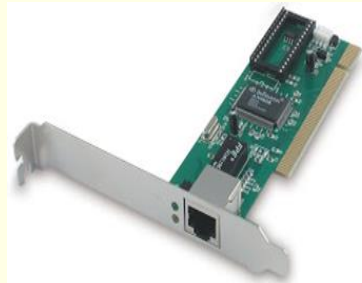
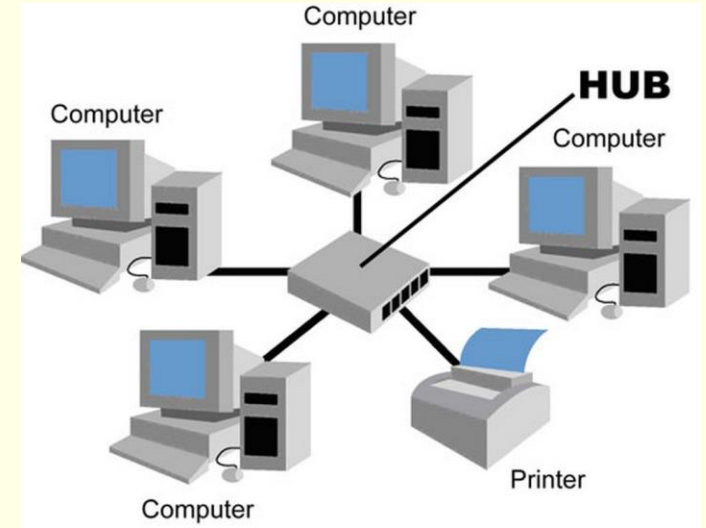


Starter: What do these represent?



Learning Aims

- Explain why computers are connected in a network
- Describe the characteristics of a LAN (Local Area Network) and WAN (Wide Area Network)
- -The hardware needed to connect stand-alone computers into a Local Area Network:
 - Wireless access points
 - Routers
 - Switches
 - NIC (Network Interface Controller/Card)
- The difference between a MAC and IP address



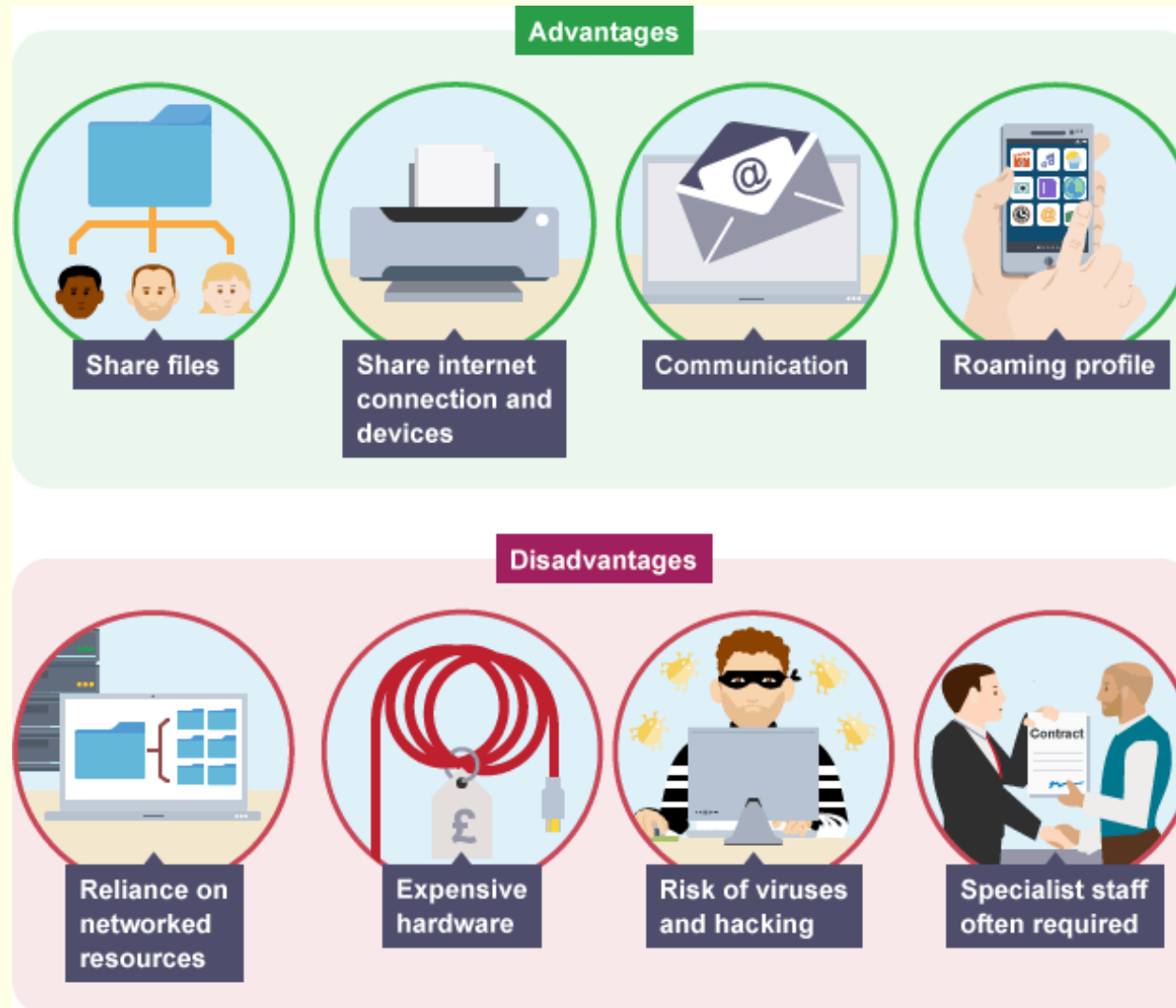
Key terms

Keyword	Definition
Network	A group of computers and devices linked together to share resources such as files, printers, and internet connections.
LAN (Local Area Network)	A network covering a small geographical area such as a home, school, or office. Owned and maintained by the organisation or individual.
WAN (Wide Area Network)	A network that connects computers over a large geographical area, often connecting multiple LANs. Usually managed by telecom companies.
Router	A device that connects different networks together and directs data between them (e.g. connects a LAN to the internet).
Switch	A device used within a LAN to connect multiple computers and manage the flow of data to the correct destination using MAC addresses.
Wireless Access Point (WAP)	Hardware that allows wireless devices to connect to a wired network using Wi-Fi.
NIC (Network Interface Card / Controller)	Hardware component inside a computer or device that allows it to connect to a network (wired or wireless).
Server	A powerful computer that provides services, data, or applications to other computers (clients) on a network.
Client	A computer or device that accesses services provided by a server on a network.
Peripherals	External devices (e.g. printers, scanners) that can be shared across a network.
IP Address (Internet Protocol Address)	A unique virtual address used to identify devices on a network or the internet. Can be IPv4 or IPv6.
MAC Address (Media Access Control Address)	A unique physical address built into the hardware of a network device, used for communication within a LAN.
Backups	Copies of data stored in a separate location (often on a server) to prevent data loss.
Network Security	Measures taken to protect a network from unauthorised access, viruses, and data theft.



What is a network?

- A computer network is a number of computers linked together to allow them to share resources.



What communication might take place in a network?



Send an email



Accessing a file from another computer



View a web page



Control smart home devices



Streaming a YouTube video



Send a document to a printer



Example – network communication

These are examples of how communication might take place in a network:

- An email sent from one person to another
- A document sent to a networked printer
- View a web page
- Smart-home lights responding to a command in an app to turn them on
- Streaming a YouTube video on a tablet computer
- Accessing a file on a school's virtual learning environment



Activity: What are the benefits of networking computers? What do the pictures represent?



Share peripherals



Shared Internet Connection



Receive malware updates



Share files



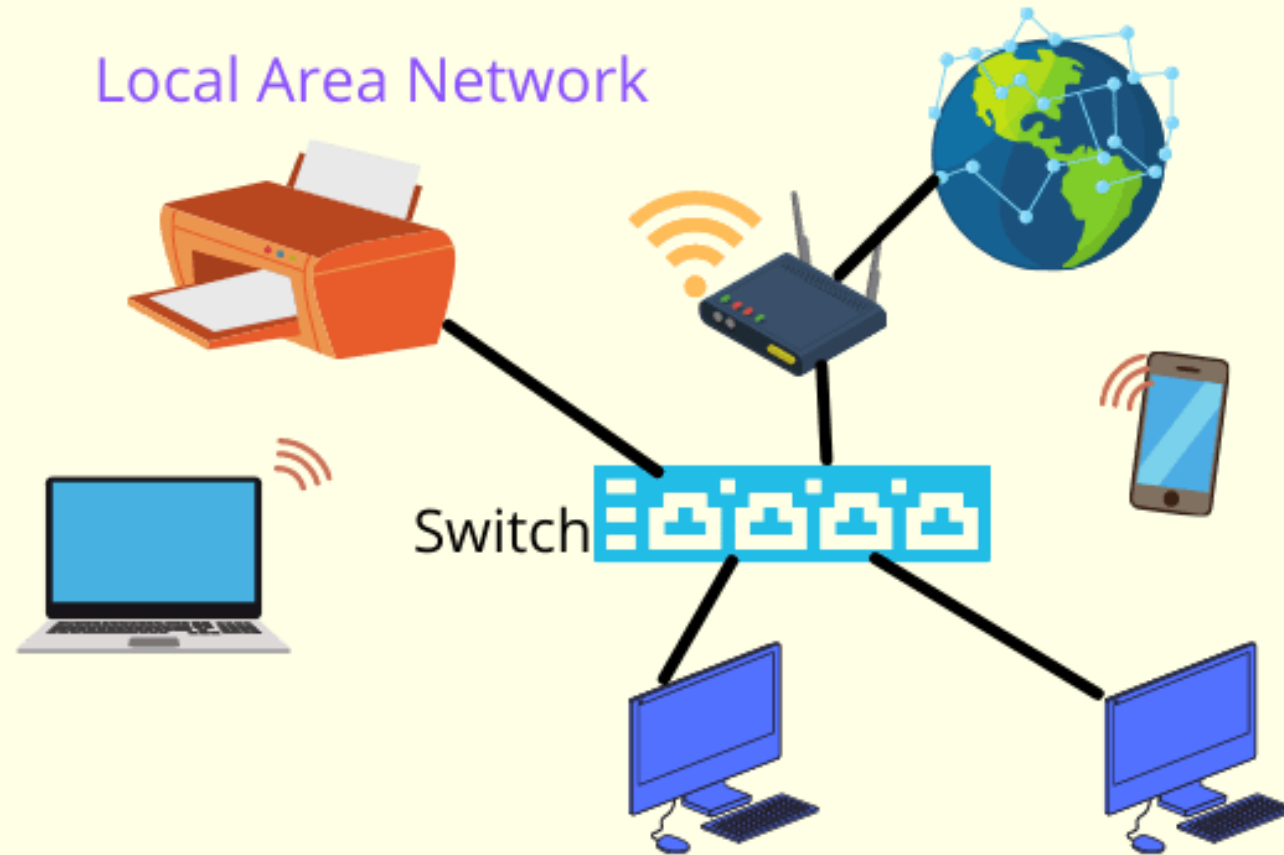
Login to any computer



Control smart-home devices remotely



What are the benefits of networking computers?



Benefits of networking computers

Software and file sharing - users can share software and files with other users

Share hardware/peripherals - users can share hardware, such as a printer

Communication - users can communicate via email, chat, or by video

Roaming access - users can sign in to any computer on the network and access their files

On larger networks:

Centralised maintenance and updates - network managers can apply software updates across a network, removing the need for users to have to do so

Centralised security - anti-virus software and firewalls can be implemented across a network, helping to protect user files from risks

User monitoring - network managers can monitor what users do on a network levels of access - different users can be given different access rights, giving network managers the ability to restrict groups of users access to certain files while granting permission to specific users



What are potential drawbacks of a network?

- **Cost** - additional equipment is needed to allow computers to communicate
- **Management** - larger networks require management by specialist staff such as a network manager
- **Spread of malware** - viruses and other forms of malware can easily spread across an improperly secured network
- **Hacking**- once a device is connected to another device, it is possible that data may be accessed without the device owner's permission

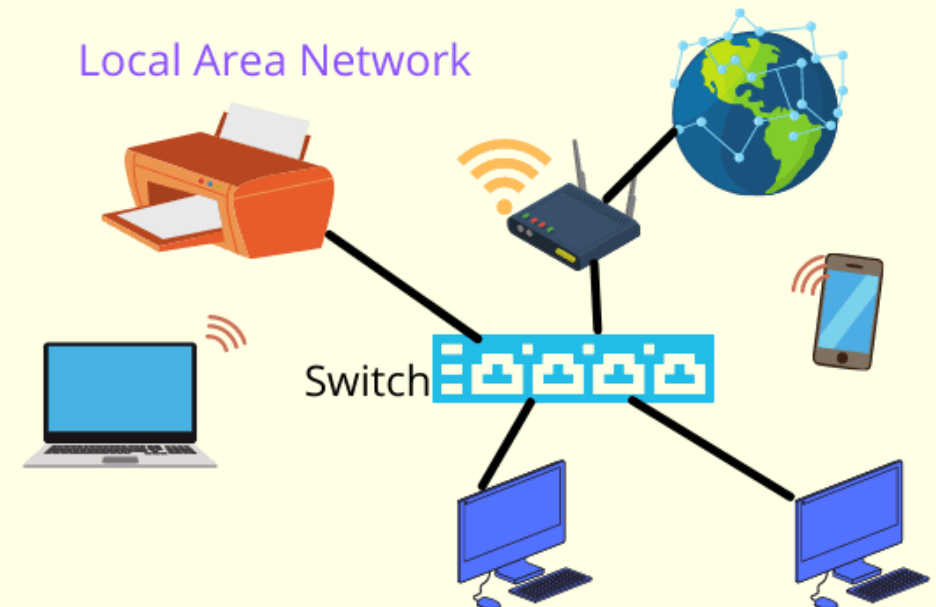







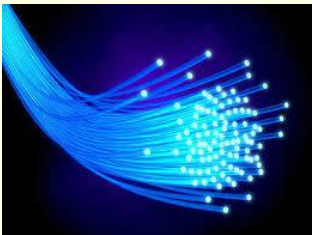


LAN – Local Area Network

- A local area network (LAN) is usually found within a **small geographic area** such as a building or campus.
- LANs are often used in schools, hospitals, businesses, and libraries.
- Also, can be set up in homes.

A LAN has the following characteristics:

- computers are within a **small geographic area**
- computer workstations with **network interface cards (NICs)**, including wireless NICs
- connected using its own dedicated cables (or wireless devices) owned by the company, organisation or home
- often has shared peripherals, eg printers



For the devices to connect to the network, some of the following network hardware will be required:		
Switch	A switch connects several devices together to enable communication between those devices. A cable can be connected between each port (socket) on the switch and a network socket on a device.	
Network Interface Card	Computers need a network interface card (NIC). This will include a network socket which can be connected to a port on the switch. Most computers have a NIC built-in to the motherboard. Also, can be a wireless network card.	 
Wireless Access Point	A wireless access point (WAP) enables wireless devices such as tablets, laptops and mobile phones to connect to the network using Wi-Fi. It will usually be connected to a switch using a cable.	
Ethernet Cable	A network cable is needed to connect each ethernet network interface card to the switch. Fibre-optic cable - Suitable for high traffic networks and WAN connections across the long distances. High bandwidth.	 
Router	Allows Internet access.	 

Network server

Larger local area networks will include one or more servers. A server is a powerful computer that performs functions on behalf of devices connected to it.

Servers can perform a range of functions including:

- shared access to files
- security (e.g. logging on)
- providing access to software
- managing print jobs
- providing mailboxes for email
- performing automated backups

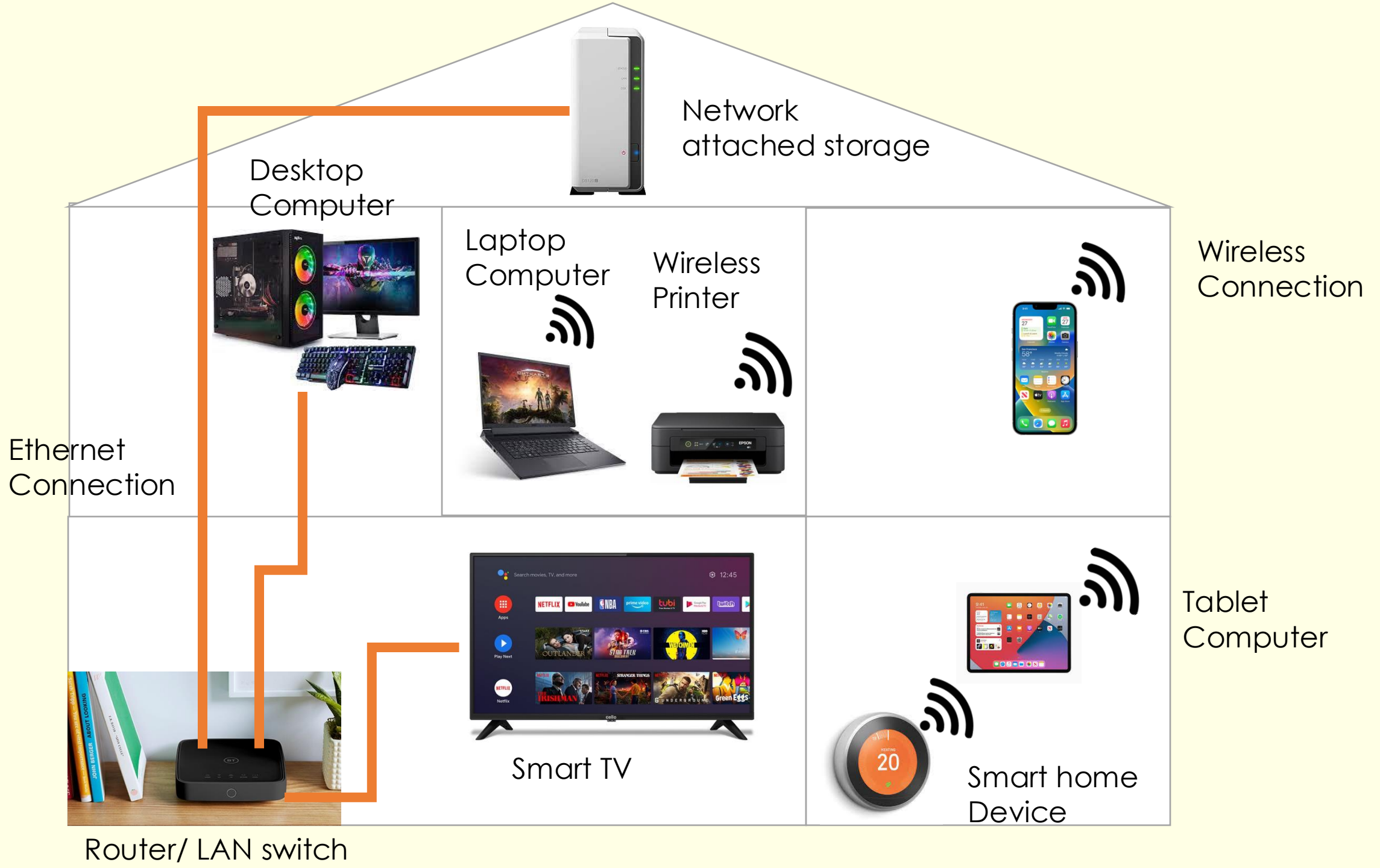


A local area network in a typical home could include the following devices:

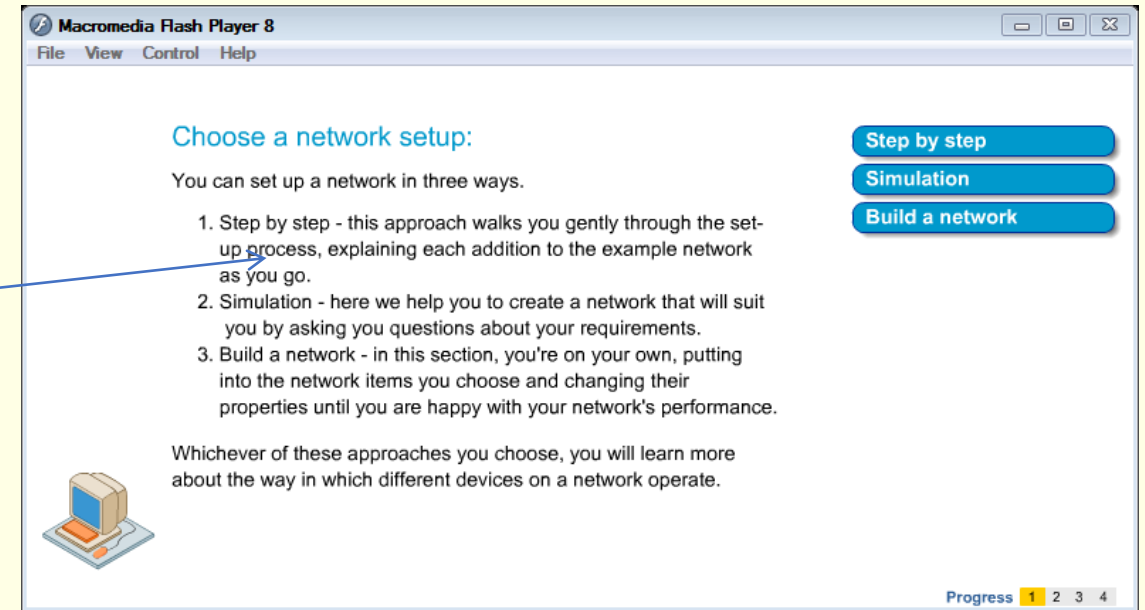
- Desktop computer
- Laptop computer
- Tablet computer
- Mobile phone
- Printer
- Network attached storage
- smart home devices
- Smart TV

The key device at the centre of a home LAN is the **router**. This connects all of the devices to each other and, where required, to the internet.





- Let's build a Network.
- Open the file:
Network Simulation
Go through
the step by step
Option

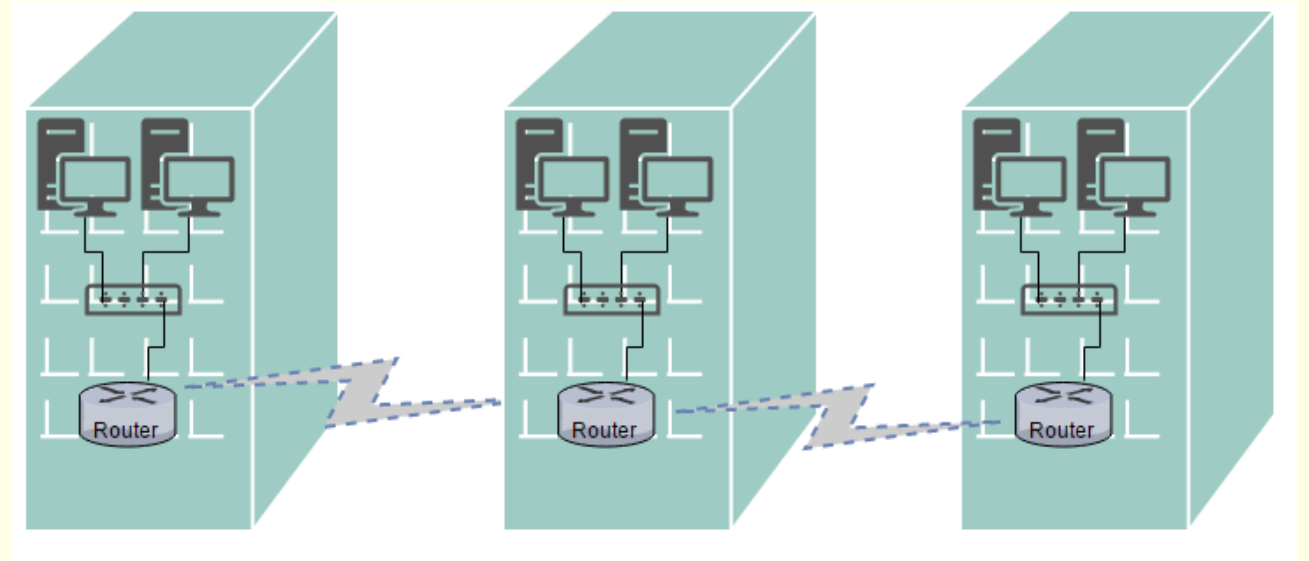


WAN

- A wide area network (WAN) consists of computers that are connected but are **geographically remote** from each other.
- A WAN often connects LANs that are in different locations.

Example – wide area network

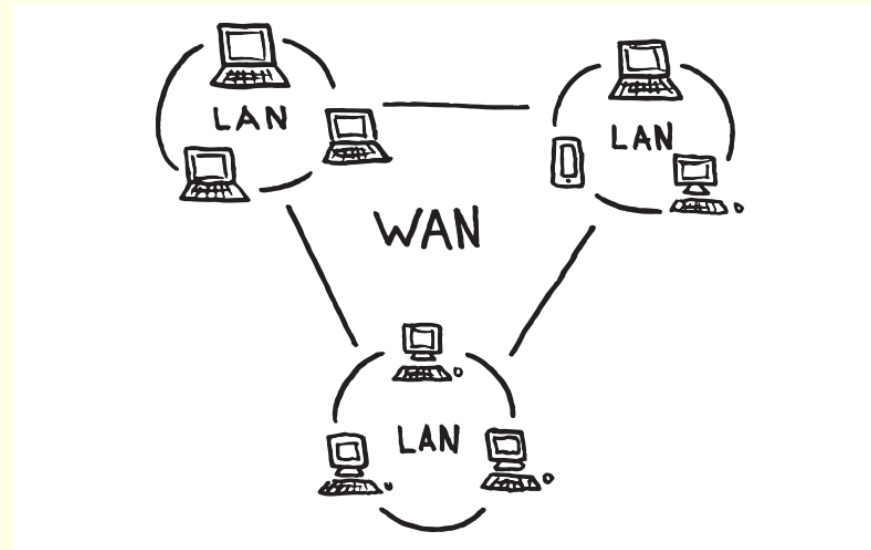
These 3 office blocks are several miles apart. Each block has its own LAN with a switch. Each switch is connected to a router which connects the LAN to the WAN.



The characteristics of a WAN are:

Router is needed to connect to the WAN

To connect to a WAN you have to pay a fee, because the communication links in a WAN is owned by telecommunications companies, such as BT or Virgin Media.



To transmit data across a WAN and connect LAN's together requires either a phone lines, 4G/5G, leased lines, or satellite.

Cover large geographical areas.



WANs are used in large organisations. Some examples include:

- **Example – wide area networks**

- Universities which have multiple campuses a long way from each other
- Local education authorities which connect together lots of schools
- Airline booking systems
- National Lottery terminals
- Automated Teller Machines (ATMs)
- Train timetable systems
- Large businesses with lots of offices or shops



What are the benefits for organisations using a WAN?

- Allows for data to be shared across all locations
- Allows for easy communication across locations, using email and video conferencing.
- Allows for remote access and 24/7 access
- Employees can log in to the network wherever they are, access shared systems and work together collaboratively.
- Only need one IT support team to manage all locations
- Updates to software can be deployed easily



The internet

- The internet is the largest WAN in the world.
- It is a global network of networks.
- There are potentially billions of devices connected to the internet at any one time.



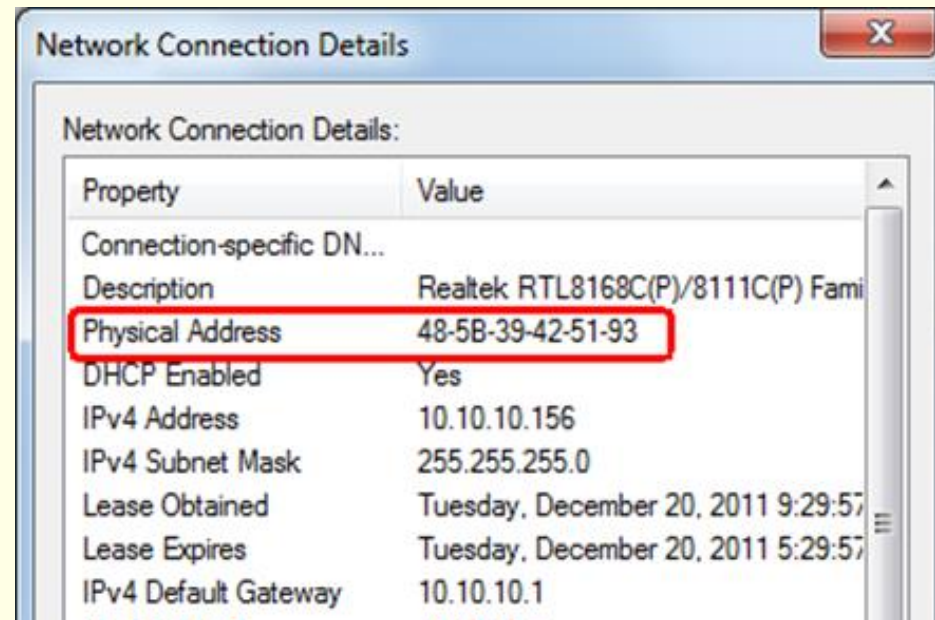
How to find a device on a network?

- Each device in a network needs a unique address so that connections can be made to it.
- There are two types of address that you will learn about.
- IP addresses are used on the internet.
- MAC addresses are used on LANs.



MAC Address (Media Access Control)

- **Physical Address**
- It is unique to the device & built into the hardware
- The MAC address is used to deliver the data **to the right device on a local area network (LAN)**
- **Switch** will use **MAC addresses** to get the data to the correct device
- MAC addresses are not part of Internet traffic and only used inside a given network.

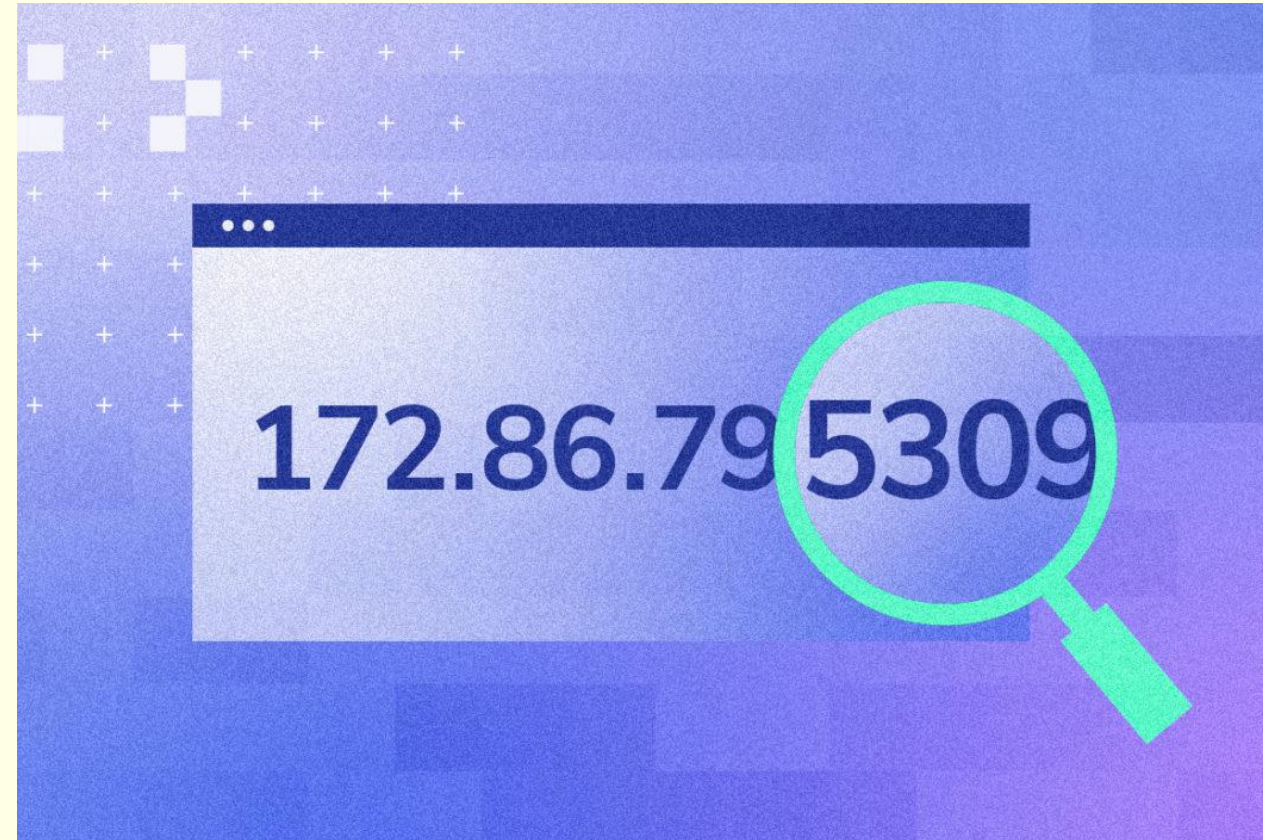


IP Addresses

In a WAN, an IP (Internet Protocol) address is used to identify an individual device or network access point.

There are two types of IP address. These are known as version 4 and version 6 (IPv4, IPv6) addresses.

IPv6 addresses are longer. IPv6 can therefore address a greater number of unique devices. They were created to help manage the huge number of devices on the internet.



IP Addresses

- **The IP address is a virtual address** and it changes depending on the network your device connects to
- IP address is used to transport data from one network to another network using the TCP/IP protocol, basically to connect to the internet.
- A router connects to the internet using a **public IP Address assigned by your ISP (Internet Service Provider)**
- Every device connected to the router will be assigned a **Internal IP address along with the devices MAC address**
- The MAC address is used to deliver the data to the right device on a network
- Routers assign internal IP addresses to devices as they connect and recycle them when devices disconnect.
- **MAC Filtering:** You can tell your router to deny access to specific MAC addresses (i.e. specific physical devices) or only allow certain MAC addresses to connect to the internet.

