

IS 370 computer networking
Review Sheet 1

1. Define a computer network? What are the motivations to transfer from single computer to computer networking?

A computer network is a collection of computers and devices connected by communications channels that facilitate communication among users and allow them to share resources with other users

Motivations for using computer nets are:

- **Higher Computation Power**
- **Facilitating communications**
- **Sharing hardware**
- **Sharing files, data, and software**
- **remote access to centralized resources (e.g. databases)**
- **Many useful applications: WWW, e-commerce, e-learning, e-medicine, video-on-Demand and multimedia communications**

2. Compare between each of the following:

- a. Client server, P2P

Client-Server	P2P
Needs dedicated server	No dedicated server
expensive	More economic and more scalable
Difficult to maintain	Easy to install and maintain
Will work with any applications	Good for file, printer, and resource sharing.
Clients communicate through server	Peers communicate directly
Handles shared database applications	Good for distributed database applications
More reliable (dedicated server) and more secure	Less reliable (server is workstation)

b. LAN,WAN

LAN	WAN
Computers interconnected in short distance (less than few hundred meters)	Computers interconnected in a long distance (Kms and more)
Primary used to provide higher computation power and to move information within a company, school, campus,...	Used to move information efficiently and quickly, not only within a company, but also from one business to another within a city, country and intercontinental areas
Operates at up to 10Gbps	Operate at slower rate than LAN

c. Hub, switch, router

Hub	switch	router
forwards the packets arrive at one port, copied unmodified, to its all ports for transmission	forwards and filters packets between ports involved in the communication based on the MAC addresses in the packets	forwards packets between ports using information in protocol headers and forwarding tables (IP address) and determine the best next router for each packet

d. Bluetooth, Wi-Fi, Wi-Max

	Blue tooth	Wi-fi	Wi-max
Distance range	From 10m to 100m	Few hundred meters	6 miles
Bit rate	1Mbps	11-200 Mbps	14 Mb
Protocol	802.15	802.11	802.16

e. Twisted pairs, coaxial cable, optical fiber cables

Twisted pairs	coaxial cable	optical fiber cables
<ul style="list-style-type: none"> ■ The most widely used medium for comm. ■ Twisted-pair wires are ordinary telephone wires which consist of two insulated copper wires twisted into pairs and are used for both voice and data transmission. ■ The use of two wires twisted together helps to reduce crosstalk and electromagnetic induction ■ The transmission speed ranges from 2 Mbps to 100 Mbps 	<ul style="list-style-type: none"> • Widely used for cable television systems, office buildings, and other worksites for local area networks. • The cables consist of copper or aluminum wire wrapped with insulating layer typically of a flexible material with a high dielectric constant, all of which are surrounded by a conductive layer. • The layers of insulation help minimize interference and distortion. • Transmission speed range from 200 Mbps to more than 500 Mbps 	<ul style="list-style-type: none"> ■ Consists of one or more filaments of glass fiber wrapped in protective layers. ■ It transmits light which can travel over extended distances without signal loss. ■ Fiber-optic cables are not affected by electromagnetic radiation. ■ Transmission speed may reach Gbps ■ The transmission speed of fiber optics is hundreds of times faster than for coaxial cables and thousands of times faster than for twisted-pair wire

f. Bandwidth, throughput

Bandwidth	throughput
The carrying capacity of a communications circuit	refers to actual measured bandwidth, at a specific time of day, using specific Internet routes, and while a specific set of data is transmitted on the network

3. Define the Internet in terms of

Internet : is a global system of interconnected governmental, academic, public, and private computer networks

- Its components : Hardware components: Hosts (end systems), Communication links, Routers**
- Software components: Internet Service Providers (ISP), Packets, Protocols, Internet standards**
- Its services : remote login, email, web surfing, chatting, video conferences, VoIP, multimedia, distributed games and databases, e-learning, e-health, e-business, appliances**

4. Explain briefly what is meant by network edge, access network and network core of the Internet

Network edge: hosts (end systems)

Network core: routers and communication links

Access Network: physical media connecting hosts to edge routers (e.g, access point, links)

5. Compare between each of the following:

- a. TCP and UDP

Service	TCP	UDP
<i>connection-oriented</i>	Yes, setup required between client and server processes (handshaking)	no
<i>reliable transport</i>	Yes, deliver all messages sent without error and in the proper order by message retransmission	no
<i>flow control</i>	Yes, sender won't overwhelm receiver	no
<i>congestion control</i>	Yes, throttle sender when network overloaded	no
<i>timing</i>	no	no
<i>Min throughput guarantee</i>	No, transmission rate depends on congestion control	no
<i>speed</i>	Relatively slow	Fast .good for real-time applications
<i>security</i>	no	no

b. Circuit switching and packet switching

Packet switching	Circuit switching
resources are not reserved; users use the resource on demand, and as a consequence, may have to wait (i.e., queue) for access to a communication link (allow multiple users to share network resources)	the resources needed along a path (buffers, link bandwidth) to provide communication between the end systems are <i>reserved</i> (dedicated) for a user for the duration of the session (no sharing between users)
Variable and unpredictable delays (store and forward & queuing)	Smaller delays make it suitable for real time applications telephone calls and video conferences
Packet loss	Smaller prob. for data loss
More efficient, less cost, simpler (no call setup required), better sharing of BW	Relatively expensive and complex
Used in computer networks	Used in telephone networks

c. DSL, TV cable modem, Ethernet

DSL: it uses telephone infrastructure, dedicated to a single user

TV cable modem: it uses television infrastructure, shared by multiple users

Ethernet: it is used in companies and universities etc , and the end system connects to Ethernet switch

6. What are the sources of delay in packet switching? Explain using a schematic diagram.

- **transmission delay**
- **nodal delay**
- **queuing delay**
- **propagation delay**

7. Describe briefly each of the following techniques in TCP: handshaking, reliability, flow control, congestion control.

- **Handshaking: means that the client program and server program (residing in different end systems) send control packets to each other before sending the real data (such as email).**
- **Reliability is achieved through the use of acknowledgement and retransmission.**

-
- **The flow-control service forces the sending end system to reduce its rate whenever there is such a risk.**
- Makes sure that neither side of a connection overwhelms the other side by sending too many packets too fast.

congestion if every pair of communicating end systems continues to pump packets into the network as fast as they can, few packets will be delivered to their destinations

8. When does packet loss occur in computer network? Explain using a schematic diagram.

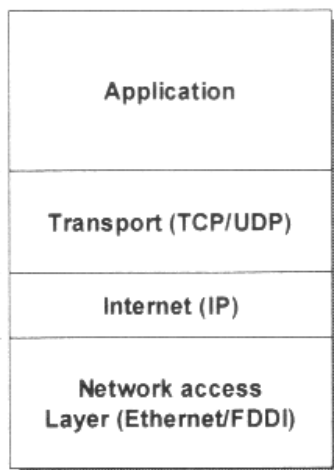
When a router becomes congested, its buffers can overflow and packet loss can occur.

9. What is a network protocol? Give an example using schematic diagram.

a protocol defines the format and the order of messages exchanged between two or more communicating entities, as well as actions taken on the transmission and/or receipt of message or other event

10. Why do we use layers to describe computer network architecture? Draw the TCP/IP layer model.

- **Simplifies the complexity of network systems**
- **helps identify the functions and the relationships between these pieces**
- **Assists in protocol design, because protocols that operate at a specific layer have defined information that they act upon and a defined interface to the layers above and below.**
- **eases maintenance, updating of system**
- **change of implementation of layer's service doesn't affect the rest of system**



TCP/IP model

Fill in the space in the following sentences:

1. **COMPUTER NETWORK** is a collection of computers and devices connected by communications channels.
2. **Twisted pair, coaxial and optical** fiber are wired media used in computer networks.
3. The transmission speed of fiber optics is **hundreds** of times faster than for coaxial cables and **thousands** of times faster than for twisted-pair wire
4. **Bluetooth, WIFI and Wi-Max** are examples of wireless network technology.
5. Wi-Fi uses **IEEE 802.11** protocol, transfers data at **(11-200 mbps)** bit rate and covers a range of **few 100** meters.
6. Bluetooth uses **IEEE 802.15** protocol, transfer data at **1Mbps** bit rate and covers a range of 100 meters.
7. Wi-Max uses **IEEE 802.16** protocol, transfer data at **14Mbps** bit rate and covers a range of **6 miles**.
8. **PAN** is a computer network used for communication among IT devices close to one person.
9. **HAN** is a residential network used for communication between digital devices in a home.
10. **LAN** is a network that connects computers in a building, or closely positioned group of buildings.
11. LANs are most likely to be based on **Ethernet** technology and operates at speeds up to **10Gbps**
12. **WAN** is a computer network that covers a large geographic area such as a city or a country.
13. A **Router** is a networking device that forwards **Packets** between networks using IP address.
14. **Bandwidth** Is the amount of information that can flow through a communication link in a given period of time
15. **Protocol** is a set of rules that control the transmission of information within the internet.
16. **Host(End system)** is a device connected to the internet and uses it to communicate.
17. The Internet structure consists of **edge, access network ,core**
18. The Internet edge consists of **Hosts(End systems)**
19. The network core includes **Router and Communication Links**
20. **Access network** is the communication links provided by ISP to connect hosts to edge routers such as **Modem, DSL, Ethernet, wireless**
21. **Client program** is an end system that requests and receives a service from a sever.
22. **Server program** is an end system that provides services to a client.
23. **P2P** is an end system that is not a pure client nor a pure server.
24. Examples of client-server applications are **Web browser/server; email client/server ; File Transfer**
25. Examples of P2P applications are **Skype, BitTorrent**
26. **Peer** acts as a **client** when it requests a file from another **Peer**; and as a server when it sends file to another **Peer**
27. TCP provides the following transport services **handshaking, reliability, flow control, congestion control**
28. **Handshaking** means that the client program and server program send control packets to each other before sending the real data to prepare for packet transmission.

29. **Reliable data transfer** means to deliver data without error, loss, and in the proper order and is achieved through the use of **acknowledgment** and **retransmission**
30. **flow control** makes sure that neither side of a connection overwhelms the other side by sending too many packets too fast.
31. **Congestion-control** diminishes the rate at which packets are pumped to the network.
32. TCP is used by most network applications such as **Telnet (remote login), SMTP (for electronic mail), FTP (for file transfer), and HTTP (for the Web).**
33. UDP is used by some network applications such as **Internet phone, and video conferencing**
34. **telephone networks** is an example for circuit switching while **computer networks** is an example for packet switching.
35. **Store-and-forward** transmission means that the router must receive the entire packet, store it in its input buffer, before it can begin to transmit the first bit of the packet onto the outbound link.
36. **Processing delay** is the time required to examine the packet's header and determine where to direct the packet.
37. **queuing delay** is the time for which a packet waits in the router's queue to be transmitted onto the outbound link
38. **transmission delay** the amount of time required to push all of the packet's bits into the outbound link.
39. **propagate delay** time required for a bit to propagate from the beginning of the link to destination router.
40. **Network Applications** are the services that a computer network makes available to the users.

Put T in front of the true statement and F in front of the false statement in each of the following:

1. Resource sharing is one of the advantage of computer networks. T
2. The use of two wires twisted together helps to reduce crosstalk and electromagnetic induction. T
3. Insulation layer in coaxial cable helps minimize interference and distortion. T
4. Fiber-optic cables are affected by electromagnetic radiation. F
5. Coaxial cable transfer data much faster than fiber-optic cables. F
6. Bluetooth cover a wide range of distance for data transfer. F
7. Wi-Fi uses IEEE 802.11 protocol while Wi-Max uses IEEE 802.16 protocol. T
8. Wi-Max covers wider range of distance than Wi-Fi but has smaller bit rate transfer. T
9. Wired LANs are most likely to be based on Ethernet technology. T
10. LAN connects computers in a wide geographically area. F
11. WAN operates at slower rate than LAN, but covers wider geographical area. T
12. The Internet is a network of networks. T
13. A protocol is not considered as a network component. F
14. In the Internet, hosts are connected together directly through one communication link. F
15. Hosts form the core part of the Internet. F

16. DSL, High speed LAN, and wireless access are examples for network access provided by ISP. T
17. Skype is an example of client-server application. F
18. File transfer uses peer-to-peer model. F
19. UDP provides reliable data transfer. F
20. TCP provides congestion control. T
21. In circuit-switching, data is sent through the net in discrete chunks. F
22. In circuit-switching, users share network resources. F
23. In circuit switching, the bandwidth is divided into pieces using FDM or TDM. T
24. In statistical multiplexing packets have a fixed pattern . F
25. In packet switching, network resources are reserved for each user. F
26. Packet switching allows more users to use network. T
27. A protocol defines the format and the order of messages exchanged between hosts. T
28. Modularization and standardization are advantages for network layer structure. T
29. Queuing delay can vary from packet to packet. T
30. A queue forms when the arrival rate of packets is less than the transmission rate. F
31. Packet loss occurs when packets arrive to a full queue. T
32. Network layer handles reliable data transfer. F
33. Link layer divides data into segments. F
34. Network layer determines the route and IP address of the destination. T
35. P2P architecture have always on servers. F
36. In client-server architecture the server has a permanent IP address. T
37. In client-server architecture clients communicate directly with each other. F
38. P2P is highly scalable but difficult to manage. T
39. Throughput cannot exceed network bandwidth T
40. Circuit switching support more users than packet switching and utilize the BW more efficiently

that packet switching is more efficient than circuit switching,
that IP is simpler,

Problems

1. In a circuit switching network, the following information are given:
Link capacity = 2 Mbps, time to establish a circuit = 0.25 sec, TDM with 10 slot/sec is used. How long does it take to transmit a file of size 200kb on the circuit?

Link capacity = 2 Mbps, time to establish a circuit = 0.25 sec, TDM with 10 slot/sec, file size= 200kb.

Transmission speed = $2/10 = 0.2$ Mbps = 200 kbps.

File Transmission time = $200 / 200 = 1$ sec.

Overall transmission time = $1 + 0.25 = 1.25$ sec

2. Data is transmitted from node A to node B on a route of **three** identical links with the following setup:

Packet size= 8500bits, Transmission rate = 2Gbps, Distance between two nodes = 3500 Km/s, Signal speed = 270000 Km/s , N = 3

Find its transmission delay, propagation delay and end-to-end delay.

Packet size=L= 8500bits, Transmission rate = R= 2Gbps, Distance between two nodes= d = 3500 Km, Signal speed = s = 270000 Km/s

Transmission delay = $3L/R = 3 * 8500 / 2 * 10^9 = 12.75$ microsec

Propagation delay = $d/s = 3500 / 270000 = 13$ msec.

End-to-end delay = $13 + .01275 = 13.01275$ msec

3. Suppose users share a 1Mbps link. Also suppose each user requires 100 kbps when transmitting, but each user transmits only 10% of the time.

- a) When circuit switching is used, how many users (N) can be supported?

no. of users (N) = 1Mbps / 100 kbps = 10 users

- b) For the remainder of this problem, suppose packet switching is used. Find the probability (p) that a given user is transmitting

P = 10% = 10/100 = 0.1

- c) Suppose there are a population M=40 users. Find the probability that at any given time n users are transmitting simultaneously. (Hint use binomial distribution)

$$\binom{40}{n} p^n (1 - p)^{40-n}$$

- d) Find the probability that N users or more transmitting at the same time.

$$1 - \sum_{n=0}^{10} \binom{40}{n} p^n (1 - p)^{40-n}$$