1. Introduction

# Indoor Positioning System:

An **indoor positioning system** (**IPS**) is a network of devices used to locate people or objects where [GPS](https://en.wikipedia.org/wiki/Global_Positioning_System) and other satellite technologies lack precision or fail entirely, such as inside multistory buildings, airports, alleys, parking garages, and underground locations. A large variety of techniques and devices are used to provide indoor positioning ranging from reconfigured devices already deployed such as smartphones, [Wi-Fi](https://en.wikipedia.org/wiki/Wi-Fi) and [Bluetooth](https://en.wikipedia.org/wiki/Bluetooth) antennas, digital cameras, and clocks; to purpose built installations with relays and beacons strategically placed throughout a defined space.

What are the applications of Indoor Positioning?

From mobile navigation to location-based engagement and analytics, Indoor Positioning has plenty of use cases.

Location-based Services With an accurate indoor positioning system, venue owners can guide visitors with turn-by-turn navigation as they walk through the venue. Routes are personalised for visitors, who can navigate to their car or to their favourite shop. This is particularly useful in large venues such as airports, shopping centres, resorts or workplaces. Indoor positioning systems also have the added advantage of being able to understand which floor of a building you are on. This is not possible with GPS. With indoor wayfinding at their fingertips, visitors enjoy a better, more relaxed experience at the venue. Navigation is just one of many use cases a better indoor experience. Other use cases include: • Share your live location with colleagues, friends or family when you’re indoors • Order food at your exact location inside a venue • Search live information about products, stores and services available • Provide assistance for visually impaired people.

Location-based Analytics Indoor Positioning can also be used to give venue managers insights into the volume of people in a particular area, plus finer detail such as returning customers or clients and the location and concentration of crowds. Shopping centres can use this intelligence to drive informed leasing strategies. Airports can react to real-time data and ensure that resources are being allocated in an optimal way. Asset tracking makes it possible to get the real-time position of trolleys and wheelchairs and ensure they are available when customers need them. Crowd analytics makes it easy to check the passenger density in a specific area so that queues are kept to a minimum. By leveraging smartphones, smart IoT sensors and Bluetooth and Wi-Fi networks, it is now possible to get location analytics solutions up and running quickly and easily in physical venues.

Location-based Marketing Indoor Positioning can be used to recognize when a user’s smartphone or tablet has moved into a specific location, thanks to a technique called geofencing. The system can then send a notification to the smartphone, alerting them to special offers, opening times, freebies; anything that increases customer engagement. Common places to find contextual notifications are:

• Airports, particularly around duty-free

• Shopping centres, supermarkets

• Other transport hubs, like train stations

• Conventions and exhibitions Someone walking to their flight in an airport may pass duty free. If they have accepted to receive offers, they can receive a personalized notification informing them of special offers tailored to their needs. Another notification can inform them that they need to make a move to their gate when boarding is starting, and guide them through the airport. That’s just one example of the multitude of uses for location-based marketing.

Which Indoor Positioning Technologies are available today? In the absence of GPS, Indoor Positioning Systems utilise several different techniques, each with slightly different results. In this section, we give an overview of the most common techniques used today.

Bluetooth Low Energy & Beacons(hardware)

Fingerprinting (Wi-Fi, Geomagnetic)

# Indoor Navigation System

Indoor navigation is a system, tool or app that enables the user to be guided through an indoor location, typically via a handheld interface such as a smartphone, or by a static interface such as an information kiosk. Handheld interfaces will aim to provide turn-by-turn instructions and account for the steps the user has already taken (known as dynamic wayfinding), while an interface like a kiosk is more likely to simply show the route overlaid upon a map and rely upon the user remembering how to get to their destination. Indoor navigation systems universally rely upon an accurate map of the indoor location being available, and, in the case of dynamic wayfinding systems, the ability to accurately calculate a user’s position within an indoor environment is also required.

Here I will speak about various systems:

* Google Map Platform

Google Maps Platform Features

Google Maps Platform offers a comprehensive suite of tools and APIs to integrate maps into your applications. Here are some of the key features:

Core Mapping Features

* Maps SDKs: Create custom maps for web and mobile applications with interactive features.
* Static Maps: Generate static images of maps for embedding on websites.
* Street View: Integrate 360-degree street-level imagery into your applications.
* Geocoding: Convert addresses into geographic coordinates and vice versa.
* Geolocation: Determine a device's approximate location using Wi-Fi and cell tower signals.
* Directions: Calculate routes between points for different transportation modes.
* Distance Matrix: Calculate distances and travel times between multiple locations.
* Places API: Search for places, get details about places, and find nearby places.

Advanced Features

* Elevation API: Get elevation data for specific locations.
* Roads API: Identify roads and their attributes.
* Time Zone API: Determine time zones for specific geographic coordinates.
* Maps Styling: Customize map appearance with different styles and themes.
* Indoor Maps: Create and manage indoor maps for complex locations.
* Location Sharing: Allow users to share their location with others.
* Geofencing: Trigger actions when a device enters or exits a predefined geographic area.

Additional Features

* Route Optimization: Find the optimal route for multiple stops.
* Maps Datasets: Access and analyze geospatial data.
* Maps Styling with Cloud Style Editor: Create and manage map styles in the cloud.

Limitations:

* Indoor Positioning: Google Maps Platform primarily focuses on outdoor positioning. Indoor positioning requires additional technologies like Bluetooth beacons or Wi-Fi fingerprinting.
* Complex Building Structures: For very large or complex buildings, dedicated indoor mapping platforms might offer more advanced features.

## **How do indoor maps in Google Maps work?**

As anyone who has previously tried to use Google Maps in an indoor environment will know, only a limited number of buildings have indoor maps. This is because, unlike the world map that Google is constantly working to keep updated, indoor maps operate more like the local business listings you see frequently on the Maps interface.

The business listings rely upon the business owner to keep them updated and make any changes, such as opening hours or new menus. [Indoor maps](https://www.pointr.tech/solutions/location-based-services/indoor-mapping) are very similar; it is down to the individual business owner to submit their floor plans in order for Google to then turn them into an indoor map and feature them on Google Maps. Naturally, it's much easier for a business to submit an image of their logo or add their open hours via the Google Business Profile manager than it is to submit a detailed floor plan file, for the simple reason that most businesses don't have their floor plan available digitally.

While every business has the ability to submit their floor plans, Google’s own documentation makes it clear that the areas they’re most interested in presenting indoor maps for are large venues that see a lot of foot traffic - buildings that a user is most likely to want and need a map for when inside. [Google specifies](https://www.google.com/maps/about/partners/indoormaps/) venues such as transportation hubs (particularly airports), shopping malls, and stadiums as ideal use cases for their indoor maps.

Once a business has submitted their floor plans, Google is able to convert these plans into a large-scale indoor map, with key points of interest included. Users are also able to toggle which floor or level they’re looking at.

## **What are the benefits of using Google Maps for your indoor maps?**

The key benefit when using Google Maps for your business’s indoor map is the ubiquity of the service. As previously discussed, Google Maps has a gigantic user base, one that no other maps-based app can rival currently. Featuring your indoor maps within Google Maps means that a vast number of potential visitors or customers can benefit from the maps without needing to download a new app or piece of software. Simply telling your customers to Google your maps certainly has a nice ring to it.

Indoor maps within Google Maps are also free. As long as you have an accurate and up-to-date floor plan for Google to work from, there’s no cost to have these floor plans converted into an indoor map. These maps also come complete with the iconic Google Map styling, which will help lend the maps a degree of legitimacy and authenticity that would be lost if a company used a bespoke solution which produced particularly unattractive or difficult to use maps.

## **What are the drawbacks of using Google Maps for your indoor maps?**

There are, however, certain drawbacks to using Google Maps for your business’s indoor maps.

Firstly, not every business may be able to use Google Maps whether they want to or not. Google have an approval process for indoor maps, due to a natural desire on their part to maintain the high quality of their Maps product. If the uploaded floor plan files aren’t detailed enough, or the building in question doesn’t meet Google’s eligibility standards, they may choose not to publish the map.

For those businesses that do have floor plan files accepted, it will still take some time for Google to initially process the maps. The same is true for future updates. While these both also apply for bespoke indoor mapping companies, when dealing with a company the size of Google, which has to handle millions of mapping requests every day, time delays are inevitable.

There are also limitations on the amount of detail an indoor map on Google Maps can contain. Due to being processed via floor plans, Google will naturally omit certain features of a building in order to maximize functionality. In the big venues that Google favor for their indoor maps, such as stadiums and airports, these smaller details - such as seating areas - matter less. However, in cases such as office buildings, the minutiae of desks, chairs, power sockets and meeting rooms are critically important - without them, the indoor map serves little purpose.

Finally, Google Maps has some fundamental drawbacks when it comes to operating as an [indoor positioning system](https://www.pointr.tech/solutions/location-based-services/indoor-positioning).

## **How can I add my indoor maps to Google?**

If, after weighing up the pros and cons of Google Maps, you think they're the solution for your business, you can begin the process of submitting your files for transformation into indoor maps within Google Maps by becoming a mapping partner. You can do that by clicking [here](https://www.google.com/maps/about/partners/).

Becoming a partner comes with the added benefits of accessing the Maps API, which lets businesses layer their own technology and icons upon the foundation of Google Maps, as well as adding immersive 3D tours of the inside of locations to Google.

(To add indoor map to google you need to video 360 degree and file contains coordination for place you want to publish indoor map in google)

## **Can Google Maps be used as an indoor positioning system?**

As discussed, under the right conditions, Google are more than capable of producing detailed, intuitive, user-friendly indoor maps, particularly for large indoor venues such as stadiums and airports, where individual features (such as rooms or lounges) tend to be spacious and clearly separated from one another. As we’ve covered many times elsewhere on the Pointr blog and website, maps form the foundation for any high performance indoor positioning system, and Google have this fundamental requirement covered.

Unfortunately, Google Maps come with one critical drawback that means their efficacy for indoor positioning and indoor navigation is extremely limited; GPS. We have a [full post detailing GPS, how it works and the challenges it faces indoors](https://www.pointr.tech/blog/indoor-gps-does-it-work-everything-you-need-to-know), but if you want a quicker summary of how it impacts Google Maps, read on.

GPS ascertains a user’s position on a global map by triangulating their position using multiple satellite signals. This is the technology used by Google Maps to calculate a user’s position and display it on a map via the blue dot. Outdoors, GPS is a remarkably reliable and accurate system given the amount of data that the system deals with every second. Accuracy is typically within a 10 meter range, which in outdoor environments is more than enough in most situations, particularly paired with other information, such as the internal compass reading of a smartphone to help ascertain orientation.

Indoors, however, it’s a different story.

Firstly, GPS has tremendous difficulty penetrating ceilings. In some cases, GPS is just about able to garner enough signal in an indoor environment to track a device’s position. However, as soon as multiple obstacles are presented - for example, a user in a building with multiple walls either side of them, and several floors above them - GPS signal is almost always completely compromised. For environments such as stadiums, which feature both indoor and outdoor locations and tend to be relatively sparse indoors, GPS may just work; in architecturally complex buildings such as offices or airports however, it is often completely unreliable.

Even if GPS signal is somehow able to find its way into a building and provide a reliable signal, there is a second, equally insurmountable problem to it being used for indoor positioning. As previously mentioned, GPS positional accuracy often has a margin for error around 10 meters. When driving, for example, this level of discrepancy between a user’s reported and actual location tends not to matter too much. Turnings are spaced far enough apart that even if the GPS believes you’re slightly ahead or behind of where you actually are, there’ll be enough information to tell you which turning is the one for you, particularly when this data is fed through a complex algorithm such as Google’s which can incorporate other factors such as orientation and travel speed.

In indoor locations, however, accuracy is paramount. A 10 meter difference could mean GPS believing you’re two rooms away from the one you’re actually in, in a completely different store inside a mall, or multiple desks from the one you’re actually sat at. The same is true for navigation. A 10-meter discrepancy in where you’re actually standing and where GPS believes you are could mean an instruction to turn left or right sending you down the completely wrong corridor.

Because of these two major drawbacks of [using GPS indoors](https://www.pointr.tech/blog/indoor-gps-does-it-work-everything-you-need-to-know), Google Maps’ ability to function as an effective indoor positioning and navigation system is severely impaired.

# Other system

## Navigine (Indoor navigation and positioning but depend on hardware)

Navigine is a global provider of integrated positioning technologies that enable advanced wayfinding and tracking solutions, with over 500 implementations worldwide. We assist developers and systems for people navigation as well as asset and vehicle tracking. We deliver an indoor positioning and analytics platform.

Navigine supports both navigation and positioning.

Features:

Turn-by-turn directions inside shopping malls based onf QR codes, AR or other technologies; a quick search of catering facilities and technical rooms.

Problem:

It depends on BLE (Bluetooth Low Energy) hardware to locating position.

Navigine provides SDK and docs for developers

Documentation:

<https://navigine.com/developers/>

API:

<https://apidoc.navigine.com/>

SDK:

<https://github.com/Navigine/Indoor-Navigation-Android-Mobile-SDK-2.0/wiki>

## Oriient (Indoor positioning system)

GPS has become an invisible but essential part of everyday life. People rely on apps like Waze and Google Maps to guide them from location to location, in addition to a myriad of other services which can’t function without GPS (imagine getting an Uber without GPS…).

But GPS doesn’t work indoors, where we spend 90% of our time.

Indoor GPS has clear benefits to any building with foot traffic. Those benefits spread over various markets & verticals and go far beyond way-finding Way-Finding Help visitors, customers, or tenants find people, products and places.

By providing optimal routes throughout points of interest in a building, people no longer feel lost.

Utilizing navigation decreases user abandonment related to unfound items and locations.

Way-finding saves people time, improves mobile app retention rate and increases satisfaction.

Route planning also offers improved operational efficiency and cost reduction.

Location-Based Actions

Reach app users with messages as they enter, dwell in or exit a predetermined zone, and act contextually on their specific position.

Oriient enables pushing location-based offers or alerts at the right time and place.

Tag and report current positions, and control other systems in the building according to occupancy.

Monitoring & Analytics

Better understand and manage how your space is being used with real-time monitoring and historical data analysis.

Oriient provides building owners and facility managers with a wealth of information about their spaces, without having to install any sensors in the building.

Current user positions are displayed live on a dashboard for controlling logistics and security, and assigning tasks based on proximity and optimal route planning.

Movement patterns are recorded (at an individual level but anonymously) to supply vital information on foot traffic, space utilization and operational efficiency.

These links help to understand system there is no need to any hardware using this system but it is only indoor positioning system:

<https://www.youtube.com/watch?v=D9I3HYmjEq4&feature=youtu.be&start=43&autoplay=1&rel=0&controls=0&showinfo=0>

<https://youtu.be/8FeOayb39JA?feature=shared>

## MapsIndoors (Indoor mapping and navigation)

MapsIndoors is a dynamic mapping platform that integrates seamlessly into any existing application. Using outdoor mapping engines like Google Maps or Mapbox, MapsIndoors takes mapping one step further by extending their capabilities to indoor spaces. MapsIndoors deliver high-resolution maps at scale in both 2D and 3D for you to visualize data.

Whether you prefer the flexibility of SDKs, the ease of Flutter and React Native, or the simplicity of a pre-built web app, the MapsIndoors platform has got you covered.

Native web and mobile SDKs

Opt for the advanced solution with endless customization and integration options. The native SDKs on web, iOS, and Android give you complete freedom in your implementation and customization.

Web app

For a low effort implementation with best practice map functionality, get a finalized MapsIndoors solution for immediate use as a URL, iframe or embedded web app, or use the source code to fast-track your project.

Flutter and React Native

Integrate our mobile SDKs into your React Native or Flutter projects. Our mobile SDKs are optimized for seamless compatibility, ensuring a smooth implementation tailored to your framework of choice.

Developer documentation

Guiding you through every step of your implementation, the MapsIndoors Developer Docs offers comprehensive guides, tutorials, and reference materials designed to make your implementation process fast and easy

Native SDKs: Your Building Blocks

Our Software Development Kits (SDKs) empower you to craft a tailored app that seamlessly integrates with your existing software. Available for web, iOS, and Android, these SDKs are the engines that enable users to view, navigate and interact with indoor spaces effortlessly.

With MapsIndoors SDKs, the possibilities are endless. Here are just a few common scenarios:

Provide outdoor-to-indoor directions

Search for indoor locations

Display location-specific information

Showcase dynamic location data

And much more!

Integration API: Connecting the Dots

The Integration API allows you to make location or POI related data changes when needed, like bulk floor plan updates and map data population. Leverage the Integration API's various endpoints to access data with ease:

Update data seamlessly

Connect via tools like Postman

Use the Swagger frontend.

The MapsIndoors Content Management System (CMS) is your self-service tool for keeping your map solution updated by making location or POI related changes and customizing how your floor plan(s) looks in an easy-to-use visual interface. The CMS is a web-based portal used for day-to-day management of your map(s). Within the CMS you can manage Venue, Building, Room, Point of Interest (POI), and Route attributes. The content updated within the CMS is immediately accessible to the SDKs.

Formal website:

<wwww.mapspeople.com>

videos on YouTube

<https://youtu.be/DCjhhSVG3v4?feature=shared>

Docs:

<https://docs.mapsindoors.com/>