Radio Frequency Protocols of The Internet of Things
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IoT Protocols for IoT Problems

- Device Constraints

  - Low Power, Low CPU, Small Size

- Network Constraints

  - Radio Propagation Issues

  - Radio Power Utilisation

  - Interference from Self, Other Devices

  - Itinerant Connectivity & Mobility

IoT Protocols: Wi-Fi

- 802.11b/g/n is pervasive and low cost

- Microprocessor + WiFi module at US $7 each.

- Default protocol for "connected devices"

- Where power & cover is available, Wi-Fi works, but…

- Secure mobility with WiFi IoT is very difficult

- Wi-Fi doesn't solve all IoT problems

- And it's not designed for battery operation

- But anyone can run a Wi-Fi network

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IoT Protocols: 802.15.(n)

- Includes Zigbee, Bluetooth, BLE, 6LoWPAN

- 868 MHz, 915 MHz, 2.4GHz, 20kbps – 1mbps

- Star, tree, mesh topologies

- Low power consumption – can be battery operated

- Low cost - at least in 2.4GHz band

- 128-bit encryption keys

- Personal or Local area solution w/out mobility

- Anyone can run 802.15 networks

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IoT Wireless: Lo-Fi, Motenio, Etc.

- Serial across 433, 868, 915 MHz MHz

- Star topology

- Up to 300 kbps - rx to -120dBm at 1.2kbps

- Some support encryption using RFM69W chip

- Other Similar chips / protocols available

- Very inexpensive – US $3.50 per module

- Does not scale beyond local applications

- Anyone can run serial over wireless

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IoT Protocols: SigFox

- Proprietary at 868MHz & 915MHz in the US

- SigFox owns/operates the Receiver network

  - European, USA, and AU/NZ Networks.

- Low power consumption

- Up to 140 12-byte messages a day, 10-1000 bps

- Optional payload encryption

- Mobility possible where channels are the same

- Only SigFox can run a SigFox network

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IoT Protocols: Weightless / nbIoT

- Open Standard at Multiple Frequency Bands
  - Standards for TVWS & now Narrowband 868MHz
  - Integrates w/ Cellular as nbIoT using re-farmed GSM
- Low power – battery nodes can sleep for days
- From bits per second to megabits per second
- Public Key Encryption
- Mobility scaling to international networks
- Only Mobile Network Operators can run nbIoT.

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LTE-M (LTE-MTC / Cat M1)

- MTC = "Machine Type Communications"
- Cat-M1 version to be included in 3GPP Release 13
- Uses existing LTE base stations w/ software upgrade
- Six 230 KHz channels per 1.4 MHz carrier
- Data transmissions can be repeated at intervals
- Endpoints tell towers how often they want to talk
- Mobility scaling to international networks
- Only Mobile Network Operators can run Cat M1

IoT Protocols: LoRa/LoRaWAN

- Low Power Wide Area Network

- Designed for wireless, battery operated devices

- Supports bi-directional comms, mobility, localisation

- Star topology. Multiple base stations can rx messages

- 0.3-50kbps via adaptive data rate scheme

- Multiple levels of encryption (Net/App/Device)

- Scales to International networks

- Anyone can run a LoRaWAN network

IoT for Community Networks

- Wi-Fi works where there's Wi-Fi coverage

- 6LoWPAN works well in small areas

  - It's a "Personal Area" Network

- LoRaWAN is the best for large areas

  - It's a "Long Range" network

- Free & Community Controllers Help

  - The Things Network is free!

  - It's easy to set up, robust, and very secure

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TTN Community Networks

- Full-featured, free, cloud control community IoT network with 3,317 gateways online.