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Exercise 1: Compare between

a. Synchronous modems and Asynchronous modems (**solution**)

- Asynchronous modems are relatively simple and economic
- Large overhead - can be up to 20 to 27% of the data traffic
- Error control is done by using parity bit or higher layer protocols, e.g. MNP, V.42
- Synchronous modems are relatively complicated and expensive
- Seldom use in home market
- Less overhead means higher efficiency
- More sophisticated error control protocol is required

**b. what is the difference between Classless and classfull in IP addresses?**

**Solution**

The difference between classful IP addressing and classless IP addressing is in selecting the number of bits used for the network ID portion of an IP address. In classful IP addressing, the network ID portion can take only the predefined number of bits 8,16,or 24. In classless addressing, any number of bits can be assigned to the network ID.

**c. Half Duplex, Full Duplex Mode of Communication (The solution found in first sheet)**

**d. Connectionless and connection Oriented protocols?**

**Solution**

1. In connectionless communication there is no need to establish connection between source (sender) and destination (receiver). But in connection-oriented communication connection must established before data transfer.
2. Connection-oriented communication is more reliable then connectionless communication.
3. In connection-oriented communication information can be resend if there is an error in missing data, corrupt data etc.). But in connectionless communication it is not possible because the destination does not inform the source about data is received or not.
4. Connection-oriented communications have higher overhead and place greater demands on bandwidth. But in connectionless communication requires far less overhead than connection-oriented.

Exercise 2: Full the blanks

**Solution**

1. Data Communication is a process of exchanging data or information; In case of computer networks this exchange is done between two devices over a transmission medium.
2. A protocol is a set of rules that governs data communication.
3. Computer Networks are used for data communications
4. A computer network can be defined as a collection of nodes. A node can be any device capable of transmitting or receiving data
5. The communicating nodes have to be connected by communication links. A Compute network should ensure reliability process security of the data performance by achieving higher throughput and smaller delay times.
6. The three basic categories of computer networks are: LAN,MAN and WAN
7. Transmission Media can be guided media or unguided media .
8. In analog systems the difference between highest frequency to lowest frequency component is called bandwidth.
9. In data communication, the bandwidth is the amount of information that can pass through the channel or medium.
10. In any type of communication, noise is the biggest impairment

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11. By **Multiplexing** different message signals can share a single transmission media (The media can be guided or unguided).
  12. (FDM, WDM, TDM) is a type of multiplexing used in fiber optical communications.
  13. In The Internet model, **Transport Layer** has two protocols **TCP (Transmission Control Protocol)** and UDP (User Datagram Protocol).
  14. In The Internet model the **Network Layer** has the main protocol is IP (Internet Protocol). It is responsible for creating network layer packets called **IP datagrams**.
  15. **Value-added networks (VAN)** are communications networks supplied and managed by third-party companies that facilitate electronic data interchange, Web services and transaction delivery by providing extra networking services.
  16. The logical topology defines how the data flows from one device to another. Broadly (بصورة عامة) categorized into **Bus, Ring, Star, Mesh**.
  17. **Routing** is the selection of a path to guide a packet from the source to the destination
  18. TCP/IP is built on “**connectionless**” technology, each datagram finds its own way to its destination
  19. FTP – File Transfer Protocol used For **file transfer**
  20. Telnet – Remote terminal protocol used For remote login on any other computer on the network
  21. SMTP – Simple Mail Transfer Protocol used For mail transfer
  22. HTTP – Hypertext Transfer Protocol used For Web browsing
  23. ARP – Address Resolution Protocol used to Define the procedures of network address / MAC address translation.
  24. ICMP – Internet Control Message Protocol Define the procedures of error message transfer
  25. How a packet finds its way to a computer in a network?
    - a. **By using Routers**    b. **Routing**    c. **shortest path**    d. **routing protocol**
  26. The information passed with the SMTP messages are
    - a. **The recipient name**    b. **The sender name**    c. **The mail**    d. **All**
  27. To access a computer, we need to specify its ?
    - a. **network address**    b. host address    c. subnet address    d. MAC Address
  28. DNS Stands for **Domain Name Server**.
  29. TCP is a **protocol**?
    - a. **connection-oriented**    b. **connectionless**    c. **classless**    d. **classfull**
  30. The port number that is reserved (محجوز) for file transfer (FTP) is ?
    - a. Port 23    b. Port 25    c. **Port 21**    d. Port 80:
  31. **Each IP address** is -----bits long
    - a. 128    b. **32**    c. 64    d. 8
  32. In the Class C can Addressing the NetworkID & hostID as:
    - a.  $2^7$  NetID &  $2^{24}$  hostID .
    - b.  $2^{14}$  NetID &  $2^{16}$  HostID.
    - c.  **$2^{21}$  NetID &  $2^8$  HostID.**
    - d.  $2^4$  NetID &  $2^{28}$  HostID.
  33. The transport layer protocol that the packet belongs to
    - a. TCP    b. UDP    c. ICMP    d. **all**
  34. (**Source address , Destination address**) – The network address of the computer that *sends* the data.
  35. (**Destination address , Source address**) – The network address of the computer that the data is *sending to*.
  36. for very large network the class is :
    - a. Class C    b. class D    c. **Class A**    d. Class B

37. for medium size network the class is :  
a. Class C      b. class D      c. Class A      d. Class B
38. for small size network the class is :  
a. Class C      b. class D      c. Class A      d. Class B
- 39.

**Exercise 3:** List the **Characteristics of Data Communication**

**Exercise 4:** List the **Components of Data Communication**

**Exercise 5:** In **Data representation** there are many different forms in which data may be represented. Some of the forms of data used in communications: list and explain briefly.

**Exercise 6 :** There is three key elements of a protocol: list and explain briefly

A. **Syntax:**

- It means the structure or format of the data.
- It is the arrangement of data in a particular order.

B. **Semantics :**

- It tells the meaning of each section of bits and indicates the interpretation of each section.
- It also tells what action/decision is to be taken based on the interpretation.

C. **Timing**

- It tells the sender about the readiness of the receiver to receive the data
- It tells the sender at what rate the data should be sent to the receiver to avoid overwhelming the receiver.

Q:\There are several types of noise sources, which can abruptly ( مفاجئ بشكل ) affect the quality of reception signal. List these type of noise and explain briefly.

**Exercise 7:** There are four parameters involved in the evaluation of channel capacity. List and Explain, briefly?

**Exercise 8:** Based on the requirements, the communications can be of different types: list and explain briefly?

**Exercise 8:** For Modes of transmission, List and explain the key factors have to be observed regarding serial transmission?

- **Timing problem:** There should be some mechanism to know when the bit has arrived and at what rate the next bit is going to arrive at the serial input terminal of the receiver. We will see this can be accomplished in two ways.
- **Error detection:** Provision should be made (during transmission itself) to verify the integrity of the received data. Like parity, checksum bits.
- **Error correction:** Ability to correct the data in case of corrupted data reception.

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**Exercise 9:** The OSI Model has seven layers. They are separate but related. Each layer has well defined tasks and provides services to the corresponding lower layer while in transmission. In receiving mode the lower layer provides the necessary services to the upper layer. **List those layers and provides services of any one layer you want?**

**Exercise 10: Why networking?**

- **Sharing of hardware:** Computer hardware resources (Disks, Printers)
- **Sharing of software:** Multiple single user licenses are more expensive than multi-user license. Easy maintenance of software
- **Sharing of information:** Several individuals can interact with each other Working in groups can be formed.
- **Communication:** (e-mail, internet telephony, audio conferencing video conferencing
- **Scalability:** Individual subsystems can be created and combine it into a main system to enhance the overall performance.
- **Distributed systems:** In a networked environment computers can distribute the workload among themselves keeping transparency to the end user.

**Exercise 11:** What is TCP/IP?

- TCP/IP is a set of protocols developed to allow cooperating computers to share resources across a network
- TCP stands for "Transmission Control Protocol"
- IP stands for "Internet Protocol"
- They are Transport layer and Network layer protocols respectively of the protocol suite
- The most well known network that adopted TCP/IP is Internet – the biggest WAN in the world.

**Exercise 12:** What are the functions provides by TCP?

- **Dividing a chunk of data into segments**
- **Reassembly segments into the original chunk**
- **Provide further the functions such as reordering and data resend**
- **Offering a reliable byte-stream delivery service**

**Exercise 13: What Are the Typical Procedures of TCP/IP in the Sender and Recipient Sides?**

- **Sender**
  - TCP divides a message into segments
  - Add sequence no.
  - Send the segments in sequence and wait for acknowledgement
  - If an acknowledgement for a segment is not received for a certain period of time, resend it until an acknowledgement is received
- **Recipient**
  - When receiving segments, send the acknowledgement with correct number
  - Reassembly the segments back to the message

**Exercise 14:** What is the principal difference between connectionless communication and connection-oriented communication?

**Exercise 15:** What is the main difference between TCP and UDP?

**Exercise 16:**

1. Enumerate different types of communication. Site examples for each of them?
2. What is noise? How many types of noise are there?

3. Discuss in detail about multiplexing.
4. What are the factors involved in serial transmission?
5. Why Protocols are needed?
6. **Explain TCP/IP model**
7. **Narrate the seven layers of OSI model**
8. State any two benefits of networking.
  1. WANs are spread over .....
  2. Site an example for distributed processing
  3. Why peer-peer configuration is not preferred?
  4. The one advantage of star topology is:
  5. VANS are run by.....
  6. Why networking?-Elaborate
  7. How many types of networks are there?
  8. State the characteristics of LAN
  9. Describe WAN and its associated terms
  10. Discuss in detail about hybrid topology
  11. How many ways a MAN is different from LAN and WAN?
  12. UTP stands for .....
  13. Contrast hubs with repeater.
  14. MAC address stands for .....

**Exercise 16:**

**List the Limitations and Features of Repeater**

- **Cannot link unlike segments**
- **Cannot join segments with different access methods (e.g. CSMA/CD and token passing)**
- **Do not isolate and filter packets**
- **Can connect different types of media**
- **The most economic way of expanding networks**

**Exercise 17:**

**List the Differences between Bridges and Repeaters?**

	<b><i>Repeaters</i></b>	<b><i>Bridges</i></b>
<b><i>OSI layer</i></b>	Physical layer	Data link layer
<b><i>Data regeneration</i></b>	Regenerate data at the signal level	Regenerate data at the packet level
<b><i>Reduce network traffic</i></b>	No	Yes

**Exercise 18:**

List the Advantages and limitation of Switches?

**Solution****Advantages of Switches**

- Switches divide a network into several isolated channels (**or collision domains**)
- **Reduce the possibility of collision**
- Collision only occurs when two devices try to get access to one channel
- Can be solved by buffering one of them for later access
- **Each channel has its own network capacity**
- Suitable for real-time applications, e.g. video conferencing
- **Since isolated, hence secure**
- Data will only go to the destination, but not others

**Limitations of Switches**

- Although contains buffers to accommodate bursts of traffic, can become overwhelmed by heavy traffic
- **Device cannot detect collision when buffer full**
- CSMA/CD scheme will not work since the data channels are isolated, not the case as in Ethernet
- **Some higher level protocols do not detect error** E.g. UDP
- Those data packets are continuously pumped to the switch and introduce more problems

**Exercise 19:****Compare Between Static and Dynamic Routers**

<i>Static Routers</i>	<i>Dynamic Routers</i>
Manual configuration of routes	Manual configuration of the first route. Automatic discovery of new routes
Always use the same route	Can select the best route
More secure	Need manual configuration to improve security

**Exercise 20:****Distinguishing Between Bridges and Routers**

- Bridges forward everything they don't recognize
- Routers select the best path
- **Routers are layer 3** devices which recognize network address
- **Bridges are layer 2** devices which look at the MAC sublayer node address

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**Exercise 21:**

Compare between the following? Choose Only Two.

**TCP and UDP protocols?**

Solution

TCP is a connection oriented but UDP Connectionless

-  
-  
-

**Synchronous modems and Asynchronous modems?**

Solution

**Asynchronous modems** are relatively simple and economic

- Large overhead - can be up to 20 to 27% of the data traffic
- Error control is done by using parity bit or higher layer protocols, e.g. MNP, V.42
- **Synchronous modems** are relatively complicated and expensive
- Seldom use in home market
- Less overhead means higher efficiency
- More sophisticated error control protocol is required

**Bridges and Routers?**

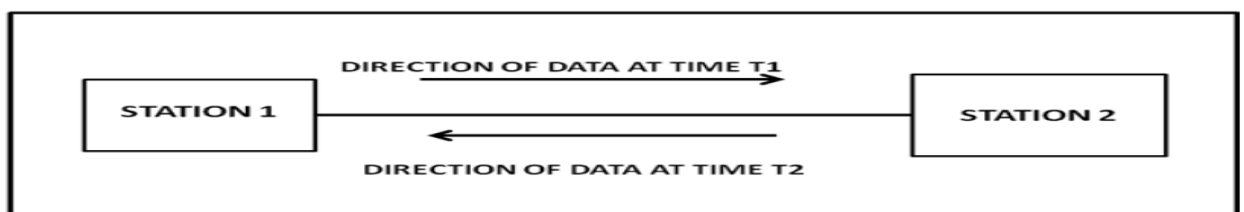
Solution

**Bridges are layer 2** devices which look at the MAC sublayer node address

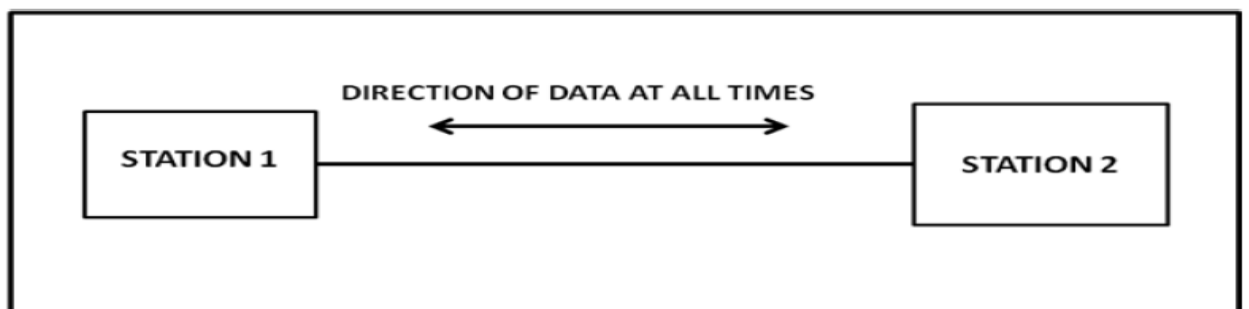
**Half Duplex and Full Duplex Modes of Communication?**

Solution

Half duplex



Full Duplex



**Exercise 22:**

What are the principal differences between?

**Classless and Classfull in IP addresses?****Solution**

The difference between classful IP addressing and classless IP addressing is in selecting the number of bits used for the network ID portion of an IP address. In classful IP addressing, the network ID portion can take only the predefined number of bits 8,16,or 24. In classless addressing, any number of bits can be assigned to the network ID.

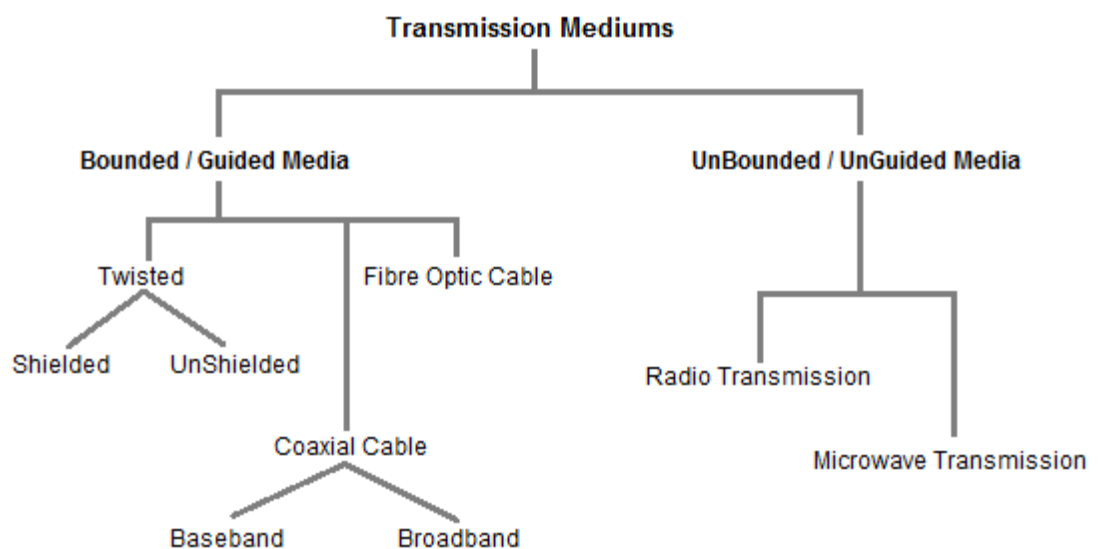
**b.Connectionless communication and Connection-Oriented communication?****Solution**

In connectionless communication there is no need to establish connection between source (sender) and destination (receiver). But in connection-oriented communication connection must established before data transfer.

Connection-oriented communication is more reliable then connectionless communication.

In connection-oriented communication information can be resend if there is an error in missing data, corrupt data etc.). But in connectionless communication it is not possible because the destination does not inform the source about data is received or not.

Connection-oriented communications have higher overhead and place greater demands on bandwidth. But in connectionless communication requires far less overhead than connection-oriented.

**Guided and Unguided transmission Media?****Solution**



**Exercise 23:**

Answer the following Questions?

**Why networking? List the possible topologies of Constructed Networks? Elaborate Solution**

**Sharing of hardware:** Computer hardware resources (Disks, Printers)

**Sharing of software:** Multiple single user licenses are more expensive than multi-user license. Easy maintenance of software.

**Sharing of information:** Several individuals can interact with each other Working in groups can be formed.

**Communication:** (e-mail, internet telephony, audio conferencing video conferencing

**Scalability:** Individual subsystems can be created and combine it into a main system to enhance the overall performance.

**Distributed systems:** In a networked environment computers can distribute the workload among themselves keeping transparency to the end user.

Bus,Star,Mesh,Ring,....

**Exercise :What are the factors involved in serial transmission?****Solution**

The following key factors have to be observed regarding serial transmission:

- **Timing problem:** There should be some mechanism to know when the bit has arrived and at what rate the next bit is going to arrive at the serial input terminal of the receiver. We will see this can be accomplished in two ways.
- **Error detection:** Provision should be made (during transmission itself) to verify the integrity of the received data. Like parity, checksum bits.
- **Error correction:** Ability to correct the data in case of corrupted data reception.

**Exercise :List the Features and Limitations of Repeater?****Solution**

Cannot link unlike segments

Cannot join segments with different access methods (e.g. CSMA/CD and token passing)

Do not isolate and filter packets

Can connect different types of media

The most economic way of expanding networks

**Exercise 24: Answer the following Questions?****a.Explain TCP/IP model?****Solution**

This model consists of four layers

Application Layer

Transport Layer

Network Layer

Data Link and Physical Layer.

In Data representation there are many different forms in which data may be represented. Some of the forms of data used in communications: list and explain briefly?

There are several types of noise sources, which can abruptly (مفاجئ بشكل) affect the quality of reception signal. List these types of noise and explain briefly?

**Exercise 25:**

Fill the following table with appropriate information (2 .5degrees)

<i>IP Address Class</i>	<i>Class A</i>	<i>Class B</i>	<i>Class C</i>
First bit values (binary)			
First byte value (decimal)			
Number of network identifier bits			
Number of host identifier bits			
Number of possible networks			
Number of possible hosts			
Subnet mask			

**Solution**

<i>IP Address Class</i>	<i>Class A</i>	<i>Class B</i>	<i>Class C</i>
First bit values (binary)	<b>0</b>	<b>10</b>	<b>110</b>
First byte value (decimal)	<b>1-127</b>	<b>128-191</b>	<b>192-223</b>
Number of network identifier bits	<b>8</b>	<b>16</b>	<b>24</b>
Number of host identifier bits	<b>24</b>	<b>16</b>	<b>8</b>
Number of possible networks	<b>126</b>	<b>16,384</b>	<b>2,097,152</b>
Number of possible hosts	<b>2,097,152</b>	<b>65,534</b>	<b>254</b>
Subnet mask	<b>255.0.0.0</b>	<b>255.255.0.0</b>	<b>255.255.255.0</b>

**Exercise 20:**

Describe Client/Server technology? Give an example.

**Solution**

**Client/server** describes the relationship between two computer programs in which one program, the client, makes a service request from another program, the server, which fulfills(يستوفي) the request. Although the client/server idea can be used by programs within a single computer, it is a more important idea in a network. In a network, the client/server model provides a convenient way to interconnect programs that are distributed efficiently across different locations. Computer transactions using the client/server model are very common.

List and Explain the Well-known Port Numbers briefly?

**Solution**

- Some port numbers are reserved for some purposes
- Port 21: FTP – file transfer
- Port 25: SMTP – mail transfer
- Port 23: TELNET – remote login
- Port 80: HTTP – Web access

**Exercise 26:**

What means by Value-Added Networks (VAN)?

**Solution**

**Value-added networks (VAN)** are communications networks supplied and managed by third-party companies that facilitate electronic data interchange, Web services and transaction delivery by providing extra networking services.

A **value-added network (VAN)** is a private network provider (sometimes called a turnkey communications line) that is hired by a company to facilitate electronic data interchanges (EDI) or provides other network services.

**Exercise :List and explain Modem Performance Measures?****Solution**

- Baud rate - the number of symbol change per second on the transmission line
- Bit per second (bps) - number of bits transmitted per second
- In the past, they are identical
- With compression technique, a change of signal can mean more than one bits 28.8kbaud can mean 115.2kbps when using V.42bis

**Exercise 27:**

**Find the NetID and the HostID of the following IP addresses:**

- a. 114.34.2.8    b. 132.56.8.6    c. 208.34.54.12    d. 251.34.98.5

**solution**

- a. Class is A → **Netid: 114**                      and **Hostid: 34.2.8**  
 b. Class is B → **Netid: 132.56**                      and **Hostid: 8.6**  
 c. Class is C → **Netid: 208.34.54**                      and **Hostid: 12**  
 d. Class is E → **The address is not divided into netid and hostid.**

**Exercise 28:**

**Write the following mask in slash notation (/n):**

- a. 255.255.255.0    b. 255.0.0.0    c. 255.255.224.0    d. 255.255.240.0

**solution**

**We first change the mask to binary to find the number of 1's:**

- a. 11111111 11111111 11111111 00000000 → /24  
 b. 11111111 00000000 00000000 00000000 → /8  
 c. 11111111 11111111 11100000 00000000 → /19  
 d. 11111111 11111111 11110000 00000000 → /20

**Exercise 29: full the following table by provides additional information**

<i>IP Address Class</i>	<i>Class A</i>	<i>Class B</i>	<i>Class C</i>
<b>First bit values (binary)</b>			
<b>First byte value (decimal)</b>			
<b>Number of network identifier bits</b>			
<b>Number of host identifier bits</b>			
<b>Number of possible networks</b>			
<b>Number of possible hosts</b>			
<b>Subnet mask</b>			

**Solution**

<i>IP Address Class</i>	<i>Class A</i>	<i>Class B</i>	<i>Class C</i>
<b>First bit values (binary)</b>	<b>0</b>	<b>10</b>	<b>110</b>
<b>First byte value (decimal)</b>	<b>1–127</b>	<b>128–191</b>	<b>192–223</b>
<b>Number of network identifier bits</b>	<b>8</b>	<b>16</b>	<b>24</b>
<b>Number of host identifier bits</b>	<b>24</b>	<b>16</b>	<b>8</b>
<b>Number of possible networks</b>	<b>126</b>	<b>16,384</b>	<b>2,097,152</b>
<b>Number of possible hosts</b>	<b>2,097,152</b>	<b>65,534</b>	<b>254</b>
<b>Subnet mask</b>	<b>255.0.0.0</b>	<b>255.255.0.0</b>	<b>255.255.255.0</b>

**Exercise 29 :What is Bridges and how it Works?****Solution**

- Bridges Has one input and one output
- Bridges Used to isolate network traffic and computers
- Bridges Has the intelligent to examine incoming packet source and destination addresses , But cannot interpret higher-level information
- Hence Bridges cannot filter packet according to its protocol

**Bridges Works as:**

- Bridges work at the Media Access Control Sub-layer of the OSI model
- Routing table is built to record the segment no. of address
- If destination address is in the same segment as the source address, stop transmit
- Otherwise, forward to the other segment

**Exercise 30: Explain Coaxial Transmission Characteristics?****Solution**

- Analog signal
  - Amplifiers every few km
  - Closer if higher frequency
  - Up to 500MHz (about 4MHz for each TV channel)
- Digital signal
  - Repeater every 1km or so
  - Closer for higher data rates

**Exercise 31:**

**What is the Subnetwork Address if the destination address is 19.30.80.5 and the mask is 255.255.192.0?**

**Solution**

IP Address									
19	•	30	•	84	•	5			
Mask									
255	•	255	•	192	•	0			
19	•	30	•	64	•	0			
Subnet Address									
84	0	1	0	1	0	1	0	0	0
192	1	1	0	0	0	0	0	0	0
64	0	1	0	0	0	0	0	0	0

**Then subnetwork address is 19.30.64.0**

**Exercise 32:**

**Using Different prefixes for the IP address 172.16.8.0 network starts with /24 and ends with /27 and full the following table with required information?**

Network	Network Address	Host Range	Broadcast Address
172.16.8.0/25	172.16.8.0	172.16.8.1---172.16.8.126	172.16.8.127
172.16.8.0/24	172.16.8.0	172.16.8.1---172.16.8.254	172.16.8.255
172.16.8.0/27	172.16.8.0	172.16.8.1---172.16.8.63	172.16.8.63
172.16.8.0/26	172.16.8.0	172.16.8.1---172.16.8.30	172.16.8.31

**Exercise 33:**

**What are Modem Performance Measures?**

**Solution**

- **Baud rate** - the number of symbol change per second on the transmission line
- **Bit per second (bps)** - number of bits transmitted per second
- **In the past, they are identical**
- **With compression technique**, a change of signal can mean more than one bits 28.8kbaud can mean 115.2kbps when using V.42bis .

**Exercise 34:**

**Given the following Subnet Masks for Class C Addresses Complete the table ?**

Subnet Mask	Subnets	Hosts	Host Total
255.255.255.192	2		
255.255.255.224	6		
255.255.255.240	14		
255.255.255.248	30		
255.255.255.252	62		

**Solution**

Subnet Mask	Subnets	Hosts	Host Total
255.255.255.192 (2bits)	2	$2^n - 2 = 2^6 - 2 = 62$	$2 * 62 = 124$
255.255.255.224(3bits)	6	30	180
255.255.255.240(4bits)	14	14	196
255.255.255.248(5bits)	30	6	180
255.255.255.252(6bits)	62	2	124



### full the following Subnet Short Cut Table

# of Bits	1	2	3	4	5	6	7	8
Incrementing Value								
Subnet Mask								
# of hosts (2 <sup>n</sup> -2)								

#### solution

# of Bits	1	2	3	4	5	6	7	8
Incrementing Value	128	64	32	16	8	4	2	1
Subnet Mask	128	192	224	240	248	252	254	255
# of hosts(2 <sup>n</sup> -2)	0	2	6	14	30	62	126	254

What means by Routing? Explain in details? (in Sheet)

Compare between Asynchronous modems and Synchronous modems? (in Sheet)

List and explain Modem Performance Measures? (in Sheet)

Find the class of the following IP addresses:

a. 208.34.54.12

b. 238.34.2.1

c. 242.34.2.8

d. 119.14.6.8

#### solution

**note** :see ranges of classes in the lecture sheet 3

a. The first byte is 208 (between 192 and 223) → **Class C**

b. The first byte is 238 (between 224 and 299) → **Class D**

c. The first byte is 242 (between 240 and 255) → **Class E**

d. The first byte is 119 (between 000 and 127) → **Class A**

Find the NetID and theHostID of the following IP addresses:

a. 114.34.2.8

b. 132.56.8.6

c. 208.34.54.12

d. 251.34.98.5

#### solution

a. Class is A → **netid: 114** and **hostid: 34.2.8**

b. Class is B → **netid: 132.56** and **hostid: 8.6**

c. Class is C → **netid: 208.34.54** and **hostid: 12**

d. Class is E → **The address is not divided into netid and hostid.**

Write the following mask in slash notation (/n):

a. 255.255.255.0

b. 255.0.0.0

c. 255.255.224.0

d. 255.255.240.0

### solution

We first change the mask to binary to find the number of 1's:

a. 11111111 11111111 11111111 00000000 → /24

b. 11111111 00000000 00000000 00000000 → /8

c. 11111111 11111111 11100000 00000000 → /19

d. 11111111 11111111 11110000 00000000 → /20

fill the following table by provides additional information about each of the address classes, including the value of the first binary bits and the first decimal byte in each class. The value of the first bits and first byte that you use to determine the class of a particular network address. The table also must specifies the number of bits in the network and host identifiers for each class, as well as the number of possible addresses you can create with each identifier?

IP Address Class	Class A	Class B	Class C
First bit values (binary)			
First byte value (decimal)			
Number of network identifier bits			
Number of host identifier bits			
Number of possible networks			
Number of possible hosts			
Subnet mask			

### Solution

IP Address Class	Class A	Class B	Class C
First bit values (binary)	0	10	110
First byte value (decimal)	1–127	128–191	192–223
Number of network identifier bits	8	16	24
Number of host identifier bits	24	16	8
Number of possible networks	126	16,384	2,097,152
Number of possible hosts	2,097,152	65,534	254
Subnet mask	255.0.0.0	255.255.0.0	255.255.255.0

What is Bridges and how it Works?

### Solution

- Bridges Has one input and one output
- Bridges Used to isolate network traffic and computers
- Bridges Has the intelligent to examine incoming packet source and destination addresses , But cannot interpret higher-level information
- Hence Bridges cannot filter packet according to its protocol



**Bridges Works as:**

- Bridges work at the Media Access Control Sub-layer of the OSI model
- Routing table is built to record the segment no. of address
- If destination address is in the same segment as the source address, stop transmit
- Otherwise, forward to the other segment

Compare between Asynchronous modems and Synchronous modems?

**Solution**

- Asynchronous modems are relatively simple and economic
- Large overhead - can be up to 20 to 27% of the data traffic
- Error control is done by using parity bit or higher layer protocols, e.g. MNP, V.42
- Synchronous modems are relatively complicated and expensive
- Seldom use in home market
- Less overhead means higher efficiency
- More sophisticated error control protocol is required G

What is the subnetwork address if the destination address is 19.30.80.5 and the mask is 255.255.192.0?

**Solution**

IP Address									
19	•	30	•	84	•	5			
Mask									
255	•	255	•	192	•	0			
19	•	30	•	64	•	0			
Subnet Address									
<div>↓</div>									
84	0	1	0	1	0	1	0	0	
192	1	1	0	0	0	0	0	0	
64	0	1	0	0	0	0	0	0	

Then subnetwork address is 19.30.64.0

Using Different prefixes for the IP address 172.16.8.0 network starts with /24 and ends with /27 and full the following table with required information?

Network	Network Address	Host Range	Broadcast Address
172.16.8.0/25			
172.16.8.0/24			
172.16.8.0/27			
172.16.8.0/26			

الحل موجود في الملزمة في موضوع (البريفكس /)

### What are Modem Performance Measures?

#### Solution

- **Baud rate** - the number of symbol change per second on the transmission line
- **Bit per second (bps)** - number of bits transmitted per second
- In the past, they are identical
- With compression technique, a change of signal can mean more than one bits  
28.8kbaud can mean 115.2kbps when using V.42bis .

Given the following Subnet Masks for Class C Addresses Complete the table ?

Subnet Mask	Subnets	Hosts	Host Total
255.255.255.192	2		
255.255.255.224	6		
255.255.255.240	14		
255.255.255.248	30		
255.255.255.252	62		

#### Solution

Subnet Mask	Subnets	Hosts	Host Total
255.255.255.192	2	62	124
255.255.255.224	6	30	180
255.255.255.240	14	14	196
255.255.255.248	30	6	180
255.255.255.252	62	2	124

توضيح ( حل الصف الأول)

192 يعني اني مستعير (2بت) من البايت الأخير قيمها (64+128) على سبيل المثال (001000 1 1)  
 اذا عدد البتات المخصصة لعنوان الشبكة هو (2)  
 عدد البتات المخصص للهوست هو (6)  
 اذا نطبق القانون

$$2^n = 2^2 = 4 \text{ no. of subnets}$$

عدد البتات المتبقية هو ستة

$$2^n - 2 = 2^6 - 2 = 62 \text{ no. of hosts in each subnet}$$

اني رايد عدد الهوست بس شبكتين فقط من الأربعة

$$\text{Hence: } 2 * 62 = 124 \text{ host total}$$

البقية نفس الشيء

What is the subnetwork address if the destination address is 200.45.34.56 and the subnet mask is 255.255.240.0?

### Solution

11001000 00101101 00100010 00111000

11111111 11111111 11110000 00000000

11001000 00101101 00100000 00000000

The subnetwork address is 200.45.32.0.

### Other Solution

We apply the AND operation on the address and the subnet mask.

Address (200.45.34.56)                      ➡ 11001000 00101101 00100010 00111000

Subnet Mask (255.255.240.0 )           ➡ 11111111 11111111 11110000 00000000

Subnetwork Address                        ➡ 11001000 00101101 00100000 00000000.

1. Compare between the following? .
  1. Synchronous modems and Asynchronous modems?
  2. Half Duplex and Full Duplex Modes of Communication?
2. What is the principal difference between?
  - a. Classless and Classfull in IP addresses?
  - b. Guided and Unguided transmission Media?
3. Branch A: Answer the following Questions?
  1. Why networking? [List the possible topologies of Constructed Networks?](#) Elaborate
  2. List the Features and Limitations of Repeater?
    - a. Explain OSI model? Briefly.
    - b. What Means by Multiplexing? List their types of Multiplexing?
4. Branch A: Fill the following table with appropriate information ?

IP Address Class	Class A	Class B	Class C
First bit values (binary)			
First byte value (decimal)			
Number of network identifier bits			
Number of host identifier bits			
Number of possible networks			
Number of possible hosts			
Subnet mask			

- 5.: Answer the following questions?
  1. What means by Routing? Explain in details?
  2. A network must be able to meet a certain number of criteria. List and Explain?
6. Answer the following questions?
  1. Describe data communications system components?
  2. List the effectiveness of a data communications system depends on fundamental characteristics?

=====

Which of the following can be the beginning address of a block that contains 16 addresses?

- a.205.16.37.32      b.190.16.42.44      c.17.17.33.80      d.123.45.24.52

solution

The address 205.16.37.32 is eligible because 32 is divisible by 16. The address 17.17.33.80 is eligible because 80 is divisible by 16.

8. A small organization is given a block with the beginning address and the prefix length 205.16.37.24/29 (in slash notation). What is the range of the block?

**Solution**

**The beginning address is 205.16.37.24.**

- ✓ To find the last address we keep the first 29 bits and change the last 3 bits to 1s.
- Beginning: 11001111 00010000 00100101 00011000
- Ending : 11001111 00010000 00100101 00011111
- ✓ There are only 8 addresses in this block.

Other solution We can argue that the length of the suffix is 32 - 29 or 3. So there are  $2^3 = 8$  addresses in this block. If the first address is 205.16.37.24, the last address is 205.16.37.31 ( $24 + 7 = 31$ ).

9. An organization is granted the block 130.34.12.64/26. The organization needs to have four subnets. What are the subnet addresses and the range of addresses for each subnet?

**Solution**

The suffix length is 6 (32-26).

- This means the total number of addresses in the block is 64 ( $2^6$ ).
- If we create four subnets, each subnet will have 16 addresses.
- Let us first find the subnet prefix (subnet mask).
- We need four subnets, which means we need to add two more 1s to the site prefix.

The subnet prefix is then /28.

Subnet 1: 130.34.12.64/28 to 130.34.12.79/28.

Subnet 2 : 130.34.12.80/28 to 130.34.12.95/28.

Subnet 3: 130.34.12.96/28 to 130.34.12.111/28.

Subnet 4: 130.34.12.112/28 to 130.34.12.127/28.

10. An ISP is granted a block of addresses starting with 190.100.0.0/16. The ISP needs to distribute these addresses to three groups of customers as follows:

1. The first group has 64 customers; each needs 256 addresses.
2. The second group has 128 customers; each needs 128 addresses.
3. The third group has 128 customers; each needs 64 addresses.

Design the subblocks and give the slash notation for each subblock.

Find out how many addresses are still available after these allocations.

**Solution****Group 1**

For this group, each customer needs 256 addresses.

This means the suffix length is 8 ( $2^8 = 256$ ). The prefix length is then  $32 - 8 = 24$ .

01: 190.100.0.0/24 ----->190.100.0.255/24

02: 190.100.1.0/24 ----->190.100.1.255/24

.....

64: 190.100.63.0/24 ----->190.100.63.255/24

Total =  $64 * 256 = 16,384$

**Group 2**

For this group, each customer needs 128 addresses

This means the suffix length is 7 ( $2^7 = 128$ ). The prefix length is then  $32 - 7 = 25$ .

The addresses are:

001: 190.100.64.0/25 ----->190.100.64.127/25

002: 190.100.64.128/25 ----->190.100.64.255/25

.....

128: 190.100.127.128/25 ----->190.100.127.255/25

Total =  $128 * 128 = 16,384$

**Group 3**

For this group, each customer needs 64 addresses. This means the suffix length is 6 ( $2^6 = 64$ ). The prefix length is then  $32 - 6 = 26$ .

001:190.100.128.0/26 ----->190.100.128.63/26

002:190.100.128.64/26 ----->190.100.128.127/26

.....

128:190.100.159.192/26 ----->190.100.159.255/26

Total =  $128 * 64 = 8,192$

11. identify which of the addresses below are correct and usable. If they are not usable addresses explain why?

a. IP Address: 0.230.190.192

Subnet Mask: 255.0.0.0

b. IP Address: 192.10.10.1

Subnet Mask: 255.255.255.0

**Solution**

IP Address: 0.230.190.192

Subnet Mask: 255.0.0.0

The network ID cannot be 0.

IP Address: 192.10.10.1

Subnet Mask: 255.255.255.0

OK

## 12. Using Class C Addressing Guide ,Full the Following Table with necessary Information?

CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/24					
/25					
/26					
/27					
/28					
/29					
/30					

### Solution

Class C Addressing Guide					
CIDR	# of Bits Borrowed	Subnet Mask	Total # of Subnets	Total # of Hosts	Usable # of Hosts
/24	0	255.255.255.0	1	256	254
/25	1	255.255.255.128	2	128	126
/26	2	255.255.255.192	4	64	62
/27	3	255.255.255.224	8	32	30
/28	4	255.255.255.240	16	16	14
/29	5	255.255.255.248	32	8	6
/30	6	255.255.255.252	64	4	2

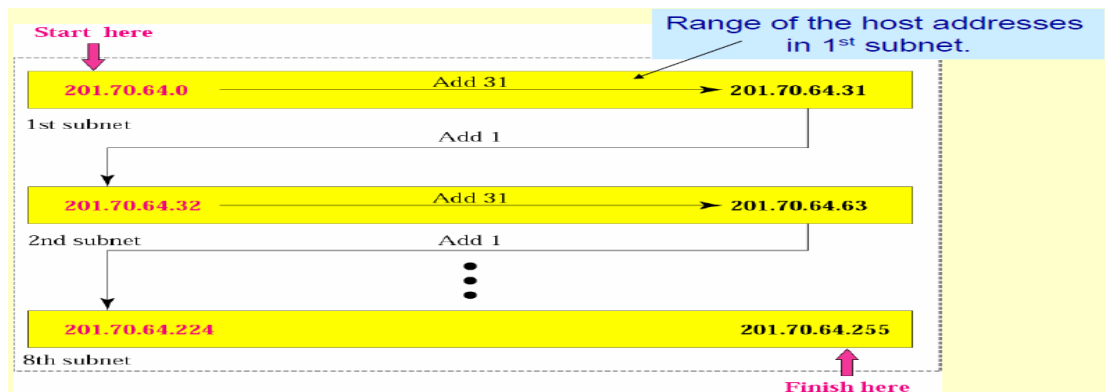
## 13. A company is granted the site address 201.70.64.0 The company needs six subnets. Design the subnets?

### Solution

Company can have 8 subnets (not six)  
The given IP is class C, therefore we consider only the last byte. Subnets:

00000000	→	201.70.64.0
00100000	→	201.70.64.32
01000000	→	201.70.64.64
01100000	→	201.70.64.96
11000000	→	201.70.64.192
11100000	→	201.70.64.224

Subnet mask = 255.255.255.224



## 14. A company needs 1000 addresses. Which of the following set of class C blocks can be used to form a supernet for this company?

- 198.47.32.0 198.47.33.0 198.47.34.0
- 198.47.32.0 198.47.42.0 198.47.52.0 198.47.62.0
- 198.47.31.0 198.47.32.0 198.47.33.0 198.47.52.0
- 198.47.32.0 198.47.33.0 198.47.34.0 198.47.35.0

**15. If Network address is 148.75.0.0 /26, Find the following?  
Address class, Default subnet mask, Custom subnet mask, Total number of subnets, Total number of host addresses, Number of usable addresses and Number of bits borrowed.**

**Solution(Custom Subnet Masks)**

Network Address	148.75.0.0 /26	<small>(/26 indicates the total number of bits used for the network and subnetwork portion of the address. All bits remaining belong to the host portion of the address.)</small>
Address class	B	
Default subnet mask	255 . 255 . 0 . 0	
Custom subnet mask	255 . 255 . 255 . 192	
Total number of subnets	1,024	
Total number of host addresses	64	
Number of usable addresses	62	
Number of bits borrowed	10	

**16. if Number of needed subnets 14 ,Number of needed usable hosts 14 and Network Address 192.10.10.0 , So, Find the following?**  
 a. What is the 4<sup>th</sup> subnet range?    b. What is the subnet number for the 8<sup>th</sup> subnet?  
 c. What is the subnet broadcast address for the 13<sup>th</sup> subnet?  
 d. What are the assignable addresses for the 9<sup>th</sup> subnet?

**Solution(Subnet )**

What is the 4th subnet range?	192.10.10.48 to 192.10.10.63
What is the subnet number for the 8th subnet?	192 . 10 . 10 . 112
What is the subnet broadcast address for the 13th subnet?	192 . 10 . 10 . 207
What are the assignable addresses for the 9th subnet?	192.10.10.129 to 192.10.10.142

**17. if Number of needed subnets 1000 ,Number of needed usable hosts 60 and Network Address 165.100.0.0, So, Find the following?**

What is the 15<sup>th</sup> subnet range?

What is the subnet number for the 6<sup>th</sup> subnet?

What is the subnet broadcast address for the 6<sup>th</sup> subnet?

What are the assignable addresses for the 9<sup>th</sup> subnet?

**Solution(Subnet )**

What is the 15th subnet range?	165.100.3.128 to 165.100.3.191
What is the subnet number for the 6th subnet?	165 . 100 . 1 . 64
What is the subnet broadcast address for the 6th subnet?	165 . 100 . 1 . 127
What are the assignable addresses for the 9th subnet?	165.100.2.1 to 165.100.0.62

18. You have sub-netted your class C network 192.168.1.0 with a subnet mask of 255.255.255.240. Please list the following: number of networks, number of hosts per network, the full range of the first three networks, and the usable address range from those first three networks.

**Solution**

*Number of networks = 16 --  $\rightarrow (2^n) = 2^4$*

*Number of hosts = 14 ----  $\rightarrow 16(2^n - 2) = 2^4 - 2$*

*Full Range for first three networks:*

*192.168.1.0-15*

*192.168.1.16-31*

*192.168.1.32-47*

*Usable Range for first three networks:*

*192.168.1.1-14*

*192.168.1.17-30*

*192.168.1.33-46*

**19. Answer the following equations**

1. You have the following address: 192.16.5.133/29. how many total bits are being used to identify the network, and how many total bits identify the host?

**Solution:** 29 bits identify the network, 3 bits identify the host.

2. What is the full subnet mask for address 172.16.5.10/28?

**Solution:** 255.255.255.240

3. You currently use the default mask for your IP network 192.168.1.0. You need to subnet your network so that you have 30 additional networks, and 4 hosts per network. Is this possible, and what subnet mask should you use?

**Solution :** Yes it is possible, using subnet mask 255.255.255.248.

4. You still are using the default mask for your IP network 192.168.1.0. You need to subnet your network so that you have 5 additional networks, and 60 hosts per network. Is this possible, and what subnet mask should you use?

**Solution:** No, it is not possible.

20. You have sub-netted your class C network 200.138.1.0 with a subnet mask of 255.255.255.252. Please list the following: number of networks, number of hosts per network, the full range of the first three networks, and the usable address range from those first three networks. Additionally, identify the broadcast addresses for each network?

**Solution**

*Number of networks = 64, Number of hosts = 2*

*Full Range for first three networks:*

*200.138.1.0-3*

*200.138.1.4-7*

*200.138.1.8-11*

*Usable Range for first three networks:*

*200.138.1.1-2*

*200.138.1.5-6*

*200.138.1.9-10*

*Broadcast Addresses for first three networks:*

*200.138.1.3*

*200.138.1.7*

*200.138.1.11*



21. If Number of needed subnets 14, Number of needed usable hosts 14 and Network Address 192.10.10.0 , So, find the following?

Address class, Default subnet mask, Custom subnet mask, Total number of subnets, Total number of host addresses, Number of usable addresses and Number of bits borrowed.

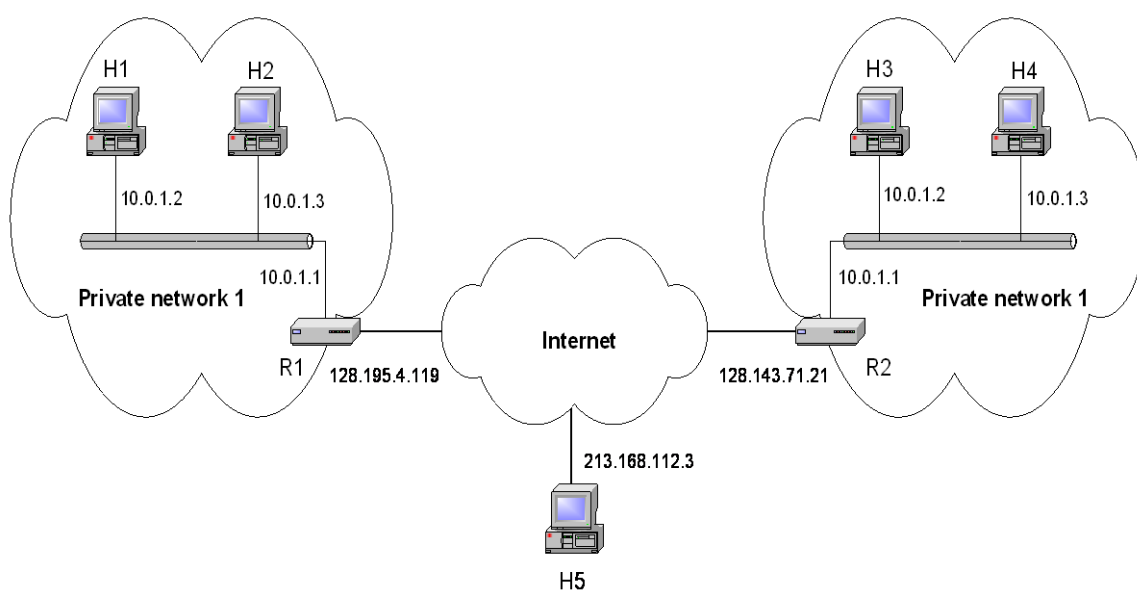
**Solution(Custom Subnet Masks)**

Address class	<u>C</u>
Default subnet mask	<u>255 . 255 . 255 . 0</u>
Custom subnet mask	<u>255 . 255 . 255 . 240</u>
Total number of subnets	<u>16</u>
Total number of host addresses	<u>16</u>
Number of usable addresses	<u>14</u>
Number of bits borrowed	<u>4</u>

22. What is Private Network? Explain Private Addresses with example?

**Solution**

- **Private IP network** is an IP network that is not directly connected to the Internet
- IP addresses in a private network can be assigned arbitrarily.
  - Not registered and not guaranteed to be globally unique
- Generally, private networks use addresses from the following experimental address ranges (*non-routable addresses*):
  - 10.0.0.0 – 10.255.255.255
  - 172.16.0.0 – 172.31.255.255
  - 192.168.0.0 – 192.168.255.255



**23.\ Is Network Address Translation (NAT) Problem or solution of Problem? If it is solution, explain its roles? If it is problem, explain the cause?**

**Solution**

- A short term solution to the problem of the depletion of IP addresses
  - Long term solution is IP v6
  - CIDR (Classless InterDomain Routing ) is a possible short term solution
  - NAT is another
- NAT is a way to conserve IP addresses
  - Can be used to hide a number of hosts behind a single IP address
  - Uses private addresses:
    - 10.0.0.0-10.255.255.255,
    - 172.16.0.0-172.32.255.255 or
    - 192.168.0.0-192.168.255.255
- NAT is a router function where IP addresses (and possibly port numbers) of IP datagrams are replaced at the boundary of a private network
- NAT is a method that enables hosts on private networks to communicate with hosts on the Internet
- NAT is run on routers that connect private networks to the public Internet, to replace the IP address-port pair of an IP packet with another IP address-port pair.
- NAT provides transparent and bi-directional connectivity between networks having arbitrary addressing schemes
- NAT eliminates costs associated with host renumbering
- NAT conserves IP addresses
- NAT eases IP address management
- NAT enhances network privacy

**24. A: Full the Following Table with appropriate Information of IP Address Classes**

Address Class	1 <sup>ST</sup> Octet range decimal	1 <sup>st</sup> octet Bits	Network(N) and host(H) Part of address	Default Sunet mask decimal and binary	Number of possible Networks and Hosts Per Sub net
A					
B					
C					
D					
E					

Solution

=====

IP Address Classes

Address Class	1st octet range (decimal)	1st octet bits (green bits do not change)	Network(N) and Host(H) parts of address	Default subnet mask (decimal and binary)	Number of possible networks and hosts per network
A	1-127 <sup>**</sup>	00000000-01111111	N.H.H.H	255.0.0.0	128 nets ( $2^7$ ) 16,777,214 hosts per net ( $2^{24-2}$ )
B	128-191	10000000-10111111	N.N.H.H	255.255.0.0	16,384 nets ( $2^{14}$ ) 65,534 hosts per net ( $2^{16-2}$ )
C	192-223	11000000-11011111	N.N.N.H	255.255.255.0	2,097,150 nets ( $2^{21}$ ) 254 hosts per net ( $2^{8-2}$ )
D	224-239	11100000-11101111	NA (multicast)		
E	240-255	11110000-11111111	NA (experimental)		

<sup>\*\*</sup> All zeros (0) and all ones (1) are invalid hosts addresses.

**25.** Given the following Subnet Masks for Class C Addresses Complete the table ?

Subnet Mask	Subnets	Hosts	Host Total
255.255.255.192	3		
255.255.255.224	5		
255.255.255.240	12		
255.255.255.248	20		
255.255.255.252	62		

**26.** What is the subnetwork address if the destination address is 200.45.34.56 and the subnet mask is 255.255.240.0?

**Solution**

You must convert both addresses to binary and make ANDING

**27.:** Compare between the following? Choose Only Two.

**1. TCP and UDP protocols?**

**Solution**

TCP is a connection oriented but UDP Connectionless

**2. Synchronous modems and Asynchronous modems?**

**Solution**

**Asynchronous modems** are relatively simple and economic

- Large overhead - can be up to 20 to 27% of the data traffic
- Error control is done by using parity bit or higher layer protocols, e.g. MNP, V.42
- **Synchronous modems** are relatively complicated and expensive
- Seldom use in home market
- Less overhead means higher efficiency
- More sophisticated error control protocol is required

### 3. Bridges and Routers?

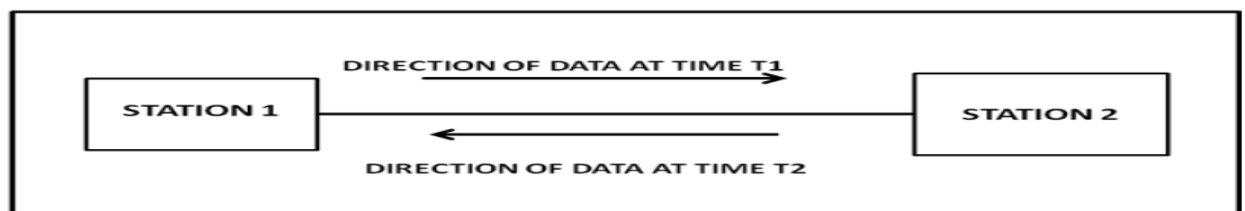
**Solution**

**Bridges are layer 2** devices which look at the MAC sublayer node address

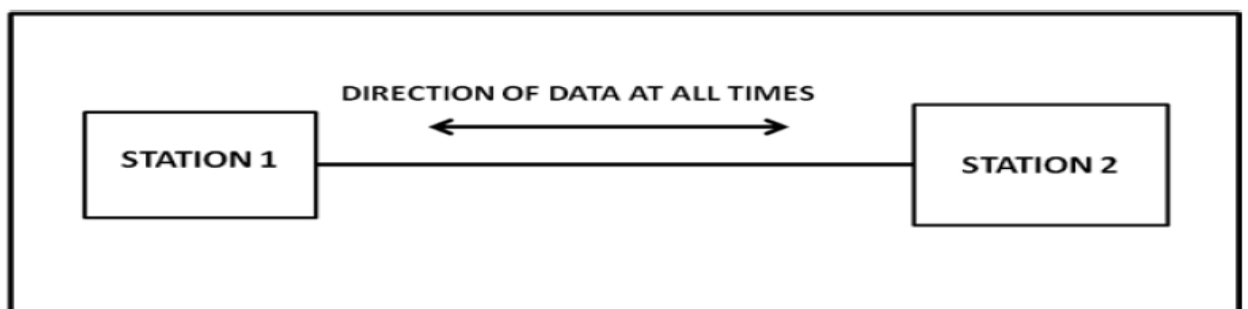
#### 4. Half Duplex and Full Duplex Modes of Communication?

**Solution**

##### 1. Half duplex



**Full Duplex**



What are the principal differences between? Choose only two (2 .5degrees)

#### c. Classless and Classfull in IP addresses?

**Solution**

- The difference between classful IP addressing and classless IP addressing is in selecting the number of bits used for the network ID portion of an IP address. In classful IP addressing, the network ID portion can take only the predefined number of bits 8,16,or 24. In classless addressing, any number of bits can be assigned to the network ID.

#### e. Connectionless communication and Connection-Oriented communication?

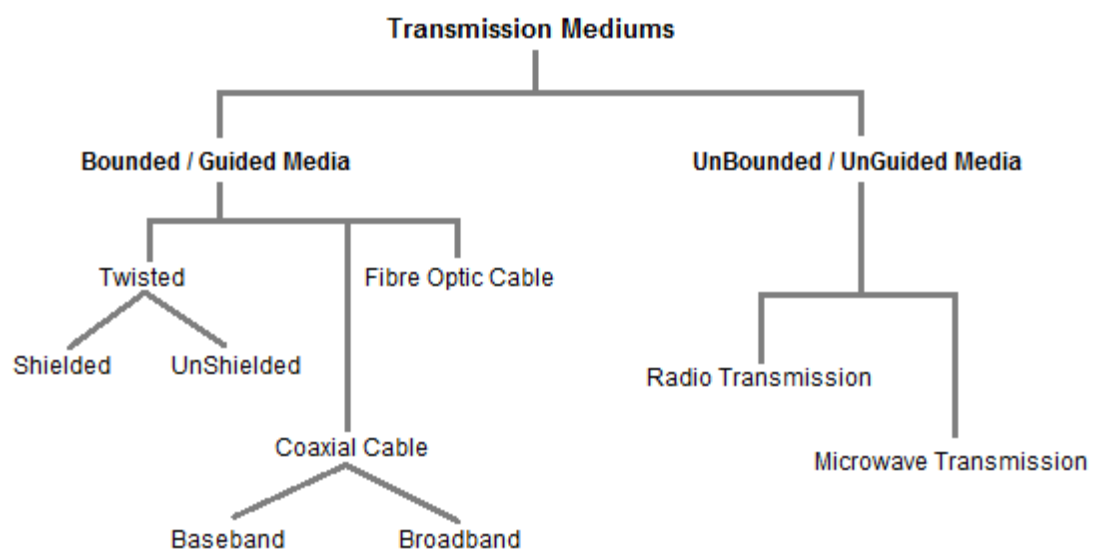
**Solution**

=====

1. In connectionless communication there is no need to establish connection between source (sender) and destination (receiver). But in connection-oriented communication connection must be established before data transfer.
2. Connection-oriented communication is more reliable than connectionless communication.
3. In connection-oriented communication information can be resent if there is an error in missing data, corrupt data etc.). But in connectionless communication it is not possible because the destination does not inform the source about data is received or not.
4. Connection-oriented communications have higher overhead and place greater demands on bandwidth. But in connectionless communication requires far less overhead than connection-oriented.

f. **Guided and Unguided transmission Media?**

**Solution**



**Answer the following Questions? Choose only two?**

**Why networking? List the possible topologies of Constructed Networks? Elaborate**

**Solution**

1. **Sharing of hardware:** Computer hardware resources (Disks, Printers)
2. **Sharing of software:** Multiple single user licenses are more expensive than multi-user license. Easy maintenance of software.
3. **Sharing of information:** Several individuals can interact with each other. Working in groups can be formed.
4. **Communication:** (e-mail, internet telephony, audio conferencing, video conferencing)
5. **Scalability:** Individual subsystems can be created and combined into a main system to enhance the overall performance.

- 6. Distributed systems:** In a networked environment computers can distribute the workload among themselves keeping transparency to the end user.  
Bus,Star,Mesh,Ring,....

### 3. What are the factors involved in serial transmission?

#### Solution

The following key factors have to be observed regarding serial transmission:

- **Timing problem:** There should be some mechanism to know when the bit has arrived and at what rate the next bit is going to arrive at the serial input terminal of the receiver. We will see this can be accomplished in two ways.
- **Error detection:** Provision should be made (during transmission itself) to verify the integrity of the received data. Like parity, checksum bits.
- **Error correction:** Ability to correct the data in case of corrupted data reception.

### 4. List the Features and Limitations of Repeater?

#### Solution

1. Cannot link unlike segments
2. Cannot join segments with different access methods (e.g. CSMA/CD and token passing)
3. Do not isolate and filter packets
4. Can connect different types of media
5. The most economic way of expanding networks

Answer the following Questions? Choose only two.

#### a.Explain TCP/IP model?

#### Solution

This model consists of four layers

1. Application Layer
  2. Transport Layer
  3. Network Layer
  4. Data Link and Physical Layer.
- c. In Data representation there are many different forms in which data may be represented. Some of the forms of data used in communications: list and explain briefly?
- d. There are several types of noise sources, which can abruptly (مفاجئ بشكل) affect the quality of reception signal. List these types of noise and explain briefly?

Fill the following table with appropriate information?

IP Address Class	Class A	Class B	Class C
First bit values (binary)			
First byte value (decimal)			
Number of network identifier bits			
Number of host identifier bits			
Number of possible networks			
Number of possible hosts			
Subnet mask			

**Solution**

<i>IP Address Class</i>	<i>Class A</i>	<i>Class B</i>	<i>Class C</i>
First bit values (binary)	0	10	110
First byte value (decimal)	1–127	128–191	192–223
Number of network identifier bits	8	16	24
Number of host identifier bits	24	16	8
Number of possible networks	126	16,384	2,097,152
Number of possible hosts	2,097,152	65,534	254
Subnet mask	255.0.0.0	255.255.0.0	255.255.255.0

**Answer the following questions?**

1. Describe Client/Server technology? Give an example.

**Solution**

**Client/server** describes the relationship between two computer programs in which one program, the client, makes a service request from another program, the server, which fulfills (يستوفي) the request. Although the client/server idea can be used by programs within a single computer, it is a more important idea in a network. In a network, the client/server model provides a convenient way to interconnect programs that are distributed efficiently across different locations. Computer transactions using the client/server model are very common.

**List and Explain the Well-known Port Numbers briefly?****Solution**

- Some port numbers are reserved for some purposes
- Port 21: FTP – file transfer
- Port 25: SMTP – mail transfer
- Port 23: TELNET – remote login
- Port 80: HTTP – Web access

**Answer the following questions?**

3. What means by Value-Added Networks (VAN)?

**Solution**

**Value-added networks (VAN)** are communications networks supplied and managed by third-party companies that facilitate electronic data interchange, Web services and transaction delivery by providing extra networking services.

A **value-added network (VAN)** is a private network provider (sometimes called a turnkey communications line) that is hired by a company to facilitate electronic data interchanges (EDI) or provides other network services.

4. List and explain Modem Performance Measures?

**Solution**

- Baud rate - the number of symbol change per second on the transmission line
- Bit per second (bps) - number of bits transmitted per second
- In the past, they are identical
- With compression technique, a change of signal can mean more than one bits 28.8kbaud can mean 115.2kbps when using V.42bis