Untangling The Mesh

Wireless Standard	Power	Transmission Range (typical)	Data Rates
Bluetooth	Medium	1 to 100 m	1 to 3 Mbps
Bluetooth LE	Lower	>100 m	125 kbps to 2 Mbps
LoRaWAN	Low	10 km	0.3 to 50 kbps
NB-IoT	Low	<35 km	20 kbps to 5 Mbps
NFC	Low	<10 cm	106 to 424 kbps
Sigfox	Low	3 to 50 km	100 to 600 bps
6LoWPAN	Low	100 m	0 to 250 kbps
802.11/Wi-Fi	Medium	100 m to several km (with boosters)	10 to 100+ Mbps
802.15.4/Zigbee	Low	10 to 100 m	20 to 250 kbps
Z-Wave	Low	15 to 150 m	9.6 to 40 kbps

Bluetooth

Harald Bluetooth the Great of Denmark   WAR!
You're joking, right?

Negotiate Peace
Trade
Demand
Discuss
Goodbye
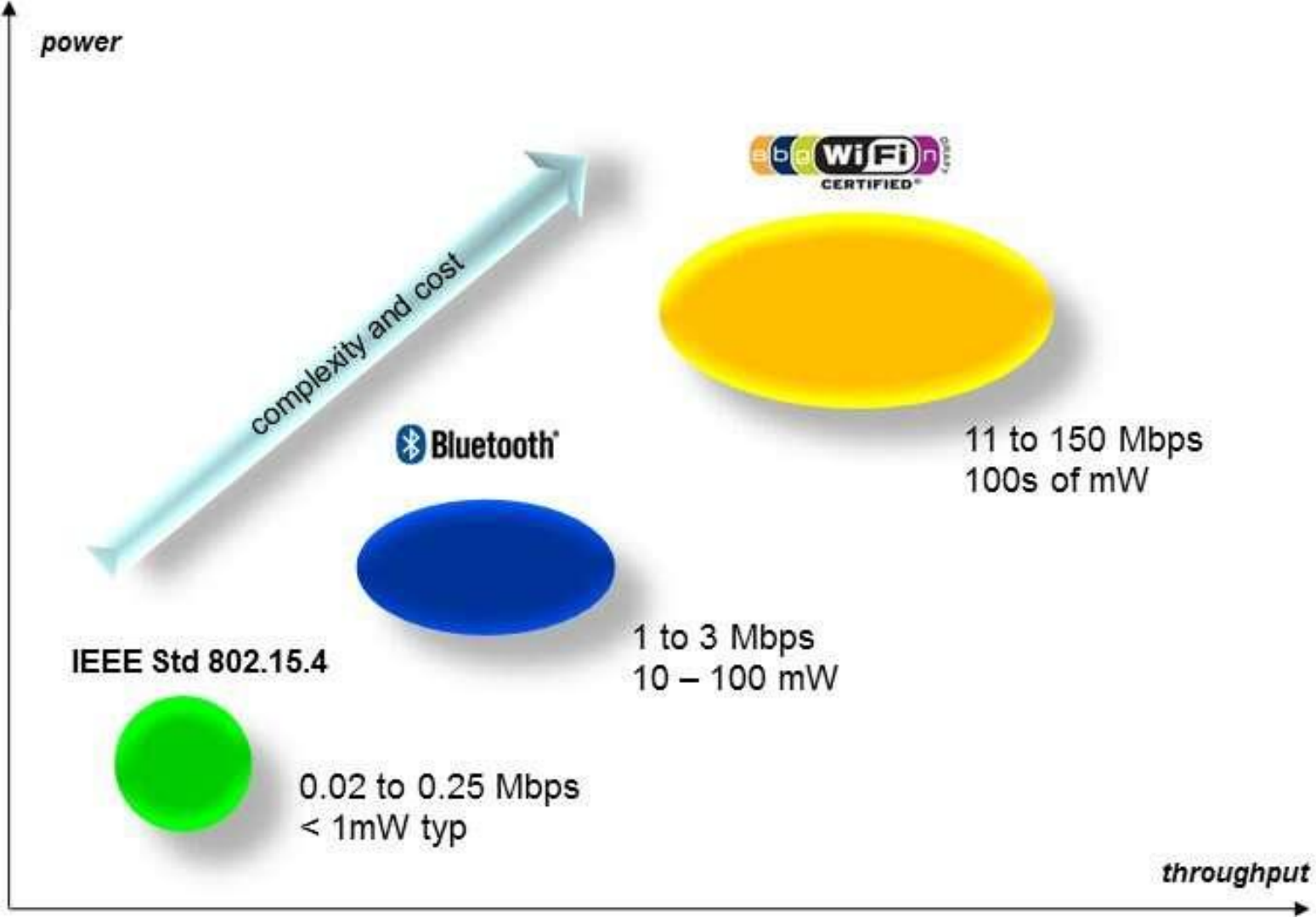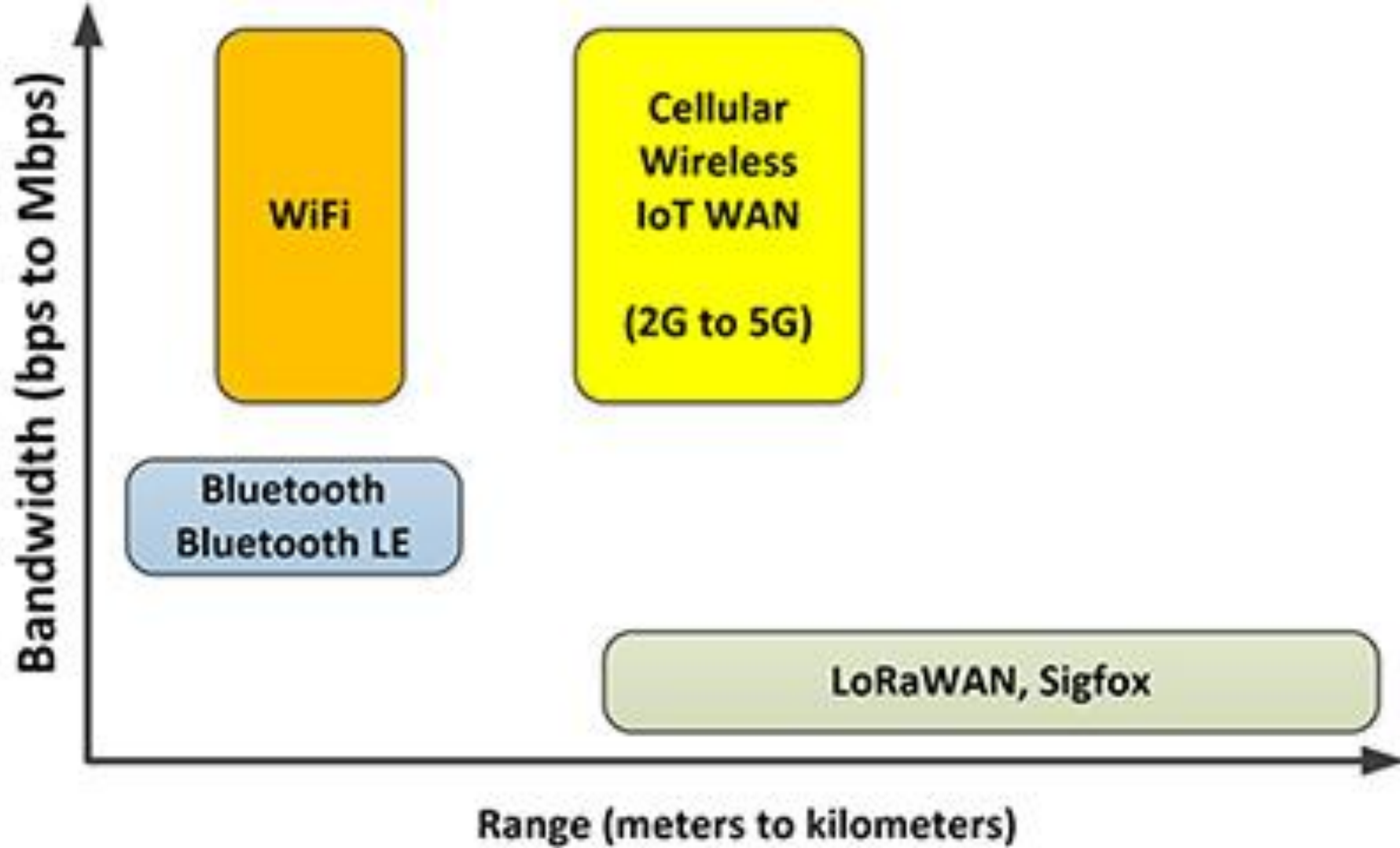
Bluetooth

- : Developed initially to wirelessly link companion devices to mobile phone handsets, Bluetooth has become a useful wireless protocol for low-power applications that need relatively short range and moderate data bandwidth of 1 to 3 megabits per second (Mbps). Because of the extensive data protocols and profiles already developed, Bluetooth RF modules are relatively easy to integrate into an embedded application.

All of the Vocabulary

- GATT
- GAP
- Classic
- Low Energy
- Smart
- Mesh
- Central/Peripheral

UUIDs

- Each characteristic and service is defined by a unique identifier called UUID.

Official BLE UUIDs are on 16 bits and custom one take 128bits

What's connected?

- Connected mode: allows a central to exchange complex data with a peripheral. The GATT protocol describes how the conversation is made in this mode. In the perspective of a peripheral, the connected mode is a one-to-one mode.

Central vs. Peripheral

client / server

peripheral /central

What's advertising?

The peripheral sends info to be available to all the centrals around. This mode allows a peripheral to be known by centrals. In this mode, simple information can be exchanged using GAP broadcasting. In the perspective of a peripheral, this is a one-to-many mode. Limited to 31 bytes

The easiest way possible

- HC-05 Module
- Arduino
- https://play.google.com/store/apps/details?id=Qwerty.BluetoothTerminal&hl=en_US
- Easiest android example to understand
- https://github.com/HarryGoodwin/Arduino-Android-Sensors
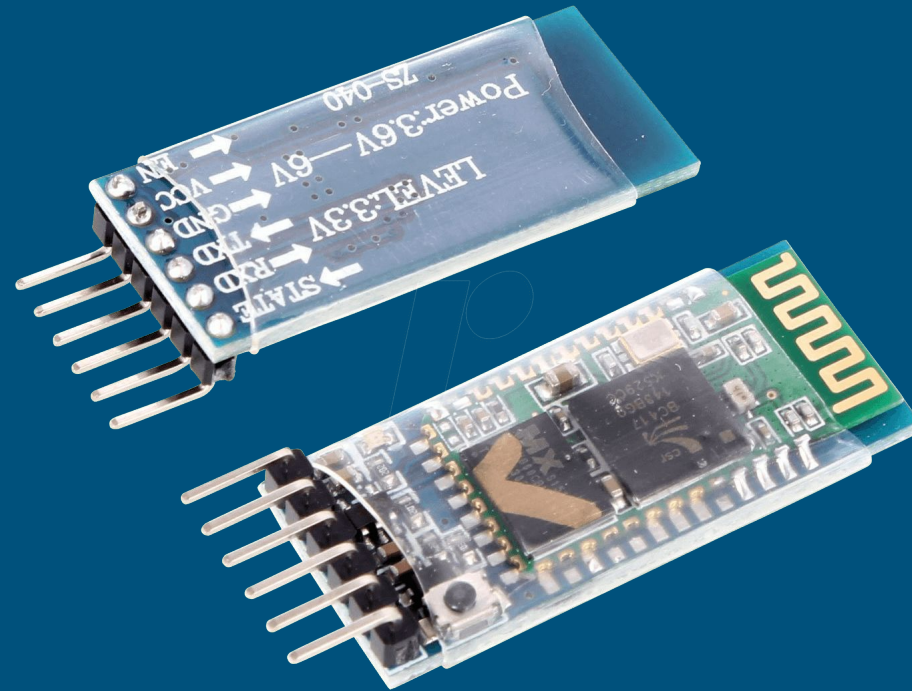
What's Apple's Deal?!?!

- Iphone 4 was the last phone to support Bluetooth classic
- MFi (Made for Iphone)
- They have their own proprietary chip

Benefits to Using Bluetooth low energy over Classic

- Less energy on the magnitude of 1-5%
- No need to use system settings to pair
- If you look for help online people will still answer your questions and you can buy new things without worrying they will be discontinued

Z-Wave

Z-Wave was developed as a simple to implement, low-speed wireless protocol that allows a variety of home electronics devices to intercommunicate using a reliable, low-power wireless protocol that easily travels through walls, floors, and cabinets. Z-Wave is a proprietary protocol developed by one vendor and requires a use license. There are now more than 700 member companies in the Z-Wave Alliance offering more than 2400 wirelessly connected, "intelligent" products such as appliances, window shades, thermostats and home lighting.

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802.15/Zigbee

- The IEEE 802.15.4 standard specifies the PHY and MAC for low data rate wireless personal area networks (WPANs). Zigbee builds on the 802.15.4 standard with a wireless protocol designed to build medium or large mesh networks that link sensors and controllers. More than 2,500 products are now Zigbee certified, and more than 300 million of these products have been shipped.

802.11/Wi-Fi:

- Native support of IP, Wi-Fi radios are relatively easy to integrate into an embedded design to connect a device directly to the IoT.

IEEE 802.15.4

- 802.15.4 itself
- Zigbee
- Thread (Google Nest)

6LoWPAN

6LoWPAN is an acronym of "IPv6 over Low-Power Wireless Personal Area Networks", and is based on the idea that the Internet protocol (IP) could and should be applicable to even the smallest devices. The 6LoWPAN protocol allows low-power devices with limited processing capabilities to participate in the IoT by defining mechanisms that allow IPv6 packets to be sent and received over radio networks based on the less complex PHY and MAC layers of IEEE 802.15.4 (which also serves as the basis for Zigbee low power RF mesh networks, and several others).

Sigfox

Low-power objects such as electricity meters or smartwatches that need to be intermittently switched on and need to operate on battery power for years or even decades, can use Sigfox's proprietary long-range radio interface to occasionally send small amounts of data to the cloud.

Narrowband IoT

- Developed to connect a wide range of devices and enable services using cellular telecommunications bands, Narrowband IoT (NB-IoT) is one of a range of Mobile IoT (MIoT) technologies standardized by the 3rd Generation Partnership Project (3GPP). NB-IoT is deployed "in-band" within the cellular spectrum allocated to 4G LTE cellular networks using resource blocks within a normal LTE carrier, or in the unused resource blocks within an LTE carrier's guard band.

Bluetooth LE

- Bluetooth LE considerably reduces power consumption and cost compared to Classic Bluetooth while maintaining a similar communication range. It's aimed at new applications in healthcare, fitness, location beacons, security, and home entertainment.

LoRaWAN

Intended for wireless battery-operated devices in a regional, national, or global network, LoRaWAN targets key IoT requirements of providing secure, low-power, bi-directional communication with mobility and localization services over a wide area. The LoRaWAN specification is a media access control (MAC) layer that can be overlaid on a variety of physical layer (PHY) protocols from satellite networks like Globalsat to terrestrial public and private networks. LoRaWAN provides seamless, long range interoperability among IoT devices without the need for local network support.

NFC

For portable devices like mobile phones, NFC provides a standardized set of protocols that enable two electronic devices to communicate in close proximity (usually less than 10 centimeters (cm)), so it's strictly a short-range connection. It's often used for financial transactions such as contactless payment systems and electronic mobile ticketing. Due to NFC's short range, one of the two NFC communicating devices is usually handheld and portable. Otherwise, a simple pair of wires usually provides a cheaper, simpler communications link.

https://www.electronicdesign.com/industrial-automation/choosing-right-wireless-protocol-your-iot-application

https://www.eetimes.com/document.asp?doc_id=1279887

https://www.embedded-computing.com/embedded-computing-design/choosing-the-best-iot-protocol

https://www.embedded.com/electronics-blogs/say-what-/4442973/Which-IoT-protocol-should-you-use-for-your-design-

- The peripheral exposes fields that the central car read, write or be notified of. Each of these fields is called a characteristic. A characteristic is also accompanied by a descriptor which explains it.
- Characteristics are grouped into a service.
- We can also group services into a profile.