Leaving Cert Computer Science Grinds - Week 7

Topic: Networks

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Leaving Cert Computer Science Grinds

Week 7: Networks

Sound & Visual Check

“I am now talking….”

“If you **cannot** hear me or see my screen please say “Cannot hear/see you” on the chat.

“If some of you can’t hear me, please restart your computer and join the class again.”

Leaving Cert Computer Science Grinds

Week 7: Networks

Lesson Overview:

By the end of this lesson you should:

- **Understand** what is meant by a network.
- **Understand** what is meant by a star network.
- **Understand** what is meant by a mesh network.
- **Know** what a local area network is & how to define it.
- **Know** what is meant by a wireless network.
- **Have** a better understanding of the hardware involved in a network.

What is a network?

A computer network is a group of computers that use a set of common rules and are connected to each other.

What is a LAN?

- **LAN** stands for **Local Area Network**
- A LAN operates on a single site such as a school or small business using their own cabling systems
  - How does this differ from a Wide Area Network?

Why network computers?

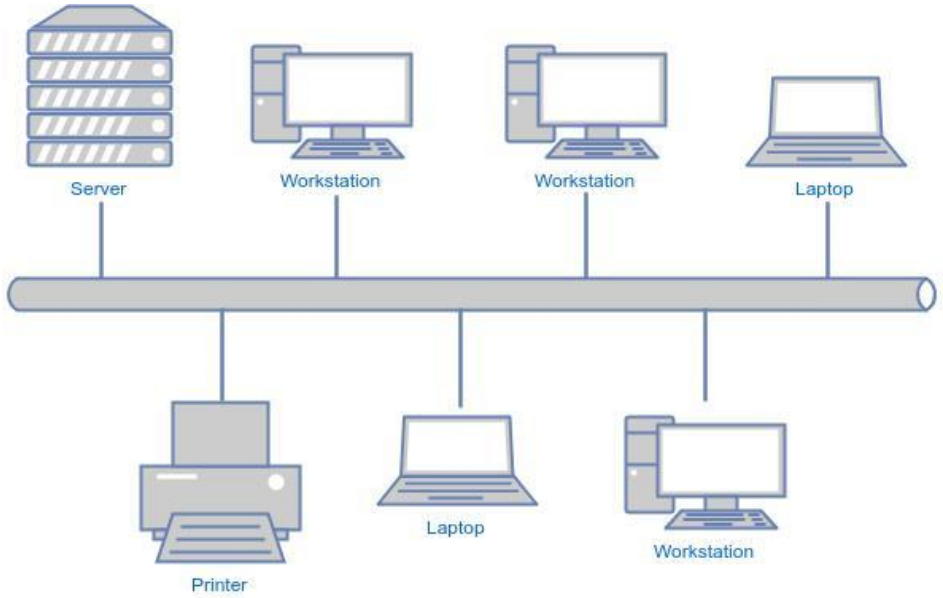
- What are the advantages of connecting together computers in a LAN?
- Are there any benefits of keeping them all as standalone machines?

Advantages and disadvantages of networking

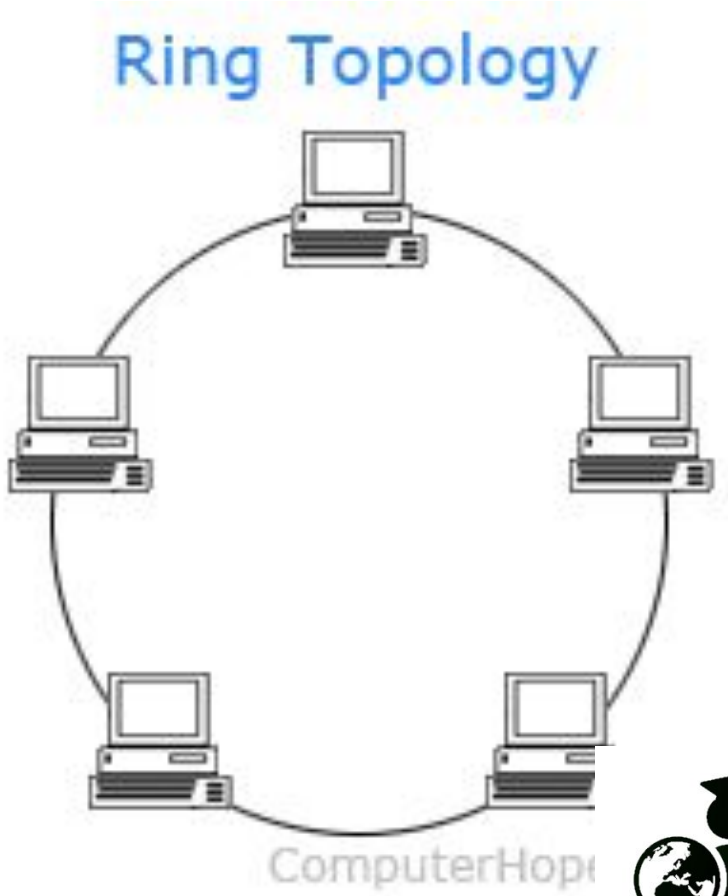
Advantages	Disadvantages
Sharing resources such as printers saves money	Purchasing the network hardware is expensive
You can access your files from any computer in the network	Managing a large network is complicated
Data is easy to back up as it is stored centrally on the server	Viruses may be able to infiltrate the network and infect every computer

Network topologies

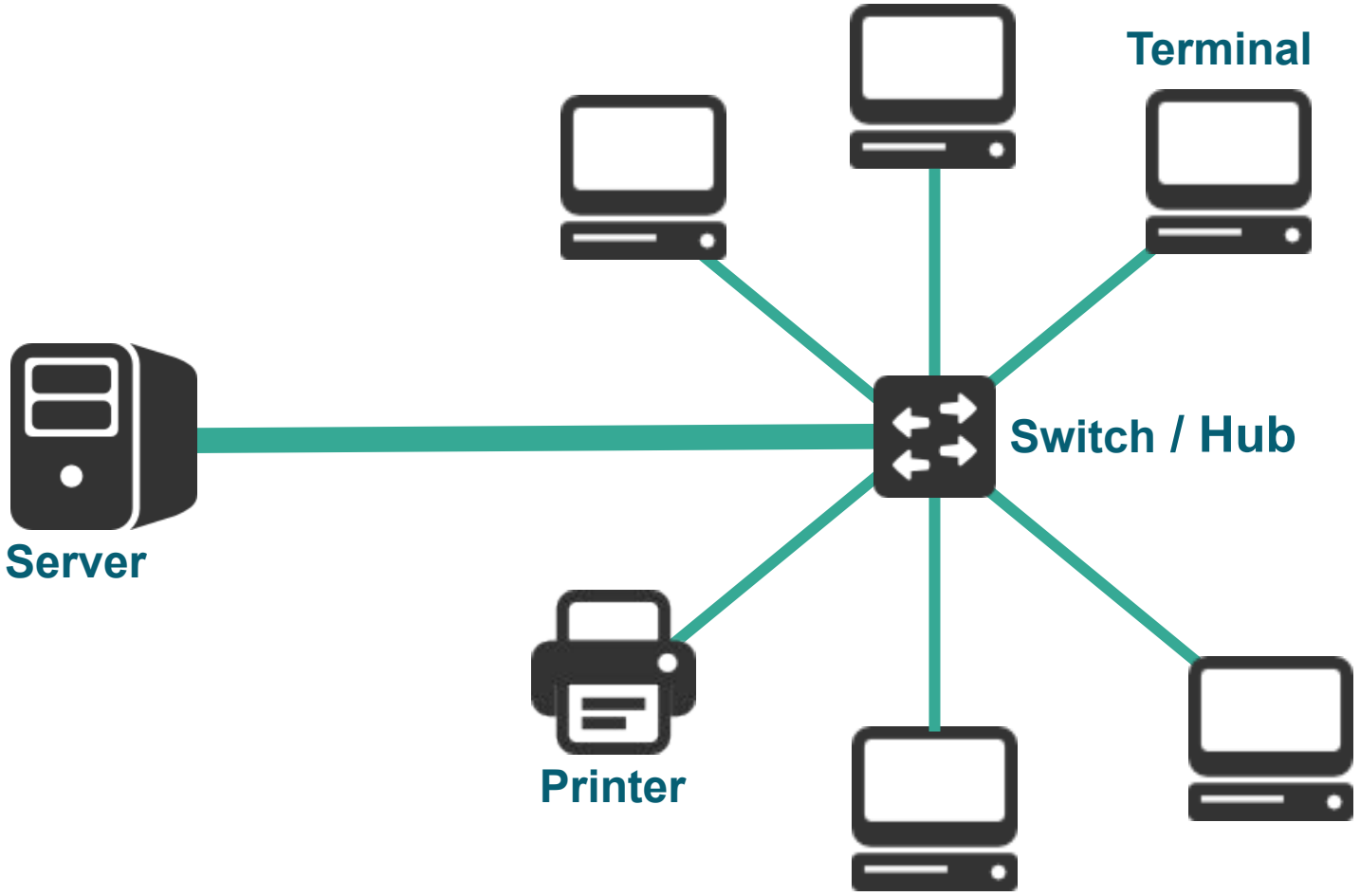
- A LAN can be set up in different ways
- Two of these topologies are:
  - Star
  - Mesh



Bus Topology Network



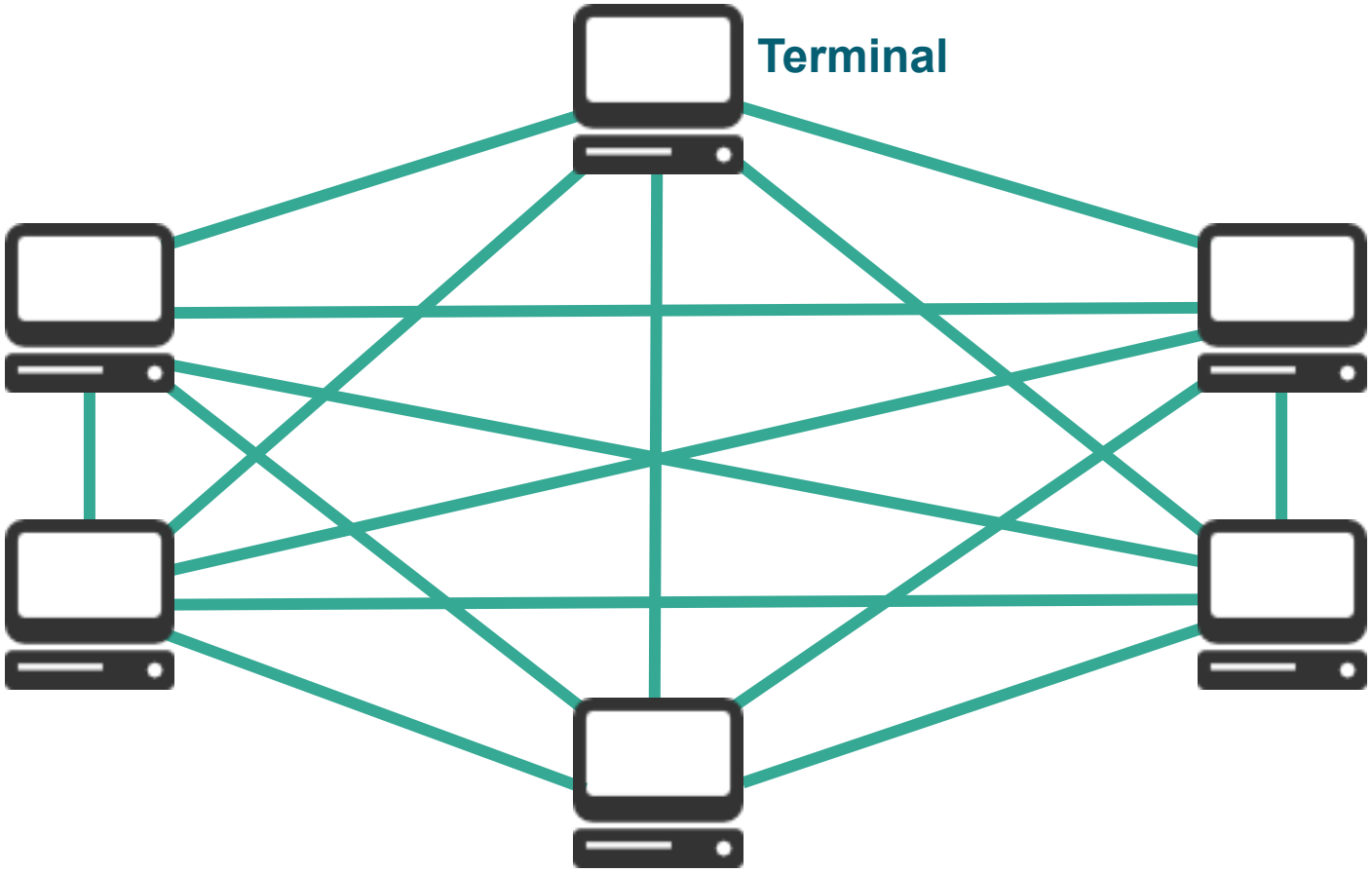
Star network



Star network

Advantages	Disadvantages
Fast data transfer as there are fewer data collisions	Requires additional hardware such as the central switch
If one cable fails the other workstations are not affected	If the central device fails the whole network goes down

Full Mesh network



Mesh networking

- Nodes act as routers for data in order to relay and propagate data in the network
- Partial mesh network model usually used, often in conjunction with star topologies to create larger networks
  - What topology does the Internet use?
  - How might mesh principles affect wireless networks?

Mesh network

Advantages	Disadvantages
No single point of failure – It is a self-healing network	Can involve redundant connections
Expansion and modification can be done without disrupting the network	Expensive to install cabling if using wired connections
Data can be transmitted from different devices simultaneously	Network maintenance and administration is difficult

Network hardware

- Additional hardware is required to connect a stand-alone computer to a LAN
  - A **Network Interface Card** (NIC) in your computer or device
  - A **router** or **switch,** which provides access to a local area network
  - A modem may also be combined with the router in a single device

Routers, hubs and switches

- **Router**
  - Sends data packets on their way in the best direction

- **Hub**
  - Central, multi-plug adaptor for computers and printers in a network
  - When a packet of data is received, it broadcasts the packet to all devices on the network

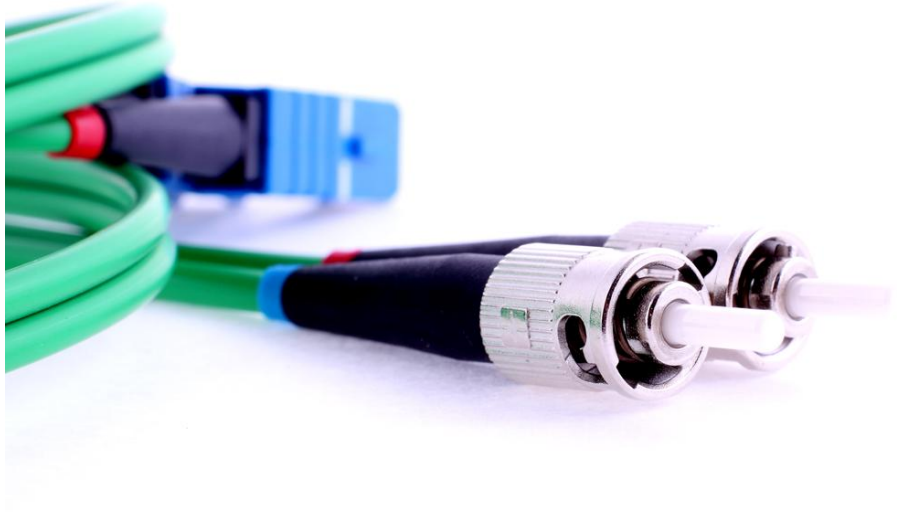
- **Switch**
  - Smart multi-plug adaptor only sends packets to the intended recipient, using its MAC address
  - Reduces network traffic and increases speed

Ethernet protocols

- ‘Ethernet’ refers to a *family of standard local networking ‘protocols’* or rules
- It describes how devices should format data ready for transmission between computers on the same network
  - Similar to polite human conversation, nodes will wait until the connection is quiet before attempting to ‘speak’ or transmit
  - Two nodes attempting to transmit simultaneously will stop and each wait a random period before reattempting

Ethernet cable

- The Ethernet networking standard uses twisted pair cabling or fibre optics

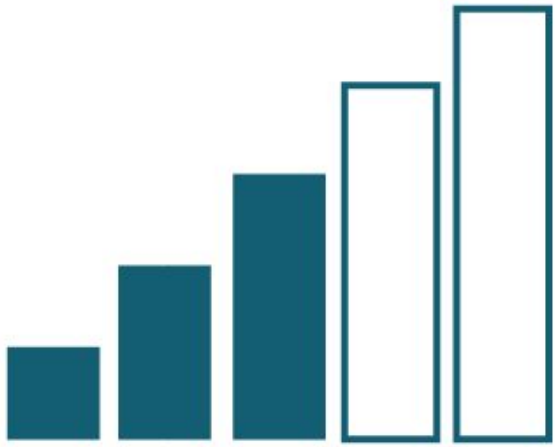


Ethernet transmission

- Ethernet systems divide data into frames, similar to Internet packets
- Each frame contains source and destination addresses and error checking data
  - Frames are broadcast to all nodes – only the intended recipient will open the frame. Others will be discarded
  - Frames which are detected to contain transmission errors are dropped or resent

Wireless transmission

- Commonly uses radio waves for communication
- Susceptible to interference from objects and other nearby electronic or radio devices
  - How does your wireless signal strength vary throughout your own home or school?

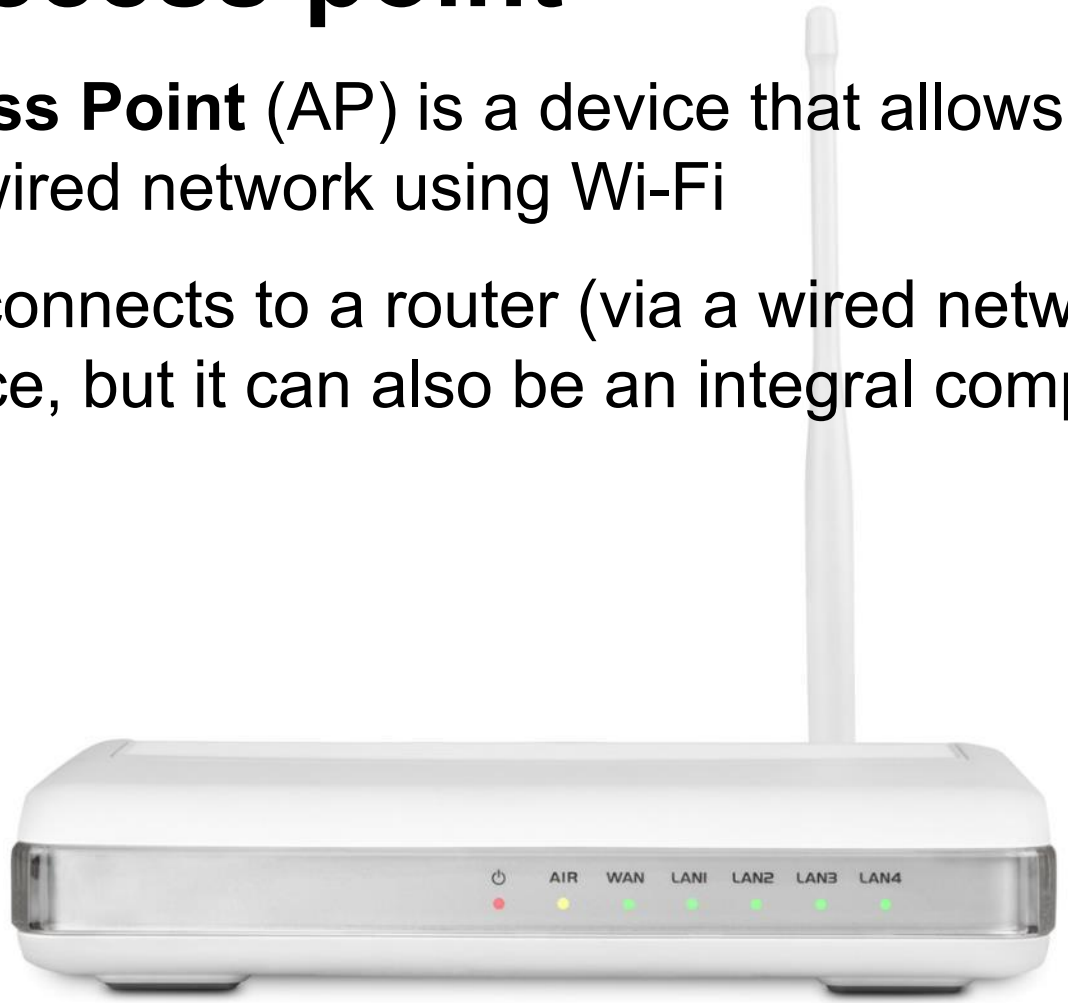


Wireless NICs

- Built into every networked device capable of connecting to a wireless network
- These include:
  - PCs
  - Smart phones
  - Wireless speakers

Wireless access point

- A wireless **Access Point** (AP) is a device that allows wireless devices to connect to a wired network using Wi-Fi
- The AP usually connects to a router (via a wired network) as a standalone device, but it can also be an integral component of the router itself



Intercepting data

- Data that is transmitted over a network can be intercepted
  - Any intercepted data can be read and understood unless measures are taken to prevent it from being interpreted
  - These measures are known as encryption

Encryption

- Encryption is the encoding of data so that it can no longer be easily understood
- A simple shift cipher might encode "*Box345*" as follows:

Encryption algorithm

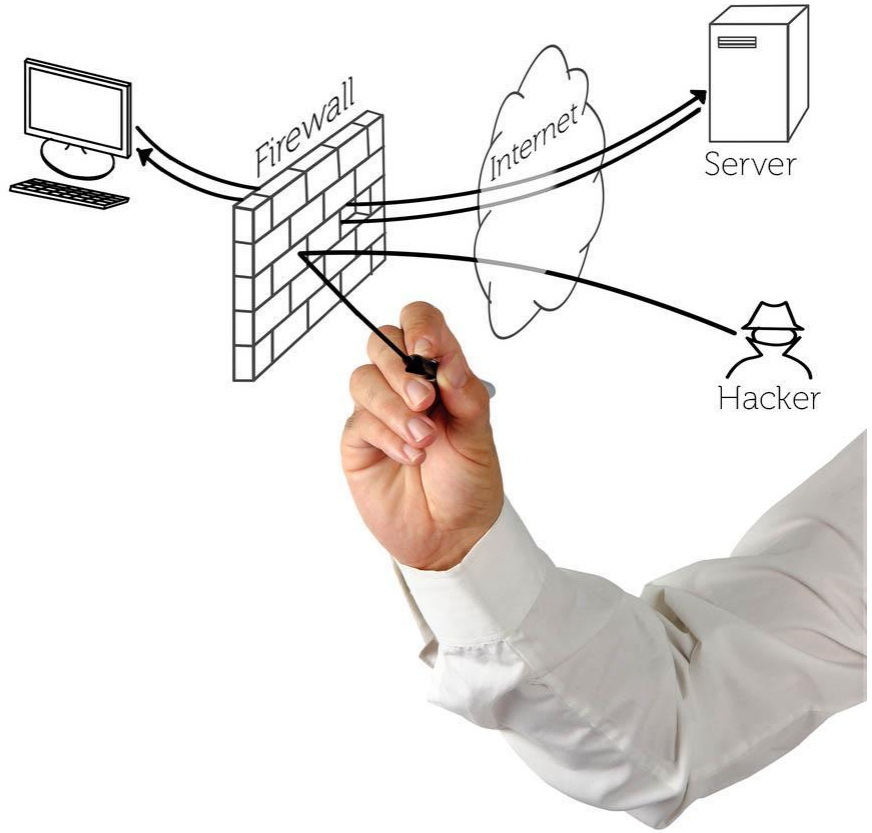
"Box345" →  → **"Dqz567"**

Brute-force attack

- Every possible key is tried
- On average, half of all possible keys need to be tried, so the longer the key, the more time it takes to find it
- The Caeser Cipher uses a shift of between 1 and 26 assuming only uppercase letters of the alphabet are used
- This means that there are 26 possible keys requiring an average of about 13 tries to crack the code

Firewall

- The entrance to a network can be protected in the same way
  - A firewall is either software or hardware that controls access to and from a network
  - Numbered doors called **ports** are opened so that only certain traffic is allowed to pass through



Summary

- **Network –** Two or more computers that are connected together and can share data & resources.
- **LAN–** Local Area Network – A network that is spread over a same geographical area (such as a school).
- **Network Topologies–** Star Network (all connected to the server) & Mesh Network (every device directly connected).
- **Network Hardware –** Ethernet cables, NIC, Router, Hub, Switch, Server & Wireless access point.

Revision Questions (Ordinary Level)

- What is meant by the term Local Area Network?(2 marks)

A local area network (LAN) is a collection of devices connected together in one physical location, such as a building, office, or home.

Revision Questions (Ordinary Level)

- List 3 items of network hardware. (3 marks)

A router can form a LAN by connecting devices within a building.

Wireless access points (WAPs) are required to connect to a network wirelessly. WAPs are usually built into the broadband router.

Hubs allow multiple devices to connect to the router and they transfer data to all devices on a network.

Revision Questions (Ordinary Level)

- What are the benefits of having a network? (3 marks)

- Sharing devices such as printers saves money.
- Site (software) licences are likely to be cheaper than buying several standalone licences.
- Files can easily be shared between users.
- Network users can communicate by email and instant messenger.
- Security is good - users cannot see other users' files unlike on stand-alone machines.
- Data is easy to backup as all the data is stored on the file server.

Revision Questions (Higher Level)

- Explain the process of sharing information of between devices over a star network? (4 marks)

In a star network, every host is connected to a central hub. In its simplest form, one central hub acts as a conduit to transmit messages. ... Data on a star network passes through the hub before continuing to its destination.

Revision Questions (Higher Level)

- Discuss the pros & cons of a school using a mesh network topology. (6 marks)

Pros

- messages can be received more quickly if the route to the intended recipient is short
- messages should always get through as they have many possible routes on which to travel

Cons

- full mesh networks can be impractical to set up because of the high number of connections needed
- many connections require a lot of maintenance

Next Week's Lesson:
Leaving Cert Computer Science Grinds - Week 8

Topic: The internet

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