# WiFi Explained

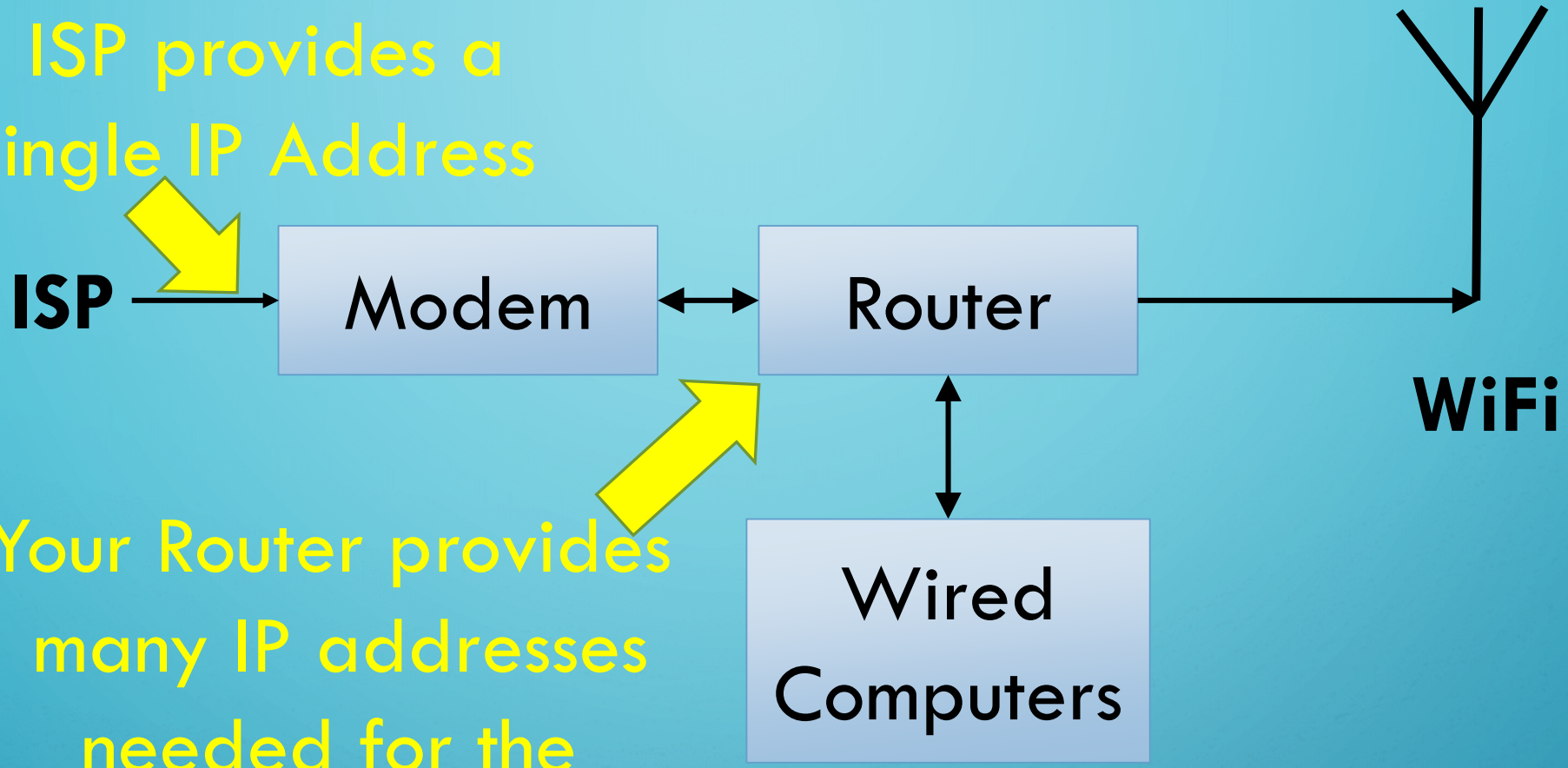
## And how to get the best from it

Hillingdon U3A Computer Club

July 2020

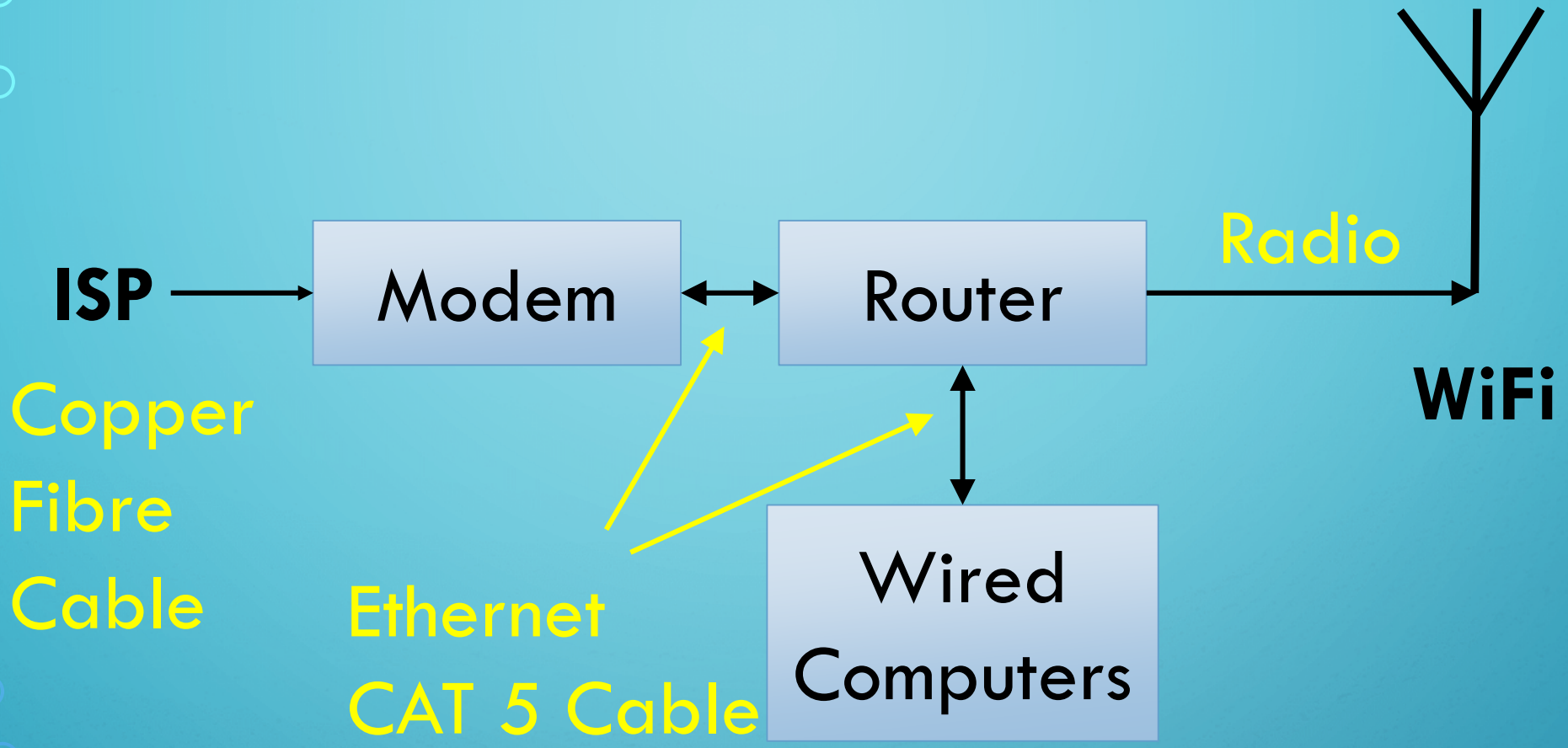
# Your Home LAN Network

ISP provides a single IP Address



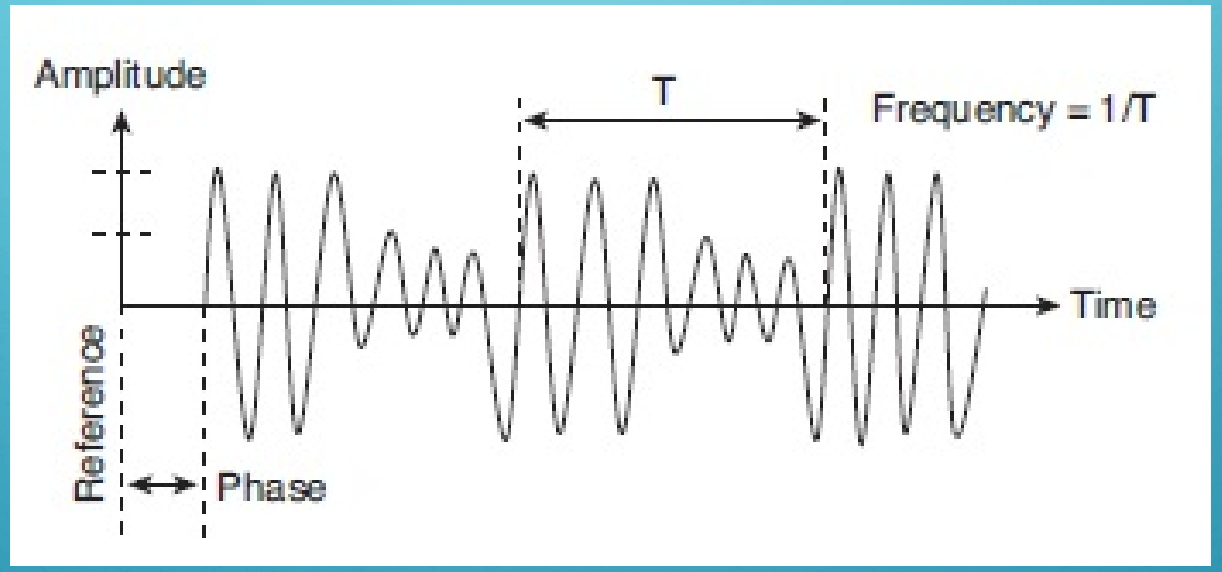

Your Router provides many IP addresses needed for the internal network

# Your Home LAN Network



# WiFi Principles

Wireless LANs use Radio Waves to carry information through the air from one point to another but encountering various obstacles that can impact range and performance.



# WiFi History 1

- WiFi came from Wireless Fidelity (a pun on Hi-Fi)
- 1971 Hawaii develops first wireless connection (ALOHA)
- 1985 US releases ISM band. Used for RF energy applications such as Microwave ovens, that caused interference to telecoms.
- 1991 NCR & AT&T develops a cashier system- WaveLAN become the precursor to 802.11 Std 1mbps/2mbps
- 1992/6 An Australian radio astronomer is actually credited with inventing WiFi - Dr John O'Sullivan

# WiFi History 2

- IEEE 802.11 protocol released in 1997
- As a wireless connection from your network to devices such as Smartphones, Tablets etc
- It uses radio frequencies 2.4 GHz and 5.8 GHz
- The 2.4 Ghz band has 13 channels (overlapping)
- The 5.8 GHz band has 30 channels (20 mhz non overlapping)

# WiFi

Wi-Fi generations

| Generation/IEEE Standard | Maximum Linkrate | Adopted | Frequency |
|---|---|---|---|
| Wi-Fi 6 (802.11ax) | 600–9608 Mbit/s | 2019 | 2.4/5 GHz<br>1–6 GHz ISM |
| Wi-Fi 5 (802.11ac) | 433–6933 Mbit/s | 2014 | 5 GHz |
| Wi-Fi 4 (802.11n) | 72–600 Mbit/s | 2009 | 2.4/5 GHz |
| Wi-Fi 3 (802.11g) | 3–54 Mbit/s | 2003 | 2.4 GHz |
| Wi-Fi 2 (802.11a) | 1.5 to 54 Mbit/s | 1999 | 5 GHz |
| Wi-Fi 1 (802.11b) | 1 to 11 Mbit/s | 1999 | 2.4 GHz |

# MIMO

**Multiple-input and multiple-output**


- WiFi 4 introduced multiple antennas and MIMO
- Exploits multipath propagation providing faster speeds and greater range.
- WiFi 5 only uses 5 GHz & capable of 1 GbpS
- Wi-Fi 5 called this 802.11ac standard
- Both router and device must support MIMO
- Supports traffic in one direction router to client

# WiFi Security

Because it uses radio waves it is easily intercepted unless additional security (a security algorithm) is employed.

- WEP – early version now easily hacked
- WPA – better security with TKIP 128 bit encryption
- WPA2 – current the best with AES 256 bit encryption

Connection uses a PSK - Pre Shared Key (a password)

Converts WiFi password to a complex string of 32 characters

# Hotspot – What is it?

- A Hotspot is any location where WiFi  to connect to the internet is made publicly available
- Hotspots are equipped with a Broadband connection via one or more Access Points
- Hotspots can be available in any public location where there is an internet connection.  Examples are :-
  Airports, Hotels & Resorts, Restaurants, Coffee Shops, Bookstores & Shopping Malls

# WiFi Network Elements 1

- *Access Point* – The AP is a transceiver or "base Station" that can connect one or many wireless devices at the same time to the internet
- *Safeguards (Network)* – Firewalls and anti-virus software protects networks from uninvited users.
- *Safeguards (User)* – Strong passwords, VPN's, anti-virus and of course "common sense".

# WiFi Network Elements 2

- *SSID* – The Service Set Identifier is the network name
- *Channel* – is the network path with a centre frequency
- *MAC Address* – The Media Access Control is a unique identifier that every network device must have. Format is 00:14:a5:41:16:6b and is assigned by the device manufacturer
- *WPS* – WiFi Protected Setup is a simple process to add WiFi clients to a network – a single button

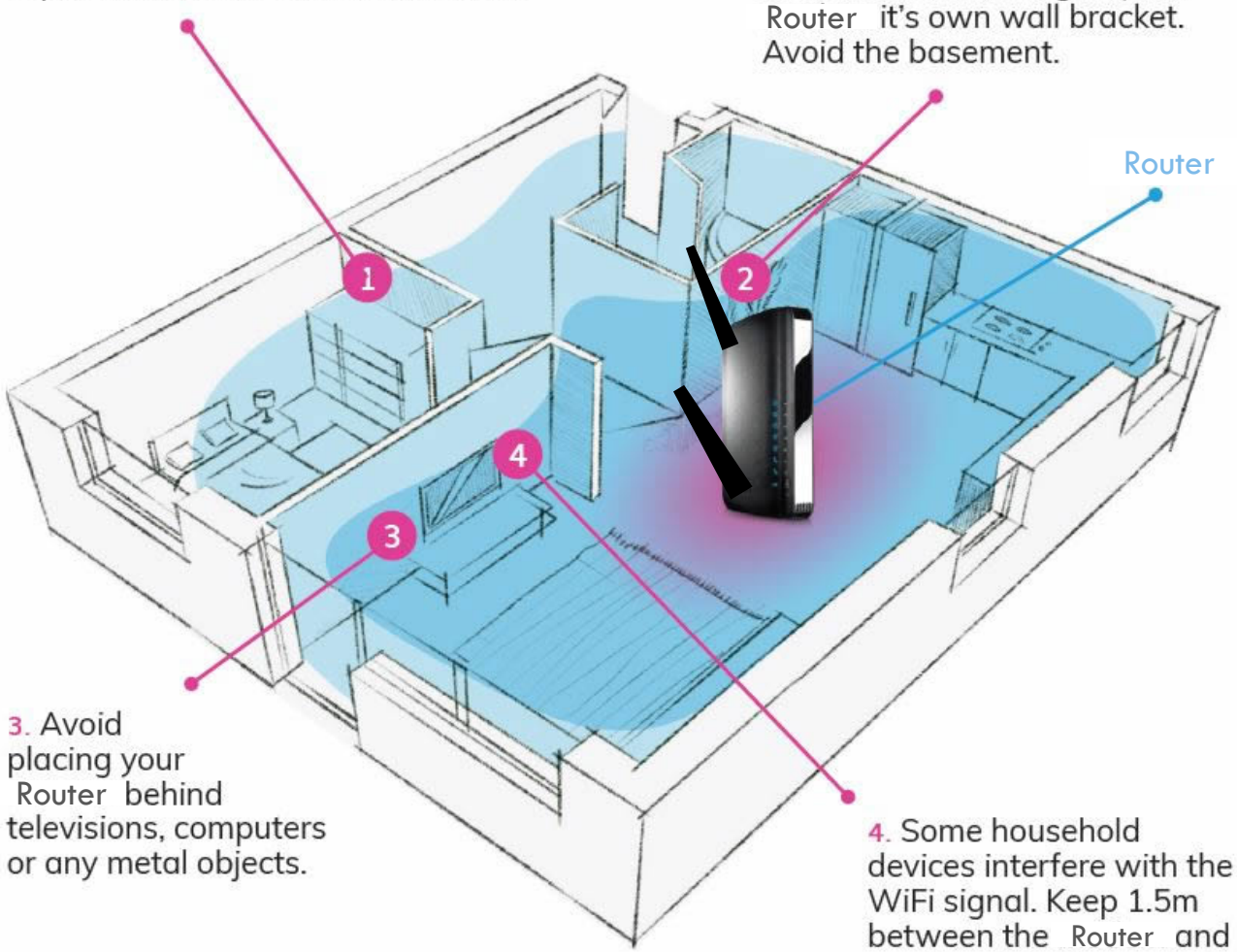
# WiFi Location

- Do you get a good connection with good speeds where you need them?
- Run a Speed Test e.g. www.speedtest.net
- In the main room, adjacent rooms & around the house
- Use a wireless printer ?

# WiFi Router Location

1. Move away from windows, out of cupboards and off enclosed shelves.

2. Higher is better; on top of a cabinet, a shelf or give your Router it's own wall bracket. Avoid the basement.



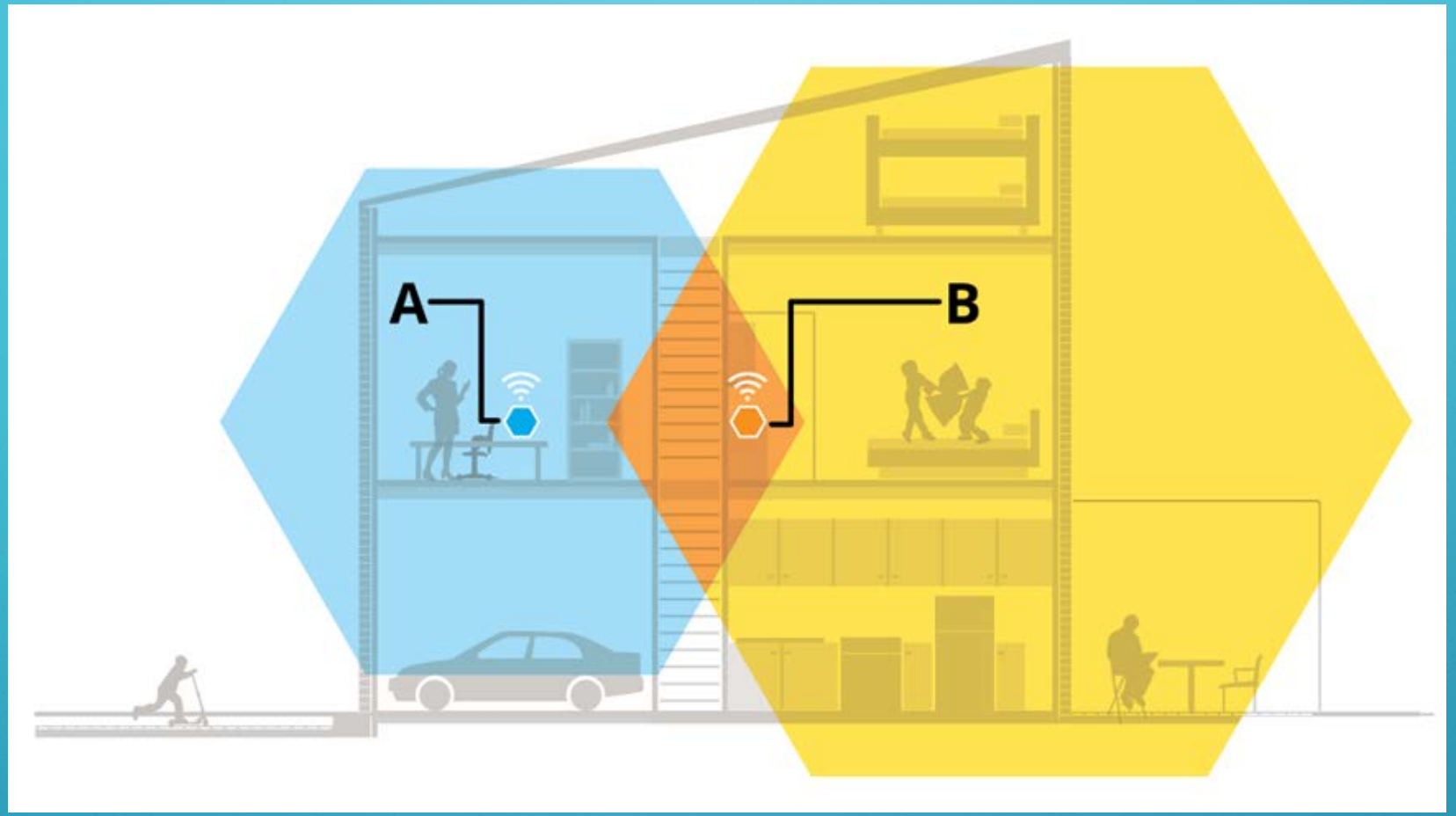

3. Avoid placing your Router behind televisions, computers or any metal objects.

4. Some household devices interfere with the WiFi signal. Keep 1.5m between the Router and cordless telephones, baby monitors, microwaves and other WiFi routers.

# WiFi Location

- Have problems where the router is in the same room?
  - How old is your router – Older than 5 yrs may need a refresh
  - If router is from your ISP and is old, ask about an update
- Have problems elsewhere in the house? – try a WiFi Booster
  - £30 - £100 depending on performance and range
  - Mains powered, easily setup.

# WiFi Location



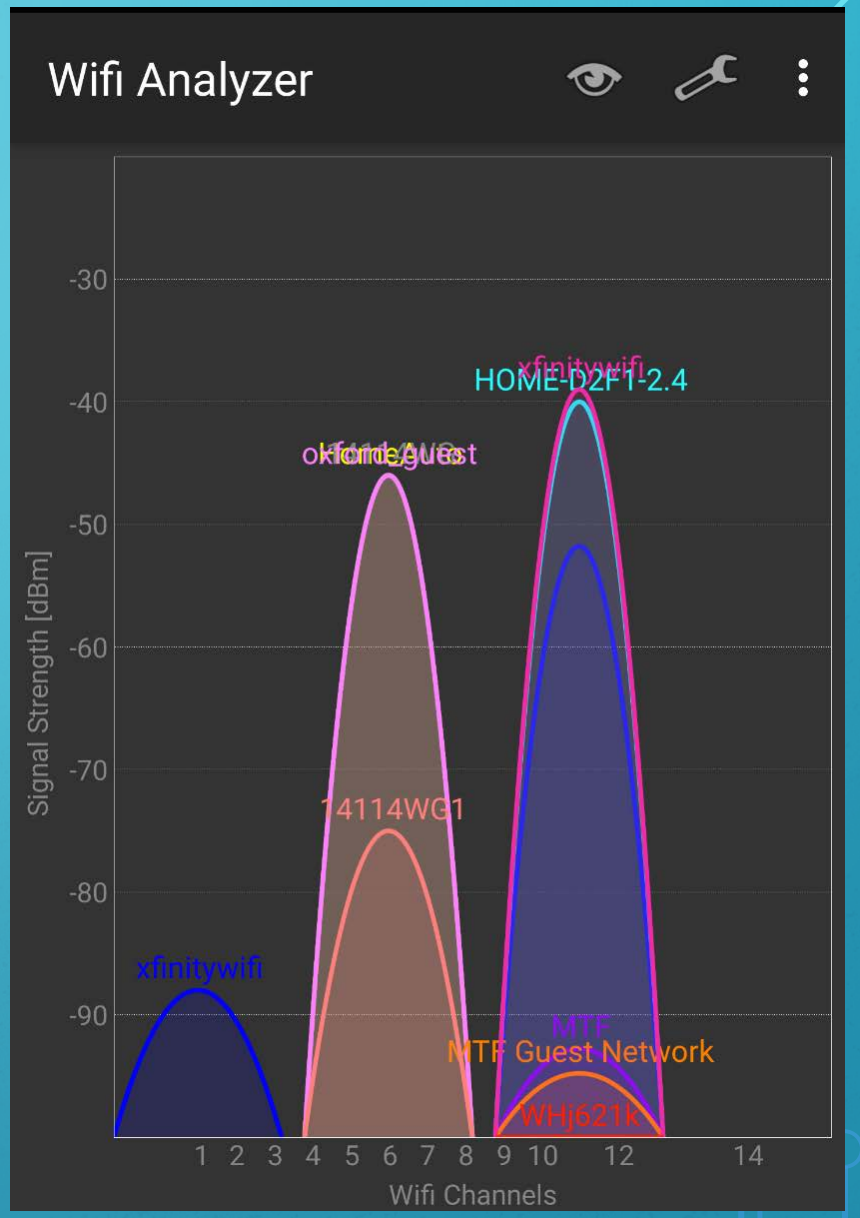

Wireless Router (A) doesn't have enough range. A WiFi Booster (B) amplifies the routers signal and provides better coverage.

# New WiFi Mesh Network System

- A Mesh router will blanket your home in WiFi extending way beyond what a single router can do
- Like having 3-5 separate routers but a single seamless WiFi network (all on the same SSID).
- Really simple to setup
- Some big names are providing a mesh-router solutions e.g. Google, Netgear, Linksys, Asus, D-Link & Samsung to name a few.
- High Cost – good system £200 to £300 and with add-on satellites at £75 to £150 each. A good router is under £100 plus extenders at £30-£70

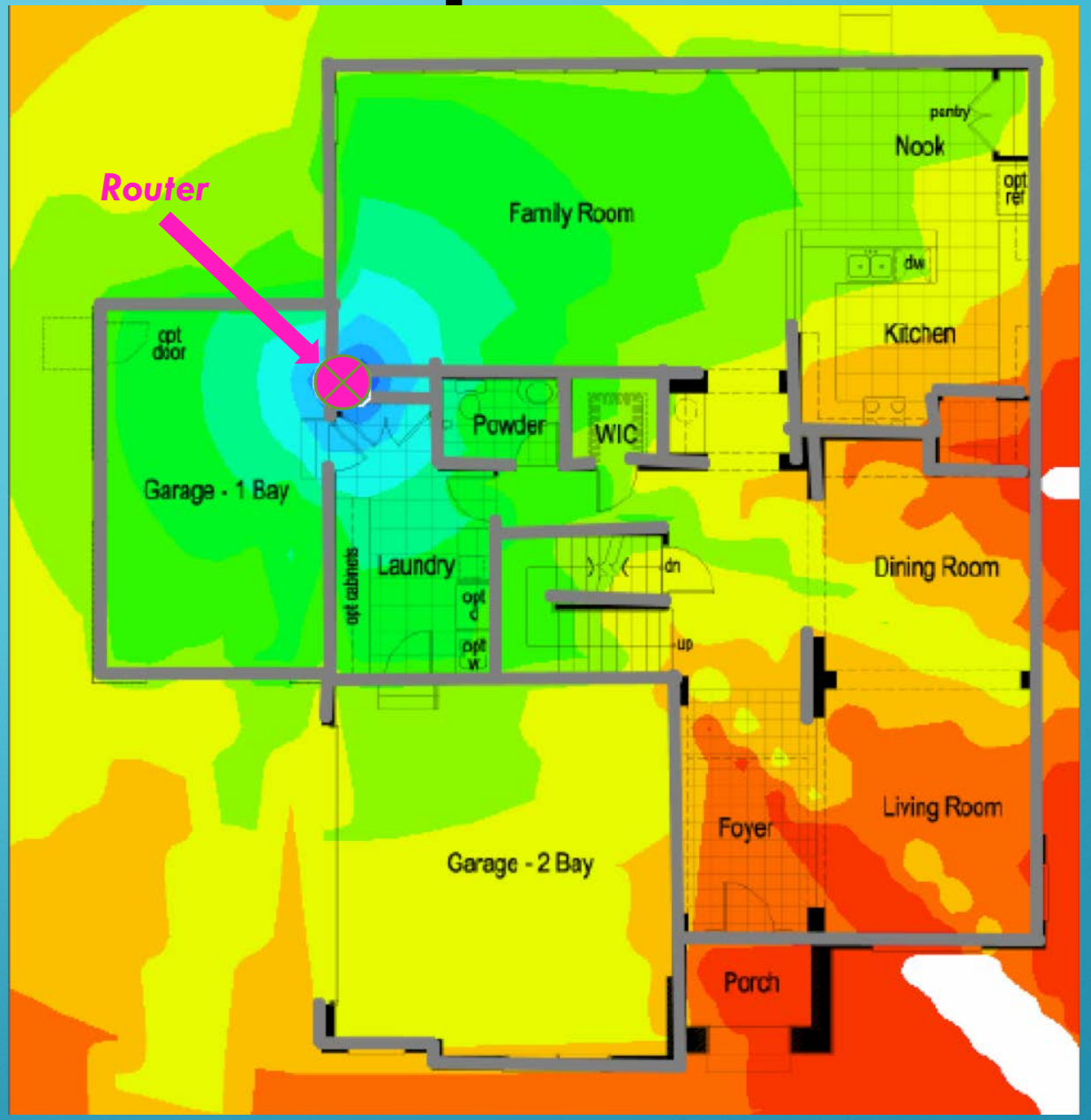
# A Useful Application

- For Android tablets and phones – Wi-Fi Analyzer is a great app
- Detects Wi-Fi signals in it's range & shows the signal strength and channel of other devices
- Allows you to know how your network performs



# The Heat Map

There are programs that can map the signal strength of WiFi transmissions from an access point and visually represent this as a multi-coloured map.
Blue to Green is strong &
Red is weakest
With yellow and orange in between



# Wireless Printers

- Perhaps you have found a wireless printer dropping off the network.
- This is usually because the IP address has changed

  - i.e. a rebooted router, computer, printer

- You can fix this by assigning a fixed IP address to the printer
- Go to settings on your router and create a fixed IP address

  – e.g. 192.168.1.10  or 192.168.0.10

# Router Settings

- Check your manual or find instructions online for your router
- Login to the webpage typically using
  - 192.168.1.1 or 192.168.0.1
- The router will have a default Username and password
  - Typically “admin” and “password” or the password may be on a label.
  - But if you don’t do anything else, change the default password and mark it on the bottom of the router (on masking tape).

# Some Statistics of WiFI

- 86% of tablets require a WiFi connection to use the internet
- 75% of smartphone owners use WiFi on their devices
- 90% of all iPads use WiFi compared to 64% for 4G enabled and 55% of 3G enabled iPads
- 71% of US iPhones use both data & WiFi networks to connect to internet compared to 32% for Android
- 75% of people say 1 week without Wi-Fi would leave them grumpier than 1 week without coffee.

# Advantages of WiFi

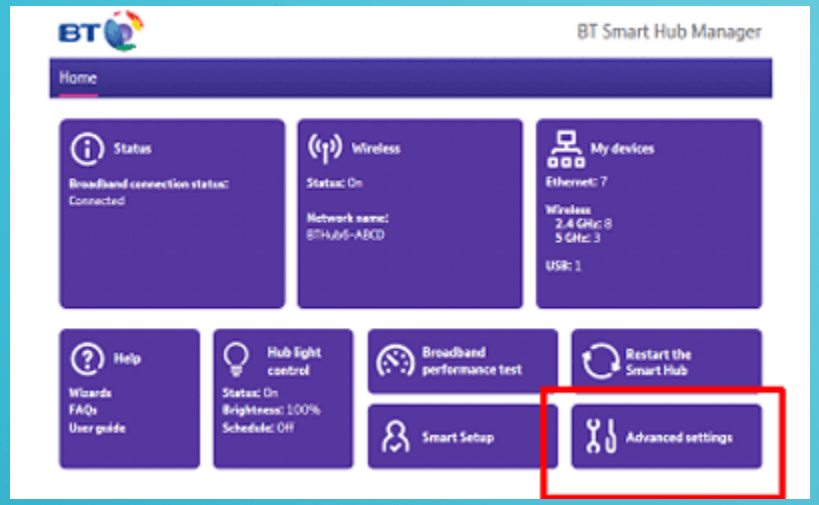

- No Wires – A truly wireless solution
- No Waiting – fast & easy to deploy
- No Worries – Secure, easy to manage & built to grow with you
- Ease of Installation
- Fast data transfer rates.

# Limitations of WiFi

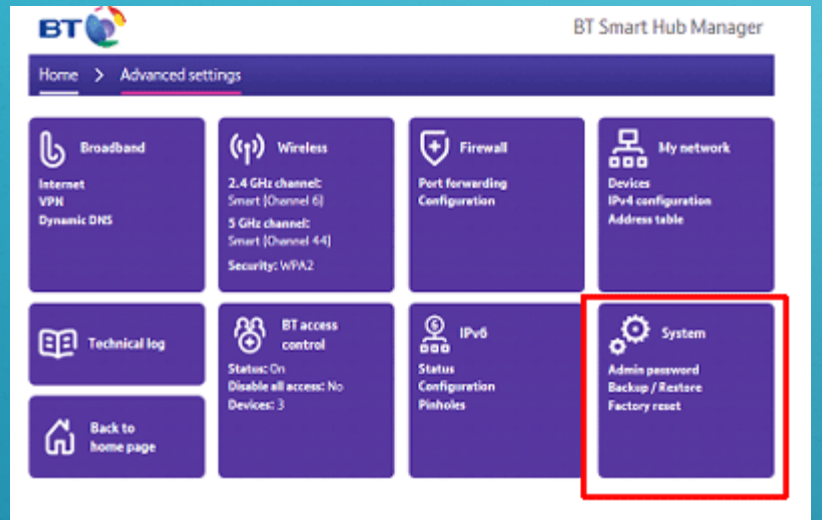

- Limited Range
- Data security risks – a big challenge for WiFi networks
- Interference from other devices like cordless telephones, Microwave ovens
- High power consumption causing battery life & heat a concern

# Example on how to change the password on a BT Smart Hub

To Access a BT Smart Hub open a web browser and put 192.168.1.254 into the address bar

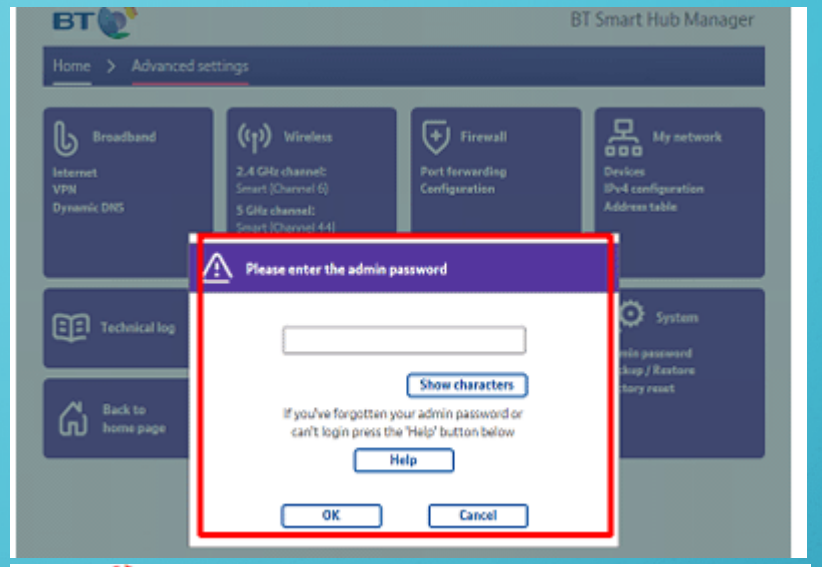


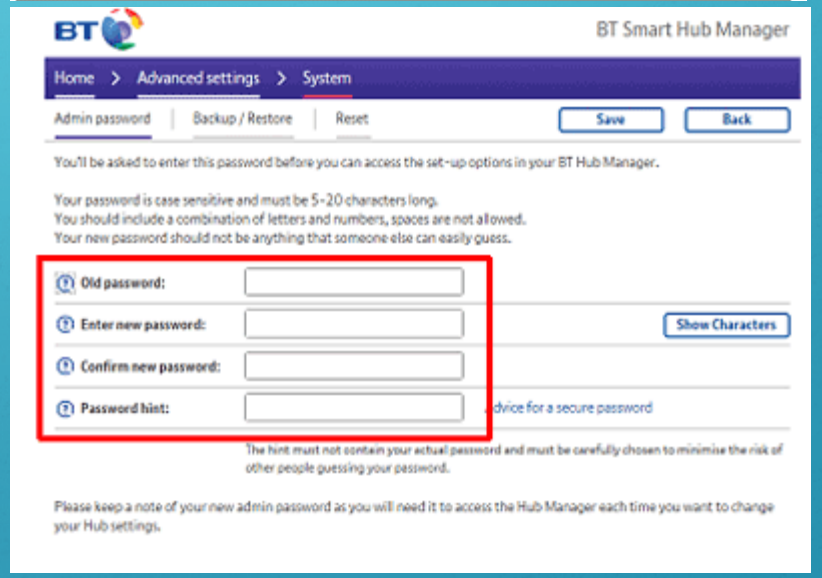

Click on Advanced




then System

Enter the admin password. Unless you have changed it, the default password is on the Hub settings card on the back of the Hub



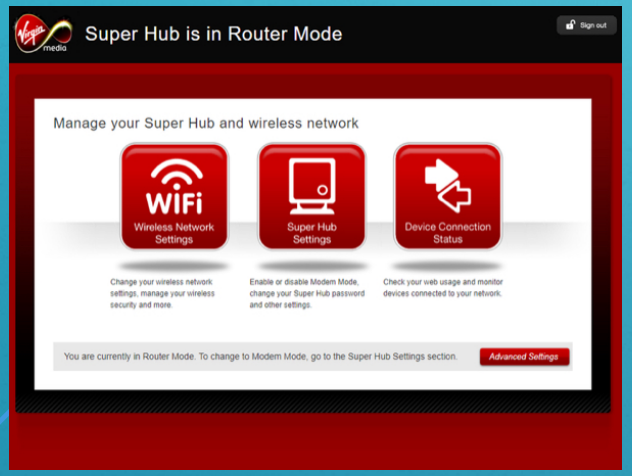



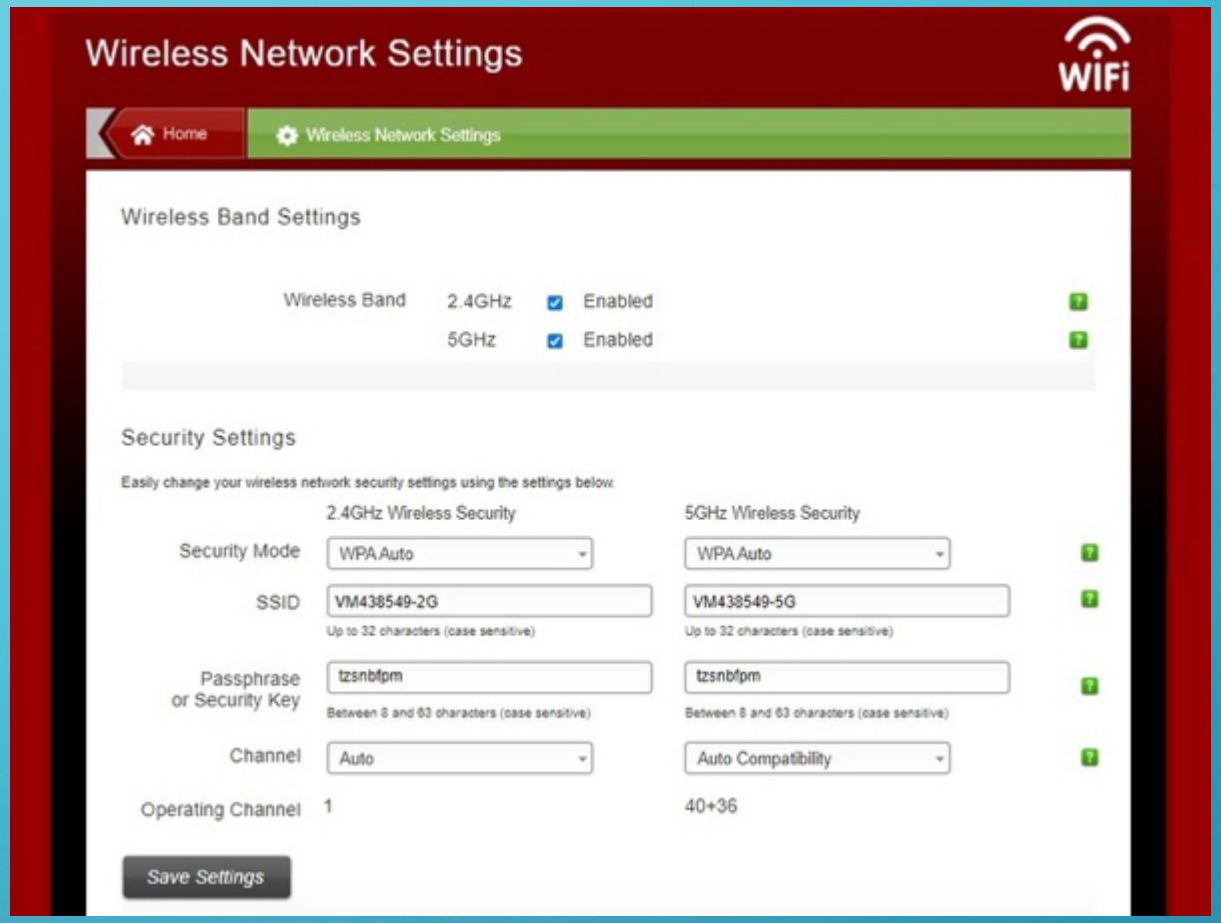

Enter the old password then the new one twice and Save

# Example on how to change the password on a Virgin Hub

To Access a Virgin Super Hub open a web browser and put 192.168.0.1 into the address bar


Username & Password is on a label on the bottom of the router




Enter the new password then Save


# *The End of the Presentation*

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**July 2020**