 2 pairs of CAT-5, STP
- ❑ **100BASE-FX:** 100 Mbps CSMA/CD over 2 fibers
- ❑ **100BASE-X:** 100BASE-TX or 100BASE-FX
- ❑ **100BASE-T:** 100BASE-T4, 100BASE-TX, or 100BASE-FX

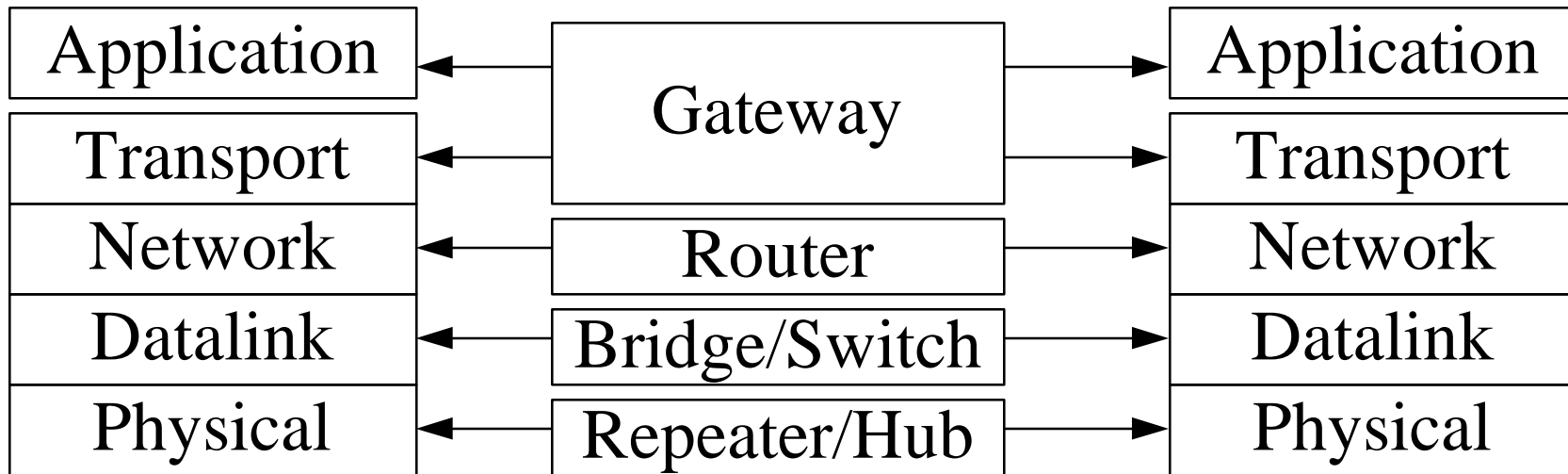
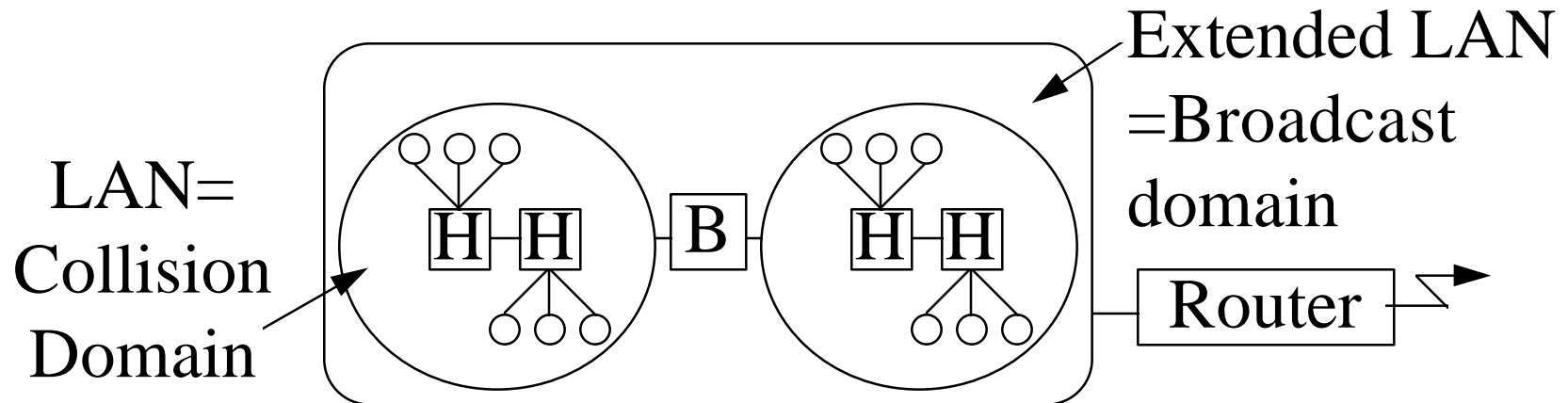


# Interconnection Devices

- ❑ **Repeater:** PHY device that restores data and collision signals
- ❑ **Hub:** Multiport repeater + fault detection and recovery
- ❑ **Bridge:** Datalink layer device connecting two or more collision domains. MAC multicasts are propagated throughout “extended LAN.”
- ❑ **Router:** Network layer device. IP, IPX, AppleTalk. Does not propagate MAC multicasts.
- ❑ **Switch:** Multiport bridge with parallel paths

These are functions. Packaging varies.

# Interconnection Devices



# Ethernet (IEEE 802) Address Format

- 48-bit: 1000 0000 : 0000 0001 : 0100 0011 : 0000 0000 : 1000 0000 : 0000 1100 = 80:01:43:00:80:0C

Organizationally Unique Identifier (OUI)		24 bits assigned by OUI Owner
Individual/ Group	Universal/ Local	
1	1	22
		24

- Multicast = “To all bridges on this LAN”
- Broadcast = “To all stations”  
= 111111...111 = FF:FF:FF:FF:FF:FF

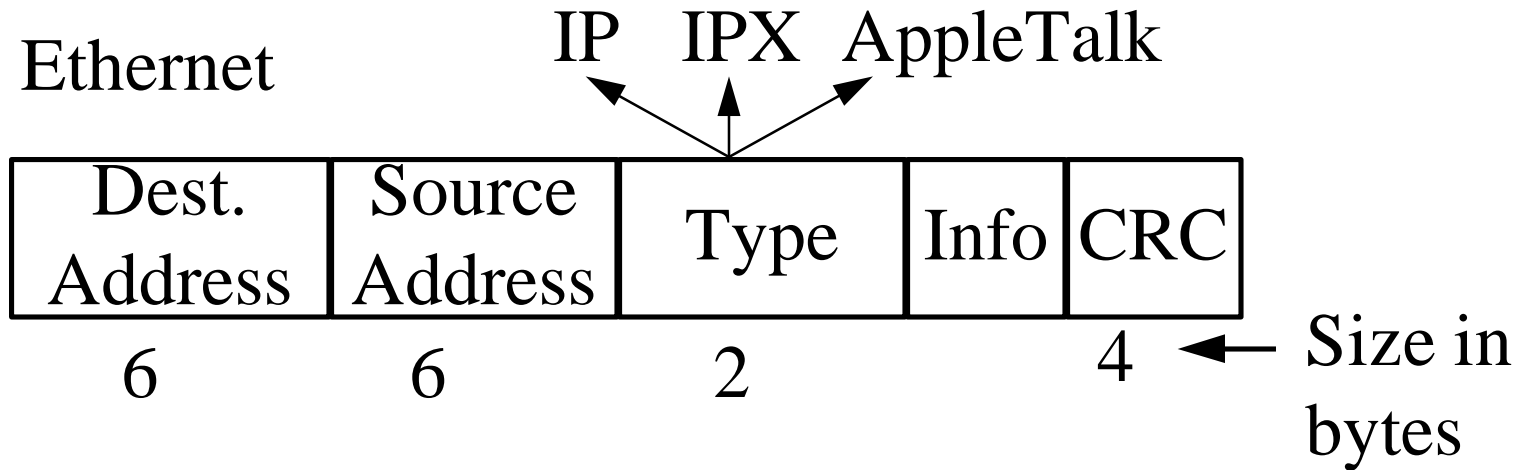
## Ethernet vs IEEE 802.3

IP	IPX	IP	IPX
Ethernet		Logical Link Control (LLC)	
		Media Access Control (MAC)	

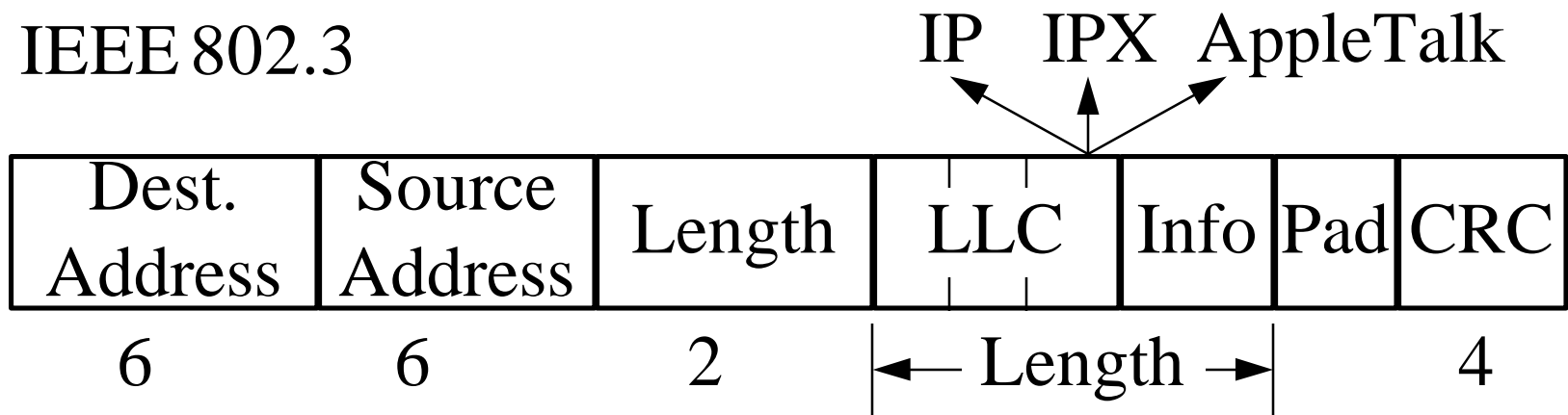
- ❑ In 802.3, datalink was divided into two sublayers: LLC and MAC
- ❑ LLC provides protocol multiplexing. MAC does not.
- ❑ MAC does not need a protocol type field.

# Ethernet Frame Format

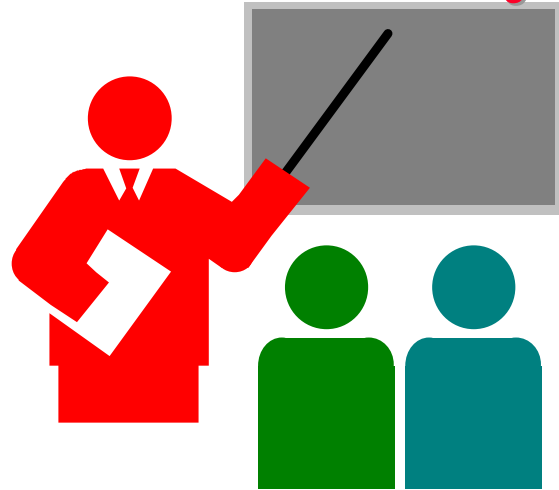
## □ Ethernet



## □ IEEE 802.3



# Summary



- ❑ ISO/OSI reference model has seven layers. TCP/IP Protocol suite has four layers.
- ❑ Ethernet/IEEE 802.3 uses CSMA/CD.
- ❑ Configuration rules depend upon physical medium 10Base5, 10Base2, 10Base-T, 100Base-TX, etc.
- ❑ Addresses: Local vs Global, Unicast vs Broadcast.

# Homework

- ❑ For each of the following addresses: indicate whether it is a multicast and whether it is a locally assigned address?

80:01:43:00:00:00

40:01:43:00:00:01

Were these addresses assigned by the same manufacturer?