16CSCN01I: Introduction to Computer Networks

Lecture 1: Logistics and Introduction

Dr. Amal ElNahas

Course Objectives

- As Computer Networking is turning 50's, we need to:

  - Understand the principles of computer networking. Communications networks are central to almost every modern computer system.

  - See how these principles apply to the Internet

  - Hopefully being able (soon) to figure out what good things, exciting challenges lie ahead (how can we do better)

Topics Covered

- This is an introductory course, so we will go through many thing: Applications, topology, delays, routing, congestion, ….

- Text book:
  - "Data Communications and Networking", 4th edition,
    B. Forouzan
  - "Computer networking: a top down approach", 5th edition, J.Kurose

- Topics covered:
  - Overview
    - Data communication
    - Layering approach
    - Network models
      - ISO/OSI model
      - Internet model (TCP/IP)
  - Application layer
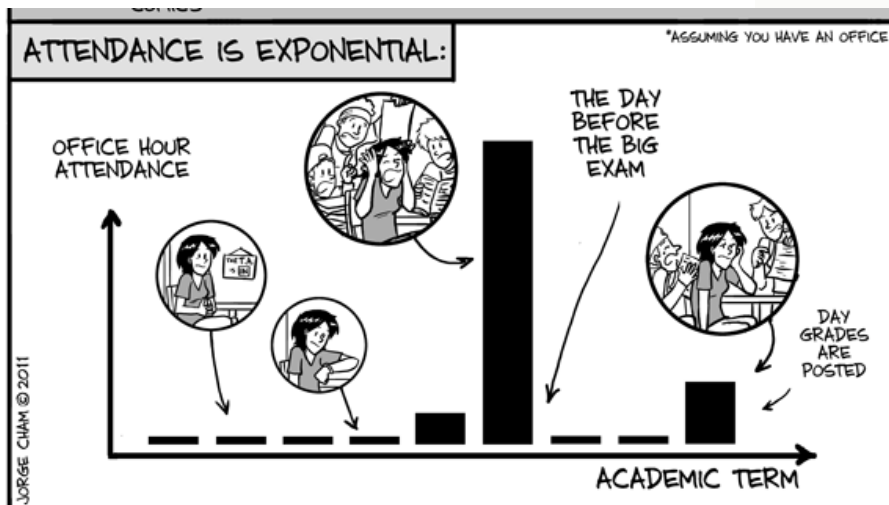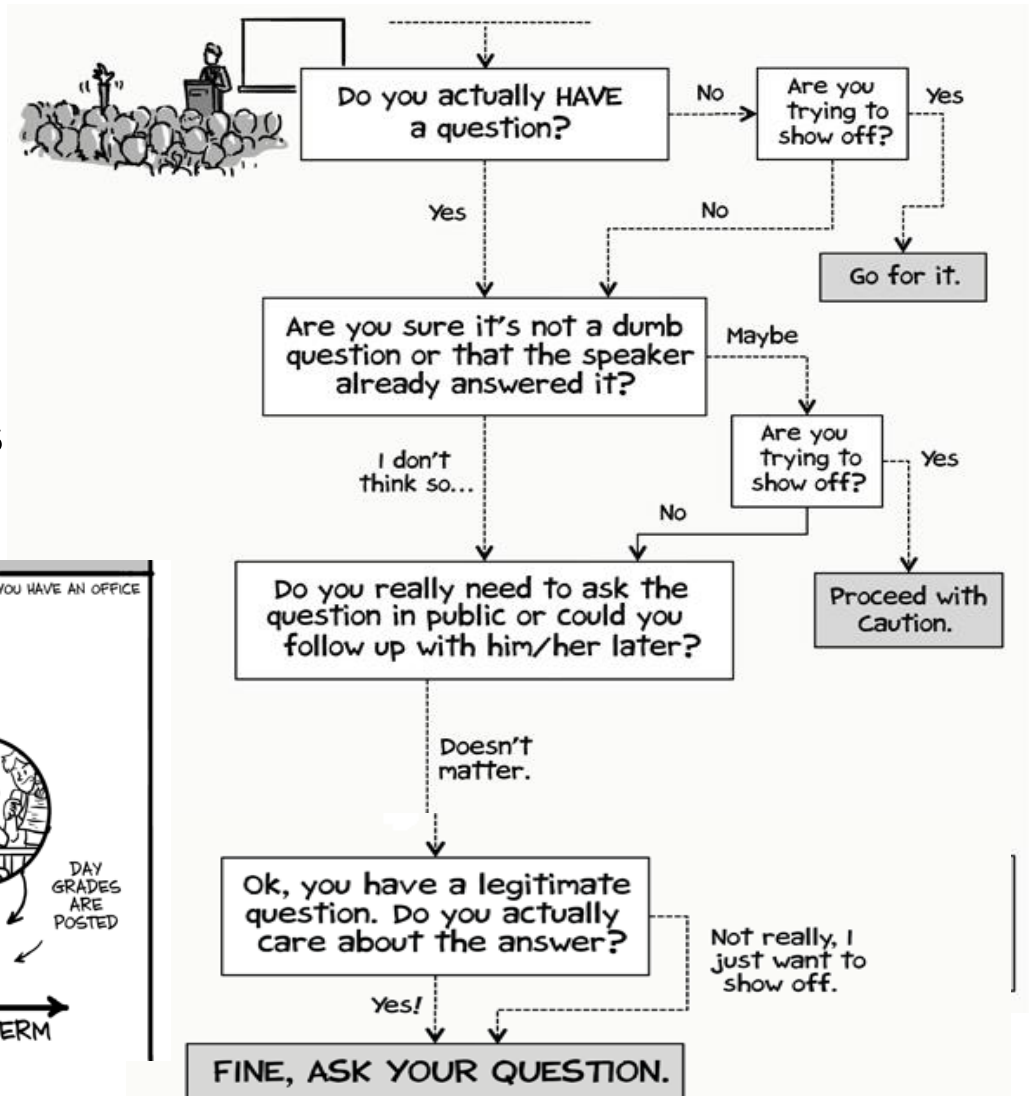 - Transport layer
  - Network layer
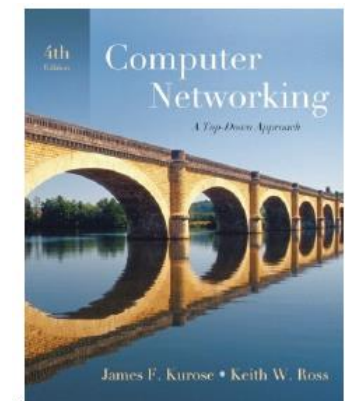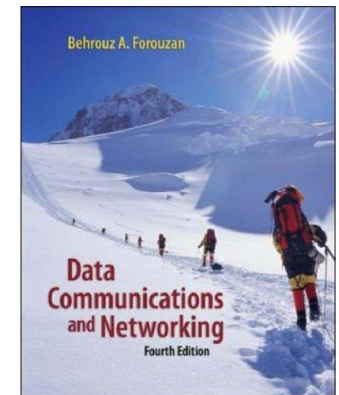
How to Pass This Course?

- Brain

- Hard work

- MOTIVATION

How to Pass This Course?

- Attend

- Ask questions
  (follow the flowchart)

- Benefit from office hours

Important Note

- These slides are **not meant to be comprehensive lecture notes**! They are only **remarks and pointers**. The material presented here is **not sufficient** for studying for the course

- Your main sources for studying are:

    - Your own lecture notes

    - Reference book

Course Assessment Tools

- In-class test

- Lab test

- Final-term exam

Course Assessment Tools

- In-class test   20%   (week 8)

- Lab test   20%   (week 12)

- Final-term exam   60%

Important Questions

- What is computer network and what is the network architecture?

- What are the different types of networks? (LAN, WAN, MAN,….)

- What is the Internet and how it works?

- How can computers communicate? (protocols)

What is a Computer Network?

- Recursive definition:
    - 2 or more computers connected by a link (each called a node)
    - 2 or more networks connected by 2 or more nodes

- Benefits:
    - Sharing resources
    - Transferring files
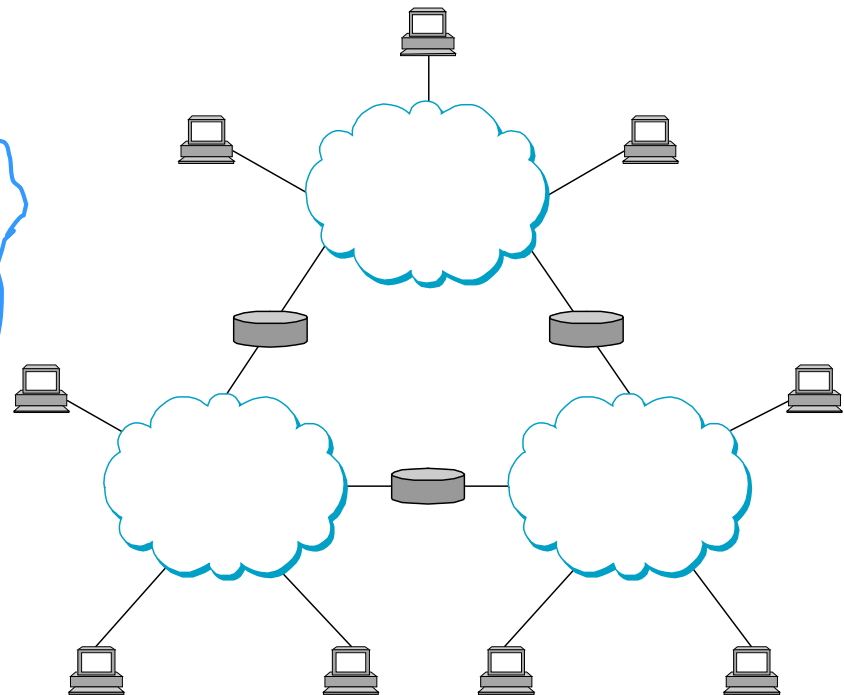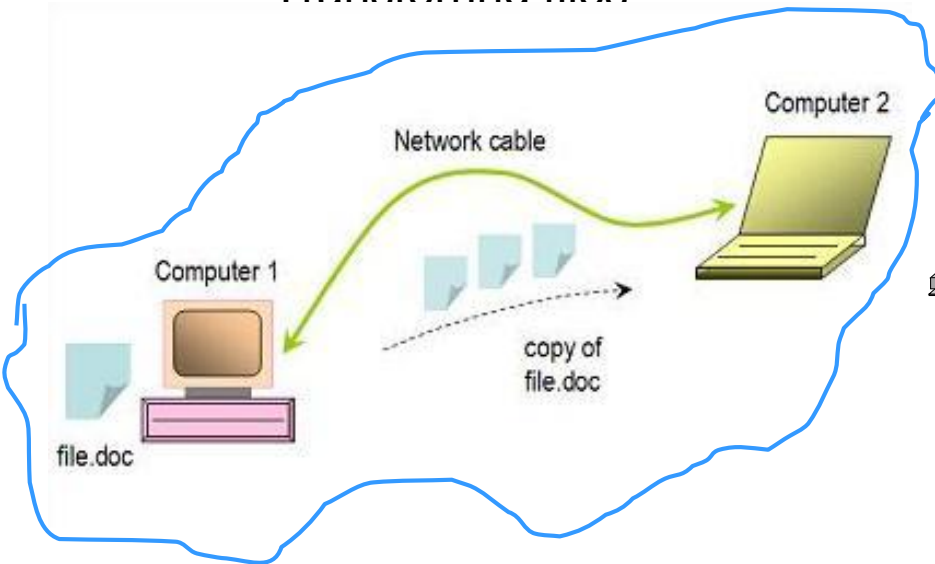
Communication Model in Networks

| Source | Transmitter | Transmission system | Receiver | Destination |
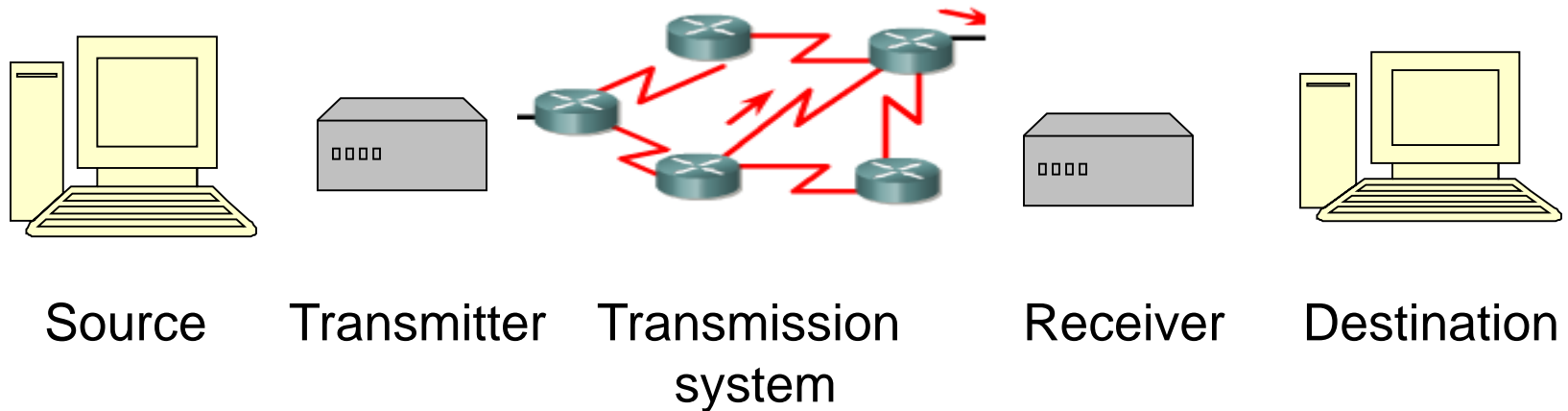
Generates data

Converts data into transmitting signals

Carries data

Converts received signals into data

Takes incoming data

Network Components

Links

Fibers

Coaxial Cable

Interfaces

Ethernet card

Wireless card

Switches/routers
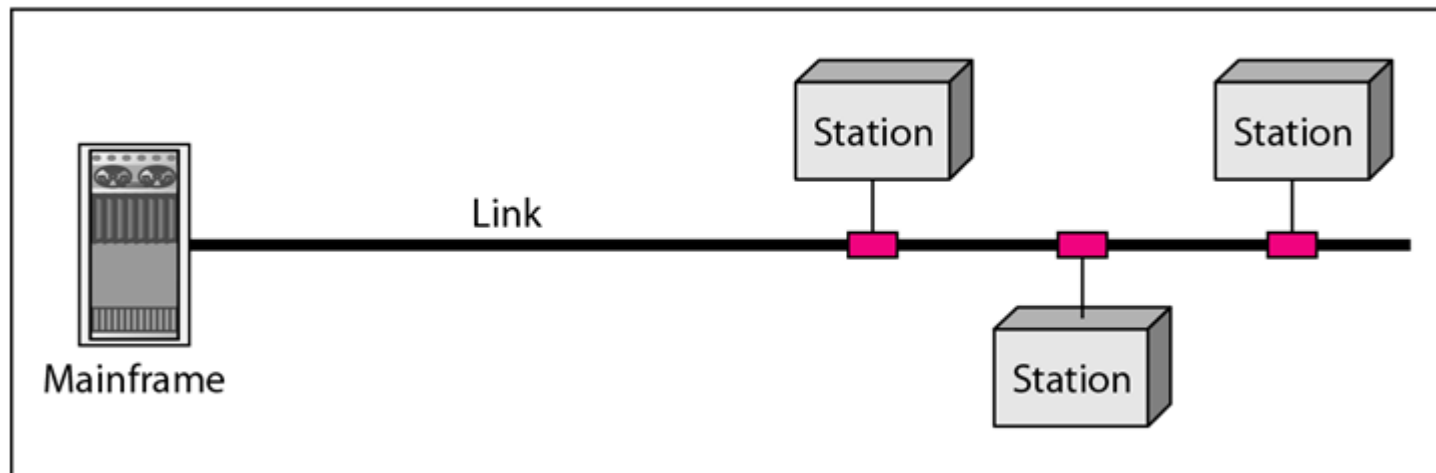
Large router

Telephone switch
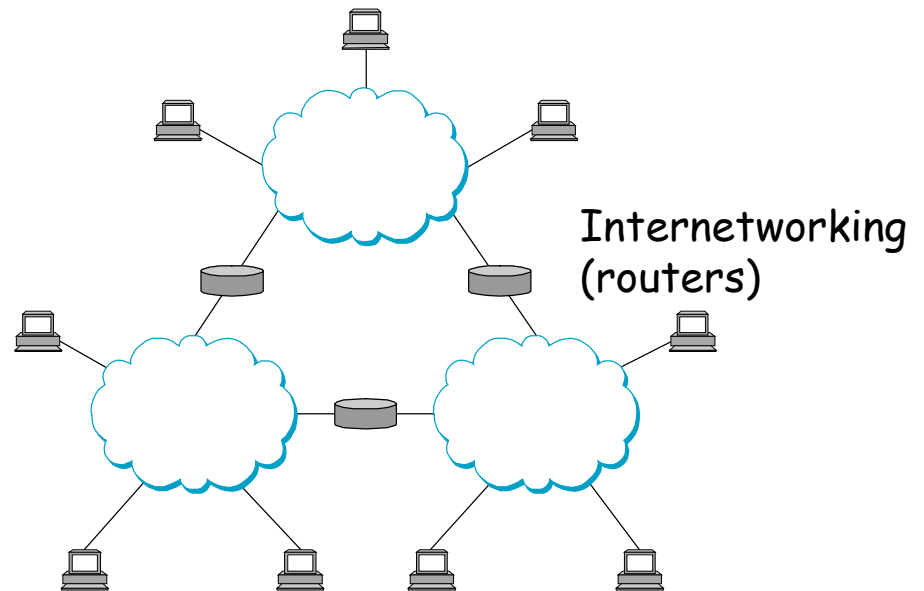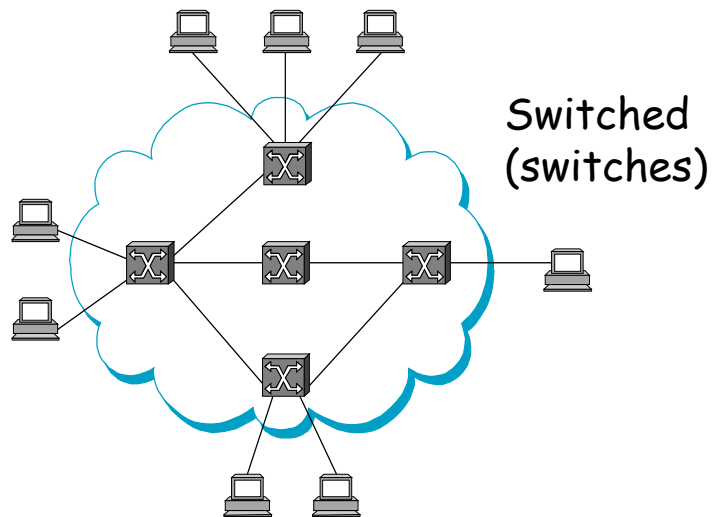
How to Connect

- Direct connectivity:
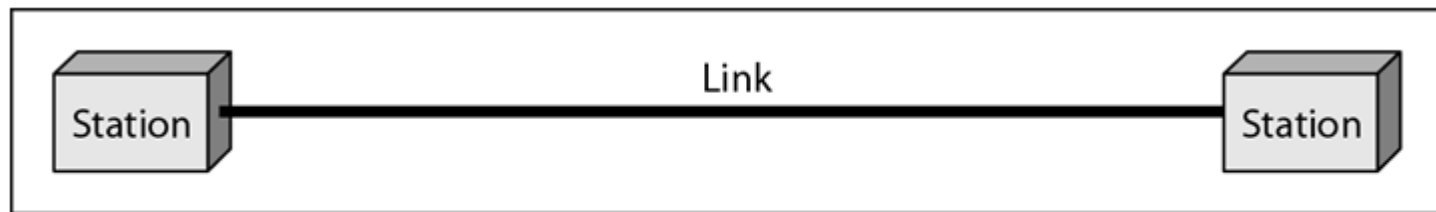
a. Point-to-point

b. Multipoint

How to Connect

- Indirect connectivity:

Switched
(switches)

Internetworking
(routers)

Networks Types

- Depending on one's perspective, we can classify networks in different ways:

  - Based on **transmission media**: Wired (coaxial cables, fiber-optic cables) and Wireless

  - Based on **network size**: LAN and WAN (and MAN)

  - Based on **management method**: Peer-to-peer and Client/Server

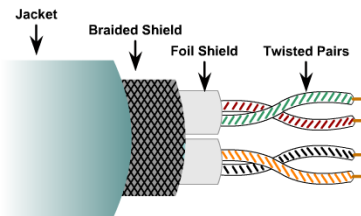 - Based on **topology** (connectivity): Bus, Star, Ring,…

  - ……

Transmission Media

**Guided**   **Un-guided**
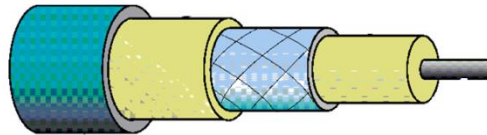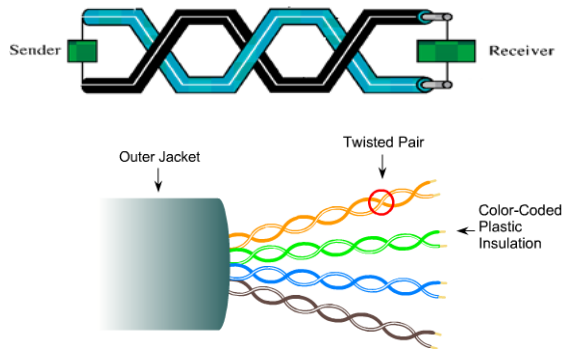
Wireless

Networks Size

- Local Area Networks (LAN)
    - Nodes within small geographic region (home, business, school)
    - Limited by no. of computers and distance covered

- Wide Area Networks (WAN)
    - Uses long-range telecommunication links to connect 2 or more LANs/computers housed in different places far apart.
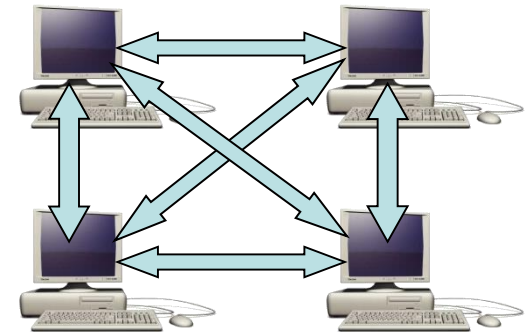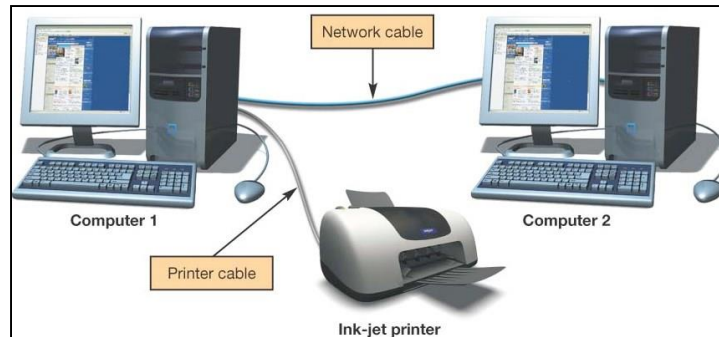   - Ex: Internet

Your home

Your university

WAN

Cairo university
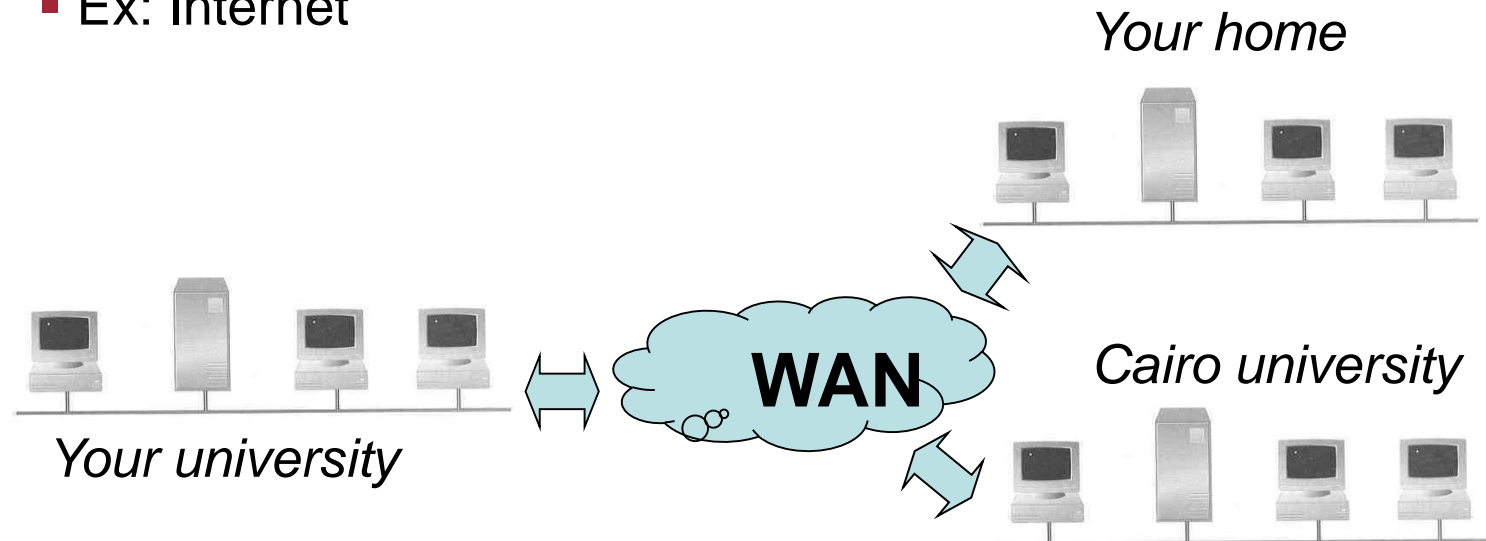
Networks Size

- Other types:
    - Metropolitan Area Networks (MAN)
    - Campus Area Network (CAN)
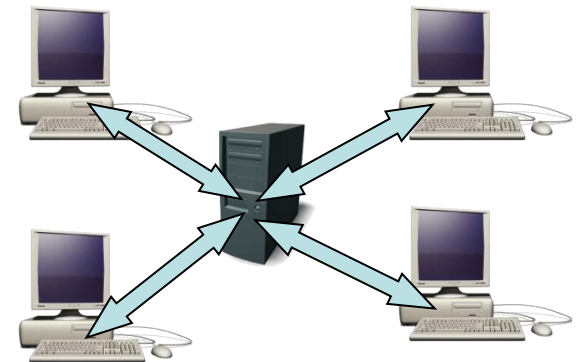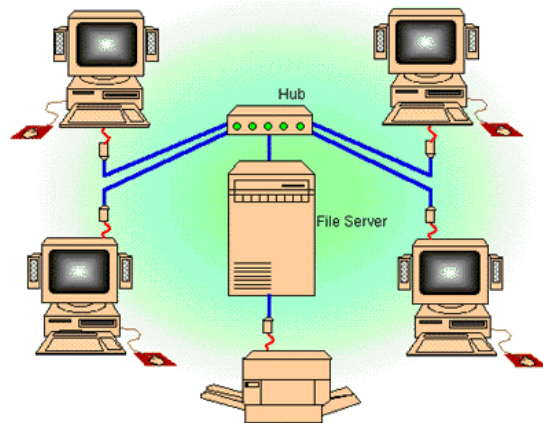   - ……..

Network Management (architecture)

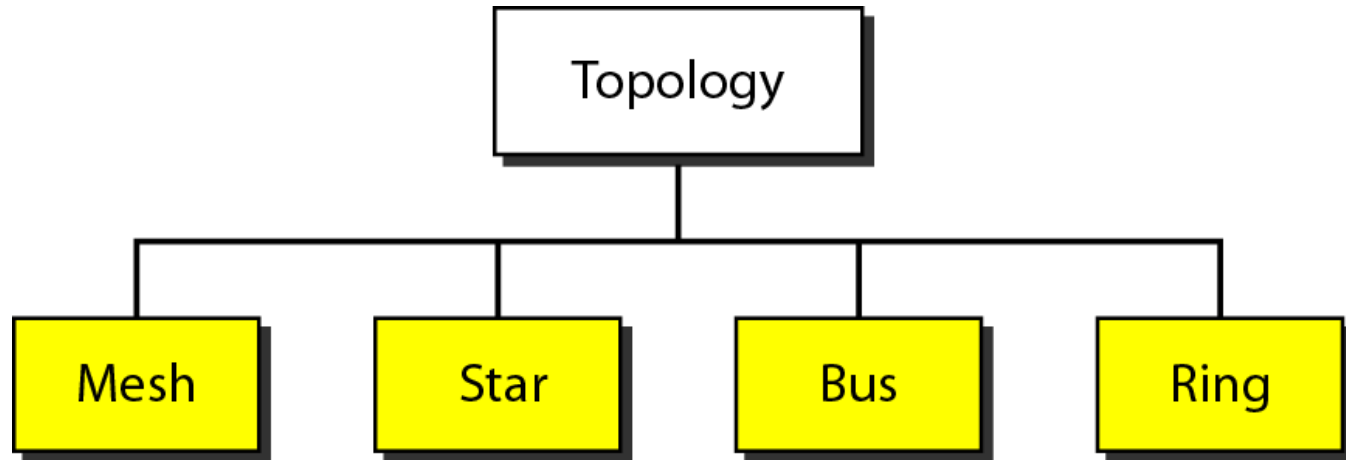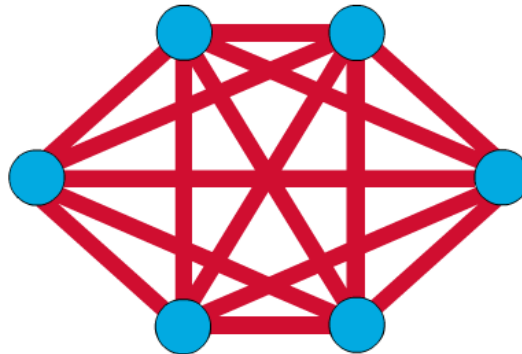- **Peer-to-peer (P2P)**
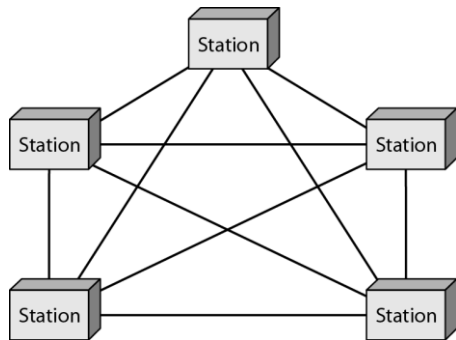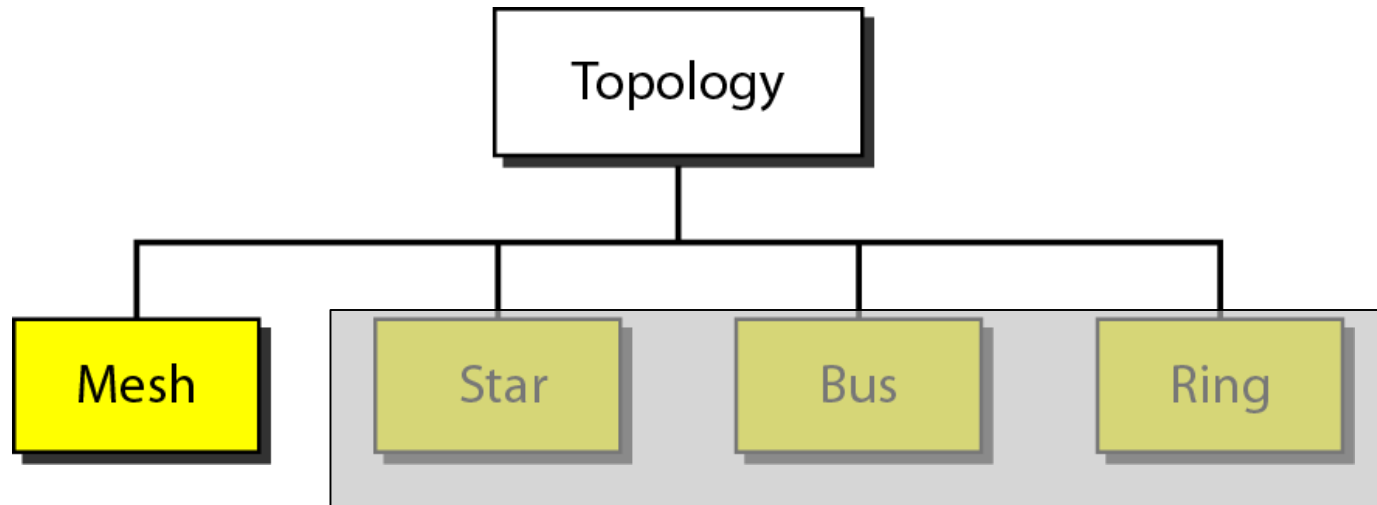 - Most common in home networks
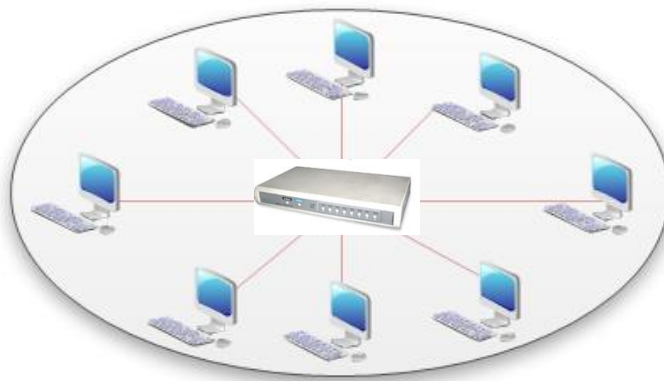

- **Client/server**
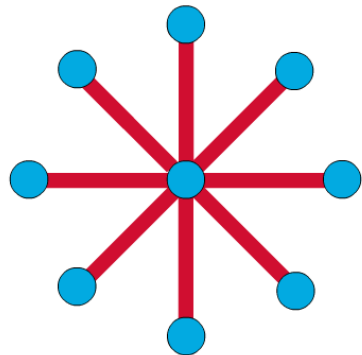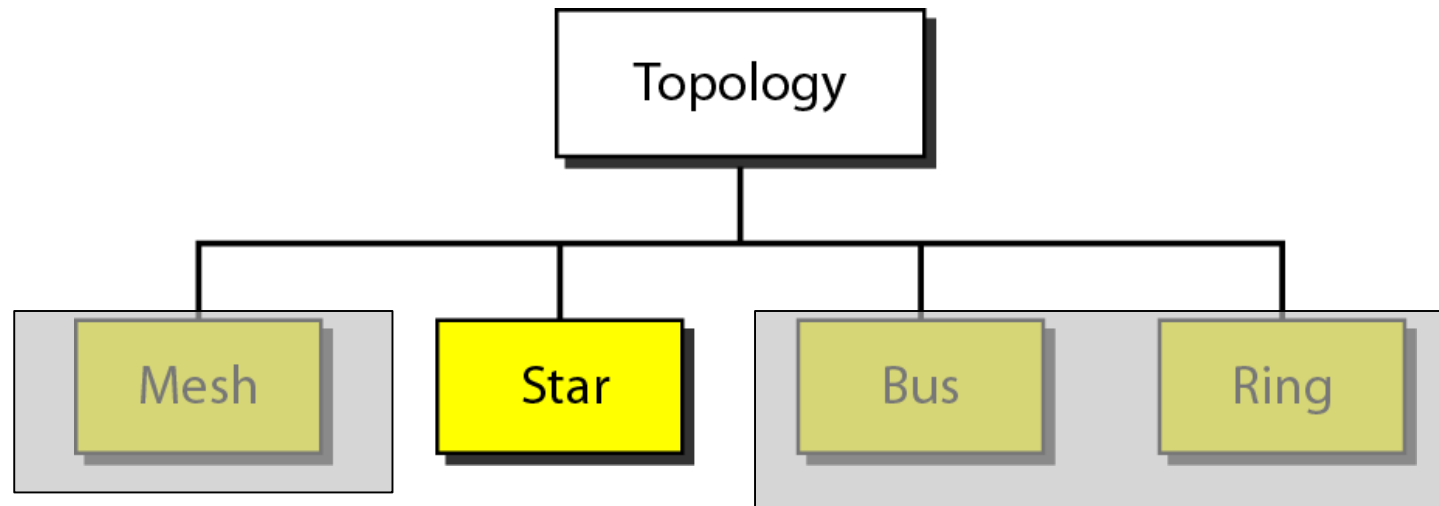 - Most common in Internet

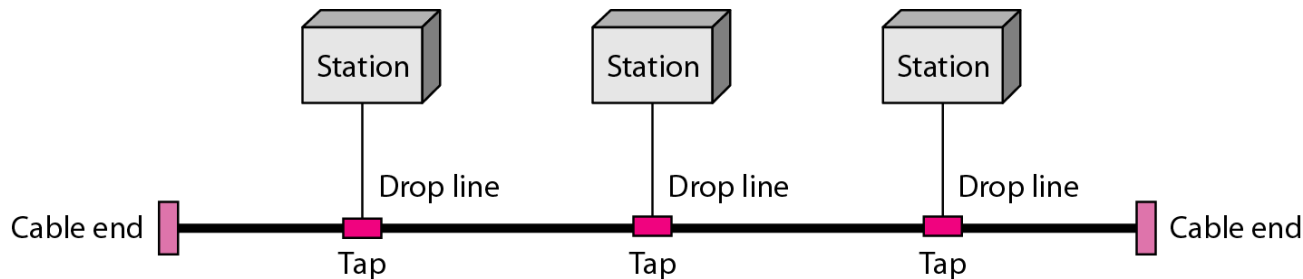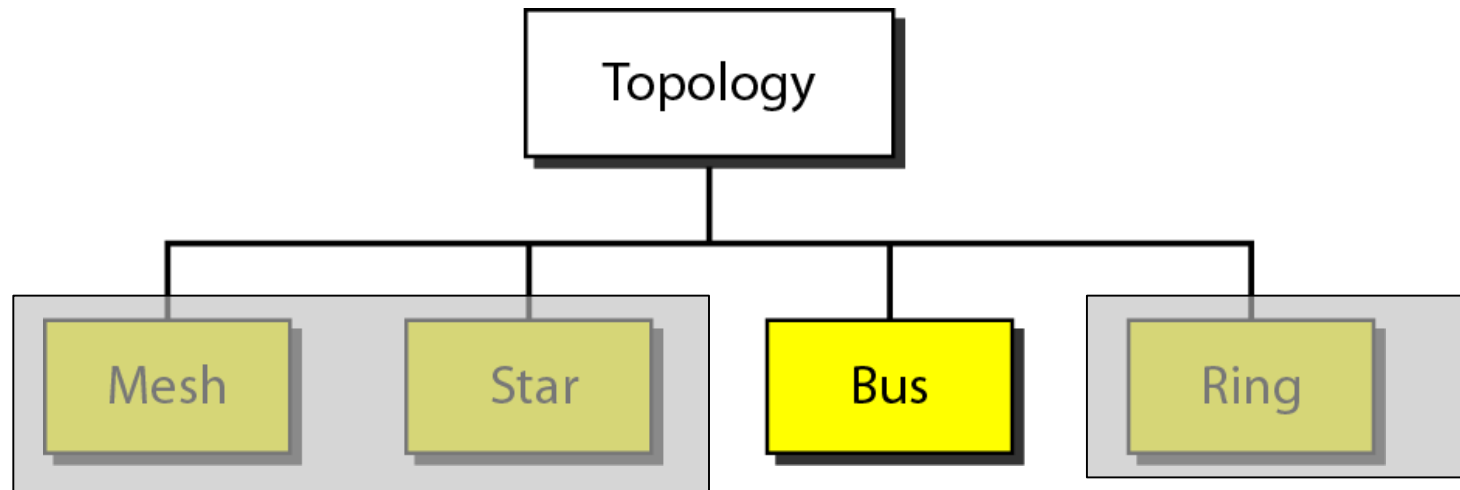# Network Topology

Network Topology

- Every node connected to every other node
- Link only carries data between *two devices only*
- Expensive (more cabling) with many redundant connections
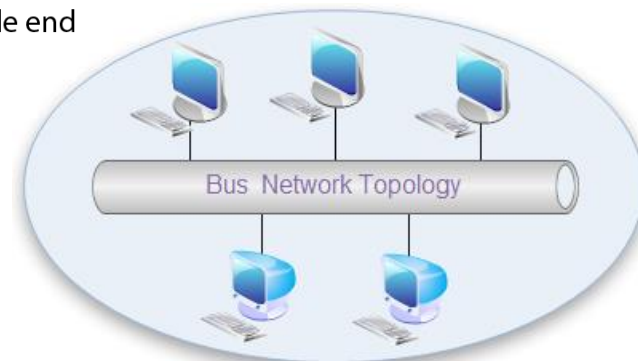
Network Topology

Topology

Mesh | Star | Bus | Ring

▪Each computer has a cable connected to a single point (hub, switch or router)
▪All signals transmission through the hub; if down, entire network down
▪Depending on the intelligence of hub, two or more computers may send message at the same time
▪Inexpensive and easy to install
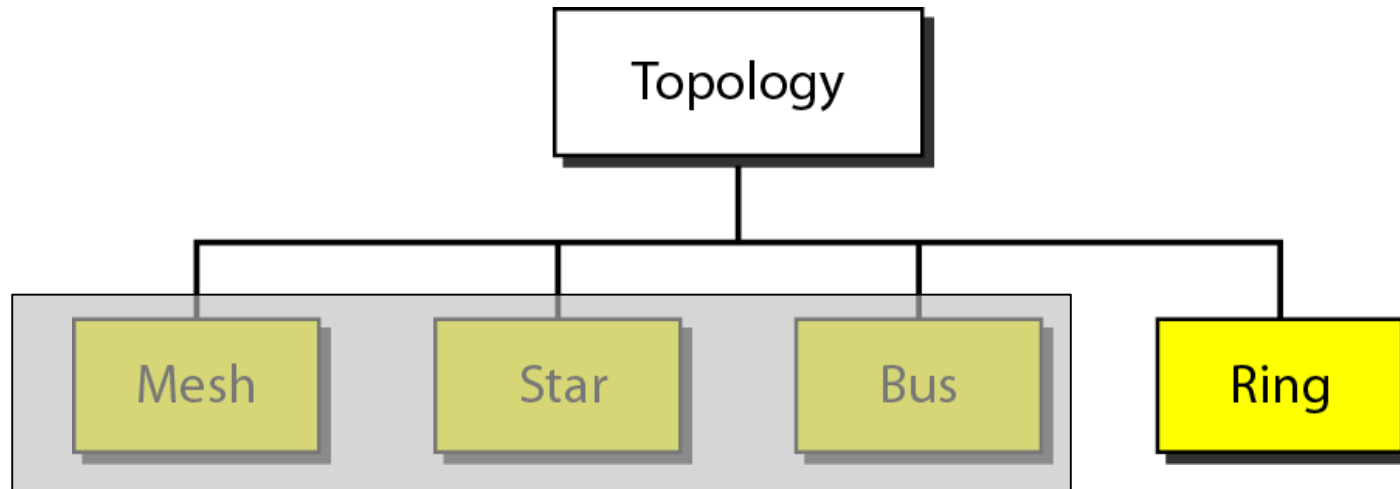▪Used mainly in LANs

Network Topology

- Simple and low-cost
- Only 1 cable, but terminators required at each end.
- Only one computer can send messages at a time
- Whole system breaks if main cable breaks
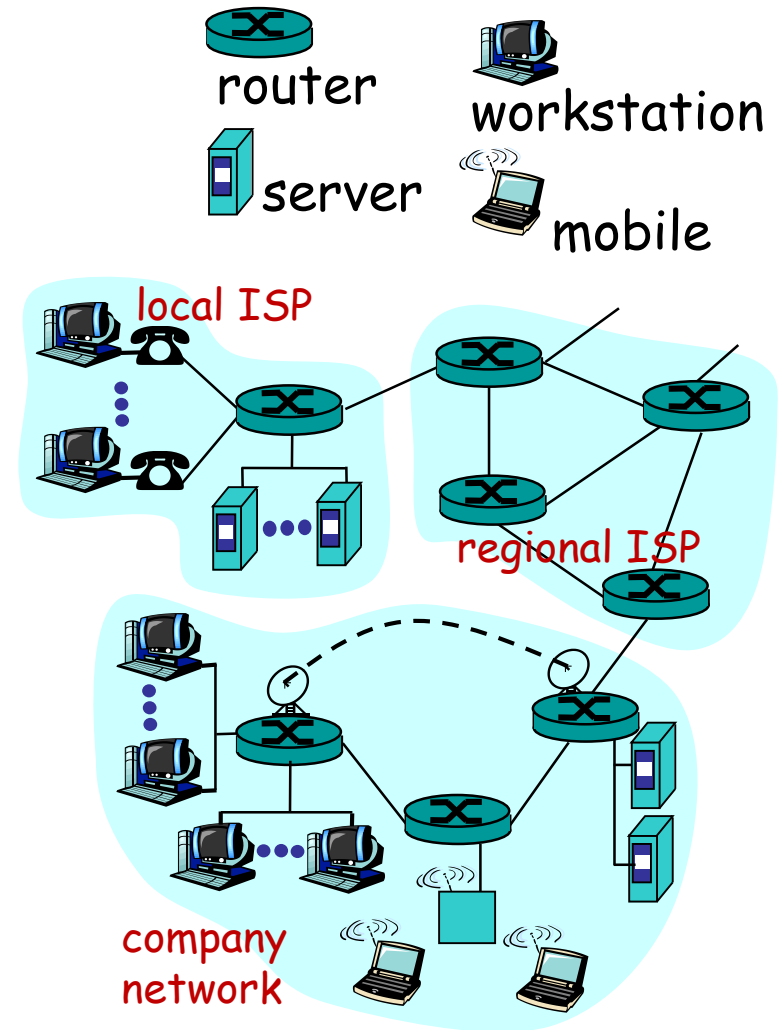
Network Topology

Topology

| Mesh | Star | Bus | Ring |

- Every node has exactly 2 neighbors
- All messages travel in one direction
- Typical way to send data: Token passing
- Expensive and difficult to install
- Offers high bandwidth
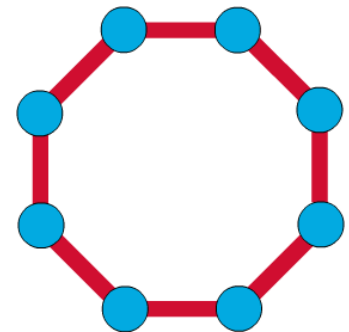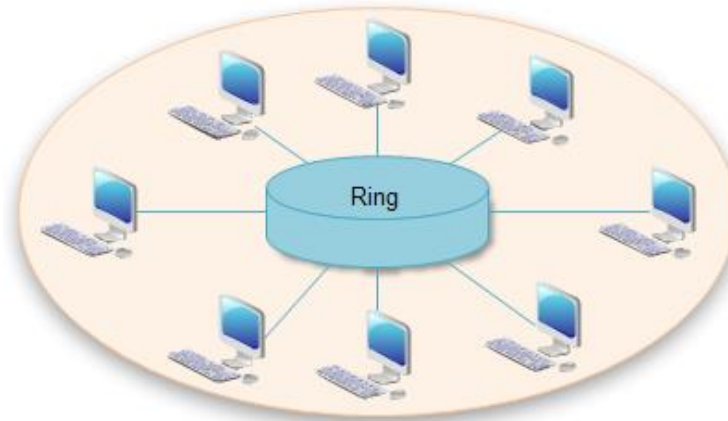
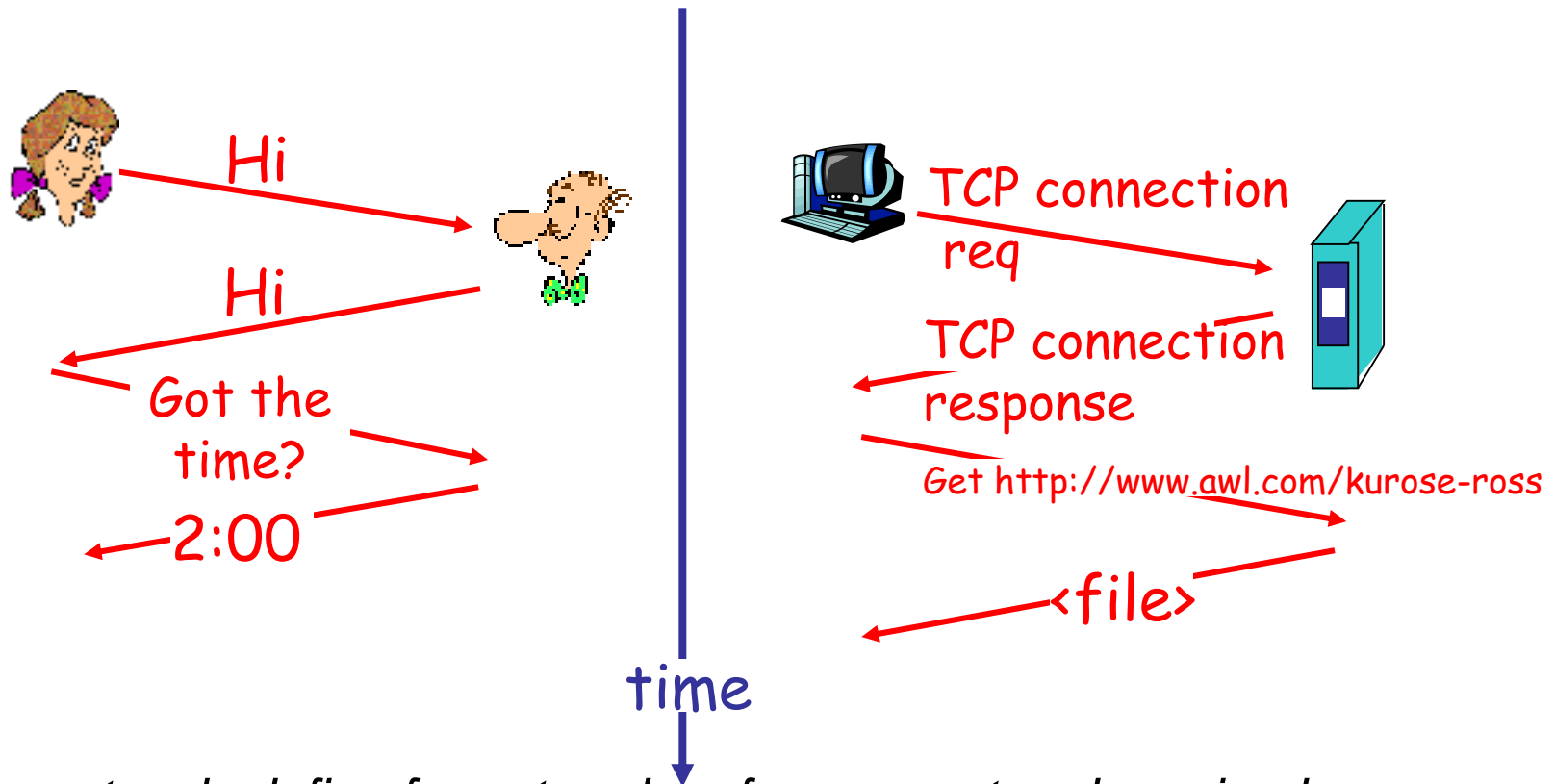# What's the Internet: "nuts and bolts" view

- millions of connected computing devices: *hosts = end systems*

- running *network apps*

- *communication links*
  - fiber, copper, radio, satellite

- *routers:* forward packets (chunks of data)

- Protocols control sending, receiving of msgs
  - e.g., TCP, IP, HTTP, FTP,...

router

workstation

server

mobile

local ISP

regional ISP

company network

What's a protocol?

a human protocol and a computer network protocol:

Hi

Hi

Got the time?

2:00

TCP connection req

TCP connection response

Get http://www.awl.com/kurose-ross

<file>

time

🔟 *protocols define format, order of msgs sent and received among network entities, and actions taken on msg transmission, receipt*
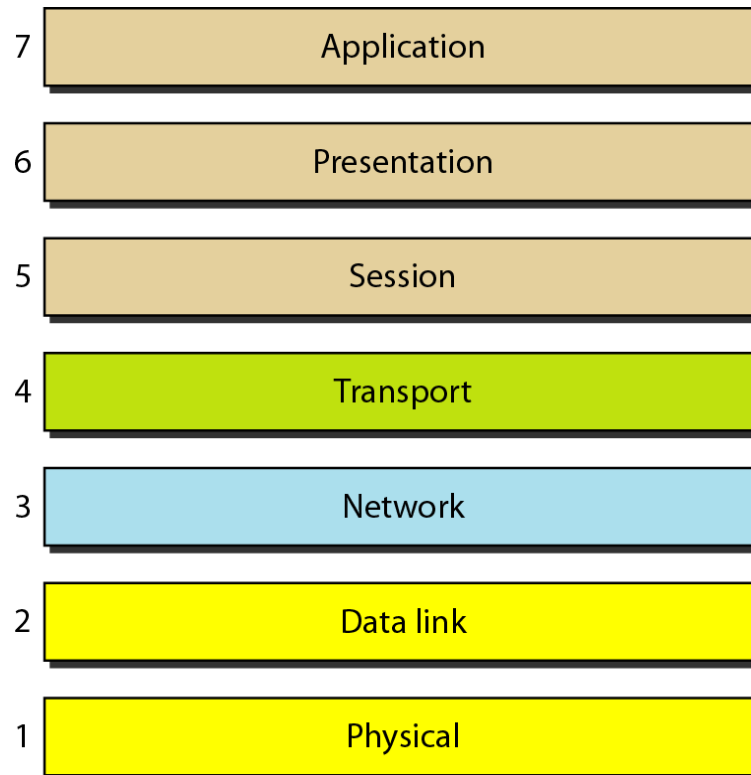
Protocol "Layers"

Networks are complex!
many "pieces":

- hosts
- routers
- links of various media
- applications
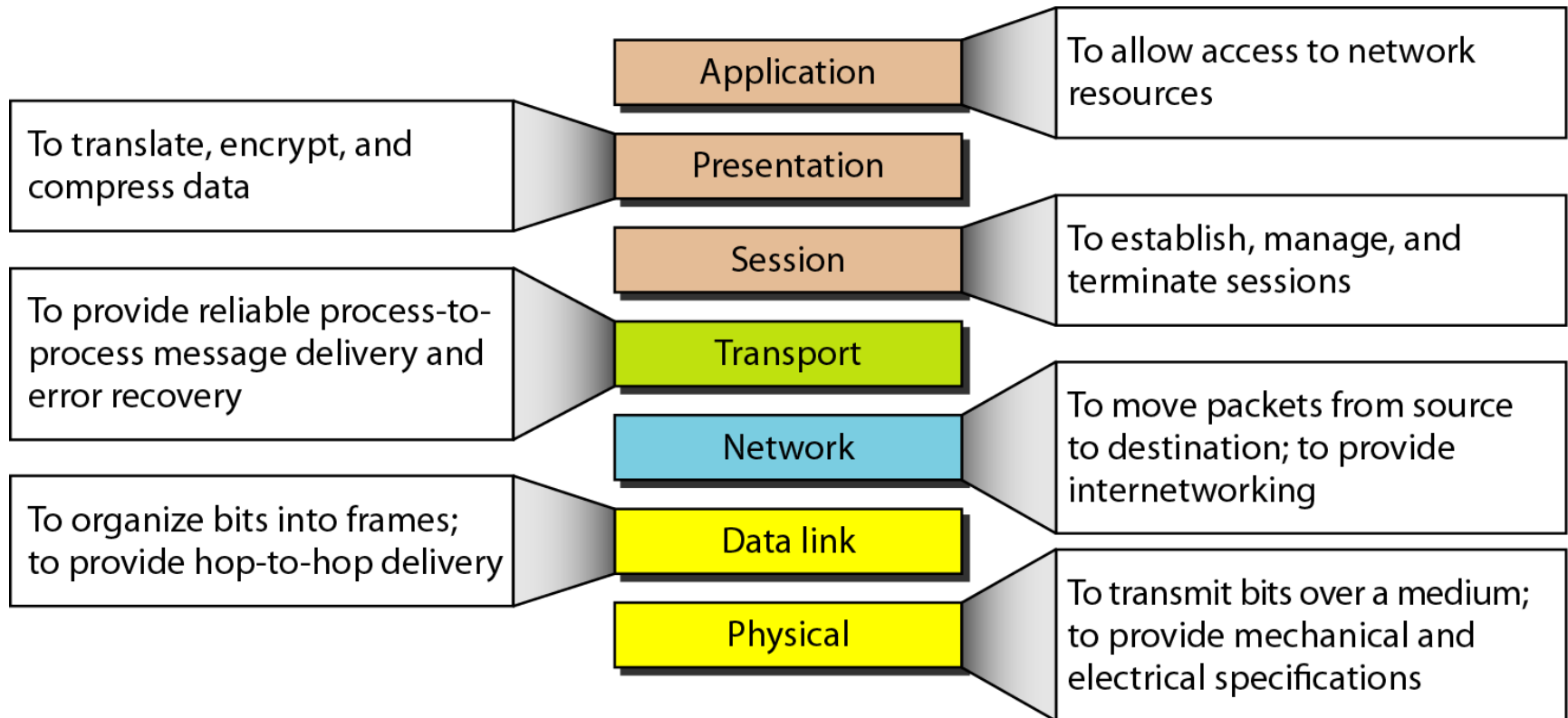- protocols
- hardware, software

Question:
Is there any hope of *organizing* structure of network?

ISO/OSI Reference Model

- Established in 1947, the International Standards Organization (*ISO*) is a multinational body dedicated to worldwide agreement on international standards. An ISO standard that covers all aspects of network communications is the Open Systems Interconnection (*OSI*) model. It was first introduced in the late 1970s. It is composed of 7 layers

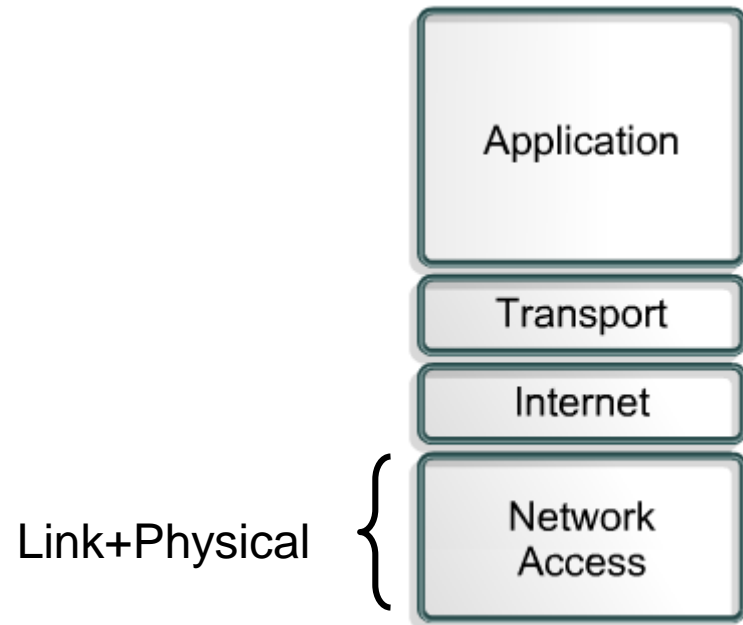|	
7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data link
1	Physical

ISO/OSI Reference Model

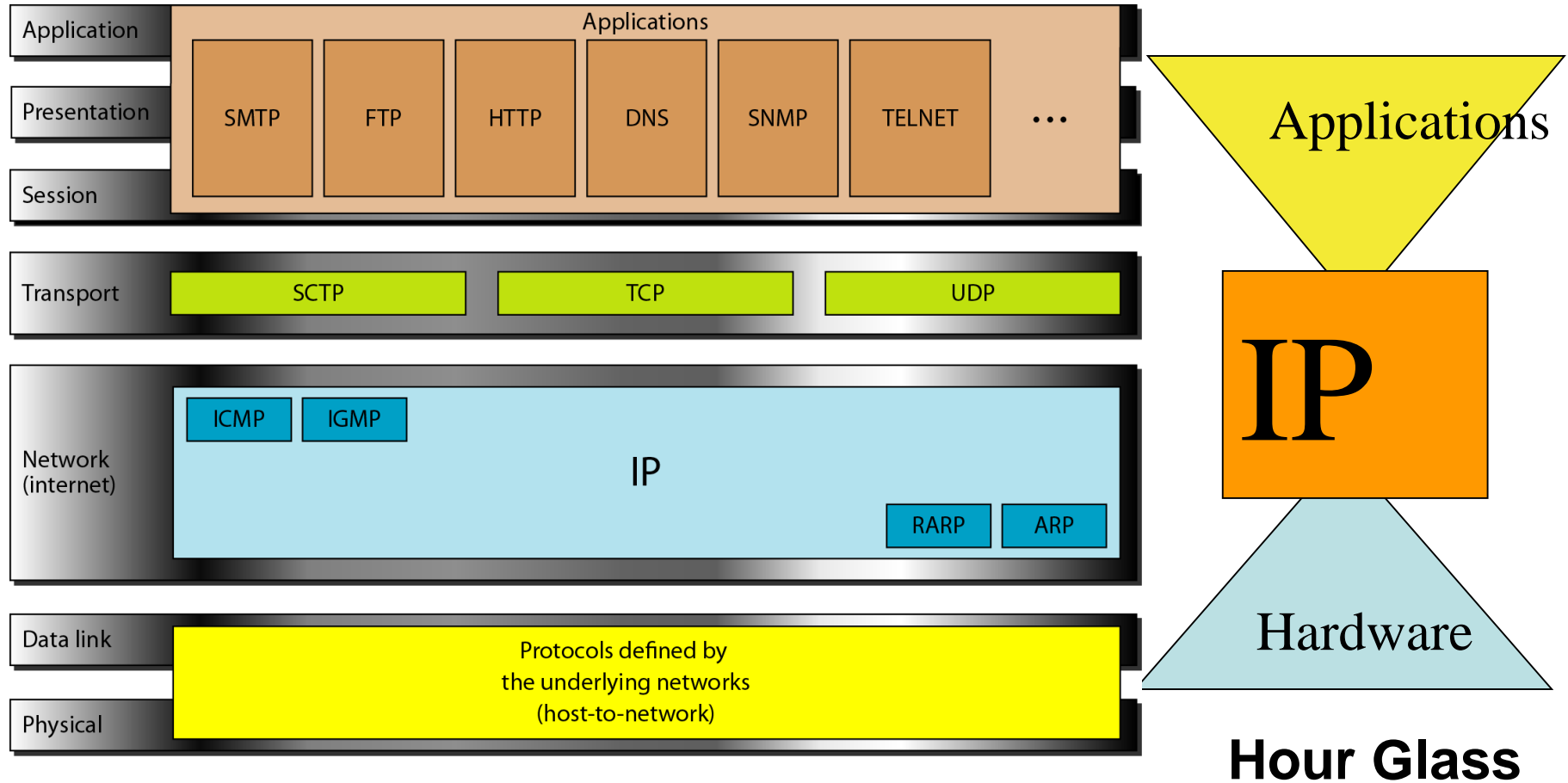# Interaction between layers in the OSI model
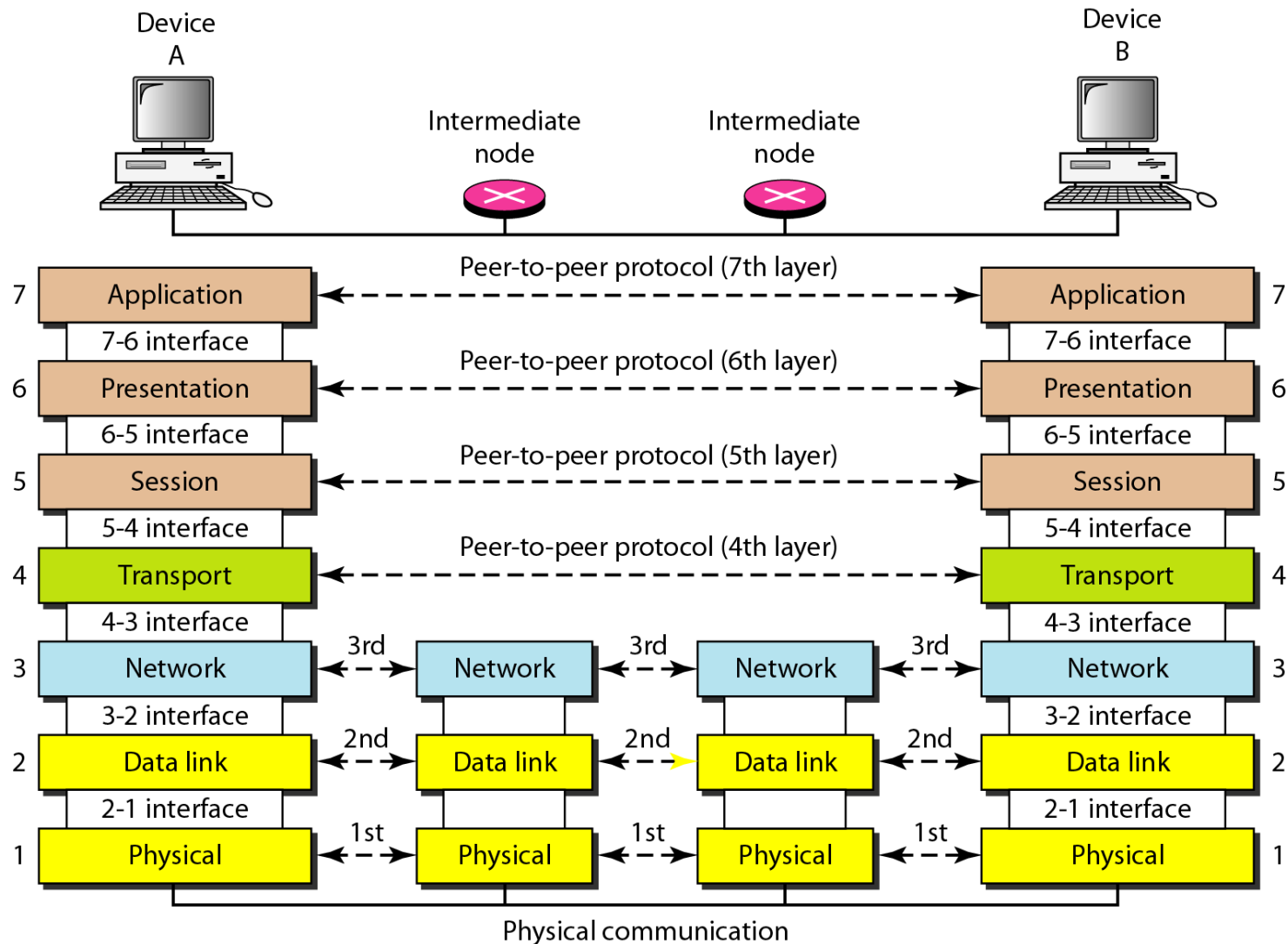
Internet protocol stack

- **application:** supporting network applications
    - FTP, SMTP, HTTP

- **transport:** host-host data transfer
    - TCP, UDP

- **Network (internet):** routing of datagrams from source to destination
    - IP, routing protocols

- **link:** data transfer between neighboring network elements
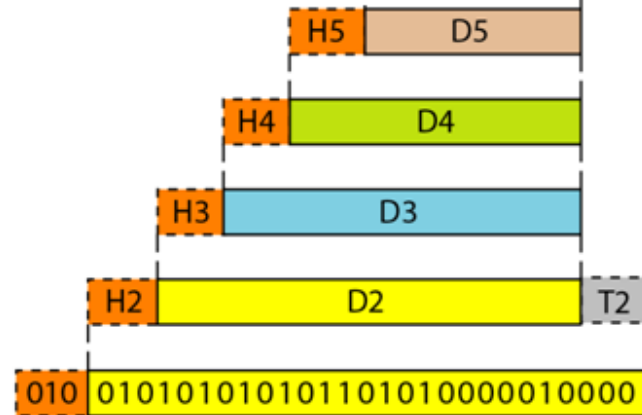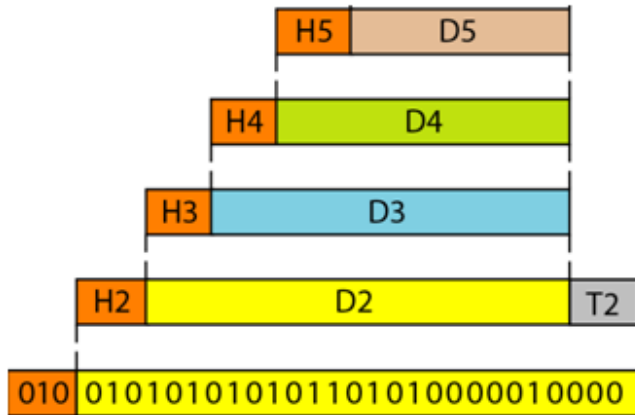   - PPP, Ethernet

- **physical**: bits "on the wire"

Application

Transport

Internet

Link+Physical { Network Access

OSI vs TCP/IP Layers

Networking: A Top-Down Approach

To be continued ……