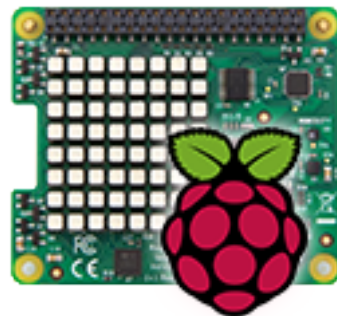# BLUETOOTHLE PROTOTYPING WITH THE RASPBERRY PI

ROBERTO HERNANDEZ

WHAT WE WILL COVER?

▸ Brief history of Bluetooth LE (BLE).

▸ Why is it vital?

▸ Bluetooth LE Platform Support

▸ Topology

    ▸ Central and Peripherals?

    ▸ GAP - General Access Profile

    ▸ GATT - General Attribute Profile

    ▸ Service and Characteristics

    ▸ iBeacons

▸ Tools of the Trait

▸ Demos

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BRIEF HISTORY OF BLUETOOTHLE

Bluetooth Low Energy (BLE), sometimes referred to as "Bluetooth Smart", is a light-weight subset of classic Bluetooth and was introduced as part of the Bluetooth 4.0 core specification. While there is some overlap with classic Bluetooth, BLE actually has a completely different lineage and was started by Nokia as an in-house project called 'Wibree' before being adopted by the Bluetooth SIG in 2010.
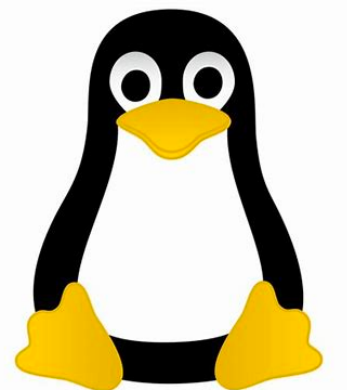
BLUETOOTHLE PLATFORM SUPPORT

Support for Bluetooth 4.0 and Bluetooth Low Energy is available on most major platforms as of the versions listed below:

‣ iOS5+ (iOS7+ preferred)

‣ Android 4.3+
  (numerous bug fixes in 4.4+)

‣ Apple OS X 10.6+

‣ Windows 8
  (XP, Vista and 7 only support Bluetooth 2.1)
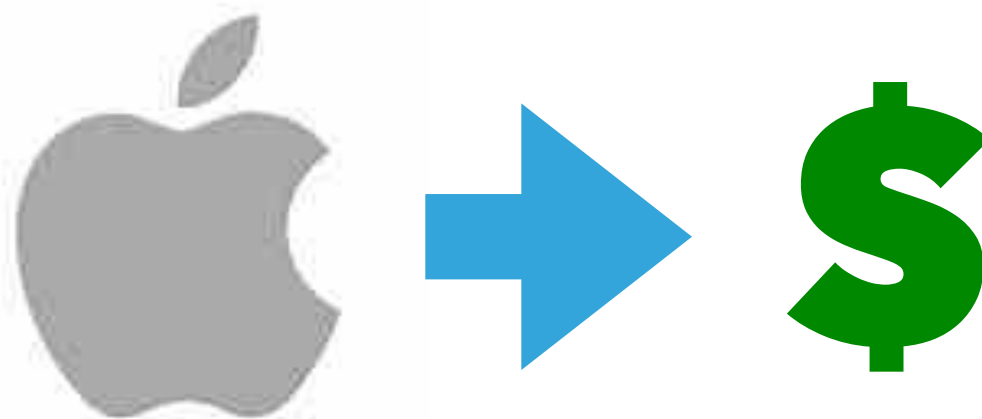
‣ GNU/Linux Vanilla BlueZ 4.93+

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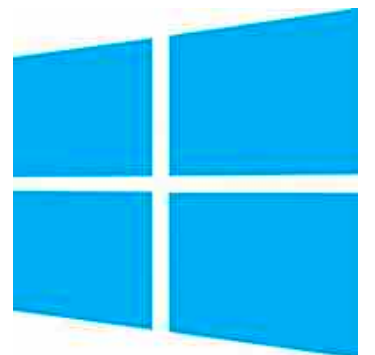
WHY IS IT SO VITAL?

▸ If the hardware you are designing will be complemented by an app that will be part of the the iOS echo system, using BLE is the only way to get Apple's approval without having to have your hardware and software go thru additional review.

BLUETOOTHLE TOPOLOGY – GAP

▸ **Generic Access Profile**
Controls connections and advertising in Bluetooth. GAP is what makes your device visible to the outside world, and determines how two devices can (or can't) interact with each other.
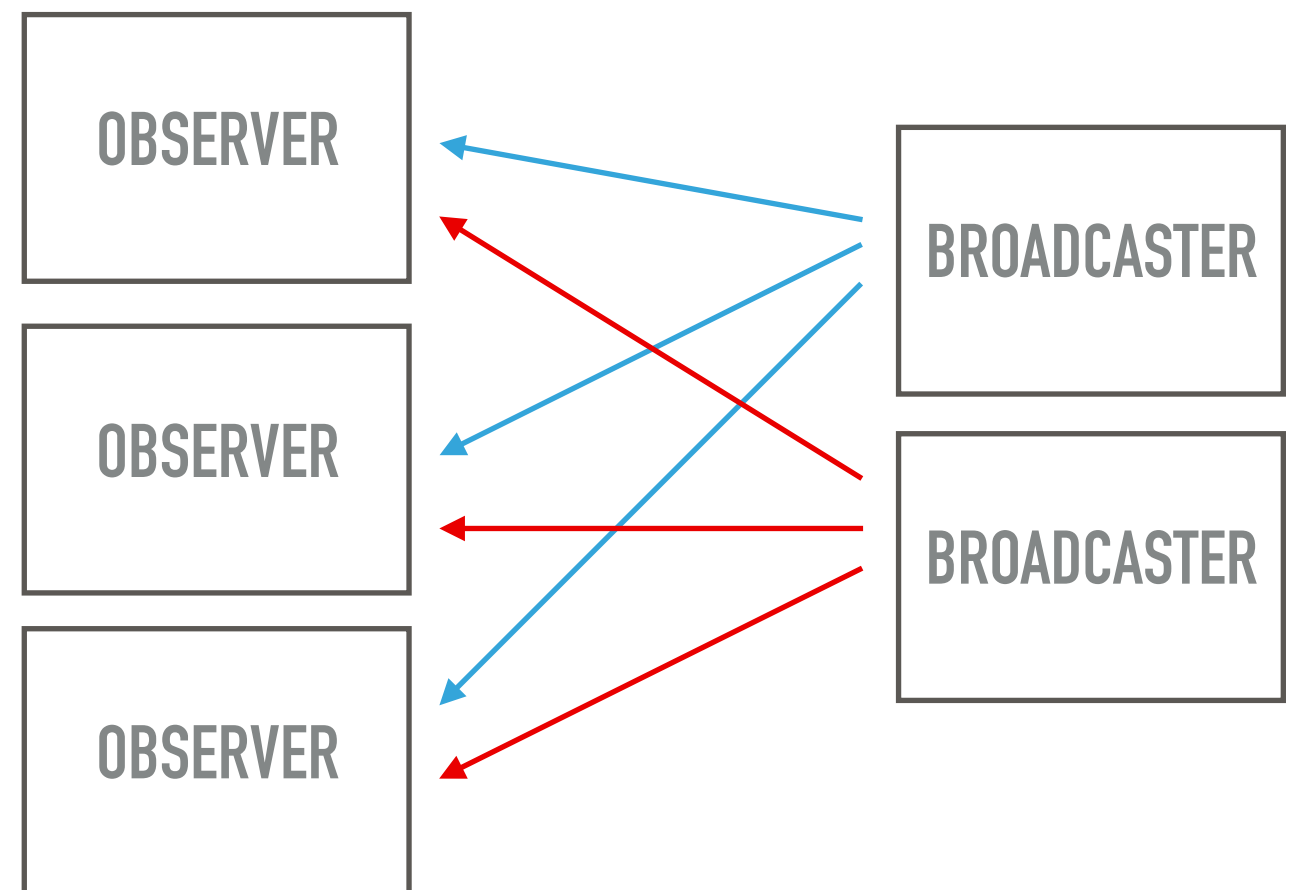
GAP defines various roles for devices, but the two key concepts to keep in mind are **Central** devices and **Peripheral** devices.

BLUETOOTHLE TOPOLOGY – BROADCAST TOPOLOGY

▸ aka. Beacon Mode

  ▸ Observer = Central

  ▸ Broadcaster = Peripheral

OBSERVER

OBSERVER

OBSERVER

BROADCASTER

BROADCASTER

* One way advertisement information transfer from broadcaster to observer.

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BLUETOOTHLE TOPOLOGY – CENTRALS AND PERIPHERALS

▸ **Peripheral** devices are small, low power, resource constrained devices that can connect to a much more powerful central device. Peripheral devices are things like a heart rate monitor, a BLE enabled proximity tag, etc.

▸ **Central** devices are usually the mobile phone or tablet that you connect to with far more processing power and memory.

# BLUETOOTHLE TOPOLOGY – CENTRAL AND PERIPHERALS

▶ Central

▶ Peripheral
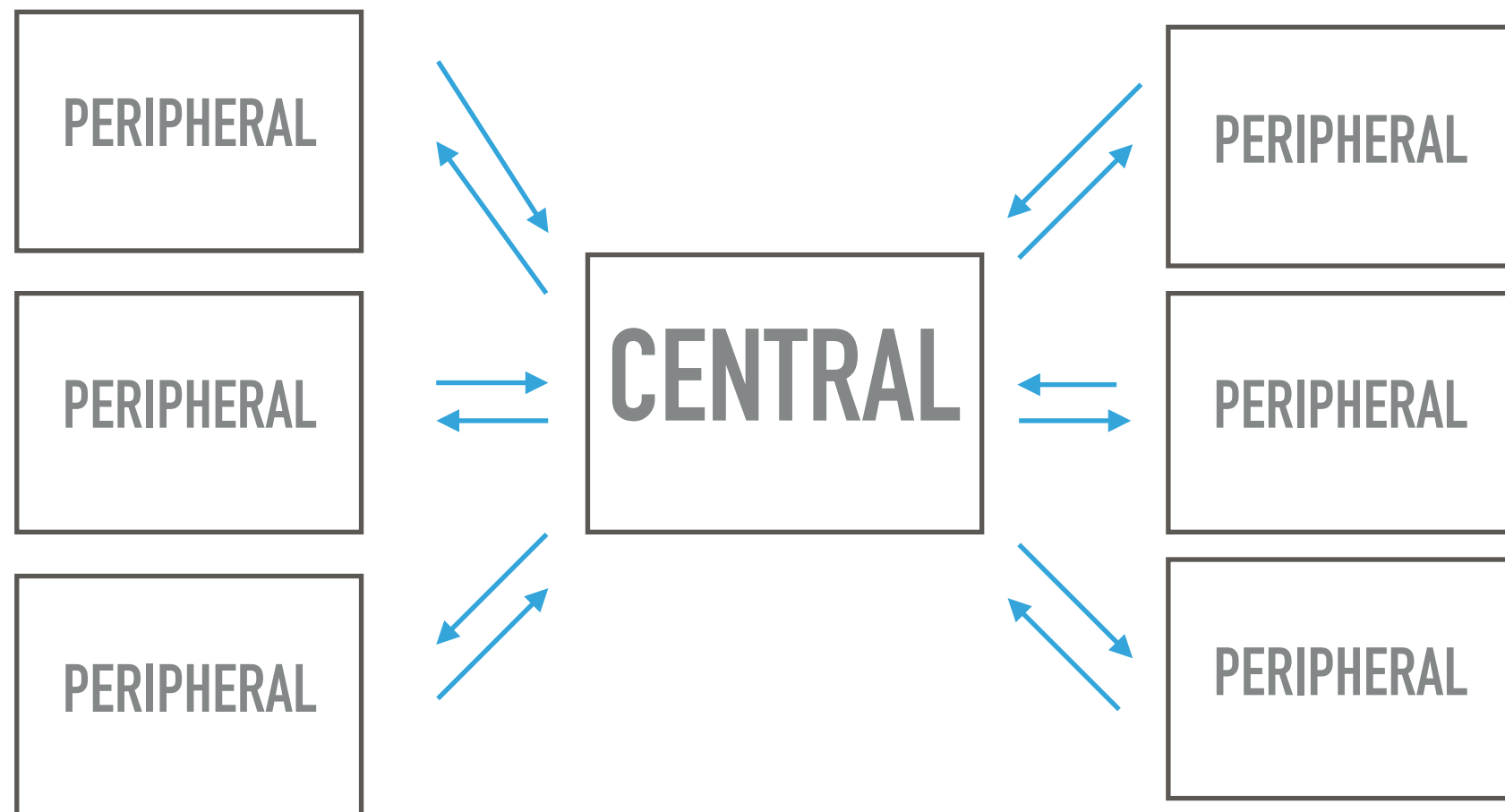
***A central** can connect to many **peripherals** but a **peripheral** can only connect to one **central**.*

BLUETOOTHLE TOPOLOGY – GATT TRANSACTIONS

▸ GATT Transactions

   ▸ **Profile**: One approved by the Bluetooth SIG or custom to your hardware. For Example: Environment Sensor Profile, or Heart Rate Profile.

   ▸ **Service**: break data up into logic entities, and contain specific chunks of data called characteristics.

   ▸ **Characteristic**: The lowest level concept in GATT transactions is the Characteristic, which encapsulates a single data point. These expose a data point that can be have **read**, **write** access and provide **notifications**.

PROFILE

  SERVICE

    CHARACTERISTIC

    CHARACTERISTIC

  SERVICE

    CHARACTERISTIC

    CHARACTERISTIC

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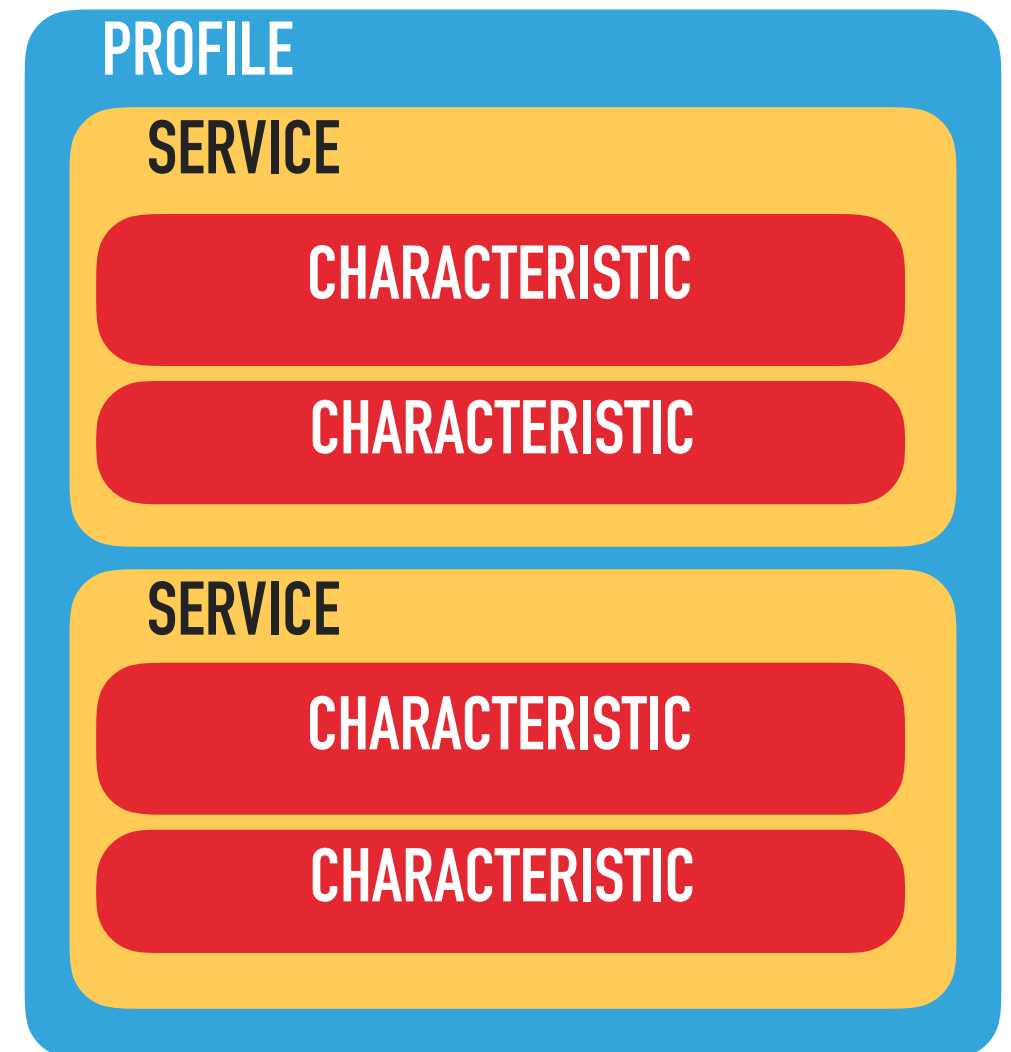
DEMOS – TOOLS OF THE TRAIT

▸ Raspberry Pi

▸ SenseHat

▸ BLE Scanners

DEMOS

▸ 01 - Beacon

▸ 02 - Read Characteristic

▸ 03 - Write Characteristic

▸ 04 - Notification

DONE

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▸ Resources
https://learn.adafruit.com/introduction-to-bluetooth-low-energy/gatt
https://github.com/Adam-Langley/pybleno
https://github.com/noble/bleno

▸ Code

https://bitbucket.org/overridethis/pi-ble-demos

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