

# Beacon for Proximity Target Marketing

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**Abstract**— This paper presents a concept of an extended iBeacon system for proximity target marketing. iBeacon is a proximal wireless notification service proposed by Apple, Inc. This service uses beacon modules emitting radio waves based on Bluetooth Low Energy technology and provides automatic triggering of a single notification from a beacon module to multiple smart phones at proximity. In usual iBeacon systems, there is one-to-one correspondence between notification and beacon module. However, if we introduce a memory to remember the history of iBeacon detection, iBeacon systems can be extended to handle multiple notifications by multiple beacon modules with awareness of some contexts of pedestrians' moving directions, which enables a guide, for example, to the exit of buildings. We explain this idea for proximity target marketing using iBeacon and discuss its implementation with our simple experiment and performance evaluation. We are going to explain what it is and how it works, in order to understand how the app works and how it uses these potentialities. This new technology may also be used by Android system. iBeacon works with Bluetooth Low Energy (BLE), also known as Bluetooth 4.0 or intelligent Bluetooth. We show in this project how iBeacon technically really work, The app. Smart devices, such as Android phone can detect advertising signals sent by the low energy consumption tiny device. Notifications will be pushed automatically to the user when smart device with iBeacon Apps come to certain areas. It provides promising and portfolio usage scenarios for business, such as retail stores, to push related information about customers' interested items with the awareness of customers' location.

**Index Terms**—Beacon, Proximity target marketing, ibeacon, BLE, etc

## I. INTRODUCTION

For the recent explosive spread of smartphone users in the world, the possibility of novel services using smartphone has been explored. One of exploring fields is the close-range wireless communication technology, such as Bluetooth and Wi-Fi. As a recent trending topic of this, there is iBeacon proposed by Apple, Inc [1], [2]. iBeacon is a concept of wireless communication service using Bluetooth Low Energy (BLE) [3]. It enables to communicate between a beacon module and a smartphone at proximity with saving electric power. The beacon module emits radio waves based on BLE to broadcast an automatic triggering to smartphone users at proximity to push information with help from an installed application. A typical use case of iBeacon is automatic information transferring for in-store advertising and couponing. It also enables to use as an indoor positioning system based on the location information where the beacon module is placed and Received Signal Strength Indicator (RSSI) measured by smartphone. Because iBeacon is based on the BLE technology, it is available in the latest versions of iOS [1] and Android OS [4]. A service by iBeacon is usually done by a single beacon module that corresponds to a single automatic triggering for push-type information advertising regardless of any context of smartphone users approaching to the module. However, if iBeacon changes what to advertise by sensing a context of smartphone users, for example, where the users come from, such an extended iBeacon could be used for navigation and route guidance. This type of navigation and guidance will be applicable to attracting potential customers to a shop, and also to disaster evacuation guidance. In this paper, we propose a system for Proximity target marketing using iBeacon. Here, our image of proximity marketing for retailers, brands. Retailer's can greatly benefit using Proximity

Targeting. With ever increasing competition restaurants need a technology that will automate the task of customer acquisition and tracking in real time and inexpensively. For example, imagine a group of students hanging out. They're tired, they're thirsty, and it would be great to send these folks a special offer when they are near a restaurant's (or a coffee joint's) retail location. Lets say one of the restaurant broadcasts a special offer to these bunch of guys, there's a good chance that the group would be swayed by the deal and choose this restaurant over its neighboring competitors. This particular strategy had nothing to do with broadcasting a deal over social media or placing an ad in magazines or the school paper; it was all about giving the students the deal when they were in near proximity to the restaurant and ready to utilize it. We also implemented a prototype of the smartphone application of the 'Beacon Observer', this system run on Android OS to evaluate the performance of the proposed method. The rest of this paper is organized as follows. In Section II, iBeacon and its application cases are briefly introduced. In Section III, our idea of how to implement the route guidance system using iBeacon is explained. In Section IV, some results about the performance evaluation of the proposed system are shown. In Section V, we finally summarize our contribution and discuss some future works. iBeacon is one of the open Bluetooth Low Energy technology is used widely in commercial fields. Some successful applications have been developed by retailers to interact with their customers or potential customers very well. On museum scenario, we can also take advantage of iBeacon to make collections in the hall interact with visitors and potential history learners actively when visitors roaming in museum aimlessly. iBeacon is able to find visitors' interests or potential interest via their behaviors, so as to push collection information and history knowledge for visitors nearby automatically. In this research, we

are trying to find a better way to guide visitors learn more history knowledge behind collections and evoke their interests about local history.

**What is Proximity Marketing ?**

Proximity Targeting is a form of marketing that uses mobile technology to transmit marketing messages to mobile-devices. In most cases, individuals with mobile devices in a close proximity to a business can receive marketing messages. For Proximity Targeting uses Bluetooth or our proprietary low energy technology to send messages electronically to nearby consumers.

**Why Proximity Marketing?**

It's simple! At least 90% of your customers may be reached via WiFi on their mobiles.

- At their permission,
- With full measurability,
- At zero cost per customer!

**Benefits**

- Increase mobile engagement
- Retailer-branded experiences
- Seamless and valuable for consumers
- Combat showrooming
- Influence buying decisions at right place/time
- Enhance in-store shopping experience
- Insights into in-store shopping behavior
- Key component of omni-channel strategy

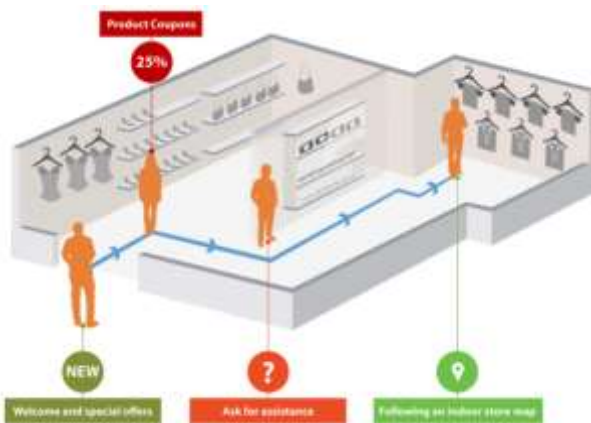


Figure 1 : Proximity Marketing for Retailers

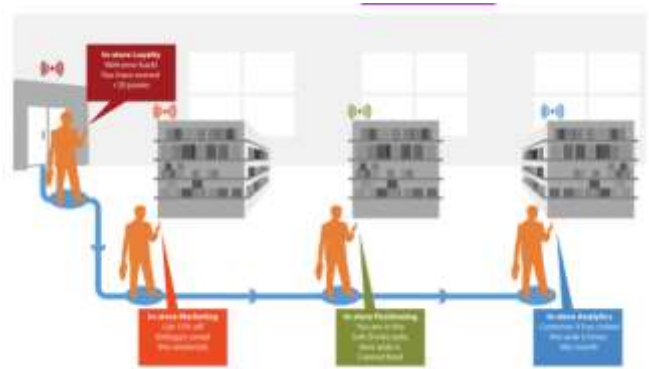


Figure 2: Proximity marketing for Brands

**II. ABOUT IBEACON AND ITS APPLICATION CASES**

**A. What is iBeacon?**

iBeacon [1], [2] is a new technology proposed by Apple Inc. that provides automatic transmission of location-based advertisement information to iOS and Android smartphones. iBeacon systems deploy a beacon module, which is an advertising-specific peripheral to broadcast advertising packets to smartphones at proximity by using Bluetooth Low Energy (BLE) [3], [4].

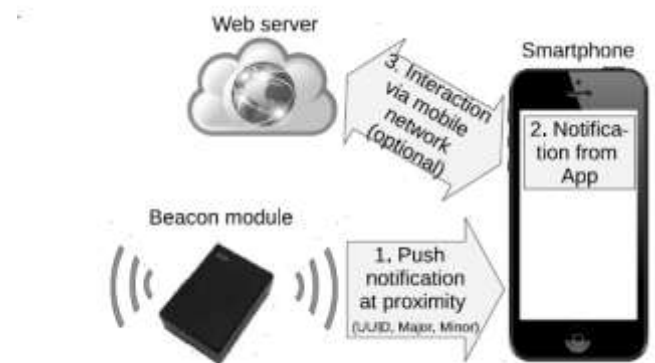


Figure 3. A typical conceptual design of iBeacon..

The protocol of iBeacon is transmit-only, i.e., the beacon module is a broadcaster that transmits periodic advertising packets, which contain information used by the receivers. The advertising packet mainly consists of three numerical identifiers: Universal Unique Identifier (UUID), Major number, and Minor number. The UUID is a 128-bit identifier that uniquely identifies the organization the beacon module belongs to. The major number is a 16-bit identifier used to identify major groups of beacon modules. The minor number is also a 16-bit identifier used to identify the lowest level of the hierarchy within a set of beacon modules. When a smartphone receives an advertising packet, it starts an advertisement event at the receiver through some application software installed on the smartphone. The advertisement event usually happens as a display of some advertisement information on the smartphone. After advertising packets are received, the application software sometimes interacts with a Web server on the Internet to obtain additional information such as webpages, or to send the status of the received advertising packets to a Web server for locationbased features. The typical conceptual design of iBeacon is illustrated in Fig. 3. iBeacon also estimates proximity using a number called the Received Signal Strength Indication (RSSI). RSSI is the power

level of the signal when it reaches the receiver. It can provide indoor location positioning and navigation, where access to cell tower signals and GPS might not work well or at all. But, the accuracy of the location positioning based on RSSI is not so high in general. Beacon modules usually are designed simple, small, lowcost, and low-powered in order to be easily maintained anytime anywhere. There is some dedicated iBeacon hardware that runs on batteries such as coin cell and AA, or on USB dongles to supply power using USB. One of the main reasons that the beacon modules are simple is that it allows beacon modules to run on small battery power for long time. According to the iBeacon specification, the interval of the advertising packets is at 100 ms. Setting the advertising interval is a balance between preserving battery life in beacon modules with long advertising intervals. Recently Google has also announced a project called *the Physical Web* [5] to standardize a mechanism to interact between things, *i.e.*, Internet of Things (IoT) using web technologies. In this project, Google's UriBeacon [6] is used for the interaction of things. UriBeacon is almost the same thing as iBeacon, but it is going to define an open beacon specification for the IoT. Because these "iBeacon" concepts are based on proximal awareness by beacon modules, we call them *Proximity-Based Service* (PBS). If these beacon modules become widespread as an information-communication infrastructure for IoT services, it will possibly open up a new direction of the Internet in the future. There is also a similar but extended concept proposed by the Third Generation Partnership Project (3GPP), which is called *Proximity Services* (ProSe) [7]. This concept treats Device-to-Device (D2D) communication using LTEAdvanced enabling new peer-to-peer public safety networks to function when cellular networks are not available or disrupted.

### B. Application cases

Many application cases for iBeacon have been proposed. Most of the cases are in practical use now, but some others are under demonstration experiment. Typical use cases are (1) mobile advertisements and couponing, (2) orders and payments without contacting with a store clerk, (3) ticket validation, (4) indoor location positioning and navigation, (5) possession tracking, and (6) safety confirmation in a time of disaster. The mobile advertisements and couponing are introduced to attract potential customers who happen to pass in front of a shop. When a customer's device gets close to a beacon module, an advertisement or a coupon of goods for sale is pushed to the display of the device. The orders and payments using iBeacon are helpful to reduce labor costs for a store clerk. By using beacon modules, they can trigger an app to wake up and pay for a transaction automatically using an existing payment system such as PayPal. If this system completely works, it might be unnecessary to stand in line for orders and payments to wait for a long annoying time. By using iBeacon with combining ticket validation and indoor navigation, it is possible to automatically assist travelers to find boarding gate and time or to find the correct exit at the airport. As an application of possession tracking, it is useful to find the baggage in the airport or to find lost items using iBeacon. If a beacon module is attached on personal belongings, automatic proximity triggering by iBeacon indicates that there exist the belongings at proximity.

### III. WHAT'S BLE AND iBEACON TECHNOLOGY?

Beacon is a kind of short- range, low power, low cost and tiny transmitters that can push information or notification to the smart mobile devices within 100 meters. It's a small device which uses Bluetooth Low Energy (BLE), an open standard makes it available to enable short-range wireless communication by a fraction of the power of the standard Bluetooth. This small device is low cost (from \$5 to \$30) with low energy. It has ability to run for one or

two years on standard coin-cell batteries. iBeacon technology works with the Bluetooth Low Energy (BLE) technology, also known as Bluetooth Smart. Beacon is a small device use only the advertisement channel, and transmit data packets in a regular intervals (several seconds for example), then, the data broadcasted by Beacons can be received by devices, take smart phones for example. When the smart devices (with iOS 7 or 8) picked up the data sent by iBeacon, the application installed in devices will make some certain responses. That is to say, iBeacons broadcast data by using BLE standard. The signals (data) will trigger some APP functionalities to perform some specific actions on a certain smart device at exactly a specific time or location. The working process above can be illustrated by Fig. 2 below.

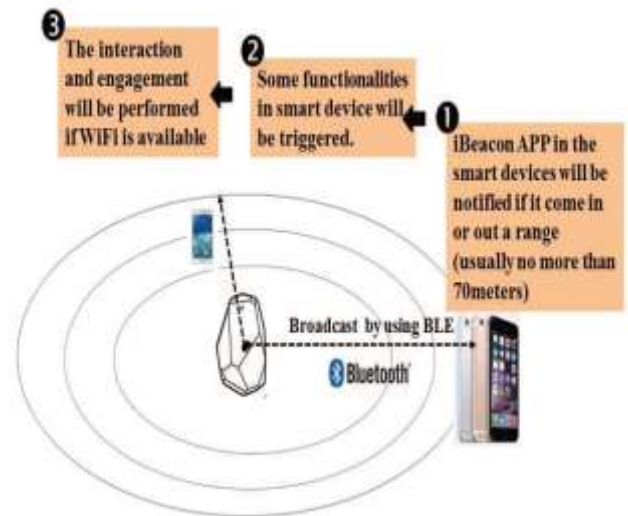


Fig. 4. Working process of iBeacon technology

How does an iBeacon broadcast signal in specific areas? There are two main modes that a Beacon works, advertising and connecting. iBeacon uses the former. "Advertising is a one-way discovery mechanism." [4] By advertising, Beacons will transmit packets of data in different intervals from 20ms to 10 seconds in order to let other smart devices in certain areas discover them easily. Of course, the shorter the intervals, the faster the Beacon can be found, and the higher the energy consumption is, the battery life is shorter correspondingly.

### A. BLE packet format

The data packets in no more than 47 bytes in length and composed of 4 parts shown in Fig.3.

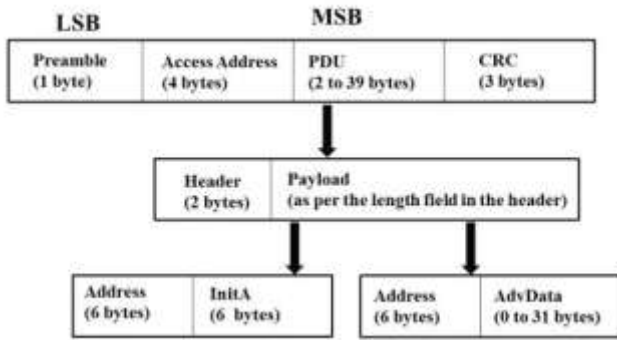


Fig. 5. BLE packet format

Packets sent by a Beacon consist of 4 parts [4]: 1) Preamble All Link Layer packets have one byte preamble. The preamble is used in the receiver to perform frequency synchronization, symbol timing estimation, and Automatic Gain Control (AGC) training.

2) Access address The Access Address for all advertising channel packets shall be 0x8E89BED6. For data channels, it is different for each Link Layer connection between two devices 3) Advertising channel PDU has four types: a) ADV\_IND: connectable undirected advertising event b) ADV\_DIRECT\_IND: connectable directed advertising event □; c) ADV\_NONCONN\_IND: non-connectable undirected advertising event □ d) ADV\_SCAN\_IND: scannable undirected advertising

Event 4) CRC error detection

#### 2.1.2 how does ibeacon work?

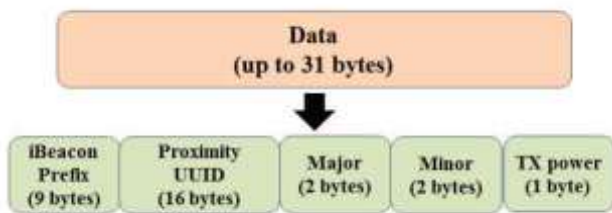


Fig.6. Work principle of iBeacon

Breaking down the iBeacon format, there are five parts [5]: fixed iBeacon prefix; the proximity UUID: an identifier used to distinguish your Beacons from others, such as your stores or a museum; the major number can group a related set of beacons in an organizations, such as a floor in a store or a exhibition hall in a museum; the minor number can be used to identify individual beacons in a specific areas because each Beacon have a different minor number, by which we know where the customer is exactly; TX power, is used to determine how close you are to a beacon. It can be presented either as rough information (immediate/far/out of range) or as a more precise measurement in meters. An iBeacon can be placed in around an item (goods, art works, or some places of a shop or institution) or a special areas, take the lobby or the hallway between two exhibition halls or between the exhibition hall and other area. In addition, iBeacon technology is not an Apple's monopoly. Android devices can also support it. iBeacon technology will be used widely in our social lives for its low cost, low energy consumption and the tiny shapes.

#### IV HOW PROXIMITY TARGET MARKETING HAPPEN

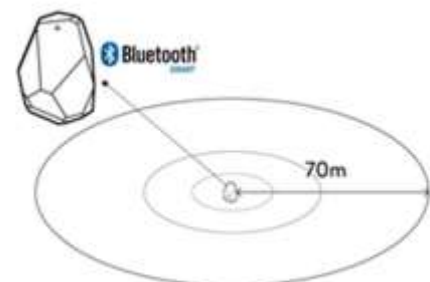
As an indoor positioning system, iBeacons are popular in

commercial fields. Push information about what's on sale. With an iBeacon, the software in a smart device or smartphone, can find where they are, and get notifications from the items nearby that are on sale. Even more, customers can pay at the "point of sale (POS)" without touching their credit cards or wallets at all. Control the shoppers' behaviors via recommending services automatically by iBeacons. In a store, the retailer can sense shoppers' interests via the calculation of time a shopper in front of a specific item in the store, and then, the software in shopper's smartphone will show the other color or style of this item, or even let shopper access to the online shop to compare the price and style at real time. If the shopper does not buy an item, they will get some advertisements or coupons relevant to this item later. Promote O2O commercial actions. The retailers can gather shoppers behavior info, for instance, the shopper have ever seen the same goods in the other store of the same chain online or onsite with iBeacon technology. And then, push the good

coupons info at the store, meanwhile, show the shopper this goods in their online shop, so as to guide shoppers make purchase online or offline. iBeacon technology brings many chances for the retailers to keep broadcasting the items/events info automatically by smartphone APP of users; to tracing users interests or potential demands; to contextualize shoppers' purchase tendency. All these, no doubt, will be great help in commercial fields [6]. And it also can be worked well in other scenarios, take museum for instance. Proximity Targeting Suite (Software and Hardware) is leveraging the power of Mobile and stateofheart LowEnergyWiFi technology to reinvent the instore shopping experience



Figure 7: Connection Establishment with Smartphone



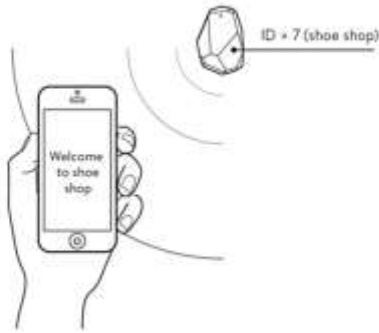


Figure8: Person with Smartphone entering in beacon range

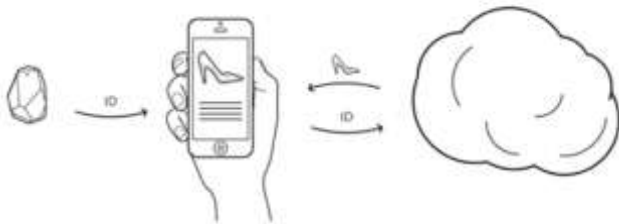


Figure 9: Showing deal on Smartphone

### B. Always active

The app that use this technology are able to understand when an iBeacon enters its range even if the app is not running or if the device is locked, whether it is IOS or Android [3] (Fig.9)

### C. Always knows where you are

The mobile device is always able to understand the area in which we are, dividing it into 3 parts. When we change the area it perceives it through the id and signals by changing the state and context of the app. The app is also able to understand whether we are entering or exiting a given area.

## VI. The application

In order to improve the customer experience, many new things can be integrated such as: report discounts and sales, invite them to come in, show them videos and info about the products they are viewing, allow a fast payment and surveys on their tastes. All this is achieved through a single app, and most importantly, depending on the proximity to other beacons or devices [3] (FIGURE 9) Now we are going to examine three possible app examples which were created to better demonstrate and explain how this technology works App is essential to understand how iBeacon works, and in fact it underlies all the mechanisms of this technology. This app measures the distance from the iBeacon to the IOS device and determines its position through the ID. This app can also determine if the device is

still and if it enters or leaves an area, in order to vary the contest in which it is! [4] (FIGURE 5) The way this technology operates is very simple. The iBeacon sends its ID, from which you can determine the signal strength. This is constantly monitored through the power and calibration of the device and it's easy to deduce

the distance from it. Figure 10: showing Hardware of beacon & figure 11 with Battery added to beacon & signal transmission started

Green LED glows indicated transmission started.

### The proximity demo app

In this demo the iBeacon's functionality is used as before, but in a way not only to monitor the distance but also to provide useful information to those who use it according to the context in which it is located. For example, when you come into range of a store shows the welcome message (Figure 8), then a presentation of a special collection of shoes and finally news on a particular model. (Figure 9).



Figure 10: Hardware of beacon



Figure 11: Battery added to beacon & signal transmission started  
Green LED glows indicated transmission started

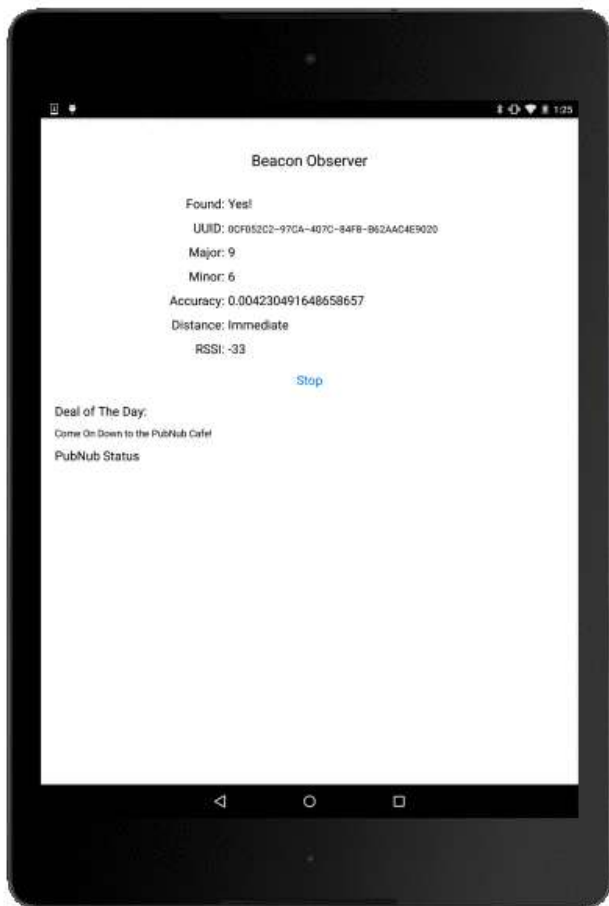


Figure 12: Result showing in android app

(FIGURE 12) with result in android app call Beacon observer. In this app.. We can observe distance of person from beacon also. App. Showing UUID of smartphone connected. Last showed Deal from retailer .

### VII. Conclusions

In this paper, we demonstrated a possibility to extend the method to advertise with aware of the contest of human behavioral patterns using iBeacon. As an example, we proposed an extended iBeacon for Proximity target marketing. .We also performed a simple experiment using our application software implemented for the route guidance to work on a Android OS smartphone. iBeacon as a low cost , low energy consumption tiny device with BLE technology is widely used in commercial fields, especially in retail areas. Its characteristics make it available to applied in museum scenario, and provide visitors with chance to interact with collection of an exhibition ultimate supports at real time. In this project, we addressed a system design in which iBeacons is utilized.. In most cases, individuals with mobile devices in a close proximity to a business can receive marketing messages.For Proximity Targeting uses Bluetooth or our proprietary low energy technology to send messages electronically to nearby consumers.

### Benefits by using this system are

Increase mobile engagement  
Retailer-branded experiences  
Seamless and valuable for consumers  
Combat showrooming  
Influence buying decisions at right place/time.  
Enhance in-store shopping experience  
Insights into in-store shopping behavior  
Key component of omni-channel strategy.

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