

COMPUTER NETWORKS



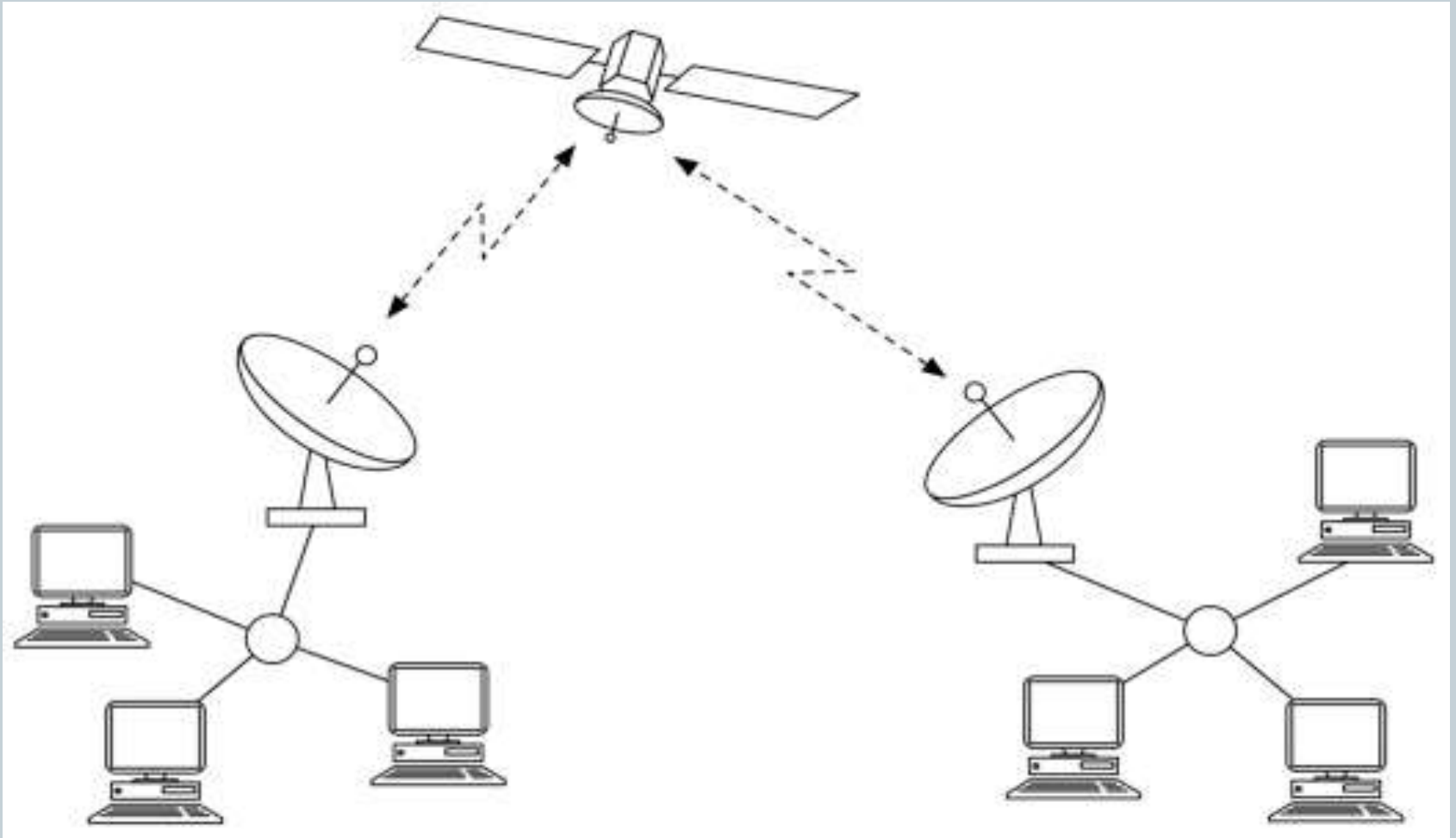
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Computer Network : Devices & classification



- What is a Network? Why Use Networks? Why Not Use Networks?
- Identify the advantages and disadvantages of using common network environments such as the Internet.
- Define and differentiate Internet, Intranet and extranets.
- What do you mean by Servers and clients.
- Define and differentiate, identifying their main characteristics the terms Local Area Network (LAN) and Wide Area Network (WAN).
- Identify the different network typologies, including: Star, Ring and Bus.
- Various networking devices: Describe a modem and its purpose.
- Explain the use of Hub, Switch, Router, Bridge.
- What is IP AND MAC? Differentiate them.
- How computers use Wi-Fi and Bluetooth to connect to networks?

What is a Network?



What is a Network?



- A network is **two or more computers**, or other electronic devices, **connected** together so that they can **exchange data**.

For example a network allows computers to **share files**, users to **message** each other, a whole room of computers to **share a single printer**, etc.

How to create a network?



- Network connections between computers are typically created using **cables** (wires). However, connections can be created using **radio signals** (wireless / wi-fi), **telephone lines** (and modems) or even, for very long distances, via **satellite** links.

standalone computer



- *A computer that is **not connected** to a network is known as a **standalone** computer.*

Why Use Networks?



A) Using a computer connected to a network allows us to...

- Easily **share files** and data
- **Share resources** such as printers and Internet connections
- **Communicate** with other network users (e-mail, instant messaging, video-conferencing, etc.)
- **Store data centrally** (using a file server) for ease of access and back-up
- Keep all of our **settings centrally** so we can use any workstation

Why Not Use Networks?



Using a computer connected to a network means that...

- The computer is vulnerable to **hackers**
- If the **network breaks**, many tasks become very difficult
- Your computer can more easily be attacked by a **virus**

Identify the advantages of using common network environments such as the Internet.



- Make use of **on-line services** such as **shopping** (e-commerce) or **banking**
- Get access to a huge range of **information** for research
- Access different forms of **entertainment** (games, video, etc.)
- Join **on-line communities** (e.g. MySpace, Facebook, etc.)

Identify the disadvantages of using common network environments such as the Internet.



- We have to be careful about **revealing personal information**
- We have to be careful to **avoid suspect websites** that might contain **malware**
- We have to be aware that **information** found on The Internet is **not always accurate or reliable**

Computers in a Network



- Computers connected together to create a network fall into two categories: **servers** and **clients** (workstations).

Servers



Servers are special, powerful computers that provide ‘**services**’ to the **client** computers on the network.

Servers are built to be **very reliable**. This means that they are much more **expensive** than normal computers.

Servers services might include:



- Providing a **central**, common **file storage** area
- **Sharing hardware** such as **printers**
- Controlling who can or can't have **access the network**
- **Sharing Internet** connections
- In a small network one server might provide all of these services. In a larger network there might be many servers sharing the work.

Networks are controlled by the Servers.



Different types of servers:

1. **File Servers:** Allow to save and load data/files.
2. **Application Servers:** Distribution of applications software.
3. **Printer Servers:** Printing from devices on the network.
4. **Proxy servers:** Used to buffer between WANs and LANs.

Clients



- Client computers, or **workstations**, are the **normal computers** that people sit at to get their **work** done.

Web Server and Web Client



- When you use your Web browser, you are in fact using a Web **client**. When you type in the URL of a web page, you are actually providing the address of a Web **server**.

e.g. **www.bbc.co.uk** is the address of the BBC's web server.

Your Web browser/client asks this server for the web page you want, and the server '**serves**' the page back to the browser/client for you to see.

Types of Network

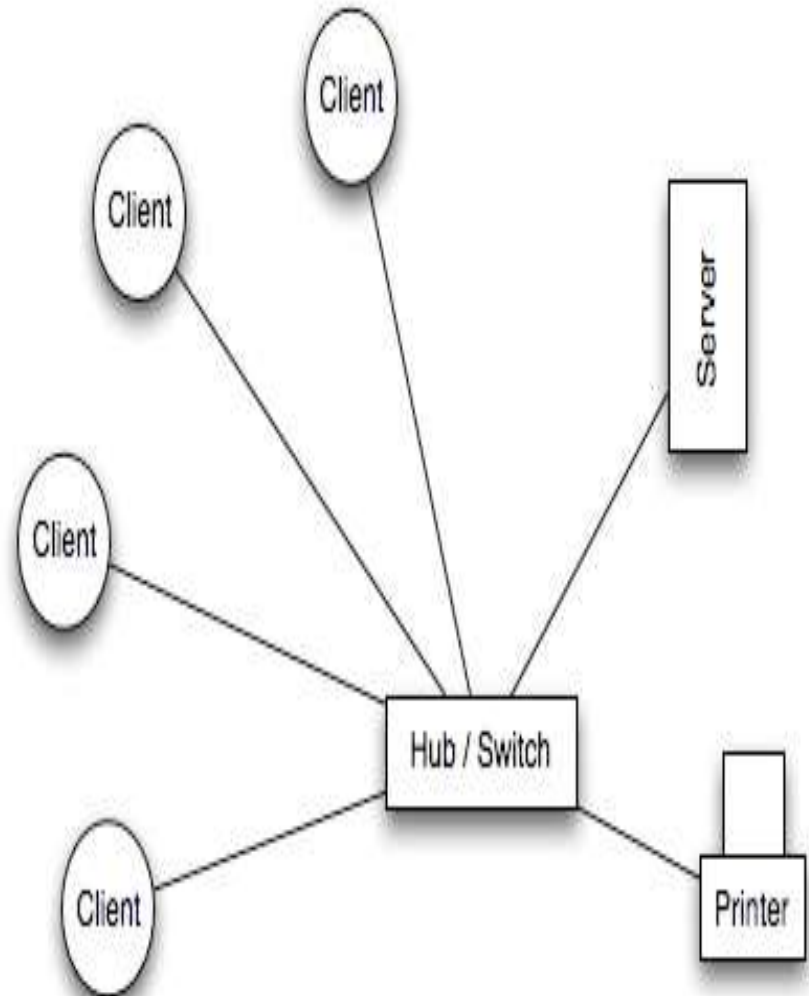


- **Local Area Network (LAN)**
- **Wireless Local Area Network (WLAN)**
- **Wide Area Network (WAN)**
- **Bluetooth (Personal Area Network)**

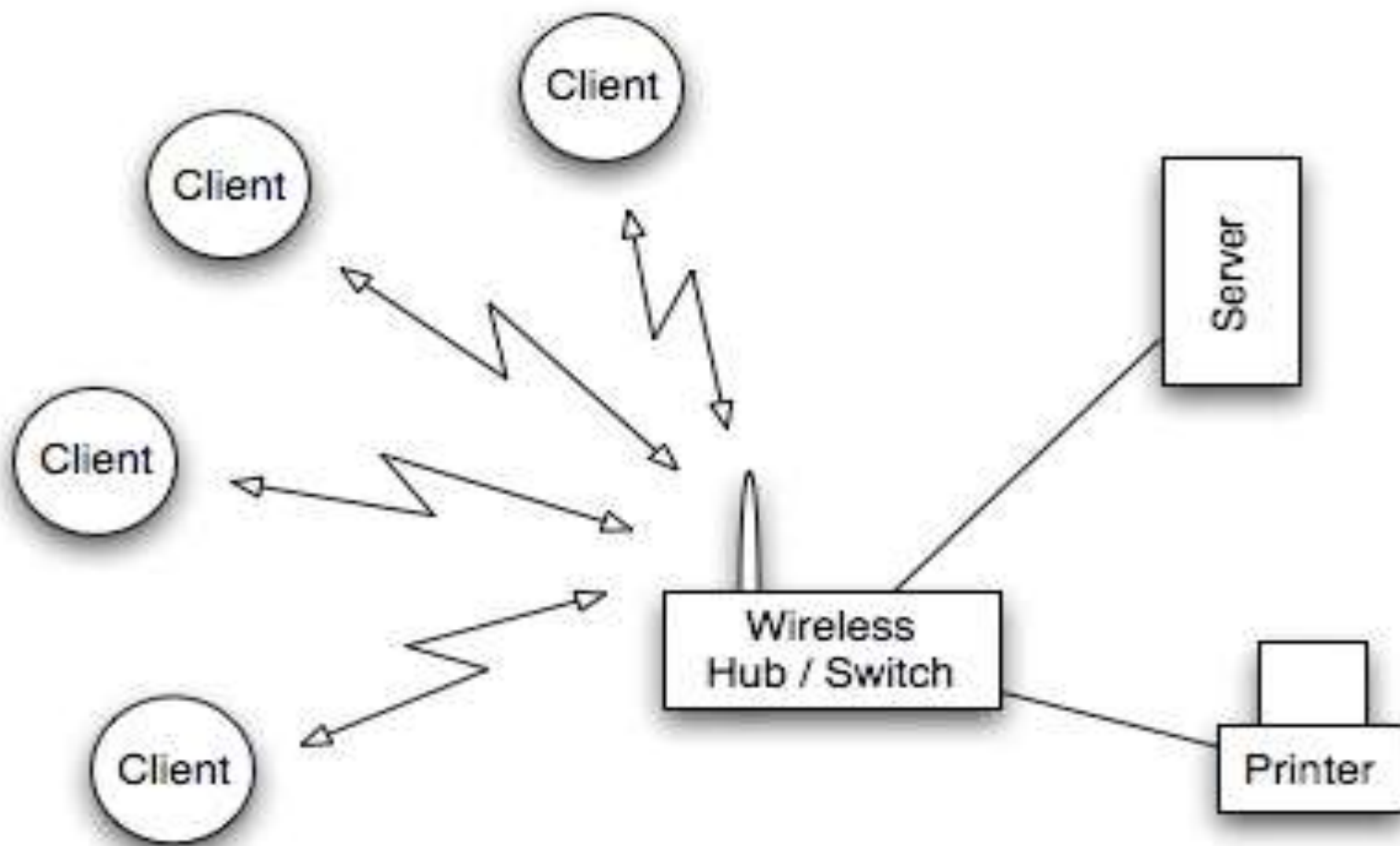
Local Area Network (LAN)

- A Local Area Network is a network confined to **one building or site**. Often a LAN is a **private network** belonging to an organisation or business.

Because LANs are geographically small, they usually use **cables** or low-power radio (**wireless**) for the connections.



Wireless Local Area Network (WLAN)

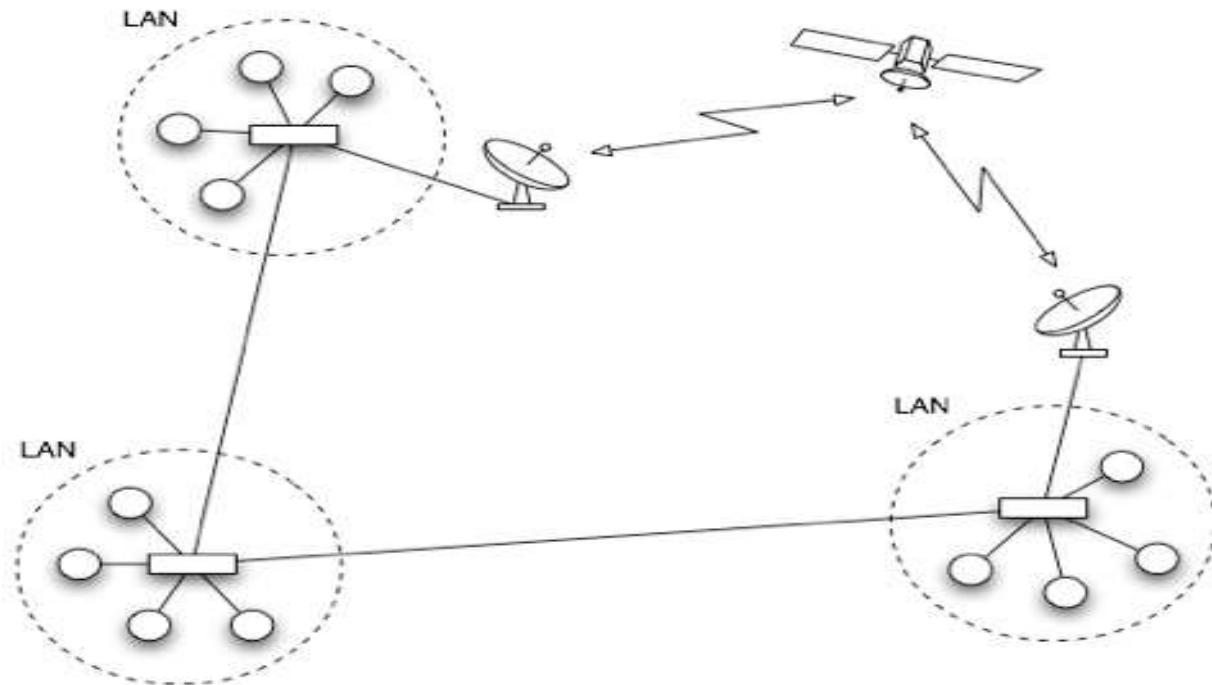


Wireless Local Area Network (WLAN)

- A wireless LAN (WLAN) is a LAN that uses **radio signals (WiFi)** to connect computers instead of cables.
- At the centre of the WLAN is a **wireless switch or router** - a small box with one or two antennas sticking out the back - used for **sending and receiving data** to the computers. (Most laptops have a wireless antenna built into the case.)
- It is much more **convenient** to use wireless connections instead of running long wires all over a building.
- However, WLANs are more **difficult to make secure** since other people can also try to connect to the wireless network. So, it is very important to have a good, hard-to-guess **password** for the WLAN connections.
- *Typically, the **range** of a wireless connection is about **50m**, but it depends how many walls, etc. are in the way.*

Wide Area Network (WAN)

- A Wide Area Network is a network that extends over a **large area**. A WAN is often created by **joining several LANs** together, such as when a business that has offices in different countries links the office LANs together.



Wide Area Network (WAN)



- Because WANs are often geographically spread over large areas and **links** between computers are over **long distances**, they often use quite exotic connections technologies: **optical fibre** (glass) cables, **satellite** radio links, **microwave** radio links, etc.

Wide Area Network (WAN)

- The **Internet** is an example of a **global WAN**. In fact it is the world's largest WAN.
- Computers on the International Space Station are linked to the Internet, so you could say the Internet is now the first off-planet WAN!



LAN Topologies



- The word topology means ‘arrangement’, so when we talk about the topology of a network, we mean how the different parts are arranged and connected together.

There are three common network topologies...

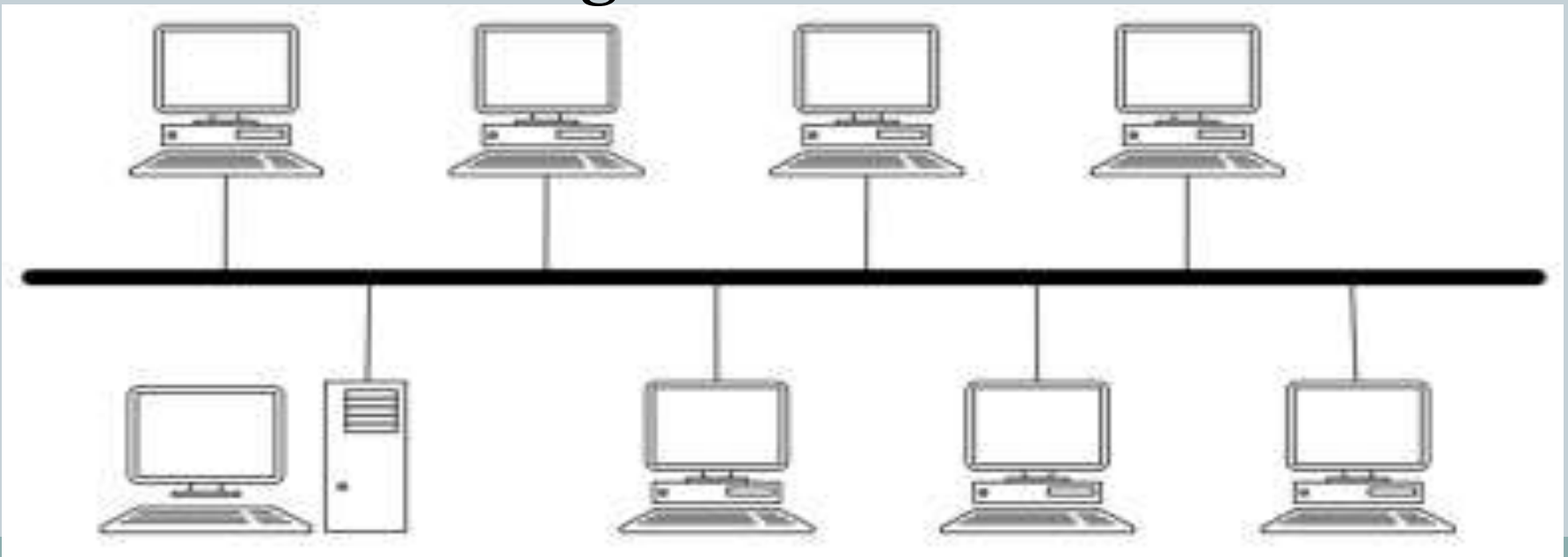


- **Bus Network**
- **Ring Network**
- **Star Network**

Bus Network



In this type of network, a **long, central cable**, the 'bus' is used to connect all of the computers together. Each computer has a short cable linking it to the 'bus'.



A bus network...



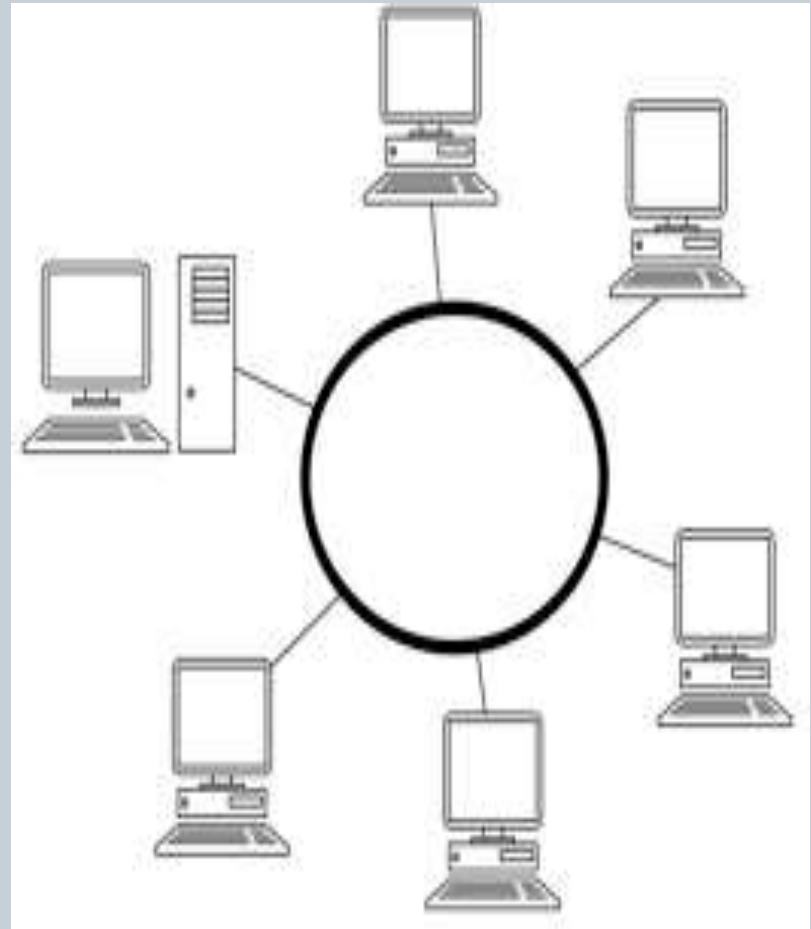
- Is **cheap to install** (just one long cable)
- Can be **quite slow** since all computers share the same cable when communicating
- Will **stop** working if there is a **break** in the central bus **cable**.

Ring Network



In this type of network each computer is connected to a **loop of cable**, the 'ring'. (If you took a bus network and connected the ends of the bus cable together, you would have a ring network.)

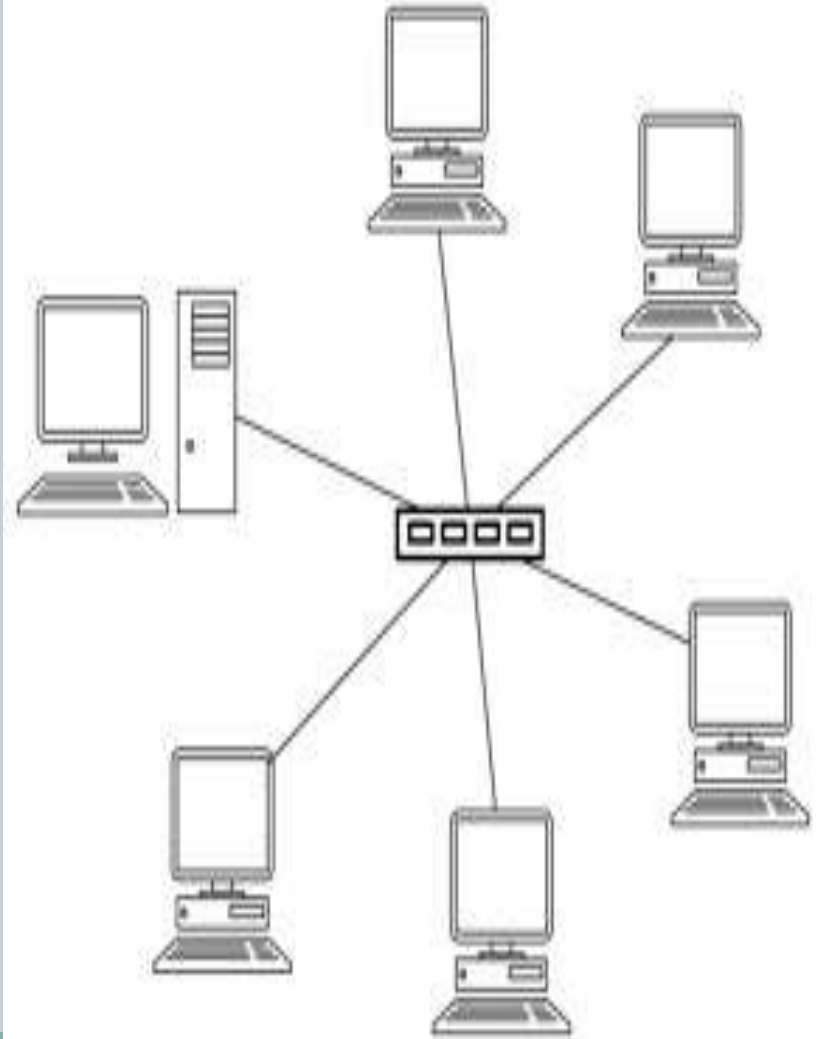
A ring network...
Can **cope** with a **break** in the ring cable since all computers are still joined together (it is now a bus network)



Star Network

In this type of network every computer is connected to a **central device**. The device **passes messages** between computers.

At the centre of a star network you might use a **hub** (cheap, but slower) or a **switch** (more expensive, but faster).



A star network...



Is **quite expensive** to install (you have to buy **lots of cable** and the **central device**)

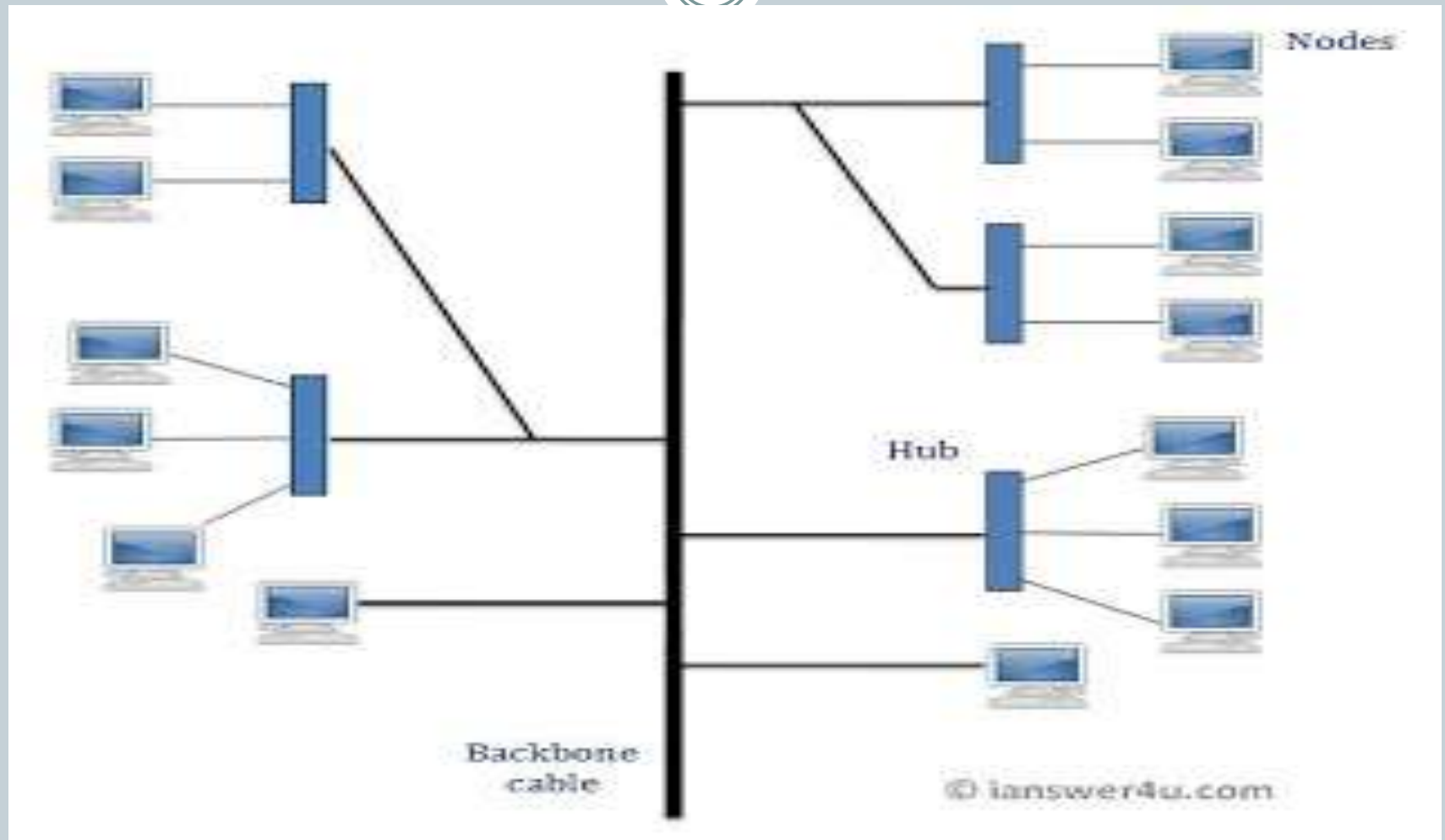
Is **very fast** since each computer has its own cable which it doesn't need to share

Can **cope** with a **broken cable** (only one computer will be affected)

Will **stop** working if the central **device breaks**

Is the most **common** network topology

TREE TOPOLOGY



In Tree Topology



Number of Star networks are connected using Bus. This main cable seems like a main stem of a tree, and other star networks as the branches. It is also called **Expanded Star Topology**.

Advantages of Tree Topology



1. Expansion of Network is possible and easy.
2. Here, we divide the whole network into segments (star networks), which can be easily managed and maintained.
3. Error detection and correction is easy.
4. If one segment is damaged, other segments are not affected.

Disadvantages of Tree Topology



1. Because of its basic structure, tree topology, relies heavily on the main bus cable, if it breaks whole network is crippled.
2. As more and more nodes and segments are added, the maintenance becomes difficult.
3. Scalability of the network depends on the type of cable used.

Modem

It is short for "Modulator / Demodulator." It is a hardware component that allows a computer or other device, such as a router or switch, to connect to the Internet. It converts or "modulates" an analog signal from a telephone or cable wire to a digital signal that a computer can recognize. Similarly, it converts outgoing digital data into an analogue signal for transmission over an telephone line.

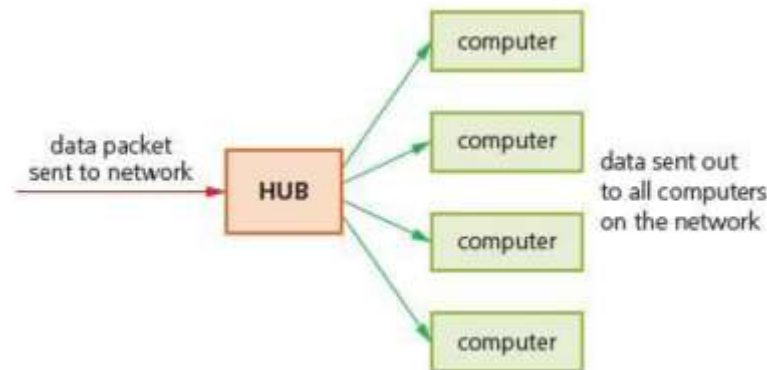




Hub

Hubs are the hardware devices that can have a number of devices or computers connected to them to create a network.

- It is known as the most simplest amongst other network devices. Its a common connection point for device in a network.
- In general, hub is the central part of a wheel where the spokes come together. Hubs are commonly used to connect segments of a LAN.
- It cannot filter data. Data packets are sent to all connected devices, and there is no intelligence to find out the best path for data packet which then leads to inefficiencies and security threads.
- A hub contains multiple ports. Its main task is to take any data packet received at one port and broadcast it to every computer in the network.
- Hubs are used on a small networks where data transmission is not very high.



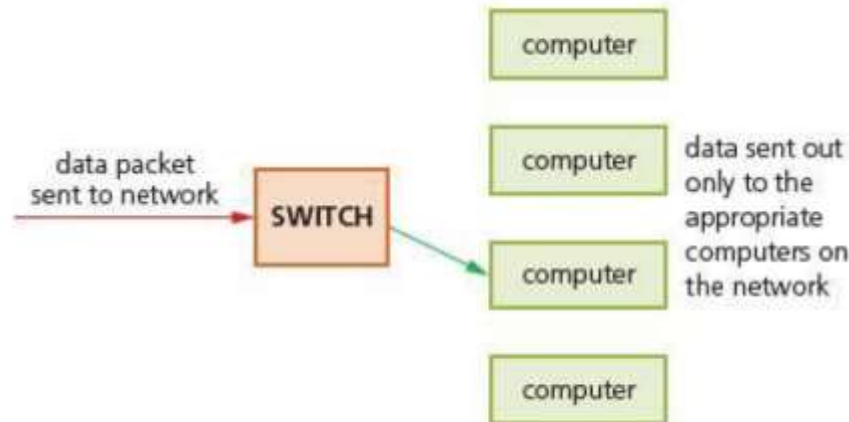


Switches

They are similar to hubs but Switches can perform error checking before forwarding data, which are very efficient by not forwarding packets that error-end out or forwarding good packets selectively to correct devices only. This makes using a switch a more secure way of distributing data.

As with hubs, they connect a number of devices or computers together to form a LAN. However, unlike a hub, large networks use switches instead of hubs to connect computers.

It checks the data packet received and works out its destination address (or addresses) and sends the data to the appropriate computers only.

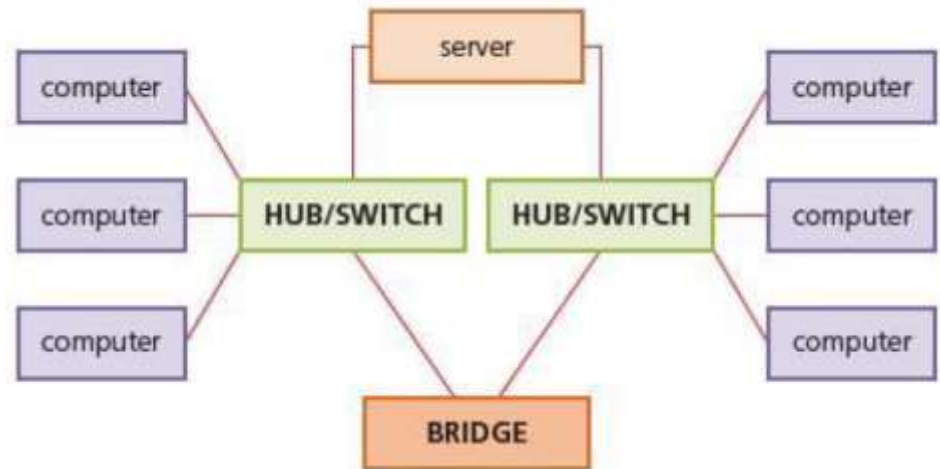


Bridges

In a telecommunication networks, Bridges are devices that connect one LAN to another LAN that uses the same protocol (communication rules). They often used to connect together different parts of a LAN so that they function as single LAN.

Bridges tend to be used to interconnected LANs (or parts of LANs) since sending out every data packet to all possible destinations would quickly flood larger networks with unnecessary traffic. For this reason a router is used to communicate with other networks, such as the internet.

Filters traffic on the LAN by looking at the Media Access Control (MAC) address, thus a bridge is more complex than a hub.



Router

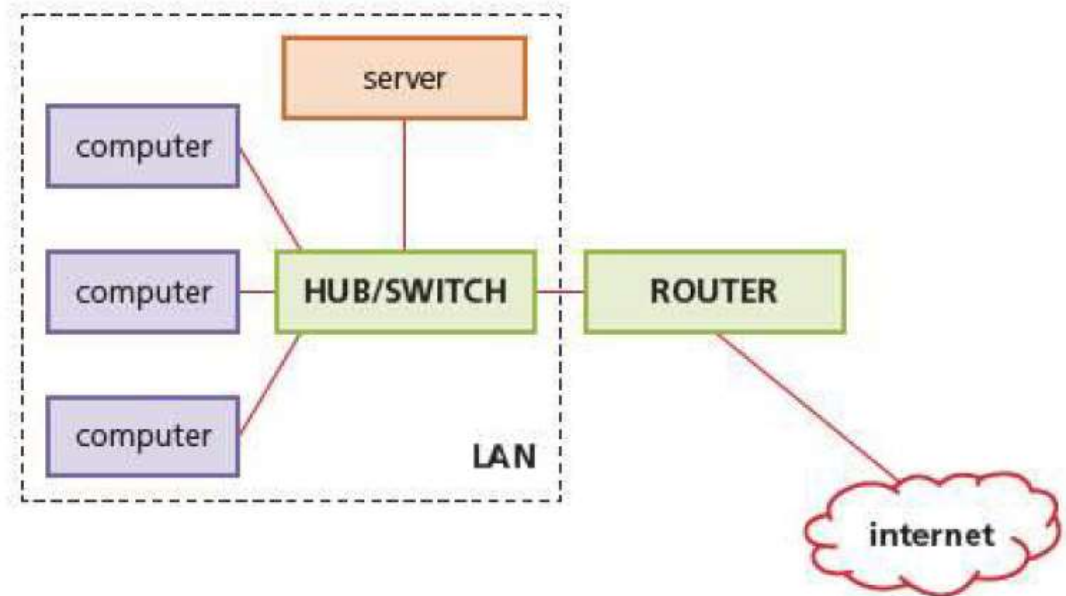
It enable data packets to be routed between the different networks, for example to join a LAN to a wide area network (WAN).

A router would typically have an internet cable plugged into it and several cables connecting to computers and other devices on the LAN.

A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISP.s network.

Router forwards packets based on address just like a switch.

Routers usually use the IP address to forward packets, which allow the network to go across different protocols.



Internet Protocol Address

Internet Protocol Address (or IP Address) is a 32 bits unique address that computing devices use to identify itself and communicate with other devices in the Internet Protocol network. A home computer is given an IP address when it connects to the internet. This is assigned by the ISP and is unique for that particular internet session.

IP address uniquely identify all computers on the public Internet. It signifies the address of both the sender and receiver of packets on a network.

Example: 172.16.254.1 (IPv4) 32 bits

2001:db8:0:1234:0:567:8:1 (IPv6) 128 bits

Type of IP Address

1. Static ip address: A static IP address is an IP address that can be manually configured for a device and it will never change
2. Dynamic ip address: A dynamic IP address is an IP address assigned by a DHCP(Dynamic Host Configuration Protocol) server which can be change automatically any time.

MAC address

The physical address is also called the MAC address and it is generated by the manufacturer of NIC(network interface card).

The Media Access Control (MAC) address. MAC addresses are six bytes (48 bits) that manufacturers of network adapters burn into their products to uniquely identify them.

Example: 01:02:31:a2:b3:cf

A network interface card (NIC) is a computer circuit board or card that is installed in a computer so that it can be connected to a network



Wi-Fi or wireless networking technology uses radio waves to provide wireless high-speed Internet and network connections.

Wi-Fi is not short for "*wireless fidelity*," . Wi-Fi is simply a trademarked phrase that means *IEEE 802.11x*.



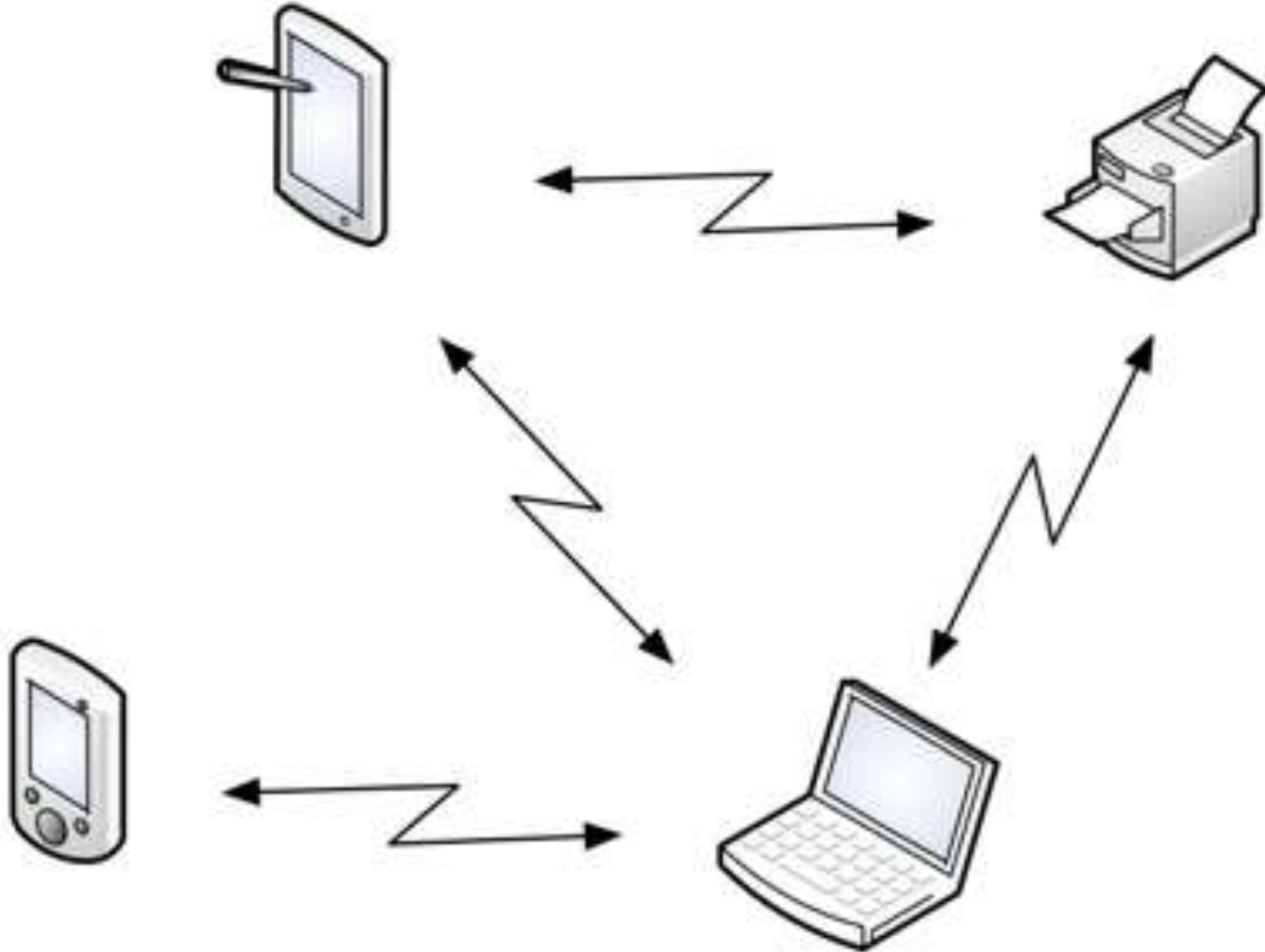
Wi-Fi or wireless networking

A wireless transmitter (WAP) receives information from a network via its connection. This transmitter converts the received information into radio waves and then transmits them.

A device receives the radio waves via installed wireless adaptor which allows it to download the information from the data source and vice versa.

It provides better data transfer rates, range and security as compared to Bluetooth.

Bluetooth (Personal Area Network)



Bluetooth (Personal Area Network)



- Bluetooth is a wireless networking technology designed for very **short-range** connections (typically just a few metres).

'Personal Area Network'

- Because Bluetooth networking only works over very short distances, and with devices belonging to one user, this type of network is sometimes called a **'Personal Area Network'**

Why Bluetooth?



- The idea of Bluetooth is to get rid of the need for all of those cables (e.g. USB cables) that connect our computer to peripheral devices such as printers, mice, keyboards, etc.

How to create Bluetooth network?



- Bluetooth devices contain small, **low-power** radio transmitters and receivers. When devices are in range of other Bluetooth devices, they detect each other and can be '**paired**' (connected)

Typical uses of Bluetooth:

- Connecting a **wireless keyboard** to a computer
- Connecting a **wireless mouse** to a computer
- Using a **wireless headset** with a mobile phone
- **Printing wirelessly** from a computer or PDA
- **Transferring data** / music from a computer to an MP3 player
- **Transferring photos** from a phone / camera to another device
- **Synchronising** calendars on a PDA and a computer