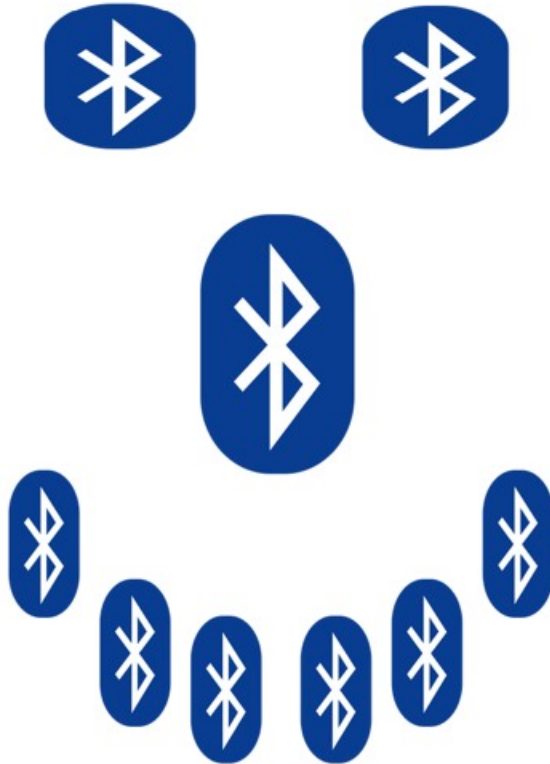






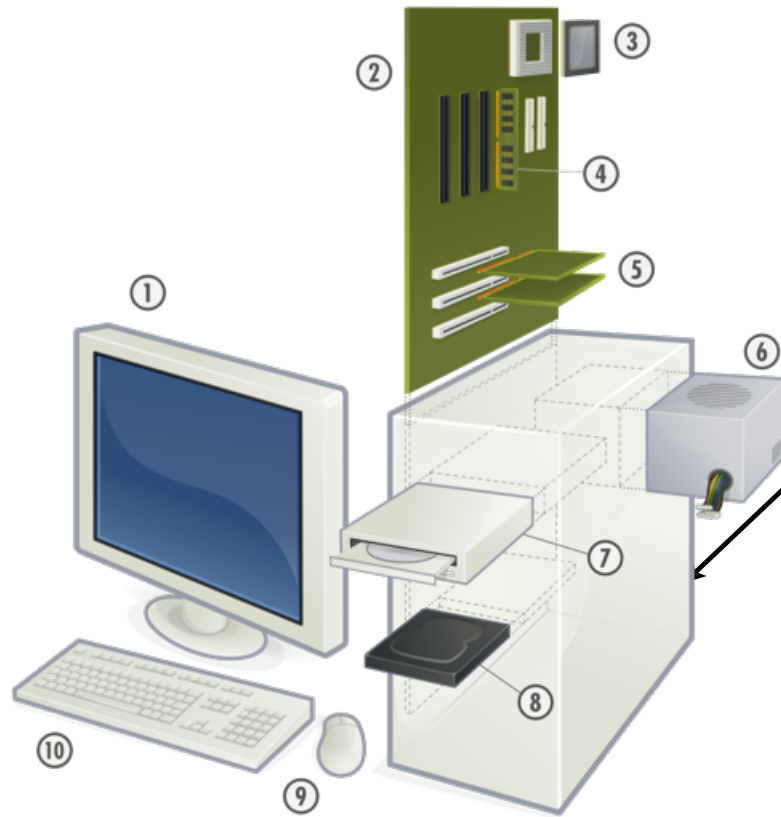
Best Practices for Bluetooth Development

Rich Hyndman / Scout Sinclair Brody / Matthew Xie

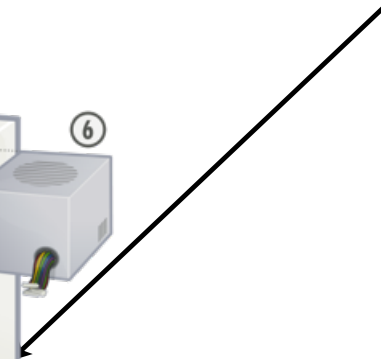


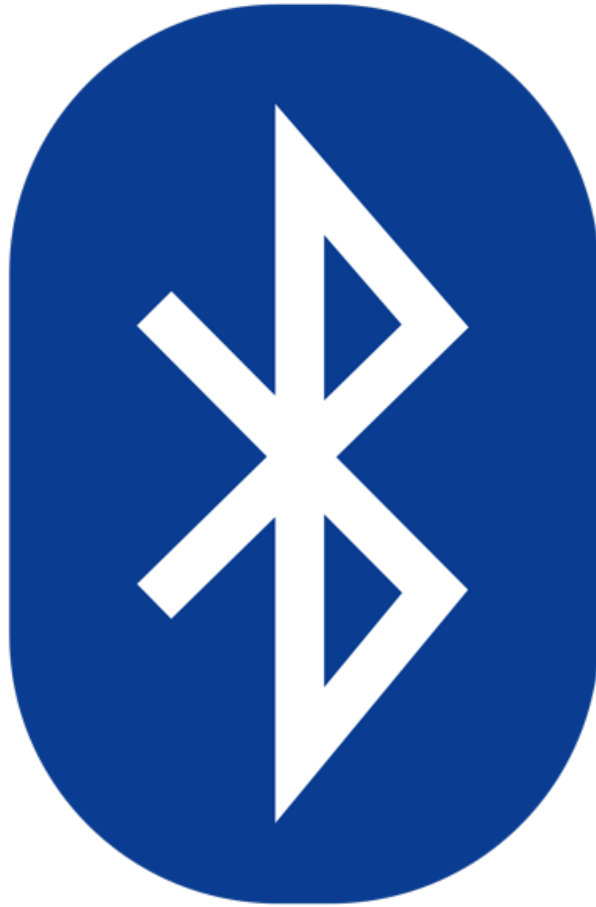
MCMXCIV

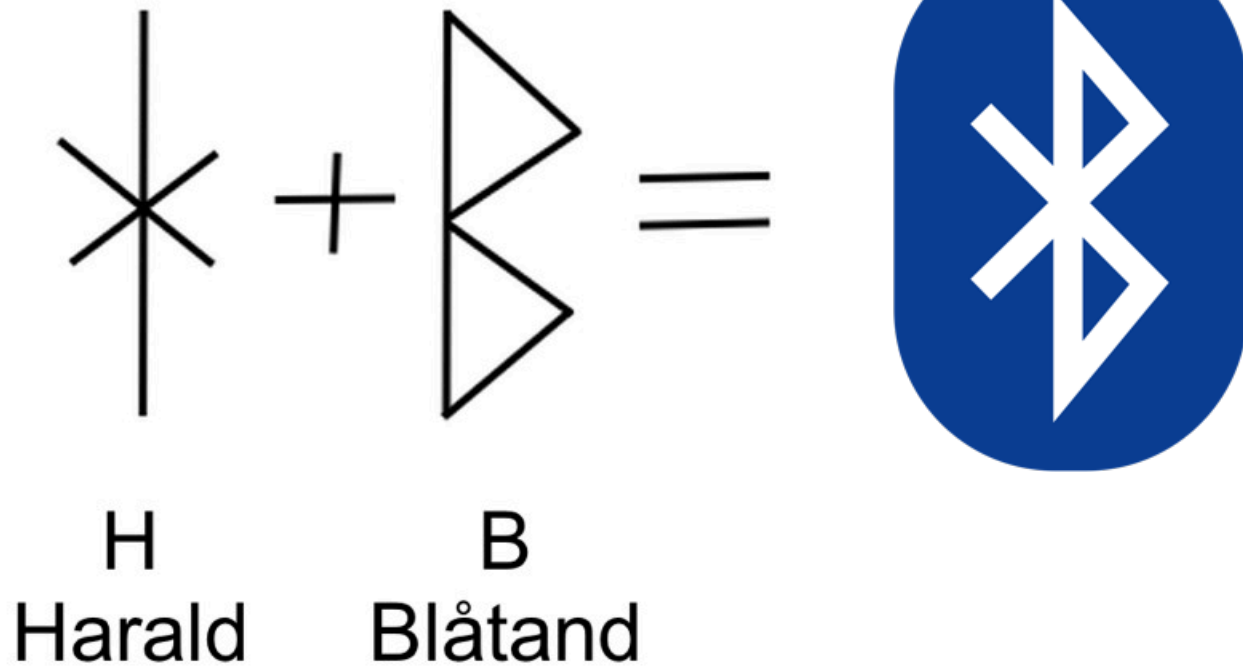




RS-232 Port
located somewhere
near here

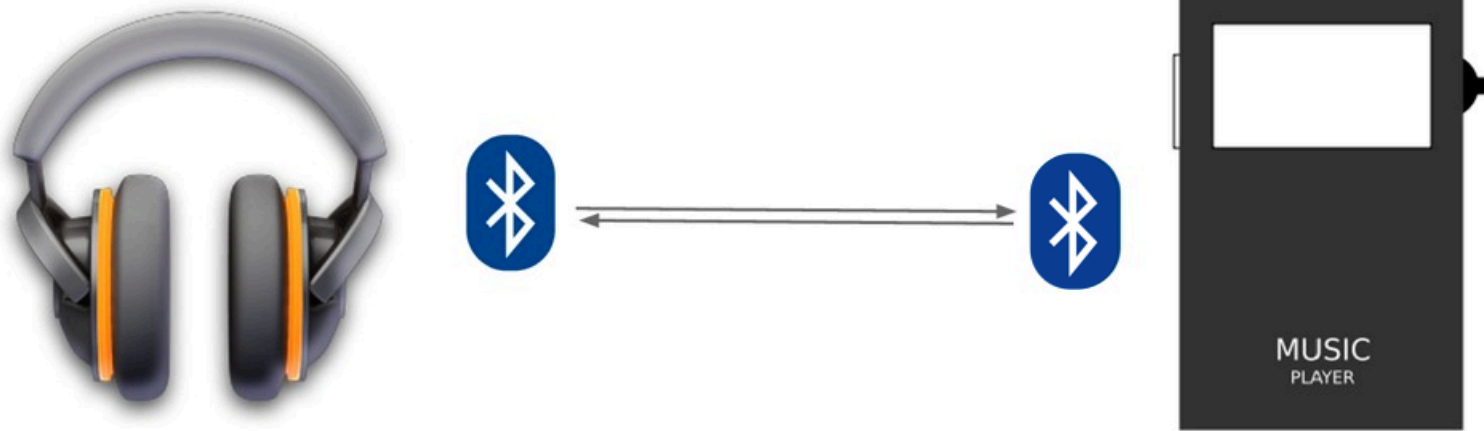




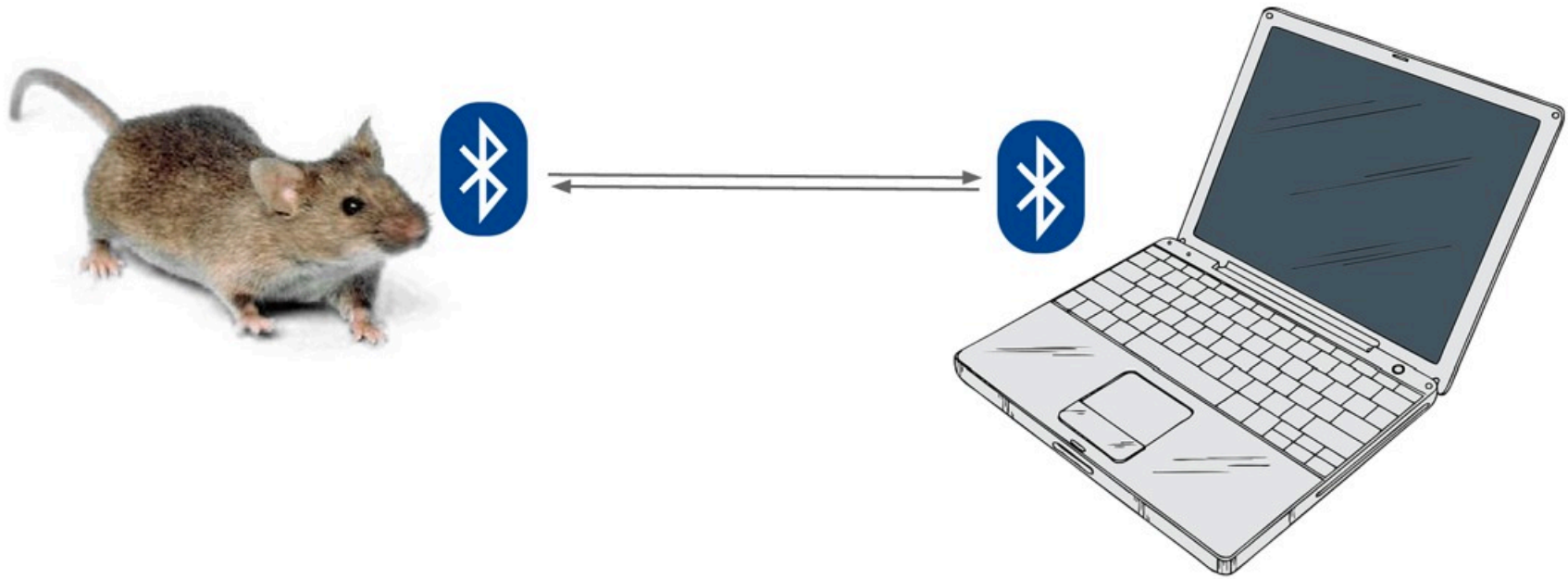




Bluetooth Classic



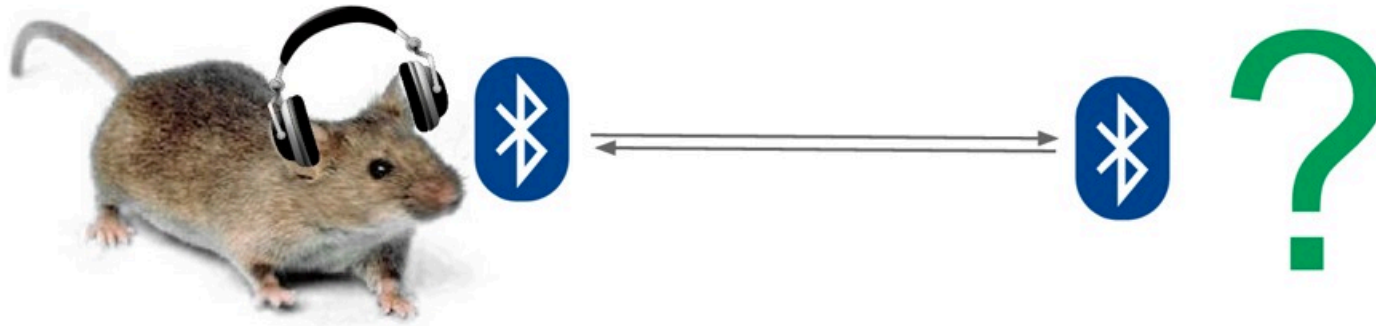
Bluetooth Classic



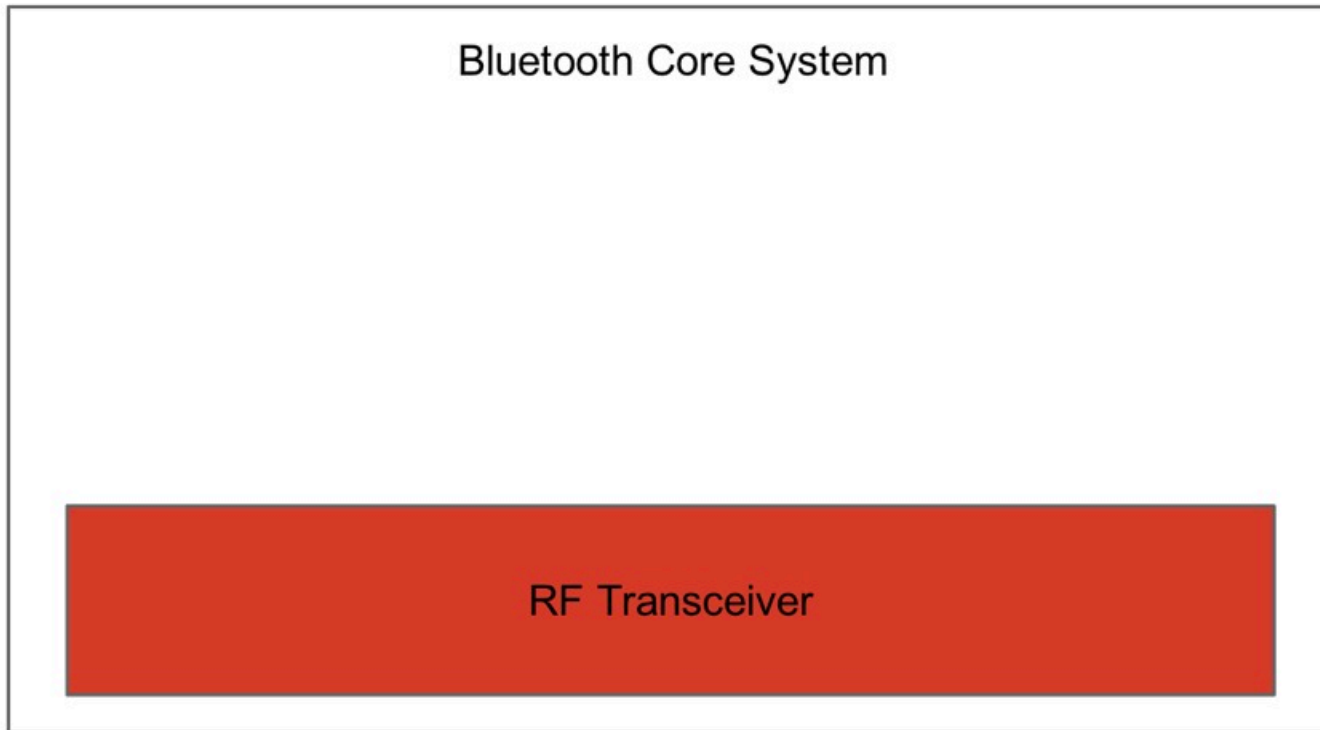
Creative Commons Images <http://pixabay.com/en/computer-apple-macintosh-book-30310/>
https://pt.wikipedia.org/wiki/Ficheiro:Mouse_white_background.jpg
KDE - <http://commons.wikimedia.org/wiki/File:Oxygen480-devices-audio-headphones.svg>



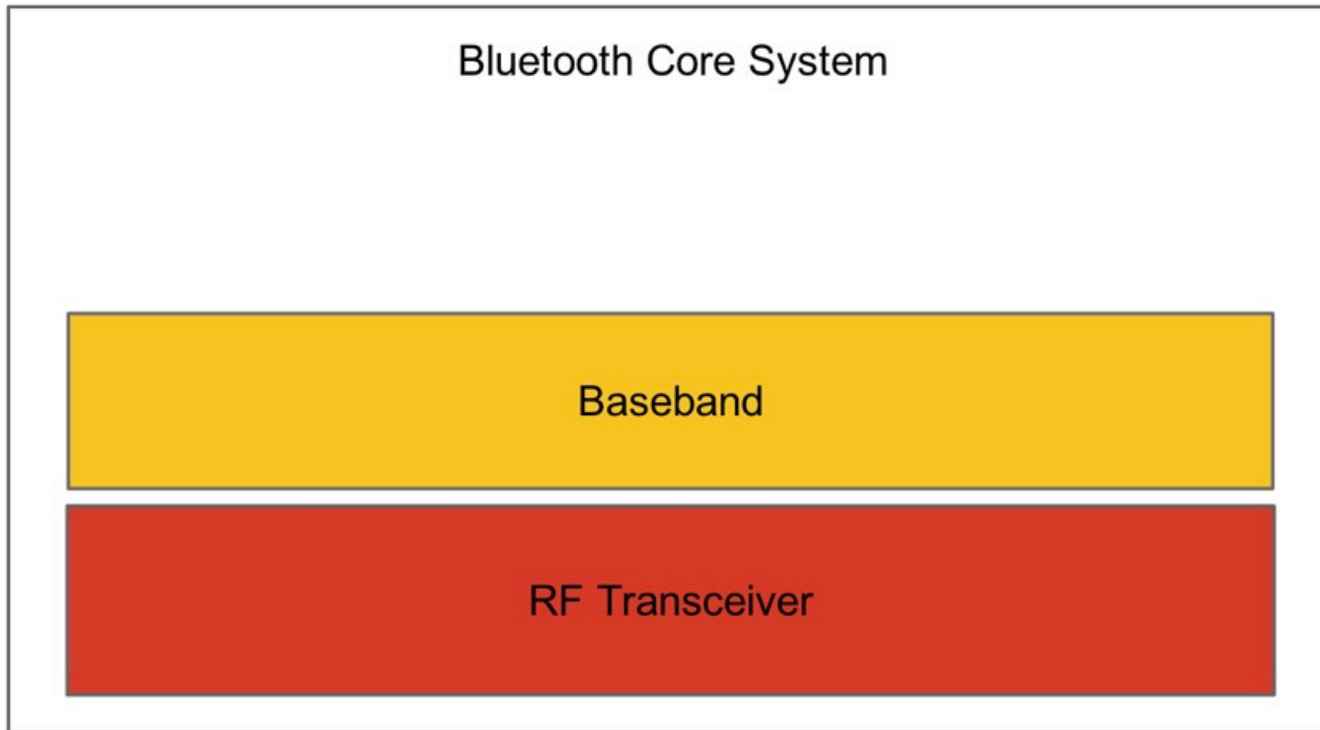
Bluetooth Classic



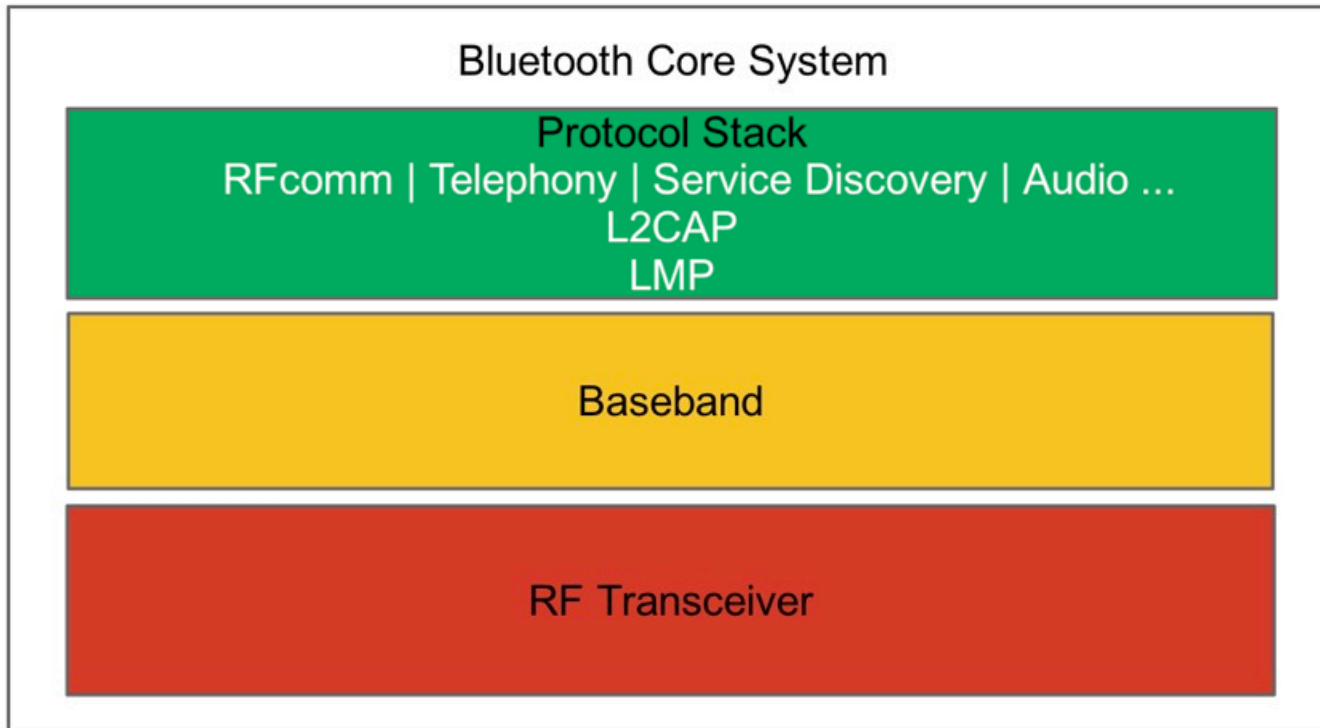
The Bluetooth Core Specification



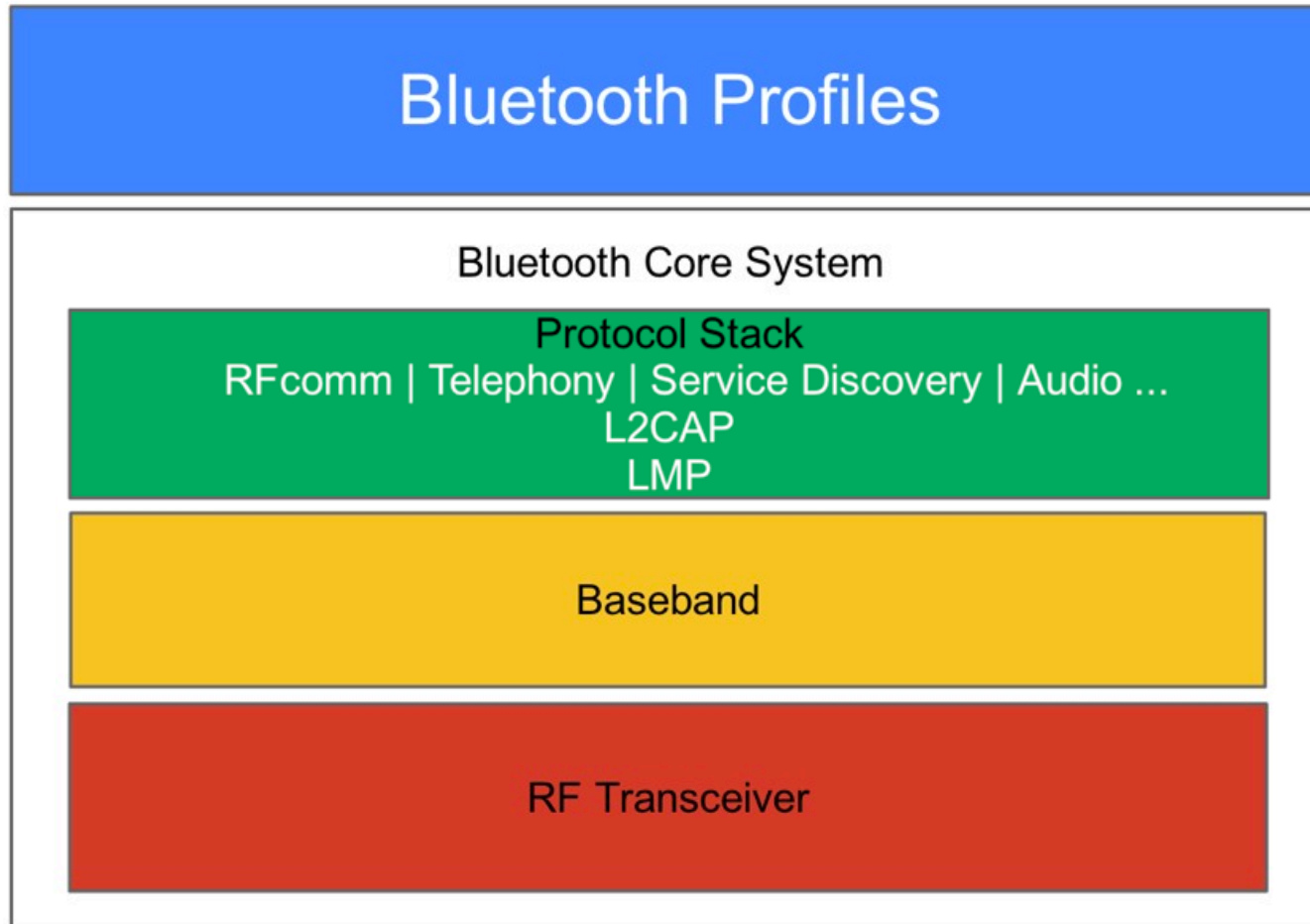
The Bluetooth Core Specification



The Bluetooth Core Specification



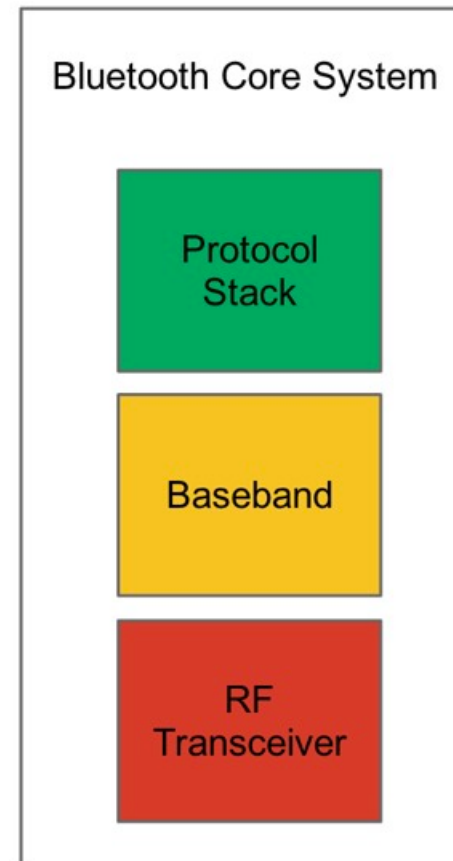
The Bluetooth Core Specification



The Bluetooth Core Specification

Key Versions

- v1.0
- v1.1 (IEEE 802.15.1–2002)
- v1.2
- v2.0 + EDR
- v2.1 + EDR
- v3.0 + HS
- v4.0





android.bluetooth

android.bluetooth

Linux BlueZ stack

- AOSP 2.3-4.1 (Nexus S, Galaxy Nexus)
- most Samsung and HTC phones on Android 4.0/4.1
- Sony Xperia with Android 4.0

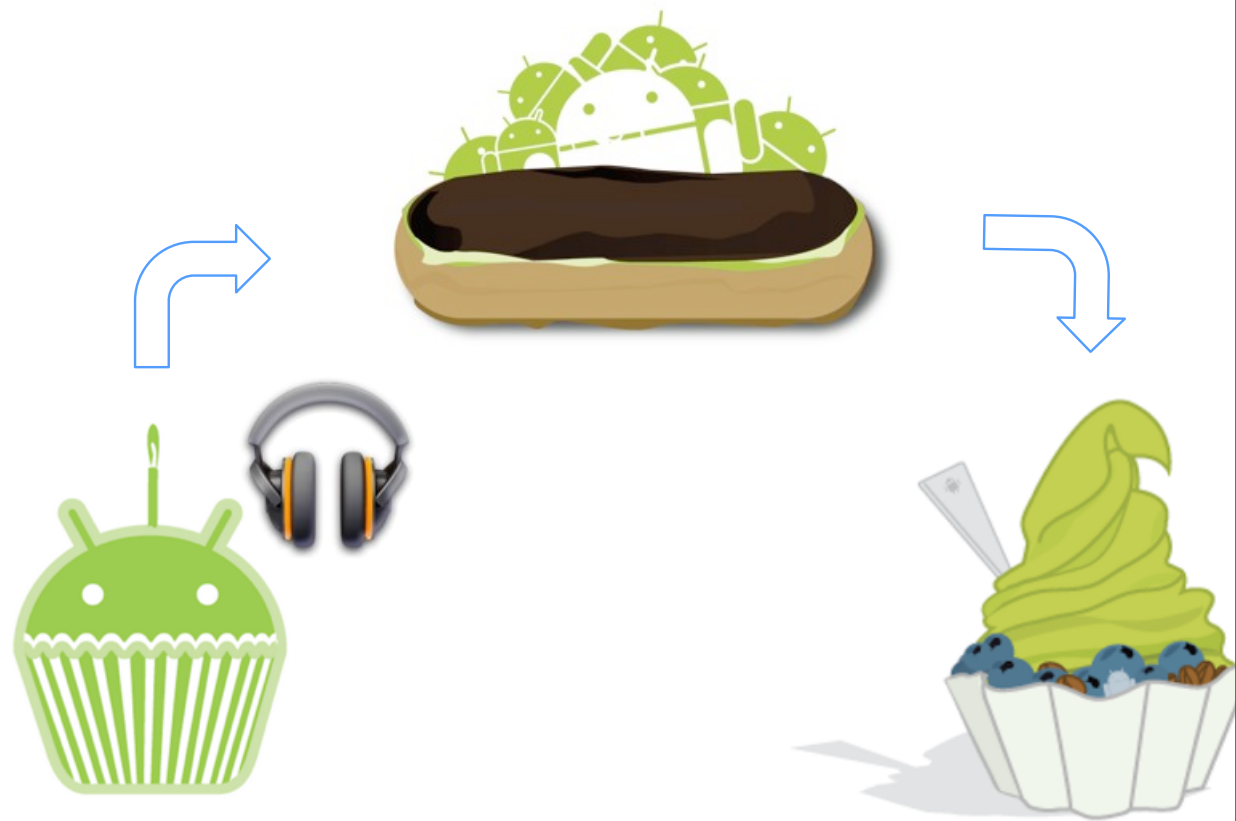
Older Broadcom Stack

- Samsung and HTC < Android 4.0

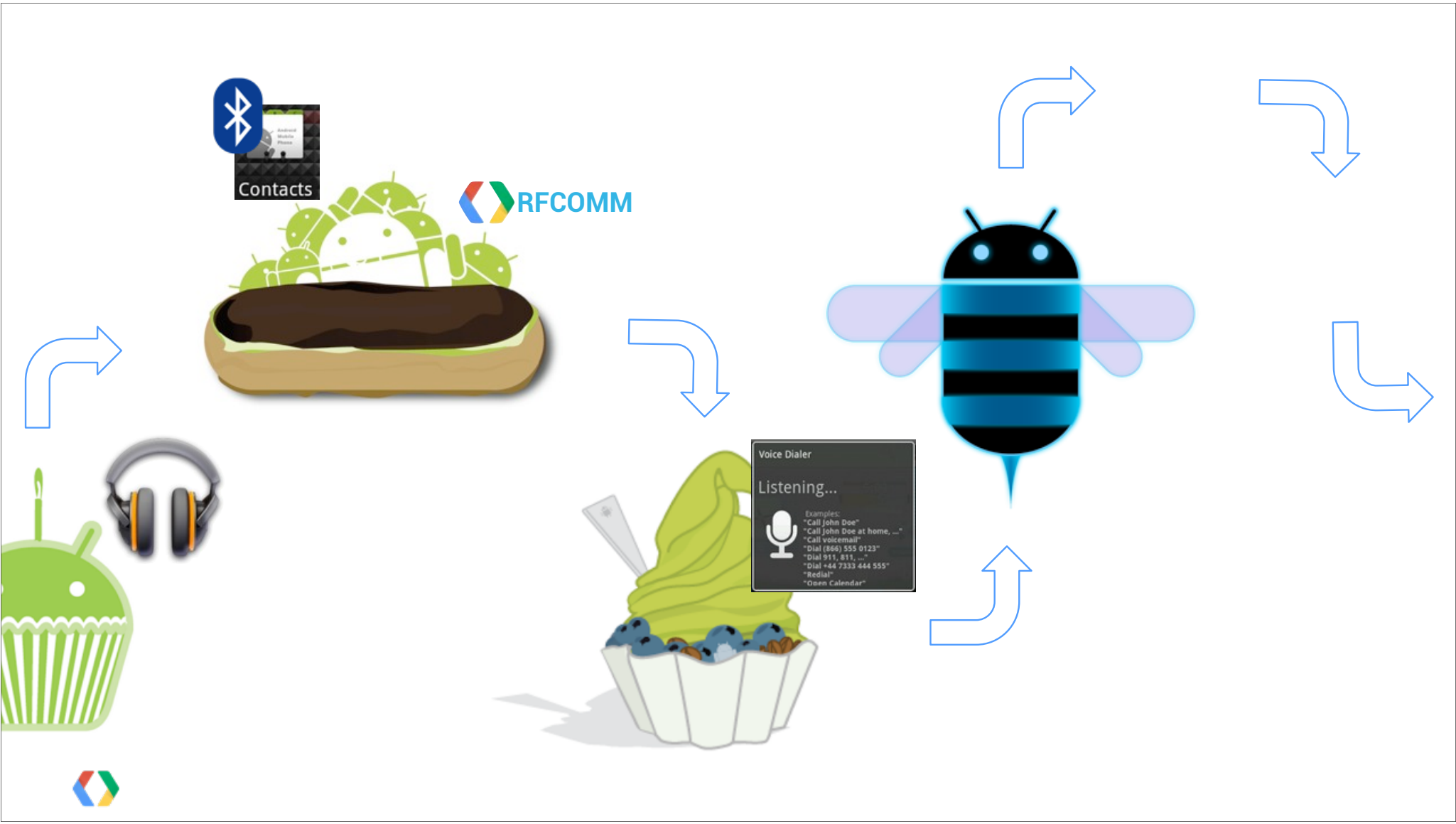
Motorola Bluetooth Stack

+others....





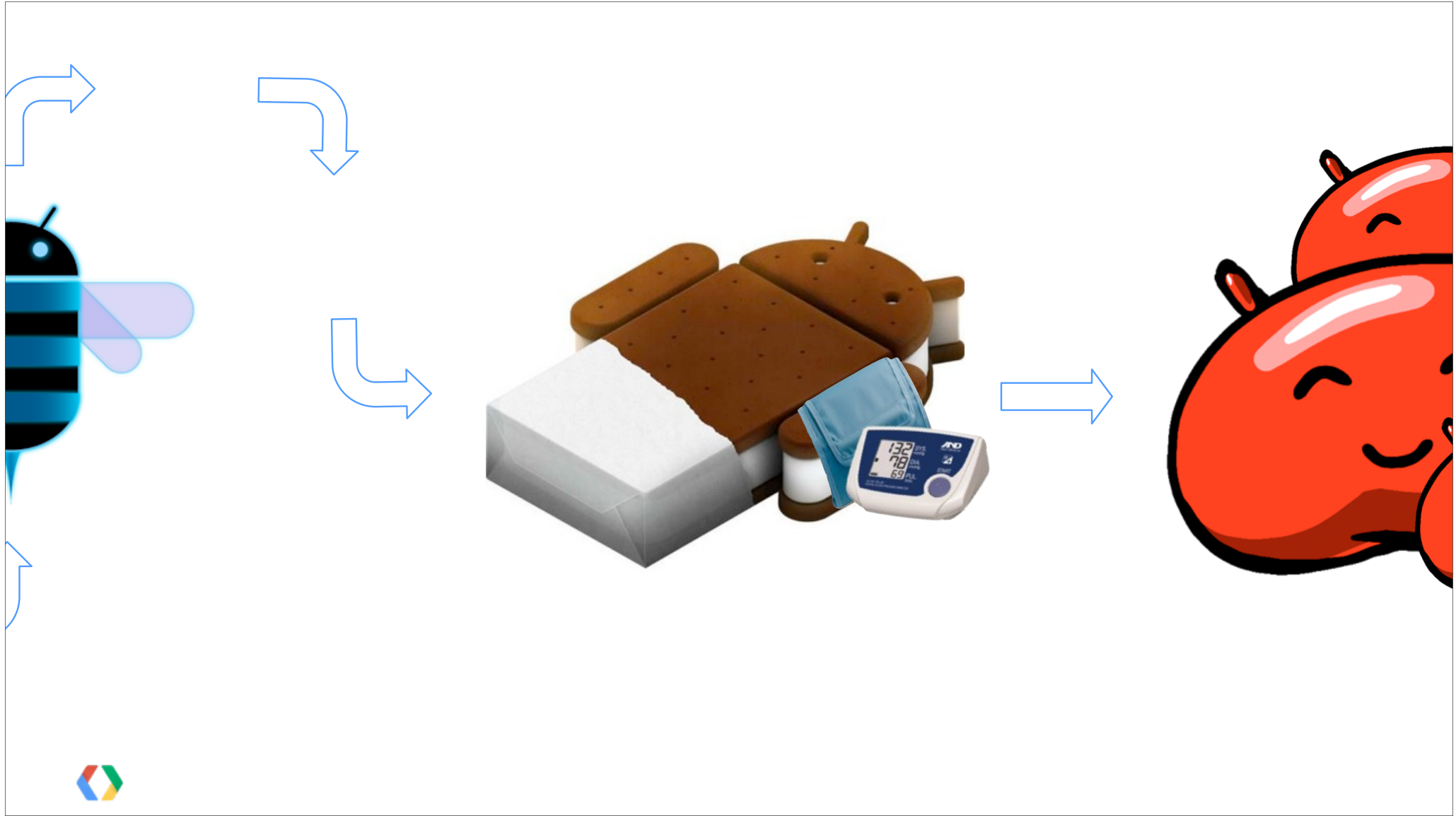


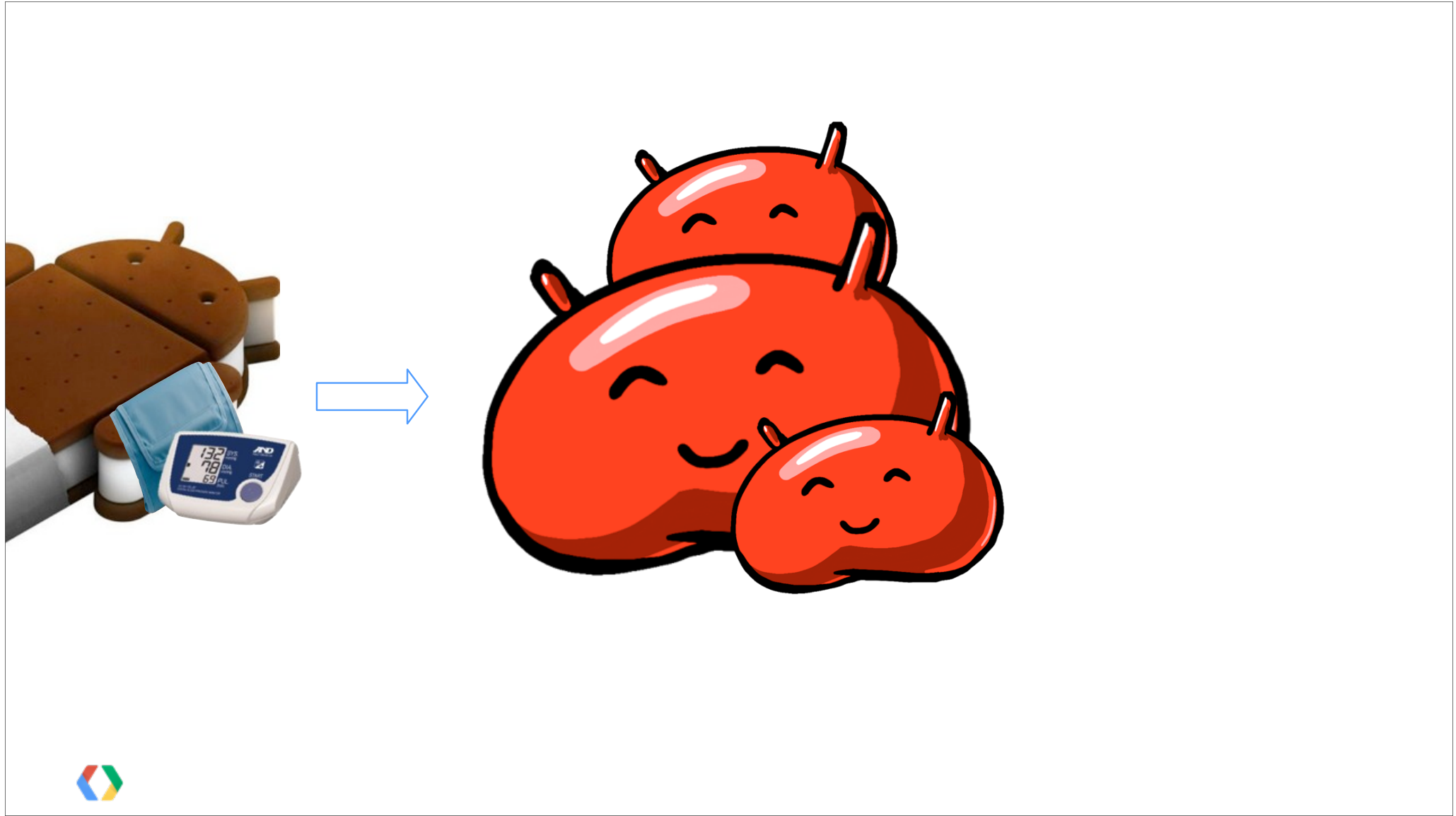


cts

RFCOMM







android.bluetooth

- BlueDroid stack introduced 4.2
- Embedded optimization, performance (processes), general velocity
(oh my)





Bluetooth Low Energy

Bluetooth & batteries



http://en.wikipedia.org/wiki/File:Li_ion_laptop_battery.jpg

Bluetooth & batteries



<http://en.wikipedia.org/wiki/File:Battery-lithium-cr2032.jpg>
http://en.wikipedia.org/wiki/File:Li_ion_laptop_battery.jpg

Bluetooth Low Energy (BLE)



http://commons.wikimedia.org/wiki/File:Pebble_watch_trio_group_04.png
<http://pixabay.com/en/action-exercise-fit-fitness-health-2461/>
<http://commons.wikimedia.org/wiki/File:Generic-remote-control-shallow-focus.jpg>
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<http://en.wikipedia.org/wiki/File:Battery-lithium-cr2032.jpg>

Bluetooth Low Energy (BLE)



Single-mode
(BLE only)



Dual-mode
(Bluetooth Classic and BLE)



Bluetooth Low Energy (BLE)



Single-mode
(BLE only)



Dual-mode
(Bluetooth Classic and BLE)

Available starting in
Android API version 18



BLE Terminology

GATT (General Attribute Profile)

ATT (Attribute Protocol)



BLE Terminology: GATT characteristics

Characteristic

Value

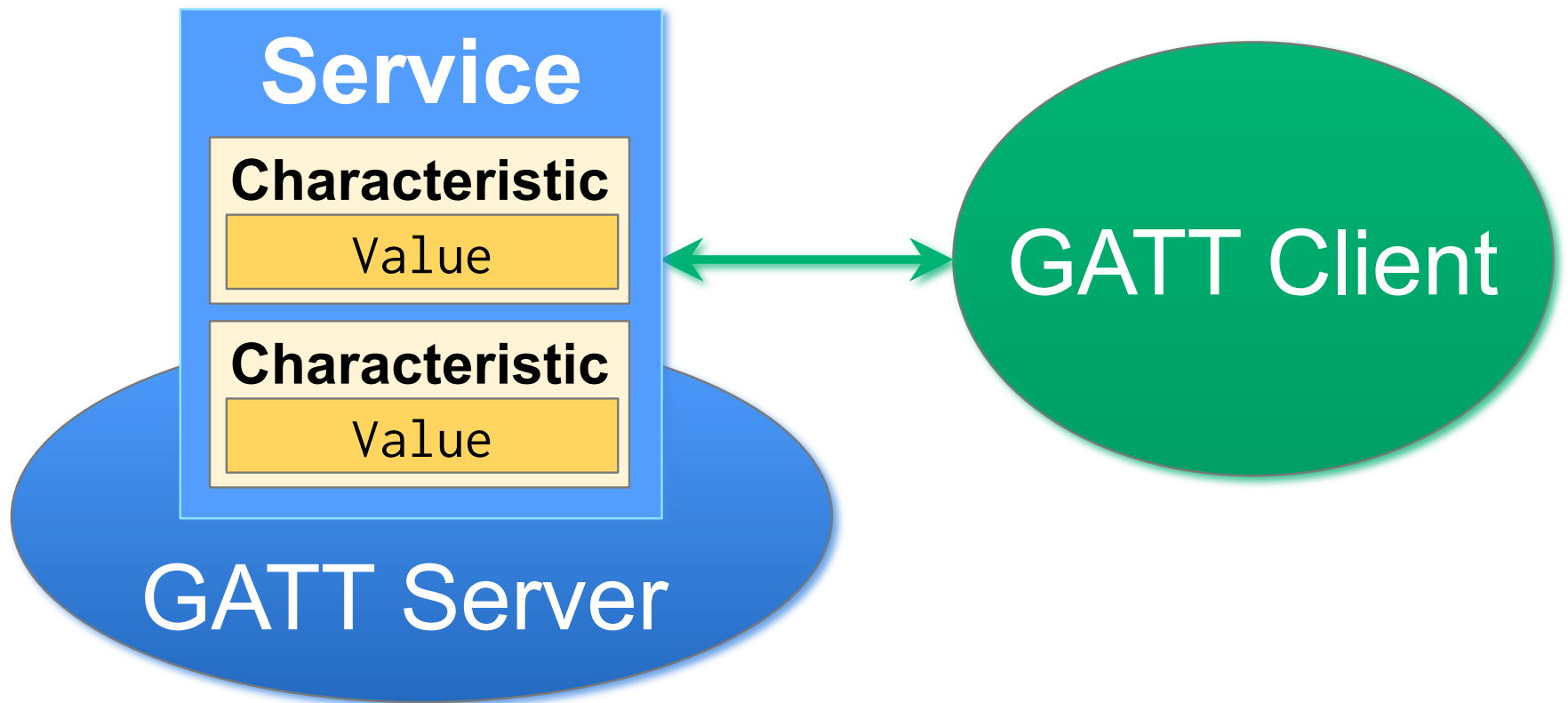
Descriptor

Descriptor

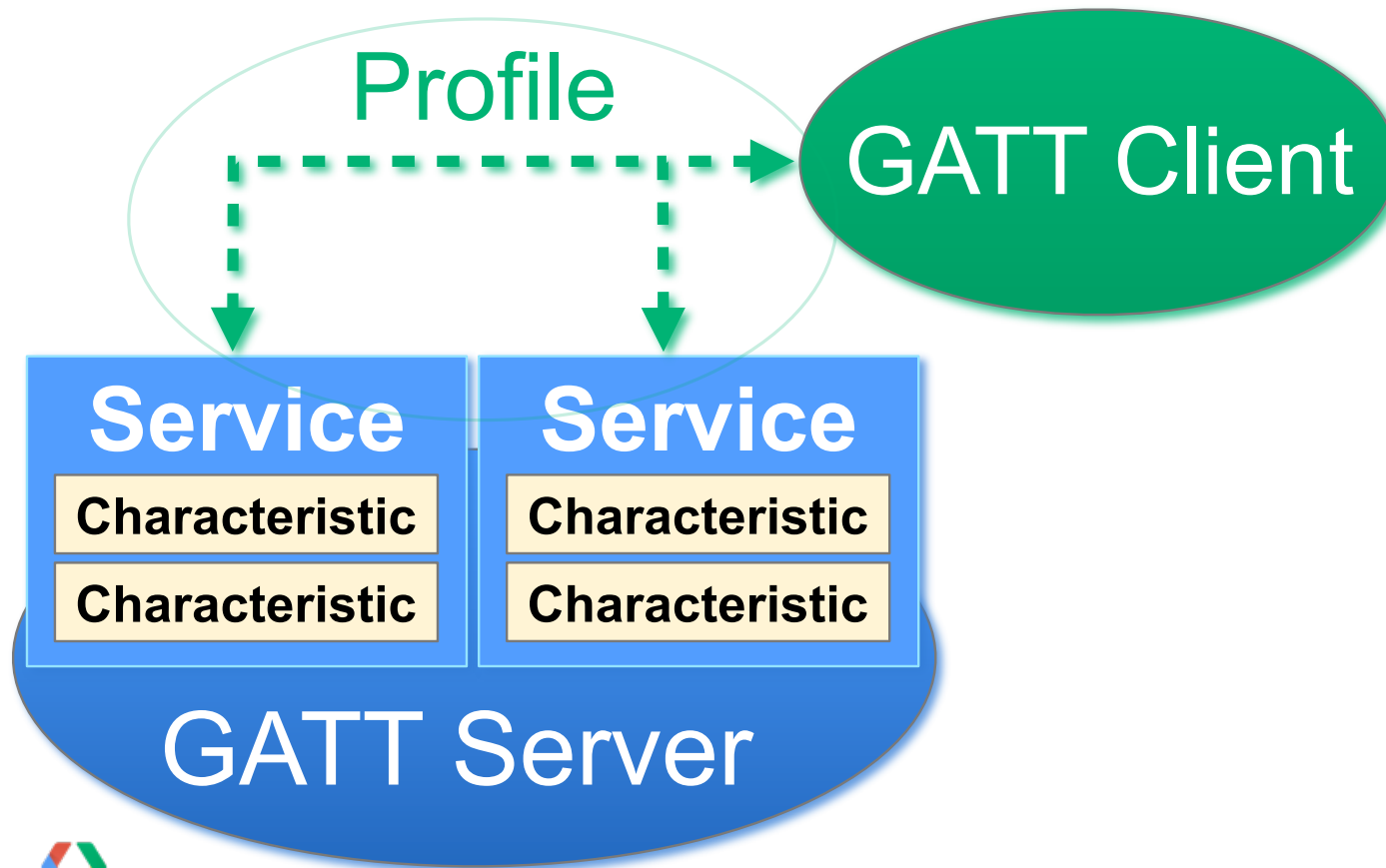
Descriptor



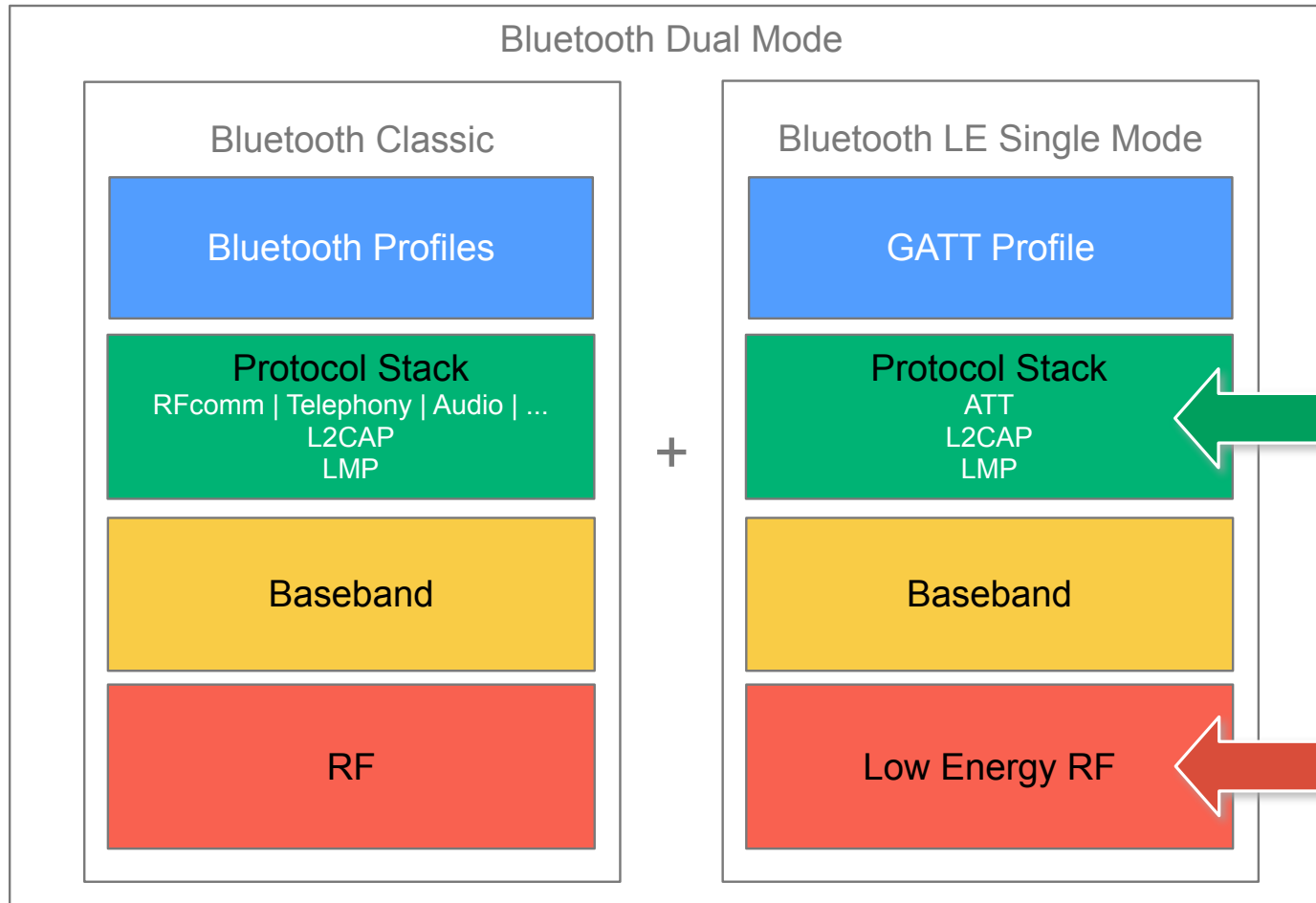
BLE Terminology: GATT services



BLE Terminology: GATT Profiles



Bluetooth v4 Core Specification Layers



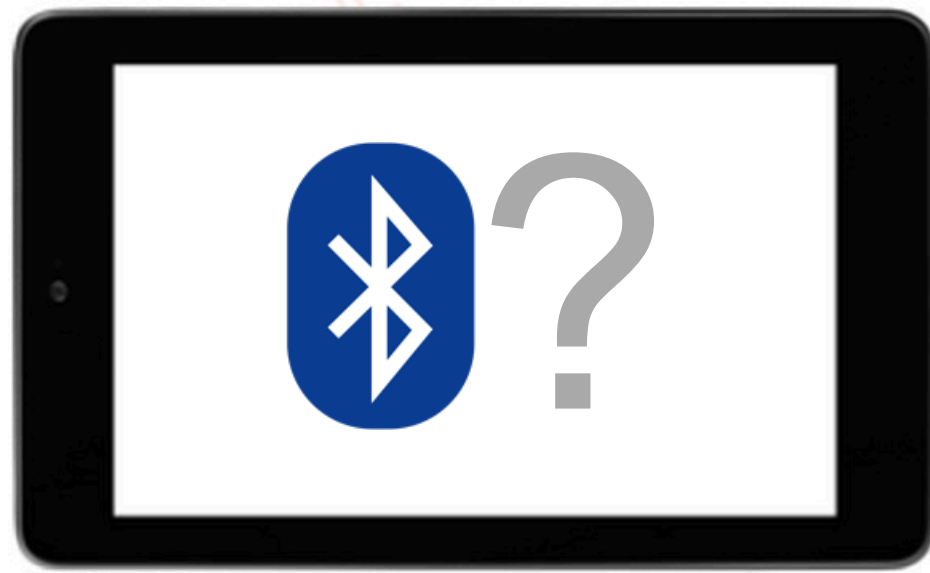


best practices



Bluetooth Low Energy





Does the device have Bluetooth?

```
BluetoothManager manager = context.getSystemService(Context.BLUETOOTH_SERVICE);  
BluetoothAdapter mBluetoothAdapter = manager.getAdapter();  
if (mBluetoothAdapter == null) {  
    // Device does not support Bluetooth  
}
```



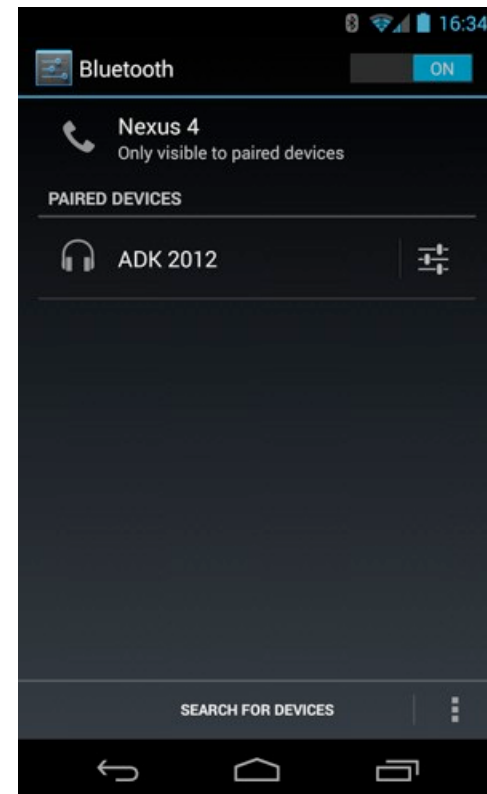
Bluetooth Best Practices

Is this thing on?

An app wants to turn on Bluetooth.

Deny

Allow



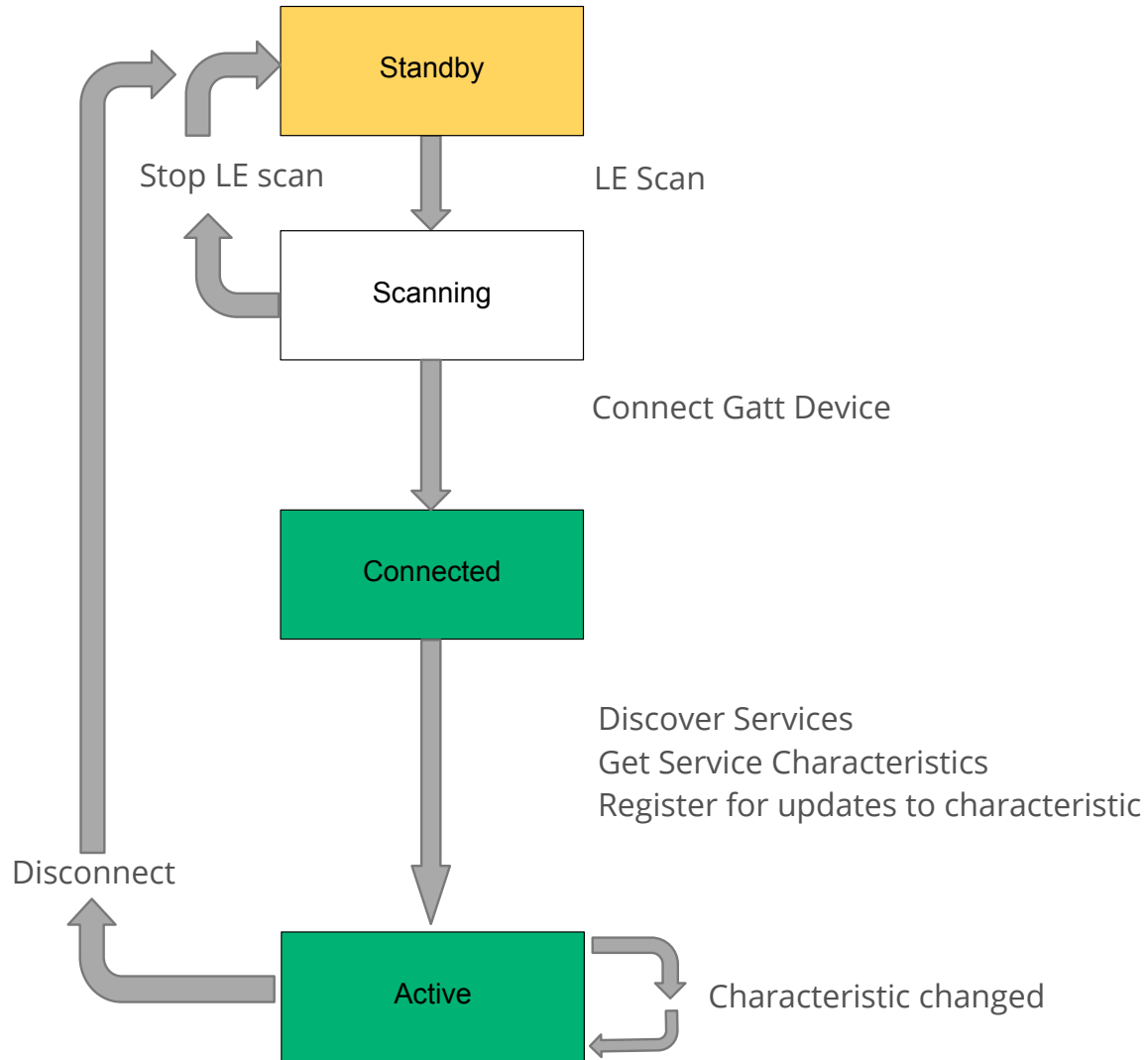
Is Bluetooth on?

```
if (!mBluetoothAdapter.isEnabled()) {  
    Intent enableBtIntent = new Intent(BluetoothAdapter.ACTION_REQUEST_ENABLE);  
    startActivityForResult(enableBtIntent, REQUEST_ENABLE_BT);  
}
```





BLE Flow



Scanning for BLE Devices

```
mBluetoothAdapter.startLeScan(mLeScanCallback);

private BluetoothAdapter.LeScanCallback mLeScanCallback
    = new BluetoothAdapter.LeScanCallback() {
    public void onLeScan(final BluetoothDevice device, int rssi, byte[] scanRecord) {
        // handle discovered device
    }
};
```



Scanning for BLE Devices

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mBluetoothAdapter.startLeScan(mLeScanCallback);

private BluetoothAdapter.LeScanCallback mLeScanCallback
    = new BluetoothAdapter.LeScanCallback() {
    public void onLeScan(final BluetoothDevice device, int rssi, byte[] scanRecord) {
        // handle discovered device
    }
};
```



Connecting to an LE Device

```
BluetoothGatt mBluetoothGatt = device.connectGatt(this, false, mGattCallback);

private final BluetoothGattCallback mGattCallback = new BluetoothGattCallback() {
    public void onConnectionStateChange(BluetoothGatt gatt, int status, int newState) {}
    public void onServicesDiscovered(BluetoothGatt gatt, int status) {}
    public void onCharacteristicRead(BluetoothGatt gatt, BluetoothGattCharacteristic, int status) {}
    public void onCharacteristicChanged(BluetoothGatt gatt, BluetoothGattCharacteristic) {}
};
```



Connecting to an LE Device

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BluetoothGatt mBluetoothGatt = device.connectGatt(this, false, mGattCallback);

private final BluetoothGattCallback mGattCallback = new BluetoothGattCallback() {
    public void onConnectionStateChange(BluetoothGatt gatt, int status, int newState) {}
    public void onServicesDiscovered(BluetoothGatt gatt, int status) {}
    public void onCharacteristicRead(BluetoothGatt gatt, BluetoothGattCharacteristic, int status) {}
    public void onCharacteristicChanged(BluetoothGatt gatt, BluetoothGattCharacteristic) {}
};
```



Read/Write LE attributes

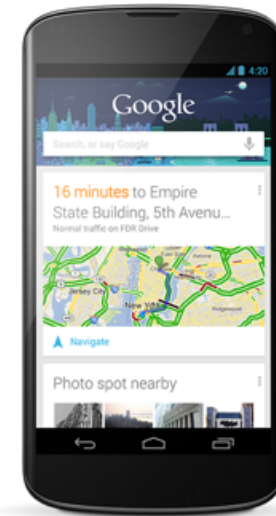
```
for (BluetoothGattService service : services) {  
    List<BluetoothGattCharacteristic> characteristics = service.getCharacteristics();  
  
    for (BluetoothGattCharacteristic characteristic : characteristics) {  
        UUID uuid = characteristic.getUuid()  
        //if characteristic matches heart rate uuid  
  
        mBluetoothGatt.setCharacteristicNotification(characteristic, enabled);  
    }  
}  
  
public void onCharacteristicChanged(BluetoothGatt gatt, BluetoothGattCharacteristic) {}
```



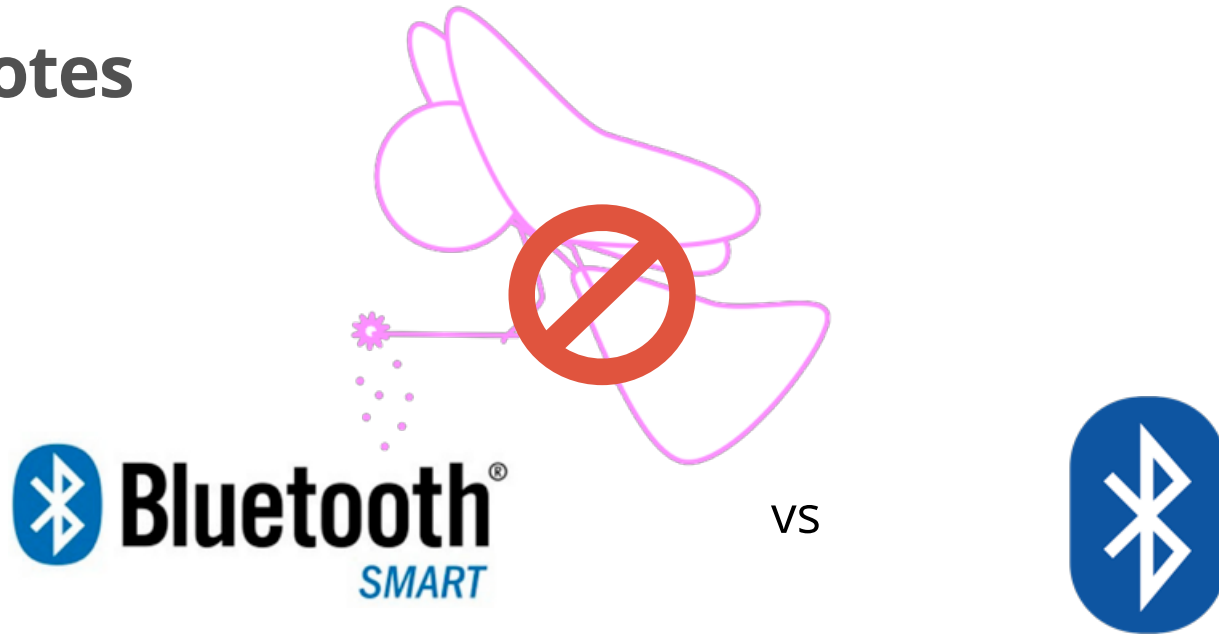
BLE Notes

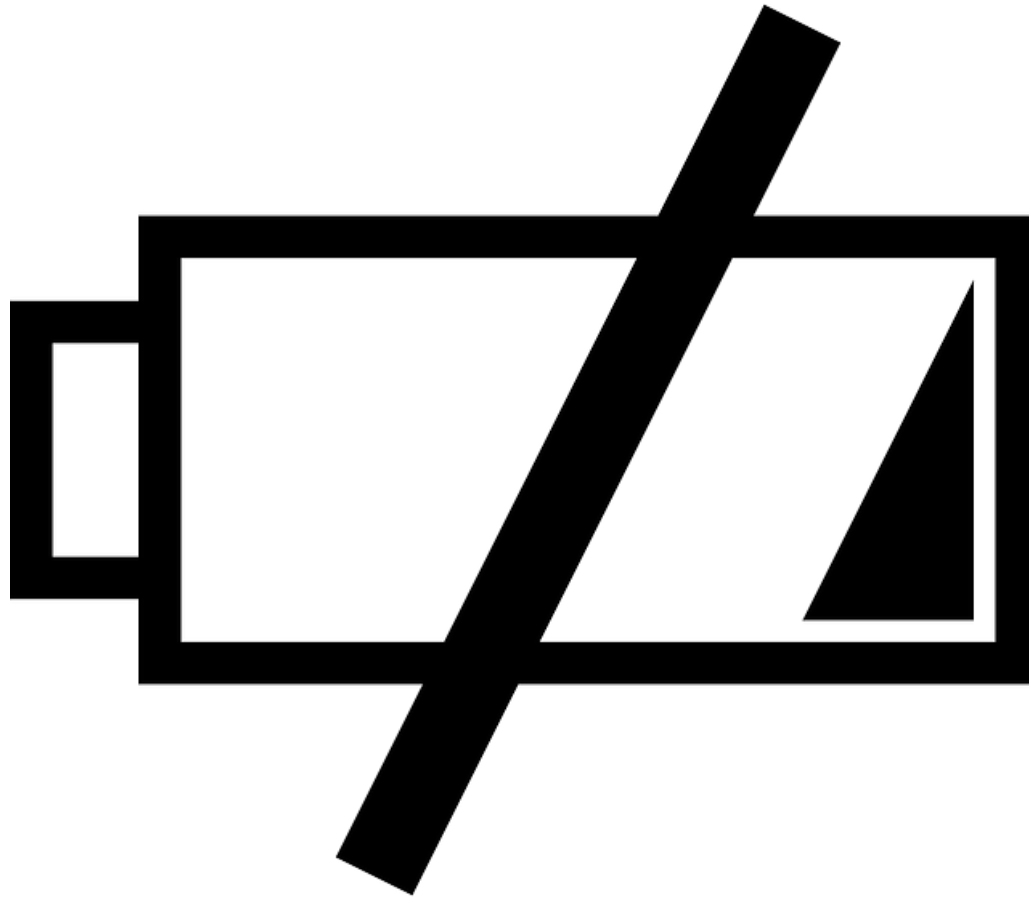


BLE Notes



BLE Notes









NfcAdapter.[setBeamPushUri](#) ()

NfcAdapter.CreateBeamUriCallback



(In)secure Rfcomm



`BluetoothAdapter.listenUsingRfcommWithServiceRecord(...)`

`BluetoothDevice.createRfcommSocketToServiceRecord(...)`

`BluetoothAdapter.listenUsingInsecureRfcommWithServiceRecord(...)`

`BluetoothDevice.createInsecureRfcommSocketToServiceRecord(...)`





one last thing.....



AVRCP MetaData

```
RemoteControlClient rcc = audioManager.registerRemoteControlClient(remoteControlClient);
RemoteControlClient.MetadataEditor metaDataEditor = rcc.editMetaData();

metaDataEditor.clear();
metaDataEditor.putBitmap(int key, Bitmap bitmap);
metaDataEditor.putString(int key, String value);
metaDataEditor.apply();

// Keys enumerated in MediaMetadataRetriever e.g.
// MediaMetadataRetriever.METADATA_KEY_ALBUM
// MediaMetadataRetriever.METADATA_KEY_ARTIST
```



Coming soon...

- Bluetooth Low Energy is coming to Android!
 - In API 18, landing in a few short months
 - ... along with AVRCP 1.3
- Questions? → Android Office Hours in 15 minutes
- Find out more:
 - <http://developer.android.com/guide/topics/connectivity/bluetooth.html>



<Thank You!>

+Sara Sinclair Brody
+Rich Hyndman
+Matthew Xie





Google
Developers