



iBeacons Bible 1.0

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Preface

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| <p>Who is Andy Cavallini and what's Gaia-Matrix?</p> | <p>Andy Cavallini is a Computer Engineer involved in</p> <ul style="list-style-type: none"> • designing, managing, implementing software projects • building digital solutions and products <p>for European companies and organizations such as Nectar – Aimia Group (loyalty management), Vibram (high performance rubber soles), the Chamber of Commerce of Milan, Toshiba Global Commerce Solutions (IT solutions for retail), Coop (<i>big-box</i> retailer), etc.</p> <p>As a Sr. Project Manager and Business Analyst, under the Gaia-Matrix brand, Andy Cavallini works with many international Business and IT professionals.</p> |
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Introduction to iBeacons technology

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| <p>iBeacons technology in a few words</p> | <p>“iBeacons” is the name Apple chose for a particular technology that allows Mobile Apps (running on millions of recent iPhones, iPads, etc.) to know how close they are to tiny, low-cost, wireless transmitters called “hardware iBeacons” (or just “iBeacons”).</p> <p>It’s important to note that iBeacons technology isn’t an Apple’s monopoly: all recent Android devices already support it too.</p> <p>iBeacons broadcast signals using the well-known Bluetooth Low Energy (BLE) standard, allowing precise, indoor geo-location (often called “Micro-location”), but also contextual interaction/engagement, as proximity to an iBeacon can trigger some specific App functionalities.</p> <p style="text-align: center;"><i>Digression: iBeacons (short) story</i></p> <p style="text-align: center;">Earlier this year Apple subtly introduced iBeacons as part of iOS 7 at WWDC 2013 (Worldwide Developers Conference), though it revealed the feature only in a single keynote slide and didn't go into detail at all.</p> <p>Of course there is more to iBeacons technology, but before entering into the details, let’s see in advance a simple Use Case to understand the benefits of this technology (more Use Cases are described later on).</p> <p>[To know more about support and compatibility, refer to the iBeacons hardware and software support section]</p> <p>[To read additional interesting Use Cases, refer to the iBeacons Use Cases section]</p> |
| <p>Fancy a simple iBeacons Use Case as a starter?</p> | <p>Let’s pretend that Joe is a shoes store-owner and that Jane is a loyal shopper who installed Joe’s store iBeacon-enabled Mobile App on her iPhone (or Galaxy S3).</p> <p>Jane is visiting Joe’s store; an iBeacon mounted under a store-shelf will alert Jane’s iPhone that she (Jane, loyalty-card #28746) is in a particular physical location, for example in front of Nike shoes, and allows Joe to monitor her behaviour (for how long is she looking at Nike shoes?).</p> <p>Thanks to this technology, Joe is able to serve Jane customized offers (for example a discount-coupon for Nike shoes) according to her behaviour, shopping history, etc.</p> <p>That’s just the tip of the iceberg – there is a lot more Joe could do using iBeacons technology.</p> <p>[To read additional interesting Use Cases, refer to the iBeacons Use Cases section]</p> |





Let's get back to iBeacons technology: two valuable key concepts...

To better figure out how iBeacons technology works, we have to understand two key concepts: **Micro-location** and **Interaction/Engagement/Context**.

First key concept: Micro-location

iBeacons technology allows your Mobile device to understand its position, even in indoor locations where smartphones or tablets are not able to pick up GPS signals from satellites overhead – that's geo-location with a very high level of granularity, conventionally known as **Micro-location**.

Digression: about current geo-location technologies

It's difficult for radio signals to go through the bricks, steel and glass of buildings, that's why GPS doesn't work well indoors; moreover Global Positioning System is not suitable for reliably determining distances within 15/20 meters – so road-navigation is ok, indoor location (especially in multi-floor buildings) is not.

You could object that modern geo-location technologies also triangulates signals from cellular towers or WiFi hotspots where GPS is partially available (or not available at all); that's true, but anyway the results are quite approximate considering both stability and precision.

How does fine-granularity positioning work? It's simple, iBeacons-enabled Apps on your Mobile device are notified when the device moves in and out of range of iBeacons, and are able to monitor the distance as their proximity changes over time.

This allows Apps to know precisely where they are not in terms of a map-location using longitude and latitude (like GPS does), but considering where the Mobile device is relative to known points.

Digression: iBeacon-enabling a Mobile App

Existing Mobile Apps need to be upgraded to be iBeacon-enabled, but fortunately the impact from a software development point of view is quite limited.

For example, a retailer may already have a Mobile App shoppers use to manage their loyalty-card and to receive coupons; this App could be easily upgraded to also interact with iBeacons installed in the retailer's chain of stores.

Let's talk about hardware iBeacons: they are little battery-operated radios you can place wherever you want; if your Mobile device gets within range, it senses iBeacons and locates itself.

iBeacons broadcast a "I am here!" message more or less once per second to any device within range of the Bluetooth Low Energy radio signal; since each iBeacon has its own ID, the Mobile device can tell them apart and recognize the context of the world around itself.

Note that iBeacons broadcasts have no data payload: they just identify themselves via customizable IDs.

[To know more about iBeacons IDs, refer to the **iBeacons IDs** section]

Using strategically installed iBeacons, your smartphone or tablet work out where it is with an extraordinary degree of precision – an accuracy far higher than that of GPS.

[To know more about iBeacons spatial accuracy, refer to the **iBeacons location precision** section]





Features of the iBeacons technology

Second key concept: Interaction/Engagement/Context

After understanding the first key concept (Micro-location), let's now talk about the second key concept: **Interaction/Engagement/Context**.

The iBeacons signals enable interaction with Mobile Apps, for example triggering some App functionality to perform a specific action on a specific Mobile device – at exactly a specific time and in a specific location.

In other words, iBeacons signals express two valuable concepts at the same time: “This is where you are” and “This is what you (can) do”.

iBeacons therefore make it possible to effortlessly engage with people in a physical space through their Mobile devices.

Two key concepts recap

Creating a smart location-oriented infrastructure provides Mobile devices with contextual info based on the environment they move through; iBeacons technology can be leveraged to make Apps aware of the user's context: who is she AND where is she (at a specific time); this feature allows a new level of interaction and engagement – that can be furthermore improved if the App is able to connect to the Net, for example to fetch the user's shopping history, updated info about traffic or meteo, etc.

Let's shed some light on other interesting features of the iBeacons technology: here we have a list of items in no particular order.

Item #1: Mobile App automatic start

Mobile devices will automatically react to when they come within range of iBeacons: there is no need to take your iPhone or Galaxy S3 out of the pocket to manually start the pertinent iBeacon-enabled App.

iBeacons are identified in the background by iOS or Android, and the pertinent App is started when necessary; in technical words, an App can register with iOS/Android to be started when specific types of iBeacons move in the range of the device.

Of course you have to install the pertinent iBeacons-enabled App before you can actually enjoy iBeacons benefits – currently there is no mechanism to auto-install Apps.

Item #2: Energy consumption

I know what you are thinking: geo-location and Bluetooth combined are batteries drainers.

Don't worry, actually Bluetooth Low Energy standard (*...as the name implies...*) is very, very battery friendly.

Item #3: Hardware iBeacons deployment

Hardware iBeacons are very easy to set-up and deploy; consider also that they are quite low-cost and will become almost free when critical mass (and economies of scale) will be reached; there are already a number of hardware companies selling iBeacons on the web.





Item #4: Internet connection

No connection to the Net is necessary (even though accessing valuable resources in the cloud is always beneficial), so your 3G data-plan won't be affected – and there is no need to switch WiFi on as well.

Item #5: From listening to broadcasting

So far we have considered Mobile devices passively receiving signals from hardware iBeacons, but Mobile devices can also actively transmit signals and become *de facto* iBeacons – opening your Mobile world to new useful possibilities.

A person with a Mobile device in the pocket performing as an iBeacon is able to trigger action around her (for example switching lights on, unlocking doors, etc.) just by announcing her vicinity to devices listening for it via Bluetooth Low Energy.

By the way, many desktop/laptop computers are iBeacons-enabled too, and that opens up further possibilities.

Thinking about it, iBeacons could significantly push the concept of **Internet of Things**, a network of connected “smart” physical objects we can interact with.

[To know more about support and compatibility, refer to the **iBeacons hardware and software support** section]





iBeacons Use Cases

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| iBeacons for retail | <p>Are iBeacons born for retail? The level of targeting that iBeacons technology provide could greatly change how brands and companies interact with customers and improve their shopping experience; that's why retailers – above all others – are paying so much attention, and some proofs of concepts are already underway in selected stores in Europe and in the USA. Marketers want to join the party too, since iBeacons technology is sparking new marketing ideas: advertising probably won't be the same any more.</p> <p>Let's see some interesting Use Cases.</p> <p>Contextualized deals iBeacons technology allows to convey specific, customized deals to shoppers based on the time/day/..., which aisle they're in (remember the first key concept, Micro-location?), their purchase history, their loyalty profile, etc. (apply here the second key concept, Interaction/Engagement/Context) Think of very customized offers; for example a shopper has checked an item in store but did not purchase it: the retailer can offer the shopper a discount via email or directly on the Mobile device the next time she enters the same store (or another store of the same chain).</p> <p>Monitoring shoppers behaviour Monitoring shoppers behaviour (store visits, walking-paths, etc.) is another possibility: for example the iBeacons system allows the retailer to know (in real-time) that the shopper has been standing in front of one specific display for more than three minutes; sensing second-by-second a shopper's (<i>inferred</i>) interest about a specific product, the system can supply additional information such as online reviews and – talking about fashion – other available styles or colours. As you go on shopping, a blue tie might (metaphorically) tell you: "I'm perfect with the gray suit you purchased here last week".</p> <p>You can even do real-time A/B testing (a method very dear to online marketers, that allow to directly compare the results of different marketing initiatives) with different displays in multiple stores: which one gets the most attention?</p> <p>The online/offline integration (a.k.a. "Multi-channel integration") The retailer can gather, for instance, if the shopper visited the same store or other stores of the same chain, which shelves/items she checked there, if she previously went online on the retailer's website to check out the same or different items, and so on. Come to think about it, iBeacons technology allows an effective integration of online and offline shopping, for example a customer may shop in a retailer's store and, while there, picks also up the items purchased the evening before on the retailer's ecommerce site.</p> |





That's what retail experts call "**Multi-channel integration**", the beneficial merging of the online and the offline shopping experience. iBeacons make things like abandoned online shopping-cart follow-up a realistic opportunity for brick-and-mortar stores.

Furthermore, the integration of online and offline analytics allows, for instance, to evaluate conversion-rates that can help maximize ecommerce and in-store sales at the same time.

The big deal for retail is...

Acquiring a wealth of information on in-store shopping behaviour in real-time **prior to purchase** – that's the big deal.

Let me explain; shopping in brick-and-mortar stores hasn't evolved much during the past 100 years: shoppers enter a store, get hold of the items they need, pay them and then carry their purchases out of the store.

Traditionally, shoppers' behaviour can be realistically deducted only at the end of the shopping process, at payment time – when the loyalty-card and all the purchased items are scanned by the cashier.

So far real-time shoppers behaviour monitoring has been possible only online; but from now on – using iBeacons – this tremendous opportunity is available also in-store.

Shopper-engagement

Let's make an example of shopper-engagement: in a DIY-store the iBeacons system could allow a shopper to receive a notification regarding an upcoming workshop session he may wish to attend to – topics of interest can be automatically deducted considering his purchase history, surveyed hobbies, etc.

iBeacons in a small neighbourhood store

iBeacons potentially are ideal for big retailers with huge store chains, but could as well be conveniently employed in small stores, with very limited investments; a mom and pop store can easily iBeacon-enable the Mac (or iPad) already used for their POS system, so coupons automatically come up on shoppers' Mobile devices when close to the cashier's desk – cheap, simple, but effective.

Retail: a recap of what we learned so far

Remember the wise words of John Wanamaker? "Half the money I spend on advertising is wasted; the trouble is I don't know which half".

Retailers can now target the right shopper, in the right place, at the right time, interactively engaging her in new ways – while learning in real-time from her movement patterns and behaviour.

Could shopping with your Mobile device as a loyal assistant become a reality? Or are shoppers too "conservative"? Only time will tell, however consider that today a fast increasing number of consumers already use their smartphones during shopping to investigate and compare products – so let's consider this nascent habit already in place.





iBeacons ~~for retail~~ in other situations

Are iBeacons just for retail?

iBeacons are not just for retail, there are a lot of other situations where applying the two key concepts of this technology (Micro-location and Interaction/Engagement/Context) can prove to be very valuable.

Museums and exhibitions

Visiting a museum or an exhibition will be a different experience thanks to iBeacons technology: micro-location and interactivity allow visitors to get information about the objects or products they are seeing and to be timely notified of pertinent events, sessions, workshops, etc.

At the same time, it's possible to track which expositions attract the most foot traffic.

Mass transit

Think about the value of iBeacons in an airport or in a train station.

Interested, for instance, about a train travel App that is aware of which train you are travelling on, and – as you board – automatically starts plotting your train's real-time progress?

Fancy an airport interactive guide that shows you the shortest way from Check-in to your Gate?

Healthcare

There could be also very important healthcare applications; imagine a doctor visiting patients: his iBeacon-enabled tablet could precisely know about its location inside the hospital, and automatically fetch the information for a specific patient – saving time and avoiding dangerous mistakes.

Sport events

In a sport stadium your Mobile device could direct you to the fastest route from the parking-lot to your seat.

Parking

Don't remember where you parked your car?

In a multi-floor parking garage your Mobile device could help to quickly find your exact parking space.

A final recap

iBeacons are quite flexible, aren't they? Innovative applications will come up every day, once critical mass will be reached; finally your Mobile device will have the chance to evolve from an high-priced time-killer (...an "angry birds machine"...) to a valuable time-saver.





iBeacons hardware and software support

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| Companies supporting iBeacons | <p>iBeacons technology is cross-platform The great news about iBeacons technology is that both Apple (with iOS and OS X) and Google (with Android) have committed to support for Bluetooth LE – this means very, very broad availability (literally millions of devices are already iBeacons-enabled) and no danger of launching services that only target a single OS.</p> <p>What about Microsoft? Microsoft appears to have recently added support for Bluetooth Low Energy in Windows 8 and Windows Phone 8; Nokia's recent Lumia WP8 phones are confirmed to include BLE hardware.</p> |
| Apple's iOS/OS X and Google's Android | <p>Let's get into details of hardware and software support for the two main players, Apple and Google.</p> <p>Apple's iOS/OS X The following iDevices – running at least iOS 7 – are supported: iPhone 4S or later, iPad 3 or later, any iPad mini, iPod touch 5th generation or later. Macs (equipped with at least OS X 10.9 Mavericks): mid-2011 MacBook Air, Mac mini, mid-2012 MacBook Pros. Earlier Macs can add Bluetooth 4.0 support through a third party USB dongle.</p> <p>Google's Android The first version of Android supporting iBeacons is 4.3 (Jelly Bean). Many Android devices already support Bluetooth Low Energy: Samsung Galaxy S3, Samsung Galaxy Note II, HTC One, Nexus 7 2013 edition, Nexus 4, HTC Butterfly, Droid DNA, etc.</p> |





iBeacons IDs

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| How does an iBeacon identify itself? | <p>An iBeacon identifies itself using three customizable values: Proximity UUID (128 bit), Major and Minor (16 bit each); there is also an additional Internal Identifier for your own reference.</p> <p>Therefore you have three levels to identify a micro-location: only Proximity UUID, Proximity UUID and Major, Proximity UUID and Major and Minor.</p> <p>For example, Proximity UUID identifies your entire retail company, Major identifies a specific store and Minor specify individual shelves or different checkout tills inside each store.</p> <p>Another example: Proximity UUID identifies your museum, Major identifies a specific gallery within the museum and Minor identifies an exhibit within that gallery.</p> <p><i>Digression: Proximity UUID in detail</i></p> <p>To generate a genuinely unique 128-bit Proximity UUID for any iBeacon, you can use the Mac OS X <code>uuidgen</code> command-line tool.</p> <p>Since this procedure is not mandatory or enforced (you can choose your 128-bit Proximity UUID as you like), true uniqueness is not guaranteed.</p> |





iBeacons location precision

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| iBeacons ranges/regions | <p>iBeacons signals allow to calculate distances in quite an approximate and qualitative way – specifically your iBeacon-enabled can monitor three ranges/regions:</p> <ul style="list-style-type: none">- Immediate (less than 50 centimetres)- Near (approximately between 50 centimetres and 2/5 meters)- Far (more or less between 2/5 meters and 30/50 meters, depending on walls, the iBeacon output power and many other factors) <p>Bear in mind that – especially indoors – radio signals jump around constantly: that's why ranges are not precise.</p> <p>For the same reason, delays are artificially introduced so that region changes can be conveniently minimized when the Mobile device moves back and forth on the boundaries; to be specific, while entering a region is sensed almost immediately, leaving it is usually notified with a delay of several seconds.</p> |





iBeacons security and privacy

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| Security | <p>Since data broadcasted by an iBeacon is public, anyone could pick up the signal and use it within an “unofficial” Mobile App: retailers plausibly don't want third-party Mobile Apps to trigger actions on shoppers' Mobile devices once they are in <u>their</u> stores.</p> <p>Or – even worse – an hacker may clone an iBeacon for some fraudulent reason.</p> <p>How to prevent hackers from "hijacking" iBeacons and mess with your micro-location infrastructure?</p> <p>Companies who fears for the security of their iBeacons can use effective encryption techniques to prevent unauthorized manipulations.</p> |
| Privacy | <p>Can privacy become an issue with iBeacons technology? Yes it can, actually.</p> <p>Consumers may not be pleased about the fact of being monitored by retailers at every step in the store and have the right to know how their location information (and any other data) is used.</p> <p>Additionally, what happens if consumers are constantly fired on with unsolicited location-based offers as they walk through town? Game over, iBeacons-enabled Mobile Apps would be considered like a plague.</p> <p>Some (common sense) advice for retailers</p> <p>To be successful, iBeacons-based marketing needs to be respectful of the consumer and must improve the shopping experience – not kill it shamelessly.</p> <p>Retailers, be as transparent as possible and clearly explain how your iBeacons system works and how it interacts with your shoppers' Mobile devices; tell what data is specifically monitored and stored (and for how long). Finally, do your best to build a clear and smooth Opt-in/Opt-out process.</p> |





Conclusion

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| <p>The end? No, it's just the beginning...</p> | <p>This is the final section of the iBeacons Bible, but it's not the end – there is still so much to do.</p> <p>iBeacons technology is very powerful and flexible, so we (engineers, marketers, creatives, etc.) have the opportunity to create new important applications to improve the life of people and to create business value for big and small companies.</p> <p>iBeacons technology will evolve, and this Bible will evolve too, so feel free to visit http://www.gaia-matrix.com to download the latest version of this document.</p> |



