Venkatesh Babu* and Ashok Yalamanchili**

*Sr. Principal Architect, Technology CoEs in R&I group @ iGATE
**Technical Lead, Technology CoEs in R&I group @ iGATE

Indoor Positioning System (IPS) using Beacons

Introduction

What is IPS?

An indoor positioning system (IPS) is a network of devices used to wirelessly locate objects or people inside a building.

Why IPS?

Due to the signal attenuation caused by construction materials, the satellite based GPS signal loses significant power indoors. For this reason the receiver cannot get coverage of 4 satellites which atleast is needed to accurately get the location coordinates.

The consumer devices will have a maximum location accuracy of 10 mts when the location is set by the GPS. This accuracy is not acceptable with respect to the use cases for indoor positioning and navigation as a lot of things change at indoor level, for eg. aisles are placed adjacent to each other within a distance of 1-2 metres in a retail store or there can be multiple stores within a distance of 10 meters in a mall.

Also due to the nature of indoor environment, GPS cannot provide information about the floor and building level at which user is located.

This brings up the need for a system where a user/object has to be located inside a building accurately and precisely to make positioning and navigation inside indoors as easy as outdoors.

Current Scenario

Even though there was a market pull for this technology from a long time, it didn't come into mainstream due to limitations of the software / hardware available with consumers in general. Now that smart phones are ubiquitous, the technology is gaining momentum in terms of scale and variety with the entry of innovative companies.

Future Market

The global indoor positioning market is estimated to grow from $448.6 million in 2013 to $2.60 billion in 2018. (Source: www.marketsandmarkets.com)

Usage of IPS

Indicative list of use cases and scenarios where IPS can be used are given below

Consumer:

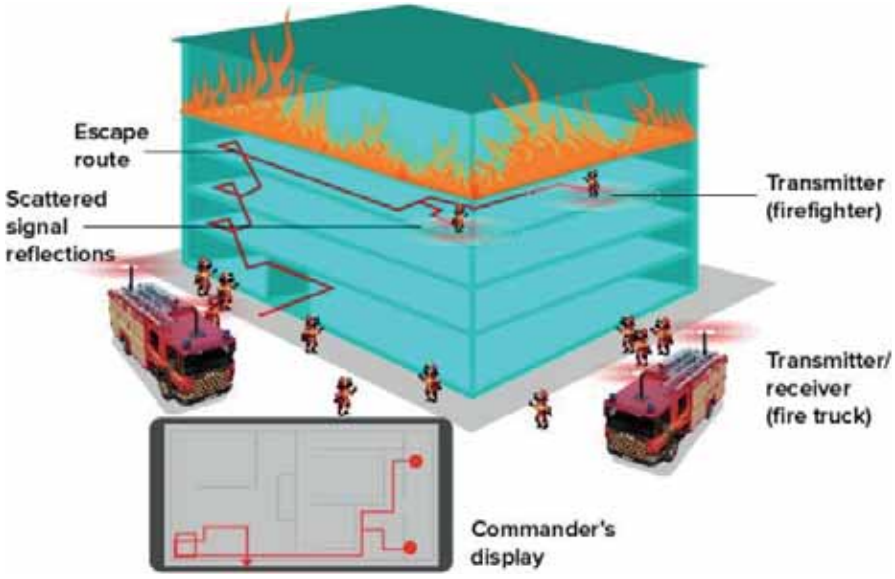
- Transportation hubs like Airports, Railway & Bus stations
- Indoor venus like university campus, hospitals
- Commercial venus like shopping malls, offices

Non Consumer:

- Emergency services like fire rescue, police and medical
- Asset tracking & logistics for offices, hospitals, industries and retail stores
- Industrial Automation

Source: www.extremetech.com (http://www.extremetech.com/extreme/126843-think-gps-is-cool-ips-will-blow-your-mind)

Source: Internet, Enhanced by iGATE



Enabling Technologies for IPS Solution

Some of the enabling technologies used for an IPS solution are listed below

- Wi-Fi access points
- BLE Beacons
- Sensors (Accelerometer, Gyro, Compass, etc.)
- Indoor Lights
- Magnetic Field
- Low Orbit Satellites
- Camera Technology

iGATE chose to experiment with BLE Beacons and Wi-Fi access points. Sample BLE beacons images are given below.

Source: Beacon's images are from their respective vendor websites

iGATE's Exploratory Activities

iGATE has worked on the PoCs for proximity using Estimote's iBeacons, positioning and navigation using indoo.rs bluetooth beacons and its framework.

Proximity PoC: In this PoC, bluetooth beacons are placed in the store at strategic positions and configured with their major and minor identifiers. If the user with the mobile app comes into the field of the beacons, then an offer that is configured for that beacon will be pushed to the user.

Indoor positioning and Navigation PoC: This PoC will provide the user his current location with an accuracy of 1 meter which gives accurate results from an analytics perspective. The user can also navigate inside the store based on the products he has in his shopping cart.

iGATE is building a omni channel solution which will enable retailers to push real time personalised promotions and offers to the customers, also identify the customer behaviour across physical stores. The offers that are pushed are based on the users past shopping history across different channels like web, mobile, and physical store. In addition to this the product also gives insights like how the customer has moved inside the store, dwell times at particular aisles.

Challenges

There were many challenges encountered by iGATE while implementing an indoor positioning system. Some of the these challenges are mentioned below

Precision and Latency - The amount of time for which the user can get his current position with maximum accuracy varied a lot from vendor to vendor. We got a precision of 1-2 mts for 70% of the time by using Bluetooth Low Energy (BLE) beacons based IPS. When the Wi-Fi Access Points were used for positioning, we got a precision of 5-8 mts for 60% of the time. Latency is the time taken by the system to identify the users position from the time the request to get location is sent from the device to the server. Typical latency of 5-6 seconds was observed to get the position with good accuracy.

Signal accuracy & stability - The signals emitted from either Wi-Fi AP's / Bluetooth beacons are prone to be absorbed by human bodies, walls, aisles and other structural elements. This creates interference to these signals and it gets more complicated if people are moving which creates more fluctuations ultimately leading to stability issues. One of the main challenges for the IPS to work consistently is to minimize the effect of these interferences by filters implemented by IPS providers.

Structural movements – Any change in the position of a sensor or change in the structure will need a recalibration of the entire area of interest, so that accurate results are provided by the IPS.

Power consumption - Although Bluetooth LE consumes less power on a mobile device compared to Bluetooth 2.0/3.0, continuously fetching the position will involve significant battery consumption as the location has to be fetched from the server. Beacon vendors typically specify a battery life of 1-2 years per beacon, but during our solution implementation, we found that batteries drained out in less than 6 months.

Supporting multiple devices - Another major challenge for these IPS solutions is to have compatibility with multiple platforms, device and Operating System versions. As the current mobile market is highly fragmented this becomes a major challenge in selecting the IPS solution.

Conclusion

IPS seems very promising which can be leveraged in many scenarios / areas. There are many vendors that are heavily investing in this space. Some of the major players that are having a considerable impact in this space are

- Navizon (http://navizon.com/indoors-solutions)
- Meridian apps (http://www.meridianapps.com/)
- Aisle411 (http://aisle411.com/solutions/publisher-solutions/)
- Indoors (http://indoo.rs/)

Even though there are many vendors out there in this space, the technology is still at a very nascent stage, accurate and easy-to-setup solutions can make IPS realize its full potential in many areas.

References

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About the Authors

Venkatesh Babu is a Sr. Principal Architect working in the Technology CoEs in R&I group @ iGATE. He has more than 20 years of experience in IT industry and is currently involved with R & D of emerging trends & technologies. The R&I Technology CoE team works on PoCs, Solutions, and provides thought leadership for evangelization of new trends / technologies for solving business problems of clients.

Ashok Yalamanchili is a Technical Lead with more than 7 years of experience in IT industry. At iGATE, he is currently working in the Technology CoEs in R&I group working on emerging technologies and trends. The R&I Technology CoE team works on creating POCs, Solutions, evaluating new technologies and helps in client engagements.