Question 1(a) [03 marks]

Differentiate between client server and peer to peer network.

Answer:

Parameter	Client-Server Network	Peer-to-Peer Network
Architecture	Centralized with dedicated server	Decentralized, all nodes equal
Cost	Higher due to server hardware	Lower, uses existing computers
Security	High, centralized control	Lower, distributed control
Scalability	Limited by server capacity	Better, resources increase with nodes

Mnemonic: "CSS-P: Client-Server = Centralized Security, P2P = Peer Power"

Question 1(b) [04 marks]

Explain ARP Protocol with its working.

Answer:

ARP (Address Resolution Protocol) maps IP addresses to MAC addresses in local networks.

Working Process:

- **Broadcast Request**: Host broadcasts ARP request with target IP
- **Cache Check**: Receiving hosts check if IP matches theirs
- **Reply Generation**: Target host sends ARP reply with MAC address
- **Cache Update**: Requesting host updates ARP table

ARP Table Example:

```
IP Address      MAC Address         TTL
192.168.1.1     00:1A:2B:3C:4D:5E   300s
```

Mnemonic: "BCRU: Broadcast, Cache, Reply, Update"

Question 1(c) [07 marks]

Explain OSI model with diagram.

Answer:

The **OSI (Open Systems Interconnection)** model has 7 layers for network communication.

Layer Functions:

- **Physical**: Bit transmission over physical medium
- **Data Link**: Frame transmission, error detection
- **Network**: Routing, IP addressing
- **Transport**: End-to-end delivery, TCP/UDP
- **Session**: Connection management
- **Presentation**: Data encryption, compression
- **Application**: User interfaces, email, web

Mnemonic: "All People Seem To Need Data Processing"

Question 1(c OR) [07 marks]

What is Congestion? Explain Congestion Control.

Answer:

Congestion occurs when network traffic exceeds available bandwidth, causing packet delays and losses.

Types of Congestion Control:

Type	Method	Description
Open-Loop	Prevention	Traffic shaping before congestion
Closed-Loop	Reaction	Feedback-based adjustment

Congestion Control Techniques:

- **Traffic Shaping**: Regulate data transmission rate
- **Admission Control**: Limit new connections during congestion
- **Load Shedding**: Drop packets when buffers full
- **Backpressure**: Send congestion signals upstream

Mnemonic: "TALB: Traffic, Admission, Load, Backpressure"

Question 2(a) [03 marks]

What is Ad-hoc Network? Explain it.

Answer:

Ad-hoc Network is a wireless network without fixed infrastructure where nodes communicate directly.

Characteristics:

- **Self-organizing**: Automatic network formation
- **Dynamic topology**: Nodes can join/leave freely

- **Multi-hop routing**: Messages relay through intermediate nodes
- **Distributed control**: No central authority

Applications:

- Emergency response, military operations, sensor networks

Mnemonic: "SDMD: Self-organizing, Dynamic, Multi-hop, Distributed"

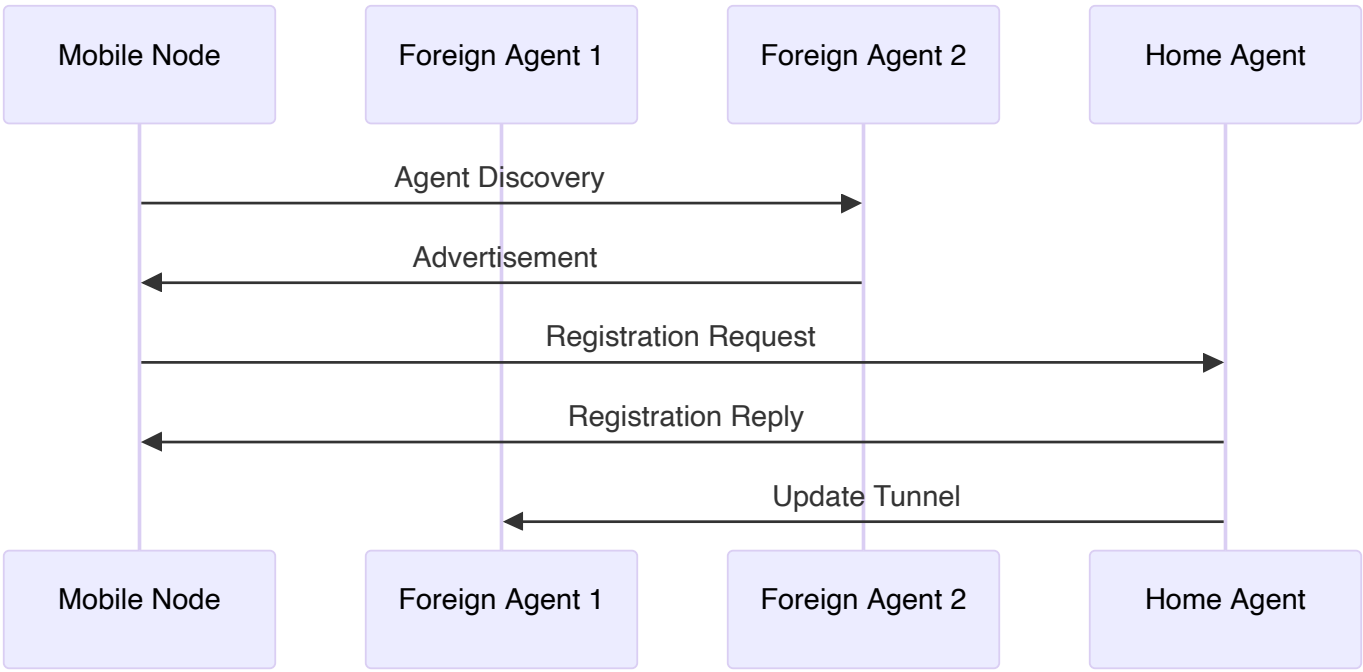
Question 2(b) [04 marks]

Explain Handover Management in Mobile IP.

Answer:

Handover is the process of maintaining connectivity when a mobile node moves between networks.

Handover Process:



Types:

- **Hard Handover**: Break-before-make connection
- **Soft Handover**: Make-before-break connection

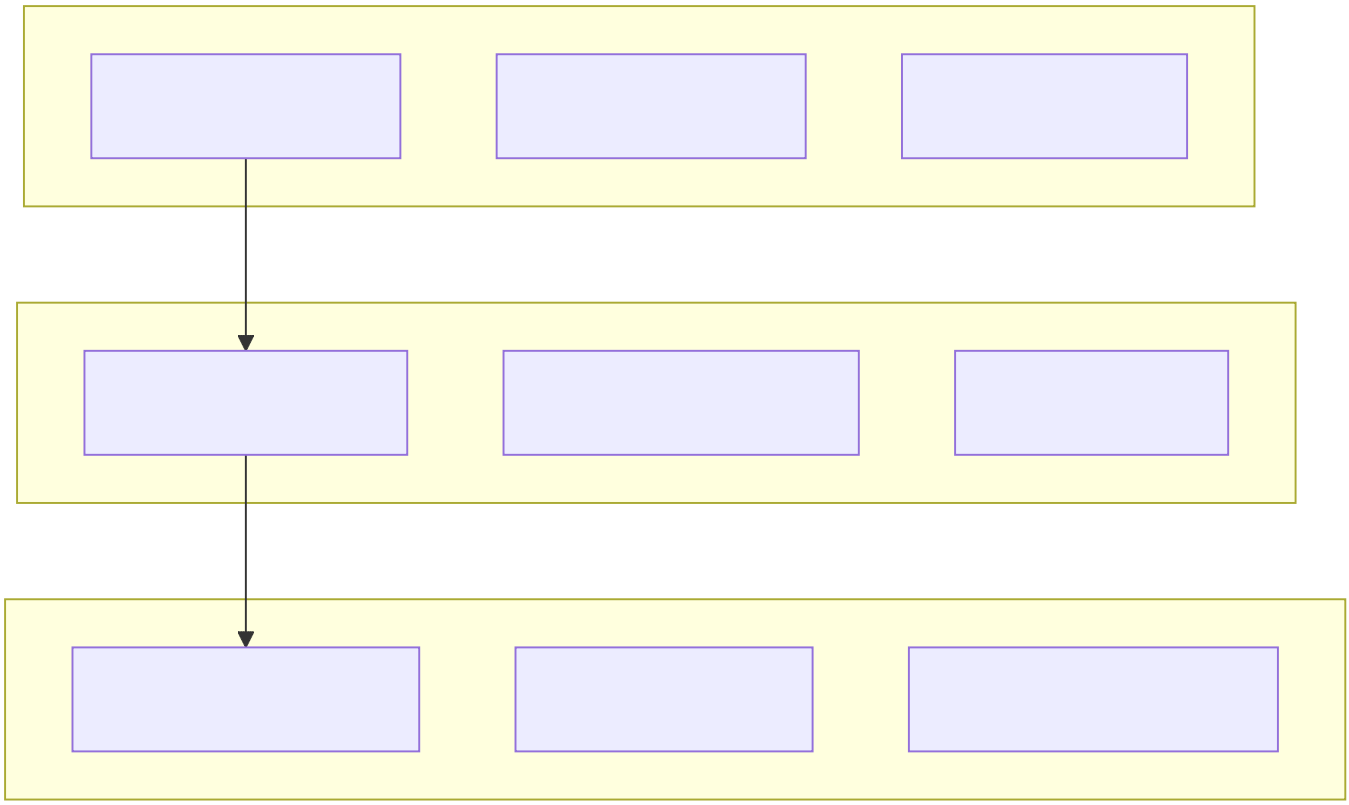
Mnemonic: "DARU: Discovery, Advertisement, Registration, Update"

Question 2(c) [07 marks]

Explain Three tier architecture of mobile computing with diagram.

Answer:

Three-tier architecture separates mobile applications into presentation, application logic, and data layers.



Layer Functions:

- **Presentation**: User interface, mobile apps
- **Application**: Business logic, middleware services
- **Data**: Database management, storage systems

Benefits:

- **Scalability**: Independent layer scaling
- **Maintainability**: Separate concerns
- **Flexibility**: Technology independence

Mnemonic: "PAD: Presentation, Application, Data"

Question 2(a OR) [03 marks]

Explain Need of Wireless Network.

Answer:

Wireless Networks provide connectivity without physical cables.

Needs:

- **Mobility**: Users can move freely while connected
- **Flexibility**: Easy network expansion and reconfiguration
- **Cost-effective**: Reduced cabling infrastructure costs

- **Accessibility**: Internet access in remote areas

Applications:

- Mobile communications, WiFi hotspots, IoT devices

Mnemonic: "MFCA: Mobility, Flexibility, Cost, Accessibility"

Question 2(b OR) [04 marks]

Explain Registration, tunneling and encapsulation in mobile ip.

Answer:

Mobile IP Components:

Process	Description	Purpose
Registration	Mobile node registers with home agent	Location update
Tunneling	Creates virtual path between agents	Route packets
Encapsulation	Wraps original packet in new header	Address translation

Process Flow:

```
Original Packet → Encapsulation → Tunnel → Decapsulation → Destination
```

Registration Steps:

- Mobile node discovers foreign agent
- Sends registration request to home agent
- Home agent updates location binding

Mnemonic: "RTE: Registration, Tunneling, Encapsulation"

Question 2(c OR) [07 marks]

What is Middleware? Write down examples of middleware and explain any one of them in detail.

Answer:

Middleware is software that connects different applications and services in distributed systems.

Examples of Middleware:

- **Message-Oriented Middleware (MOM)**
- **Remote Procedure Call (RPC)**
- **Object Request Broker (ORB)**
- **Database Middleware**
- **Web Services**

Message-Oriented Middleware (MOM) - Detailed:

Architecture:

Features:

- **Asynchronous Communication**: Non-blocking message exchange
- **Reliability**: Message persistence and delivery guarantees
- **Scalability**: Handle multiple concurrent connections
- **Platform Independence**: Cross-platform communication

Benefits:

- Loose coupling between applications
- Improved system reliability
- Better fault tolerance

Mnemonic: "ARSP: Asynchronous, Reliable, Scalable, Platform-independent"

Question 3(a) [03 marks]

Give Full form for 'www'. Explain it.

Answer:

WWW = World Wide Web

Explanation:

- **Global Information System**: Interconnected web of documents
- **HTTP Protocol**: Uses HyperText Transfer Protocol
- **URL Addressing**: Unique resource locators
- **Hyperlinks**: Navigate between web pages

Components:

- Web servers, browsers, HTML documents, URLs

Mnemonic: "GHUH: Global, HTTP, URL, Hyperlinks"

Question 3(b) [04 marks]

Explain applications of Mobile Computing.

Answer:

Mobile Computing Applications:

Category	Applications	Benefits
Business	Email, CRM, Sales	Productivity, Real-time access
Healthcare	Patient monitoring, Telemedicine	Remote care, Emergency response
Education	E-learning, Digital libraries	Flexible learning, Resource access
Entertainment	Gaming, Streaming, Social media	On-demand content, Connectivity

Key Features:

- **Location-based services**: GPS navigation, local search
- **Mobile payments**: Digital wallets, contactless transactions
- **IoT integration**: Smart home, wearable devices

Mnemonic: "BHEE: Business, Healthcare, Education, Entertainment"

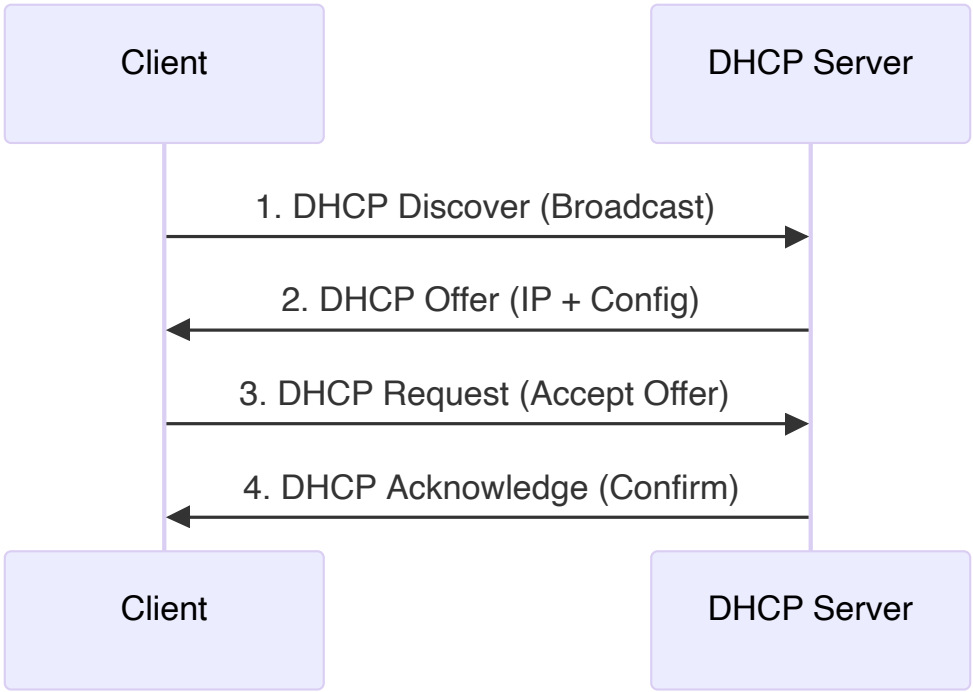
Question 3(c) [07 marks]

Explain working of DHCP with the help of diagram and explain its advantages.

Answer:

DHCP (Dynamic Host Configuration Protocol) automatically assigns IP addresses to network devices.

DHCP Process (DORA):



Configuration Information Provided:

- IP address and subnet mask
- Default gateway address

- DNS server addresses
- Lease duration

Advantages:

- **Automatic Configuration**: No manual IP assignment
- **Centralized Management**: Single point of control
- **Efficient IP Usage**: Dynamic allocation prevents waste
- **Reduced Errors**: Eliminates manual configuration mistakes
- **Easy Maintenance**: Simple network changes

DHCP Message Types:

- DISCOVER, OFFER, REQUEST, ACK, NAK, RELEASE, RENEW

Mnemonic: "DORA: Discover, Offer, Request, Acknowledge"

Question 3(a OR) [03 marks]

Write down: Importance of HTTPS.

Answer:

HTTPS (HyperText Transfer Protocol Secure) provides secure web communication.

Importance:

- **Data Encryption**: Protects data in transit using SSL/TLS
- **Authentication**: Verifies server identity with certificates
- **Data Integrity**: Prevents data tampering during transmission
- **Trust Building**: Increases user confidence in websites

Security Benefits:

- Protection against eavesdropping and man-in-the-middle attacks

Mnemonic: "EADT: Encryption, Authentication, Integrity, Trust"

Question 3(b OR) [04 marks]

What is Bearer Network? Explain in Detail.

Answer:

Bearer Network is the underlying network infrastructure that carries data traffic between endpoints.

Types of Bearer Networks:

Type	Technology	Characteristics
Circuit-Switched	Traditional telephony	Dedicated path, Guaranteed bandwidth
Packet-Switched	Internet, IP networks	Shared resources, Variable bandwidth
Wireless	Cellular, WiFi	Mobile connectivity, Air interface

Functions:

- **Data Transport**: Carry user data and signaling
- **Quality of Service**: Manage bandwidth and latency
- **Routing**: Direct traffic between networks
- **Network Management**: Monitor and control traffic

Examples:

- PSTN, Internet backbone, 4G/5G cellular networks

Mnemonic: "DQRN: Data transport, QoS, Routing, Network management"

Question 3(c OR) [07 marks]

List out types of TCP and explain any one in detail.

Answer:

Types of TCP:

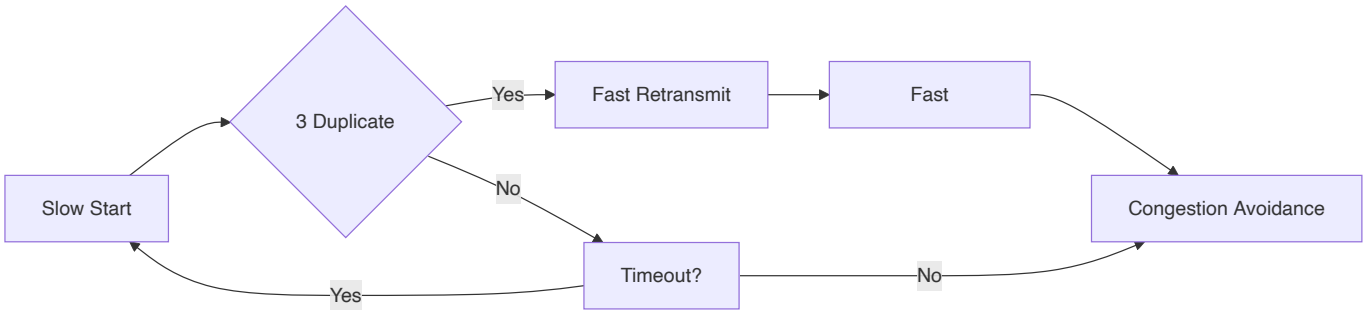
- **Standard TCP (TCP Tahoe)**
- **TCP Reno**
- **TCP New Reno**
- **TCP Vegas**
- **TCP SACK (Selective Acknowledgment)**
- **TCP Cubic**

TCP Reno - Detailed Explanation:

Features:

- **Fast Retransmit**: Retransmit lost packets quickly
- **Fast Recovery**: Avoid slow start after fast retransmit
- **Congestion Avoidance**: Linear increase in congestion window
- **Duplicate ACK Detection**: Identify packet loss

Congestion Control Algorithm:



Advantages:

- **Better Performance**: Faster recovery from packet loss
- **Efficiency**: Maintains higher throughput
- **Fairness**: Equitable bandwidth sharing

Window Management:

- Exponential growth in slow start
- Linear growth in congestion avoidance

Mnemonic: "FFCE: Fast retransmit, Fast recovery, Congestion avoidance, Efficiency"

Question 4(a) [03 marks]

Define WLAN. List out types of WLAN.

Answer:

WLAN (Wireless Local Area Network) provides wireless connectivity within a limited area.

Types of WLAN:

- **Infrastructure Mode**: Uses access points for connectivity
- **Ad-hoc Mode**: Direct device-to-device communication
- **Mesh Networks**: Multi-hop wireless connectivity
- **Hybrid Networks**: Combination of infrastructure and ad-hoc

Standards:

- IEEE 802.11a/b/g/n/ac/ax (WiFi 6)

Mnemonic: "IAMH: Infrastructure, Ad-hoc, Mesh, Hybrid"

Question 4(b) [04 marks]

What is Routing? Explain types of Routing.

Answer:

Routing is the process of selecting paths for data packets across networks.

Types of Routing:

Type	Method	Characteristics
Static Routing	Manual configuration	Fixed paths, No automatic updates
Dynamic Routing	Automatic updates	Adaptive paths, Real-time changes
Default Routing	Catch-all route	Used when no specific route exists
Distance Vector	Hop count based	RIP protocol, Simple implementation
Link State	Network topology	OSPF protocol, Faster convergence

Dynamic Routing Advantages:

- **Automatic adaptation** to network changes
- **Load balancing** across multiple paths
- **Fault tolerance** with alternate routes

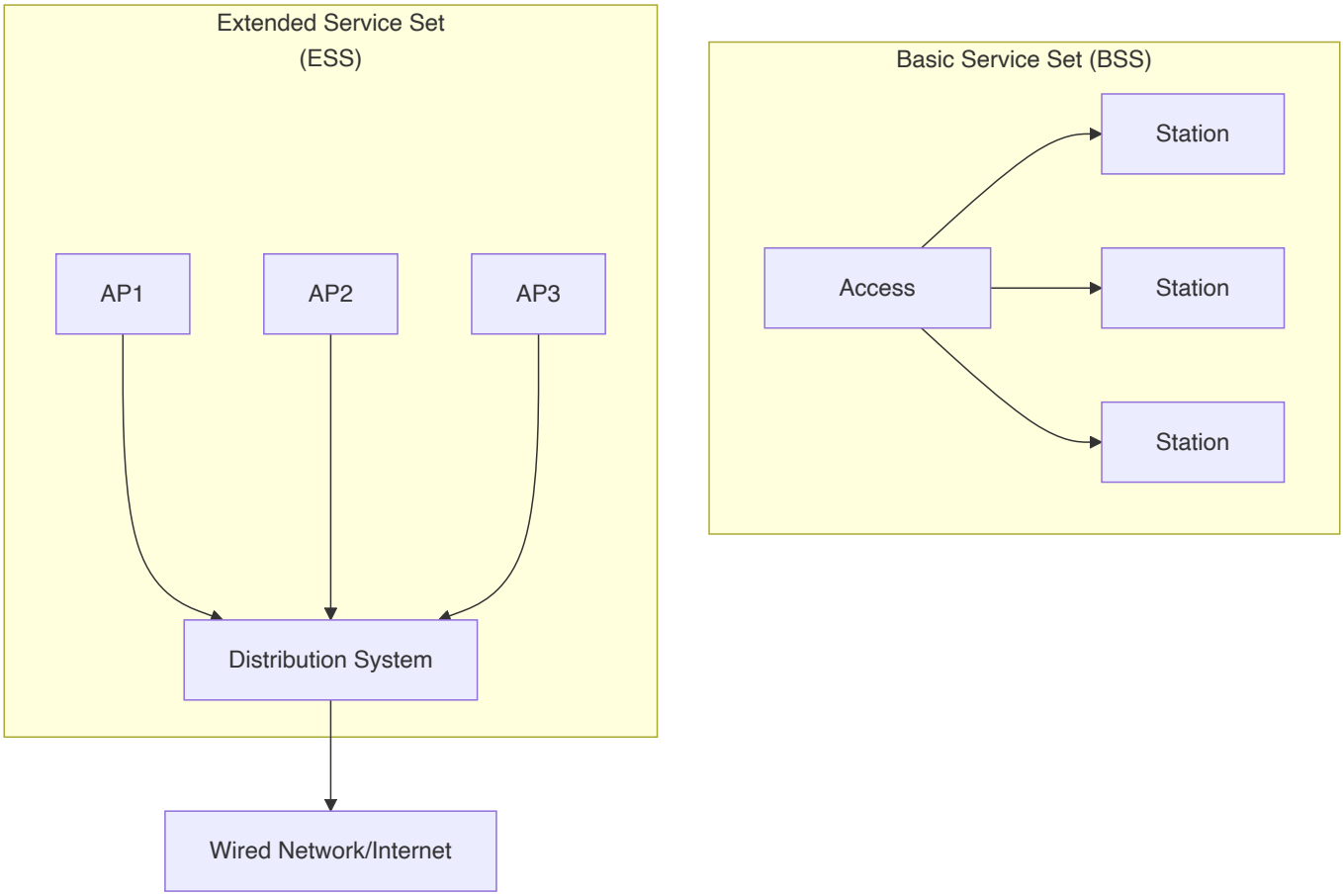
Mnemonic: "SDDL: Static, Dynamic, Default, Link-state"

Question 4(c) [07 marks]

Explain architecture of WLAN.

Answer:

WLAN Architecture Components:



Architecture Elements:

- **Station (STA)**: Wireless client devices
- **Access Point (AP)**: Central wireless hub
- **Basic Service Set (BSS)**: Single AP coverage area
- **Extended Service Set (ESS)**: Multiple interconnected APs
- **Distribution System (DS)**: Backend network connecting APs

WLAN Topologies:

- **Infrastructure Mode**: Centralized through AP
- **Ad-hoc Mode**: Direct peer-to-peer communication
- **Mesh Topology**: Multi-hop wireless connections

Services Provided:

- **Association**: Device connection to AP
- **Authentication**: Security verification
- **Data Delivery**: Packet transmission
- **Roaming**: Seamless movement between APs

Frequency Bands:

- 2.4 GHz (802.11b/g/n)
- 5 GHz (802.11a/n/ac/ax)

Mnemonic: "SABED: Station, Access Point, BSS, ESS, Distribution System"

Question 4(a OR) [03 marks]

Define WPAN. List out applications of WPAN.

Answer:

WPAN (Wireless Personal Area Network) connects devices within personal space (typically 10 meters).

Applications of WPAN:

- **Device Synchronization**: Phone to computer data transfer
- **Audio Streaming**: Wireless headphones, speakers
- **Input Devices**: Wireless keyboard, mouse
- **Healthcare**: Medical sensors, fitness trackers
- **Smart Home**: IoT device control

Technologies:

- Bluetooth, Zigbee, NFC, infrared

Mnemonic: "DSAHS: Device sync, Streaming, Audio, Healthcare, Smart home"

Question 4(b OR) [04 marks]

Explain working of IMAP Protocol.

Answer:

IMAP (Internet Message Access Protocol) manages email on mail servers.

IMAP Working Process:

Step	Action	Description
Connection	Client connects to server	Establish TCP connection on port 143/993
Authentication	Login credentials	Username/password verification
Mailbox Selection	Choose folder	Select INBOX or other folders
Message Operations	Read/Delete/Flag	Manipulate messages on server

IMAP vs POP3:

- **Server Storage**: Messages remain on server
- **Multi-device Access**: Sync across devices
- **Folder Management**: Server-side folder structure
- **Partial Download**: Headers first, body on demand

IMAP Commands:

```
LOGIN user password
SELECT INBOX
FETCH 1 BODY[]
STORE 1 +FLAGS (\Deleted)
```

Mnemonic: "CAMS: Connection, Authentication, Mailbox, Storage"

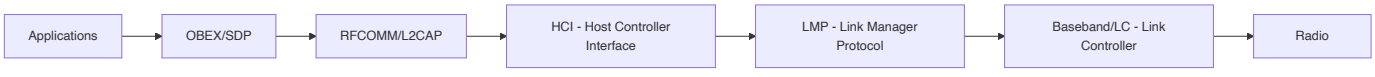
Question 4(c OR) [07 marks]

Explain Bluetooth technology with a figure of its protocol stack.

Answer:

Bluetooth is a short-range wireless communication technology for personal area networks.

Bluetooth Protocol Stack:



Layer Functions:

- **Radio Layer**: 2.4 GHz ISM band, frequency hopping
- **Baseband**: Timing, access control, packet formats
- **LMP**: Link establishment, security, power management
- **L2CAP**: Packet segmentation, protocol multiplexing
- **RFCOMM**: Serial port emulation over wireless
- **SDP**: Service discovery protocol
- **Applications**: File transfer, audio streaming, HID

Bluetooth Characteristics:

- **Range**: 10 meters (Class 2 devices)
- **Data Rate**: 1-3 Mbps (depending on version)
- **Topology**: Star network (piconet)
- **Security**: Authentication, authorization, encryption

Bluetooth Versions:

- Classic Bluetooth (BR/EDR)
- Bluetooth Low Energy (BLE/LE)
- Bluetooth 5.0+ (Enhanced range/speed)

Applications:

- Audio devices, keyboards, file transfer, IoT sensors

Mnemonic: "RBLSRA: Radio, Baseband, LMP, SDP, RFCOMM, Applications"

Question 5(a) [03 marks]

What is 4G? List out Features of 4G.

Answer:

4G (Fourth Generation) is a mobile communication standard providing high-speed wireless internet.

Features of 4G:

- **High Data Speed**: Up to 100 Mbps mobile, 1 Gbps stationary
- **All-IP Network**: Packet-switched architecture
- **Low Latency**: Reduced delay for real-time applications
- **Quality of Service**: Guaranteed service levels
- **Global Roaming**: Worldwide compatibility

Technologies:

- LTE (Long Term Evolution), WiMAX

Mnemonic: "HALQG: High-speed, All-IP, Low latency, QoS, Global roaming"

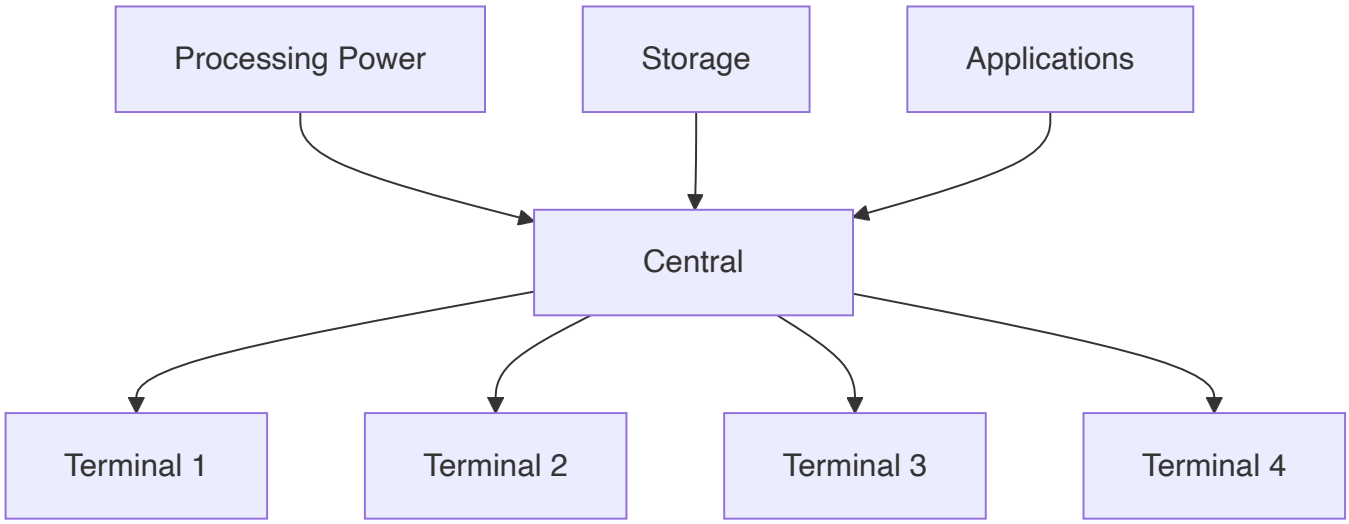
Question 5(b) [04 marks]

Explain Centralized Computing.

Answer:

Centralized Computing processes all data and applications on a central server.

Architecture:



Characteristics:

- **Single Point of Control**: All processing at central location
- **Thin Clients**: Minimal local processing capability
- **Shared Resources**: CPU, memory, storage centrally managed
- **Network Dependent**: Requires reliable network connectivity

Advantages:

- **Security**: Centralized data protection
- **Management**: Easier system administration
- **Cost**: Lower client-side hardware costs

Disadvantages:

- **Single Point of Failure**: Server downtime affects all users
- **Network Bottleneck**: Heavy reliance on network performance

Mnemonic: "SSNG: Single control, Shared resources, Network dependent, Greater security"

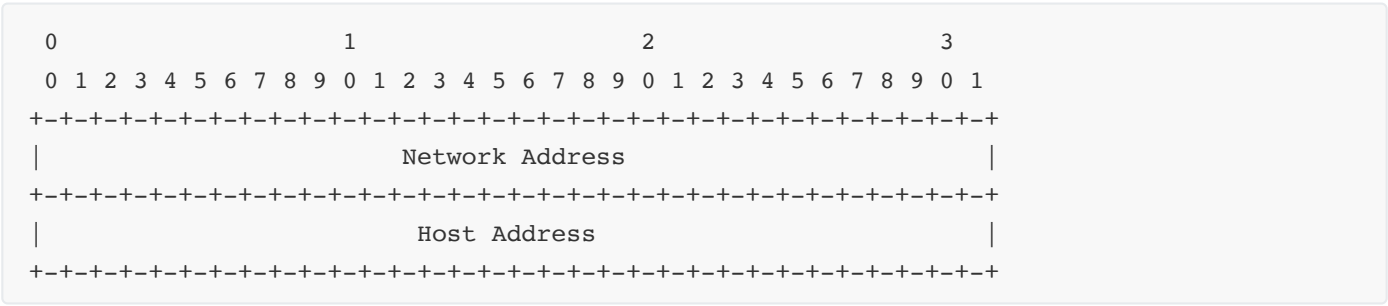
Question 5(c) [07 marks]

What is ipv4 addressing scheme? Explain with a neat and clean diagram with its working.

Answer:

IPv4 (Internet Protocol version 4) uses 32-bit addresses for network identification.

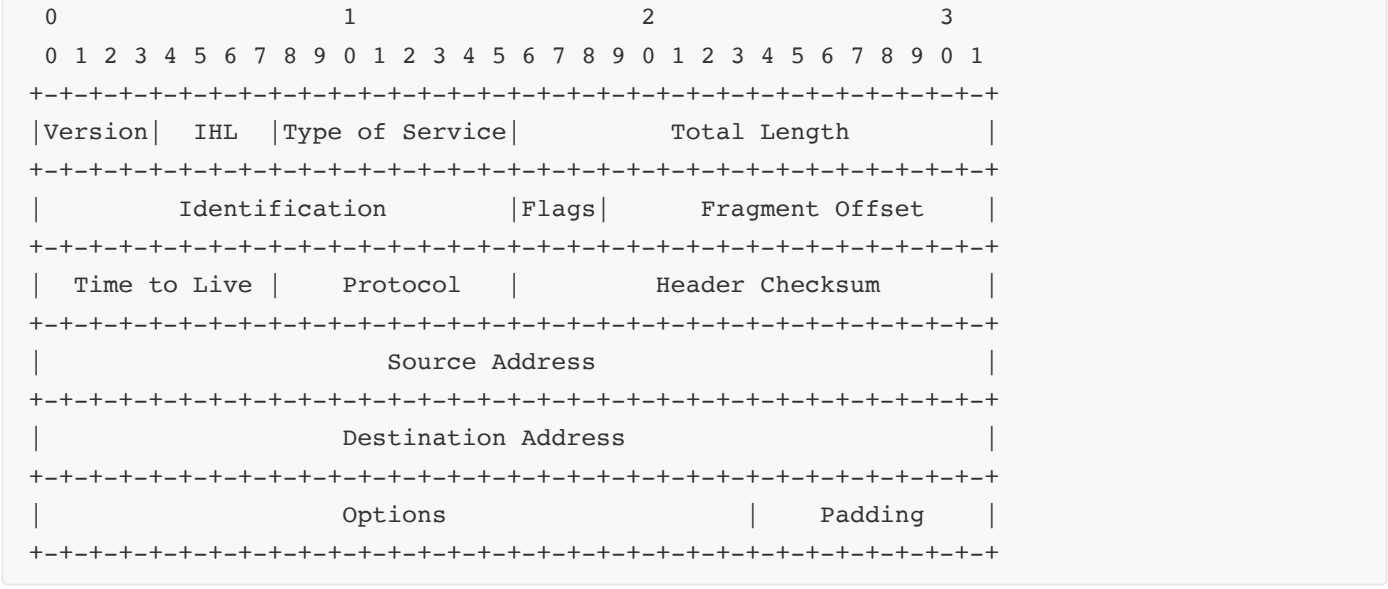
IPv4 Address Structure:



IPv4 Address Classes:

Class	Range	Network Bits	Host Bits	Default Subnet Mask
A	1-126	8	24	255.0.0.0
B	128-191	16	16	255.255.0.0
C	192-223	24	8	255.255.255.0
D	224-239	Multicast	-	-
E	240-255	Experimental	-	-

IPv4 Packet Header:



Working Process:

- **Address Assignment**: Network administrator assigns IP addresses
- **Routing Decision**: Router examines destination IP
- **Subnet Determination**: Apply subnet mask to find network
- **Packet Forwarding**: Route to appropriate network interface

Special Addresses:

- **Loopback**: 127.0.0.1 (localhost)
- **Private**: 10.x.x.x, 172.16-31.x.x, 192.168.x.x
- **Broadcast**: 255.255.255.255

Limitations:

- **Address Exhaustion**: Only 4.3 billion addresses
- **Inefficient Allocation**: Class-based wastage

Mnemonic: "ABCDE: Address classes A, B, C, D multicast, E experimental"

Question 5(a OR) [03 marks]

What is 5G? List out Features of 5G.

Answer:

5G (Fifth Generation) is the latest mobile communication standard with enhanced capabilities.

Features of 5G:

- **Ultra-High Speed**: Up to 10 Gbps data rates
- **Ultra-Low Latency**: Less than 1ms response time
- **Massive Connectivity**: 1 million devices per km²
- **Network Slicing**: Virtual dedicated networks
- **Enhanced Mobile Broadband**: Improved user experience

Key Technologies:

- Millimeter wave, Massive MIMO, Beamforming

Mnemonic: "UUMNE: Ultra-speed, Ultra-low latency, Massive connectivity, Network slicing, Enhanced broadband"

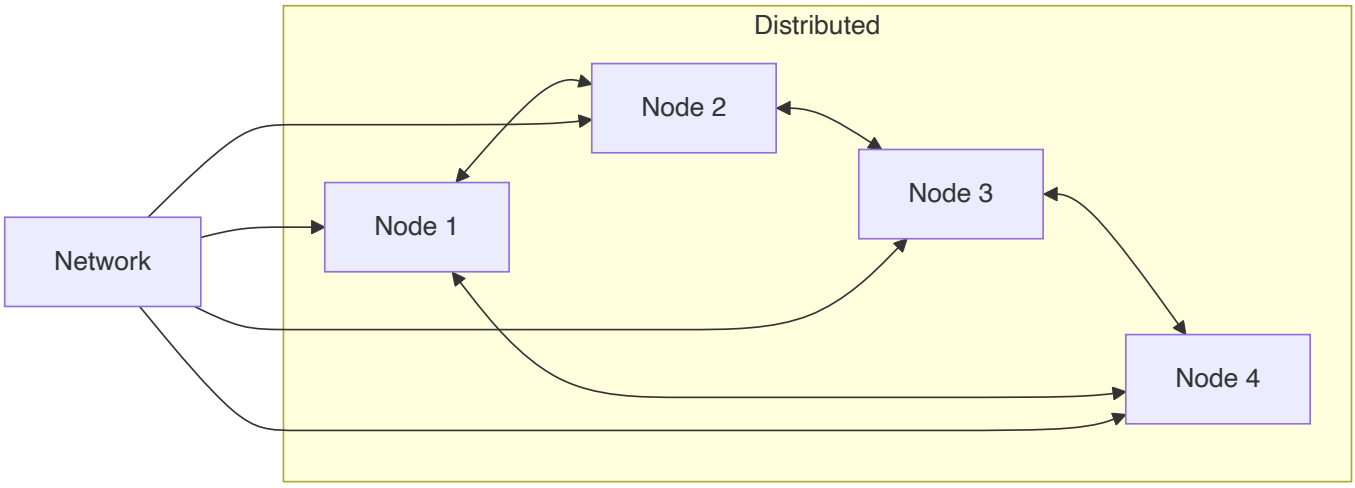
Question 5(b OR) [04 marks]

Explain Distributed Computing

Answer:

Distributed Computing spreads processing across multiple interconnected computers.

Architecture:



Characteristics:

- **Resource Sharing**: Distributed processing and storage
- **Scalability**: Add more nodes to increase capacity
- **Fault Tolerance**: System continues if some nodes fail
- **Location Transparency**: Users unaware of resource locations

Advantages:

- **Reliability**: No single point of failure
- **Performance**: Parallel processing capabilities
- **Cost-effectiveness**: Use commodity hardware

Examples:

- Cloud computing, peer-to-peer networks, grid computing

Mnemonic: "RSFL: Resource sharing, Scalability, Fault tolerance, Location transparency"

Question 5(c OR) [07 marks]

Explain Data Link Layer Protocol.

Answer:

Data Link Layer provides reliable data transfer between adjacent network nodes.

Functions:

- **Framing**: Organize bits into frames
- **Error Detection**: Identify transmission errors
- **Error Correction**: Fix detected errors
- **Flow Control**: Manage data transmission rate
- **Access Control**: Coordinate shared media access

Frame Structure:

```
+----------+----------+----------+----------+----------+
| Start    | Address  | Control  | Data     | FCS      |
| Delimiter| Field    | Field    | Field    | (CRC)    |
+----------+----------+----------+----------+----------+
```

Error Detection Methods:

Method	Description	Capability
Parity Check	Single bit addition	Detect single-bit errors
Checksum	Arithmetic sum	Detect multiple errors
CRC	Polynomial division	Detect burst errors

Flow Control Protocols:

- **Stop-and-Wait**: Send one frame, wait for ACK
- **Sliding Window**: Multiple frames in transit
- **Stop-and-Wait ARQ**: Add error recovery
- **Go-Back-N ARQ**: Retransmit from error point
- **Selective Repeat**: Retransmit only error frames

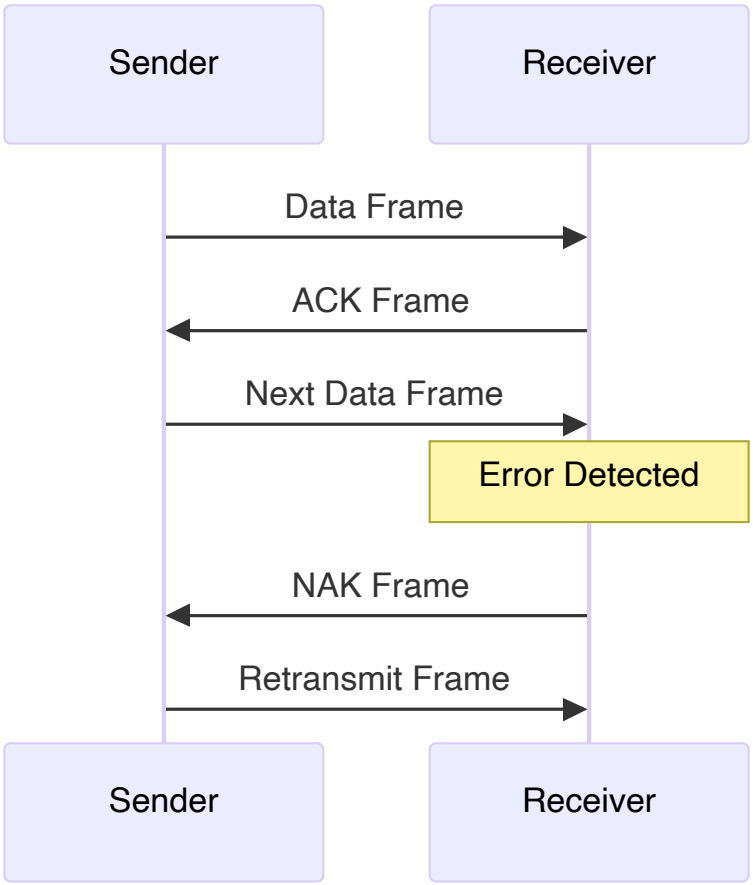
Access Control Methods:

- **CSMA/CD**: Carrier Sense Multiple Access with Collision Detection
- **CSMA/CA**: Collision Avoidance
- **Token Passing**: Controlled access using token

Protocol Examples:

- Ethernet, PPP, HDLC, LLC

Working Process:



Mnemonic: "FECFA: Framing, Error detection, Correction, Flow control, Access control"