

# Subject Name Solutions

4351602 – Winter 2023

Semester 1 Study Material

*Detailed Solutions and Explanations*

## Question 1(a) [03 marks]

Differentiate between client server and peer to peer network.

### Solution

Parameter	Client-Server Network	Peer-to-Peer Network
<b>Architecture</b>	Centralized with dedicated server	Decentralized, all nodes equal
<b>Cost</b>	Higher due to server hardware	Lower, uses existing computers
<b>Security</b>	High, centralized control	Lower, distributed control
<b>Scalability</b>	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.

### Solution

**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.

### Solution

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

#### Mermaid Diagram (Code)

```
{Shaded}
{Highlighting} []
graph LR
    A[Application Layer {- 7} {-}{-}{-}{} B[Presentation Layer {-} 6]]
    B {-{-}{-}{} C[Session Layer {-} 5]}
```

```

C {-{-}{}} D[Transport Layer {-} 4]
D {-{-}{}} E[Network Layer {-} 3]
E {-{-}{}} F[Data Link Layer {-} 2]
F {-{-}{}} G[Physical Layer {-} 1]
{Highlighting}
{Shaded}

```

#### **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.**

#### **Solution**

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

#### **Types of Congestion Control:**

Type	Method	Description
<b>Open-Loop</b>	Prevention	Traffic shaping before congestion
<b>Closed-Loop</b>	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.**

#### **Solution**

**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.

#### Solution

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

**Handover Process:**

```
sequenceDiagram
    participant MN as Mobile Node
    participant FA1 as Foreign Agent 1
    participant FA2 as Foreign Agent 2
    participant HA as Home Agent

    MN{-FA2: Agent Discovery}
    FA2{-MN: Advertisement}
    MN{-HA: Registration Request}
    HA{-MN: Registration Reply}
    HA{-FA1: Update Tunnel}
```

**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.

#### Solution

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

```
graph TB
    subgraph "Tier 1: Presentation Layer"
        A[Mobile Device]
        B[User Interface]
        C[Input/Output]
    end

    subgraph "Tier 2: Application Layer"
        D[Business Logic]
        E[Processing Rules]
        F[Middleware]
    end

    subgraph "Tier 3: Data Layer"
        G[Database Server]
        H[Data Storage]
        I[Data Management]
    end

    A {-{-} D}
    D {-{-} G}
```

**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.**

**Solution**

**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.**

**Solution****Mobile IP Components:**

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

**Process Flow:**

Original Packet  $\rightarrow$  Encapsulation  $\rightarrow$  Tunnel  $\rightarrow$  Decapsulation  $\rightarrow$  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.

### Solution

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:

Mermaid Diagram (Code)

```
{Shaded}
{Highlighting} []
graph LR
    A[Sender Application] --> B[Message Queue]
    B --> C[MOM Layer]
    C --> D[Message Queue]
    D --> E[Receiver Application]
{Highlighting}
{Shaded}
```

##### 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.

### Solution

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.

#### Solution

##### Mobile Computing Applications:

Category	Applications	Benefits
<b>Business</b>	Email, CRM, Sales	Productivity, Real-time access
<b>Healthcare</b>	Patient monitoring, Telemedicine	Remote care, Emergency response
<b>Education</b>	E-learning, Digital libraries	Flexible learning, Resource access
<b>Entertainment</b>	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.

#### Solution

**DHCP (Dynamic Host Configuration Protocol)** automatically assigns IP addresses to network devices.  
**DHCP Process (DORA):**

```
sequenceDiagram
    participant C as Client
    participant S as DHCP Server

    C{-S: 1. DHCP Discover (Broadcast)}
    S{-C: 2. DHCP Offer (IP + Config)}
    C{-S: 3. DHCP Request (Accept Offer)}
    S{-C: 4. DHCP Acknowledge (Confirm)}
```

##### 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.

#### Solution

**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.

#### Solution

**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.

#### Solution

##### 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:

#### Mermaid Diagram (Code)

```
{Shaded}  
{Highlighting} []  
graph LR  
    A[Slow Start] --> B{3 Duplicate ACKs?}  
    B -- Yes --> C[Fast Retransmit]  
    B -- No --> D[Fast Recovery]  
    C --> E[Congestion Avoidance]  
    D --> E  
    E --> F[Timeout?]  
    F -- Yes --> A  
    F -- No --> E  
{Highlighting}  
{Shaded}
```

### 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.

### Solution

**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.

## Solution

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

### Types of Routing:

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

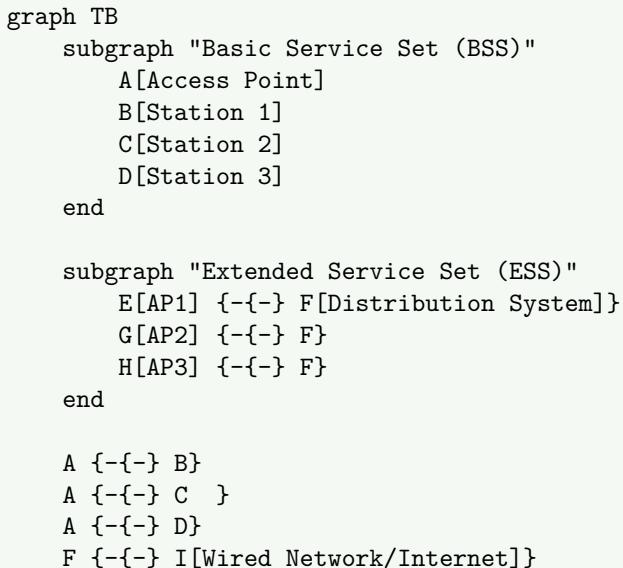
“SDDL: Static, Dynamic, Default, Link-state”

## Question 4(c) [07 marks]

Explain architecture of WLAN.

## Solution

### 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.

**Solution**

**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.

**Solution**

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

**IMAP Working Process:**

Step	Action	Description
<b>Connection</b>	Client connects to server	Establish TCP connection on port 143/993
<b>Authentication</b>	Login credentials	Username/password verification
<b>Mailbox Selection</b>	Choose folder	Select INBOX or other folders
<b>Message Operations</b>	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.

### Solution

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

#### Bluetooth Protocol Stack:

Mermaid Diagram (Code)

```
{Shaded}  
{Highlighting}[]  
graph LR  
    A[Applications] --> B[OBEX/SDP]  
    B --> C[RFCOMM/L2CAP]  
    C --> D[HCI <--> Host Controller Interface]  
    D --> E[LMP <--> Link Manager Protocol]  
    E --> F[Baseband/LC <--> Link Controller]  
    F --> G[Radio Layer]  
{Highlighting}  
{Shaded}
```

#### 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.

### Solution

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”

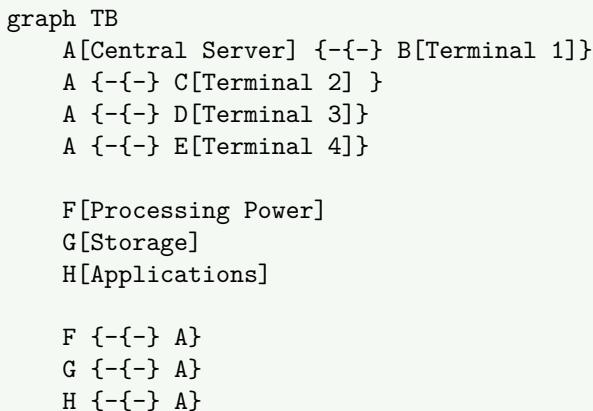
### Question 5(b) [04 marks]

Explain Centralized Computing.

#### Solution

**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”

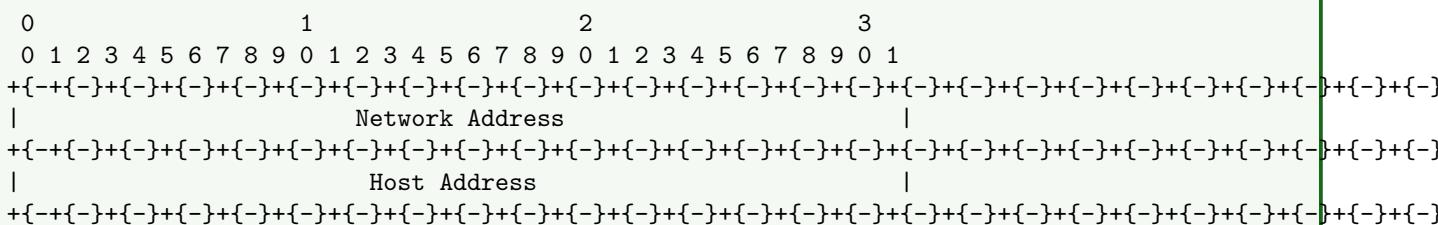
### Question 5(c) [07 marks]

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

#### Solution

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

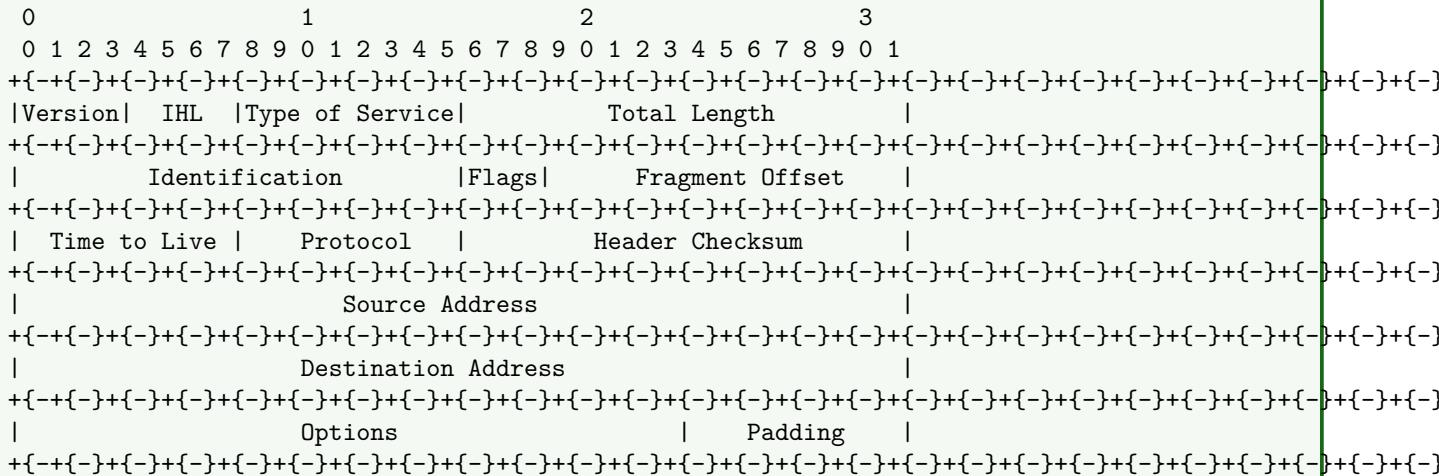
**IPv4 Address Structure:**



**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.

### Solution

**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 km<sup>2</sup>
- **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

#### Solution

**Distributed Computing** spreads processing across multiple interconnected computers.

**Architecture:**

#### Mermaid Diagram (Code)

```
{Shaded}  
{Highlighting} []  
graph LR  
    subgraph "Distributed System"  
        A[Node 1] --- B[Node 2]  
        B --- C[Node 3]  
        C --- D[Node 4]  
        A --- D  
    end  
  
    E[Network] --- A  
    E --- B  
    E --- C  
    E --- D  
{Highlighting}  
{Shaded}
```

**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.

#### Solution

**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:**

#### Error Detection Methods:

Method	Description	Capability
<b>Parity Check</b>	Single bit addition	Detect single-bit errors
<b>Checksum</b>	Arithmetic sum	Detect multiple errors
<b>CRC</b>	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:

- #### **Protocol Examples:**

- Ethernet, FTT

**Working Process:**

```

sequenceDiagram
    participant S as Sender
    participant R as Receiver

    S{-R: Data Frame}
    R{-S: ACK Frame}
    S{-R: Next Data Frame}
    Note over R: Error Detected
    R{-S: NAK Frame}
    S{-R: Retransmit Frame}

```

## Mnemonic

“FECFA: Framing, Error detection, Correction, Flow control, Access control”