

## **Chapter 1 Problem Solution:**

### **Q1-1: Five Components of a Data Communications System**

1. **Message** – The data being communicated.
2. **Sender** – The device that sends the message (e.g., computer, phone).
3. **Receiver** – The device that receives the message.
4. **Transmission Medium** – The channel through which the data travels (e.g., cables, wireless).
5. **Protocol** – The set of rules that govern data communication.

### **Q1-2: Three Criteria for an Effective & Efficient Network**

1. **Performance** – Measured in speed, latency, and throughput.
2. **Reliability** – Ensures consistent data transmission without errors.
3. **Security** – Protects data from unauthorized access and attacks.

### **Q1-3: Advantages of Multipoint Over Point-to-Point**

1. **Cost-effective** – Uses fewer cables and hardware resources.
2. **Scalability** – Easier to add new devices to the network.
3. **Efficient Resource Use** – Multiple devices share the same link.

### **Q1-4: Two Types of Line Configuration**

1. **Point-to-Point** – A dedicated link between two devices.
2. **Multipoint** – A shared link among multiple devices.

### **Q1-5: Topologies in Terms of Line Configuration**

1. **Mesh** – Point-to-point.
2. **Star** – Point-to-point between devices and the central hub.
3. **Bus** – Multipoint (shared communication medium).
4. **Ring** – Point-to-point between adjacent devices.

### **Q1-6: Difference Between Half-Duplex & Full-Duplex**

- **Half-Duplex** – Data flows in both directions but **one at a time** (e.g., walkie-talkies).
- **Full-Duplex** – Data flows in **both directions simultaneously** (e.g., phone calls).

### **Q1-7: Four Basic Network Topologies & Their Advantages**

1. **Mesh** – Reliable (each device has a dedicated link).
2. **Star** – Easy to troubleshoot and scalable.
3. **Bus** – Cost-effective (less cabling).
4. **Ring** – Ensures equal data transmission among devices.

### Q1-8: Number of Cable Links Required

For  $n$  devices:

- **Mesh** –  $\frac{n(n-1)}{2}$
- **Ring** –  $n$
- **Bus** – 1 (shared link)
- **Star** –  $n$  (each device connects to the central hub)

### Q1-9: Factors That Differentiate LAN & WAN

1. **Geographical Scope** – LAN covers a small area, WAN covers large areas.
2. **Speed** – LANs are faster than WANs.
3. **Ownership** – LANs are typically privately owned; WANs may involve multiple providers.

### Q1-10: Difference Between "Internet" and "internet"

- **Internet** (capital "I") – The global public network.
- **internet** (lowercase "i") – Any interconnected network of computers.

### Q1-11: Why Protocols Are Needed

Protocols define **rules for communication**, ensuring **data integrity, compatibility, synchronization, and security**.

### Q1-12: Does a Link-Layer Switch Need an Address?

No, because a **link-layer switch operates at Layer 2 (Data Link Layer)** and forwards data based on **MAC addresses** rather than needing an IP address.

### Q1-13: Point-to-Point WANs Needed for $n$ LANs

For  $n$  LANs, the number of direct **point-to-point WAN connections** needed is  $\frac{n(n-1)}{2}$  (same as a mesh network).

### Q1-14: Circuit-Switched vs. Packet-Switched Networks (Local Telephone Call)

A local telephone call uses a **circuit-switched network**, where a dedicated communication path is established between the two callers.

### Q1-15: Role of the Telephone Company in Internet Connection

The **telephone company** provides access to the internet by acting as an **ISP (Internet Service Provider)** using **DSL (broadband)** or **dial-up connections**.

### Q1-16: First Principle for Protocol Layering

Each layer should **perform a specific function independently** while ensuring **bidirectional communication** with adjacent layers.

### Q1-17: Internet Draft vs. Proposed Standard

- **Internet Draft** – A working document that may change before becoming a standard.
- **Proposed Standard** – A more stable and reviewed document, awaiting final approval.

### Q1-18: Required RFC vs. Recommended RFC

- **Required RFC** – Must be implemented in all systems for compatibility.
- **Recommended RFC** – Suggested but not mandatory for system implementation.

### Q1-19: IETF vs. IRTF

- **IETF (Internet Engineering Task Force)** – Develops **protocols and standards** for the internet.
- **IRTF (Internet Research Task Force)** – Focuses on **long-term research** related to networking and future internet technologies.

### Problems:

#### P1-1: Maximum Number of Characters Represented by Unicode

Unicode can represent up to **1,114,112 characters** (from **0x0000 to 0x10FFFF**). However, currently, only about **150,000 characters** have been assigned.

#### P1-2: Maximum Number of Colors in a 16-bit Color Image

Since 16 bits are used per pixel:

$$2^{16} = 65,536$$

Thus, **65,536 different colors** can be represented.

#### P1-3: Mesh Topology with Six Devices

- **Number of cables required** =  $n(n-1)/2$   
 $6(6-1)/2 = (6 \times 5)/2 = 15$
- **Number of ports per device** =  $n-1$

$$6-1=5$$

Thus, **15 cables** and **5 ports per device** are needed.

#### P1-4: Failure Consequences in Different Topologies

- a) **Mesh Topology** – No major impact; alternate paths exist.
- b) **Star Topology** – If a device fails, only that device is affected. But if the **hub** fails, the entire network goes down.
- c) **Bus Topology** – A single cable failure can bring down the entire network.
- d) **Ring Topology** – If a single device fails, the entire network is disrupted unless a dual-ring structure is used.

#### P1-5: LAN or WAN for Two Computers Connected by an Ethernet Hub?

It is a **LAN (Local Area Network)** because:

- It covers a **small area** (home).
- Uses Ethernet, which is typical for LANs.
- The devices are directly connected without requiring an external service provider.

#### P1-6: Effect of Unplugging a Station in a Ring Topology

- If a station is unplugged, the ring is broken, **disrupting the entire network** unless a bypass mechanism exists.

#### **P1-7: Effect of Unplugging a Station in a Bus Topology**

- If a **device** is unplugged, the network still works.
- If the **main bus cable** is disconnected or damaged, the entire network **fails**.

#### **P1-8: Sensitivity of Applications to Delay**

- Sending an E-mail – Not very sensitive** (small delays are acceptable).
- Copying a File – Somewhat sensitive** (affects transfer speed, but data remains intact).
- Surfing the Internet – Highly sensitive** (delays lead to slow page loading).

#### **P1-9: Local Telephone Call – Point-to-Point or Multipoint?**

A **local telephone call** is **point-to-point**, as it establishes a dedicated connection between two parties.

#### **P1-10: Comparison of Telephone Network and the Internet**

<b>Feature</b>	<b>Telephone Network</b>	<b>Internet</b>
<b>Type of Connection</b>	Circuit-switched	Packet-switched
<b>Dedicated Path</b>	Yes, per call	No, packets take different routes
<b>Primary Use</b>	Voice communication	Data transfer
<b>Scalability</b>	Limited	Highly scalable
<b>Reliability</b>	High (if the line is established)	Depends on routing protocols