

Basic Networking

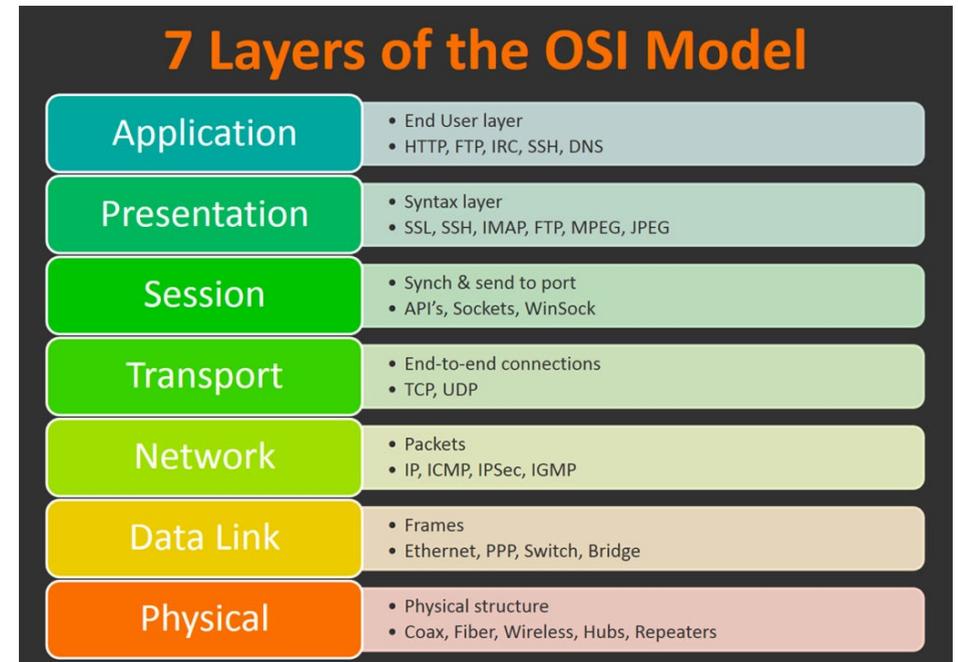
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By Giles Godart-Brown

Layers

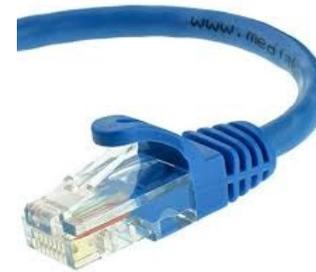
Networking uses a layered architecture, like a sponge cake. Each layer talks to the layers above and below in a standardised way called an interface.

I don't think anyone
knows how ALL of the
layers work



The physical connections

- Wi-Fi
- Ethernet (cat-5 cat-6)
- Copper phone lines
- Fibre

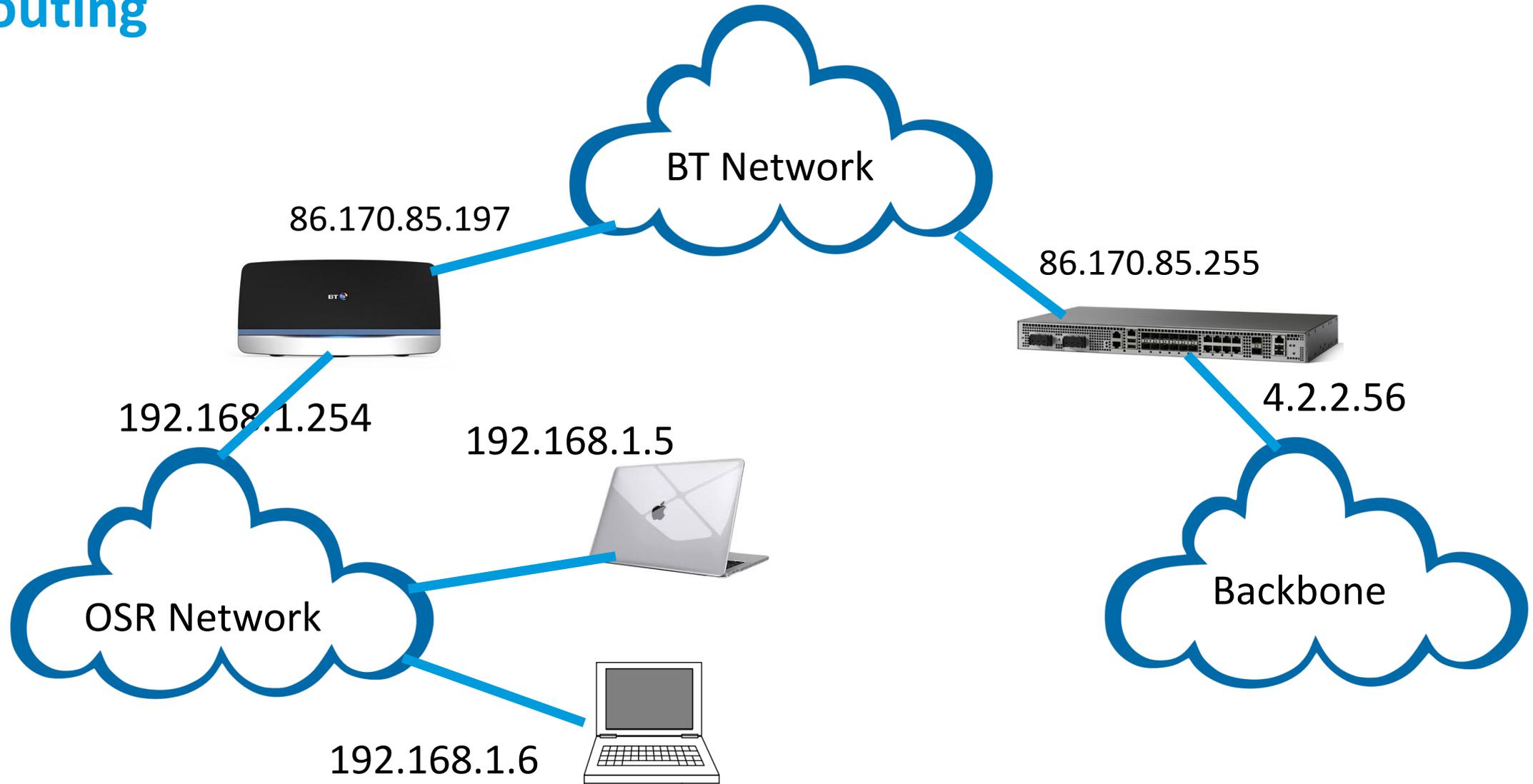


Addressing on the internet

How does my computer find google.com?

- Everything on the internet has a 4 digit IP address (IPv4)
 - Google is at 216.58.211.174
 - OSRB was 86.170.85.197 see <https://whatismyipaddress.com/>
 - We are running out of numbers so we are also using 8 numbers (IPv6) in some places
- Routers are a bridge between two networks and have 2 address, one for the Local Area Network (LAN) and one for the broadband or Wide Area Network(WAN)
- The Domain Name Service (DNS) manages the cross reference between IP address and a name e.g. godartbrown.co.uk = 217.42.65.88.

Routing



Routing

What happens when we want to get to Amazon

- First my PC looks up Amazon's address using DNS and discovers that it is at 54.230.10.193
- My PC is at 192.168.1.20, and the home side of my router is at 192.168.1.254
- My PC sees that Amazon isn't on my network because it doesn't start 192.168.1, so it passes the message to my router at 192.168.1.254.
- The BT side of my router is at 86.161.221.244, and Amazon isn't on that network either so it passes the message onto its router and so on until it reaches amazon.

Hands on addressing exercise

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What is cloud storage

- A disk drive connected to you by the internet
- Examples
 - iCloud for Apple users
 - BT cloud storage
 - Google Drive
 - Microsoft Outlook Onedrive
 - Dropbox
- Used to share Photos, videos, and documents
- Depending on the supplier it may offer additional services like backup

Networking part 2

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What is a Firewall?

What is a firewall?

- It blocks inbound and outbound messages, a firewall is automatically installed on;
 - The router and
 - Your PC/laptop/phone
- Some applications require access to the internet, your PC Firewall will warn you if you want to allow them, only allow if it is from an application you trust e.g. OpenOffice, AVG
- Otherwise under normal circumstance you do not need to worry about the Firewall

Network performance

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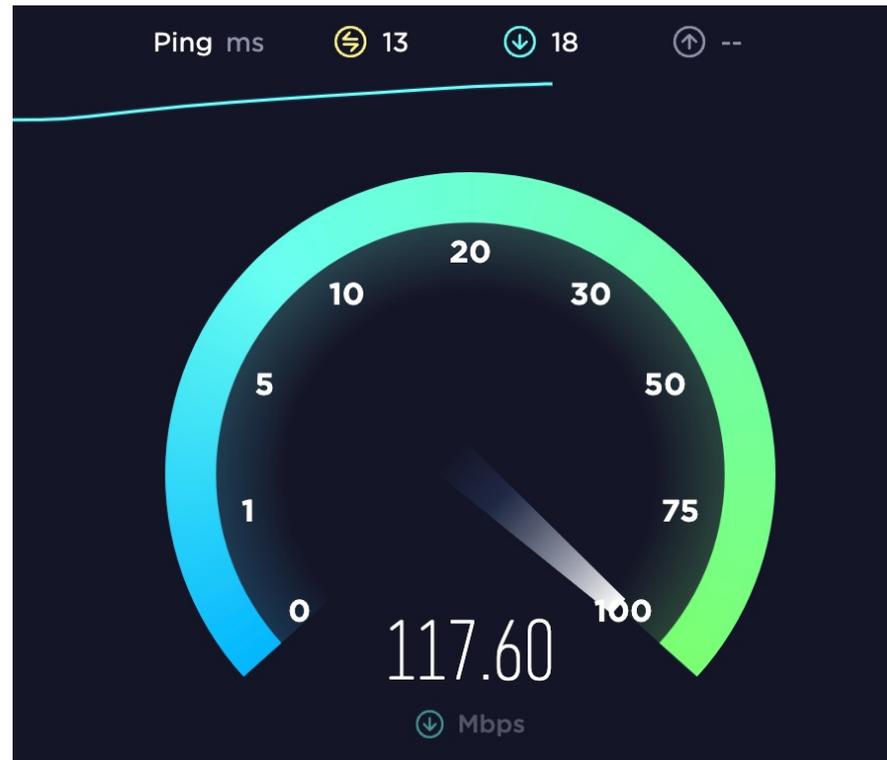
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If a web site doesn't work

- Check you have the correct URL
- Try a known, reliable site like www.amazon.com
- If it loads slowly, or partially - leading to errors, just reload it.
- If it is still slow perform a speed test

The speed test

Use a speed checker e.g. <https://www.speedtest.net/>



Fixing WiFi problems

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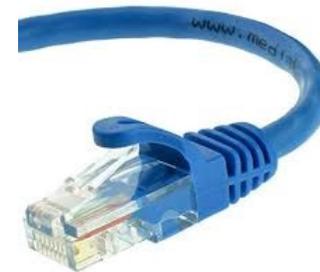
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Wi-Fi Problems

- Wi-Fi only has a short range. The rule-of-thumb is it will pass through 2 walls and one ceiling, less if the rooms have brick walls, foil-backed plasterboard, render over metal mesh, chimneys or, doors are closed.
- Look at the number of bars to see the signal strength, or download a Wi-Fi signal strength app (e.g NetSpot for Android) NOTE: There are no similar apps for iPhone
- There are various mechanisms to boost strength.

How to Wi-Fi boost signal strength.

- Move your router
- Boosters
 - Mesh
 - Wireless
 - Powerline
 - Hybrid
- Use wires instead of wireless



Mesh boosters

Most expensive, but best solution (about £170)



Wi-Fi Booster

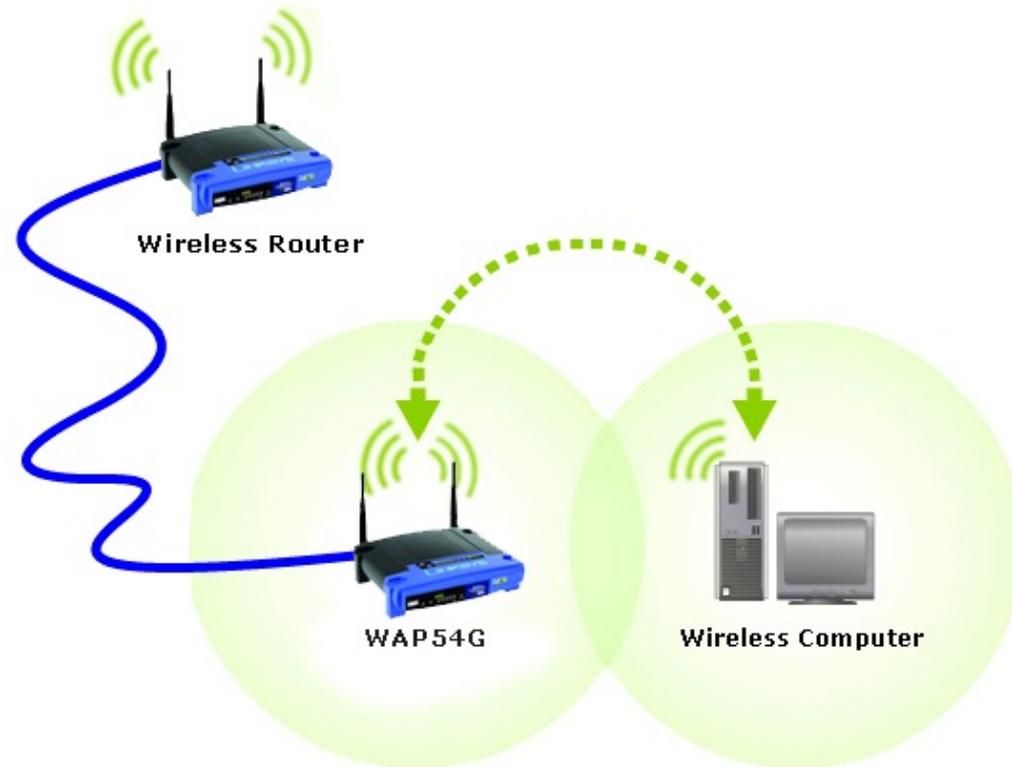
Wi-Fi Boosters have 2 networks, one connects to your current Wi-Fi and the other amplifies and transmits these signals to extend the network

About £20.



Second access point

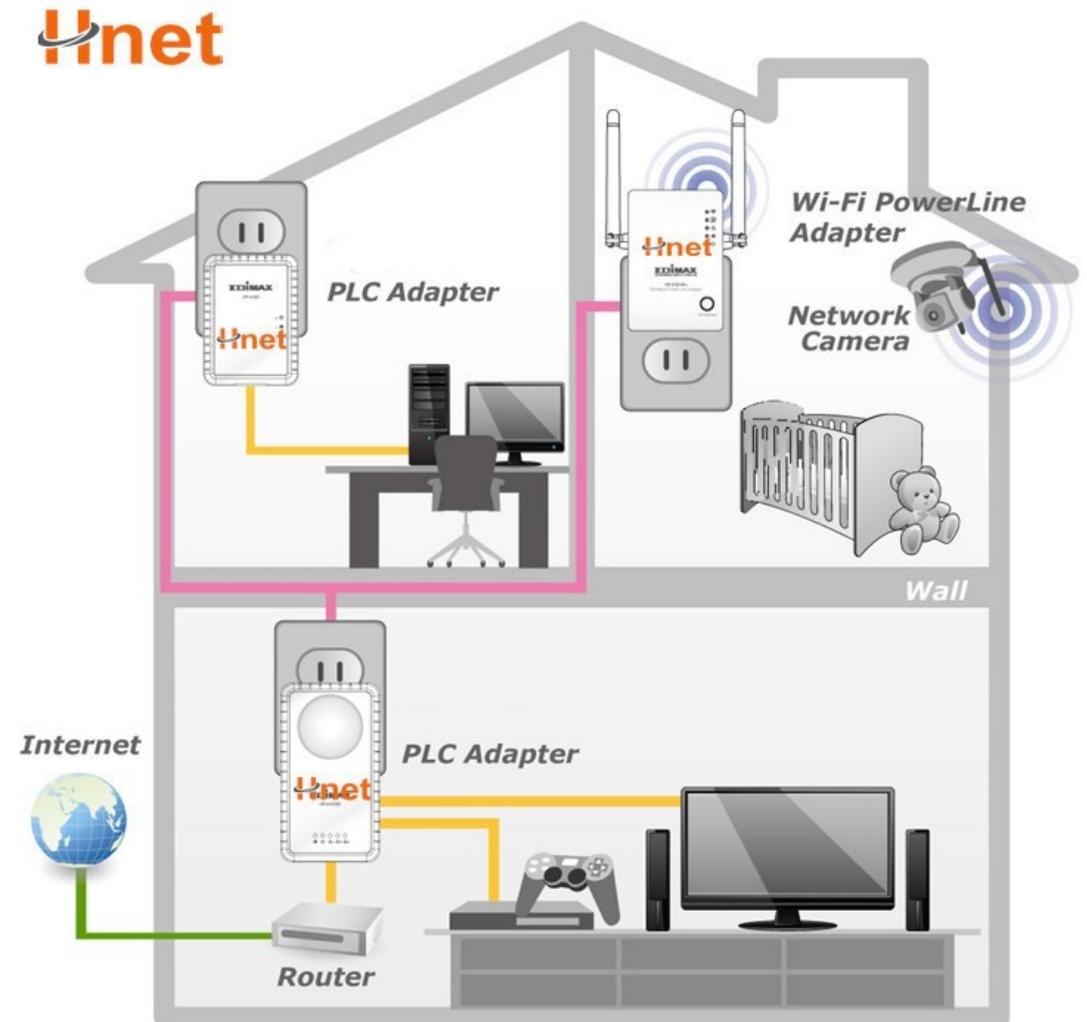
- Wired Ethernet between your current router and the second access point



Powerline

Use you house mains wiring to extend the network.

Some have additional wireless network.



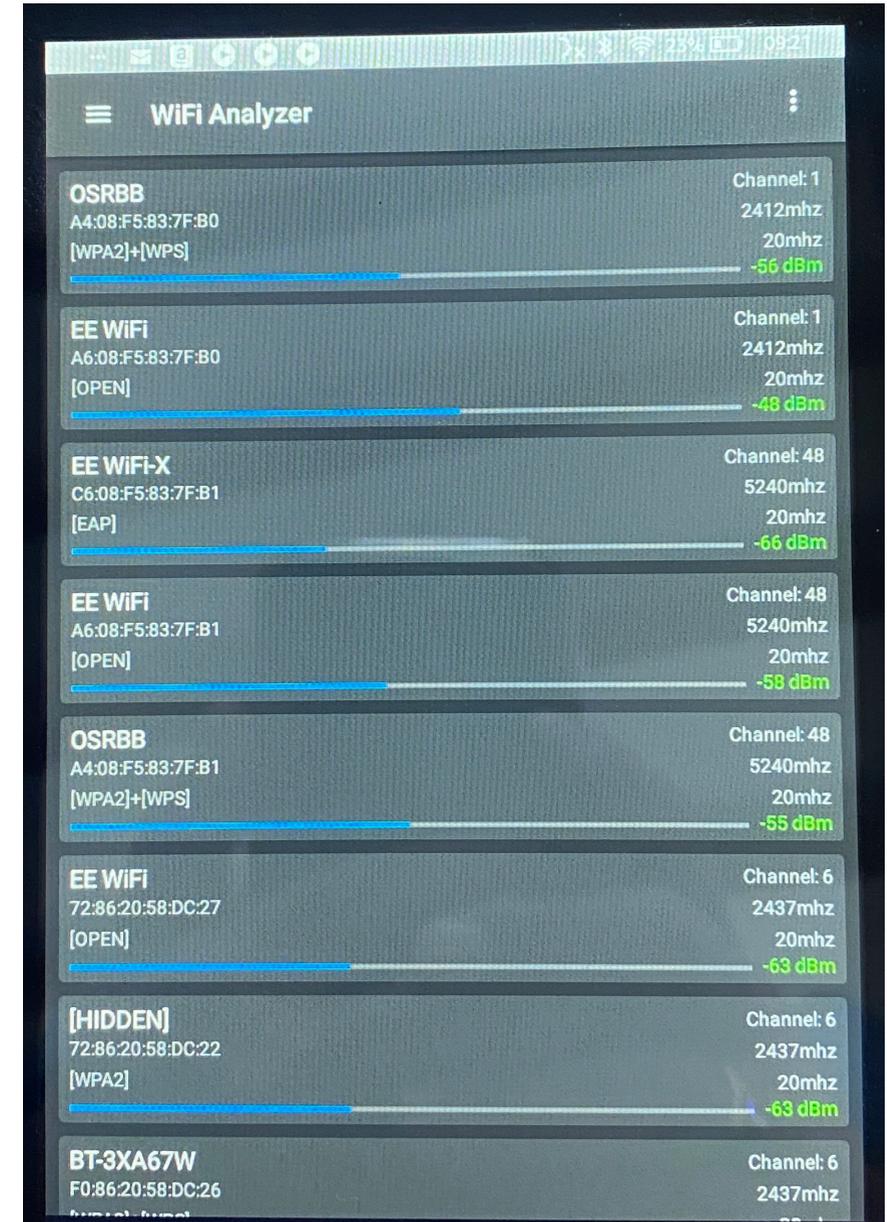
Hotspots

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What is a hotspot?

- Wifi routers nearly always support more than one wifi network, a private one and a public one e.g. EE-wifi.
- The public one gives you free roaming access with your broadband provider.
- It is safe to log into public networks so long as you only use secure sites (look for the padlock) and that your default firewall and anti virus are up to date.
- When at home, its important to check you are logged into the correct network



Network troubleshooting

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Is it the WiFi? Testing your Wi-Fi signal strength

- Signal strength drops the further you are from your router.
- Look at the number of 'bars' on your device, its usually OK down to 1 bar.
- There are good Android apps to display the signal strength as a graph e.g NetSpot
- You will be able to see the networks of your neighbours.
- Devices are often not clever at selecting the correct network.
- Check that you are connected to the correct network.

If there appears to be no connection, find where the fault is

- You will need to know your address and that of your router
 - Windows – chose settings>Network & Internet>status>view your hardware and connection properties and look for 'default gateway' – this is your router.
 - Mac Ventura - click on Apple then System Preferences then chose Network>WI-FI, chose the Wi-Fi you are connected to, click on the "..." symbol then Network Settings or Details.
- 'ping' is the simplest tool to diagnose your network, It is run via 'command' on a Windows PC or 'network utility' on a Mac
 - Windows - Type **command** in the search box, then select the command app to open a window to a 'command line' and enter **ping www.amazon.com**
 - Mac - Click on magnifying glass to do a spotlight search and type 'Network Utility' then select ping. NOTE Network Utility has been removed from recent Mac versions but can be downloaded from [here](#), or you can run ping from a Terminal window as above.

Can you reach a web site by name?

- Ping a known site by name e.g. www.amazon.com

```
pi@mhmaster:~ $ ping www.amazon.com
PING e15316.e22.akamaiedge.net (23.39.112.133) 56(84) bytes of data.
64 bytes from a23-39-112-133.deploy.static.akamaitechnologies.com (23.39.112.133): icmp_seq=1 ttl=57 time=7.33 ms
64 bytes from a23-39-112-133.deploy.static.akamaitechnologies.com (23.39.112.133): icmp_seq=2 ttl=57 time=7.69 ms
```

- If this fails, proceed to next step.
- If it works then you do NOT have a network connectivity problem, but it may be slow.
 - Most probable cause is something with the browser.

Can you reach a known site by IP address ?

- Ping a known site by address e.g. 4.2.2.1

```
pi@hmhmaster:~ $ ping 4.2.2.1
PING 4.2.2.1 (4.2.2.1) 56(84) bytes of data.
64 bytes from 4.2.2.1: icmp_seq=1 ttl=55 time=7.86 ms
64 bytes from 4.2.2.1: icmp_seq=2 ttl=55 time=7.73 ms
```

- If this works and the ping by name did not work you have a Dynamic Name Server (DNS) problem.
 - First try rebooting your router.
 - Check your DNS settings, it should be set to your router address
- If this does not work proceed to next step.

Can you see your router

- Ping your router e.g. 192.168.100.1

```
pi@mhmaster:~ $ ping 192.168.100.1
PING 192.168.100.1 (192.168.100.1) 56(84) bytes of data.
64 bytes from 192.168.100.1: icmp_seq=1 ttl=64 time=1.15 ms
64 bytes from 192.168.100.1: icmp_seq=2 ttl=64 time=1.14 ms
```

- If this works and the other tests did not, then you have a problem between you router and the internet
 - Check the cables
 - Reboot the router and look for warning lights
 - Call your provider, e.g. BT
- If this does not work then the problem is between your pc and the router
 - Check wireless settings

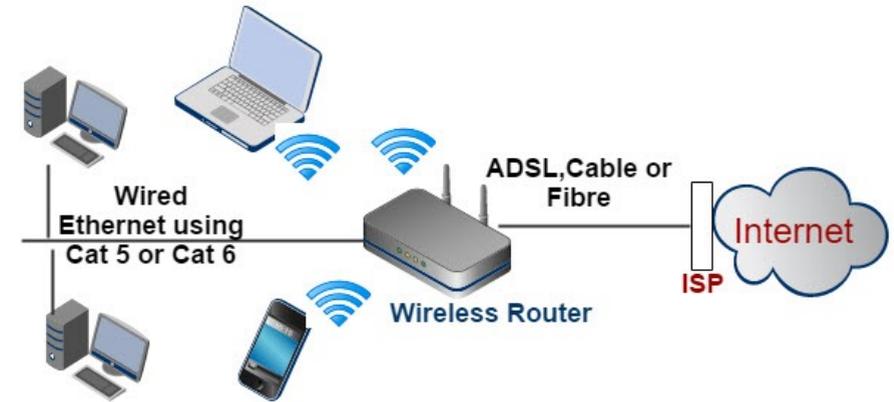
Questions

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Local addressing

- Your hub/router links your home network to the internet
 - It has a local side (LAN) and a remote side (WAN)
 - The WAN side address is set by your service provider (e.g. BT)
 - Addresses on your home network (LAN) usually start 192.168.0.xxx
 - Your router is usually 192.168.0.1
 - Your PC sends any message to an address not starting 192.168.0 to your router which then send it out to the internet.



Network Diagram-Typical Simple Home Network

Routing

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- My PC sees that Amazon isn't on my network because it doesn't start 192.168.0, so it passes the message to my router at 192.168.0.1.
- The BT side of my router is at 86.161.221.244, and Amazon isn't on that network either so it passes the message onto its router and so on until it reaches amazon.

Routing example

Here is how I get from my PC in Seamans to google.com using the command;

```
tracert -l -w 10 google.com
```

```
tracert to google.com (142.250.180.14), 64 hops max, 72 byte packets
 1  skyrouter (192.168.100.1)  9.752 ms  2.975 ms  3.404 ms
 2  97e7fe7a.skybroadband.com (151.231.254.122)  4.956 ms  4.840 ms  4.468 ms
 3  be383.pr2.thlon.isp.sky.com (2.120.8.182)  7.205 ms  7.771 ms  7.263 ms
 4  89.200.133.169 (89.200.133.169)  7.374 ms  7.327 ms  7.372 ms
 5  216.239.40.71 (216.239.40.71)  8.787 ms  8.705 ms  12.777 ms
 6  142.251.54.31 (142.251.54.31)  7.253 ms  6.842 ms  7.388 ms
 7  lhr25s32-in-f14.1e100.net (142.250.180.14)  7.052 ms  6.993 ms  6.604 ms
```