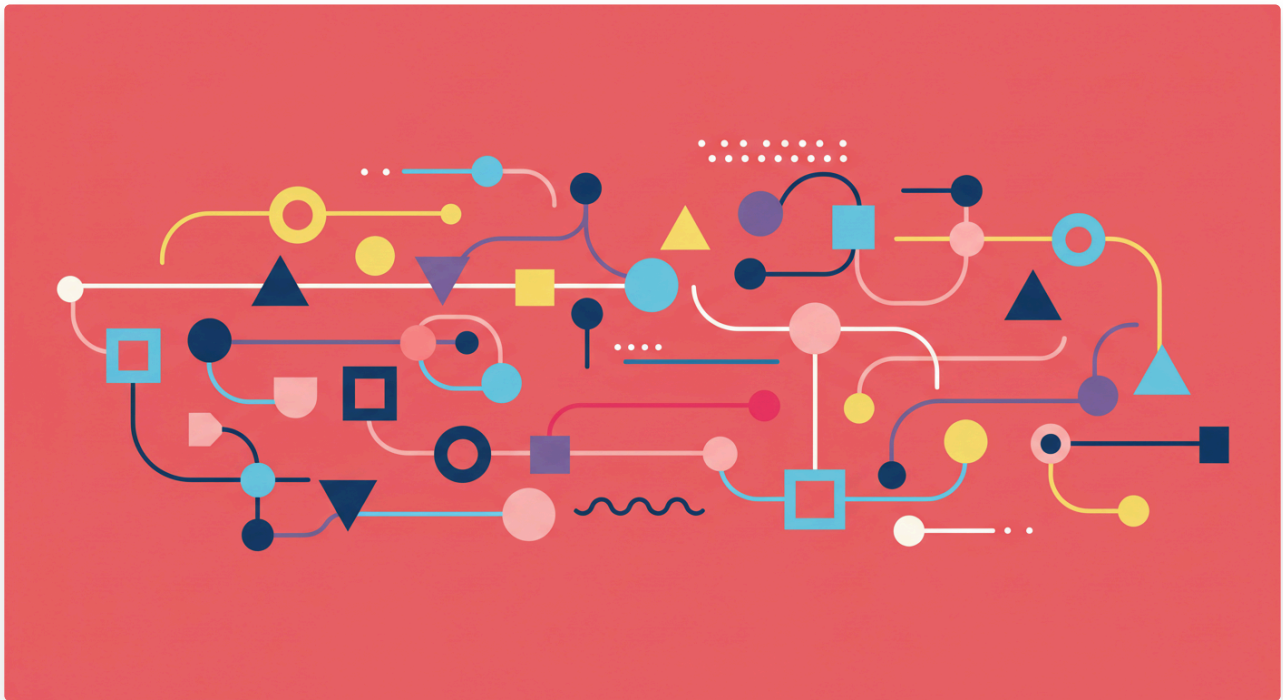


Computer Networks

Textbook

Computer Networks



A computer network is simply a group of connected devices that can talk to each other and share things.

The Internet: A Global Network

The Internet is a massive, worldwide "network of networks." It connects countless smaller networks, like those in homes, schools, and businesses, all over the world. This huge structure allows people everywhere to communicate. The World Wide Web (WWW) is a part of the Internet that lets you look at websites and share information across different countries, making instant communication possible no matter how far apart people are.

Wired Computer Networks

Wired networks use physical cables to create connections that are usually very dependable and fast. For two or more devices to talk to each other in a wired network, they need a few key parts:

- **Network Interface Card (NIC):** This is a piece of hardware in a device that lets it connect to a wired network. Think of it as the port where you plug in the cable.
- **Ethernet Cable:** This is the actual physical cable that carries data between devices. You plug it into the NIC.
- **Network Switch:** This device connects many computers together. It's smart enough to send data efficiently to the correct destination.

How they communicate: Devices with NICs connect to a switch using Ethernet cables. The switch acts like a central point, taking data from one computer's NIC and sending it only to the intended recipient's NIC. This allows computers to talk to each other and share resources.

Wireless Computer Networks

Wireless networks, often called Wi-Fi, use radio waves instead of cables for connections, giving you more flexibility. For two or more devices to communicate wirelessly, they need these main parts:

- **Wi-Fi Adapter:** This allows a device (like a laptop or phone) to connect to a wireless network. It works like the device's radio to send and receive signals.
- **Wireless Access Point (WAP):** This device broadcasts the Wi-Fi signal and acts as a central hub for all wireless devices. Your home router often has a WAP built into it.

How they communicate: Devices with Wi-Fi adapters connect to the same WAP. The WAP then sends data between these devices using radio waves, making it possible to browse the internet or print wirelessly.

Data Packets: The Mail of the Internet

When you send data over a network, it's broken down into tiny pieces called **data packets**. Each packet contains:

- **Header:** This is like the address on an envelope. It includes information such as where the data came from, where it's going (IP addresses), and a sequence number so the pieces can be put back together in the right order.
- **Payload:** This is the actual piece of data you're sending.
- **Trailer (or Footer):** This contains information to check for errors.

How they are routed: These packets travel individually across the network and might even take different paths. Network devices called **routers** use the information in the header to guide the packets to their destination. Once all the packets arrive, the receiving computer uses their sequence numbers to reassemble them and recreate the original data.

Issues Impacting Network Functionality

Several things can cause problems with how well a network works:

- **Bandwidth/Congestion:** If too much data tries to travel over a connection with limited capacity, it causes congestion, which slows down communication significantly.
- **Latency:** This is the delay in data transfer, which can cause "lag" in things like video calls. It's often due to long distances the data has to travel or network congestion.
- **Packet Loss:** This happens when data packets get lost during their journey, leading to incomplete data or interruptions in service.
- **Security Threats:** Malicious software (malware), people gaining unauthorized access, and phishing scams can all compromise networks.
- **Hardware Failure:** If any network components like a NIC, cable, switch, or WAP stop working correctly, it can disrupt the connection.
- **Software/Configuration Errors:** Incorrect settings or outdated software drivers can prevent devices from communicating properly.

- **Interference (Wireless):** For wireless networks, other electronic devices, physical objects blocking the signal, or too many Wi-Fi signals overlapping can make the connection weaker.

Critical Thinking Questions

1. Imagine you're having a video call with a friend who lives across the globe. Think about how data packets and the Internet's "network of networks" structure work together to make that real-time conversation possible.
2. Your school is planning a new computer lab and needs to decide between a wired Ethernet network and a wireless Wi-Fi network. Discuss the benefits and drawbacks of each choice for this specific situation, considering factors like speed, how reliable the connection will be, the cost, and how easy it is to set up for many devices.
3. You're experiencing very slow internet speeds and frequent disconnections at home. Based on the factors that can impact network performance, list at least three possible reasons for these problems and suggest one initial step you could take to try and fix each issue.

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.