AQA Computer Science AS Level
3.9.2 Networking
Intermediate Notes

Specification:

3.9.2.1 Network topology:
Understand:
- physical star topology
- logical bus network topology

and:
- differentiate between them
- explain their operation

3.9.2.2 Types of networking between hosts:
Explain the following and describe situations where they might be used:
- peer-to-peer networking
- client-server networking

3.9.2.3 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

Topology refers to the structure of a network. There are two types of topology to consider: physical and logical.

## Physical network topology

Physical network topology refers to the actual architecture of a network. Networks using one physical topology will interconnect components differently to those networks that use another physical topology.

There are two types of physical network topology to learn: star and bus.

Physical star network topology

In a physical star network, each client (that is, a device connected to the hub) has its own connection to the central hub.
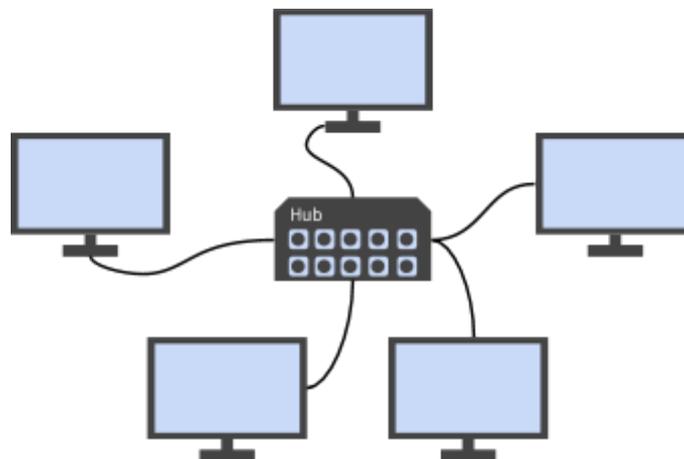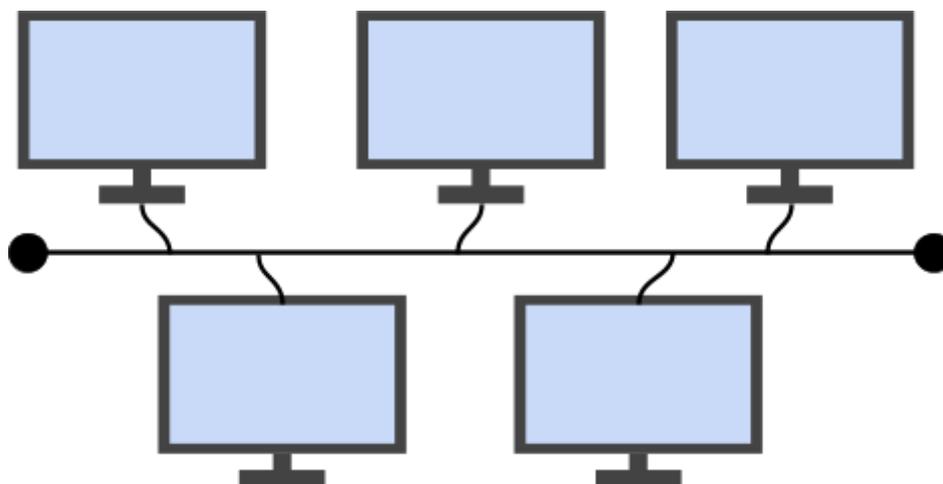

Advantages	Disadvantages
Data is sent directly to its recipient, over a cable that is connected only to the recipient. Other clients on the network cannot see data that isn't intended for them.	Should the central hub fail, all communication over the network is stopped.
It is easy to add and remove clients to and from the network.	Expensive to install thanks to the amount of cable required.
The failure of one cable does not affect the performance of the rest of the network.	

Physical bus topology

A physical bus connects clients to a single cable called a backbone. There is no need for a central hub like in physical star networks.

Advantages	Disadvantages
There is no central hub, reducing the chances of a network failure and decreasing the cost of installation.	Data is sent through the shared backbone, allowing every client on the network to see data that isn'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

In contrast to a network's physical topology, a network's logical topology refers to the flow of data packets within a network. A logical bus network delivers packets to all clients on the network whereas 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 the physical connections between clients and the central hub follow that of the physical star topology, running special software on the hub allows it to distribute data 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, which can provide services such as file storage but can also be the clients on a network themselves.

Client-server networking
In a client-server network, a central server provides services to the clients on the network. Servers are connected to the network in the same way as clients, but are often more powerful than the clients.

Most schools, colleges and businesses use client-server networks to allow for central management of clients on the network. This can improve security but requires a fair degree of expertise to set up and manage.

Peer-to-peer networking
Peer-to-peer networks do away with a shared server. Instead, services are provided by the clients themselves. For example, one computer on the network might manage print queues, another manage storage and a third manage emails.

The main disadvantage of peer-to-peer networking is that all of the clients which provide services must be running in order for the network to be fully operational. If the computer responsible for managing storage is turned off or faulty, none of the clients on the network can access their files.

On the other hand, peer-to-peer networking is more cost effective than client-server networking as there is no need for a powerful server to provide services. Furthermore, peer-to-peer networks are easier to set up and maintain than their client-server counterparts

Wireless networking

Wireless networks allow clients to communicate within a network without being physically connected to it.

Wireless networks require a wireless access point, which connects to a wired network just like any other client would, and a wireless network adapter in the device that connects to the wireless network.
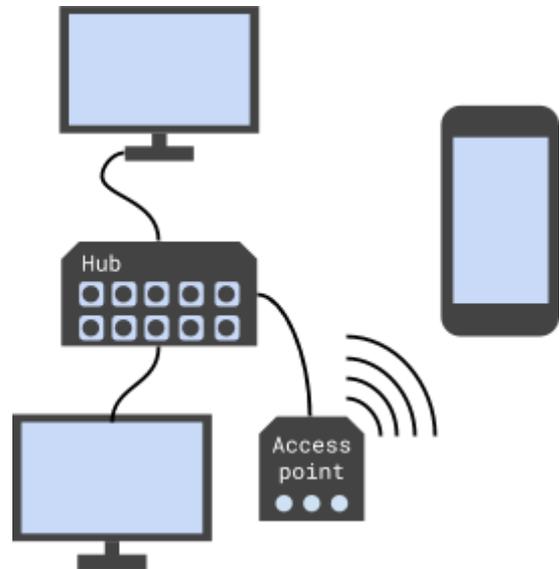

WiFi

WiFi is widely used to provide wireless networks and can be secured by encrypting transmitted data so that a new wireless client has to enter a password in order to connect to the network.

Another method of securing a wireless network is disabling SSID broadcast. A network's SSID is the name that identifies it. 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.

Carrier Sense Multiple Access with Collision Avoidance

Carrier sense multiple access with collision avoidance (CSMA/CA) is a process used in wireless networks to avoid data collisions caused by multiple devices communicating simultaneously.
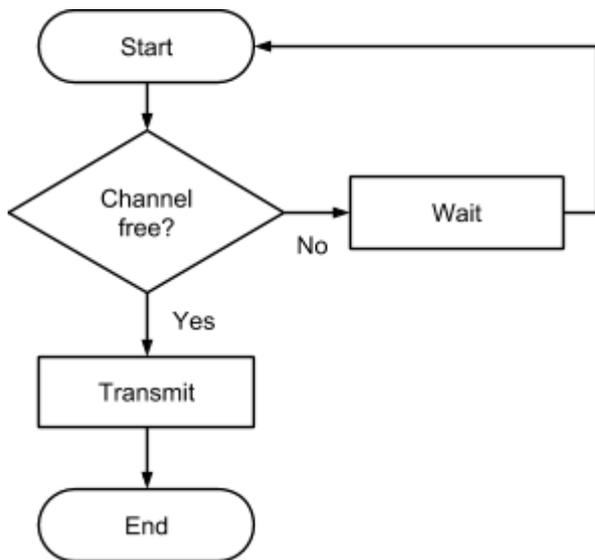
When a device is ready to transmit, it listens to its communication channel to check whether it is free. If so, then the data is transmitted. If the channel is busy, the device waits for a random period of time before checking the channel again.

While CSMA/CA is effective at eliminating collisions in small networks, it cannot overcome hidden nodes: a problem that arises when the device checking for a free channel cannot "see" some parts of the network on which communication may be occuring.

To get around the problem of hidden nodes, a process called request to send/clear to send (or RTS/CTS) is used. RTS/CTS adds an additional step into the CSMA process. Once the transmitting device has checked whether the channel is free, it sends a "request to send" message to the server.

If the server is indeed free, 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.