

What's my heart rate?

An introduction to the awesomeness of Bluetooth 4 and iOS

Doug Wait
dwait@acm.org

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What we're covering

- Bluetooth 4 - briefly
- The specs related to our heart rate demo
- iOS Core Bluetooth
- A demo application

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Bluetooth

- Bluetooth specifications are defined and promoted by the Bluetooth SIG (bluetooth.com & bluetooth.org)
- Bluetooth 4.1 is the latest version of the core specification (December of 2013)
- Bluetooth 4.0 is the specification that first included a “Low Energy” core configuration
- Bluetooth Smart is the official branding term for the low energy aspect

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LE is part of the larger 4.0 spec. Legacy bluetooth is still there however LE is emerging as the dominant technology. The technology is different between LE and “classic” even though some parts of the spec may overlap.

Bluetooth 4 (low energy)

- L2CAP (Logical Link Control and Adaptation Protocol) - transport, QOS, packets, multiplexing ...
- GAP (Generic Access Profile) - device discovery, link management, security...
- ATT (Attribute Protocol) - discover/read/write attributes
- GATT (Generic Attribute Profile) - discover services, read/write characteristics
- SM (Security Manager) - pairing, authentication, encryption

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GATT and GAP are the most common terms as they'll be most important to what you're doing with core bluetooth.

General operation

- Scanning for Advertising devices
- Connecting
- Communicating
- Terminating connection

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iOS Core Bluetooth

Central



Peripheral



**Services (e.g. Heart Rate)
Characteristics
(e.g. Heart Rate Measurement)**

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Central requests data from the peripheral.

Demo won't cover

- Control points
- Background mode
- Multiple CBCentralManagers
- Saving devices and restoring them
- iOS device as a peripheral

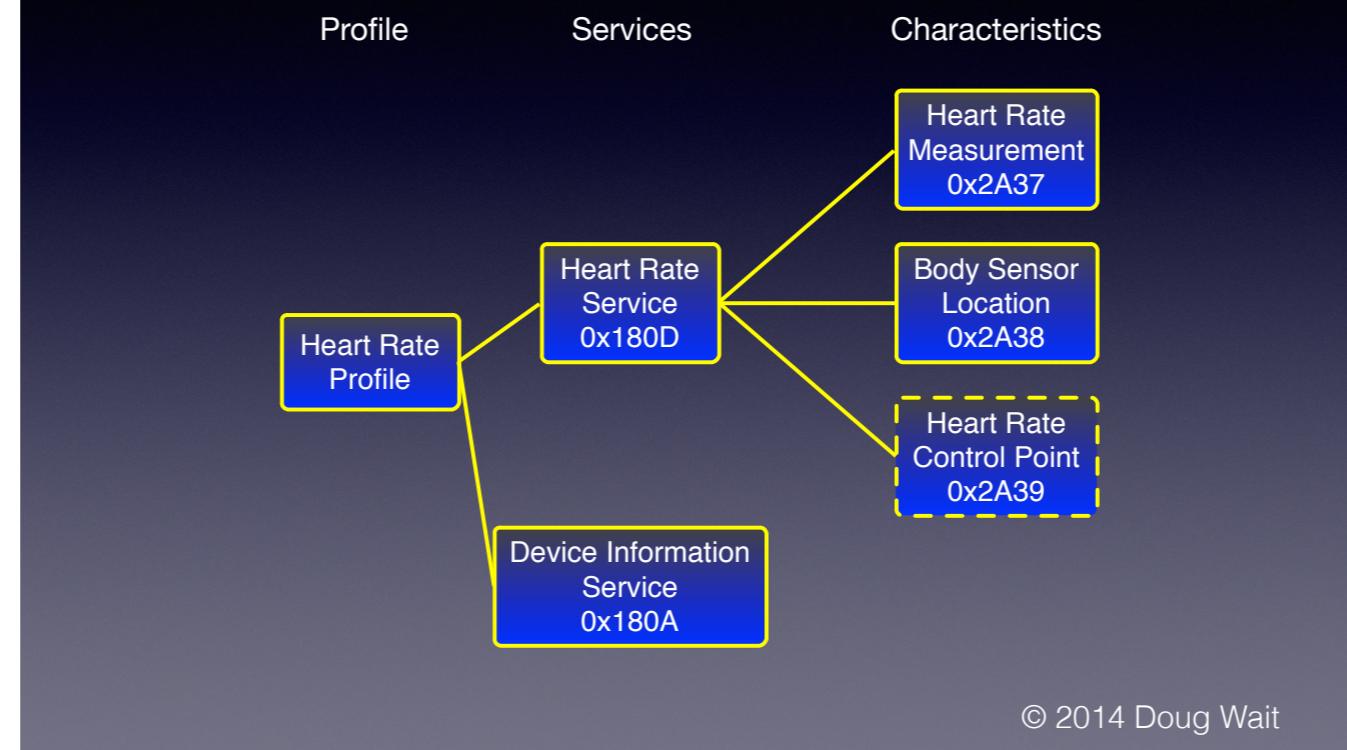
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Heart Rate Sensor



Wait

Specs for our demo



The 16 bit UUIDs are shown on the diagram and these are important. It's important to understand how the specifications are organized in order to connect to something other than what I'm demoing. The first thing I realized as I started working with Core Bluetooth was that I would need to read the Bluetooth SIG spec.

Profile: Heart Rate

type: org.bluetooth.heart_rate

Role: Heart Rate Sensor

Service	Requirement
org.bluetooth.service.heart_rate	Mandatory
org.bluetooth.service.device_information	Mandatory

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Service: Heart Rate

Assigned Number: 0x180D

Service Characteristics	Properties
Heart Rate Measurement	Notify
Body Sensor Location	Read
Heart Rate Control Point (conditional: mandatory if Energy Expended feature is supported, otherwise excluded)	Write

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Specless

- Use Bluetooth 4 but don't have a published specification for profiles/services/characteristics
- Use self-assigned numbers - 128 bit UUIDs
- Some devices may publish according to a spec and then supplement with additional custom characteristics and control points
- Vendors do one of three things - no access to their data or device, access to their data via REST services in cloud, access to their device via proprietary API

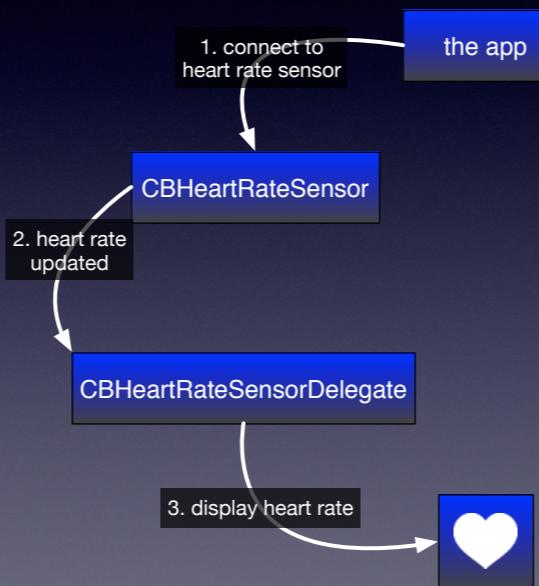
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Bluetooth LE is intended to be extended by vendors. These extensions are not covered by the SIG specs. Vendors use a variety of approaches to provide developers with access to their proprietary extensions.

Core Bluetooth Interactions

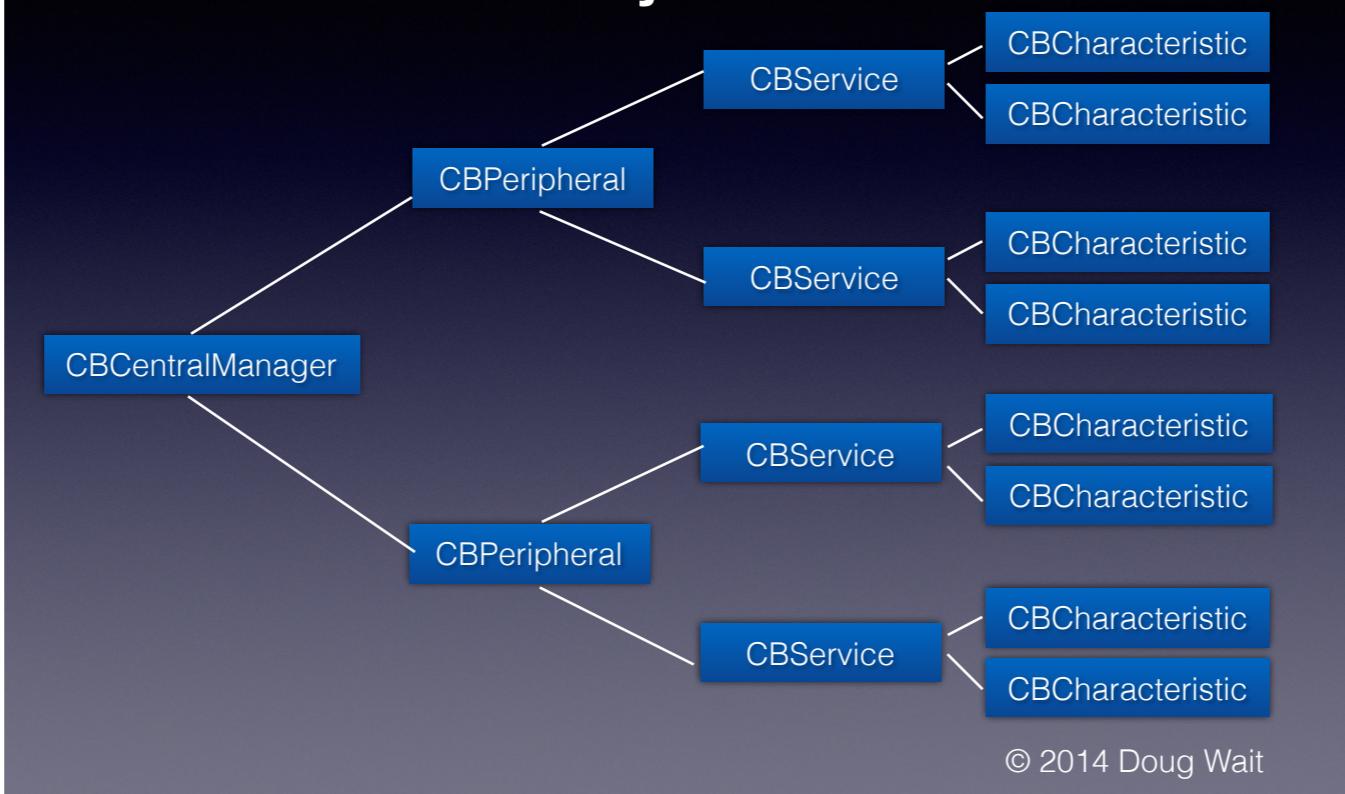
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The way we'd like it to be



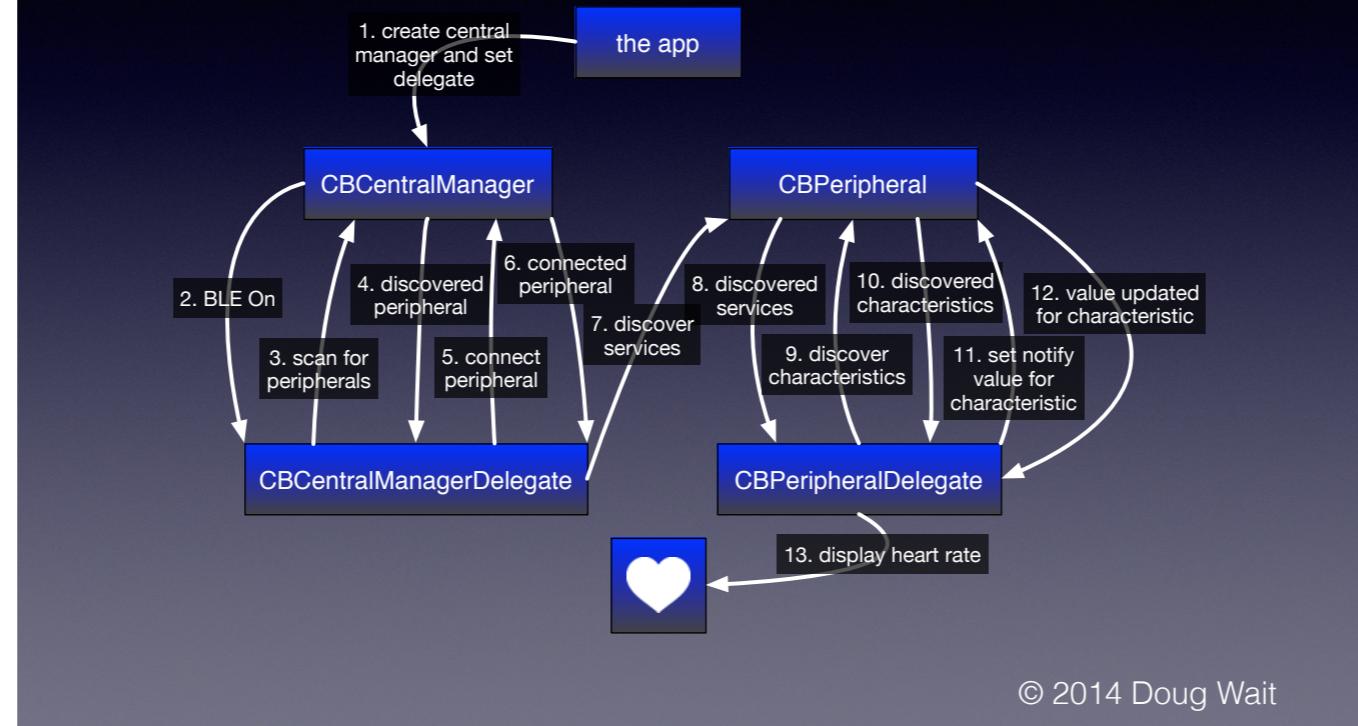
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Objects



Core Bluetooth has to support the complete breadth of Bluetooth LE which means it must be generic. This objective doesn't lead the framework to address specific SIG specifications. It does lead the framework to mirror the Bluetooth structure and basic protocols.

Simplicity Reality



Demo Time

Requires: iPhone 4S or later - no simulator support

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Subjective Questions

- What's the best thing about your iPhone?
- What can you really screw up when working with Core Bluetooth?
- Same answer: **battery life**
- Improper use has negative battery life impact on both iOS device and bluetooth peripheral

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Pointers

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Maximize Battery Life

- Be specific about what you scan for
- Scan until you find what you want then stop
- Let the framework filter out duplicate advertising data from same device
- Don't look for data you don't need
- Subscribe when appropriate (e.g. HR)
- Unsubscribe when appropriate (e.g. HR sensor not in contact)
- Don't forget to disconnect when you're done

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Reconnection

Typically go after devices in this order:

1. ask CBCentralManager for devices you know (provide the list of UUIDs)
2. ask CBCentralManager for currently connected devices (probably connected to other apps)
3. Scan for devices

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Coding

- Don't let go of your CBPeripheral
- Use CB objects as keys into dictionaries (they're NSCopying compliant)
- If your code suddenly stops working try resetting your iOS device and check the battery in your peripheral

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Resources for Learning

- Bluetooth Programming Guide
- 2012 WWDC Bluetooth Sessions
- 2013 WWDC Bluetooth Session

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SIG Docs

<http://developer.bluetooth.org>

[https://developer.bluetooth.org/gatt/profiles/Pages/
ProfilesHome.aspx](https://developer.bluetooth.org/gatt/profiles/Pages/ProfilesHome.aspx)

[https://developer.bluetooth.org/gatt/profiles/Pages/
ProfileViewer.aspx?u=org.bluetooth.profile.heart_rate.xml](https://developer.bluetooth.org/gatt/profiles/Pages/ProfileViewer.aspx?u=org.bluetooth.profile.heart_rate.xml)

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