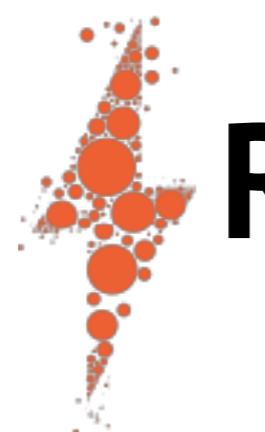


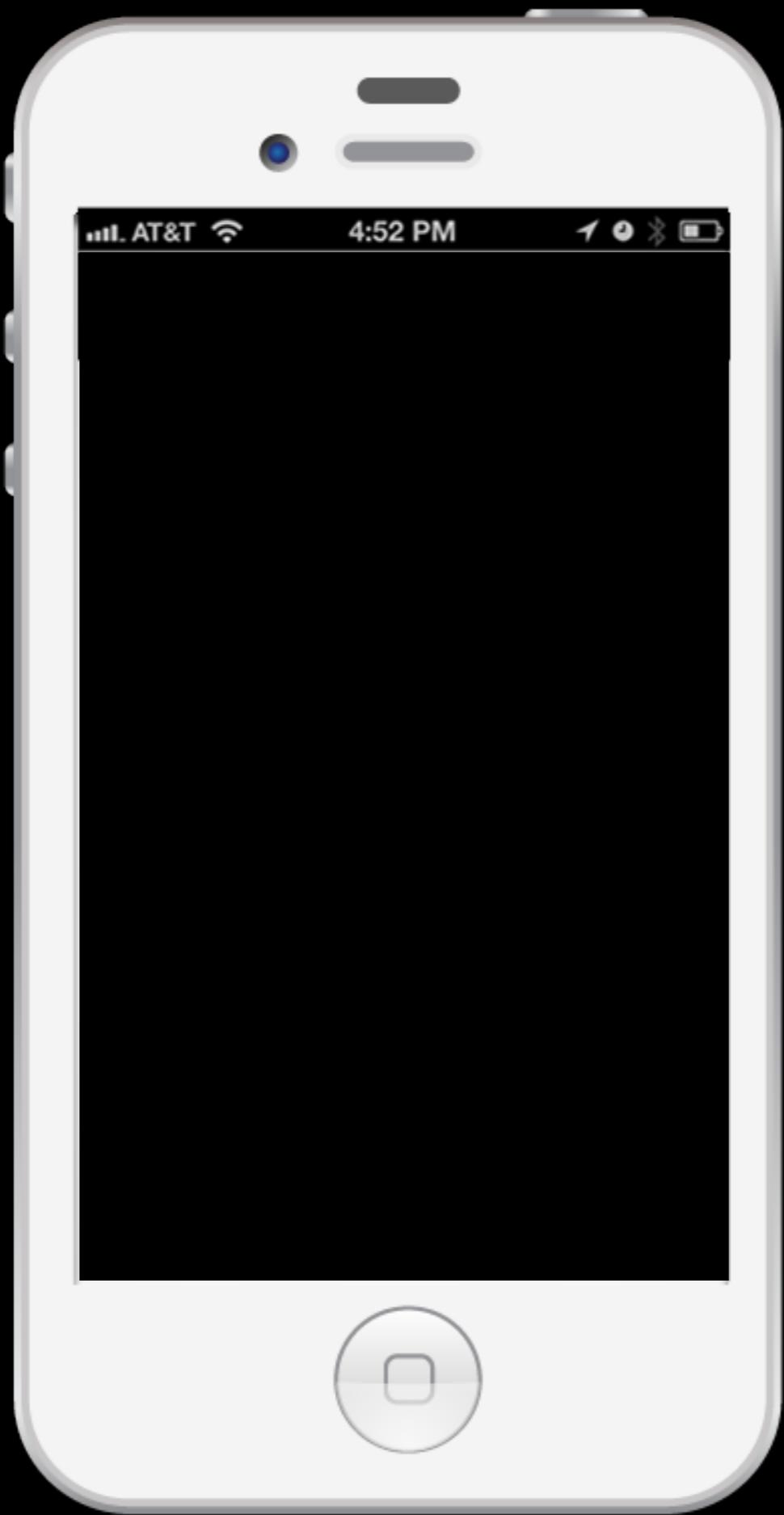


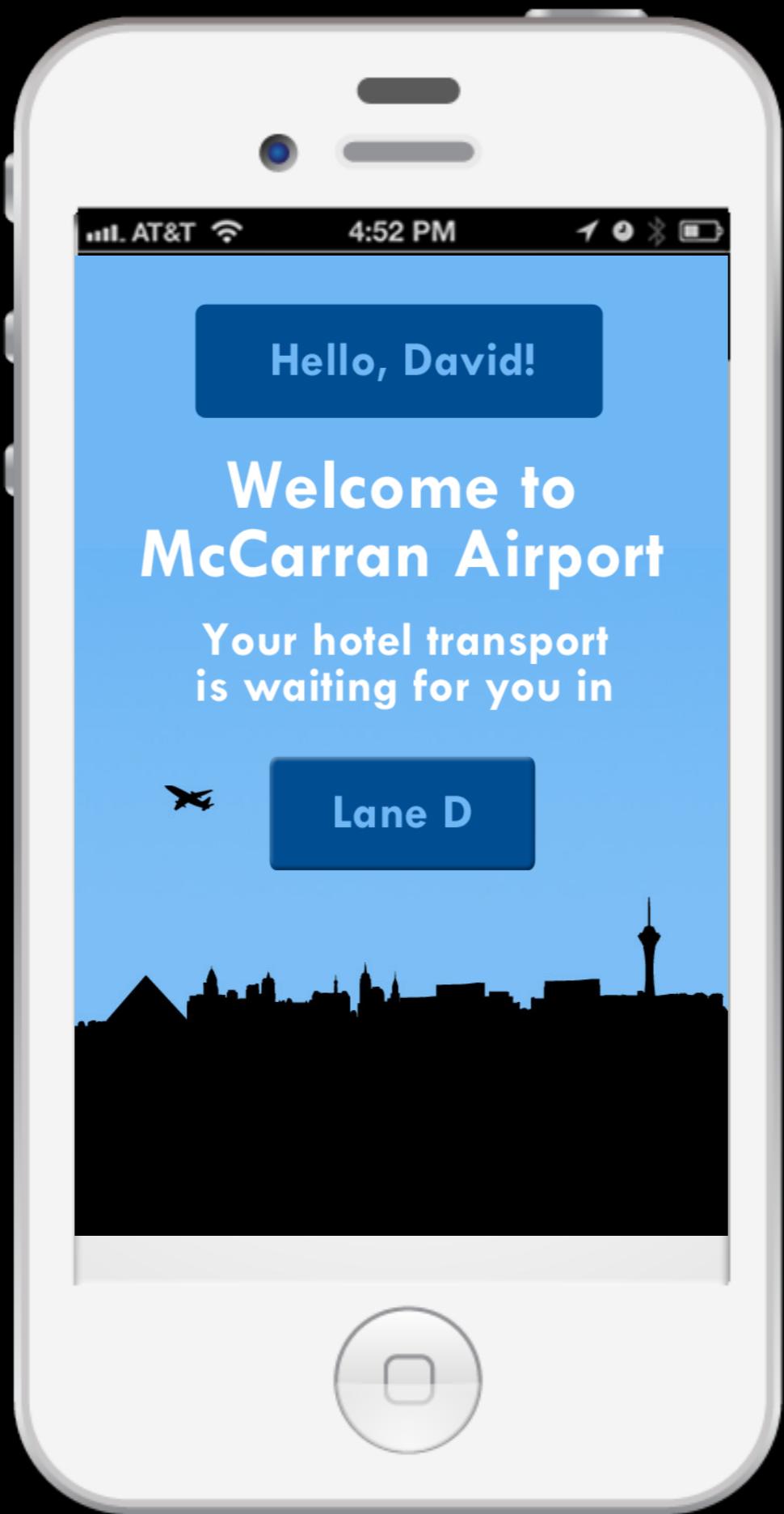
iBeacon Essentials

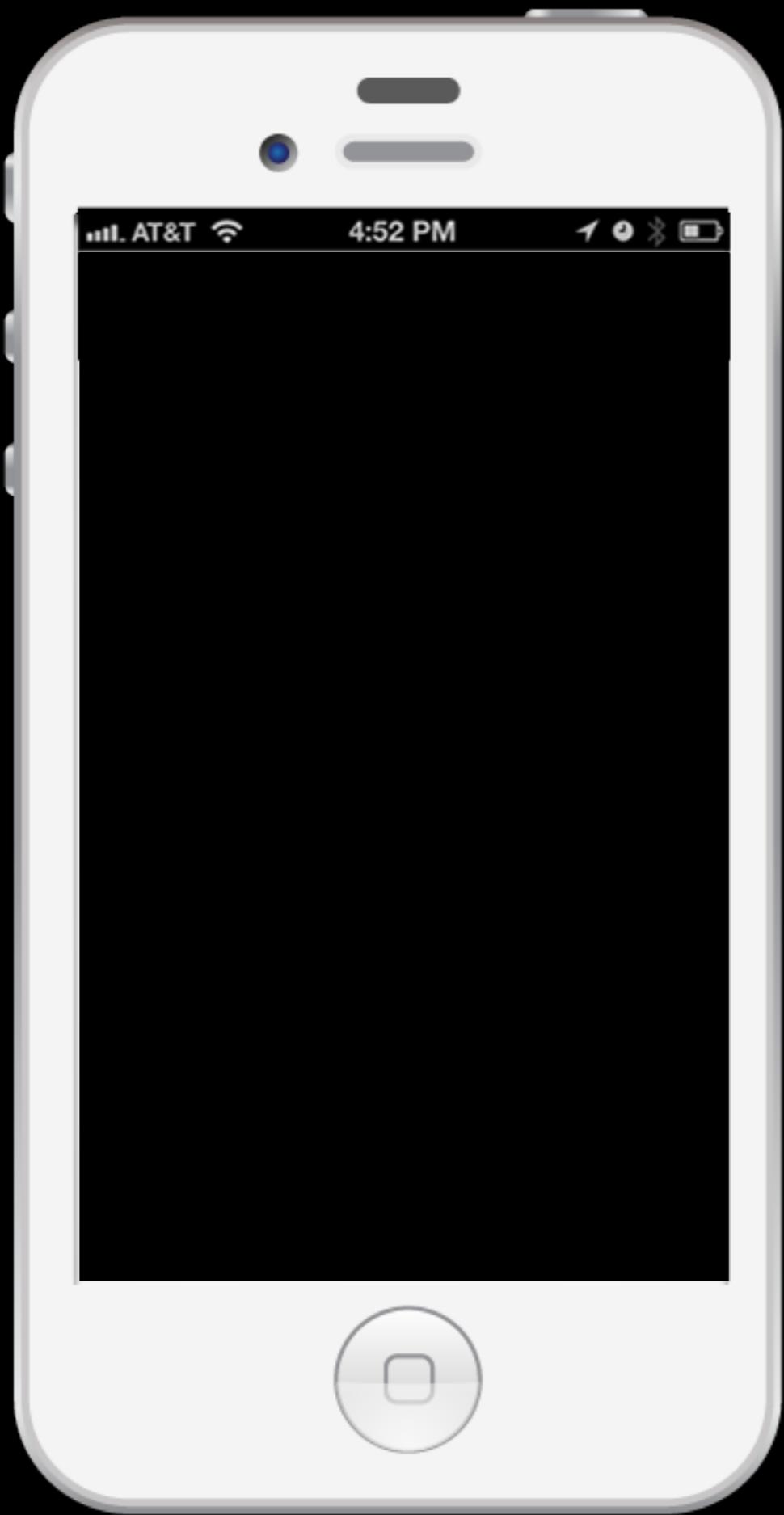


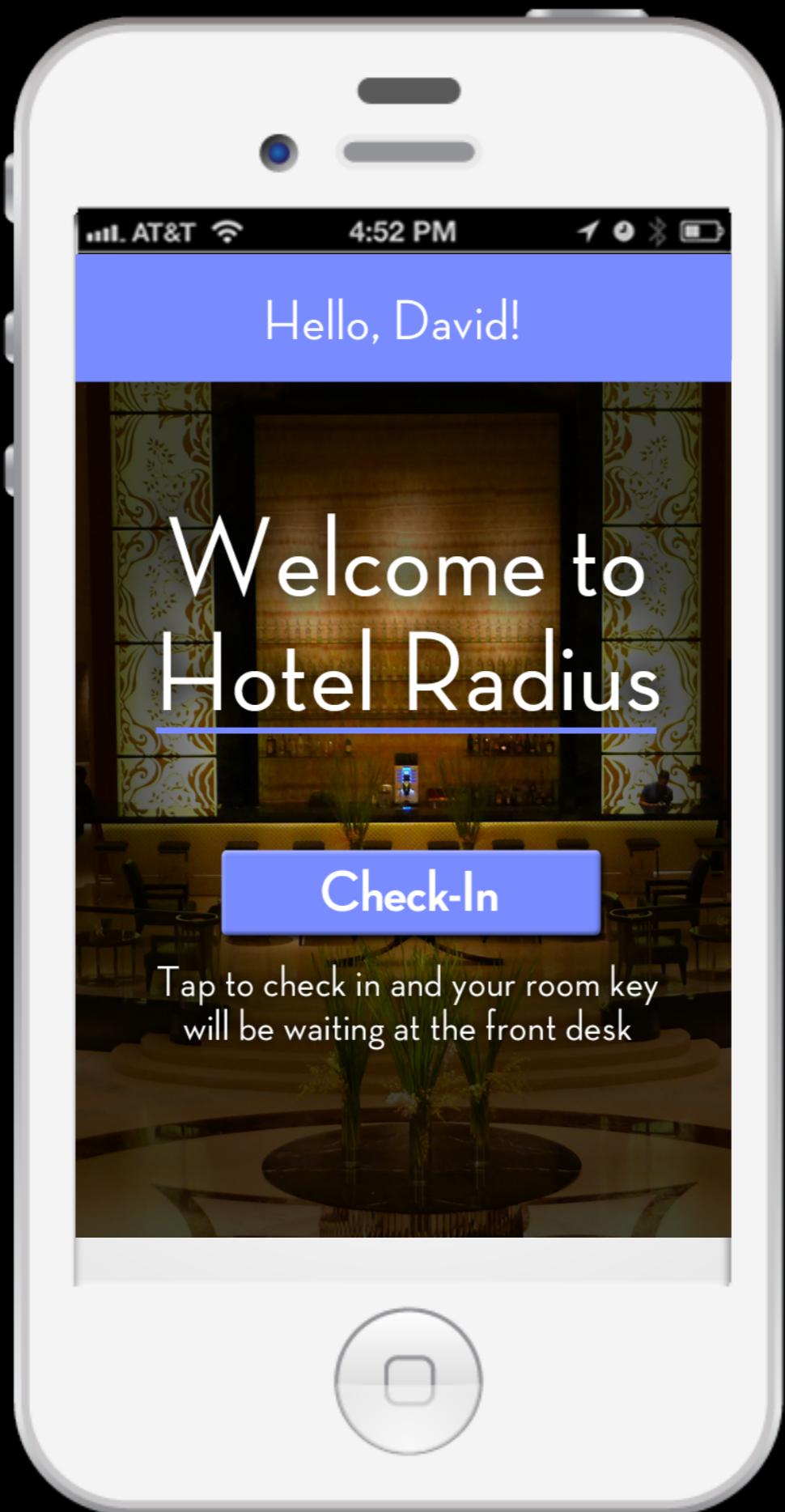
Radius Networks

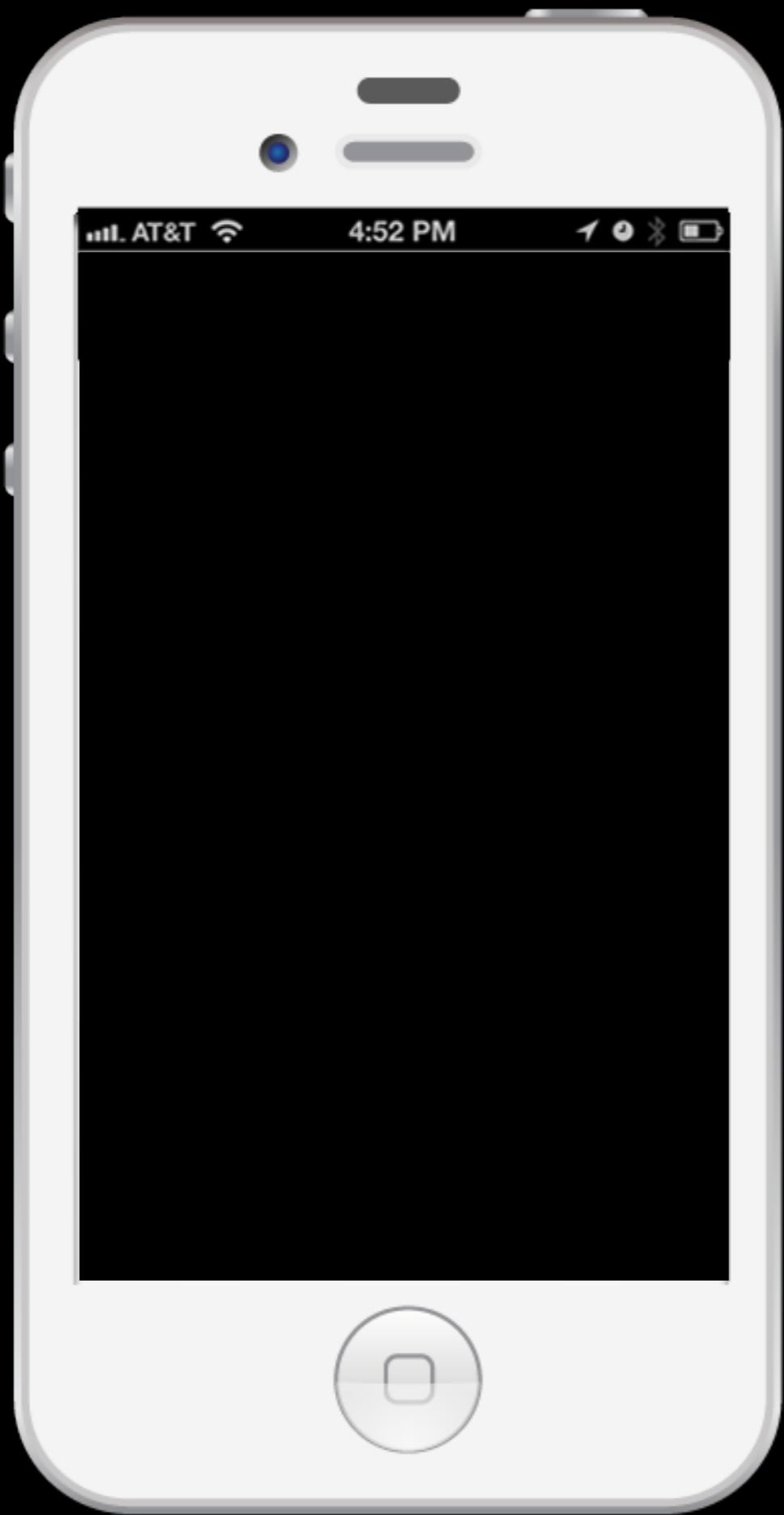
CES 2015
(the near future)











AT&T

4:52 PM

Welcome to the
2015
International CES

CES

You have 2
colleagues in:

LVCC Ballroom

Introduction: What you'll see

- ★ See iBeacon varieties
- ★ Learn how iBeacons work
- ★ Demos of iBeacons in action - you can participate!
- ★ Learn to build iBeacon apps



Radius Networks

Introduction: About Radius Networks

- ◆ Proximity Services Company
- ◆ iBeacon Sales
- ◆ Rich iBeacon web service provider
- ◆ Dev tools for iBeacons, many free
- ◆ Open-source Android iBeacon Library development



Radius Networks

Introduction: About David Young



Chief Engineer at Radius Networks



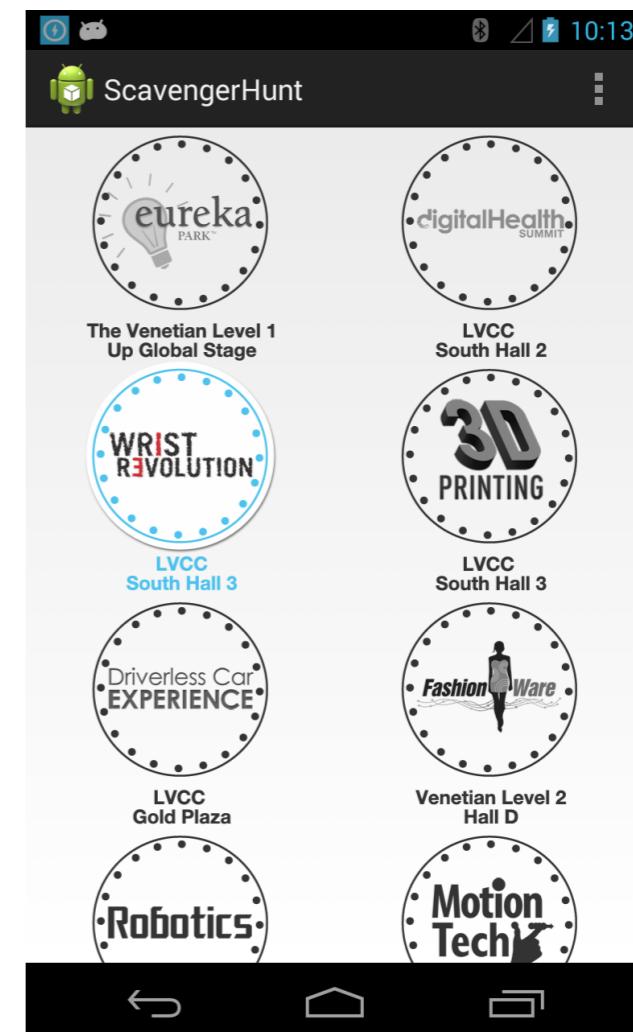
Android iBeacon Library author



Rev-engineered iBeacon profile



CES Scavenger Hunt
iOS/Android App Developer
(inspired Android iBeacon Library)

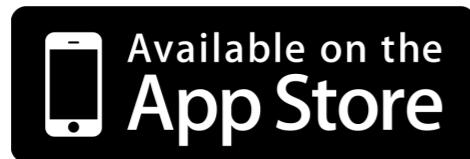


Radius Networks

Introduction: Get the App



iOS 7 users with iPhone 4S+, iPad 3+



Locate for iBeacon



Android 4.3 users w/ phone < 1yr old



iBeacon Locate



Make sure Bluetooth is turned on!



Radius Networks

iBeacon Essentials



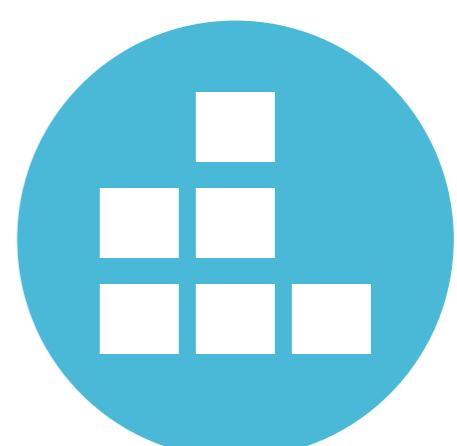
**What are
iBeacons?**



**How they
work**



**Using
iBeacons**



**Building
Apps**



Radius Networks



**What are
iBeacons?**

What are iBeacons?

- ◆ Extremely simple radio device
- ◆ Transmits Bluetooth LE signal
- ◆ Connectionless / transmit only



Radius Networks

What are iBeacons? - Bluetooth LE



Low Energy Bluetooth (BLE)

- Bluetooth 4.0 / “Bluetooth Smart”
- Peripheral Role (transmit), Central Role (listen)



iPhone 4S, iPad 3, Android 2013+



Less power, more reliable



Range of about 50 meters



What are iBeacons? - OS Support



iOS 7+

- Detect iBeacons, act as iBeacons



Android 4.3+

- Detect iBeacons
- Most Android phones will be capable by the end of the year,
CANNOT act as iBeacons



Mac, Linux, Windows

- Detect iBeacons, act as iBeacons



Radius Networks

What are iBeacons? - Form factors

- ⚡ Battery powered
- ⚡ USB Nub (USB power or A/C power adapter)
- ⚡ iOS (iPhone or iPad)
- ⚡ Specialized computer (e.g. Raspberry Pi)
- ⚡ Laptop Software (Mac, Linux, Windows)



Radius Networks

What are iBeacons? - iOS choice



PRO: Lowest cost, if iOS device present
- [Locate for iBeacon App \(FREE\)](#)



CON: iBeacon must be in foreground

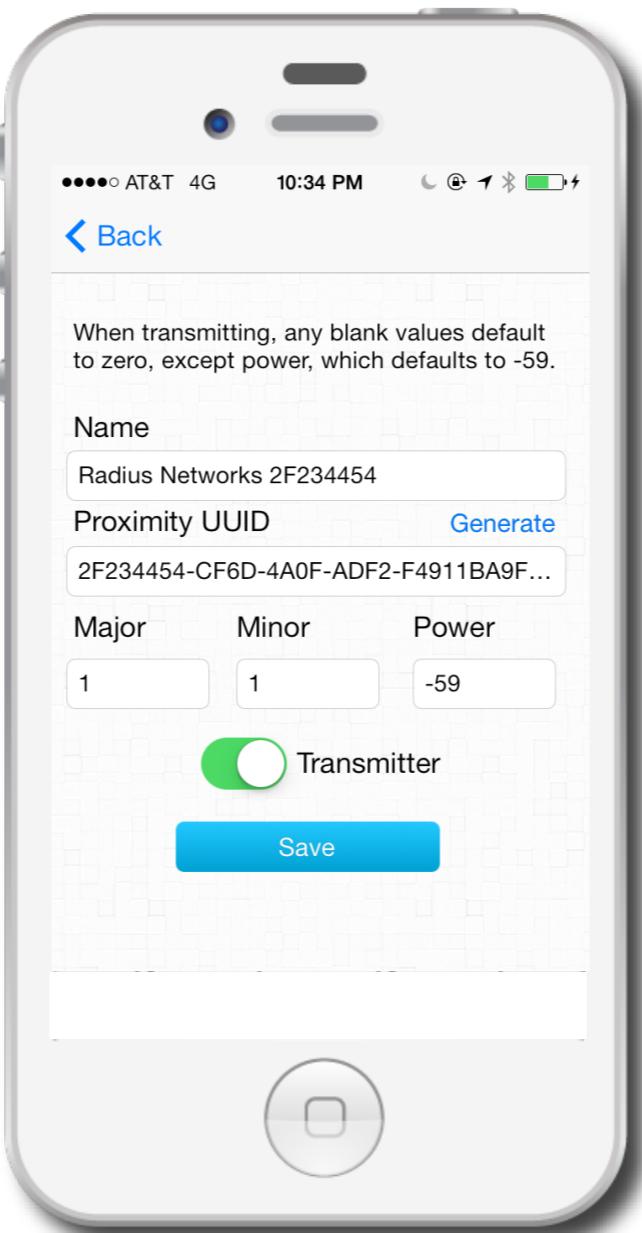


CON: must keep iPad/iPhone powered



Radius Networks

What are iBeacons? - iOS choice



Radius Networks

What are iBeacons? - Laptop choice



PRO: Low cost, if computer present

- [MacBeacon](#) (\$10), [Virtual Machine](#) (free)



PRO: iBeacon app runs in background

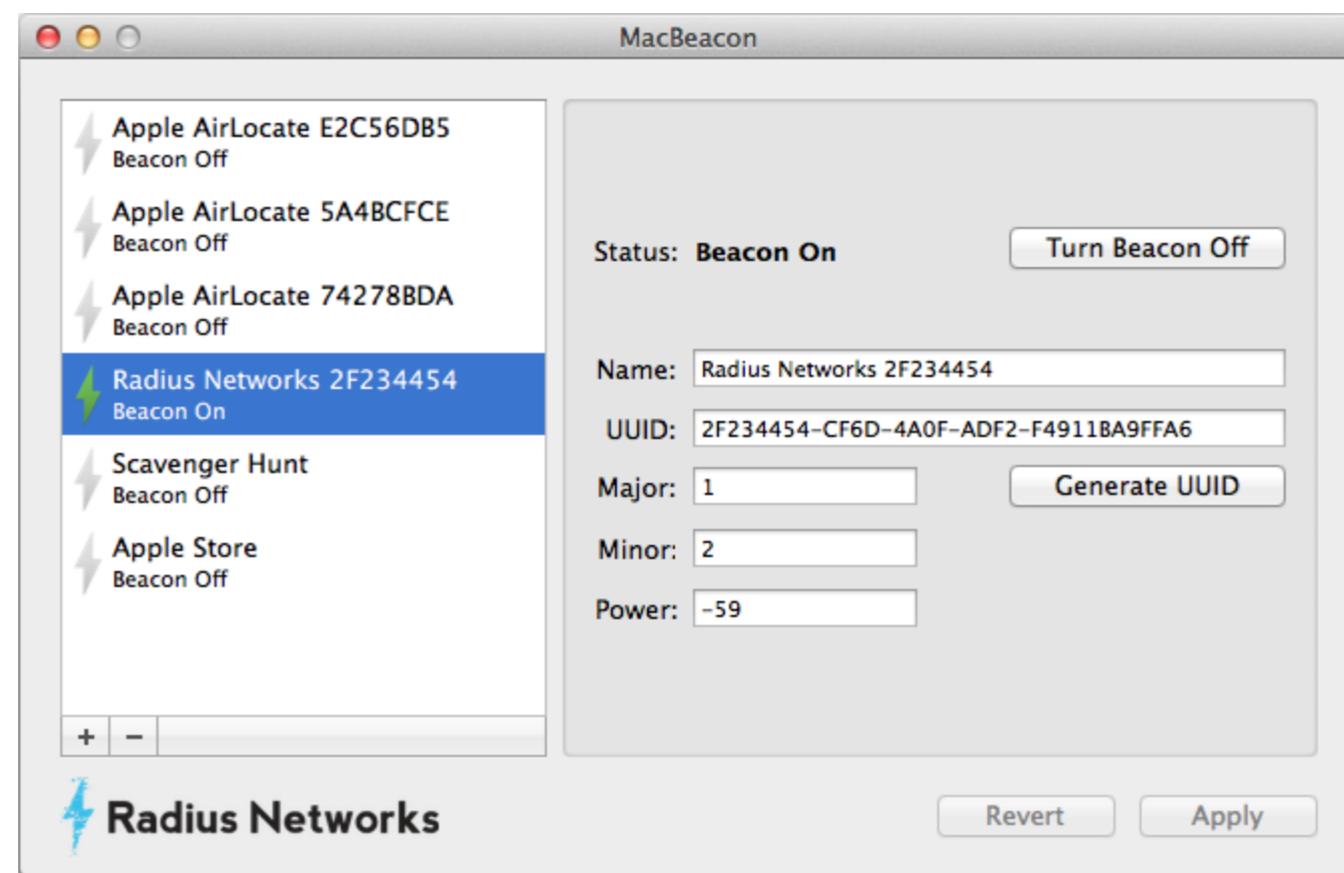


CON: Computer can lock up



Radius Networks

What are iBeacons? - Laptop choice



Radius Networks

What are iBeacons? - Powered choice



USB Nub or Dedicated Computer

- RadBeacon (USB Power, \$49)
- [iBeacon Dev Kit](#) (AC Power, \$99)



PRO: Maintenance Free



CON: Must have USB or A/C power



Radius Networks

What are iBeacons? - Battery choice

- ⚡ Various Models (\$30-\$60)
- ⚡ PRO: Total flexibility of placement
- ⚡ CON: Battery **will** run out - be skeptical of manufacturer claims. Use only if you have to!



Radius Networks



How iBeacons Work

How iBeacons work - Basics



Constant Bluetooth LE transmission

- “advertisement” sent once per second or more

Three part identifier in advertisement

- Org-specific “proximity UUID” (e.g. 2F234454-CF6D-4A0F-ADF2-F4911BA9FFA6)
- Site-specific “major” id (0-65535)
- Location-specific “minor” id (0-65535)



RSSI (signal strength)

- RSSI @1m calibration constant embedded in advertisement
- Enables rough estimate of distance from phone to iBeacon



Radius Networks

How iBeacons work - What they do

- ★ Tell iOS/Android devices they're nearby
- ★ Allow devices to uniquely identify them
- ★ Allow devices to estimate their distance

THAT'S ALL THEY DO!



Radius Networks

How iBeacons work - What they don't do



- Not anything without an app on a device
- Can't transmit, "Welcome to our store"
- Don't tell phone or tablet its lat/lon
- Can't tell what other devices are nearby
- Don't broker device-device communication



Radius Networks

How iBeacons work - building block

- Only a basic building block
- Can do **everything** mentioned above
with additional software / web services



Radius Networks



Using iBeacons

Using iBeacons - Two APIs



Monitoring

- are any iBeacons around?



Ranging

- which iBeacons are around?
- how far away are they?



Radius Networks

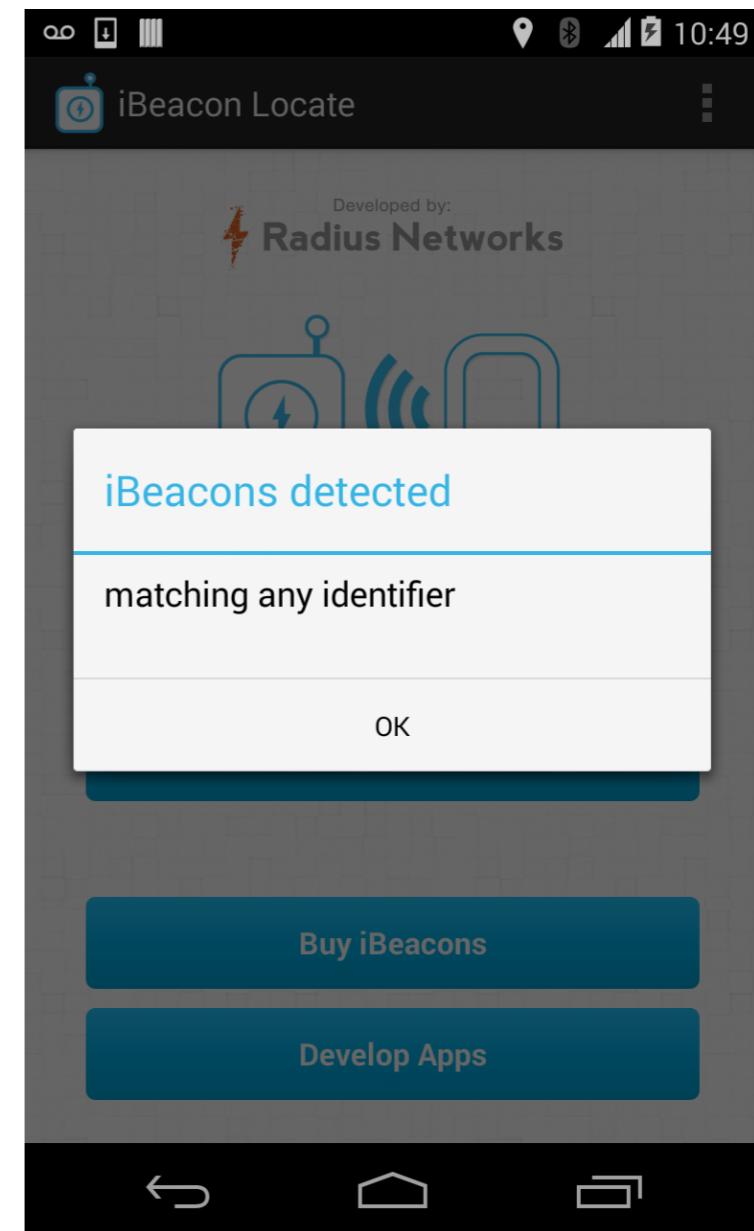
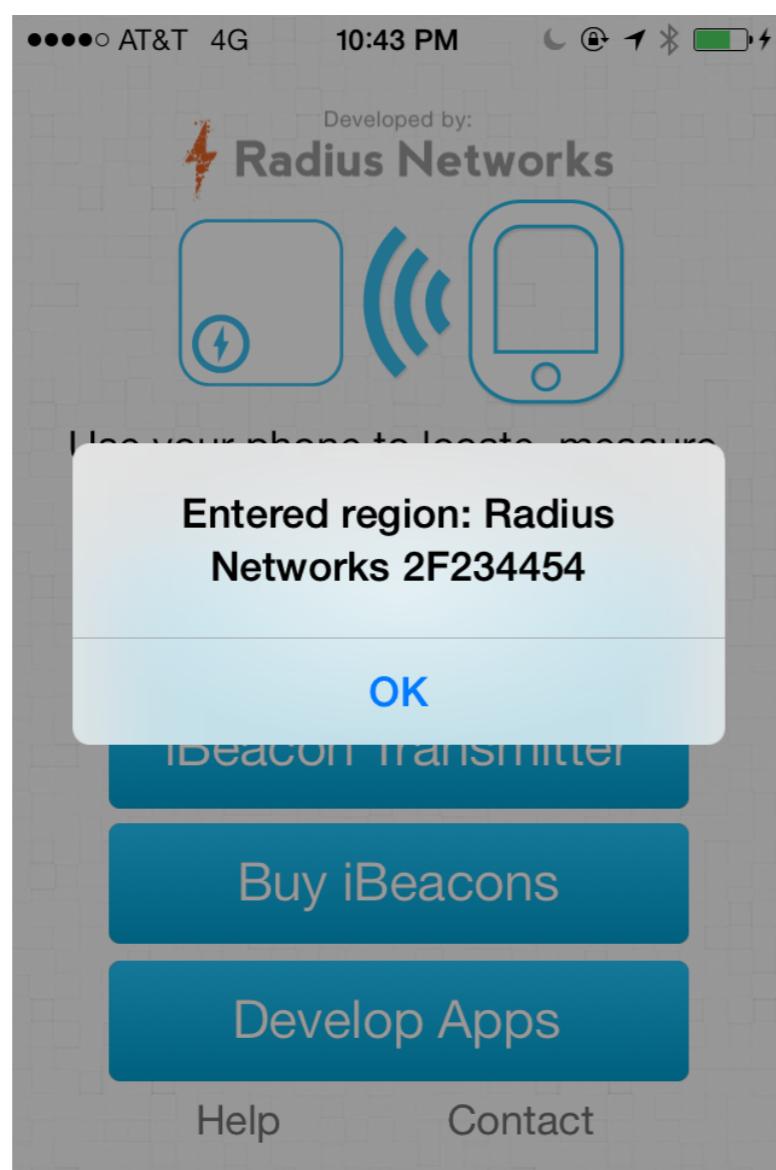
Using iBeacons - Monitoring

- ★ Tells phone when iBeacons are nearby
- ★ Works when app is in background or foreground
- ★ Does not tell you which iBeacon seen



Radius Networks

Using iBeacons - Monitoring Demo



Radius Networks

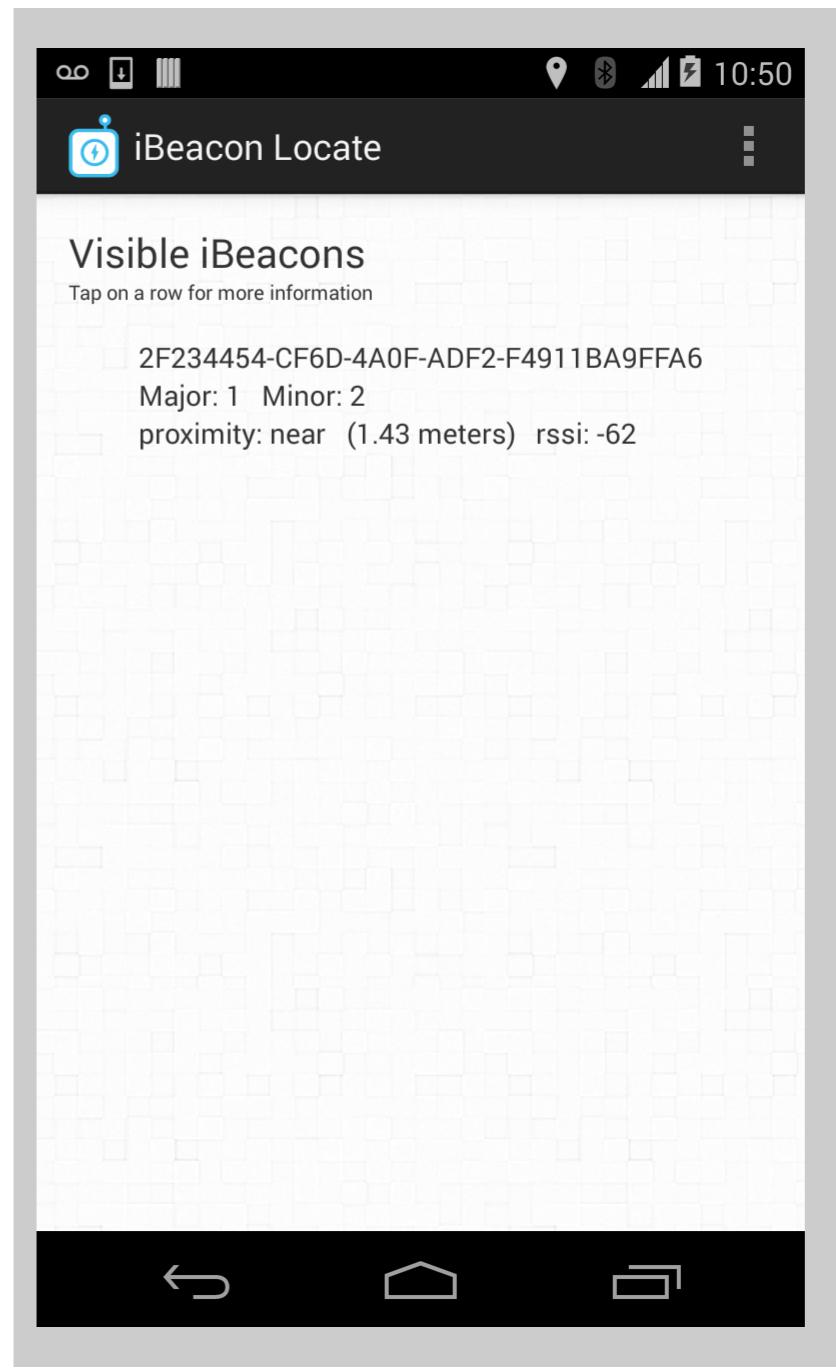
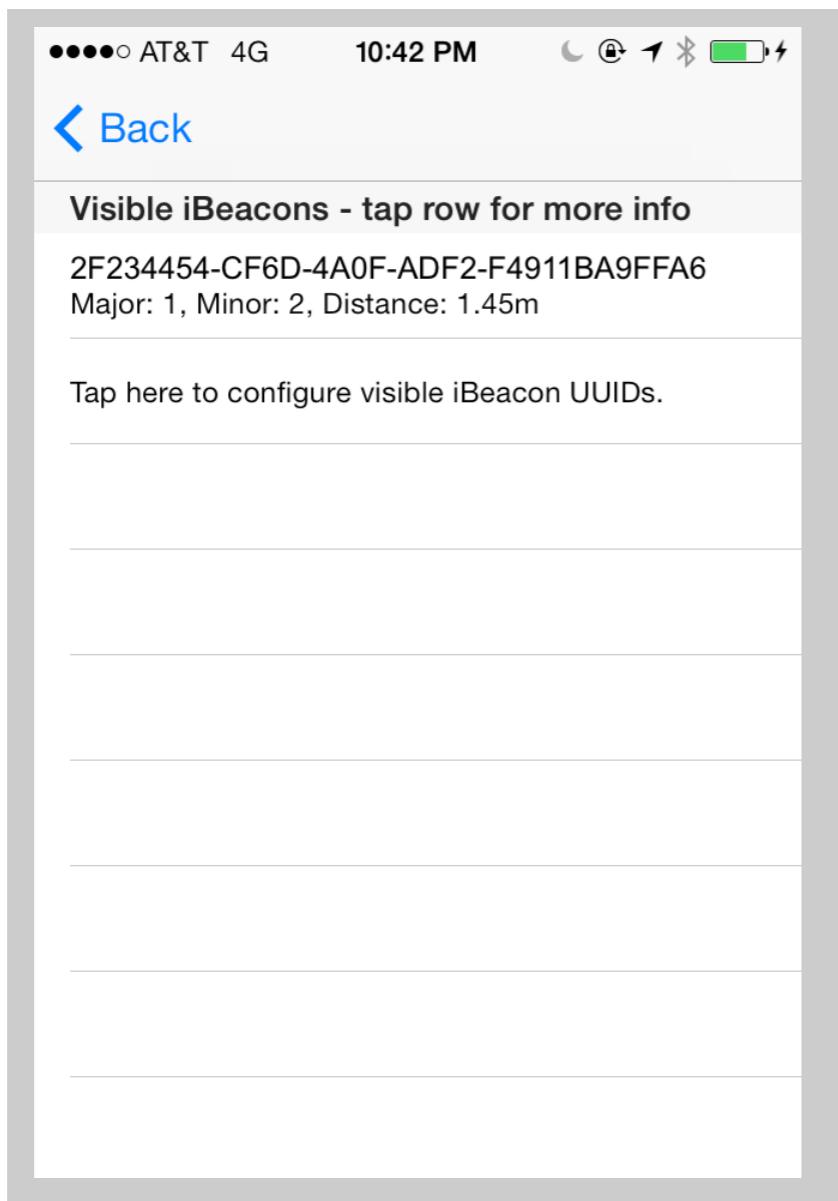
Using iBeacons - Ranging

- Provides the three-part identifier of all iBeacons in radio range
- Updates provided once per second
- Does not work in the background on iOS



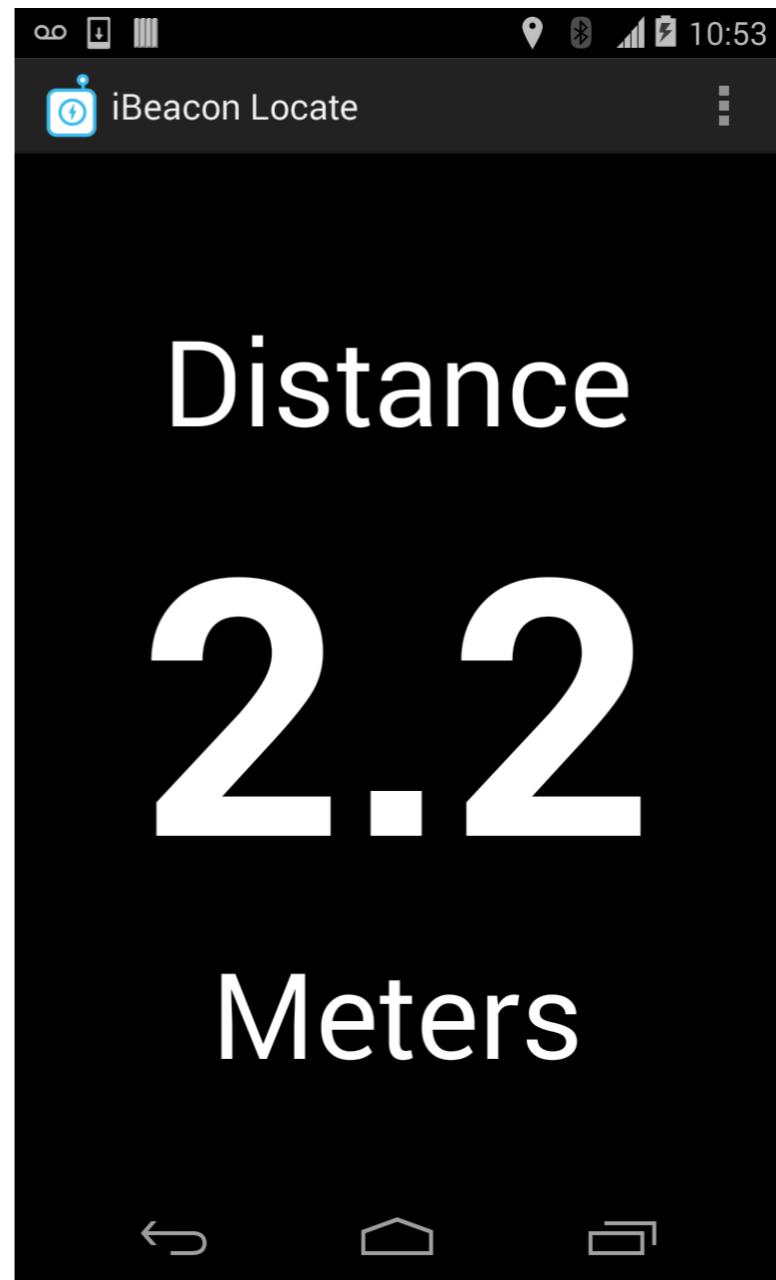
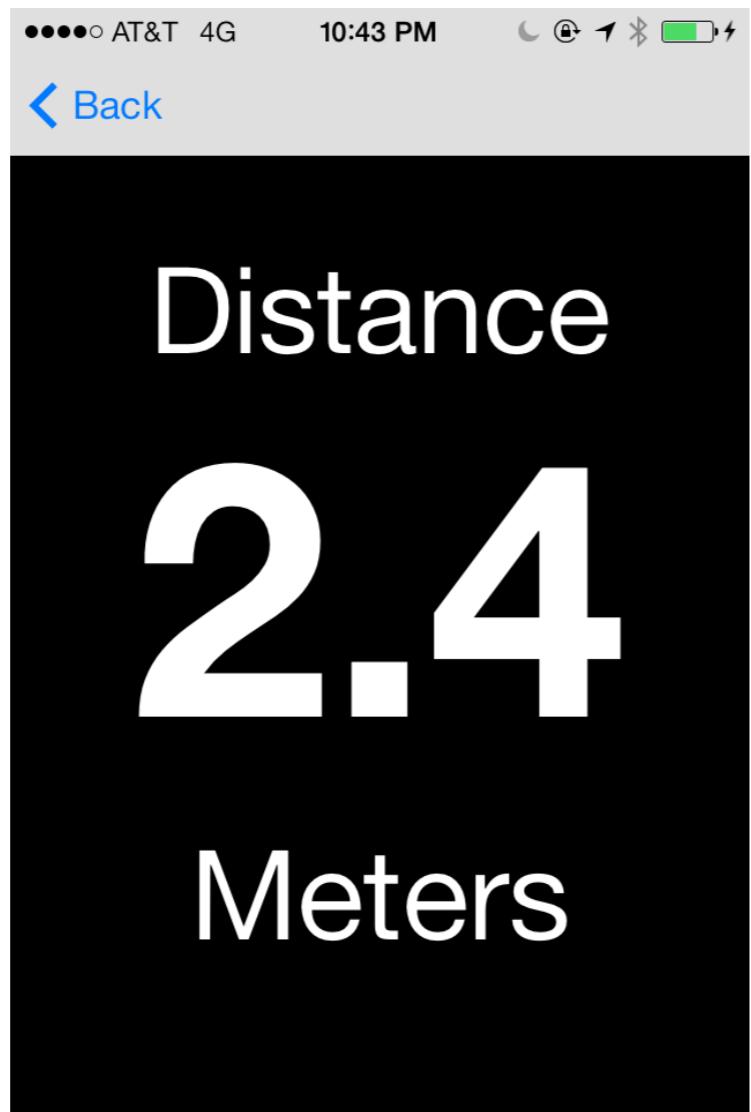
Radius Networks

Using iBeacons - Ranging Demo



Radius Networks

Using iBeacons - Ranging Demo



Radius Networks

Using iBeacons - Apps in Background



Functionality limited on iOS

- Monitoring can launch your app into background for only 5s
- Can send notifications to lock screen, call web services
- Cannot launch app at a specific distance from iBeacon
- Not very timely, especially on older phones. Takes up to 15m

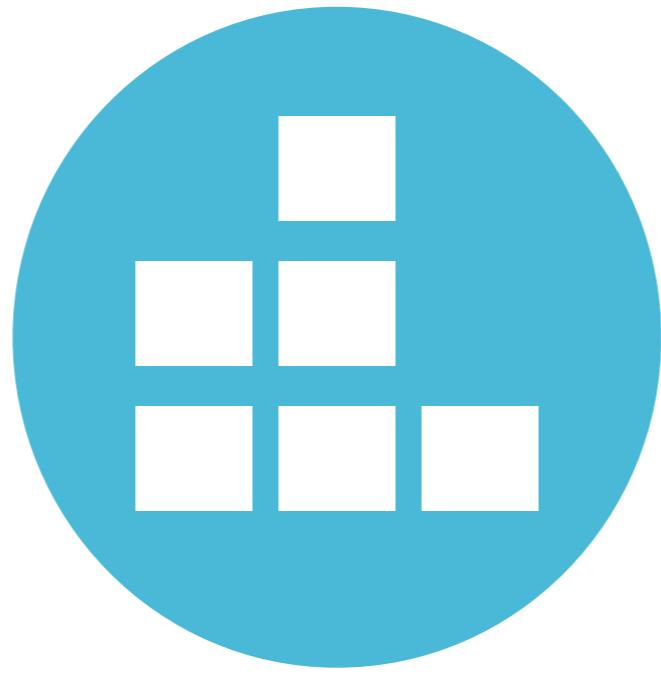


Android is very flexible

- But background use drains battery - 90mA on a Nexus 5
- [Pro Android iBeacon Library](#) provides tools to save battery



Radius Networks



Developing Apps

Developing apps - SDKs Needed



iOS 7+

- SDK built-in to CoreLocation APIs
- Lets you make the iOS device act as an iBeacon
- Only lets your app see iBeacons where you know the UUID



Android 4.3+

- Use Radius Networks' open source [Android iBeacon Library](#)
- See any iBeacon, even if you do not know the UUID
- Cannot act as an iBeacon
(no BLE peripheral mode in Android 4.3 / 4.4)



Radius Networks

Developing apps - iOS Monitoring Code

```
@implementation MEAppDelegate
{
    CLLocationManager *_locationManager;
}

- (BOOL)application:(UIApplication *)application didFinishLaunchingWithOptions:(NSDictionary *)launchOptions {
    _locationManager = [[CLLocationManager alloc] init];
    _locationManager.delegate = self;
    CLBeaconRegion *region;

    region = [[CLBeaconRegion alloc] initWithProximityUUID:[[NSUUID alloc] initWithUUIDString:@"2F234454-CF6D-4A0F-ADF2-F4911BA9FFA6"]
              identifier: @"region1"];
    region.notifyEntryStateOnDisplay = YES;
    [_locationManager startMonitoringForRegion:region];
    return YES;
}

- (void)locationManager:(CLLocationManager *)manager didDetermineState:(CLRegionState)state forRegion:(CLRegion *)region {
    if(state == CLRegionStateInside) {
        NSLog(@"I just saw an iBeacon for the first time!");
    }
    else if(state == CLRegionStateOutside) {
        NSLog(@"I no longer see an iBeacon");
    }
    else {
        NSLog(@"nobody should ever see this -- it means locationManager is having trouble with %@", region.identifier);
    }
}

@end
```



Radius Networks

Developing apps - Android Monitoring

```
public class MonitoringActivity extends Activity implements IBeaconConsumer {
    protected static final String TAG = "RangingActivity";
    private IBeaconManager iBeaconManager = IBeaconManager.getInstanceForApplication(this);

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_ranging);
        iBeaconManager.bind(this);
    }
    @Override
    public void onIBeaconServiceConnect() {
        iBeaconManager.setMonitorNotifier(new MonitorNotifier() {
            @Override
            public void didEnterRegion(Region region) {
                Log.i(TAG, "I just saw an iBeacon for the first time!");
            }

            @Override
            public void didExitRegion(Region region) {
                Log.i(TAG, "I no longer see an iBeacon");
            }

            @Override
            public void didDetermineStateForRegion(int state, Region region) {
                // Method not used in this example
            }
        });
    }

    try {
        iBeaconManager.startMonitoringBeaconsInRegion(new Region("myMonitoringUniqueId", null, null, null));
    } catch (RemoteException e) { }
}
}
```



Radius Networks

Developing apps - iOS Ranging Code

```
@implementation REAppDelegate
{
    CLLocationManager *_locationManager;
}

- (BOOL)application:(UIApplication *)application didFinishLaunchingWithOptions:(NSDictionary *)launchOptions {
    _locationManager = [[CLLocationManager alloc] init];
    _locationManager.delegate = self;
    CLBeaconRegion *region;

    region = [[CLBeaconRegion alloc] initWithProximityUUID:[[NSUUID alloc] initWithUUIDString:@"2F234454-CF6D-4A0F-ADF2-F4911BA9FFA6"]
              identifier: @"region1"];
    [_locationManager startRangingBeaconsInRegion:region];

    return YES;
}

- (void)locationManager:(CLLocationManager *)manager didRangeBeacons:(NSArray *)beacons inRegion:(CLBeaconRegion *)region {
    for (int i = 0; i < beacons.count; i++) {
        CLBeacon *beacon = (CLBeacon *)[beacons objectAtIndex:i];
        NSLog(@"iBeacon visible with proximityUUID: %@", major: %@, minor %@ that is %f meters away", beacon.proximityUUID, beacon.major,
              beacon.minor, beacon.accuracy);
    }
}

@end
```



Radius Networks

Developing apps - Android Ranging Code

```
public class RangingActivity extends Activity implements IBeaconConsumer {
    protected static final String TAG = "RangingActivity";
    private IBeaconManager iBeaconManager = IBeaconManager.getInstanceForApplication(this);

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_ranging);
        iBeaconManager.bind(this);
    }

    @Override
    public void onBeaconServiceConnect() {
        iBeaconManager.setRangeNotifier(new RangeNotifier() {
            @Override
            public void didRangeBeaconsInRegion(Collection<IBeacon> iBeacons, Region region) {
                for (IBeacon iBeacon : iBeacons) {
                    Log.i(TAG, "iBeacon visible with ProximityUUID: "+iBeacon.getProximityUuid()+" major: "+iBeacon.getMajor()+
                            "minor: "+iBeacon.getMinor()+" that is "+iBeacon.getAccuracy()+" meters away.");
                }
            }
        });
    }

    try {
        // setting proximityUuid to null instead of 2F234454-CF6D-4A0F-ADF2-F4911BA9FFA6, because Android allows nulls!
        iBeaconManager.startRangingBeaconsInRegion(new Region("myRangingUniqueId", null, null, null));
    } catch (RemoteException e) { }
}
}
```



Radius Networks

Developing apps - Privacy

 Privacy is a hot-button issue

 iBeacons are privacy friendly

- As transmit only devices, you can see them, they can't see you!

 Apps must ask permission to detect

- iOS: “[appname] would like to use your current location”
- Android: install time request for Bluetooth LE, Bluetooth Admin



Radius Networks

Developing apps - Security



Do not assume secret iBeacon IDs

- iBeacon identifiers can be read over the air
- iBeacon identifiers can be decompiled from your app binary



Be careful about wireless configuration

- Wireless configuration interfaces may be vulnerable to hacking



Small devices are easy to steal



Radius Networks



Questions

David Young
Chief Engineer

david@radiusnetworks.com

<http://stackoverflow.com/tags/ibeacon>

<http://developer.radiusnetworks.com/ces2014>