

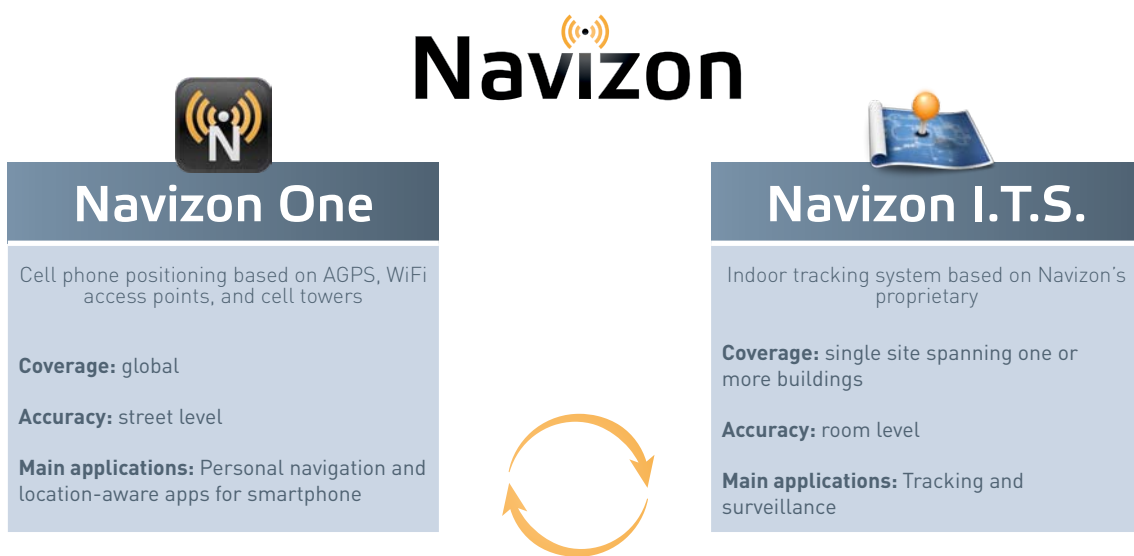
# Indoor Triangulation System

Tracking wireless devices accurately

Whitepaper

Navizon, the company that pioneered geopositioning for smart phone users with its **Navizon One** system, has come up with another first: **Navizon Indoor Triangulation System (Navizon I.T.S.)**.

Navizon One was one of the first systems that provided accurate geopositioning for smart phone users around the world. Navizon I.T.S. solves a different problem: it provides very accurate location of Wi-Fi enabled devices including smart phones, tablets and laptops, anywhere inside a building or campus. Combining both services opens up exciting possibilities for positioning, tracking people and devices, as well as marketing and security surveillance.



### Accurate Positioning Anywhere

Navizon One and Navizon ITS are designed to work together. When devices running the Navizon app enter a Navizon I.T.S. site, a higher level of accuracy is made available, enabling applications such as indoor navigation, finding friends and family, and location-based services.

Would you like to know exactly where you are in a big box store and where to find what you are looking for? Do you need to locate, rapidly and unobtrusively where all the Wi-Fi devices are within a large campus? Would you like to know how many smart phone-carrying attendees show up at your trade show, how long they stay, where they congregate and the overall traffic flow? Are you responsible for monitoring that only approved Wi-Fi devices operate in a secure area of your building? Do you need to pinpoint the location of a specific person or Wi-Fi device?

These are some of the applications enabled by Navizon, providing accurate positioning anywhere.

# Navizon One

## Where in the World am I?

**We all know that our smart phones can determine our locations anywhere on Earth's surface--i.e. ge positioning. How does this work? It is done using Assisted GPS (AGPS) and the physical location of neighboring Wi-Fi hot spots and cell phone towers.**

Why use three location references? Assisted GPS provides fast and accurate ge positioning, but works best outdoors. GPS receivers are often at a loss wherever the GPS satellite signals are blocked by or bounce off tall buildings, as in metropolitan areas congested with skyscrapers. But location can also be determined using the known location of neighboring Wi-Fi hot spots or cell phone towers. In fact, Navizon pioneered the use of these three components to provide accurate positioning anywhere in the world. Navizon has built a comprehensive database through the contributions of over a million global users. And growing. This service is provided through a mobile application called the **Navizon app**.

# Navizon I.T.S.

## How can I track smart devices indoors?

Navizon I.T.S. works in the background, quietly and unobtrusively locating Wi-Fi enabled devices. These devices (stations) are tracked within the coverage area (site) which is determined by a network of nodes. No application is needed on the devices to be tracked. The only requirement is that their Wi-Fi radios be turned on, which is the default in most smart phones, tablets and laptops.

Navizon I.T.S. nodes are small and inconspicuous, and placed approximately within 100 feet of each other to cover a three-dimensional space, the site, which may span a multi-story building or multiple buildings in a campus. Nodes are simply plugged into standard electrical outlets for power. No wiring is necessary, as the nodes automatically configure themselves into a wireless mesh network.

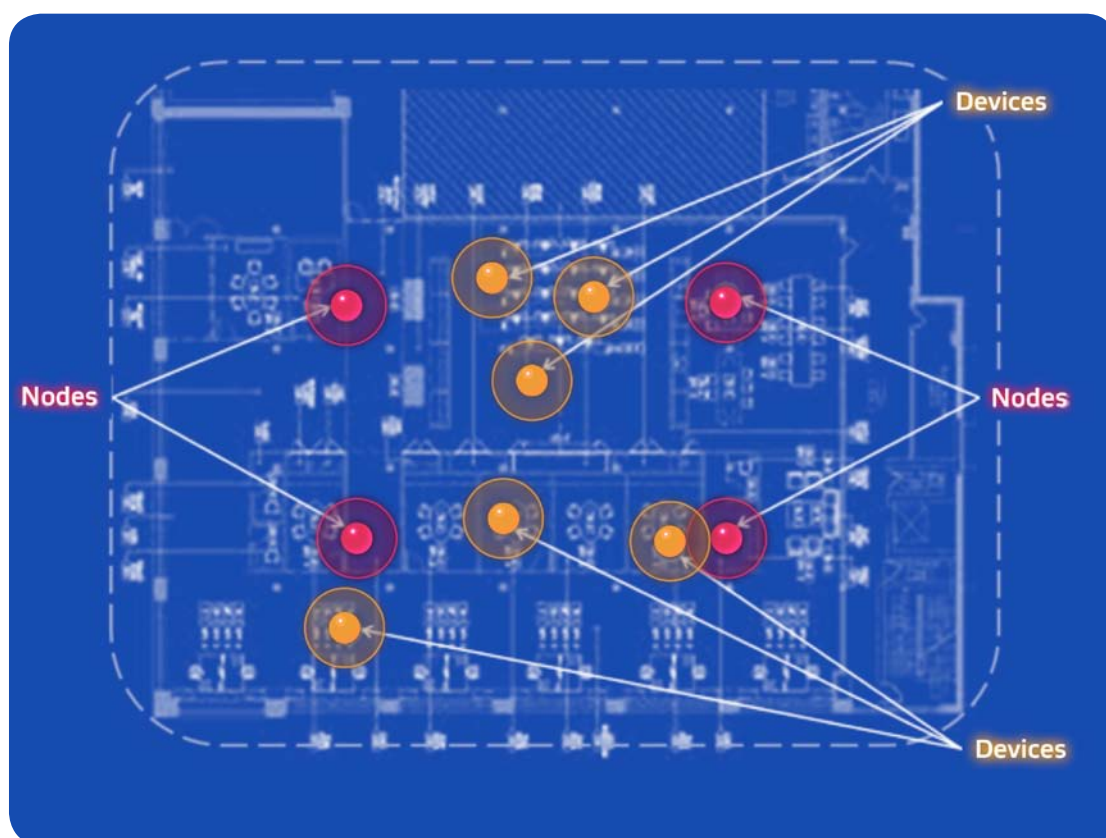


Figure 1: Sample Navizon ITS floor plan

All nodes in an I.T.S. site periodically report the list of Wi-Fi enabled devices they detect and the strength of their radio signals. The aggregate information from multiple nodes provides accurate positioning of each Wi-Fi device using Navizon's proprietary algorithms. These algorithms answer questions like: «Which floor is it on?» and «What is the precise location on that floor?»



**Figure 2: Navizon Indoor Triangulation System**

Device location information is computed by the cloud-based Navizon I.T.S. service and is accessible via a web interface. In addition, a REST API is available to access Navizon I.T.S. data and integrate with solutions such as security and marketing.

What happens when a Navizon-enabled device enters a Navizon I.T.S. site? Well, the Navizon app can seamlessly take advantage of a much more accurate geopositioning service to determine the phone's location. As a result, Navizon-enabled smart phone users get a visible boost in location accuracy when entering I.T.S. sites. We call the ability of accurately determining a device location while indoors «the last mile» in geopositioning.

# What do Navizon services provide?

Navizon provides positioning and tracking for smart phone users anywhere. Navizon I.T.S. can determine the location of Wi-Fi enabled devices throughout the coverage area, enabling surveillance.

**Positioning** is the ability for smart phone users to accurately determine their location. The Navizon app normally combines Assisted GPS, Wi-Fi tower and cell tower locations. Positioning accuracy is significantly enhanced in Navizon I.T.S.-enabled environments.

**Tracking** is the ability for Navizon users to determine the location of specific, known smart devices (phones and tablets). These may be devices belonging to friends, family or business associates. For Navizon apps, tracking works better in open spaces with a clear view of the sky (a beach, a park), and is best in Navizon I.T.S.-enabled environments. For Navizon I.T.S. users, tracking multiple Wi-Fi enabled devices is enabled throughout the site.

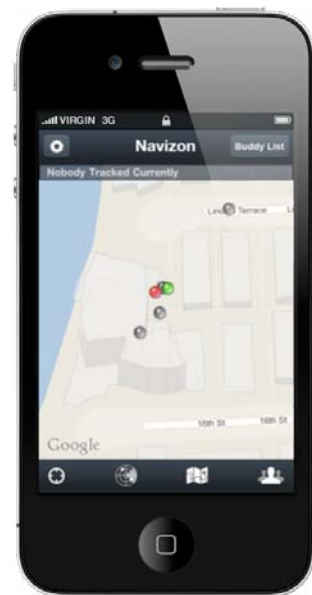
The Navizon app provides different display options for this data: the Buddy Radar, the Floor Plan View and the Google Maps View.



Buddy Radar gives users a real-time display of the physical direction where the friendly devices are located in reference to the phone's position.



Floor Plan displays an overhead view showing the devices' location in two dimensions within the building floor plan. The Floor Plan View is available exclusively in Navizon I.T.S. environments.



Google Map's View displays device locations overlaid on a map of the area.

Surveillance relies on Navizon I.T.S.' ability to determine the location of multiple Wi-Fi enabled devices within the coverage area. No app is required in the devices being tracked.

# What solutions can leverage Navizon services?

Some services target individuals while others are intended for businesses

	For Individuals	For Businesses
Positioning	Gives users the ability to determine their location anywhere, indoors or outdoors.	Provide convenience to their visitors by enabling them to find their position within a building or campus, and navigate using floor plans and maps.
Tracking	Gives users the ability to find their friends and family in crowded places--e.g. big box stores, malls and trade shows.	Provide convenience to their visitors by enabling them to track and find each other in large, crowded or unfamiliar places, and tracking known devices within the site.
Surveillance	N/A	Enables businesses to determine the location of active Wi-Fi enabled devices throughout the coverage area.

## Positioning in unfamiliar environments

Navizon app users can pinpoint their location with great accuracy within a Navizon I.T.S. environment. Floor Plan layouts can be very helpful.

Are you at big box store wondering where you are and in what direction to go to get to the garden supplies section? Navizon's Floor Plan View of the store's layout can help. You left your car in the parking garage across the street. It is after hours and the attendants have already left. Would you like to know how to find your way out of the building and back into the parking garage? Navizon's Floor Plan View of the building can help you. You are at a very large shopping mall. Can your smart phone help you find your way to the hot sale event taking place this evening? Navizon's Floor Plan View of the stores can lead you.

## Tracking friends, family and associates in large or crowded places

The Navizon app can display the physical location of devices belonging to one's friends, family members or business associates in Navizon I.T.S.-enabled environments. The devices must be registered with Navizon and tagged as members of the user's circle of acquaintances for the system to identify them.

Are you late to a meeting with your business associates, wondering in which conference room they are gathered? Any of the tracking apps can take you there. Have you and your family members wandered off in separate directions inside a shopping mall or department store? You can find their smart phones with Buddy Radar. All of these and many more are possible.

In addition, by registering known devices, Navizon I.T.S. becomes a device/people-finder application.

## Surveillance throughout buildings and campuses

Navizon I.T.S. can augment surveillance solutions for marketing or security. I.T.S. provides passive and automatic tracking of known and unknown Wi-Fi enabled devices. Deployed at large retail stores, shopping malls, hospitals, museums, corporate or government office buildings, schools, trade shows or convention centers, Navizon I.T.S. can add one more dimension to a comprehensive solution.

What are the most popular locations in the building and time of day for smart phone crowds? What are the traffic flow patterns over time? How many people show up? How long do they stay? How many walk into specific areas? As closing time approaches, do any smart phone-carrying visitors remain in the building? Are there any unrecognized devices in restricted areas? Is the same device showing up, day in and day out at the same location? Analysis of data collected over time can provide fresh insights about visitors' behavior.

# What does it take to get started with Navizon I.T.S.?

Getting started with Navizon I.T.S. is simple.

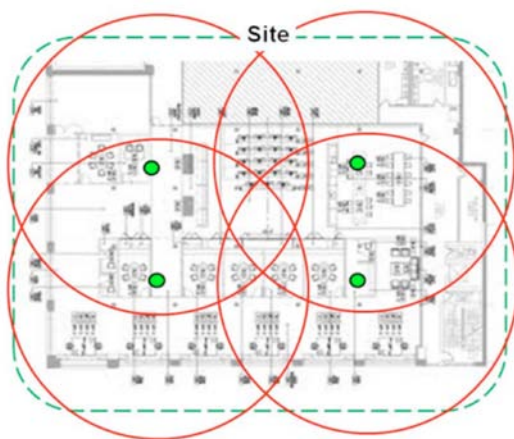


Figure 2:  
Sample Navizon I.T.S. site coverage

The required steps are described below.

**1. Determine the number of nodes needed and their placement in the areas to monitor.**

The ideal planning tool is an area floor plan that includes accurate dimensions, the location of power outlets and the physical location of one or more wired, broadband internet connections. Nodes should be placed between 50 to a 150 feet of each other--depending on number of walls and wall material--to ensure that a continuous mesh network is formed. The site's coverage area will be defined by the collection of overlapping spheres centered on each node, each sphere spanning up to 300-feet in diameter. Ideally, the wired internet connection should be roughly at the center of the group of nodes, to minimize number of hops and maximize performance.

**2. Order and install the nodes.**

Each node is simply plugged into a wall outlet. It may take a few hours for the entire mesh network to form.

**3. Describe the site on Cloudtrax, an online service portal.**

**4. Describe the site on Navizon.**

Use the online portal for I.T.S. customers to configure their systems, upload floor plan images, identify the actual physical location of each node and, if applicable, identify and tag known Wi-Fi enabled devices to be monitored.

**A web services API is available for applications to access I.T.S. system data for a given site. This API will enable complete solutions to be built on top of the basic I.T.S. system.**