

AQA Computer Science A-Level
4.9.2 Networking
Concise Notes



Specification:

4.9.2.1 Network topology:

Understand:

- physical star topology
- logical bus network topology

and:

- differentiate between them
- explain their operation

4.9.2.2 Types of networking between hosts:

Explain the following and describe situations where they might be used:

- peer-to-peer networking
- client-server networking

4.9.2.3 Wireless networking:

Explain the purpose of WiFi

Be familiar with the components required for wireless networking

Be familiar with how wireless networks are secured

Explain the wireless protocol Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) with and without Request to Send/Clear to Send (RTS/CTS)

Be familiar with the purpose of Service Set Identifier (SSID)



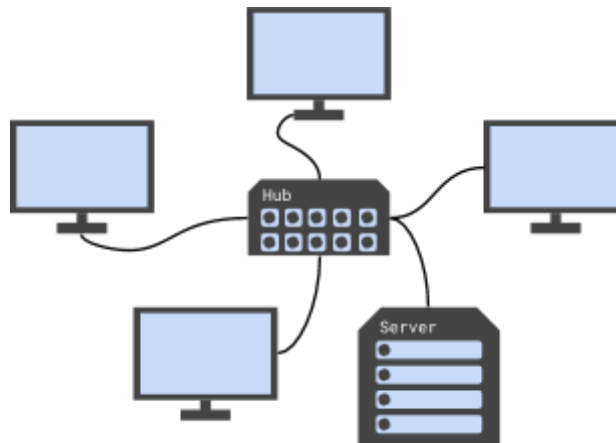
Network topology

Physical network topology

- Refers to the **actual architecture** of a network
- There are two types of physical network topology to learn:
 - star
 - bus

Physical star network topology

- Each client has **its own direct connection** to a central hub
- The hub receives packets for all of the clients and delivers them to the correct recipient
- A server can be added to the network in the same way that clients are connected to the central hub

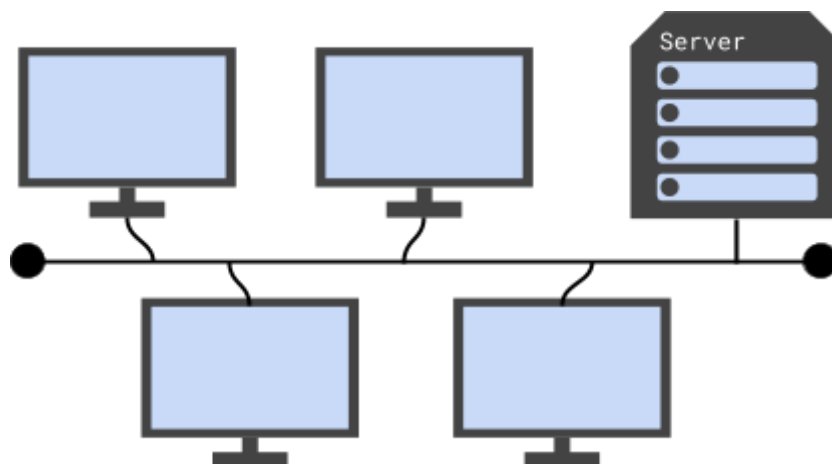


Advantages	Disadvantages
Packets are sent directly to their recipient; other clients on the network cannot see packets that aren't intended for them.	Should the central hub fail, all communication over the network is stopped.
It is easy to add and remove clients to and from the network.	Expensive to install thanks to the amount of cable required.
Each cable has just one device communicating over it, eliminating the possibility of collisions.	
The failure of one cable does not affect the performance of the rest of the network.	



Physical bus topology

- Connects clients to a **single cable** called a **backbone**
- A device called a **terminator** is placed at either end of the backbone
- There is **no need for a central hub** like in physical star networks
- A server can be connected to the backbone just like a client



Advantages	Disadvantages
There is no central hub , reducing the chances of a network failure and decreasing the cost of installation.	Packets are sent through the shared backbone , allowing every client on the network to see packets that aren't intended for them.
Inexpensive to install as a minimum length of cable is required.	The backbone is used for communication by multiple clients, introducing the risk of collisions .
	Should the backbone fail, the entire network becomes unusable.

Logical network topology

- Refers to **the flow of data packets** within a network
- A logical bus network delivers packets to **all clients** on the network
- A logical star network delivers packets **only to their recipient**

Mixing topologies

- If a network is set up as a physical star, it **can still behave as** a logical bus
- Even if physical connections follow that of the physical star topology, running a **bus protocol** on the hub allows it to distribute packets to all of the connected clients so as to **act like** a bus network



Types of networking between hosts

- A host is a device on a network that **provides services**
- This is often a **server**, but can also be the **clients** on a network themselves

Client-server networking

- One or more central servers provide services to the clients on the network
- Servers are connected to the network in the same way as clients
- Allow for **central management** of clients on the network
- Can improve network security
- Require a fair degree of expertise to set up and manage
- Servers are often **more powerful machines** than the clients
- The clients request services from the servers, which then respond to the client with the requested service
- Services provided by servers in a client-server network could include:
 - file storage
 - email management
 - user account management
 - print queue management

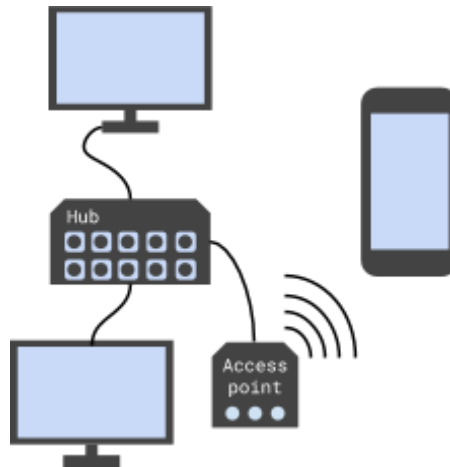
Peer-to-peer networking

- Do not use a shared server
- Services are provided **by the clients themselves**
- Every client has equal status
- All of the clients which provide services **must be running** in order for the network to be fully operational
- More **cost effective** than client-server networking as there is **no need for a powerful server** to provide services
- **Easier to set up and maintain** than client-server networks
- Large file-sharing networks and multimedia providers use peer-to-peer networking to provide high-performance services without the requirement for a server



Wireless networking

- Allows clients to communicate within a network **without being physically connected** to it
- Requires a **wireless access point**, which connects to a wired network just like any other client would
- Requires a **wireless network adapter** in the device that connects to the wireless network



WiFi

- Widely used to provide wireless networks
- Refers to a **wireless local area network** that is based on **international standards**
- Allows a device made in one part of the world to connect seamlessly to wireless networks all over the world
- Networks are secured by **encrypting** transmitted data using WPA (WiFi protected access) or WPA2
- WPA requires that new wireless clients enter a password in order to connect to the network
- Another method of securing a wireless network is **disabling SSID (service set identifier) broadcast**
- An SSID is a **name** that identifies a wireless network
- Disabling SSID broadcast stops wireless devices **within range** of the network from displaying that the network is available, only allowing those who know the SSID to connect
- A third method of securing a wireless network is to **set up a MAC (media access control) address filter**
- MAC addresses are assigned to every wireless device by their manufacturer
- MAC addresses are unique to the device
- MAC address whitelists can be created to allow only specific devices to connect to a network
- MAC address blacklists can be used to block specific devices from connecting to a network

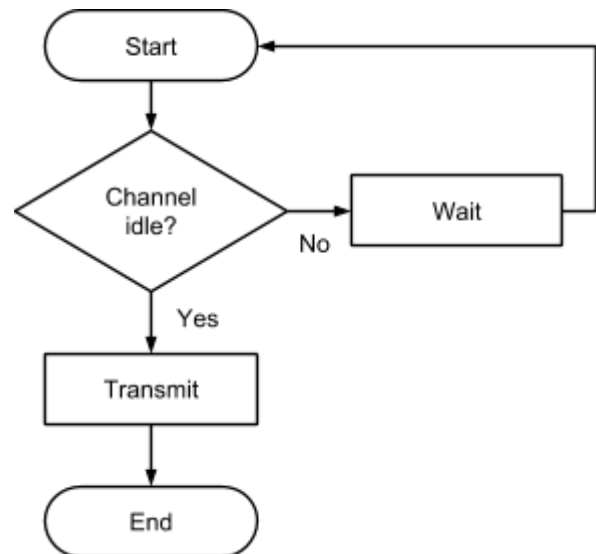


Carrier Sense Multiple Access with Collision Avoidance

- A protocol used in wireless networks to avoid data collisions caused by multiple devices communicating simultaneously

CSMA/CA

- When a device is ready to transmit, it **listens** to its communication channel to check whether it is idle
- If so, then the data is transmitted
- If the channel is busy, the device waits for a random period of time before checking the channel again
- An **exponential backoff algorithm** can be used to increase the time period for which the device waits with each check of the channel
- CSMA/CA cannot overcome **hidden nodes**: a problem that arises when the device checking for an idle channel cannot “see” some parts of the network on which communication may be occurring.



RTS/CTS

- To get around the problem of hidden nodes, a protocol called **request to send/clear to send** (or RTS/CTS) is used
- Adds an additional step into the CSMA process
- Once the transmitting device has checked whether the channel is idle, it sends a “request to send” message to the server
- If the server is idle, it will respond with a “clear to send” message at which point the transmitting device can begin communication with the server
- If no “clear to send” message is received, the server is busy communicating with a hidden node and the transmitting device must wait before starting the CSMA process again

