



## 'Beacon' a Retail's hope: Shopping that's personal

Krunal Vasani<sup>1</sup>, Darshan Thoria<sup>2</sup>, Drashti Hirani<sup>3</sup>

<sup>1</sup>CSE, SLTIET

<sup>2</sup>CSE, SLTIET

<sup>3</sup>M.E.C.S.E.

**Abstract** — since retailers has accepted to provide seamless shopping to the consumers, the line between online and offline shopping is becoming soften. Today shoppers always want to be connected in real time, enchanting, relevant shopping experiences at home, online and in the store or we can say everywhere, on any device. As a result, beacons enters to the world of retailers', which is one of the leading ways to enhance in store experience by connecting with customers through their mobile devices. Beacon technology has potential to alter the consumer retail experience dramatically, however it is recent development and so it can be complicated and may be raise some important security and privacy concerns. In this paper we are giving basic fundamental knowledge to the beacon technology, its uses, risks and rewards.

**Keywords-** *e-commerce and retail, beacon technology, low cost hardware, Bluetooth low energy (BLE), personalize marketing*

### I. INTRODUCTION

Beacon is the latest buzzword in retail marketing. It is small battery powered devices that can communicate by Bluetooth low energy with smartphones and other mobile devices. It can also points the location of a person, carrying Bluetooth enabled mobile device indoors. Beacons have potential to bring the power of big data exactly to the front doors of retailers. Retailers can use beacons to create customized in store experience and send personalized messages to customers in real time. In fact the future may be closer than it seems, BI (Business Insider) intelligence research predicts that as many as 90% of the top retailers will move forward towards beacons by the end of 2016.

Beacons are the latest development in location-based technology. But as opposed to geo-fencing, which relies on GPS that lacks accuracy indoors, and near field communications (NFC), which has a limited range, beacons can accurately pinpoint the location, within centimeters, of a smartphone equipped customer inside a store. Not only can beacons in point location, but they can also communicate with customers through push messages delivered directly to customers' smartphones [1].

### II. BECAONS AT A GLANCE

#### A. What is a Beacon?

A beacon is a small transmitter that is designed to exchange data with mobile devices that come within its range. It is essentially an electronic tripwire that sets up a connection between a customer's mobile device and a backend server of some kind. Once the connection is made, you can accurately determine the customer's location in the store, and present personalized information or offers. Integration with payment systems can make it possible for customers to do self-checkout authorizing payment for items through their own mobile devices.

Beacons are often commonly referred to as iBeacon, as Apple was the first to equip their devices with beaconing technology. All iPhones, from the iPhone 4S, are fitted with Bluetooth Low Energy, or BLE, radios. Android phones soon followed suit, and now most smartphones, and other mobile devices including tablets, are able to receive messaging through BLE communication. Beacons are a new class of short-range, low powered transmitters that can push notifications to mobile devices when they come within 70 meters of the Beacon. Thanks to the low power usage, small beacon transmitters can run for up to two years on a single cell battery. At around £20 per Beacon, they are also incredibly cheap.

#### B. What is the BLE Communication?:

BLE avoids the cost of Wi-Fi, the inaccuracy of GPS (especially indoors), and is both cost- and energy-efficient to run. BLE beacons can run on a single coin battery for months or even years. And the battery drain on a phone from nearby beacons is less than 1%. [2]There are some BLE internal concepts as follow: [4]

- 1. Peripherals and Centrals :** The BLE standard defines two types of devices – a Peripheral device, which is assumed to be a lowpower device that exposes state or information, and a Central device. The Central is usually either a powered device, or one with significantly greater processing capability and a rechargeable battery, e.g. a phone or tablet. Unlike classic Bluetooth, the Peripheral and Central are very asymmetric in their resource needs, with the standard being designed to minimize the complexity, power requirements and costs of the Peripheral. In most cases, a Peripheral device spends the majority of its life asleep, only waking when it needs to send data.
- 2. Scanners and Advertisers :** Advertising is the first thing that BLE devices do when they're turned on. A peripheral uses advertising packets to broadcast information that any other BLE device within range can hear. To listen to these, Central devices implement a Scanner mode, in which they listen for these advertisements. Both devices move from an idle state to that of either an advertiser or a scanner. The BLE standard divides the 2.4GHz spectrum into thirty-nine 2.0 MHz wide channels. Thirty-six of these are reserved for data, only used by devices that have paired with each other. The remaining three channels are used for advertisements. These three channels were specifically chosen to avoid the main channels used by Wi-Fi access points, to minimize interference. When a peripheral wants to broadcast, it starts an advertising event, where the same packet of information is transmitted sequentially on each of the three advertising channels. Devices operating as scanners will detect one of these, and pass the information it contains to the higher level protocol stack and application.
- 3. Advertising Packets :** This is where we get to the value of the specification, at least as far as location and advertising is concerned. Although the primary aim of advertising packets within the specification is to allow for the discovery of devices and make a secure connection, they also permit small amounts of data to be transmitted for any other device to hear. There are four different types of advertising packets defined, of which three are of interest. These are:
  - **Non-connectable Advertising**, where a device transmits a string of data, but will not respond to any request and cannot make a connection. This is the most common mode for beacons and can be implemented using only a transmitter, with no receiver.
  - **Discoverable Advertising** is similar, but a scanning device can request more information. This option allows a second packet of data to be sent to an application without the need to make a connection. Discoverable advertising provides the ability to request more data. Although potentially useful, most beacons would send information in a non-connectable advertisement packet directing a central device to access further information from a secondary source, such as a website accessible via a cellular or Wi-Fi link. Discoverable advertising cannot be used to initiate a connection.
  - **General Advertising**, where, in addition to the options above, a scanner can request that the beacon make a connection, which may be short term or permanent.
  - **Directed Advertising**, which is used to quickly re-establish a previously negotiated connection. This is not relevant to beacons, and is not currently supported in iOS7.

### C. How Beacon Works? :



Fig: 1 Beacon Work Model [5]

Most beacons transmit signals using Wi-Fi, Bluetooth Low Energy (BLE) or RFID. When a customer comes within range of a beacon, their mobile device can detect the beacon's signal and send a query. The beacon responds by sending back an invitation to the mobile device to establish communication. In a retail setting, the beacon might ask if the user wants to receive "in-store notifications." If the user accepts, an app is installed and the store can use it to send special

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offers, coupons, or offer other services. The beacon uses signal strength to determine location, so offers can be relevant to your exact location in the store. Most new Android and Windows phones support BLE. Apple first put a BLE radio in the iPhone 4S, and has since added the capability to the iPad, iPad mini, and iPod Touch. [7]

#### **D. Beacons Working Strategies :[5][8]**

- 1. Mobile Proximity Marketing** : As shoppers browse through stores, they can be sent messages from the beacons that are closest to them. For example, as a shopper enters the footwear section of a store, the local beacon could share shoe-related special offers, interesting facts, targeted promotions and more. As the customer moves to a different location, a new beacon in the area will alert the customer to offers on products they're now close to. Using mobile beacon technology, customers can be contacted and kept informed while in-store to enrich their experience.
- 2. Micro Location and User Targeting** : Retailers can use micro-location information in a variety of ways. In some instances a retailer may just want to know traffic patterns in the store. When customers enter the store, how many turn left and how many turn right? The information can be used to determine the best placement for end-of-aisle displays and promotions. Knowing a customer's exact location also enables the retailer to deliver information that is relevant to them at that precise moment and context. This targeting can go well beyond simple proximity marketing. By tracking a consumer's behavior, interests and location patterns within a store, we can obtain a clearer picture of the individual. Not only do we know what they purchase, but we know what interests them judging by how long they stay in a section, and we can identify the factors triggering a purchase. The information collected can then be analyzed for a truly personalized, relevant and engaging in-store experience.
- 3. Indoor Mapping** : With micro-location targeting, you can help customers navigate big stores and shopping centers. A beacon at the entrance to a large department store could welcome the customer, direct them to the department they're interested in, and then help them find a register when it's time to check out. In a shopping mall, beacons and mobile apps could be a huge improvement over the few, scattered, hard-to-find mall maps, and give retailers opportunities to push special offers and notifications.
- 4. Tracking with Business Intelligence** : The most controversial but also the most common use case of Wifi beacons today is using the data collected by the Wifi hotspots for business intelligence in retail. Without users giving permission, the owner of the Wifi nodes can use them to answer questions like:
  - How many people walk by a given location each day?
  - What are the busiest hours throughout the day/week?
  - How long is the average person spending inside the venue/location?
  - Where in the store are people spending most of their time?This can be used for everything from choosing locations and planning store layouts to understanding who the customers are and using those insights to come up with new sales strategies. With user opt-in, the data becomes even more accurate and valuable.

#### **E. Technical Approaches :**

There are three basic approaches independent of the technology (Wi-Fi or BLE):

- 1. Device Based:** This is the most common approach for an outdoor location or to at least locate the building where you are, as it can easily be implemented without permission/support from the network.
- 2. Infrastructure Based:** This uses the existing Wifi infrastructure if supported or dedicated Wifi or Bluetooth nodes.
- 3. Hybrid (Device & Infrastructure):** Combines all available location information from Wifi, Bluetooth, GPS, sensors, etc.

There is no one size fits all. The requirements for indoor positioning and customer engagement need to be assessed in each case before a recommendation can be given. Even if BLE beacons are the hottest trend right now, Wi-Fi can often fulfill the same requirements cheaper and more easily.

**F. Examples of Beacons:[5]**



**G. Comparing Beacons to other technologies :**

**Table 1: Comparison of Beacons with other Technologies [11]**

Factors	iBeacon	NFC	GPS
<b>Accessibility</b>	With smartphones primarily acting as receivers, beacons form a highly accessible indoor location technology.	Deploying a NFC system need to plan and invest upfront in new infrastructure.	GPS is a highly accessible technology.
<b>Range</b>	Beacons typically have a wireless range of 1m to 70 m.	NFC works at an optimal range of 10cm or less.	In this case, the range is unlimited.
<b>Accuracy</b>	Beacons being radio transmitters are not very accurate as they stand the chance of interference, as radio signals can be absorbed by different media, such as water, air, human bodies or even metallic surfaces.	NFC is an averagely accurate indoor location technology for near range alone.	A number of factors such as atmospheric effects, sky blockage etc., play a critical role in the accuracy of GPS. Generally, high-quality GPS receivers provide a horizontal accuracy of more than 3.5 m.
<b>Security</b>	Beacon Hacking, a common threat to beacon security, Most beacon manufacturers have now put some measures in place to prevent this from happening.	NFC supports encryption and since it requires close proximity between devices for proper functioning, the odds of a hacker intercepting the signal is minimal.	Most manufacturers these days employ various authentication and storage techniques to secure a GPS receiver.
<b>Ease of use</b>	Consumers respond to notifications that are triggered on their smartphone when they are within the range of a beacon.	Consumers use a NFC tag to control timing and engagement.	Consumers have to switch on the GPS on their smartphones.
<b>Energy Efficiency</b>	Majority of beacons are battery powered and last for up to one year before they need to be replaced. You can even find, USB powered and electromagnetic wave powered beacons in the market these days.	NFC does not need power to function. Each NFC tag creates its own power when it is in the presence of an NFC-enabled smartphone.	Constantly searching for satellites can result in a huge battery drain. Thus, when it comes to an "always-on" use case, GPS is a poor solution to go ahead with.
<b>Privacy</b>	Beacons can be more intrusive as irrespective of who deployed the beacons, a mobile app can be configured to monitor consumer movements as they move along.	NFC is less intrusive as the movements of a consumer can only be monitored based on the NFC tag that they have engaged with. No third party, other than the one who has supplied the tag contents can monitor engagement.	Privacy risk associated with GPS mainly comes from the receivers (devices) and communication mechanism inherent in the manufacturer's servers.
<b>Inherent capability of smartphones</b>	iBeacon only requires devices to have Bluetooth LE installed in them, which many smartphones already have.	Neither Apple products prior to iPhone 6 nor other popular smartphones come with an inherent	It is an inherent capability of all smartphones.

Factors	iBeacon	NFC	GPS
		NFC chip.	

**H. Challenges and Risks:**

1. **Complexity** :Retailers should be careful not to think of this as a ‘stick it on the wall and it works’ scenario. Stores need to be surveyed. Beacons need to be installed maybe a lot of them, depending on your store. Mobile apps need to be built to capture the right information and present offers. These must be integrated with back end systems. And to really be compelling, analytics need to be in place to understand captured data and drive personalized offers. It is not a small investment. It is best to proceed with caution. Consider starting with beacons to understand traffic patterns and shopping behavior first, and then move to proximity marketing.
2. **Privacy** : Customers have to really want to opt in before they are tracked by beacons. They have to download an app, turn Bluetooth on, turn on location services, and give permission. And research seems to support the notion that consumers are willing to give up all sorts of private information if there is a tangible benefit (finding your way in the mall or superstore, getting discounts, etc.). Still, privacy advocates raise legitimate questions about the fact that this is a new kind of data that is being collected and there are no commonly accepted guidelines about how it is used. We have yet to see what could be done with detailed location information in the wrong hands.[9]
3. **Security** : Recent testing by Mobiquity Labs [10] indicates that beacons are fairly easy to clone,it means that unique identifiers can be linked to malicious hardware which could be used to collect users’ information or to accomplish other mischief. This is of particular concern when it comes to applications where payment information is being exchanged.

**III. CONCLUSION**

Beacons are emerging as useful tools, retailers can use to push relevant, targeted offers to shoppers, and create more engaging shopping experiences. But the technology is new, and not without its challenges and risks. By all means, experiment, but take care. If we set up a simple pilot for proximity marketing, for example, make sure you are not pushing the same offer to a shopper each time they pass through the same area. We don’t want your new experiment to annoy customers. Beacons can solve real problems: helping shoppers find what they are looking for, getting great offers, even self-checkout. As long as we are delivering real value customers can be pretty forgiving, and are likely to appreciate your efforts.

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