

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

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

IoT Protocols: Wi-Fi HaLow

- 802.11ah is designed for the IoT
- Still ISM spectrum, but 868 or 915 MHz (not 2.4 GHz)
- 1,2, 4, 8, & 16 MHz channels
- Data rates from 0.3 to 12 Mbps per MHz
- Far lower power than Wi-Fi (1%) allows battery use
- Faster data speeds than 802.15 protocols
- Better distance than 802.15 protocols
- If products ship, anyone can run Wi-Fi HaLow

IoT Wireless: Lo-Fi, Motenio, Etc.

- Serial across 433, 868, 915 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

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

IoT Protocols: Weightless / nbloT

- Open Standard at Multiple Frequency Bands
 - Standards for TVWS & now Narrowband 868MHz
 - Integrates w/ Cellular as nbloT 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 nbloT.

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