Radio Networks and the mobile phone

Mendlesham Computer Club

By Giles Godart-Brown

A modern smartphone has up to 6 different radios

Cellular 3G,4G, 5G

WiFi 2.5GHz,5GHz

Bluetooth

Near Field Communications (NFC)

Global Positioning System (GPS)

Satellite

1st, 2nd, 3rd, 4th and 5th Generation Cellular radio

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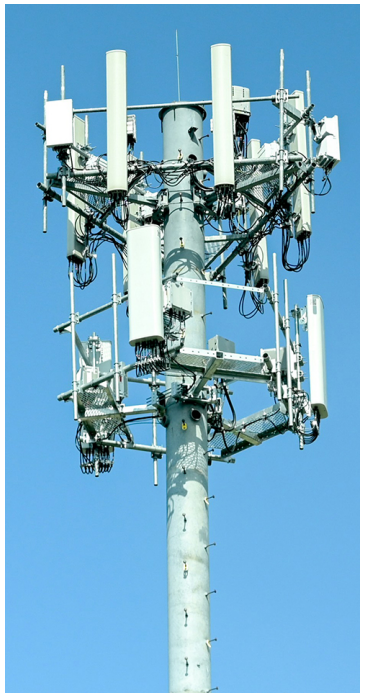
Cellular radio

- Near total coverage of the UK (except parts of Norfolk 😀)
- Speed and range has increased over time 2G to 3G to 4G to 5G
- 1G and 2G have been switched off and 3G is due to be switched off soon, when the released capacity will be used to boost 4G and 5G
- Cellular radio is used for a number of services
  - Voice calls
  - Internet
  - Short Message Service (SMS)
  - Multimedia Messaging service (MMS)
- Roaming allows it to be used seamlessly when on the move



Mobile Data and Texts

- Mobile Data and Texts are billed separately from voice calls and is a big differentiator between the different network operators, more data = more money
- Some operators allow free Overseas Roaming e.g. O2
- Video calls (WhatsApp etc.) and watching videos consume the most data, followed by App downloads. Text messages don’t consume very much at all but may also be billed separately.
- Text messages are secure, so good for sharing passwords.

The SIM card

- SIM = Subscriber Identity Module, and it does just that, it personalises the generic smartphone with your information, basically a number that uniquely identifies you, along with some security information, network information, PIN numbers and passwords.
- In the beginning it was also used to hold your phone book and other data, but this has now all moved into the cloud so if you change SIM it can still be retrieved.
- Over the years they have got smaller and now the physical card is being phased out and replaced by a downloaded ‘eSIM’ which is securely stored in the phones internal memory so cannot be removed.
- Phones that support both SIM and e-SIM can therefore have 2 numbers with just one physical SIM, e.g. a French SIM and a UK e-SIM.

Wireless Fidelity

WiFi

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WiFi

- There are 2 types of WiFi 2.4G and 5G. 5G is faster but shorter range, you usually cannot tell which one is being used, your phone will continually hunt for the best signal.
- WiFi is fairly short range, the rule of thumb is 2 walls or one ceiling from the router to the receiving device but may be shorter with brick or stone buildings
- It does NOT eat into your mobile data allowance so its best to use it whenever possible
- Its much faster than the cellular networks

Joining a WiFi network

- Wifi Networks have a name (the SSID) and an optional password,
- Connecting to a WiFi network
  - You can usually find the details on the back of the router.
  - Some routers have a QR code you can scan to set up the network on your phone.
  - Most Routers have a WPS button you can press then, for a few minutes, new devices can automatically connect.
  - If you are in a public place it will be published somewhere else e.g. on a blackboard in a cafe, if in doubt ask.

Joining a shared network

- Most modern routers have a number of networks, one of which is shared, look for networks called EEWifi or BTInternet
- These allow other subscribers to the same network (e.g. other EE customers) to piggy back onto someone else's network.
- This is usually via an App or supplying your normal login and password to a web page

Public hotspots

- You can reach the internet over Wifi pretty much anywhere thanks to shared networks and Public hotspots
- Its pretty safe to use a public hotspot so long as you make sure you only visit sites that start https in which case all of your comms are encrypted.

Hotspot demo

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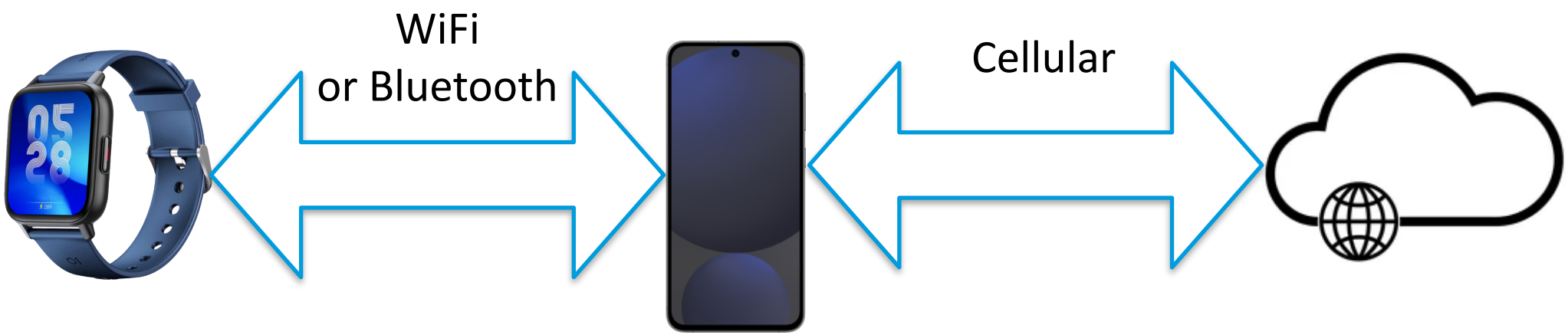
Mobile hotspots

- In settings, you can set your mobile phone up to be a mobile hotspot, this allows devices to use WiFi to connect to your phone and then your phone's cellular network to connect to the Internet
- This DOES eat into your Mobile Data allowance



Mobile Hotspot demo

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Bluetooth

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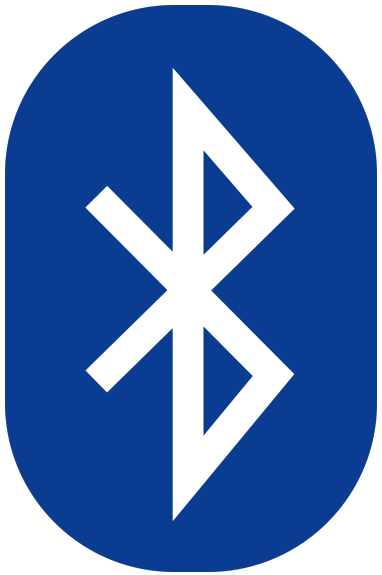
Bluetooth

- Low power, and very short range (<10metres), leads to long battery life
- Devices must be ‘Paired’
- Mainly used for;
  - Headphones
  - Boom Box speakers
  - Smart home devices
  - Car systems



Bluetooth pairing demo

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Near Field Communication

NFC

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NFC

- Very short range <4CM
- Used for contactless payment
- Security through distance combined with PIN, Fingerprint or Face recognition
- Uses induction (like a transformer), not radio.

Wireless charging

- Modern phones also support wireless charging, simply place the phone on a device and it will charge using induction.
- MacDonalds in Stowmarket has these built into the tables.
- Used in modern cars

Global Positioning System
GPS

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GPS

- Developed by US Department of Defense in the 1970s, became operational in 1995
- You need to be able to see at least 4 of the 31 active satellites to get an accurate position
- Uses very accurate clocks and trigonometry to calculate position and altitude
- Accurate to within 5 metres, down to a few centimetres in military use.

Satellite telephony

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The Mobile phone and satellite

- iPhones newer than iPhone14, Google Pixel 8 and 9 and some other smart phones can now communicate directly with satellites.
- Its not a satellite phone, more like a satellite text messaging service
- This is almost exclusively used for SOS services
- They use the 66 Iridium satellites 485 miles up which can cover the entire globe.