K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SET: A

USN										

Degree : B.E
Branch : AI&ML
Course Title : Computer Networks
Duration : 60 Minutes

Semester : 5
Course Type / Code : IPCC/21CS52
Date : 02/01/2024
Max Marks : 20

Note: Answer **ONE full** question from each part.
K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
(a)	**Construct** Metropolitan Area Network with a neat labelled diagram.	4	CO1	K3
(b)	**Obtain** the relationship between protocols, services and layers with a neat diagram.	4	CO1	K3
(c)	**Explain** Twisted Pair Cable with diagram.	4	CO1	K2
	OR			
2(a)	**Explain** OSI model with a neat diagram in detail	8	CO1	K2
(b)	**Discuss** electromagnetic spectrum with a neat diagram.	4	CO1	K2
	PART –B			
3(a)	**Choose** the differences between unacknowledged service and acknowledged service in wireless medium	4	CO2	K3
(b)	**Identify** the various design issues of data link layer.	4	CO2	K3
	OR			
(a)	**Write a note** on Flag bytes with byte stuffing in framing with examples	4	CO2	K2
(b)	**Calculate** the error correcting code for the data given below: Data=1001 Redundant bits=3 If the sender sends the original data in the communication network, then towards receiver if the error occurred at 5th position. Find the error using error detection technique.	4	CO2	K3

USHA CR
Name & Signature of Course In charge

Renuka Patil
Name & Signature of Module Coordinator

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K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
FIRST INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SET: B

USN										

Degree : B.E
Branch - Stream : AIML
Course Title : Computer Networks
Duration : 60 Minutes

Semester : V
Course Type / Code : IPCC/21CS52
Date : 02/01/2024
Max Marks : 20

Note: Answer **ONE full** question from each part.
K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	**Build** Wide Area Network using diagram with respect to ISP Network	4	CO1	K3
(b)	**Choose** the differences between connection oriented and connection less protocol.	4	CO1	K3
(c)	**Explain** how the light transmitted through Fiber optics with diagram?	4	CO1	K2
	OR			
2(a)	**Explain** a TCP/IP Protocol suite with neat diagram and explain in detail	8	CO1	K2
(b)	**Discuss** radio transmission and microwave transmission.	4	CO1	K2
	PART –B			
3(a)	**Demonstrate** character count in framing with examples	4	CO2	K2
(b)	**Construct** Flag bytes with bit stuffing in framing method with examples	4	CO2	K3
	OR			
4(a)	**Discuss** simplex stop and wait protocol with pseudocode.	4	CO2	K2
(b)	**Solve** the character encoding used in DL Protocol: **A:11010101 B:10101001 FLAG:01111110 ESC:10100011**. Show the bit sequence transmitted (in binary) for the five-character frame: **A ESC B ESC FLAG** when each of the following framing methods are used: a) Flag bytes with byte stuffing b) starting and ending flag bytes with bit stuffing.	4	CO2	K3

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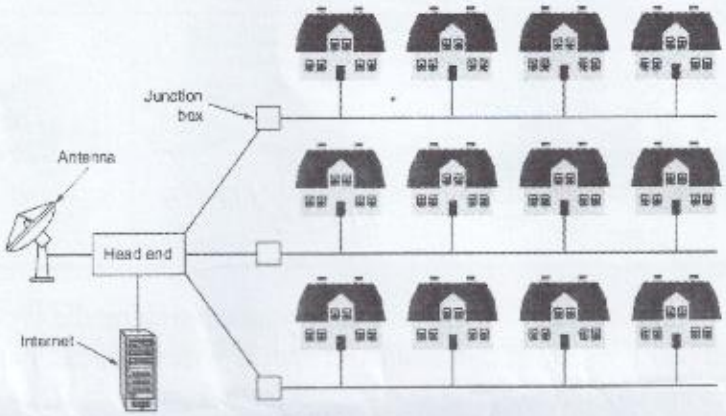
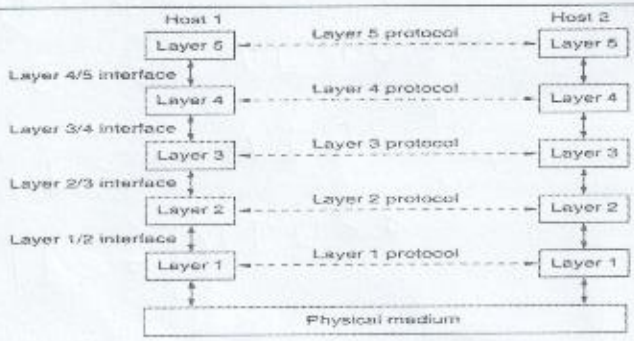
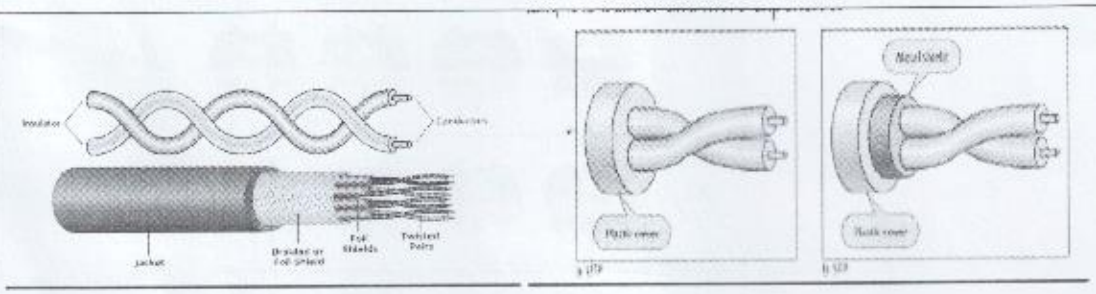
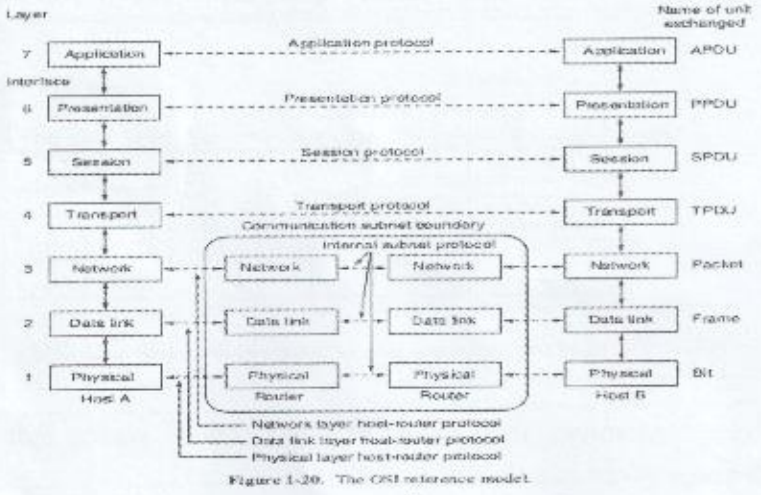
K.S. INSTITUTE OF TECHNOLOGY, BANGALORE -560109
I SESSIONAL TEST QUESTION PAPER 2023 – 24 ODD SEMESTER

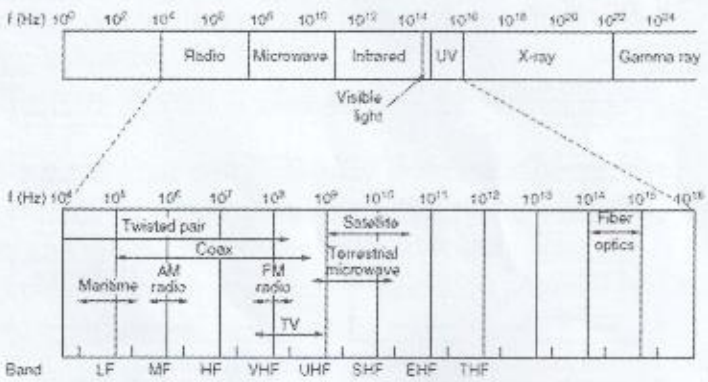
SCHEME AND SOLUTION(SET A)

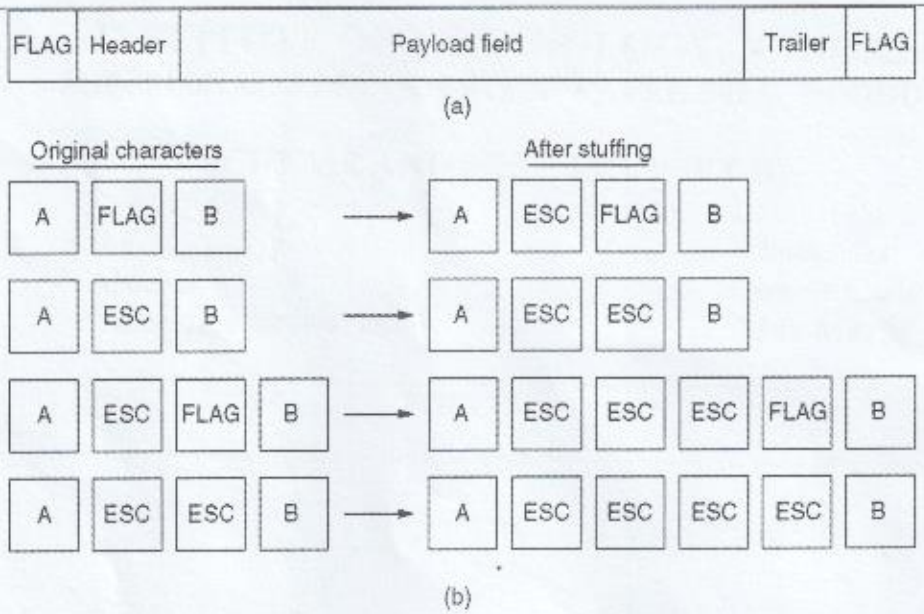
Degree	**: B.E**	**Semester :**	**V**
Branch	**: AI&ML**	**Course Code :**	**21CS52**
Course Title	**: Computer Networks**	**Max Marks :**	**20**

Q.NO.	POINTS	MARKS
1(a)	 Figure 1-9. A metropolitan area network based on cable TV. • A **MAN (Metropolitan Area Network)** covers a city. The best-known examples of MANs are the cable television networks available in many cities. • In this figure we see both television signals and Internet being fed into the centralized **cable head end** for subsequent distribution to people's homes. • When the Internet began attracting a mass audience, the cable TV network operators began to realize that with some changes to the system, they could provide two-way Internet service in unused parts of the spectrum.	2M+2M
(b)	 Layers, protocols and Interfaces. • A protocol is a set of rules for formatting and processing data. • A protocol is an agreement between the communicating parties on how communication is to proceed. • Most networks are organized as a series of layers or levels, each one built on its predecessor. This reduces design complexity.	2M+2M

	• Each layer offers certain services to higher layers, hiding details of how the services are implemented. • No data is transferred directly from n layer of one machine to n layer of another machine . • Between each pair of adjacent layers is an interface. The interface defines which primitive operations and services the lower layer makes available to the upper one. • A set of layers and protocols is called a network architecture. • A list of the protocols used by a certain system, one protocol per layer, is called a protocol stack. • Below layer 1 is the physical medium through which actual communication occurs.	
(c)	 • One of the oldest and still most common transmission media is twisted pair. • A twisted pair consists of two insulated copper wires, typically about 1 mm thick. • The wires are twisted together in a helical form, just like a DNA molecule. • Twisting is done because two parallel wires constitute a fine antenna. • When the wires are twisted, the waves from different twists cancel out, so the wire radiates less effectively. • The most common application of the twisted pair is the telephone system. • Twisted pairs can be used for transmitting either analog or digital information	**2M+2M**

a)	• Listing all the layers  Figure 1-20. The OSI reference model. **The Physical Layer** • The physical layer is concerned with transmitting raw bits over a communication channel. • The design issues have to do with making sure that when one side **The Data Link Layer** • The data link layer is responsible for moving frames from one hop (node) to the next. • It accomplishes this task by having the sender break up the input data into **data frames** (typically a few hundred or a few thousand bytes) and transmit the frames sequentially. **The Network Layer** • The network layer controls the operation of the subnet. • The network layer is responsible for the delivery of individual packets from the source host to the destination host. **The Transport Layer** • The transport layer is responsible for the delivery of a message from one process to another. • The basic function of the transport layer is to accept data from above it, split it up into smaller units if needed, pass these to the network layer, and ensure that the pieces all arrive correctly at the other end. **The Session Layer** • The session layer is responsible for establishing, managing, and terminating connections between applications at each end of the communication. • The layer allows users on different machines to establish sessions between them.	3M+5M

(b)	 Figure 2-10. The electromagnetic spectrum and its uses for communication. • When electrons move, they create electromagnetic waves that can propagate through space (even in a vacuum). • The number of oscillations per second of a wave is called its frequency, f, and is measured in Hz. • The distance between two consecutive maxima (or minima) is called the Wavelength. • In a vacuum, all electromagnetic waves travel at the same speed, no matter what their frequency. • This speed, usually called the speed of light, c, is approximately 3 × 108 m/sec,	2M
3(a)	**Unacknowledged** • Independent frames • No logical connections. • Error rate should be low • Recovery left to higher layers • Used on LANs **Acknowledged** • No connection • Acknowledgement for each frame • Resending • Ack is optimisation; also transport layer can handle errors	2M+2M
(b)	**Data Link Layer Design Issues** Physical layer delivers bits of information to and from data link layer. The functions of Data Link Layer are: • Providing a well-defined service interface to the network layer. • Dealing with transmission errors. • Regulating the flow of data so that slow receivers are not swamped by fast senders. To accomplish these task, data link layer • Takes the packets from Physical layer, and Encapsulates them into frames for transmission. • Each frame has a frame header - a field for holding the packet and frame trailer. • Frame Management is what Data Link Layer does	4M

4(a)	 FIG : (a) A Frame delimited by flag bytes. (b) Four Examples of byte sequences before and after byte **FLAG BYTES WITH BYTE STUFFING** • This methods gets around the problem of resynchronization after an error by having each frame each start and end with special bytes. • These starting and ending bytes are called **Flag** byte. • The problem with this method is that when binary data such as object program or floating point numbers are being transmitted, there is the chance that the transmitted data may contain the flag bit pattern occurs in data. • Here to solve this a **Special Escape byte (ESC)** is added just before each FLAG in the data. • This technique is called **Byte stuffing** and **Character stuffing**.	**2M+2M**
(b)	Data=1001 Redundant bits=3 Total Length=7 7 6 5 4 3 2 1(Parity) 1 0 0 P4 1 P2 P1 P1,P2,P4=redundant data P3,P5,P6,P7= original data P1=P1 101, **P1=0** (even number of 1's =0) P2=P2 101, **P2=0** (even number of 1's =0) P4=P4 001, **P4=1** (odd number of 1's= 1) **Original Message= 1001100**	**4M**

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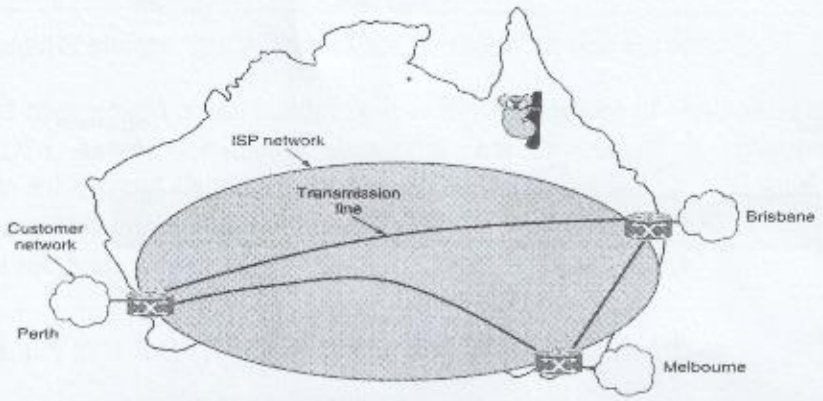
K.S. INSTITUTE OF TECHNOLOGY, BANGALORE - 560109
I SESSIONAL TEST QUESTION PAPER 2023 – 24 ODD SEMESTER

SCHEME AND SOLUTION(SET B)

Degree	:	**B.E**	**Semester**	:	**V**
Branch	:	**AI&ML**	**Course Code**	:	**21CS52**
Course Title	:	**Computer Networks**	**Max Marks**	:	**20**

Q.NO.	POINTS	MARKS
1(a)	 **Wide Area Network using ISP** • A WAN (Wide Area Network) spans a large geographical area, often a country or continent. • The subnet operator is known as a network service provider and the offices are its customers. • The subnet operator will connect to other networks that are part of the Internet. Such a subnet operator is called an ISP (Internet Service Provider) and the subnet is an ISP network. • When a network is sent from one router to another via one or more intermediate routers, the packet is received at each intermediate router in its entirety, stored there until the required output line is free, and then forwarded. A subnet using this principle is called a store-and-forward or packet-switched subnet. The sending host first cuts the message to be sent into packets, each one bearing its number in the sequence. How router makes a routing decision is called the routing algorithm. • The cellular telephone network is another example of a WAN that uses wireless technology.	2M+2M

(b)

Connection oriented service

- Reliable, Telephone system
- To talk to someone, you pick up the phone, dial the number, talk, and then hang up.
- To use a connection-oriented network service, the service user first establishes a connection, uses the connection, and then releases the connection.

Connection less service

- Unreliable, Postal system.
- Each message (letter) carries the full destination address, and each one is routed through the intermediate nodes inside the system independent of all the subsequent message.

2M+2

(c) **2M+2M**

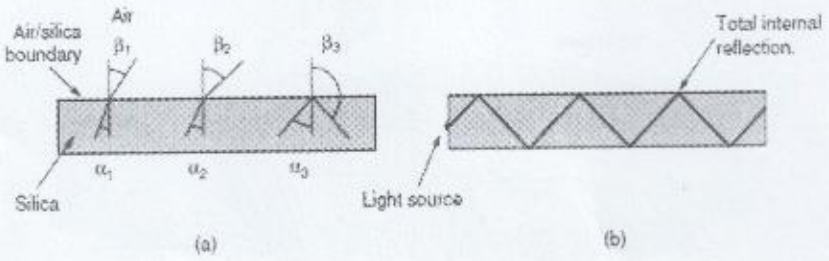


Figure 2-6. (a) Three examples of a light ray from inside a silica fiber impinging on the air/silica boundary at different angles. (b) Light trapped by total internal reflection.

- Fiber optics are used for long-haul transmission in network backbones, highspeed LANs , and high-speed Internet access such as FttH (Fiber to the Home).
- An optical transmission system has three key components: the light source, the transmission medium, and the detector.
- Conventionally, a pulse of light indicates a 1 bit and the absence of light indicates a 0 bit.
- The transmission medium is an ultra-thin fiber of glass.
- The detector generates an electrical pulse when light falls on it

- Unlike radio waves at lower frequencies, microwaves do not pass through buildings well.
- The delayed waves may arrive out of phase with the direct wave and thus cancel the signal.
- This effect is called multipath fading and is often a serious problem.

3(a) **2M+2M**

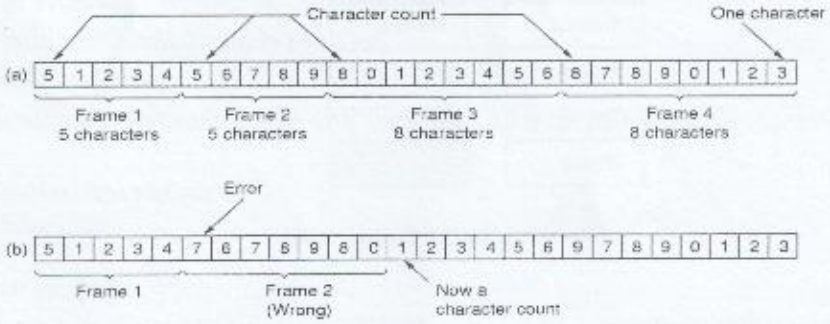


Fig: A Character stream. (a) Without Errors (b) With one Errors

- This method uses a field in the header to specify the number of characters in the frame
- When the DLL at the destination sees the character count, it knows how many characters to follow and hence where the end of the frame is.
- Problem is transmission error.
- Rarely used method.

(b) **2M+2M**

(a) 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 1 0

(b) 0 1 1 0 1 1 1 1 1 0 1 1 1 1 1 0 1 1 1 1 1 0 1 0 0 1 0

Stuffed bits

(c) 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 1 0

Fig: Bit Stuffing (a)Original data (b)Data as they appear on the line (c) Data as they are stored in the receiver's memory after destuffing.

- Bit stuffing methods achieves the same thing as Byte Stuffing method by using Bits (1) instead of Bytes (8 Bits).
- So Each frames begins and ends with a special bit pattern: 01111110
- Whenever the sender's data link layer encounters five consecutive 1s in the data it automatically stuffs a 0 bit into the outgoing bit stream.
- Bit Stuffing: Special bit pattern for start / end of frame 01111110

  In data: add '0' after 5 consecutive '1'

4(a) **Stop and Wait Protocol**

2(a)

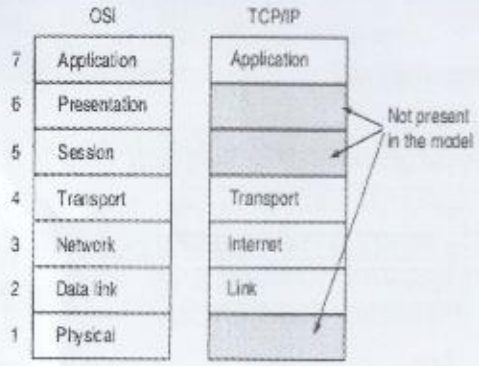


Figure 1-21. The TCP/IP reference model.

The Link Layer

- The lowest layer in the model, the link layer describes what links such as serial lines and classic Ethernet must do to meet the needs of this connectionless internet layer.
- It is not really a layer at all, in the normal sense of the term, but rather an interface between hosts and transmission links.

The Internet Layer

- The internet layer holds the whole architecture together.
- Its job is to permit hosts to inject packets into any network and have them travel independently to the destination (potentially on a different network).

The Transport Layer

- The layer above the internet layer in the TCP/IP model is now usually called the transport layer.
- It is designed to allow peer entities on the source and destination hosts to carry on a conversation, just as in the OSI transport layer.

The Application Layer

- On top of the transport layer is the application layer. It contains all the higher-level protocols.
- The early ones included virtual terminal (TELNET), file transfer protocol (FTP), and electronic mail (SMTP). Many other protocols have been added to these over the years.

(b)

Radio Transmission **2M+2**

- Radio frequency (RF) waves are easy to generate, can travel long distances, and can penetrate buildings easily, so they are widely used for communication, both indoors and outdoors.
- Radio waves also are omnidirectional, meaning that they travel in all directions from the source, so the transmitter and receiver do not have to be carefully aligned physically.
- The properties of radio waves are frequency dependent.

Microwave Transmission

- Microwaves travel in a straight line, so if the towers are too far apart, the earth will get in the way (think about a Seattle-to-Amsterdam link). Thus, repeaters are needed periodically.

- Unidirectional data transmission
- Transmitting/receiving network layers are always ready
- Finite processing speed
- Finite buffer capacity
- No errors
- Problem: Sender sends too fast
- Stop-and-wait
- Senders sends one frame and then waits for an acknowledgement before processing.

2M+2M

```
typedef enum {frame_arrival} event_type;
#include "protocol.h"

void sender2(void)
{
 frame s;                    /* buffer for an outbound frame */
 packet buffer;              /* buffer for an outbound packet */
 event_type event;           /* frame_arrival is the only possibility */

 while (true) {
    from_network_layer(&buffer);   /* go get something to send */
    s.info = buffer;               /* copy it into s for transmission */
    to_physical_layer(&s);         /* bye-bye little frame */
    wait_for_event(&event);        /* do not proceed until given the go ahead */
 }
}
```

```
void receiver2(void)
{
 frame r, s;                 /* buffers for frames */
 event_type event;           /* frame_arrival is the only possibility */
 while (true) {
    wait_for_event(&event);         /* only possibility is frame_arrival */
    from_physical_layer(&r);        /* go get the inbound frame */
    to_network_layer(&r.info);      /* pass the data to the network layer */
    to_physical_layer(&s);          /* send a dummy frame to awaken sender */
 }
}
```

(b)	a) **FLAG A ESC ESC B ESC ESC ESC FLAG FLAG** b) **FLAG A ESC B ESC FLAG FLAG** Apply bit stuffing only to the character frame	**2M+2M**

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K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SET: A

USN										

Degree : B.E | **Semester : 5**
Branch : AI&ML | **Course Type / Code : IPCC/21CS52**
Course Title : Computer Networks | **Date : 05/02/2024**
Duration : 60 Minutes | **Max Marks : 20**

Note: Answer **ONE full** question from each part.
K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	**Construct** Link State Routing algorithm with a neat labelled diagram.	4	CO3	K3
(b)	**Experiment with** Optimality principle with a neat diagram	4	CO3	K3
(c)	**Explain** the implementation of connection less service with a neat diagram	4	CO3	K2
	OR			
2(a)	**Develop** Hierarchical routing algorithm with a neat diagram.	4	CO3	K3
(b)	**Choose** the differences between virtual circuit and datagram networks.	4	CO3	K3
(c)	**Identify** routing in Broadcast networks with a neat diagram.	4	CO3	K3
	PART –B			
3(a)	**Choose** the differences between n persistant, p persistant and non persistant Carrier Sense Multiple Access.	4	CO2	K3
(b)	**Explain** Transport Service Primitives in detail	4	CO4	K2
	OR			
4(a)	**Explain** Slotted Aloha with a neat diagram.	4	CO2	K2
(b)	**Construct** state diagram for a simple connection management scheme with a neat diagram.	4	CO4	K3

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K.S. INSTITUTE OF TECHNOLOGY, BENGALURU - 560109
SECOND INTERNAL TEST QUESTION PAPER 2023-24 ODD SEMESTER

SET: B

USN										

Degree : B.E
Branch : AI&ML
Course Title : Computer Networks
Duration : 60 Minutes

Semester : 5
Course Type / Code : IPCC/21CS52
Date : 05/02/2024
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Note: Answer **ONE full** question from each part.
K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	**Construct** Distance Vector Routing algorithm with a neat labelled diagram.	4	CO3	K3
(b)	**Experiment with** Multicast Routing with a neat diagram	4	CO3	K3
(c)	**Identify** routing in Mobile Host Network with a neat diagram.	4	CO3	K3
	OR			
2(a)	**Develop** Shortest Path routing algorithm with a graphical representation.	4	CO3	K3
(b)	**Develop** Leaky Bucket Algorithm with a neat diagram	4	CO3	K3
(c)	**Identify** routing in mobile ad-hoc networks with the packet formats.	4	CO3	K3
	PART –B			
3(a)	**Design** Carrier sense multiple access with collision detection in detail	4	CO2	K3
(b)	**Explain** the services provided to the upper layers in the transport layer.	4	CO4	K2
	OR			
4(a)	**Explain** Pure Aloha with a neat diagram.	4	CO2	K2
(b)	**Explain** socket primitives for TCP in detail.	4	CO4	K2

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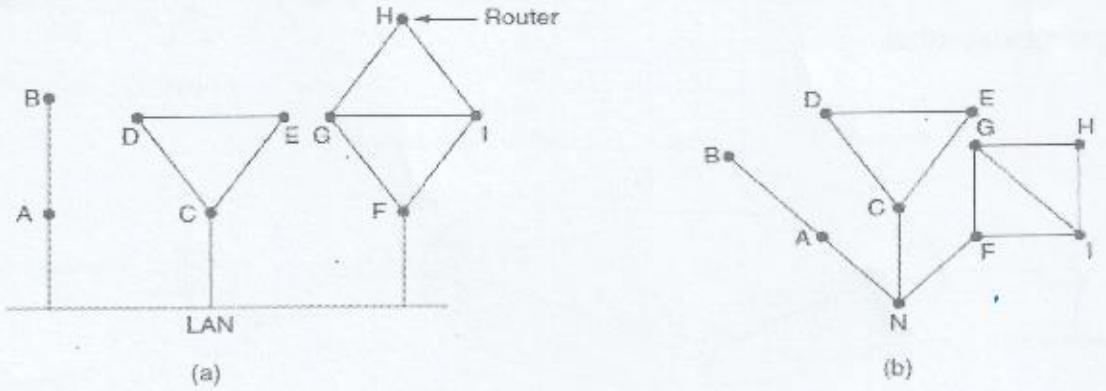
K.S. INSTITUTE OF TECHNOLOGY, BANGALORE -560109

II SESSIONAL TEST QUESTION PAPER 2023 – 24 ODD SEMESTER

SCHEME AND SOLUTION(SET A)

Degree	: B.E	Semester :	V
Branch	: AI&ML	Course Code :	21CS52
Course Title	: Computer Networks	Max Marks :	20

Q.NO.	POINTS	MARKS
1(a)	**Link State Routing:** The idea behind link state routing is fairly simple and can be stated as five parts. Each router must do the following things to make it work: 1. Discover its neighbours and learn their network addresses. 2. Set the distance or cost metric to each of its neighbours. 3. Construct a packet telling all it has just learned. 4. Send this packet to and receive packets from all other routers. 5. Compute the shortest path to every other router. Variants of link state routing called IS-IS and OSPF are the routing algorithms that are most widely used inside large networks and the Internet today.  **Figure 5-11.** (a) Nine routers and a broadcast LAN. (b) A graph model of (a).	2M+2M
(b)	**Optimality Principle:** Before we get into specific algorithms, the one can make a general statement about optimal routes without regard to network topology or traffic. This statement is known as the optimality principle.	2M+2M

The set of optimal routes from all sources to a given destination form a tree [illegible] destination. Such a tree is called a sink tree.

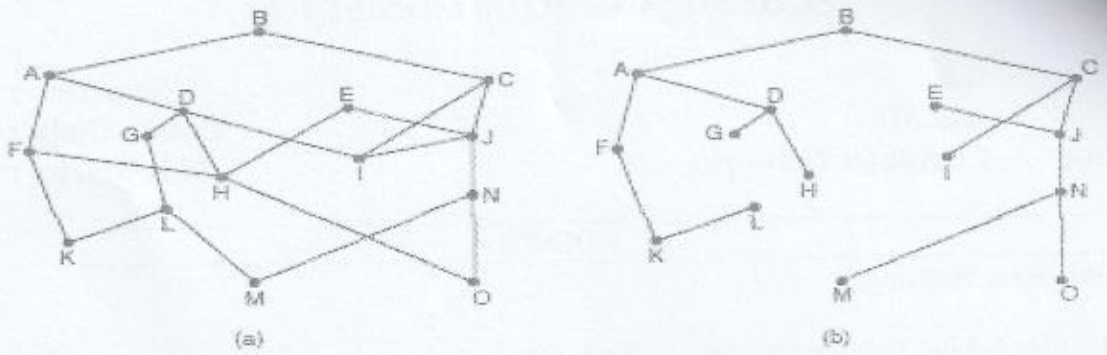
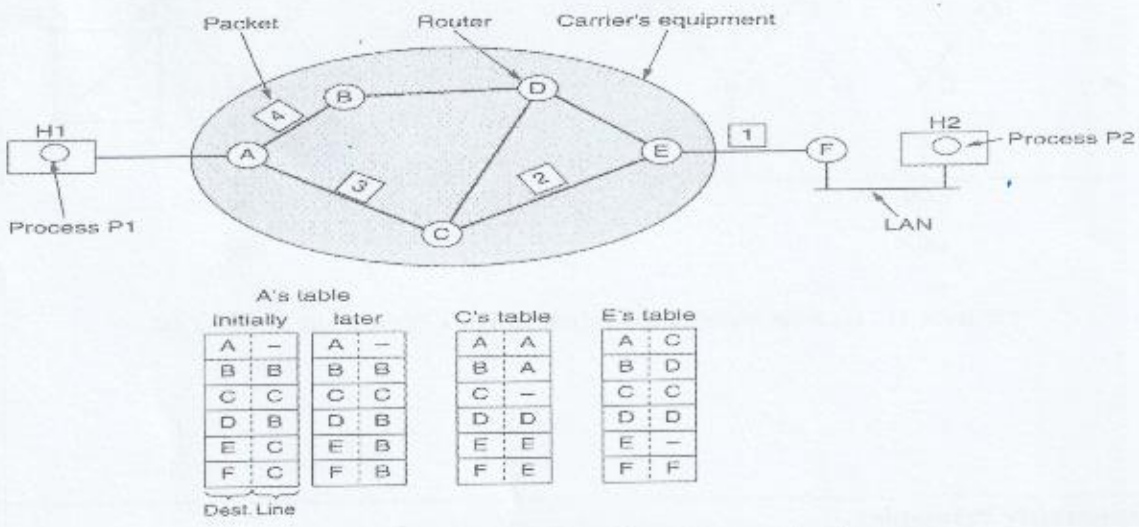


Figure 5-6. (a) A network. (b) A sink tree for router *B*.

(c) **Connectionless Service** **2M+2M**

If connectionless service is offered, packets are injected into the network individually and routed independently of each other. No advance setup is needed. In this context, the packets are frequently called datagrams (in analogy with telegrams) and the network is called a datagram network.

The algorithm that manages the tables and makes the routing decisions is called the **routing algorithm**.



A's table

Dest.	Initially Line	later Line
A	–	–
B	B	B
C	C	C
D	B	B
E	C	B
F	C	B

C's table

Dest.	Line
A	A
B	A
C	–
D	D
E	E
F	E

E's table

Dest.	Line
A	C
B	D
C	C
D	D
E	–
F	F

Routing within a datagram subnet.

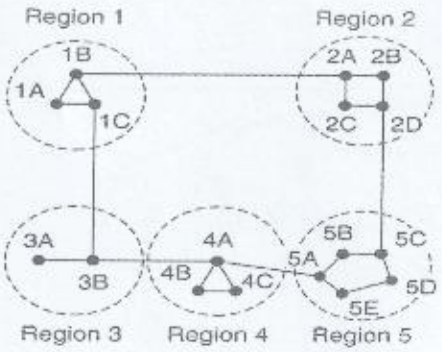
2a) **Hierarchical Routing** 2M+2M

When hierarchical routing is used, the routers are divided into what we will call **regions**.

Each router knows all the details about how to route packets to destinations within its own region but knows nothing about the internal structure of other regions.

When different networks are interconnected, it is natural to regard each one as a separate region to free the routers in one network from having to know the topological structure of the other ones.

For huge networks, a two-level hierarchy may be insufficient; it may be necessary to group the regions into **clusters,** the clusters into **zones,** the zones into **groups,** and so on, until we run out of names for aggregations.



(a)

Full table for 1A

Dest.	Line	Hops
1A	–	–
1B	1B	1
1C	1C	1
2A	1B	2
2B	1B	3
2C	1B	3
2D	1B	4
3A	1C	3
3B	1C	2
4A	1C	3
4B	1C	4
4C	1C	4
5A	1C	4
5B	1C	5
5C	1B	5
5D	1C	6
5E	1C	5

(b)

Hierarchical table for 1A

Dest.	Line	Hops
1A	–	–
1B	1B	1
1C	1C	1
2	1B	2
3	1C	2
4	1C	3
5	1C	4

(c),

(b)

Issue	Datagram subnet	Virtual-circuit subnet
Circuit setup	Not needed	Required
Addressing	Each packet contains the full source and destination address	Each packet contains a short VC number
State information	Routers do not hold state information about connections	Each VC requires router table space per connection
Routing	Each packet is routed independently	Route chosen when VC is set up; all packets follow it
Effect of router failures	None, except for packets lost during the crash	All VCs that passed through the failed router are terminated
Quality of service	Difficult	Easy if enough resources can be allocated in advance for each VC
Congestion control	Difficult	Easy if enough resources can be allocated in advance for each VC

2M+2M

(c)

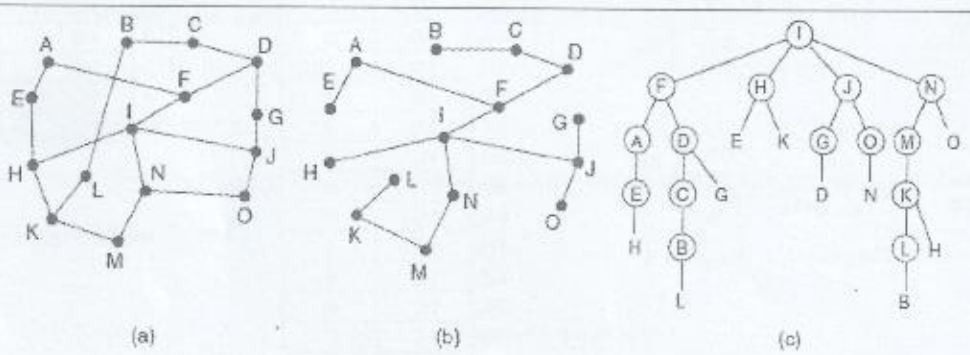


Figure 5-15. Reverse path forwarding. (a) A network. (b) A sink tree. (c) The tree built by reverse path forwarding.

2M+2M

Broadcast Routing:

Sending a packet to all destinations simultaneously is called broadcasting. When a broadcast packet arrives at a router, the router checks to see if the packet arrived on the link that is normally used for sending packets toward the source of the broadcast.

If so, there is an excellent chance that the broadcast packet itself followed the best route from the router and is therefore the first copy to arrive at the router.

3(a)

Parameter	1-persistent CSMA	p-persistent CSMA	Non-persistent CSMA
Carrier Sense	It sends with the probability of 1 when channel is idle.	It sends with the probability of p when channel is idle.	It send when channel is idle.
Waiting	It continuously senses the channel or carrier.	It waits for the next time slot.	It will wait for the random amount of time to check the carrier.
Chances of Collision	There is highest chances of collision in this.	Less chances as compared to 1-persistence and non-persistence.	Less chances as compared to 1-persistence but more than the p-persistence.
Utilization	It's utilization is above ALOHA as frames are only sent when the channel is idle.	It's utilization is depend upon the probability p.	It's utilization is above 1-persistent as not all the stations constantly check the channel at the same time.
Delay Low Load	It is low as frames are sent when the channel become idle.	It is large when p is small as station will not always send when channel is idle.	It is small as station will send whenever channel is found idle but longer than 1-persistent since it checks for the random time when busy.
Delay High Load	It is high due to collision.	It is large when the probability p of sending is small when channel is idle and channel is rarely idle.	It is longer than 1-persistent as channel is checked randomly when busy.

4M

(b)

2M+2M

Primitive	Packet sent	Meaning
LISTEN	(none)	Block until some process tries to connect
CONNECT	CONNECTION REQ.	Actively attempt to establish a connection
SEND	DATA	Send information
RECEIVE	(none)	Block until a DATA packet arrives
DISCONNECT	DISCONNECTION REQ.	Request a release of the connection

Figure 6-2. The primitives for a simple transport service.

1. consider an application with a server and a number of remote clients.
2. To start with, the server executes a LISTEN primitive, typically by calling a library procedure that makes a system call that blocks the server until a client turns up.
3. When a client wants to talk to the server, it executes a CONNECT primitive.
4. The transport entity carries out this primitive by blocking the caller and sending a packet to the server.
5. Encapsulated in the payload of this packet is a transport layer message for the server's transport entity.
6. Data can now be exchanged using the SEND and RECEIVE primitives.
7. In this model, a connection is released when both sides have done a DISCONNECT

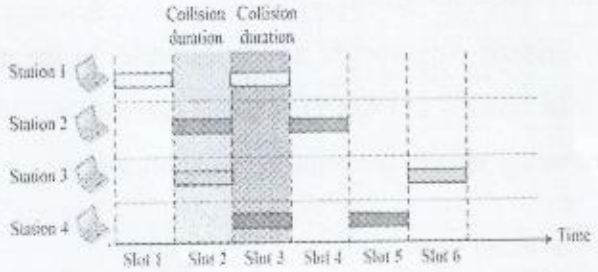
4(a)

Slotted ALOHA

2M+2M

- Soon after ALOHA came onto the scene, Roberts (1972) published a method for doubling the capacity of an ALOHA system.
- His proposal was to divide time into discrete intervals called **slots**, each interval corresponding to one frame.
- This approach requires the users to agree on slot boundaries and force the station to send only in the beginning of the time slot
- A station is not permitted to send whenever the user types a line.
- Thus, the continuous time ALOHA is turned into a discrete time one.
- The probability of no other traffic during the same slot as our test frame is then e^{-G}, which leads to

$$S = Ge^{-G}$$



- The probability of a collision is then just $1 - e^{-G}$.
- The probability of a transmission requiring exactly k attempts (i.e., $k - 1$ collisions followed by one success) is

$$P_k = e^{-G}(1 - e^{-G})^{k-1}$$

The expected number of transmissions, E, per line typed at a terminal is then

$$E = \sum_{k=1}^{\infty} kP_k = \sum_{k=1}^{\infty} ke^{-G}(1 - e^{-G})^{k-1} = e^{G}$$

(b)

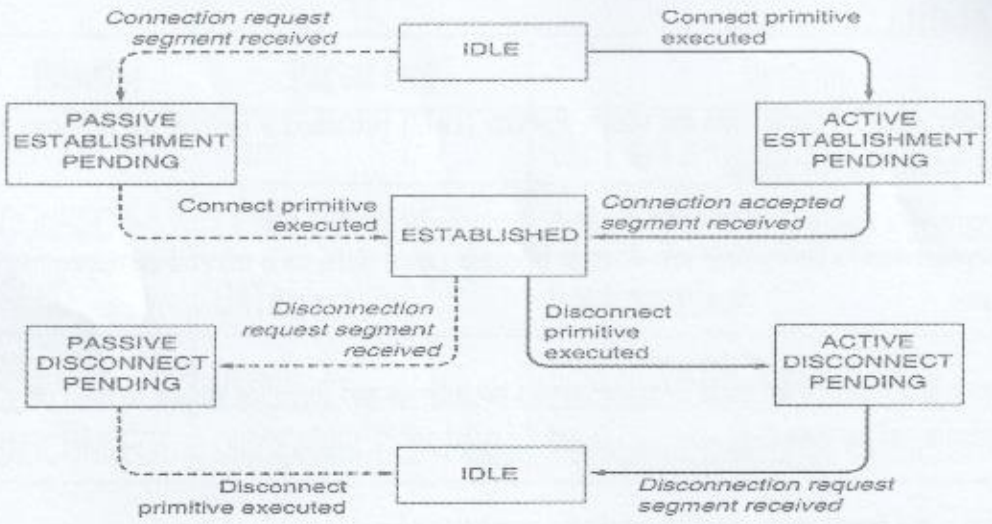


Figure 6-4. A state diagram for a simple connection management scheme. Transitions labeled in italics are caused by packet arrivals. The solid lines show the client's state sequence. The dashed lines show the server's state sequence.

The client's CONNECT call causes a CONNECTION REQUEST segment to be sent to the server. When it arrives, the transport entity checks to see that the server is blocked on a LISTEN (i.e., is interested in handling requests). If so, it then unblocks the server and sends a CONNECTION ACCEPTED segment back to the client. Data can now be exchanged using the SEND and RECEIVE primitives.

Disconnection has two variants: asymmetric and symmetric. In the asymmetric variant, either transport user can issue a DISCONNECT primitive, which results in a DISCONNECT segment being sent to the remote transport entity.

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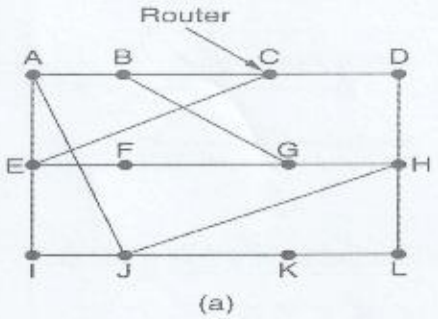
II SESSIONAL TEST QUESTION PAPER 2023 – 24 ODD SEMESTER

SCHEME AND SOLUTION(SET B)

Degree	:	B.E	Semester	:	V
Branch	:	AI&ML	Course Code	:	21CS52
Course Title	:	Computer Networks	Max Marks	:	20

Q.NO.	POINTS	MARKS
1(a)	**Distance vector routing** algorithm operates by having each router maintain a table (i.e., a vector) giving the best-known distance to each destination and which link to use to get there. These tables are updated by exchanging information with the neighbors. Eventually, every router knows the best link to reach each destination.	2M+2M
(b)	**Multicast Routing:** Sending a packets to multiple receivers is called Multicasting. and the routing algorithm used is called multicast routing. All multicasting schemes require some way to create and destroy groups and to identify which routers are members of a group.	2M+2M



(a)

New estimated delay from J

To	A	I	H	K	↓	Line
A	0	24	20	21	8	A
B	12	36	31	28	20	A
C	25	18	19	36	28	I
D	40	27	8	24	20	H
E	14	7	30	22	17	I
F	23	20	19	40	30	I
G	18	31	6	31	18	H
H	17	20	0	19	12	H
I	21	0	14	22	10	I
J	9	11	7	10	0	–
K	24	22	22	0	6	K
L	29	33	9	9	15	K
	JA delay is 8	JI delay is 10	JH delay is 12	JK delay is 6		New routing table for J

Vectors received from J's four neighbors

(b)

MOSPF (Multicast OSPF) is an example of a link state protocol and DVMRP (Distance Vector Multicast Routing Protocol) is an example of a multicast routing protocol.

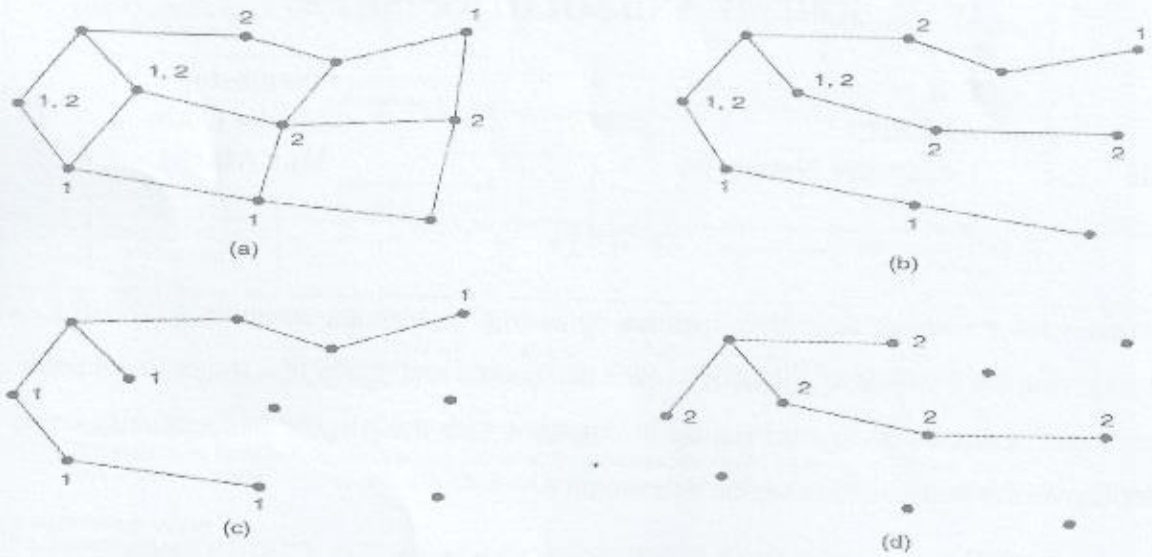


Figure 5-16. (a) A network. (b) A spanning tree for the leftmost router. (c) A multicast tree for group 1. (d) A multicast tree for group 2.

(c) **Routing in Mobile Host Networks:** 2M+2M

1. The basic idea used for mobile routing in the Internet and cellular networks is for the mobile host to tell a host at the home location where it is now.
2. This host, which acts on behalf of the mobile host, is called the home agent.
3. Once it knows where the mobile host is currently located, it can forward packets so that they are delivered.
4. The local address is called a care of address. Once the mobile host has this address, it can tell its home agent where it is now.

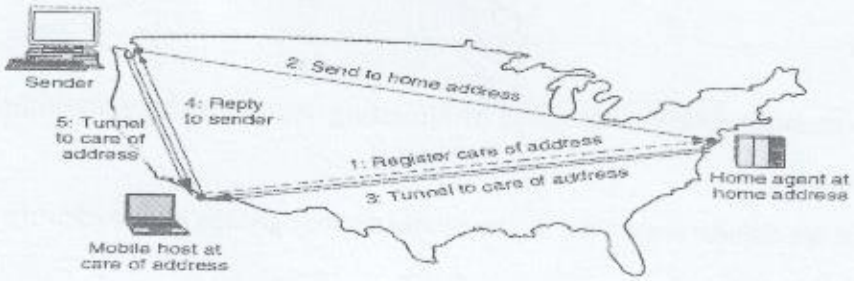
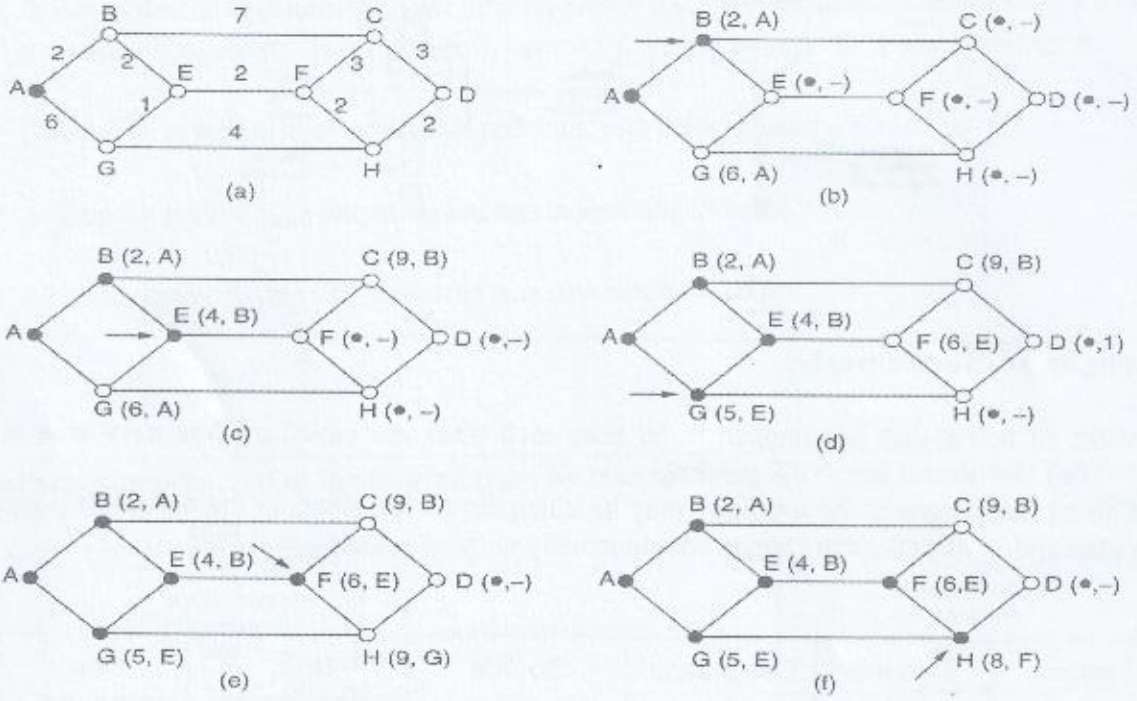
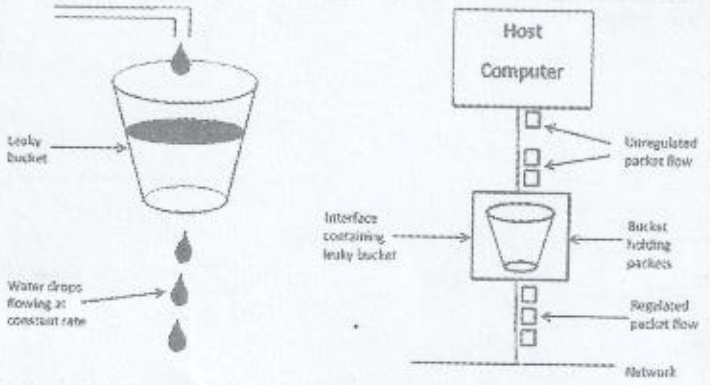


Figure 5-19. Packet routing for mobile hosts.

(a)	**Shortest Path Routing Algorithm** The idea is to build a graph of the network, with each node of the graph representing a router and each edge of the graph representing a communication line or link. To choose a route between a given pair of routers, the algorithm just finds the shortest path between them on the graph.  The first 5 steps used in computing the shortest path from A to D. The arrows indicate the working node.	2M+2M
(b)	**Leaky Bucket Algorithm** mainly controls the total amount and the rate of the traffic sent to the network. **Step 1** – Let us imagine a bucket with a small hole at the bottom where the rate at which water is poured into the bucket is not constant and can vary but it leaks from the bucket at a constant rate. **Step 2** – So (up to water is present in the bucket), the rate at which the water leaks does not depend on the rate at which the water is input to the bucket.	2M+2M

Step 3 – If the bucket is full, additional water that enters into the bucket that spills over the sides and is lost.

Step 4 – Thus the same concept applied to packets in the network. Thus, the constant flow is maintained.



(c) **Routing in Ad-Hoc Networks:** **2M+2M**

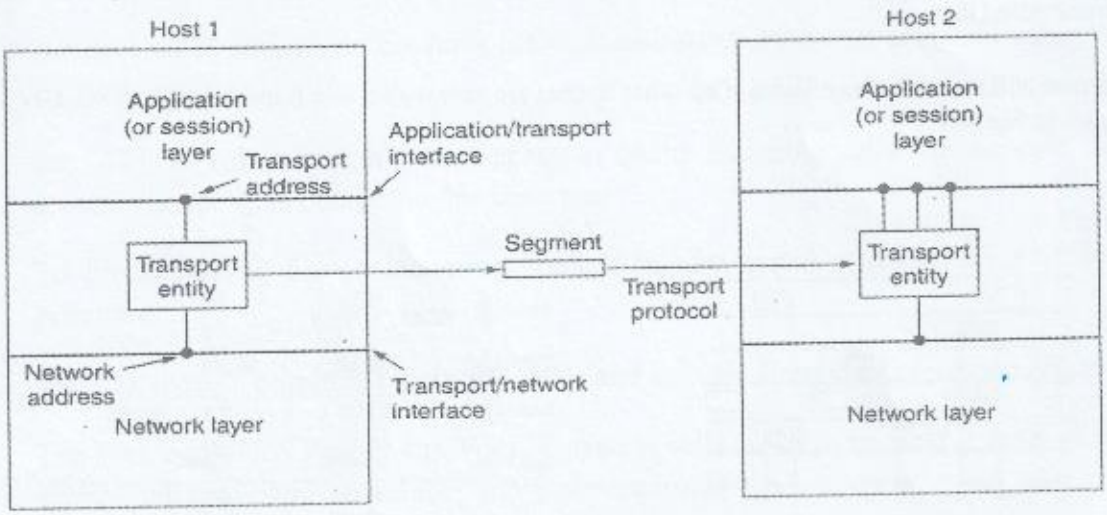
Networks of nodes that just happen to be near each other are called **ad hoc networks** or **MANETs (Mobile Ad hoc NET works)**.
With an ad hoc network, the topology may be changing all the time, so the desirability and even the validity of paths can change spontaneously without warning.

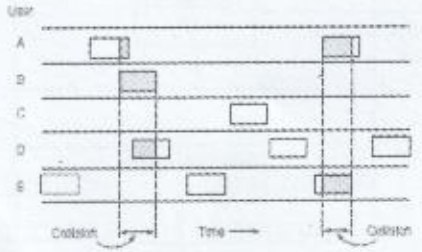
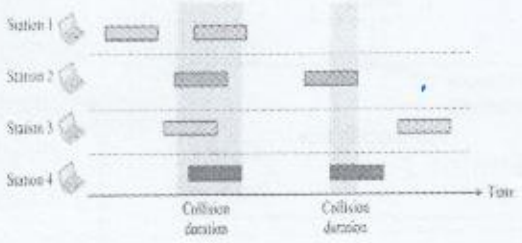
Source address	Request ID	Destination address	Source sequence #	Dest. sequence #	Hop count

ROUTE REQUEST PACKET FORMAT

Source address	Destination address	Destination sequence #	Hop count	Lifetime

ROUTE REPLY PACKET FORMAT

5(a)	**CSMA with Collision Detection** ➢ This protocol, known as **CSMA/CD (CSMA with Collision Detection)**, is the basis of the classic Ethernet LAN. ➢ Carrier sense multiple access with collision detection (CSMA/CD) augments the algorithm to handle the collision. ➢ In this method, a station monitors the medium after it sends a frame to see if the transmission was successful. If so, the station is finished. If, however, there is a collision, the frame is sent again. ➢ CSMA/CD, as well as many other LAN protocols, uses the conceptual model of Fig. 4-5. ➢ At the point marked *t* 0, a station has finished transmitting its frame. ➢ Any other station having a frame to send may now attempt to do so.	2M+2M
(b)	**The services provided to the upper layers by transport layer-**  **Figure 6-1.** The network, transport, and application layers. • The ultimate goal of the transport layer is to provide efficient, reliable, and cost-effective data transmission service to its users, normally processes in the application layer.	2M+2M

	• To achieve this, the transport layer makes use of the services provided by the network layer. • The software and/or hardware within the transport layer that does the work is called the transport entity. • The transport entity can be located in the operating system kernel, in a library package bound into network applications, in a separate user process.	
4(a)	**Pure Aloha** ➢ Pure ALOHA protocol relies on Ack. from the receiver. ➢ If station does not receive ack. with in time-out period, station assumes that frames have been destroyed and resends it. ➢ Whenever two frames try to occupy the channel at the same time, there will be a collision (as seen in Fig. 4-1) and both will be garbled. ➢ If the first bit of a new frame overlaps with just the last bit of a frame that has almost finished, both frames will be totally destroyed (i.e., have incorrect checksums) and both will have to be retransmitted later. ➢ A frame will not suffer a collision if no other frames are sent within one frame time of its start, as shown in Fig. 4-2.  Figure 4-1. In pure ALOHA, frames are transmitted at completely arbitrary times.  	2M+2M

(b) **Socket Primitives:** 2M+2M

Primitive	Meaning
SOCKET	Create a new communication endpoint
BIND	Associate a local address with a socket
LISTEN	Announce willingness to accept connections; give queue size
ACCEPT	Passively establish an incoming connection
CONNECT	Actively attempt to establish a connection
SEND	Send some data over the connection
RECEIVE	Receive some data from the connection
CLOSE	Release the connection

Figure 6-5. The socket primitives for TCP.

- The SOCKET primitive creates a new endpoint and allocates table space for it within the transport entity.
- A successful SOCKET call returns an ordinary file descriptor for use in succeeding calls, the same way an OPEN call on a file does.
- Newly created sockets do not have network addresses. These are assigned using the BIND primitive.
- the LISTEN call, which allocates space to queue incoming calls for the case that several clients try to connect at the same time.
- To block waiting for an incoming connection, the server executes an ACCEPT primitive.
- The CONNECT primitive blocks the caller and actively starts the connection process.
- The standard UNIX READ and WRITE system calls can also be used if none of the special options of SEND and RECEIVE are required.
- When both sides have executed a CLOSE primitive, the connection is released.

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THIRD INTERNAL TEST QUESTION PAPER 2023-24ODDSEMESTER

SET: A

USN										

Degree : B.E
Branch : AI&ML
CourseTitle : Computer Networks
Duration : 60 Minutes

Semester : 5
Course Type / Code : IPCC/21CS52
Date : 04/03/2024
Max Marks : 20

Note: Answer **ONE full** question from each part.
K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	**Construct** client-server architecture with a neat diagram.	4	CO5	K3
(b)	**Experiment with** the persistent connections in HTTP.	4	CO5	K3
(c)	**Explain** the working of the cookies with a neat diagram.	4	CO5	K2
	OR			
2(a)	**Develop** HTTP request message formats with a neat diagram.	4	CO5	K3
(b)	**Explain** the SMTP protocol in detail.	4	CO5	K2
(c)	**Identify** the various DNS Resource records formats.	4	CO5	K3
	PART –B			
3(a)	**Identify** UDP Header with a neat packet format.	4	CO4	K3
(b)	**Explain** three-way handshake protocol for CONNECTION REQUEST with a diagram	4	CO4	K2
	OR			
4(a)	**Explain** Remote procedure call with a neat diagram	4	CO4	K2
(b)	**Identify** RTP Header with a neat packet format.	4	CO4	K3

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THIRD INTERNAL TEST QUESTION PAPER 2023-24ODDSEMESTER

SET: B

USN										

Degree : B.E
Branch : AI&ML
Course Title : Computer Networks
Duration : 60 Minutes

Semester : 5
Course Type / Code : IPCC/21CS52
Date : 04/03/2024
Max Marks : 20

Note: Answer **ONE full** question from each part.
K-Levels: K1-Remebering, K2-Understanding, K3-Applying, K4-Analyzing, K5-Evaluating, K6-Creating

Q No.	Questions	Marks	CO	K-Level
	PART-A			
1(a)	**Construct** peer to peer architecture with a neat diagram.	4	CO5	K3
(b)	**Experiment with** the non-persistent connections in HTTP.	4	CO5	K3
(c)	**Explain** the services provided by DNS.	4	CO5	K2
	OR			
2(a)	**Develop** HTTP response message formats with a neat diagram.	4	CO5	K3
(b)	**Explain** the DNS Message formats with an example.	4	CO5	K2
(c)	**Identify** post office protocol (POP) in detail	4	CO5	K3
	PART –B			
3(a)	**Identify**IPv4 Psuedoheader with a neat packet format.	4	CO4	K3
(b)	**Explain four** protocol scenarios for CONNECTION RELEASE Protocol.	4	CO4	K2
	OR			
4(a)	**Explain** the various states of TCP Connection Management Modeling.	4	CO4	K2
(b)	**Identify** TCP Header with a neat packet format.	4	CO4	K3

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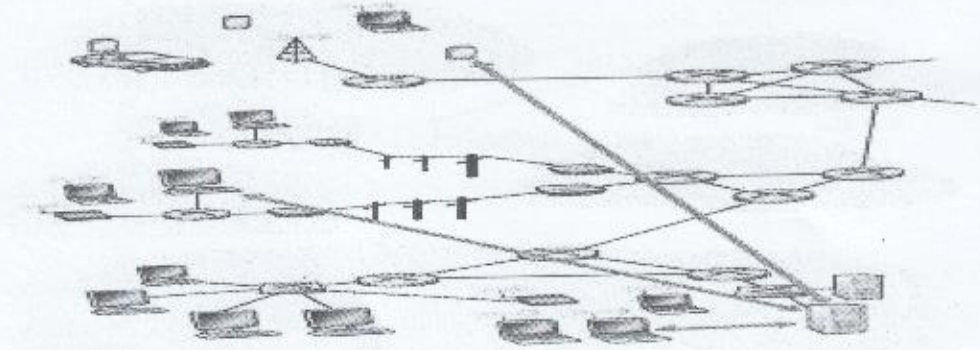
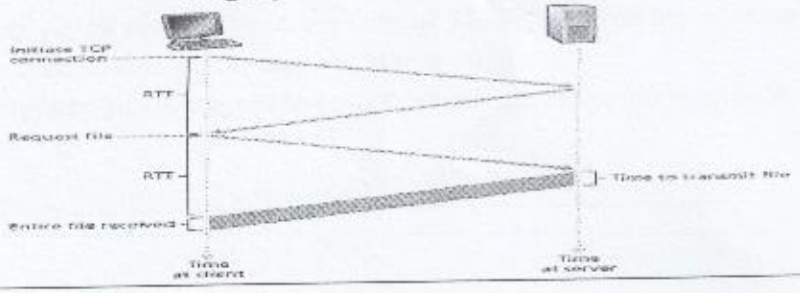
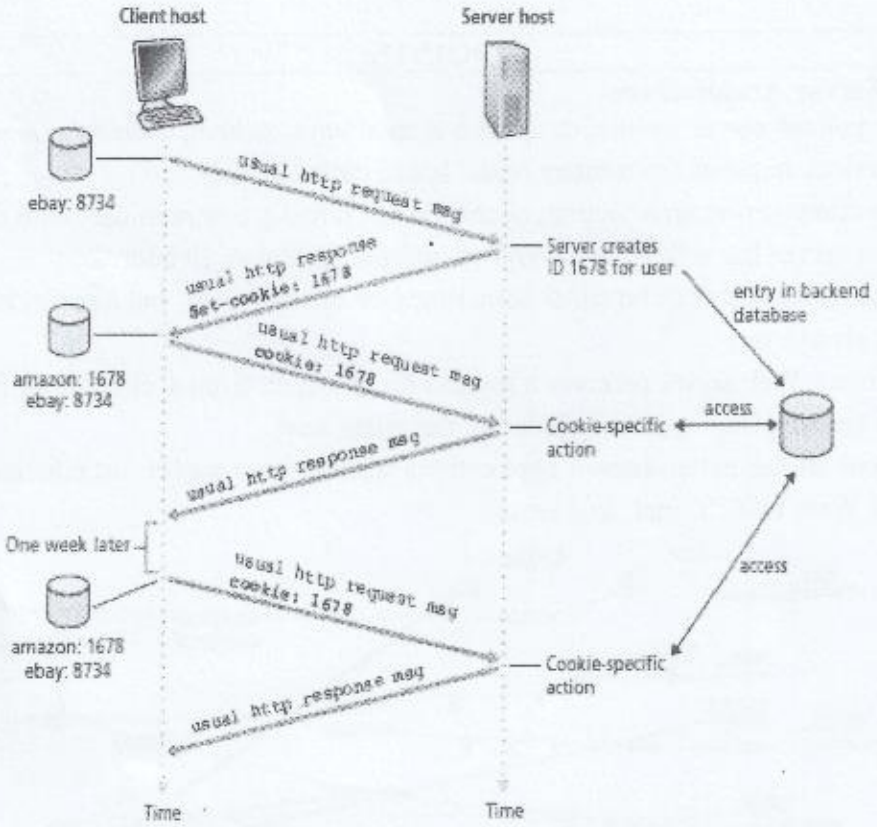
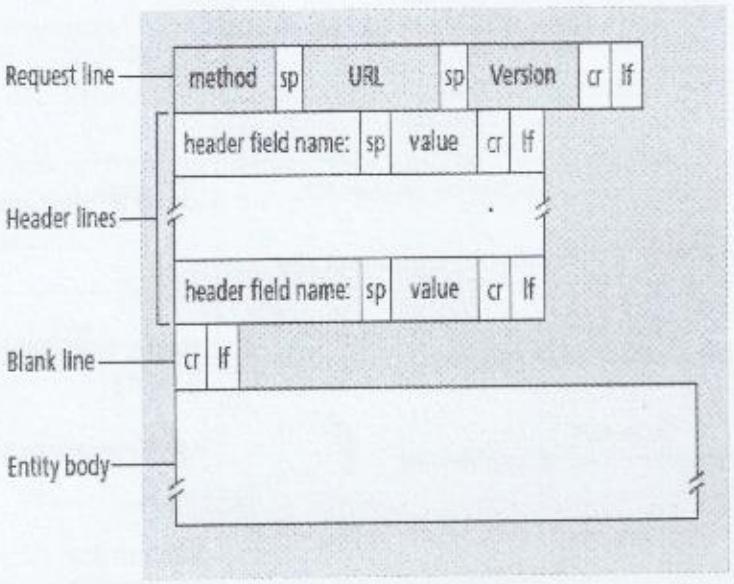
III SESSIONAL TEST QUESTION PAPER 2023 – 24 ODD SEMESTER

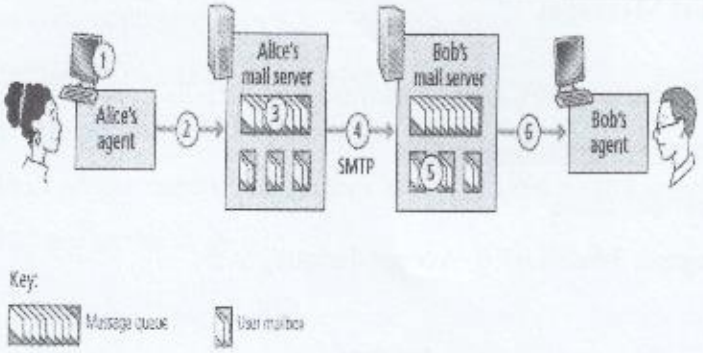
SCHEME AND SOLUTION(SET A)

Degree	: B.E	Semester :	V
Branch	: AI&ML	Course Code :	21CS52
Course Title	: Computer Networks	Max Marks :	20

Q.NO.	POINTS	MARKS
1(a)	**Client – Server Architecture** • In a client-server architecture, there is an always-on host, called the *server*, which services requests from many other hosts, called *clients*. • In client-server architecture, clients do not directly communicate with each other. • The server has a fixed, well-known address, called an IP address. • The client hosts can be either sometimes-on or always on, but a server host should be always on. • When a Web server receives a request for an object from a client host, it responds by sending the requested object to the client host. • Some of the better-known applications with a client-server architecture include the Web, FTP, Telnet, and e-mail.  a. Client-server architecture	2M+2M
(b)	**HTTP with Persistent Connections** With persistent connections, the server leaves the TCP connection open after sending a response. Subsequent requests and responses between the same client and server can be sent over the same connection. In particular, an entire Web page can be sent over a single persistent TCP connection.  	2M+2M

(c)	Cookie technology has four components: 1. A cookie header line in the HTTP response message; 2. A cookie header line in the HTTP request message; 3. A cookie file kept on the user's end system and managed by the user's browser; 4. A back-end database at the Web site.  	2M+

a)	**HTTP Request Message:** GET /Departments/CS/cs_dept.html HTTP/1.1 Host: www.someschool.edu Connection: close User-agent: Mozilla/5.0 Accept-language: fr  **HTTP Request Message format**	**2M+2M**
(b)	**Simple Mail Tranport protocol** 1. Alice invokes her user agent for e-mail, provides Bob's e- mail address (for example, bob@someschool.edu), composes a message, and instructs the user agent to send the message. 2. Alice's user agent sends the message to her mail server, where it is placed in a message queue 3. The client side of SMTP, running on Alice's mail server, sees the message in the message queue. It opens a TCP connection to an SMTP server, running on Bob's mail server. 4. After some initial SMTP handshaking, the SMTP client sends Alice's message into the TCP connection. 5. At Bob's mail server, the server side of SMTP receives the message. Bob's mail server then places the message in Bob's mailbox. 6. Bob invokes his user agent to read the message at his convenience.	**2M+2M**



Alice sends a message to Bob

(c)

2M+2M

Identification	Flags	12 bytes
Number of questions	Number of answer RRs	
Number of authority RRs	Number of additional RRs	
Questions (variable number of questions)		Name, type fields for a query
Answers (variable number of resource records)		RRs in response to query
Authority (variable number of resource records)		Records for authoritative servers
Additional information (variable number of resource records)		Additional "helpful" info that may be used

Figure 2.23 ♦ DNS message format

3(a)

2M+2M

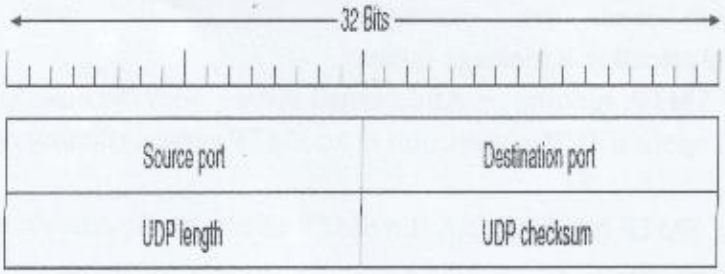


Figure 6-27. The UDP header.

- The two **ports** serve to identify the endpoints within the source and destination machines.

- The source port is primarily needed when a reply must be sent back to the source.
- By copying the *Source port* field from the incoming segment into the *Destination port* field of the outgoing segment, the process sending the reply can specify which process on the sending machine is to get it.
- The *UDP length* field includes the 8-byte header and the data. The minimum length is 8 bytes, to cover the header.
- An optional *Checksum* is also provided for extra reliability.
- It checksums the header, the data, and a conceptual IP pseudo header.
- When performing this computation, the *Checksum* field is set to zero and the data field is padded out with an additional zero byte if its length is an odd number.

(b) **2M+2M**

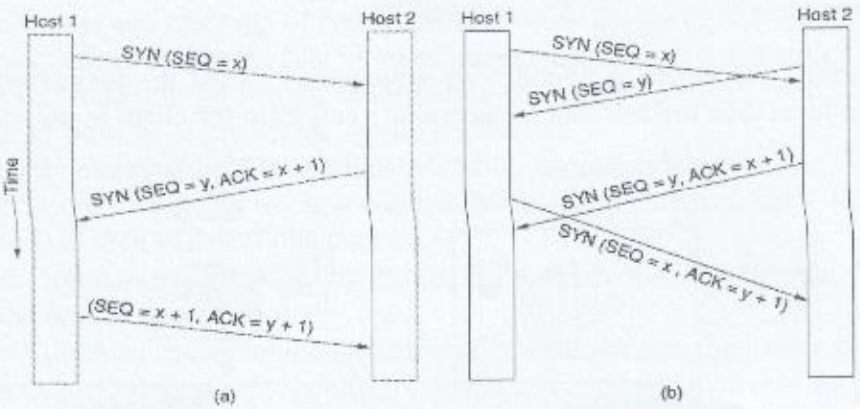


Figure 6-37. (a) TCP connection establishment in the normal case. (b) Simultaneous connection establishment on both sides.

- **Connections are established in TCP by means of the three-way handshake.**
- To establish a connection, one side, say, the server, passively waits for an incoming connection by executing the LISTEN and ACCEPT primitives in that order, either specifying a specific source or nobody in particular.
- The other side, say, the client, executes a CONNECT primitive, specifying the IP address and port to which it wants to connect, the maximum TCP segment size it is willing to accept, and optionally some user data (e.g., a password).
- The CONNECT primitive sends a TCP segment with the *SYN* bit on and *ACK* bit off and waits for a response.
- When this segment arrives at the destination. If some process is listening to the port, that process is given the incoming TCP segment.
- It can either accept or reject the connection. If it accepts, an acknowledgement segment is sent back. There is a means that a malicious sender can tie up resources on a host by sending a stream of *SYN* segments and never following through to complete the connection.
- This attack is called a **SYN flood**, and it crippled many Web servers in the 1990s.
- One way to defend against this attack is to use **SYN cookies**.

4(a) **Remote Procedure call** 2M

- When a process on machine 1 calls a procedure on machine 2, the calling process on 1 is suspended and execution of the called procedure takes place on 2.
- Information can be transported from the caller to the callee in the parameters and can come back in the procedure result.
- No message passing is visible to the application programmer. This technique is known as RPC (Remote Procedure Call) and has become the basis for many networking applications.
- Traditionally, the calling procedure is known as the client and the called procedure is known as the server, and we will use those names here too.
- The idea behind RPC is to make a remote procedure call look as much as possible like a local one.
- In the simplest form, to call a remote procedure, the client program must be bound with a small library procedure, called the **client stub**, that represents the server procedure in the client's address space.
- Similarly, the server is bound with a procedure called the **server stub.** These procedures hide the fact that the procedure call from the client to the server is not local.

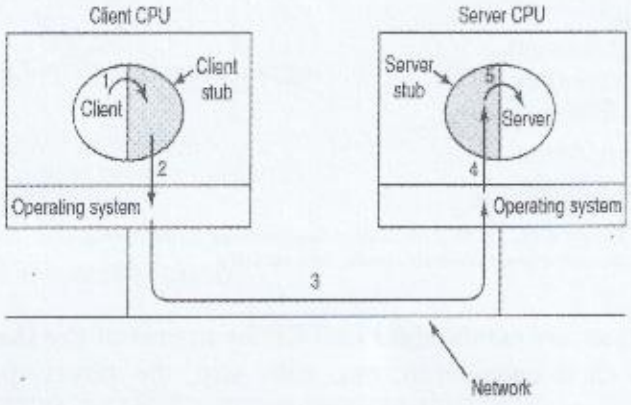


Figure 6-29. Steps in making a remote procedure call. The stubs are shaded.

(b) 2M+2M

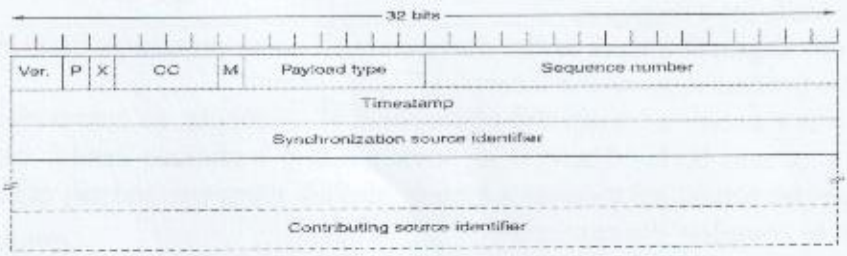


Figure 6-31. The RTP header.

RTP Header

- The basic function of RTP is to multiplex several real-time data streams onto a single stream of UDP packets.
- The UDP stream can be sent to a single destination (unicasting) or to multiple destinations (multicasting).
- The RTP format contains several features to help receivers work with multimedia information.
- Each packet sent in an RTP stream is given a number one. higher than its predecessor.
- This numbering allows the destination to determine if any packets are missing.
- If a packet is missing, the best action for the destination to take is up to the application.
- It consists of three 32-bit words and potentially some extensions.
- The first word contains the Version field, which is already at 2.
- The P bit indicates that the packet has been padded to a multiple of 4 bytes. The last padding byte tells how many bytes were added.
- The X bit indicates that an extension header is present.
- The format and meaning of the extension header are not defined. The only thing that is defined is that the first word of the extension gives the length.
- The CC field tells how many contributing sources are present, from 0 to 15.
- The M bit is an application-specific marker bit.
- The Payload type field tells which encoding algorithm has been used.
- The Sequence number is just a counter that is incremented on each RTP packet sent. It is used to detect lost packets.
- The Timestamp is produced by the stream's source to note when the first sample in the packet was made.
- The Synchronization source identifier tells which stream the packet belongs to. The Contributing source identifiers, if any, are used when mixers are present in the studio.

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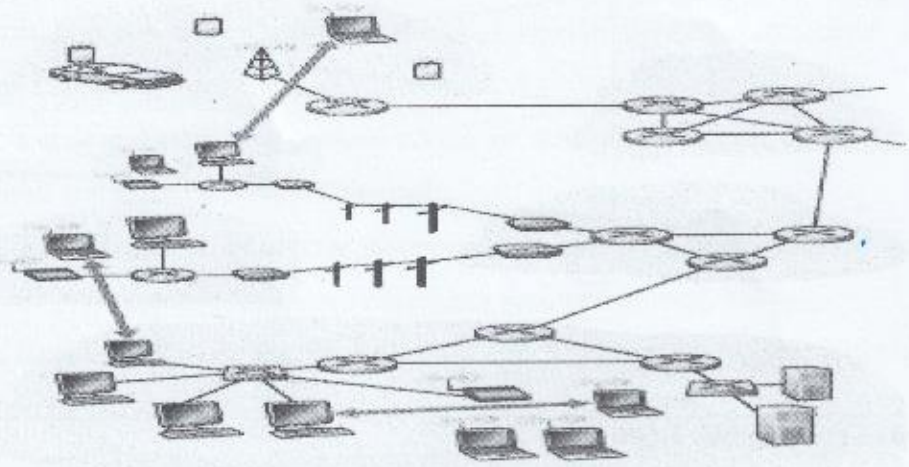
III SESSIONAL TEST QUESTION PAPER 2023 – 24 ODD SEMESTER

SCHEME AND SOLUTION (SET B)

Degree	:	**B.E**	**Semester**	:	**V**
Branch	:	**AI&ML**	**Course Code**	:	**21CS52**
Course Title	:	**Computer Networks**	**Max Marks**	:	**20**

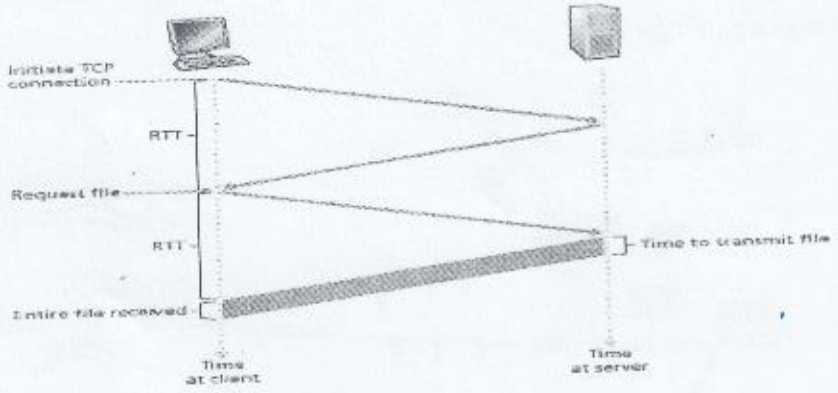
Q.NO.	POINTS	MARKS
1(a)	**Peer-to-Peer Architecture (P2P)** • In a P2P architecture, there is minimal (or no) reliance on dedicated servers. Instead the application exploits direct communication between pairs of intermittently connected hosts, called *peers*. • The peers are not owned by the service provider, but are instead desktops and laptops controlled by users, with most of the peers residing in homes, universities, and offices. • Because the peers communicate without passing through a dedicated server, the architecture is called peer-to-peer. • These applications include file sharing/distribution (e.g., BitTorrent), Internet telephony (e.g., Skype) etc.  b. Peer-to-peer architecture	2M+2M
(b)	**HTTP with Non-Persistent Connections** Steps of transferring a Web page from server to client for the case of non-persistent connections.	2M+2M

Let's suppose the page consists of a base HTML file and 10 JPEG images, and that all 11 of these objects reside on the same server. Further suppose the URL for the base HTML file is-

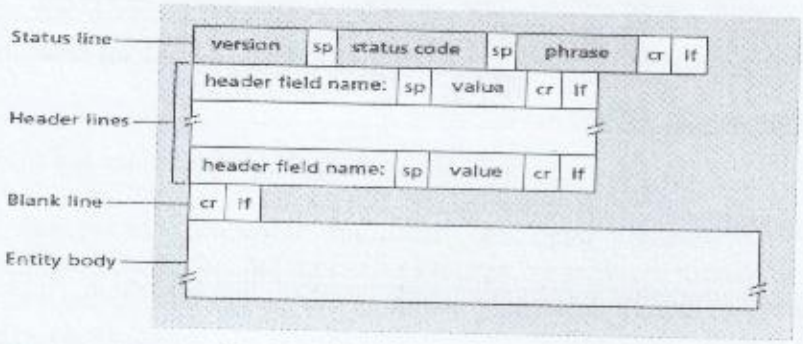
http://www.someSchool.edu/someDepartment/home.index

Here is what happens: à

- The HTTP client process initiates a TCP connection to the server.
- The HTTP client sends an HTTP request message to the server via its
- socket. The request message includes the path name
- The HTTP server process receives the request message via its socket, retrieves the object /someDepartment/home.index from its storage (RAM or disk), encapsulates the object in an HTTP response message, and sends the response message to the client via its socket.
- The HTTP server process tells TCP to close the TCP connection. (But TCP doesn't actually terminate the connection until it knows for sure that the client has received the response message intact.)
- The HTTP client receives the response message. The TCP connection terminates. The message indicates that the encapsulated object is an HTML file.



(c)	**The services provided by DNS:** • There are two ways to identify a host— by a hostname and by an IP address. • People prefer the more mnemonic hostname identifier, while routers prefer an IP addresses.	**4M**

	• To translate hostnames to IP address a special directory service is introduced known as Domain Name System (DNS). • DNS is commonly employed by other application-layer protocols—including HTTP, SMTP, and FTP—to translate user- supplied hostnames to IP addresses. • Example, consider what happens when a browser (that is, an HTTP client), running on some user's host, requests the URL www.bietdvg.edu/index.html. In order for the user's host to be able to send an *HTTP request message* to the Web server www.bietdvg.edu, the user's host must first obtain the IP address of www.bietdvg.edu.	
2(a)	 **HTTP Response Message Format** • The status line has three fields: the protocol version field, a status code, and a corresponding status message. • The status code and associated phrase indicate the result of the request. Some common status codes and associated phrases include: • 200 OK: Request succeeded and the information is returned in the response. • 301 Moved Permanently: Requested object has been permanently moved; • 400 Bad Request: This is a generic error code indicating that the request could not be understood by the server. • 404 Not Found: The requested document does not exist on this server.	**2M+2M**
(b)	**DNS Message Format**	**2M+2M**

- **Identification:** The first field is a 16-bit number that identifies the query. This identifier is copied into the reply message to a query, allowing the client to match received replies with sent queries.
- **Flags:** There are a number of flags in the flag field.

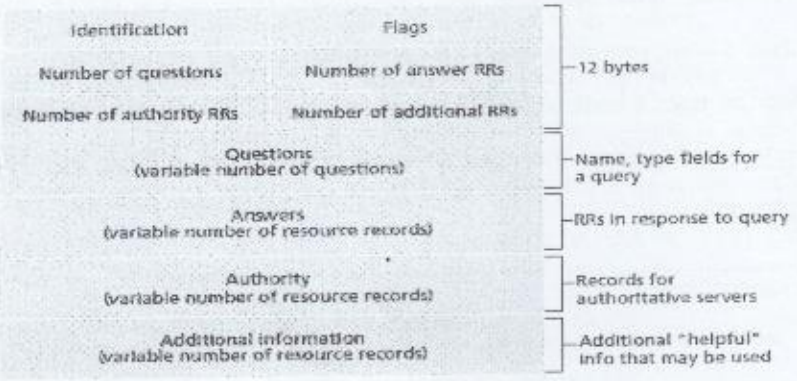


Figure 2.23 • DNS message format

(c) **4M**

Post Office Protocol

- POP3 is an extremely simple mail access protocol. It is defined in [RFC 1939], which is short and quite readable.
- Because the protocol is so simple, its functionality is rather limited.
- POP3 begins when the user agent (the client) opens a TCP connection to the mail server (the server) on port 110. With the TCP connection established, POP3 progresses through three phases:Authorization (U_name, PW), transaction and update.
- In a POP3 transaction, the user agent issues commands, and the server responds to each command with a reply.
- There are two possible responses:
- + OK, used by the server to indicate that the previous command was fine; and
- - ERR, used by the server to indicate that something was wrong with the previous command.

3(a)

IPV4 Psuedo Header Format — 2M+2M

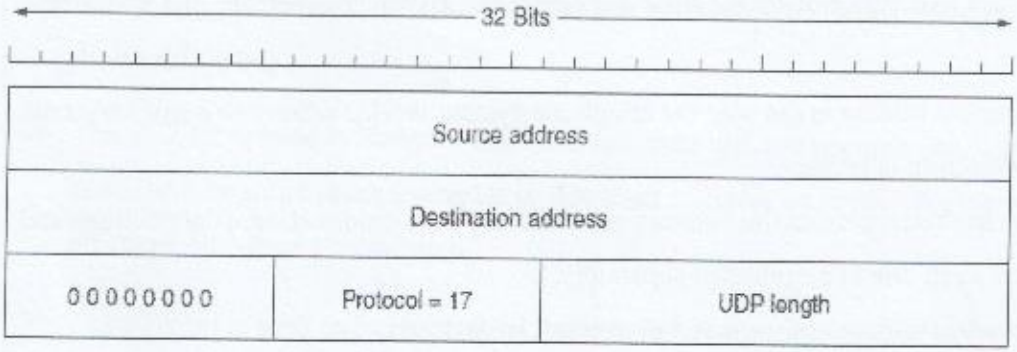


Figure 6-28. The IPv4 pseudoheader included in the UDP checksum.

- It contains the 32-bit IPv4 addresses of the source and destination machines, the protocol number for UDP (17), and the byte count for the UDP segment (including the header).
- It is different but analogous for IPv6.
- Including the pseudo header in the UDP checksum computation helps detect misdelivered packets, but including it also violates the protocol hierarchy since the IP addresses in it belong to the IP layer, not to the UDP layer. TCP uses the same pseudo header for its checksum.

(b)

CONNECTION RELEASE PROTOCOL — 2M+2M

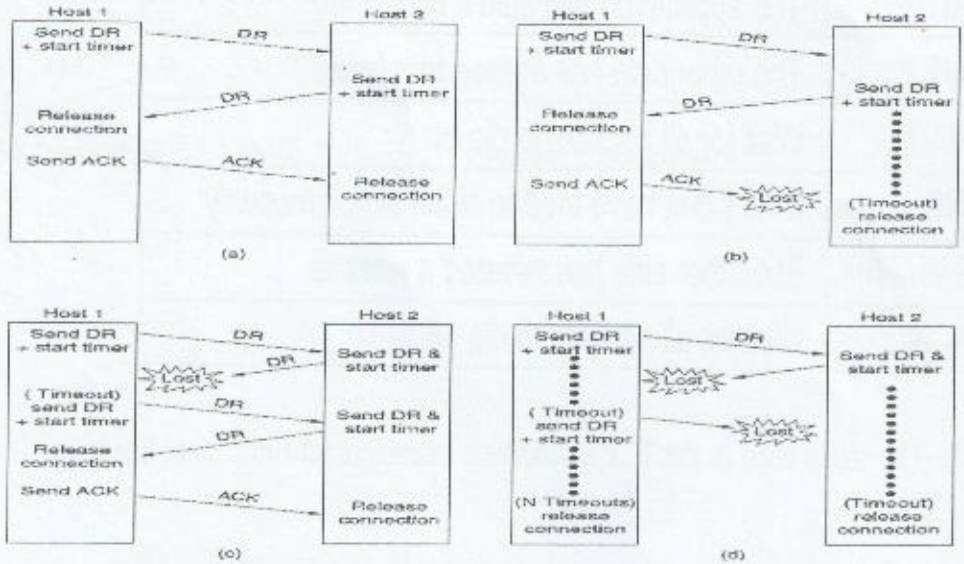


Figure 6-14. Four protocol scenarios for releasing a connection. (a) Normal case of three-way handshake. (b) Final ACK lost. (c) Response lost. (d) Response lost and subsequent DRs lost.

- Releasing a connection is easier than establishing one.

- Nevertheless, there are more pitfalls than one might expect here.
- There are two styles of terminating a connection: asymmetric release and symmetric release.
- Asymmetric release is the way the telephone system works: when one party hangs up, the connection is broken.
- Symmetric release treats the connection as two separate unidirectional connections and requires each one to be released separately.
- Asymmetric release is abrupt and may result in data loss.

4(a) **2M+2M**

State	Description
CLOSED	No connection is active or pending
LISTEN	The server is waiting for an incoming call
SYN RCVD	A connection request has arrived; wait for ACK
SYN SENT	The application has started to open a connection
ESTABLISHED	The normal data transfer state
FIN WAIT 1	The application has said it is finished
FIN WAIT 2	The other side has agreed to release
TIME WAIT	Wait for all packets to die off
CLOSING	Both sides have tried to close simultaneously
CLOSE WAIT	The other side has initiated a release
LAST ACK	Wait for all packets to die off

Figure 6-38. The states used in the TCP connection management finite state machine.

- The receiver is hereby kindly requested to deliver the data to the application upon arrival and not buffer it until a full buffer has been received (which it might otherwise do for efficiency).
- The *RST* bit is used to abruptly reset a connection that has become confused due to a host crash or some other reason. It is also used to reject an invalid segment or refuse an attempt to open a connection.
- The *SYN* bit is used to establish connections. The connection request has $SYN = 1$ and $ACK = 0$ to indicate that the piggyback acknowledgement field is not in use.
- The connection reply does bear an acknowledgement, however, so it has $SYN = 1$ and $ACK = 1$.
- In essence, the *SYN* bit is used to denote both CONNECTION REQUEST and CONNECTION ACCEPTED, with the *ACK* bit used to distinguish between those two possibilities.
- The *FIN* bit is used to release a connection. It specifies that the sender has no more data to *transmit*.

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