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

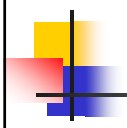
- Syllabus
- Introduction to computer networks
  - Definition
  - Uses of computer networks
  - Network hardware
  - Network software

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

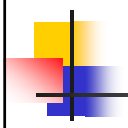


Outline of Projects

- 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

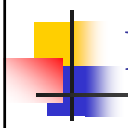
Grading Policy

- 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

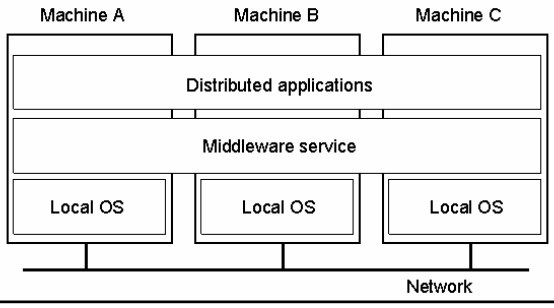
- Uses of computer networks
- Network Hardware
- Network software

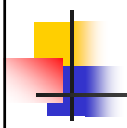
Definition of Computer Network

- **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

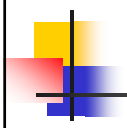
- **Distributed system** - A collection of independent computers that appear to the users as a single coherent system
  - Software specifically designed to provide an integrated computing facility
  - Two aspects (1) independent computers and (2) single system ⇒ **middleware**





Uses of Computer Networks

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

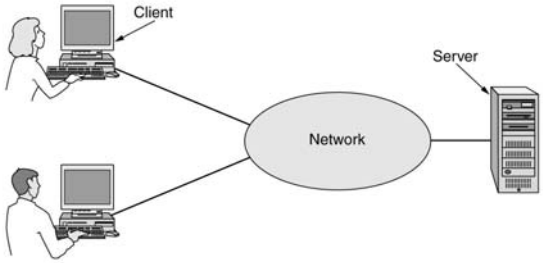


Business Applications of Networks

- 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)

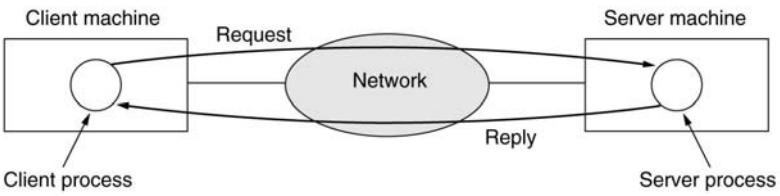
Resource Sharing

- 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

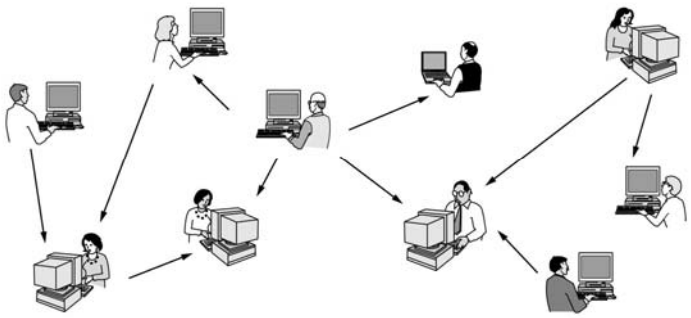


Home Network Applications

- 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

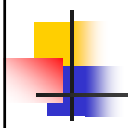
- Some forms of e-commerce

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

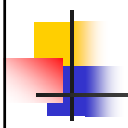
- Wireless network
  - Portable office, military, taxis, trucks
  - Fixed wireless, mobile wireless
- Combinations of wireless networks and mobile computing

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

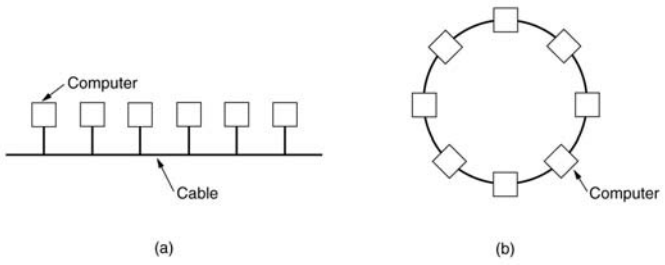
Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	
10,000 km	Planet	The Internet

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**

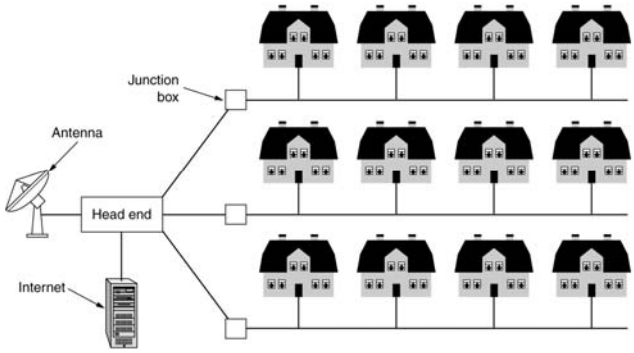
Local Area Networks

- 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

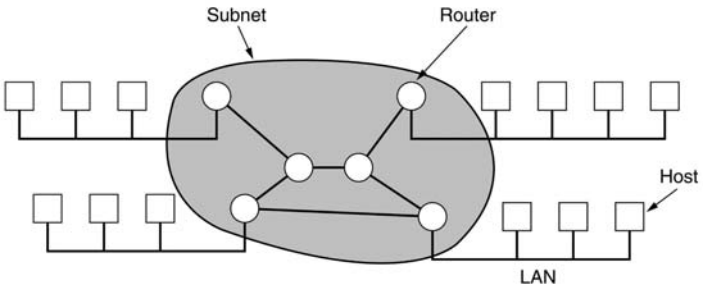
- Spans a large geographical area, often a country or continent
- Network structure in WAN
  - **Hosts** or end systems
    - Collection of machines that run user (application) programs
    - Owned by customers
  - **Communication Subnet** – connects hosts
    - The job of the subnet is to carry messages 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

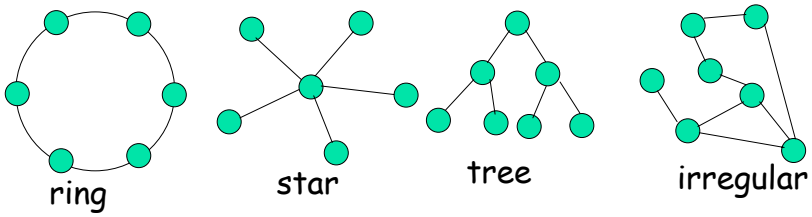
Wide Area Networks

- Relation between hosts on LANs and the subnet



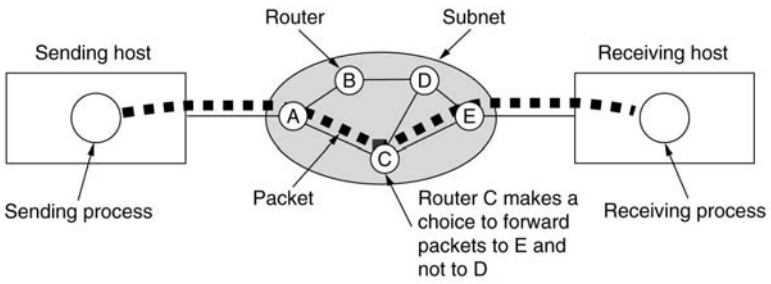
Point-to-Point Channels in WAN

- **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



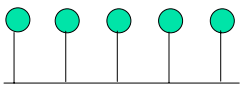
Point-to-Point Channels in WAN

- A stream of packets from sender to receiver

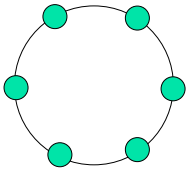


Broadcast Channels in WAN

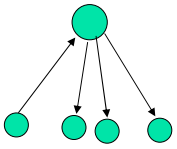
- Sent by one, received by all
- Address field specifies intended destinations
  - Multicast if more than one destination
- When machine receives packet, checks address ignores if not for it
- Topologies



bus



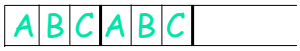
ring



satellite

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

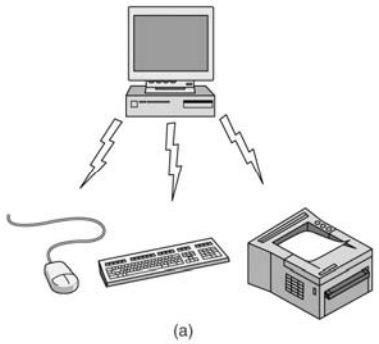
Wireless Networks

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

System Interconnection

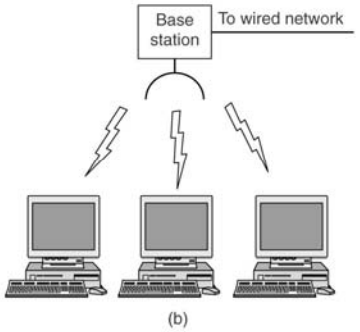
- **System interconnection**: interconnecting the components of a computer using short-range radio
  - Mouse, keyboard, printer, etc.
- **Bluetooth**: a short-range wireless network to connect these components without wires
- System interconnection networks typically use the *master-slave paradigm*

System Interconnection



(a)

Bluetooth configuration



(b)

Wireless LAN

Wireless LAN

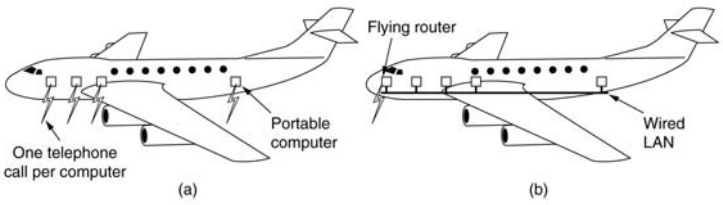
- **Wireless LANs** are systems in which every computer has a radio modem and antenna with which it can communicate with other systems
- Wireless LANs are becoming increasingly common in small offices and homes
- There is standard for wireless LANs: IEEE 802.11

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



Individual mobile computers 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**