

# Introduction to Beacon Technology

Making Beacons work for your business



*Hafa Adai!* Welcome to our overview of Bluetooth LE (Low Energy) Beacons! We hope this info will give you an introduction and some context for understanding how Bluetooth LE proximity systems work, and how Marianas GPS can help you to bring your ideas to life!

Objectives:

- 1 Explain Bluetooth Low Energy, BLE Advertising, and how beacons and other proximity systems to identify them can use the advertising scheme.
- 2 Explain the configurable parameters of a Beacon and how they can be used for real world applications, and what the tradeoffs are between parameters like transmission power and advertising intervals.

# **Bluetooth LE Advertising**

One of the most interesting and important features of the Bluetooth 4.0 Low Energy spec (called 'BLE') is that devices can discover and communicate without an explicit pairing operation. This contrasts earlier Bluetooth specs, which typically required manual pairing between devices.

When a BLE device is "advertising", it is broadcasting public advertising data that any other BLE device is welcome to receive and react to. This can be used as the first step in a connection operation, or to broadcast public packets that others may be interested in.

The advertising data packets are limited in length (31 bytes or so...), so you can't send a ton of data during advertising,

but you can certainly send enough to identify a device and some of it's most important features (such as services that it may provide).

### **Proximity Systems**

So, how does this turn into a beacon? It's simpler than you might think. There are two key components:

- 1) Bluetooth LE Advertising Data
- 2) Radio Signal Strength

By now, you have probably inferred that the BLE Advertising Data is a perfect carrier for identification information.

Beacons contain a unique ID in the advertising packets, which allows the beacon to be identified by devices scanning for known beacon ID's. These ID's are specified by Apps and services on the device.



The second component is the strength of the signal being received. Again, fairly obvious, but the stronger the received signal, the closer you are to the source. Although it can be very difficult to range exactly based on these signal strengths, you can usually quantize to categories such as far,

near, and immediate vicinity with pretty good results. These ranges can be used to tailor the responses and actions taken as the device moves through the radio field.

### **Beacon Parameters**

There are three unique parameters that the Beacon standard specifies. These are encoded in the BLE Advertising Packets and broadcast at regular intervals. Remember, these signals are public, so all Smartphones and BLE-equipped devices in range can see the packets the beacon is transmitting. The three parameters are as follows:

#### UUID

Major ID Minor ID

- <u>UUID (Universally Unique ID)</u> a 16 byte sequence usually expressed as a hex string. UUID's are usually the same for devices in the same application, but they don't have to be. For example, beacons in a specific location might all have the same UUID, or beacons manufactured by a particular vendor, and so forth. MGPS beacons allow you to set the UUID to whatever you would like via our configuration services (discussed in the next section)
- 2) <u>Major Value</u> a 16-bit unsigned integer (value from 0-65535). This is an arbitrary value you can select for your application. One idea might be to have the major value specify a particular model, department or an area. For example, not 'a' Honda Fit, but 'all' Honda Fits...
- Minor Value another 16-bit value (from 0-65535).
  Again, an arbitrary value you can choose. Often, minor is used as a sub-value such as a particular item or

specific location. This number does not have to be unique, but it should be, for identification purposes.

# **Triggering Schemes**

The most important thing to know when devising a UUID, Major, and Minor ID scheme is that Core Location allows for hierarchical triggering schemes. This is important to your design strategy.

Here's how it works. You can register beacon events on the following combinations:



Given our earlier example, let's say we had a venue, like an Automobile Dealership:

- 1) We could set up all the beacons in the Dealer location to have the same UUID.
- 2) Each brand/model could have a beacon code, which we store in the Major ID.
- 3) Finally, each vehicle in a given location would have a unique minor ID.

The hierarchy of notifications in this case would be something like this:



UUID + Major ID

Next, we might set up a message that points the user to features of a particular automobile when they get near to a beacon with the corresponding Major ID. "Check out the new 2015 Honda Accord! No Money Down and only \$200 a paycheck!" with a link to a page with more information, vehicle specifications, etcetera.



Finally, UUID + Major ID + Minor ID represents our most granular level of location event. This might trigger a notification when the user gets to a particular vehicle, or area depending on Beacon location/configuration. "This Used Mazda 3 has only 24,000 miles on it". Of course, many other permutations are possible, but you can see the idea – different levels of notification are possible based on the hierarchy of the system. Also, you may only have a single beacon or much simpler system in many cases where this level of detail is not required.

# Marianas GPS Beacons

We covered a couple of the highlights, but here's a more comprehensive breakdown of the features provided by our beacon hardware:

- Configurable UUUD, Major ID, and Minor ID we let you specify all of the ID parameters available in the Beacon protocol. This allows you to ensure that your beacons are unique and completely tailored to your desired identification scheme.
- 2) Configurable Transmit Power one unique feature of our beacons is adjustable transmitter power. You can set the beacon to 0 dB (max power) or to -6 dB, or -23 dB. This helps in two ways. First, less power lets your batteries last longer. Second, it can be a useful tool for tuning the range of your beacons. -23 dB in particular is great for creating smaller "immediate" zones for more local detection. Think 'indoor GPS', in a rough sense.
- 3) Configurable Broadcast Interval this one is a little trickier to understand as the effects are more subtle. By decreasing the broadcast interval (delay time between advertising packets), you increase the rate at which

advertising packets are sent. This reduces response time for a device to detect that it has entered a beaconenabled region. However, the more broadcast events, the more power consumed. Our beacons allow you to configure broadcast interval anywhere from 0.1s (10 advertisements per second) to 30 seconds (2 advertisements per minute).

4) Water Resistant Construction – We live on an island that periodically gets some serious typhoons. Our Beacons are water resistant, and provided they are kept out of direct weather, can be depended upon to continue operation regardless of inclement weather. Should more industrial strength be required, IP68 rated beacons can be sourced.

Some common uses of Beacon Technology:

- Item Identification (Cars, Containers, Keys, etc...)
- Automated location inventory of large items
- Indoor Navigational Assistance
- Proximity based shopping information
- Sales incentives in Department stores
- Museums and Exhibitions
- Premium content for High End shopping
- Office Keyless Entry (With custom programming)
- Rewards/Valued customer programs
- Promotional 'Scavenger' Hunts
- Interactive tours and Education
- Monitoring Children and Pets ('leaving area' alerts)
- New uses are being created daily

We hope you have enjoyed our presentation. If you have any questions we are happy to entertain any inquiry you may have at your convenience.

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