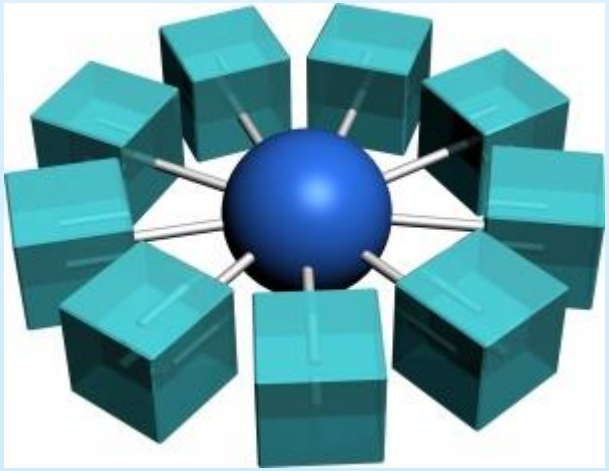
Client Server and Parallel Programming

31666

Spring 2013, Ort Braude College
Electrical Engineering Department



Course Program

- **Lecturer:** Dr. Samy Zafrany
- **Credits:** 5.0
- **Hours:** 3 lecture, 2 laboratory
- **Grade Composition:**
  - 20% - mid-term exam
  - 30% - laboratory projects
  - 50% - final exam
- **Prerequisites:** 31616 (Programming)

Course Web Site

http://www.samyzaf.com/braude/CLISERV/index.html

Slides and most figures and images are based on the Slides of Tanenbaum Book:
Computer Networks, Fourth Edition, Andrew S. Tanenbaum, Prentice Hall 4th Edition, Teacher Complimentary Materials

Course Description

- Client/server application architecture
- Interface, Protocols, Basic Networking Concepts (TCP/IP, UDP) and basic networking tools
- Socket programming
- Internet, WWW, SQL, and client/server systems
- Multitasking, multithreading, and distributed programming
- Database systems, distributed systems, distributed programming
- Client technologies, languages and tools
- Server technologies, languages and tools
- Security and social issues of client/server systems.

Course Outline

- Client/Server systems overview: www client/server, email, ftp, File Server (NFS), DBMS, SQL, RPC
- Networking concepts: protocols, TCP/IP, UDP, MIME, POP, SMTP, DNS, HTML, HTTP, XML
- Networking concepts: OSI model
- Operating systems, processes, and threads Overview. Multithreading models. Threading issues.
- Socket Programming. Synchronous vs. Asynchronous socket calls.
- Networking testing tools: ping, nslookup, ipconfig, traceroute, netstat
- Distributed system structures. Network Structure. Network Topologies. Communication Structure. Communication Protocols.
- Client/Server system design: chat client/server, simple DBMS client/server, Poker game client/server
- Client/Server system implementation: chat client/server, simple DBMS client/server, Poker game client/sever
- Communication Security. Social issues. Cryptography. SSL.

Lab Projects

- Multi processing and multithreading (parallel programming)
- File system search/indexing using single process, multiple processes, and multithreading
- Client communication with server
- Multiple clients communicating with server (Chat server, simple DBMS, Poker game server)
- RPC client/server
- Implement a simple distributed parallel algorithm

Expected Learning Outcomes

- Students will get familiar with basic networking concepts, the basic structure and organization of networking
- Common types of networking paradigms, and common Internet applications and protocols
- Particular emphasis will be put on the prevalent client/server model, and its associated parallel programming computing methods
- Multitasking, multithreading, and distributed programming
- Ability to apply solid engineering principles and methods in building network-aware applications.

Bibliography

- *Silberschatz and Galvin*. Operating Systems Concepts. 8th edition, 2008, John Wiley & Sons, Inc.
- *Andrwes S. Tanenbaum*. Computer Networks, 5th Edition, 2010, Prentice Hall.
- *W. Richard Stevens, Bill Fenner, Andrew Rudoff*. UNIX network programming, 3rd edition, 2003, Prentice Hall.
- *Allen B. Downey*. Think Python, O'Reilly 2012, http://www.greenteapress.com/thinkpython
- *Mark Pilgrim*. Dive into Python, Apress 2004, http://www.diveintopython.net
- *John Goerzen, Brandon Rhodes*. Foundations of Python Network Programming. 2nd Edition, 2010, Apress.
- www.python.org

Software

- All needed software should be downloaded from

  https://www.samyzaf.com/braude/PYTHON/index.html
- Into a personal flash drive (diskonkey)
  - at leas 2GB drive is needed
- All software can be executed from the flash drive on any standard Windows PC
- So you can do all your coding work at home and everywhere you have an access to a windows PC
- We may however need a session or two in the College Linux labs

Computer Networks

- The old model of a single computer serving all of the organization's computational needs has been replaced by one in which a large number of separate but interconnected computers do the job.
- **"computer network"** is a collection of autonomous computing devices interconnected by a single technology
- Connection is achieved by:
  - Copper wires (Ethernet cables)
  - Fiber optics
  - Microwaves
  - Infrared,
  - Communication satellites
- Computing devices: personal computers, tablets, smart phones, routers, blade servers, car controllers, televisions, refrigerators, cameras, ewatches, hard drive controllers, robot systems (unmanned aerial vehicle), etc.

Goals of Networking

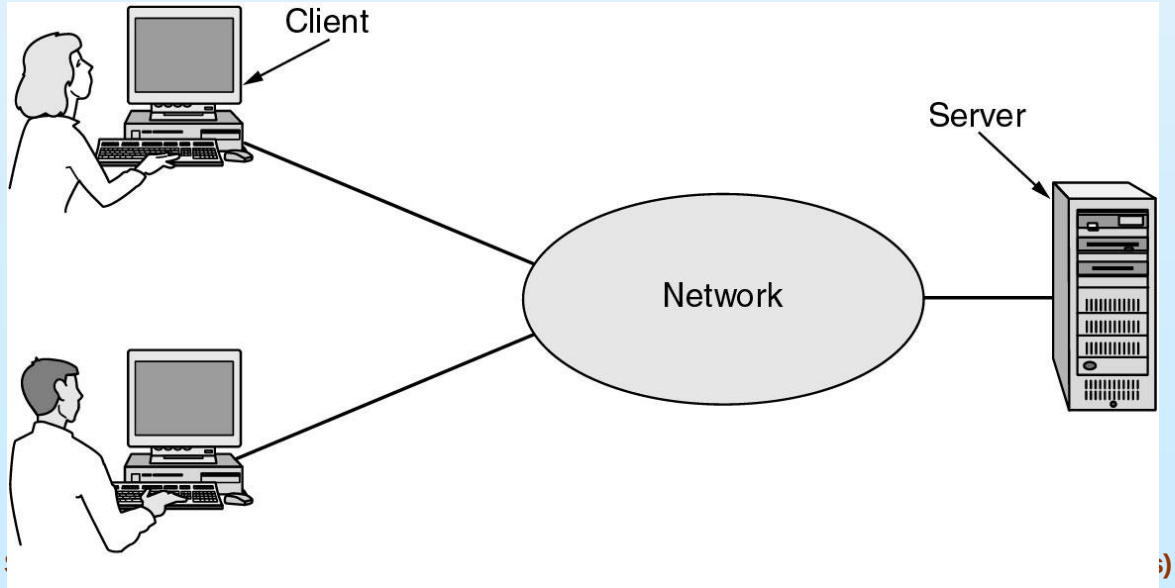
- Resource and load sharing and balancing
  - Programs do not need to run on a single machine
  - Files can span several disks (even on different continents – Hadoop)
  - Reduced cost
  - Several machines can share printers, tape drives, etc.
- Reliability & Redundancy:
  - If a machine goes down, another takes over
  - If a file or disk is damaged, data can be recovered
- Social Connectivity: mail, chat, messages, video, multimedia business, games, recreation (YouTube, Facebook, Twitter, Steam)
- Business applications: DB sharing, e-commerce, m-commerce (Amazon, eBay), Banking, Stock market, Sensor networks
- Mobile applications: tablets, smart phones, VOIP
- Scientific applications
  - knowledge bases
  - distributed computing
  - shared information systems, telelearning (education)

Computer Network & Distributed System

- In a distributed system, a collection of independent computers appears to its users as a single coherent system.
- In a computer network, users are exposed to the actual machines
  - If the machines have different hardware and different operating systems, that is fully visible to the users
  - If a user wants to run a program on a remote machine, he has to log onto that machine and run it there.
- In effect, a distributed system is a software system built on top of a network
- A well-known example of a distributed system is the **World Wide Web**. It runs on top of the Internet and presents a model in which everything looks like a document (Web page).

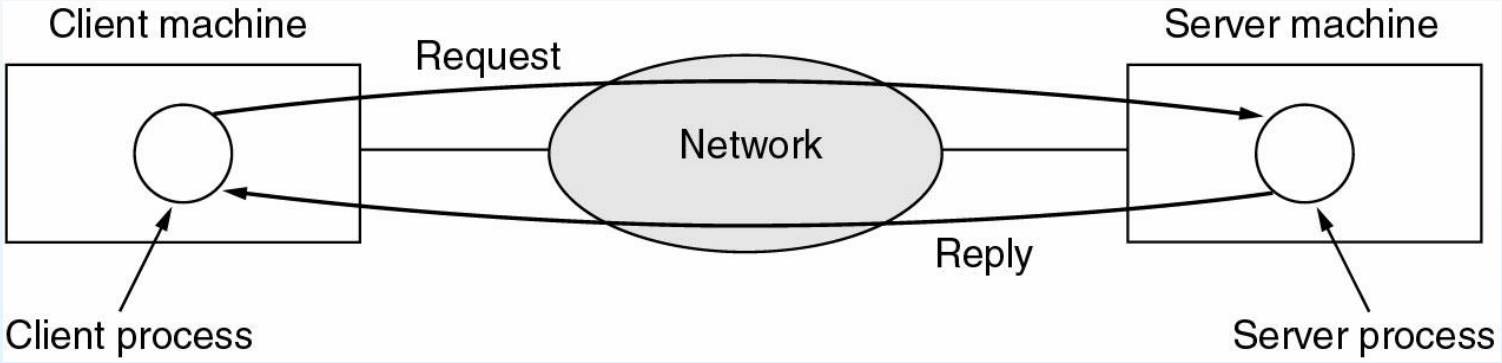
Client-Server System

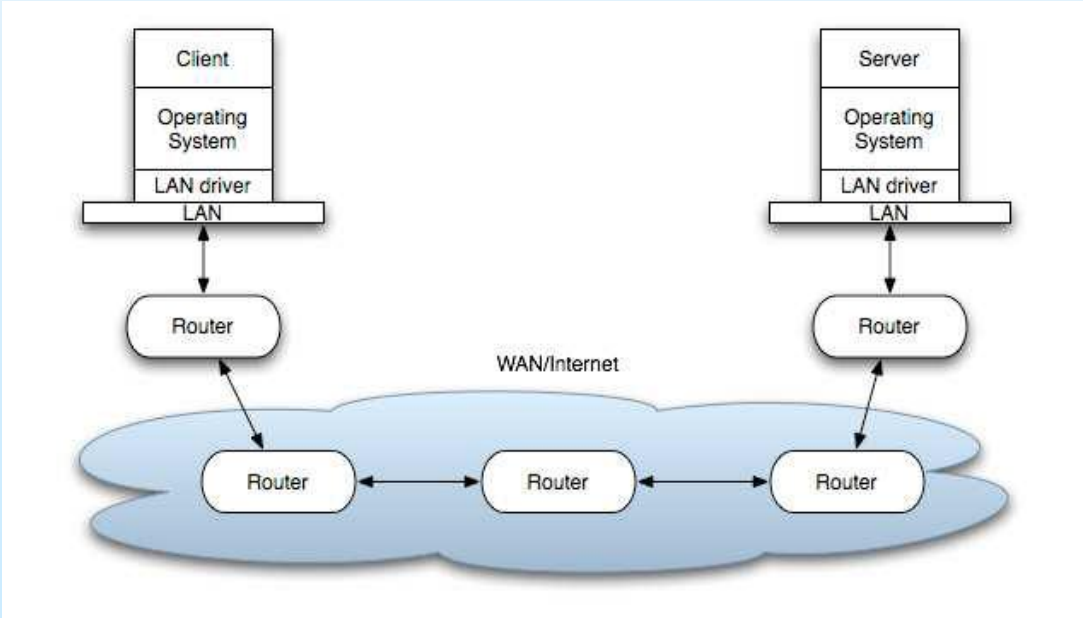
- network architecture in which two computers are connected in such a way that one computer (the client) sends service requests to another computer (the server).
- Examples: WWW, Email, Waze
- Usually, the server is a powerful computer to which many less powerful personal computers or workstations (clients) are connected. The clients run programs and access data that are stored on the server.
- Usually on distant locations but can be also on the same machine



Client Server Data Flow

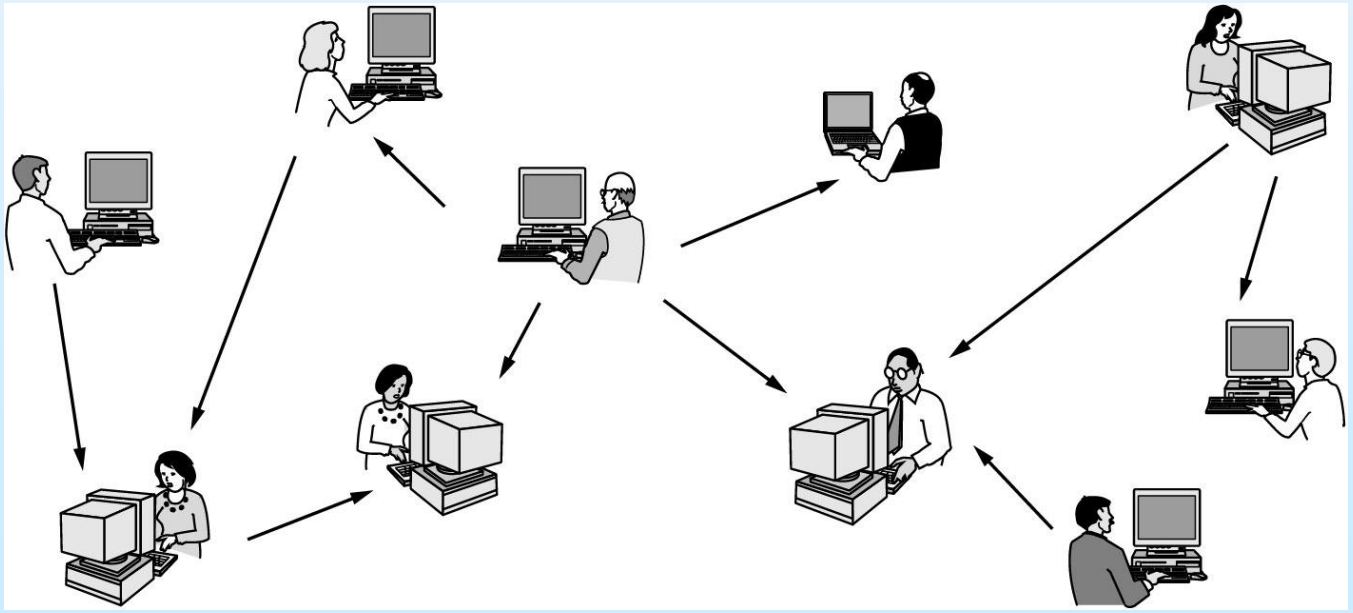
The client-server model involves requests and replies.





Peer-to-Peer System

- In peer-to-peer system there are no fixed clients and servers
- Any node can be sometimes a client and sometimes a server
- Examples: Napster, Kazaa, Emule, BitTorrent (content exchange)
- DEC president, Ken Olsen, 1977: ‘‘There is no reason for any individual to have a computer in his home.’’
  - **Digital Equipment Corporation** no longer exists



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

Network Hardware

- Personal Area Networks (PAN)
- Local Area Networks (LAN)
- Metropolitan Area Networks (MAN)
- Wide Area Networks (WAN)
- Wireless Networks (LAN/WiFi)
- Home Networks (LAN/WiFi)
- Internetworks

Networks Classification

- Network are usually classified according to transmission technology and Scale
- there are two types of transmission technology that are in widespread use:
  - **broadcast** links
  - **point-to-point** links.
- **Broadcast network**: the communication channel is shared by all the machines on the network; packets sent by any machine are received by all the others
- **Point-to-point network**: shortest routes between two peers are used for communications

Interconnected Processors by Scale

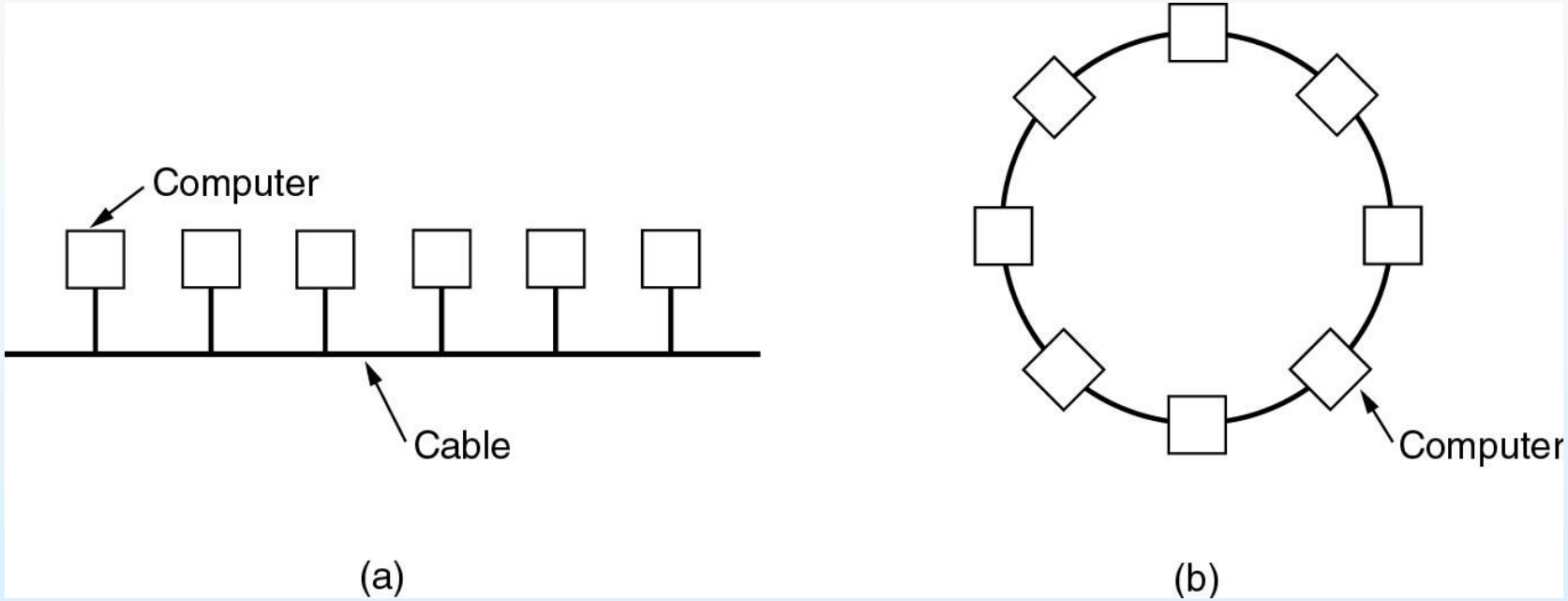
Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	
10,000 km	Planet	The Internet

Personal Area Network (PAN)

(a) Wired connection
(b) Bluetooth configuration
(c) Wireless connection

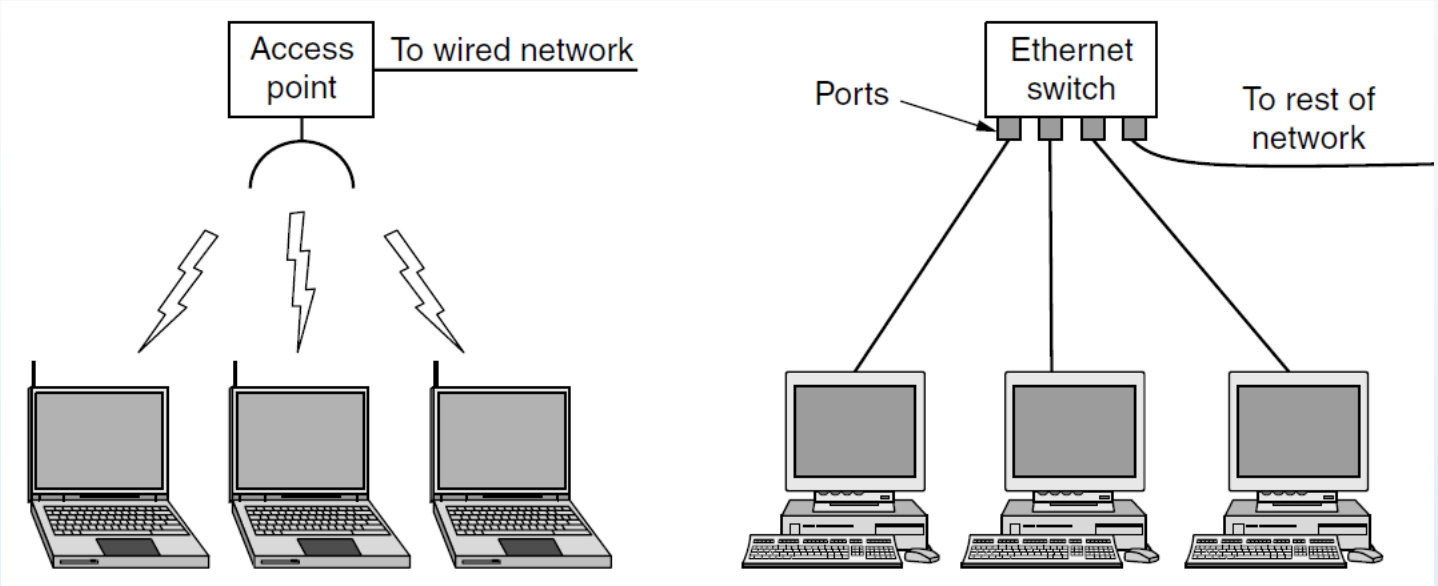
(a) Wireless keyboard/mouse/headset
(b) Wireless Printers
(c) External disks

Local Area Network (LAN)



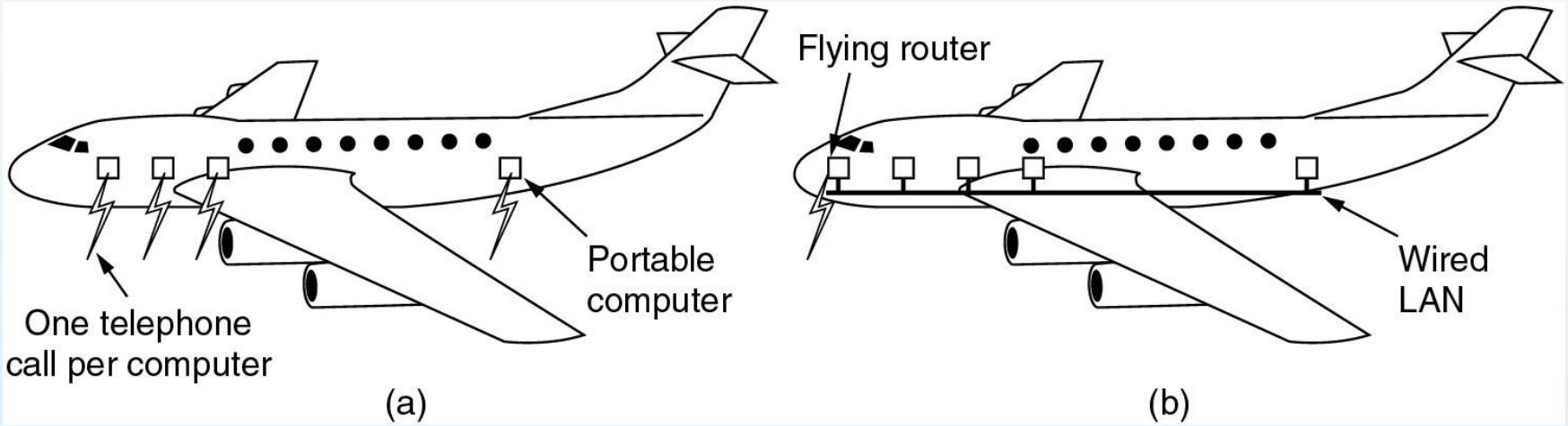
Two broadcast networks
(a) Bus
(b) Ring

Wireless and wired LANs



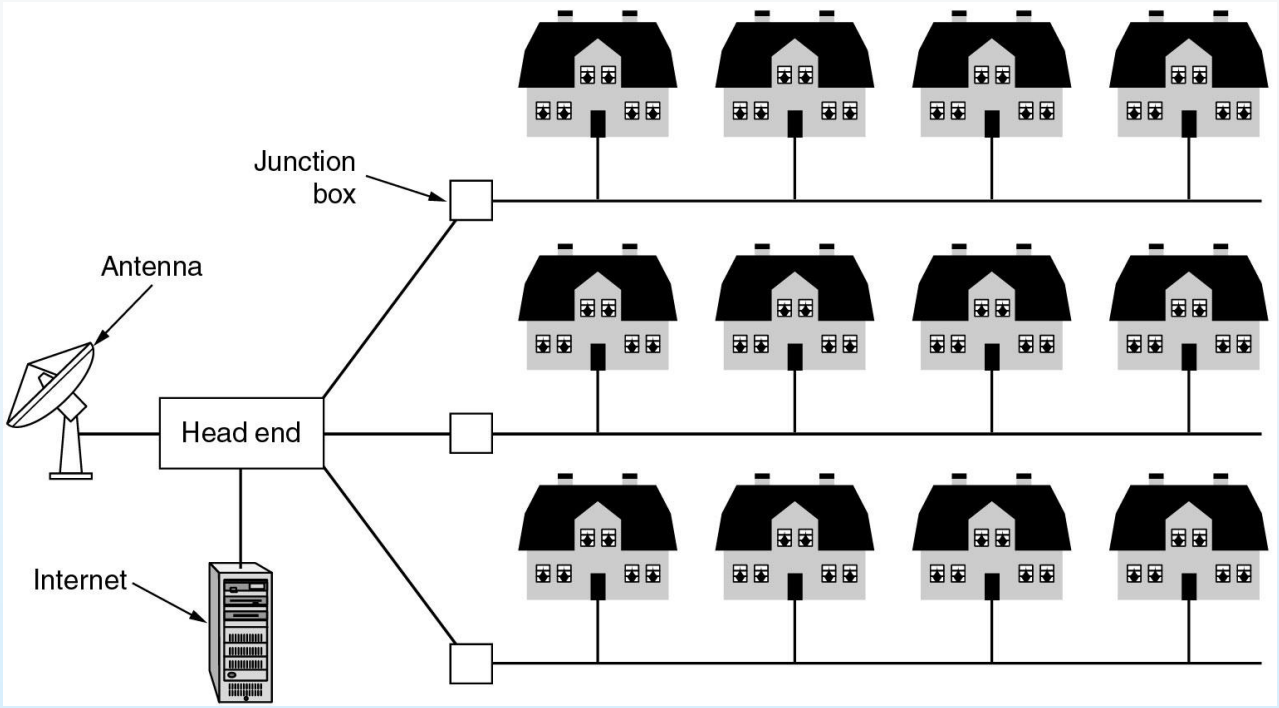
Wireless LAN: IEEE 802.11 (WiFi)
(a) 1-100 Mbps, 10 Gbps
(b) Coper wires, optical fibers
- faster than wireless LAN
(c) 802.3 (Ethernet) most popular LAN

Flying LAN



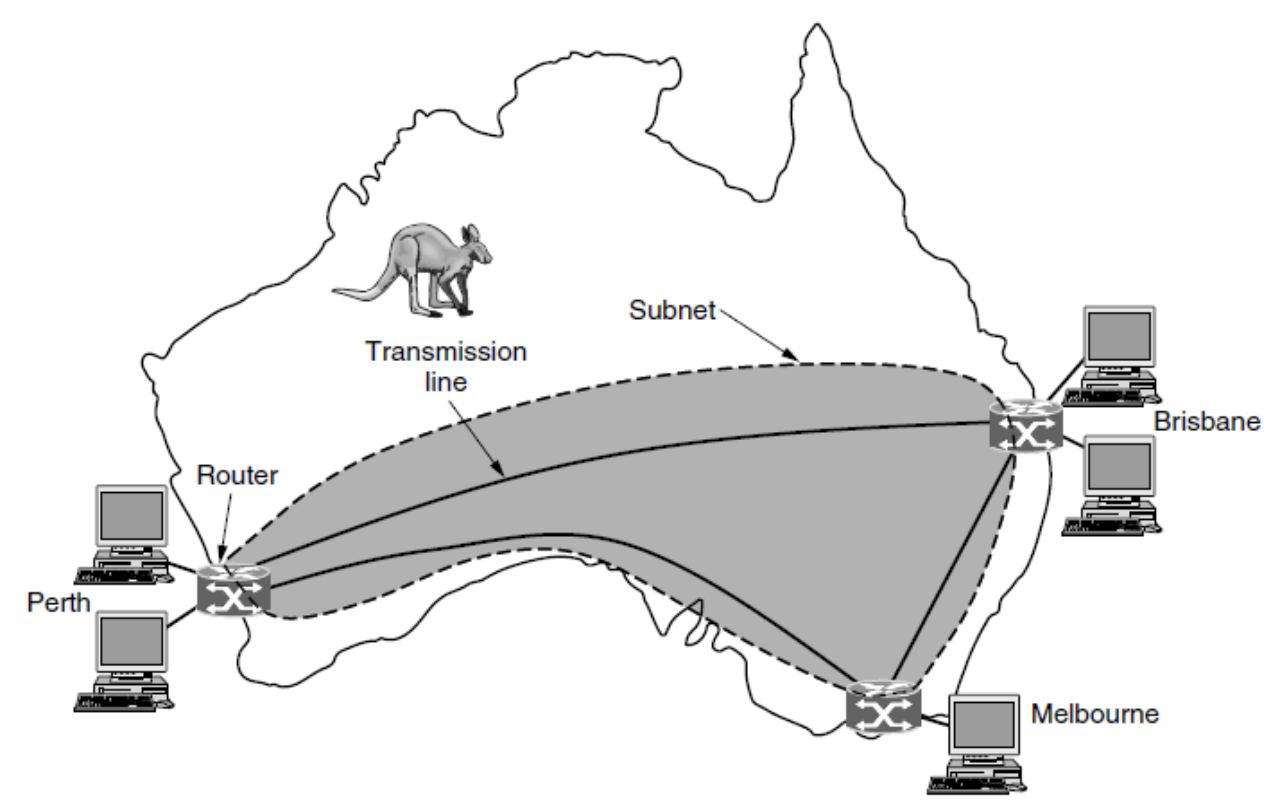
(a) Individual mobile computers
(b) Tablets, smartphones
(c) Other small factor devices

Metropolitan Area Networks (MAN)



(a) A metropolitan area network based on cable TV
(b) New MAN: IEEE 802.16 (WiMax)
- Worldwide Interoperability for Microwave Access
(c) Related standards: GSM, 3G (3rd generation of mobile technology)

Wide Area Networks (WAN)

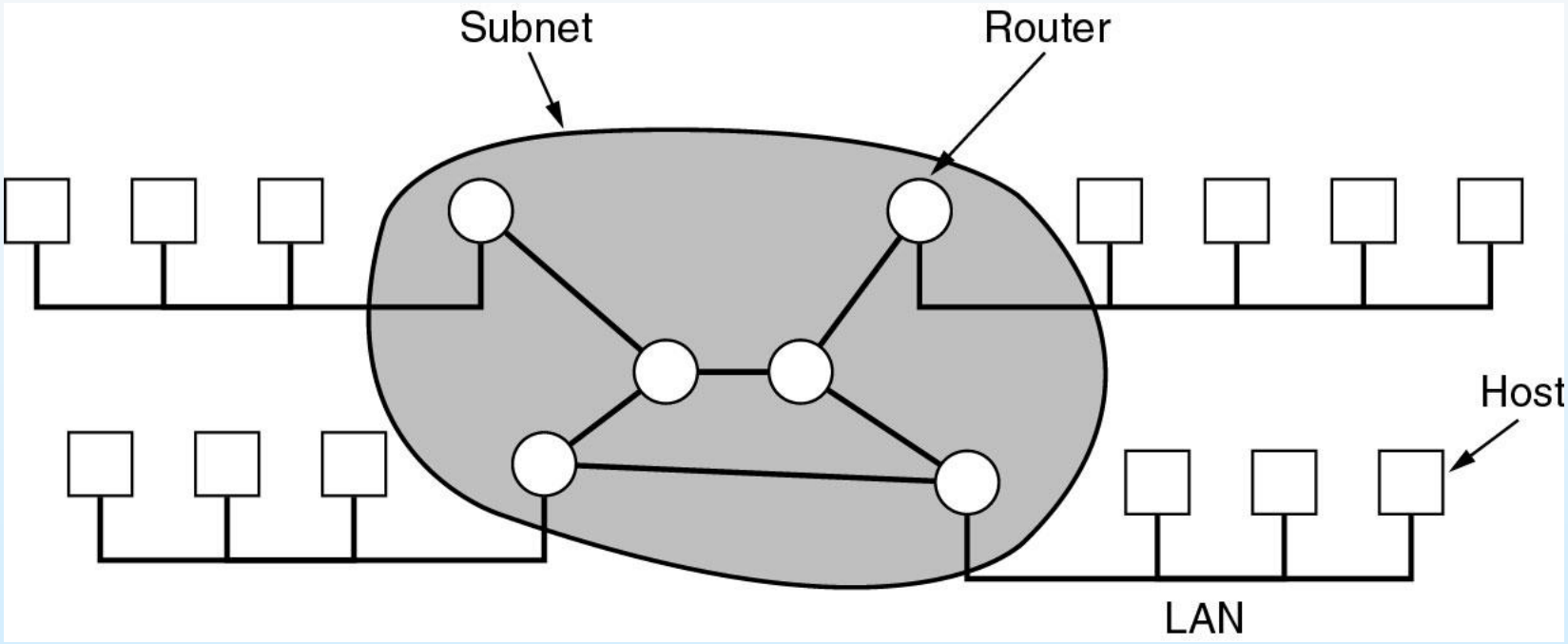


WAN that connects three branch offices in Australia

Transmission lines: copper, optical fiber, radio links

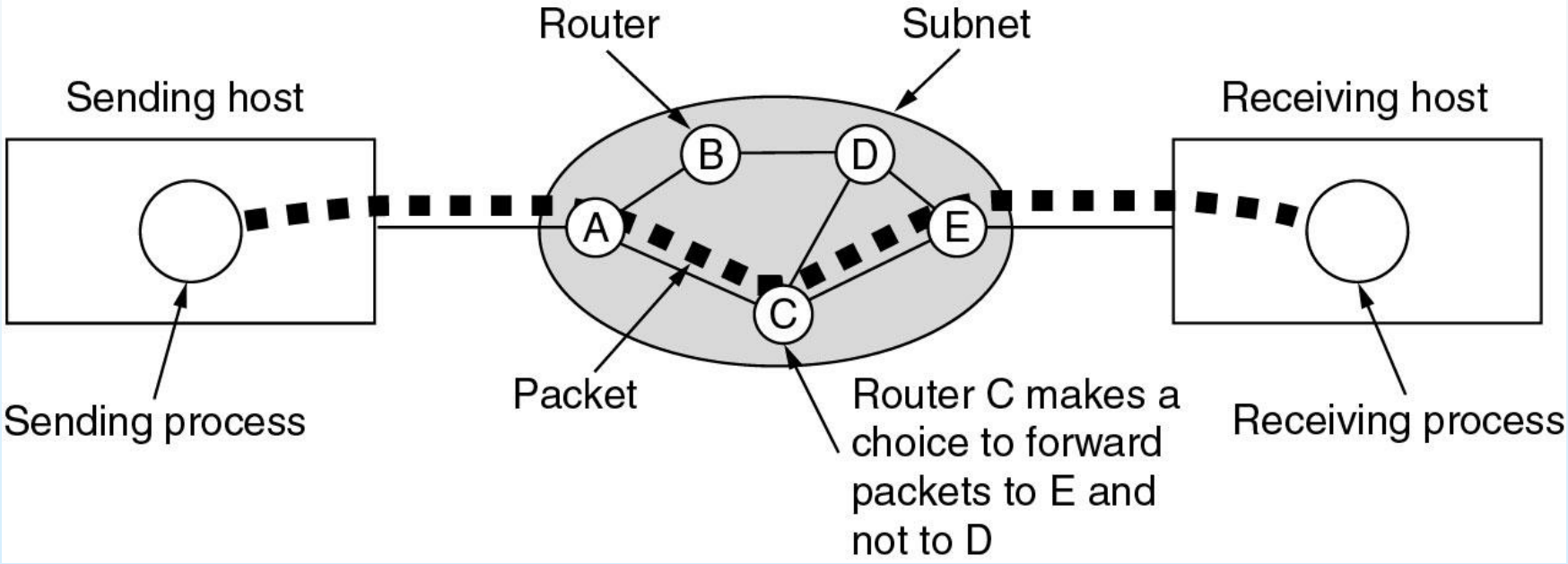
Switching elements: computers that connect two or more transmission lines (routers) - **internetworks**

Wide Area Networks (WAN)



Relation between hosts on LANs and the subnet.

Wide Area Networks (2)



A stream of packets from sender to receiver.