

# Computer Networks

## Textbook

# Computer Networks



A computer network is a collection of interconnected devices that communicate and share resources.

## The Internet: A Global Network

The **Internet** is a vast, global "network of networks," linking countless smaller networks (homes, schools, businesses) worldwide. This structure allows for truly global communication. The **World Wide Web (WWW)** is a part of the Internet enabling access to websites and information exchange across continents, allowing instant communication regardless of physical distance.

## Wired Computer Networks

Wired networks use physical cables for reliable, fast connections. Essential components for two or more devices to communicate include:

- **Network Interface Card (NIC):** Hardware enabling a device to connect to a wired network, acting as the cable port.
- **Ethernet Cable:** The physical cable transmitting data between devices, plugging into the NIC.
- **Network Switch:** A device that connects multiple computers, directing data efficiently to specific destinations.

**How they communicate:** Devices with NICs connect via Ethernet cables to a switch. The switch acts as a central hub, forwarding data from one computer's NIC to the intended recipient's NIC, enabling communication and resource sharing.

## Wireless Computer Networks

Wireless networks (Wi-Fi) use radio waves for cable-free connections, offering flexibility. Key components for two or more devices to communicate wirelessly are:

- **Wi-Fi Adapter:** Allows a device (e.g., laptop, phone) to connect to a wireless network, acting as its radio receiver/transmitter.
- **Wireless Access Point (WAP):** Broadcasts a Wi-Fi signal, acting as a central hub for wireless devices (often integrated into home routers).

**How they communicate:** Devices with Wi-Fi adapters connect to the same WAP. The WAP transmits data via radio waves between devices, enabling wireless communication for tasks like Browse or printing.

## Data Packets: The Mail of the Internet

Data sent over networks is broken into small pieces called **data packets**. Each packet contains:

- **Header:** Like an envelope address, including source/destination IPs and sequence numbers for reassembly.
- **Payload:** The actual piece of data.
- **Trailer (or Footer):** Error-checking information.

**How they are routed:** Packets travel individually across the network, potentially taking different routes. Network devices like routers use header information to guide packets to their destination. The receiving computer reassembles the packets using their sequence numbers to restore the original data.

## Issues Impacting Network Functionality

Several factors can affect network performance:

- **Bandwidth/Congestion:** Too much data on a limited connection (congestion) slows down communication.
- **Latency:** Delay in data transfer, causing lag (e.g., in video calls), often due to distance or congestion.
- **Packet Loss:** Packets dropped during transmission lead to incomplete data or interruptions.
- **Security Threats:** Malware, unauthorized access, and phishing can compromise networks.
- **Hardware Failure:** Malfunctioning components (NIC, cable, switch, WAP) disrupt connectivity.
- **Software/Configuration Errors:** Incorrect settings or outdated drivers prevent proper communication.
- **Interference (Wireless):** Other devices, obstructions, or overlapping Wi-Fi signals can degrade wireless performance.

## Critical Thinking Questions

1. Imagine you are trying to video call a friend who lives on the other side of the world. Explain how the concept of data packets and the "network of networks" structure of the Internet work together to make that real-time conversation possible.

2. Your school is building a new computer lab. The IT team is debating whether to use a wired Ethernet network or a wireless Wi-Fi network. Discuss the advantages and disadvantages of each option in this specific scenario, considering factors like speed, reliability, cost, and ease of setup for multiple devices.
3. You're experiencing very slow internet speeds and frequent disconnections at home. Based on the issues that impact network functionality, list at least three different potential causes for these problems and suggest a possible first step to troubleshoot each one.

## Questions (5)

**1. You're trying to video call a friend who lives on the other side of the world. Which statement best explains how data packets and the Internet's "network of networks" structure make this conversation possible?**

MULTIPLE CHOICE

**Choose the correct answer:**

- A. The Internet sends your entire video as one large file directly to your friend's computer.
- B. Your video is broken into data packets that travel individually across many interconnected smaller networks to be reassembled at your friend's location.
- C. Your computer connects directly to your friend's computer without passing through any other networks.
- D. The World Wide Web directly transmits your voice and video signals without using data packets.

**2. A student's laptop can't connect to the school's wireless network, but other devices can. What hardware component on the student's laptop is most likely malfunctioning?**

MULTIPLE CHOICE

**Choose the correct answer:**

- A. Ethernet Cable
- B. Network Switch
- C. Wi-Fi Adapter
- D. Power Supply Unit (PSU)

**3. Your school is building a new computer lab and prioritizing reliability and fast, consistent speeds for tasks like large file transfers. Which network type would be most advantageous for this specific scenario?**

MULTIPLE CHOICE

**Choose the correct answer:**

- A. Wireless (Wi-Fi) network
- B. Wired (Ethernet) network
- C. Bluetooth network
- D. Satellite network

**4. A data packet is described as having a 'Header' that includes source/destination IPs and sequence numbers. What is the primary purpose of this header information?**

MULTIPLE CHOICE

**Choose the correct answer:**

- A. To carry the actual piece of data (payload).
- B. To check for errors during transmission.
- C. To act like an envelope address, guiding the packet to its destination and allowing reassembly.
- D. To compress the data within the packet.

**5. You're experiencing very slow internet speeds at home, especially during peak hours when many people are online. Based on the issues that impact network functionality, what is the most likely cause of this problem?**

MULTIPLE CHOICE

**Choose the correct answer:**

- A. Hardware Failure
- B. Packet Loss
- C. Bandwidth/Congestion
- D. Software/Configuration Errors

## Answer Keys & Solutions

### Questions

1. You're trying to video call a friend who lives on the other side of the world. Which statement best explains how data packets and the Internet's "network of networks" structure make this conversation possible?

MULTIPLE CHOICE

Correct Answer:

- A. The Internet sends your entire video as one large file directly to your friend's computer. ✗ Incorrect
- B. Your video is broken into data packets that travel individually across many interconnected smaller networks to be reassembled at your friend's location. ✓ Correct
- C. Your computer connects directly to your friend's computer without passing through any other networks. ✗ Incorrect
- D. The World Wide Web directly transmits your voice and video signals without using data packets. ✗ Incorrect

**Explanation:**

Your video is broken into data packets that travel individually across many interconnected smaller networks to be reassembled at

2. A student's laptop can't connect to the school's wireless network, but other devices can. What hardware component on the student's laptop is most likely malfunctioning?

MULTIPLE CHOICE

Correct Answer:

- A. Ethernet Cable ✗ Incorrect
- B. Network Switch ✗ Incorrect
- C. Wi-Fi Adapter ✓ Correct
- D. Power Supply Unit (PSU) ✗ Incorrect

**Explanation:**

Consider what specific hardware allows a device to connect wirelessly.

**3. Your school is building a new computer lab and prioritizing reliability and fast, consistent speeds for tasks like large file transfers. Which network type would be most advantageous for this specific scenario?**

MULTIPLE CHOICE

**Correct Answer:**

- |                             |             |
|-----------------------------|-------------|
| A. Wireless (Wi-Fi) network | ✗ Incorrect |
| B. Wired (Ethernet) network | ✓ Correct   |
| C. Bluetooth network        | ✗ Incorrect |
| D. Satellite network        | ✗ Incorrect |

**Explanation:**

Recall which network type is described as offering reliable and fast physical connections.

**4. A data packet is described as having a 'Header' that includes source/destination IPs and sequence numbers. What is the primary purpose of this header information?**

MULTIPLE CHOICE

**Correct Answer:**

- |  |             |
|--|-------------|
| A. To carry the actual piece of data (payload).  | ✗ Incorrect |
| B. To check for errors during transmission.  | ✗ Incorrect |
| C. To act like an envelope address, guiding the packet to its destination and allowing reassembly. | ✓ Correct   |
| D. To compress the data within the packet.   | ✗ Incorrect |

**Explanation:**

Think about what information is crucial for directing mail to the correct recipient and putting it back in order.

**5. You're experiencing very slow internet speeds at home, especially during peak hours when many people are online. Based on the issues that impact network functionality, what is the most likely cause of this problem?**

MULTIPLE CHOICE

**Correct Answer:**

- |                                  |             |
|----------------------------------|-------------|
| A. Hardware Failure              | ✗ Incorrect |
| B. Packet Loss                   | ✗ Incorrect |
| C. Bandwidth/Congestion          | ✓ Correct   |
| D. Software/Configuration Errors | ✗ Incorrect |

**Explanation:**

Consider what happens when too much data tries to pass through a limited connection.