

Advanced BLE Programming on Android.

-----*Vincent Gao, Bluetooth SIG* *May. 2014*



Agenda

- Bluetooth Low Energy.
 - Overview of the protocol.
- Programming BLE on Android.
 - From level 17 to level 22
 - Implementation of different roles.
 - Security and Privacy.
- Bluetooth 4.2 and Android M.
- Case Study.
- `<uses-feature
android:name="android.hardware.bluetooth_le"
android:required="true"/>`

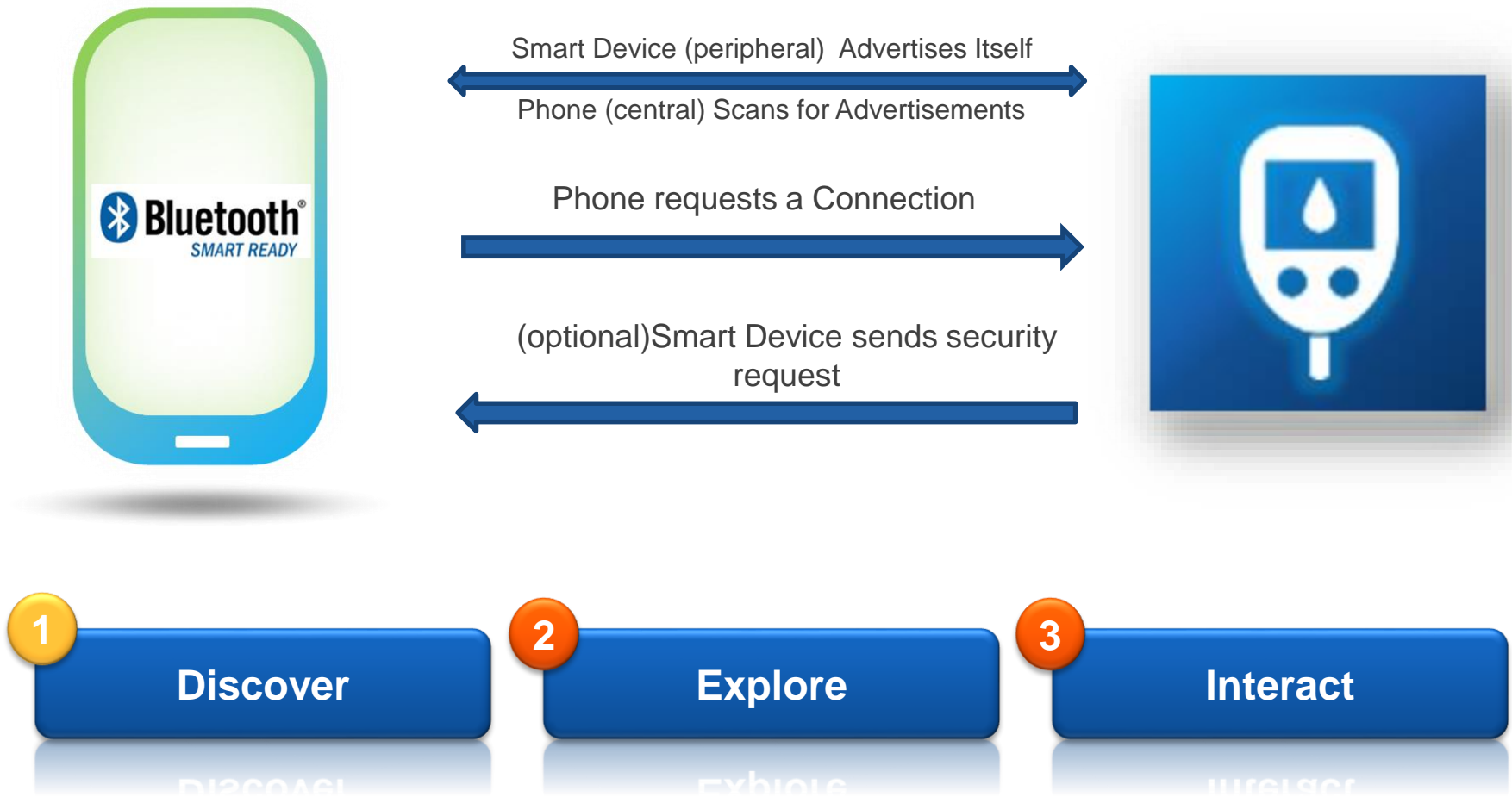
Why is BLE getting popular now...

Developers need **Connectivity + Low Power** for:

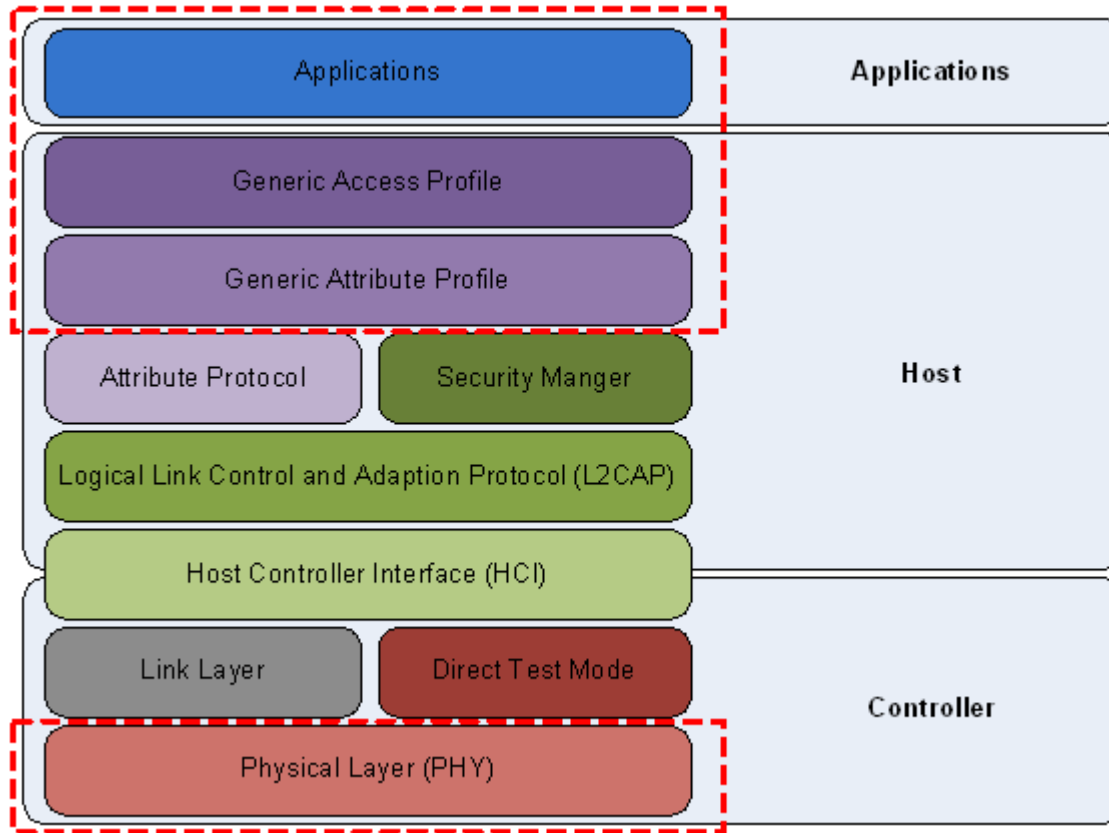
- IoT/Smart Devices
- Wearables.
- Accessories.

Bluetooth LE is low-power and available on most of the phones.

Typical Bluetooth Application Flow



Bluetooth Low Energy



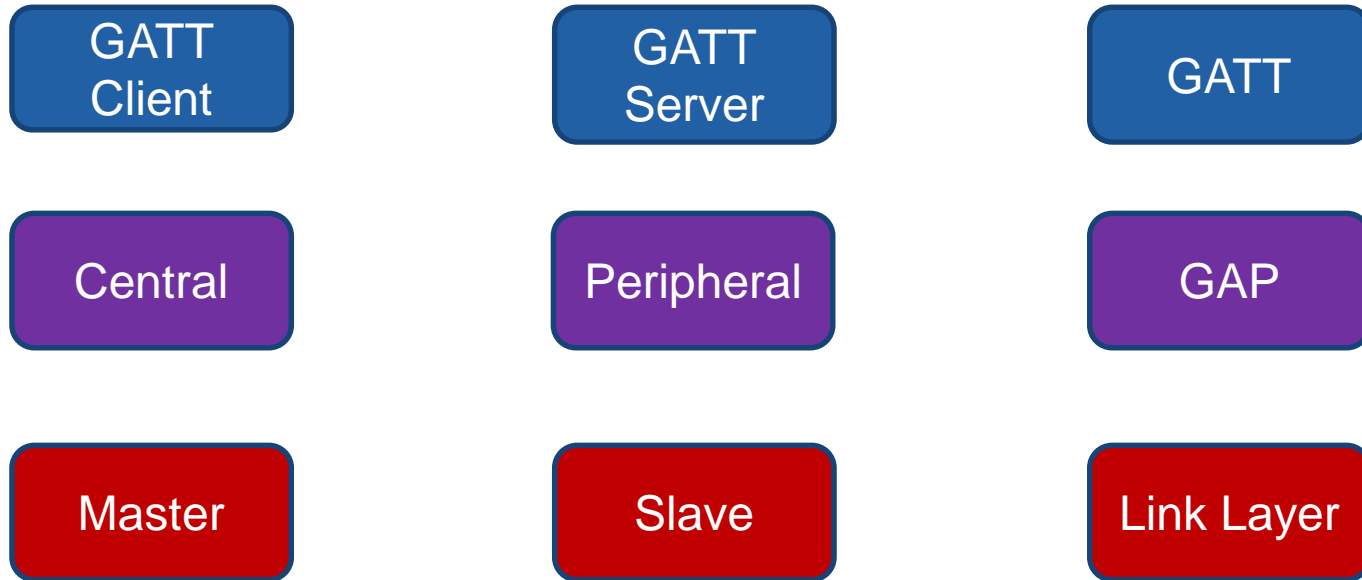
GAP--Central: Peripheral

GATT--Client : Server

LL--Master: Slave

GAP/GATT/Roles

- What does this mean to developers?



Roles

- ▶ Advertiser
- ▶ Scanner
- ▶ Broadcaster
- ▶ Observer
- ▶ Dual roles

Data and State

- Organized in the profile form.
- Adopted profiles and Custom profiles.
- What's in a profile.
 - A profile is a group of services.
 - A service is a group of Characteristics and Descriptors.
 - A service could include other services.
- Attribute is the basic data unit.
- Handle/UUID as the identifier. (getInstanceID)

Questions on BLE?

Programming BLE on Android

...from level 17 to level 22.

- Ver 4.2 Level 17—from BlueZ to BlueDroid.
- Ver 5.0 Level 21 –added GAP.
- Spec vs. Implementation.
- Known issues and gotchas
 - Feature set varies on different devices.
 - Documentation is behind.
 - Mixed GAP and GATT.

You still need to do this...

- ▶ Detect the correct stack and API

```
if(Build.MANUFACTURER.equalsIgnoreCase("samsung"))  
{  
    if(Build.VERSION.SDK_INT == 19)  
    {  
        apiVersion = BleConstant.OFFICIAL_API;  
    }  
}
```

...

```
Intent startCorrectBleApi = new Intent(getApplicationContext(),  
OfficialBLEService.class);
```

Programming BLE ----BluetoothLeScanner

...start from the basic scanning.

`startScan(List<ScanFilter> filters, ScanSettings settings, ScanCallback callback)`

- New package(`android.bluetooth.le`) in level 21

Or

`BluetoothManager` → `BluetoothAdaptor` → `startLeScan`

Programming BLE ----BluetoothLeScanner

- Scan filters.
 - setAddress
 - setName
 - setManufacturerData
 - setServiceData
 - setServiceUuid
 - Set mask

Programming BLE ----BluetoothLeScanner

- ScanSettings.
 - setScanMode
 - SCAN_MODE_LOW_POWER (default)
 - SCAN_MODE_BALANCED
 - SCAN_MODE_LOW_LATENCY

Programming BLE ----BluetoothLeScanner

...more on scanning.

- Scanning in the background.
- Multiple scanners in the background.
- Scanning services.
- Multiple scanning services.
- Connection parameters

Programming BLE on Android ----

BluetoothLeAdvertiser

...start from a basic advertising.

```
startAdvertising(AdvertiseSettings settings,  
AdvertiseData advertiseData,  
AdvertiseCallback callback)
```

- Advertising in the background.
- Multiple advertisers in the background.
- Advertising services.
- Multiple advertising services.

Programming BLE on Android ----Advertiser

...more on advertising.

- “...HAL-enabled feature.”
- `BluetoothAdapter.isMultipleAdvertisementSupported()`

Programming BLE ----BluetoothLeAdvertiser

- AdvertiseSettings.
 - setAdvertiseMode.
 - ADVERTISE_MODE_LOW_POWER (default)
 - ADVERTISE_MODE_BALANCED
 - ADVERTISE_MODE_LOW_LATENCY
 - setConnectable
 - setTimeout.
 - setTxPowerLevel
 - High
 - Medium
 - Low
 - Ultra-Low

Programming BLE ----BluetoothLeAdvertiser

- AdvertiseData.
 - addManufacturerData
 - addServiceData
 - addServiceUuid
 - setIncludeDeviceName
 - setIncludeTxPowerLevel

Programming BLE on Android ----GATT

- public BluetoothGatt connectGatt (Context context, boolean autoConnect, BluetoothGattCallback callback)
- getService(UUID uuid)
- readCharacteristic(BluetoothGattCharacteristic characteristic)
- readDescriptor(BluetoothGattDescriptor descriptor)
- setCharacteristicNotification(BluetoothGattCharacteristic characteristic, boolean enable)
 - onCharacteristicChanged

Programming BLE on Android ----GATT

android.bluetooth.BluetoothGatt

- **requestConnectionPriority**(int connectionPriority)
 - Balanced, High, Low_Power
 - Conn_Interval, Conn_Latency
- Concurrent connections.
- GATT and GAP are still coupled.

Programming BLE on Android ----GATT

- BluetoothGattServer—since level 17
- Add/Clear services
- Connect/cancelConnection
- Bluetoothmanager.OpenGattServer
- notifyCharacteristicChanged
- sendResponse

Programming BLE on Android ----Privacy

- Bluetooth Privacy.
 - BD_Addr;
 - Random Address
- Adv_Addr

Programming BLE on Android ----Security

- Bluetooth Security.
- PERMISSION_READ_ENCRYPTED
- PERMISSION_READ_ENCRYPTED_MITM
- PERMISSION_WRITE_SIGNED
- GATT_INSUFFICIENT_AUTHENTICATION
 - ```
if (gatt.getDevice().getBondState() ==
BluetoothDevice.BOND_NONE) {
```
  - ```
    mCallbacks.onBondingRequired();
```
 - ```
 BluetoothDevice.createBond
```
- Permission vs. Property.



# Bluetooth 4.2 and onward...

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What's new in Bluetooth core spec 4.2.

- Security
- Privacy
- Data packet length.

Android M:

`android.bluetooth.le.ScanSettings.Builder.setCallbackType()`

For those who match the scanfilter.

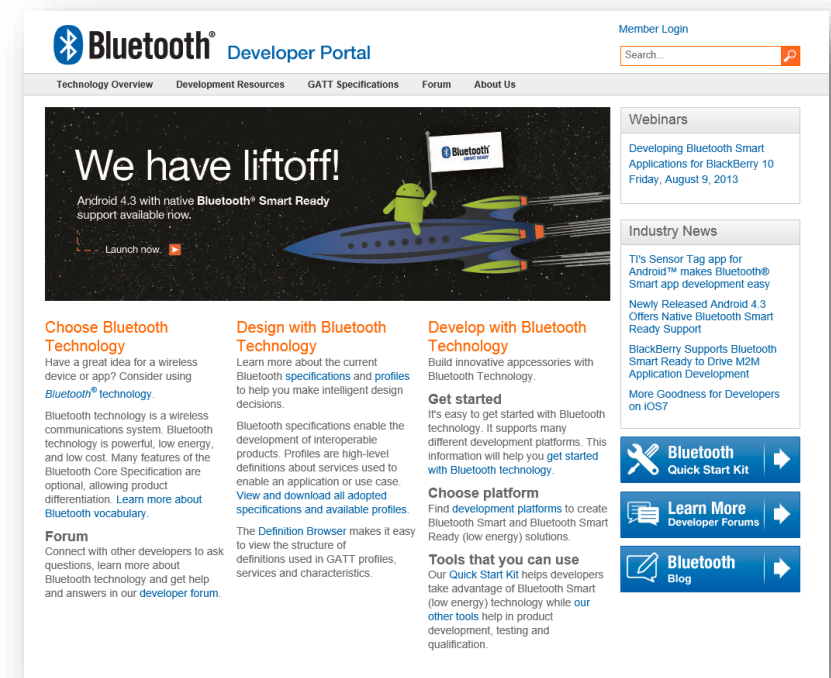
# Case study: RSSI

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- RX vs RSSI

# Resources on the Portal

- Knowledge Center
  - White papers
  - Training Videos
- Development Resources
  - Quick Start Kit
  - Application Accelerator
  - Platform availability for Smart and Smart Ready
  - Recorded webinars on development topics
  - Links to SIG tools (PTS, etc.)
- Forums
- GATT specifications



<http://developer.bluetooth.org>

# Questions:

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- Bluetooth Developer Forum
- [vgao@bluetooth.com](mailto:vgao@bluetooth.com)