

A Simple Smart Shopping Application Using Android Based Bluetooth Beacons (IoT)

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Abstract

Retail advertising and marketing is a fast growing and ever changing field with new technologies being implemented to attract more customers. IoT (Internet of Things) is a new and effective technology that can be used in Retail for marketing by making products and services interact with customers directly. BLE or Bluetooth Low Energy radio protocol provides an effective means to achieve indoor positioning and navigation by making use of Beacons; Bluetooth devices can broadcast and receive signals in a short distance range. This can help locate the transmitting device or Beacon with a mobile phone thus facilitating indoor positioning and navigation. Thus product details such as offers, coupons and such can be broadcasted to customers who can track the product through mobile devices, essentially a mobile app with an enabled Bluetooth service.

Keywords: Internet of Things, Bluetooth Low Energy.

1. INTRODUCTION

Beacon is a general term that uses Bluetooth Low Energy (BLE) proximity for sensing that transmits unique ID in android. The identifier is used to tracking the user's physical location tracking and triggers a push message over social networks that is similar to GPS and therefore increasing the battery life. BLE devices operate in any environment and detects nearby mobile devices using iBeacon.

2. RETAIL APPLICATIONS

Using the Gimbal beacon proximity sensing, the following implementations can be made to a user with the android app in the reception mode.

1. Push messages are sent to customers mobile phones regarding offers, discounts etc.,.
2. Provide special discounts and offers on the products bought by the customers.
3. Retailers can provide updates about the products during their visit etc.

4. Detailed parking information and assistance can be provided through indoor positioning and location tracking.

3. BLUETOOTH BEACONS

BLE generally operates at 2.4GHz band. Sending push messages in advertising mode is easy compared with other devices. Messages are sent using Push technology. It is done by detecting the close proximity of mobile phones using location based service called Received Signal Strength (RSS). Normally a beacon can send data up to 31 bytes.

3.1 BLE (Bluetooth Low Energy)

BLE scan response is broadly categorized as AD structures that consists of various sequence of bytes with a predefined format:

1. Byte 1- Number of bytes left to the end of the AD structure.
2. This allows a receiver of this structure to know when it ends and when a new AD structure starts
3. The second byte is the ID of an AD structure type.
4. The rest of the bytes are data that is structured in a predefined way depending on what AD type was defined by the previous byte.

3.2 Profile of iBeacon Bluetooth

Generally for an iBeacon with Proximity UUID A2E56BD5-EDFC-56E2-C060-C0E4A81056F1, where major and minor are set to 0 and calibrated to the power of – RSSI 59 that are transmitted as BLE advertisement packet have the address format as below:

```
c6 eb 98 8c30 4250 b127 6f 4d 1702 01 2a 1a bb 4c 00 02
```

The Bluetooth Advertisement can be further broken down as:

02 - Number of bytes in first AD structure

01 – AD Flag

1A – Flag offset value.

Binary bit 0 –OFF- Limited Discoverable Mode

Binary bit 1 –ON- General Discoverable Mode

Binary bit 2 – OFF - NA

Binary bit 3 – ON - Device controller

Binary bit 4 – ON - Device Capable at Host.

3.3 RSSI

Received Signal Strength Indicator (RSSI) indicates the strength of the beacon's signal in a smartphone. The strength of the signal depends on the distance and broadcasting Power value. The maximum broadcasting Power is +4 dBm. The maximum RSSI ranges from -26 inches to 40-50 m distance.

The purpose of RSSI is to approximate the distance between the smart devices and the beacons that is defined by the iBeacon standard.

4. PROPOSED SYSTEM ARCHITECTURE

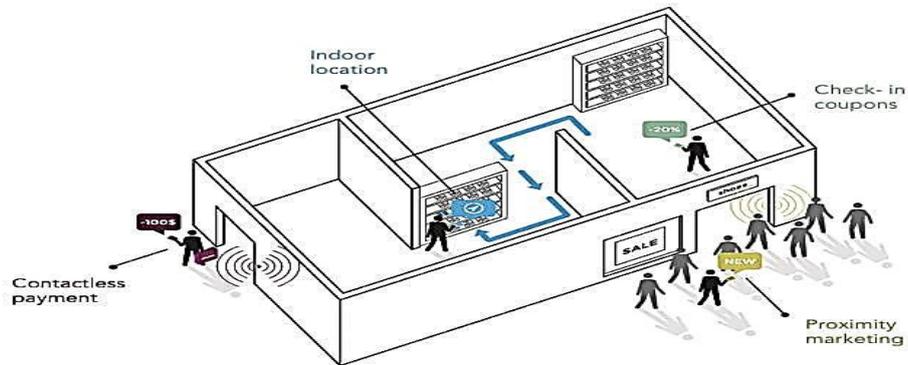


Fig.1: A Shopping Mall showing Bluetooth beacons

Beacons are small portable devices which can be placed inconspicuously at any place such as at a store entrance or near a product in a particular section or in a parked vehicle at a crowded parking lot. Retail stores can make users' shopping experience more efficient and easy by facilitating beacon in-door navigation and various other facilities.

1. The proposed system comprises of a mobile app on Android platform (version 4.4 above) which can detect a Bluetooth signal.
2. Beacons are placed at various locations in a retail store which respectively broadcasts the store location, product location, offers or vouchers, etc.
3. The mobile app is launched by the user and he enables the Bluetooth so that reception of signals is possible.
4. When the user enters a beacon transmission area, the app notifies data as specified for the respective beacon and also provides the approximate distance from the user.
5. The user may choose from various services offered by the beacons at various different positioned beacons such as product offers, store location, current location, etc.
6. A beacon may also be placed inside a parked vehicle and the user may track it at the parking lot.

5. IMPLEMENTATION

5.1 AltBeacon Library

This library allows Android devices to use beacons. An app is capable of requesting to get notifications based on beacons visibility. Generally the app requests the update ranging from approximately at a distance of 1 HZ from the beacon.

5.2 Beacons detection

The libraries are configured for detecting a wide variety of beacons and by default, it can detect beacons using the open AltBeacon standard.

Android devices with Android 4 and other versions can detect beacons using the libraries. Till June 2015, according to Google play store, this data is approximately 56%.

5.3 Configuring Gimbal beacon to iBeacon

Gimbals can be configured by logging into the Gimbal website. The given below are steps for configuration :

Click on Open Proximity tab-> Manage Configuration -> create new configuration -> select iBeacon as beacon type -> assign UUID (major and minor) and any UUID can be chosen at random.

The same procedure is followed for iPhone by selecting Configure option. Remove the battery and put it back in and thereby the Gimbal can be seen in the Gimbal Manager App. The new configuration can be saved by the update button.

5.4 AltBeacon

Proximity beacon advertisements are defined by the protocol specification AltBeacon. AltBeacons beacon advertisements are used to transmit proximity signals to the nearby receivers. Emitted message contains the information of the receiving device. The receiving device may use this information as a contextual trigger to execute procedures and implement behaviors that are relevant to being in proximity to the transmitting beacon.

1. Example use cases for proximity beacons include but are not limited to.
2. Notifying users of special offers as they visit areas within a department store
3. Presenting opportunities to explore additional information about an exhibit to a museum visitor
4. Automatically checking in with a restaurant's reservation system as the customer arrives.

5.5 Design Goals

1. The development of the AltBeacon specification has been driven by several objectives:
2. Provide a concise proximity advertising message for interchange of proximity information between advertisers and scanners
3. Maintain compliance with Bluetooth Specification Version 4.0 by utilizing defined advertising PDU and advertising data structures
4. Encourage adoption by all interested parties by avoiding any obvious implementation restrictions
5. Enable the implementation of vendor-specific features, if possible.

5.6 Implementation Requirements

AltBeacon proximity beacon functionality is not limited to single-function devices, but can be incorporated as a feature of any device that is Bluetooth Low Energy compliant and which conforms to the requirements defined in Bluetooth Specification Version 4.0, Volume 0, Part B, Section 4.4 or Section 4.5.

AltBeacon advertisements are encapsulated as the payload of a non connectable undirected advertising PDU (ADV_NONCONN_IND) as defined in Bluetooth Specification Version 4.0, Volume 6, Part B, Section 2.3 Advertising Channel PDU.

Devices that receive proximity beacon advertisements are referred to as scanners. These roles follow the conventions defined in Bluetooth Specification.

5.7 AltBeacon Protocol Format

The AltBeacon advertisement makes use of the Manufacturer Specific Advertising Data structure as defined in Bluetooth Specification Version 4.0, Volume 6, Part B, Section 2.3 Advertising Channel PDU.

The AltBeacon advertisement is of 1,1,2 –bytes company identifier, as prescribed by the Manufacturer Specific Advertising Data structure format, followed by 24 additional bytes containing the beacon advertisement data.

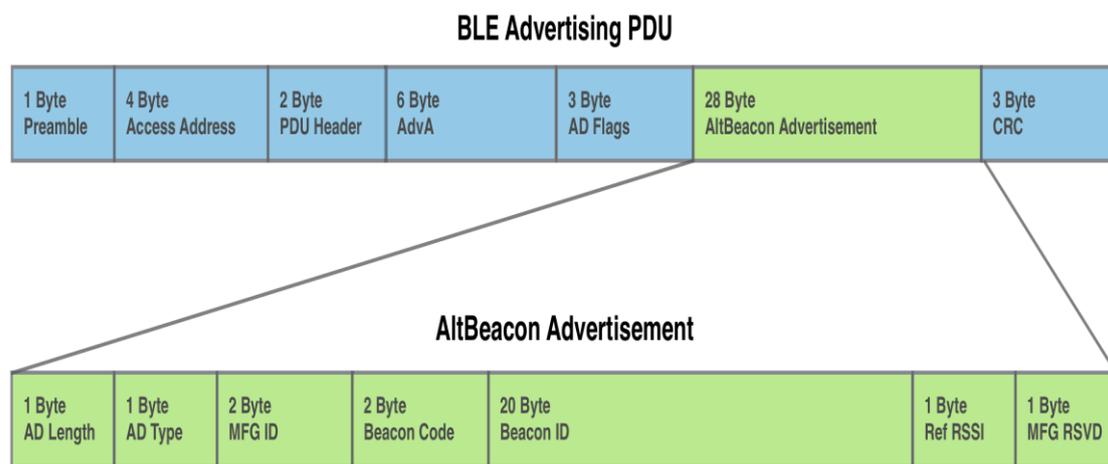


Fig.2: AltBeacon advertisement Frame Format

6. COMPARATIVE STUDY

The first company to use Bluetooth for sensing indoor proximity was DKTOB trading as Daelibs that was launched by in Australia in 2010. Daelibs was designed and manufactured as a bluetooth beacon for shopping centers that uses Bluegiga chipset. Later, Hewlett-Packard Research Labs came out with “CoolTown” technology that uses infrared beacons with software that relies on PDA technology. This approach is based on the beacon transmission URL rather than using a unique identifier.

Offsets	Octet	0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	AD LENGTH								AD TYPE								MFG ID															
4	32	BEACON CODE																BEACON ID															
8	64																	BEACON ID (CONTINUED)															
12	96																	BEACON ID (CONTINUED)															
16	128																	BEACON ID (CONTINUED)															
20	160																	BEACON ID (CONTINUED)															
24	192	BEACON ID (CONTINUED)																REFERENCE RSSI								MFG RESERVED							

Fig.3: AltBeacon Protocol Data

7. CONCLUSION

This paper provides an overview of Bluetooth beacons, how they can be used in retail and shopping outlets by effectively utilizing the minimum resources and thereby attracting customers easily without any difficulty for them to pick up the right product.

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