# EEC-484/584
# Computer Networks

Lecture 1

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(Lecture nodes are based on materials supplied by
Dr. Louise Moser at UCSB and Prentice-Hall)



## Outline

- Syllabus
- Introduction to computer networks
  - Definition
  - Uses of computer networks
  - Network hardware
  - Network software





## Course Objectives

- Become familiar with the basics of computer networks
  - What is a computer network
  - What are the network architectures
  - What are the fundamental protocols
- Get some hands-on experiences
  - Learn some basic network computing techniques
  - Learn how to design a network protocol





## Outline of Lectures

- Introduction to computer networks
- Physical layer
- Data link layer
- Medium access control sublayer
- Network layer
- Transport layer
- Application layer
- Network security

# Outline of Projects

- Project 1: *Sockets for inter-process communication*
  - Learn basic network programming skills
  - Learn how to design a network protocol
- Project 2: *Set up your Web site*
  - Learn basic HTML commands
  - Learn XML/XSL (extra-credit)
- Both are single-person projects. However, two-person team will be considered, with higher expectations
- Also open to other project ideas





# Grading Policy

- Grade components & relative weights:
  - Projects: 20%
  - Homework Assignments: 20%
  - 1st midterm exams: 20% (chapters 1-4)
  - 2nd midterm exams: 20% (chapters 5-6)
  - Final exam: 20% (chapters 7-8)
  - Exams are all closed-book closed-notes. **However, you can bring with you one page of formulas and definitions (US Letter size or smaller)**





# Grading Policy

- **Do not cheat!**
  - Do not copy other student's homework, exams or project
  - Do not copy someone else's work found on the Internet
    - Including project implementation and report
    - You can quote a sentence or two, but put those in quote and give reference
    - You can build your project or homework on top of open source libraries, but again, you need to explicitly give acknowledgement and state clearly which parts are implemented by you





# Reference Texts

- Andrew S. Tanenbaum :
  - Computer Networks
    - 4th Edition, Prentice-Hall, 2003
- James F. Kurose, Keith W. Ross,
  - Computer Networking: A Top-Down Approach Featuring the Internet
    - 3rd Edition, Addison-Wesley, 2004
- Richard Stevens:
  - Unix Network Programming: Volume 1 Sockets and XTI
    - 2nd Edition, 1998

# Misc

- Instructor:
  - Dr. Wenbing Zhao
    - Email: wenbing@ieee.org
    - Lecture hours: MW 6:00-7:50pm
    - Office hours: TTh 4:00-6:00pm and by appointment
- Course Web site:
  - http://academic.csuohio.edu/zhao_w/teaching/EEC484-F05/eec484.htm
  - Lecture nodes and homework will be posted





# Introduction of Computer Networks

- Uses of computer networks
- Network Hardware
- Network software





# Definition of Computer Network

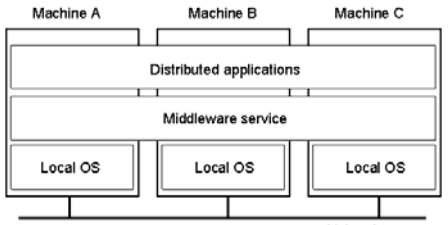
- **Computer Network**: Interconnected collection of autonomous computers
  - **Interconnected** – able to exchange info via copper wire, fiber, microwaves, satellites, etc.
  - **Autonomous** – act independently
  - Single network vs. network of networks
    - A single network uses a single technology
- User must handle network management explicitly





# Computer Network vs Distributed System

- **Distributed system** - A collection of independent computers that appear to the users as a single coherent system
  - Software specifically designed to provide an integrated computing facility
  - Two aspects (1) independent computers and (2) single system ⇒ **middleware**



# Uses of Computer Networks

- Business applications
- Home applications
- Mobile users
- Social issues





# Business Applications of Networks

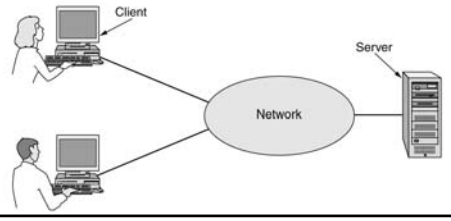
- Goals of using computer networks for business
  - Resource sharing
  - Provide powerful communication medium among employees
  - Doing business electronically with other companies
  - Doing business with consumers over the Internet (e-commence)





# Resource Sharing

- Resource sharing
  - Equipment, software programs, data
- Client-server model
  - Server – provides services for clients
  - A network with two clients and one server

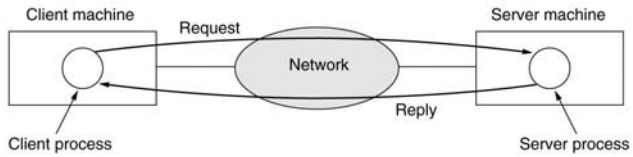







# Client-Server Model

- The client-server model involves requests and replies



# Home Network Applications

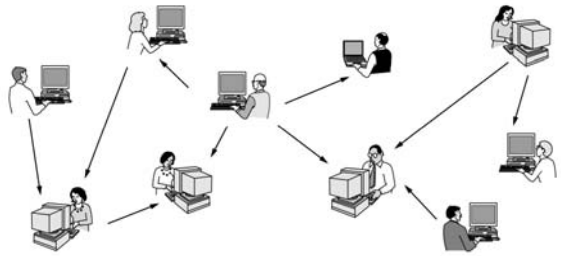
- Access to remote information
  - WWW, online newspapers, sports news
- Person-to-person communication
  - Instant messaging, chat room, peer-to-peer communication/file sharing
- Interactive entertainment
  - Video on demand, game playing
- Electronic commerce
  - Online banking, online auction, etc.





# Home Network Applications

- In peer-to-peer system there are no fixed clients and servers







# Home Network Applications

- Some forms of e-commerce

| Tag | Full name | Example |
|---|---|---|
| B2C | Business-to-consumer | Ordering books on-line |
| B2B | Business-to-business | Car manufacturer ordering tires from supplier |
| G2C | Government-to-consumer | Government distributing tax forms electronically |
| C2C | Consumer-to-consumer | Auctioning second-hand products on line |
| P2P | Peer-to-peer | File sharing |





# Mobile Network Users

- Wireless network
  - Portable office, military, taxis, trucks
  - Fixed wireless, mobile wireless
- Combinations of wireless networks and mobile computing

| Wireless | Mobile | Applications |
|---|---|---|
| No | No | Desktop computers in offices |
| No | Yes | A notebook computer used in a hotel room |
| Yes | No | Networks in older, unwired buildings |
| Yes | Yes | Portable office; PDA for store inventory |

## Mobile Network Users

- Future applications
  - Wireless parking meters, vending machine inventory report, utility meter reading, merge of cell phones and PDAs,
  - m-commerce, personal area networks and wearable computers
  - Smart watches, smart dust





## Social Issues

- Offending content
- Copyright violations
- Spams
- Viruses
- Who is responsible?
  - Network operator? Software provider? Users?
- What kind of control is appropriate?





## Network Hardware

- No generally accepted taxonomy. Two dimensions
  - Transmission technology
  - Scale
- Transmission technology
  - Broadcast links
  - Point-to-point links (unicasting)





## Classification by Scale

- Personal area networks
- Local area networks
- Metropolitan area networks
- Wide area networks
- The Internet

| Interprocessor distance | Processors located in same | Example |
|---|---|---|
| 1 m | Square meter | Personal area network |
| 10 m | Room | Local area network |
| 100 m | Building | |
| 1 km | Campus | |
| 10 km | City | Metropolitan area network |
| 100 km | Country | Wide area network |
| 1000 km | Continent | |
| 10,000 km | Planet | The Internet |

# Local Area Networks

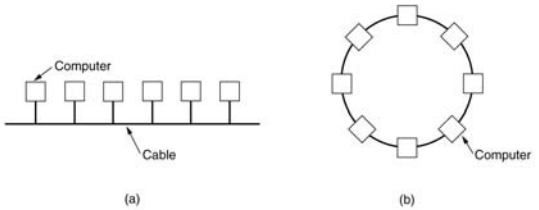
- LAN typically spans a room, a building or a campus
- LANs are distinguished from other kinds of networks by three characteristics
  - **Size** – restricted in size => worst-case transmission time is bounded
  - **Transmission technology** – typically using broadcast
    - Static and dynamic broadcast channel allocation
  - **Topology**





# Local Area Networks

- Two broadcast networks
  - (a) Bus
  - (b) Ring

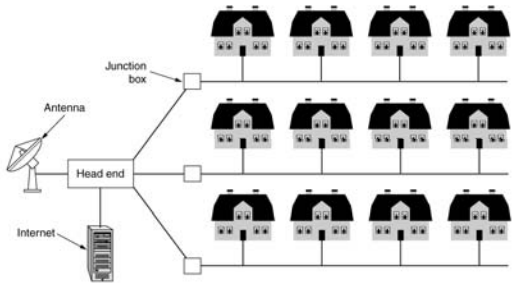







# Metropolitan Area Networks

- MAN covers a city
- A metropolitan area network based on cable TV








# Wide Area Networks

- Spans a large geographical area, often a country or continent
- Network structure in WAN
  - **Hosts** or end systems
    - Collection of machines that run user (application) programs
    - Owned by customers
  - **Communication Subnet** – connects hosts
    - The job of the subnet is to carry messages from host to host, just as the telephone system carries words from speaker to listener
- Separation of the pure communication aspects of the network (the subnet) from the application aspects (the hosts), greatly simplifies the complete network design

# Communication Subnet

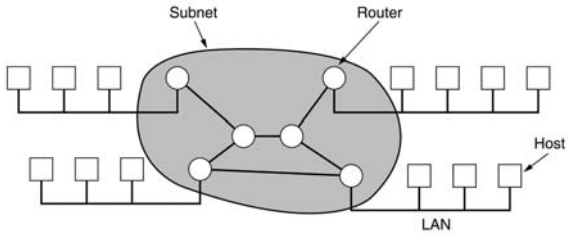
- **Communication Subnet**
  - Two distinct components
    - **Transmission lines** – move bits (circuits, channels, trunks)
    - **Routers** or **switching elements** that connect three or more transmission lines
  - Two types of designs
    - Point-to-point channels
    - Broadcast channels





# Wide Area Networks

- Relation between hosts on LANs and the subnet

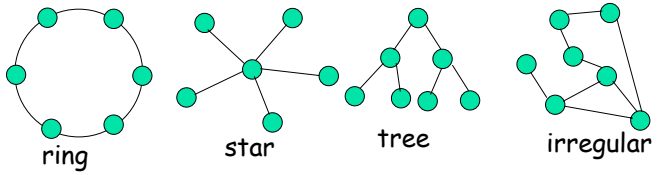







# Point-to-Point Channels in WAN

- **Store and forward** or **packet switch**
- If no direct connection, must use intermediate switching elements where store packets until required output line is free and then forward
- Many different topologies – ring, star, tree, irregular

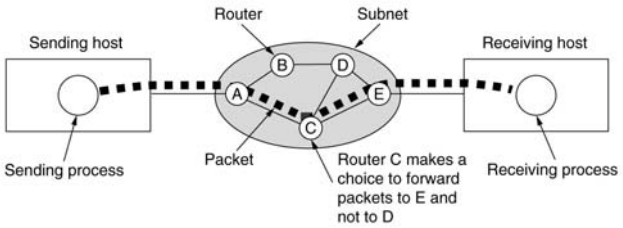






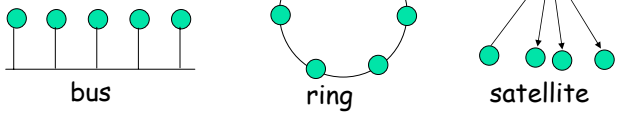

# Point-to-Point Channels in WAN

- A stream of packets from sender to receiver



# Broadcast Channels in WAN

- Sent by one, received by all
- Address field specifies intended destinations
  - Multicast if more than one destination
- When machine receives packet, checks address ignores if not for it
- Topologies

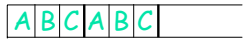







# Broadcast Channels in WAN

- Need to arbitrate simultaneous access to medium
- Two approaches
  - **Static**




    - Divide time into slots, use round robin strategy
    - Waste channel capacity when nothing to send
  - **Dynamic**
    - Centralized – bus arbitration unit decides who goes next
    - Decentralized – each machine decides for itself





# Wireless Networks

- Categories of wireless networks
  - System interconnection
  - Wireless LANs
  - Wireless WANs

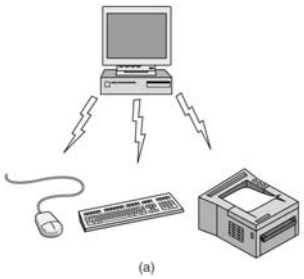




# System Interconnection

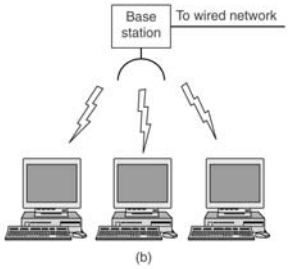
- **System interconnection**: interconnecting the components of a computer using short-range radio
  - Mouse, keyboard, printer, etc.
- **Bluetooth**: a short-range wireless network to connect these components without wires
- System interconnection networks typically use the *master-slave paradigm*

# System Interconnection



(a)

Bluetooth configuration




(b)

Wireless LAN





# Wireless LAN

- **Wireless LANs** are systems in which every computer has a radio modem and antenna with which it can communicate with other systems
- Wireless LANs are becoming increasingly common in small offices and homes
- There is standard for wireless LANs: IEEE 802.11





# Wireless WAN

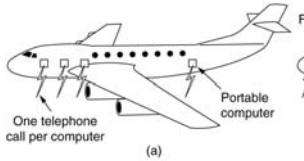
- **Wireless WAN**: wireless networks used in WAN
- Example: radio network used for cellular telephones
  - Low speed networks, date rate < 1Mbps
- Local multipoint distribution service:
  - High bandwidth
  - IEEE 802.16





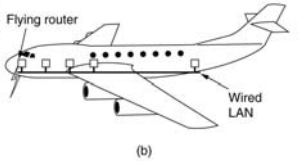
# Wireless Networks

- Almost all wireless networks hook up to the wired network at some point to provide access to files, databases, and the Internet




(a)

Individual mobile computers




(b)

A flying LAN

## Home Network Categories

- Computers
  - Desktop PC, PDA, shared peripherals
- Entertainment
  - TV, DVD, VCR, camera, stereo, MP3 player
- Telecomm
  - Telephone, cell phone, intercom, fax
- Appliances
  - Microwave, fridge, clock, furnace, air conditioner
- Telemetry
  - Utility meter, burglar alarm, babycam





## Internetworks

- Many networks exist, often with different hardware and software
- People connected to one network often want to communicate with people attached to a different one
- **Gateways** are used to make the connection and provide the necessary translation, both in terms of hardware and software
- A collection of interconnected networks is called an **internetworks** or **internet**