



White Paper

Indoor Positioning & Services

inFSOFT
smart connected locations

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Editorial

Dear readers,

The field of indoor positioning and indoor navigation has been undergoing sustainable changes and experiencing exciting new developments since I founded insoft in 2005. Over the years, we successfully demonstrated our ability to adapt fast to new trends and circumstances, anticipating and inventing new ways to connect locations. Today, positioning and navigation solutions for indoor contexts include technologies based on Wi-Fi, Bluetooth Low Energy (BLE), Ultra-Wideband (UWB), and RFID, just to name a few. We intend to build on this momentum, combining fundamental concepts in hybrid approaches to aim for more accurate, precise, and efficient solutions. There is always plenty of space for improvement and innovation, and I am very excited for what is yet to come!

With this white paper, we want to provide you with a guideline to help you find a way through the complex topic of indoor positioning and related services. You can use it to get an overview of the different positioning techniques, learn more about the wide range of possible applications, and get to know our products and solutions. If you want to dig deeper, you can always have a look at [our website](#), or our [indoor navigation wiki](#).



CEO Tobias Donaubaauer

If you have any questions, please don't hesitate to [contact us](#).

Would you prefer to reach out to us via [Facebook](#) or [Twitter](#)? No problem, please stay connected and let us in on your thoughts!

All the best,

Tobias Donaubaauer



1 | The Basics of Indoor Positioning

Indoor positioning systems (IPS) enable you to locate the position of objects and people within buildings. GPS, however, is not available in interior spaces, because there is no visual contact with the GPS satellites. Furthermore, with GPS, it is not possible to determine the floor level a device is located on. That is why an IPS has to rely on other localization methods. There are two approaches to put such an “indoor GPS” into practice.

Client- and Server-Based Indoor Positioning

Indoor positioning is based on a transmitter-receiver model where there are two possibilities to determine the current location of a person or asset indoors: client- and server-based approaches.

Client-Based

A client-based technology is used to keep track of individuals that might require a back channel for further information exchange (visualization of own position on a map, location-based alerts, task management etc.) and for navigation purposes.

Hence, a smart device with a specific application is handling the indoor positioning based on external signalers such as Wi-Fi and Bluetooth Low Energy (BLE) in combination with the internal smartphone sensors (e.g. accelerometer, gyroscope, magnetic field sensor etc.).

The position is determined on the smart device but can also be transferred continuously to a backend to provide

supervisors with the user’s current location. Therefore, the device requires a network connection.

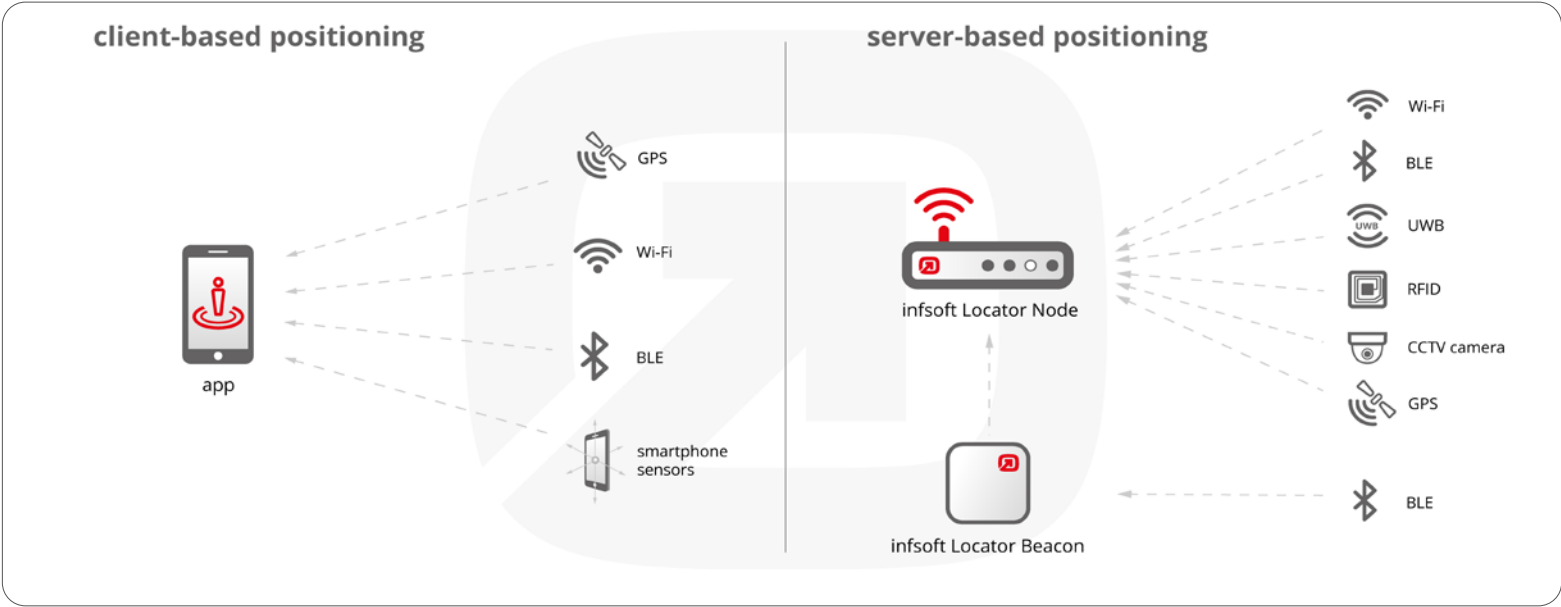


Server-Based

A server-based technology is used to keep track of assets and persons and typically comes with a one-way communication towards the receiver. However, a return communication to the asset tag is also possible, e.g. in the form of an activation of an LED or an output on an E-Ink display.

The receiver hardware is installed within the client’s premise to capture the signals of the transmitters/senders and to transfer the data to a backend engine.

insoft can set up interfaces for indoor positioning from third-party providers such as Cisco, HP Aruba and Xirrus to visualize the position data within our Analytics and Tracking engine.



Client-based and server-based indoor positioning

Technology	Accuracy	Range	Suitable for	Tracking	Transmitter power supply	Battery lifetime
Wi-Fi	< 15 m	< 150 m	area detection		or	medium
BLE	4.0 < 8 m	< 75 m	area detection			high
	5.1 < 1 m with line-of-sight					
UWB	< 30 cm	< 150 m	area detection		or	medium
RFID	presence detection only	< 1 m	spot detection		— (passive RFID tag)	— (passive RFID tag)

Comparison of different technologies for server-based indoor positioning

Technology Overview

To meet the requirements of a client with regard to the requested accuracy, there are several potential sensor technologies available.

Client-Based Approach



Bluetooth Low Energy (BLE) Beacons

A client-based positioning (typically indoor navigation) is usually realized on the basis of Bluetooth Low Energy (BLE) beacons. For this purpose, the small wireless radio transmitters are installed in the building at regular intervals. The position is determined on a mobile device (e.g. smartphone) and an app is required.

During installation and parameterization, attenuation properties of different materials have to be taken into account (e.g. wood or glass with low attenuation properties as opposed to metal or water with high attenuation properties). For calibrating the position determination in a client-based approach, insoft provides a calibration app

EXAMPLES OF USE:

- [patient call and indoor navigation in hospitals](#)
- [mobile app for company premises](#)



Wi-Fi

Wi-Fi is a possible alternative to BLE. In many cases, the existing Wi-Fi infrastructure can be used (e.g. cash register systems, public hotspots, access points of shops or exhibitors). However, due to higher inaccuracies, Wi-Fi is not the preferred option. For instance, the floor level cannot always be reliably determined. Furthermore, client-based positioning with Wi-Fi does not work under iOS.

Technology	Accuracy	Range	Cross-Platform
Wi-Fi	5-15 m	< 150 m	
BLE	1-3 m	< 30 m	

Comparison of Wi-Fi and BLE for client-based indoor positioning

Server-Based Approach

Various location technologies are available for server-based positioning (asset or person tracking).



Wi-Fi

Inside buildings, Wi-Fi can be a good alternative to GPS. For a server-based solution, infsoft receiver hardware (infsoft Locator Nodes) can be used, detecting all Wi-Fi capable devices (e.g. smartphones, tablets, Wi-Fi tags) and enabling the monitoring of people



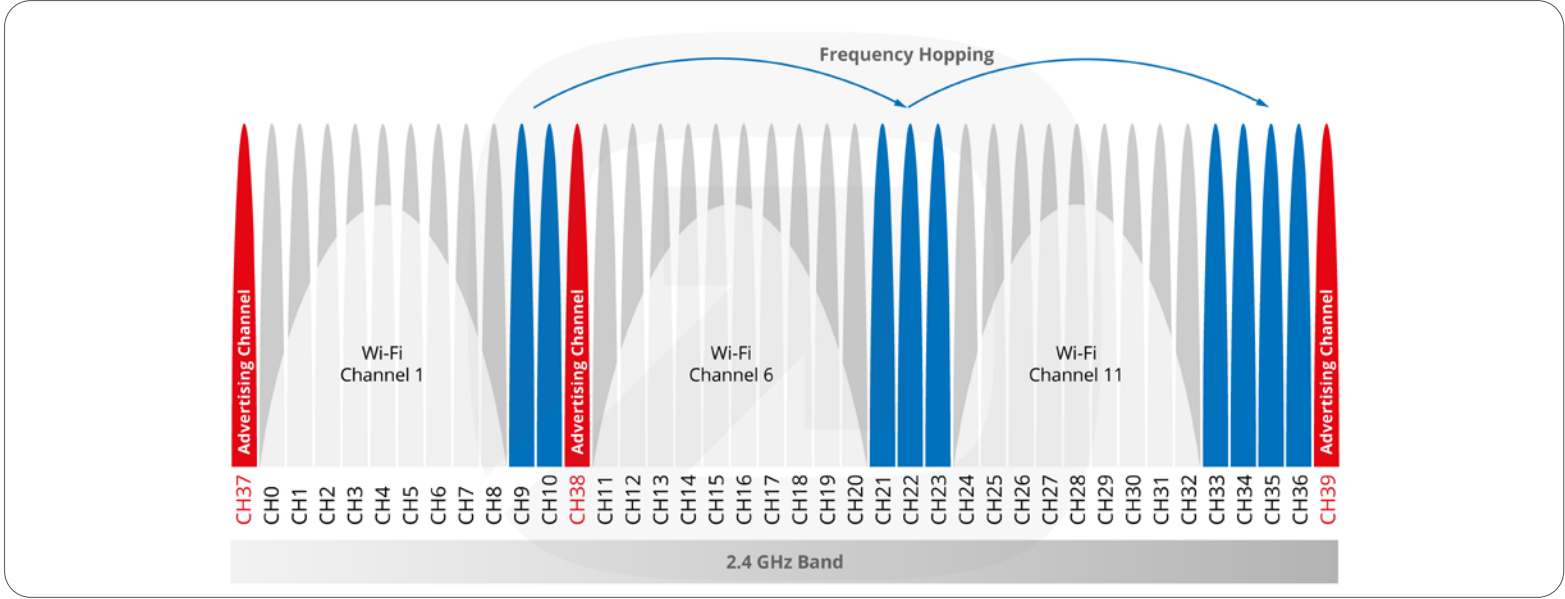
flows and the tracking of objects. The user doesn't necessarily have to connect with the Wi-Fi, it is sufficient to have Wi-Fi enabled.

Wi-Fi at a glance

- Pros:
- enabled Wi-Fi is sufficient
 - under certain circumstances, the customer's existing infrastructure can be used (e.g. Cisco DNA Spaces)
- Cons:
- relatively inaccurate (5-15 m)
 - no latency guarantees
 - use of randomized MAC address if smartphone is not connected to Wi-Fi network-
 - high energy consumption with Wi-Fi tags

- EXAMPLES OF USE:
- [occupancy analysis of office buildings](#)
 - [utilization analysis in rail traffic](#)
 - [investigation and prevention of criminal offences at ATMs](#)

For positioning, the so-called fingerprinting method is used. The strength of the Wi-Fi signals (received signal strength indication, RSSI) and the MAC address (media access control) are significant. The accuracy of Wi-Fi used for indoor positioning varies from 5 to 15 meters – depending on the preconditions.



Optimal channel utilization for simultaneous use of BLE and Wi-Fi



Bluetooth Low Energy (BLE) Beacons

Beacons are small radio transmitters that broadcast signals using Bluetooth Low Energy (Bluetooth Smart) in a radius of up to 70 meters. These signals are detected by specific receiver hardware (infsoft Locator Nodes or infsoft Locator Beacons) in a server-based approach.

The underlying technology is using a signal strength (RSSI) measurement to determine the beacon's position. While tracking with the well-established Bluetooth Low Energy 4.0 standard offers accuracies of a few meters, the new Bluetooth 5.1 standard opens up new perspectives for accuracies in the submeter range based on its "direction finding" function.

BLE beacons are cost-effective and energy-efficient components that can run on button cells up to five years and more. infsoft offers a beacon management tool to monitor battery levels.

Bluetooth beacons normally do not affect other radio networks and they also do not interfere with medical and industrial devices. However, BLE and Wi-Fi share the same frequency range (2.4 GHz). Interferences can be easily avoided by not using channels 2, 3, 4, 13 and 14 when configuring the Wi-Fi and using 1, 6, 7, 8, 9, 10, 11 and 12 instead. Bluetooth uses the remaining available channels to capacity in a uniform manner (frequency hopping). Advertising

channels that are used for positioning are marked in red in the graphic above. The blue-colored channels are reserved for additional functions such as a temperature sensor.

BLE beacons are available from numerous suppliers and come in various shapes and sizes. infsoft solutions are compatible with beacons of all manufacturers.

BLE beacons at a glance

- Pros:
- cost-effective, unobtrusive hardware
 - low energy consumption
 - high accuracy compared to Wi-Fi
 - under certain circumstances, the customer's existing infrastructure can be used (e.g. Cisco DNA Spaces)
- Cons:
- depending on size and shape of the asset, attachment of the beacon can be difficult

- EXAMPLES OF USE:
- [condition monitoring](#)
 - [personnel and vehicle tracking](#)
 - [automated workflow management](#)



Different types of Bluetooth beacons

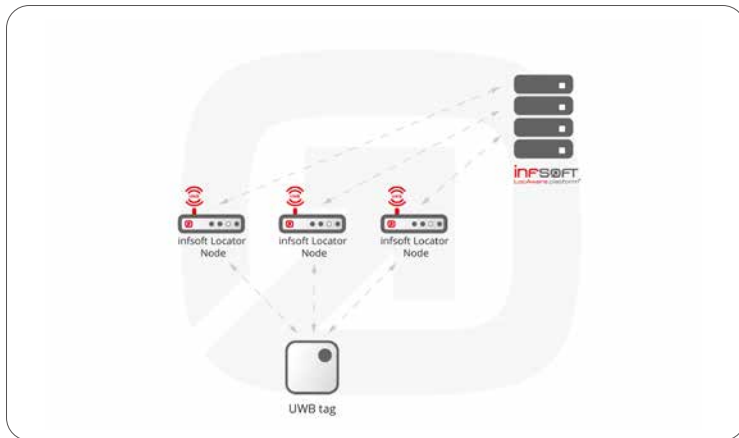


Ultra-wideband (UWB)

Ultra-wideband is a short-range radio technology that is mainly used in industrial environments with high precision needs.

With less than 30 cm, the accuracy is considerably better than when working with beacons or Wi-Fi. Also, height differences can be measured accurately. Another advantage can be the low latency times with up to 100 position updates / second.

In contrast to Bluetooth Low Energy and Wi-Fi, the position is determined by a transit time method (Time of Flight, ToF) instead of a measurement of signal strengths (Receive Signal Strength Indicator, RSSI). This method measures the running time of light between an object and several receivers (insoft Locator Nodes 1100).



Server-based positioning with UWB tag

The asset to be tracked is equipped with a small UWB tag which runs on battery power or can draw its power via a forklift, for example. The tag sends data (ID, ToF, timestamp) to the insoft Locator Nodes 1100. They have a fixed position in the infrastructure and can use the running time of light to calculate the distance of the asset.

If the position data should be immediately displayed on a mobile device (smartphone), the insoft UWB Tags can directly communicate with the smartphone via Bluetooth or USB interface.

Due to the usage of extremely wide frequency bands with a bandwidth of at least 500 MHz, there are almost no interferences. UWB is one of the preferred solutions when it



Asset tracking based on Ultra-wideband

comes to the tracking of a modest number of assets in large industrial areas. However, the price per unit is significantly higher and the battery lifetime is shorter compared to BLE beacons.

UWB at a glance

Pros:

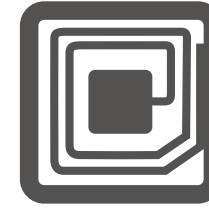
- high accuracy
- accurate measurement of height differences
- low latency times
- almost no interferences with given line-of-sight

Cons:

- cost-intensive
- shorter battery lifetime than BLE beacons

EXAMPLES OF USE:

- [tracking of emergency services](#)
- [process optimization in automotive manufacturing](#)
- [utilization analysis of work devices](#)



RFID

RFID stands for “Radio-Frequency Identification” and describes systems that use radio waves to identify objects or persons. In a passive RFID system, there is a transponder (“RFID tag”) on whose microchip data (usually a serial number) are stored, which can be forwarded wirelessly to a reader. The reading unit (insoft Locator Node 1100) generates an energy field that activates the RFID tag. In order to enable information exchange, the distance between Locator Node and transponder must be less than one meter (remote-coupling).

No matter which industry you are thinking of – since it is a very versatile technology, RFID can be used almost everywhere. Common applications are systems for access control, time recording or inventory control in logistics. Since reliable identification of products or objects is required in many industries, RFID is particularly suitable as an asset tracking solution.

Since passive transponders do not have their own energy source, they are almost maintenance-free. As a result, initial acquisition costs will pay off in the long term in most cases. RFID tags do not require visual contact with the reader, and they are durable against impact and environmental factors.

Combining RFID systems with other positioning technologies can solve the biggest problem of passive RFID technology: objects equipped with RFID tags can only be located at a specific point – namely exactly where RFID

hardware (e.g. Locator Nodes 1100) has been installed. However, if for example a forklift truck is equipped with an insoft Locator Node, whose sensors not only respond to RFID, but also to Ultra-wideband (UWB), a link between the position data of the forklift truck and the identification times of RFID-tagged goods can be established.

RFID at a glance

Pros:

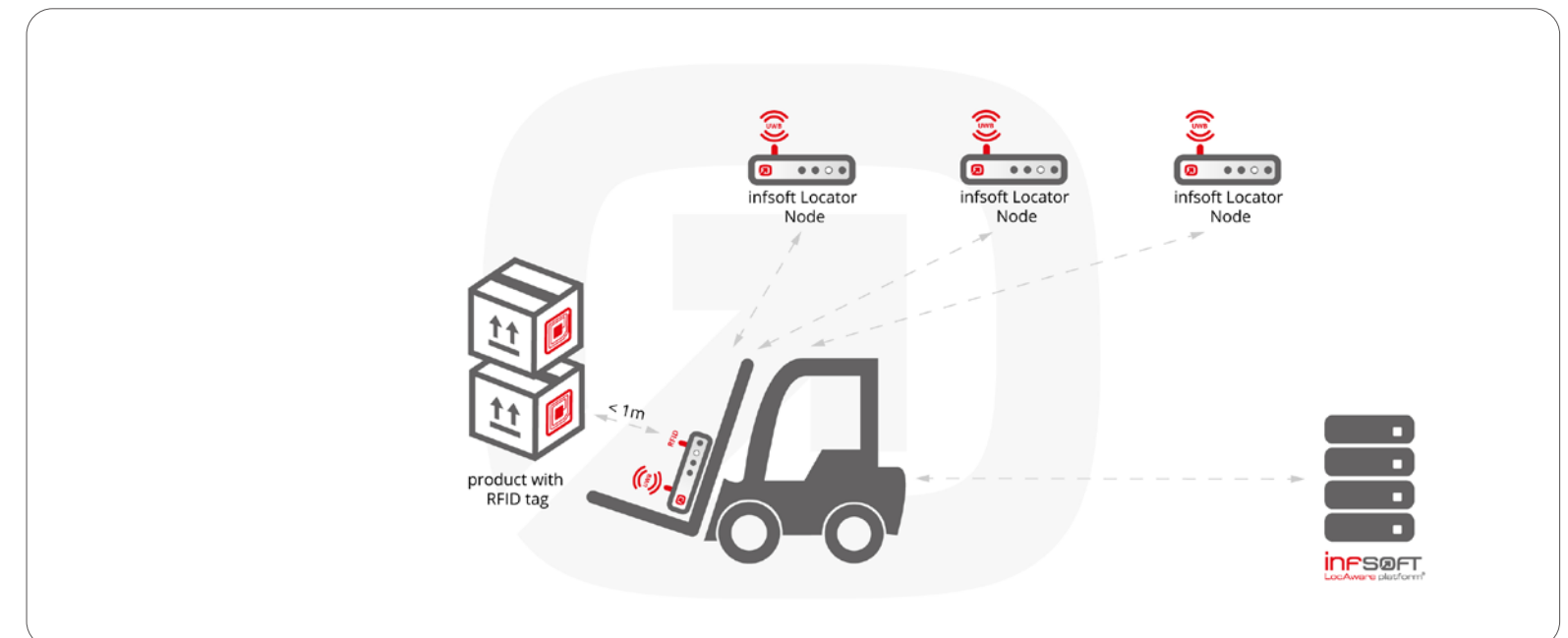
- low costs per asset
- immunity to interferences
- no battery needed

Cons:

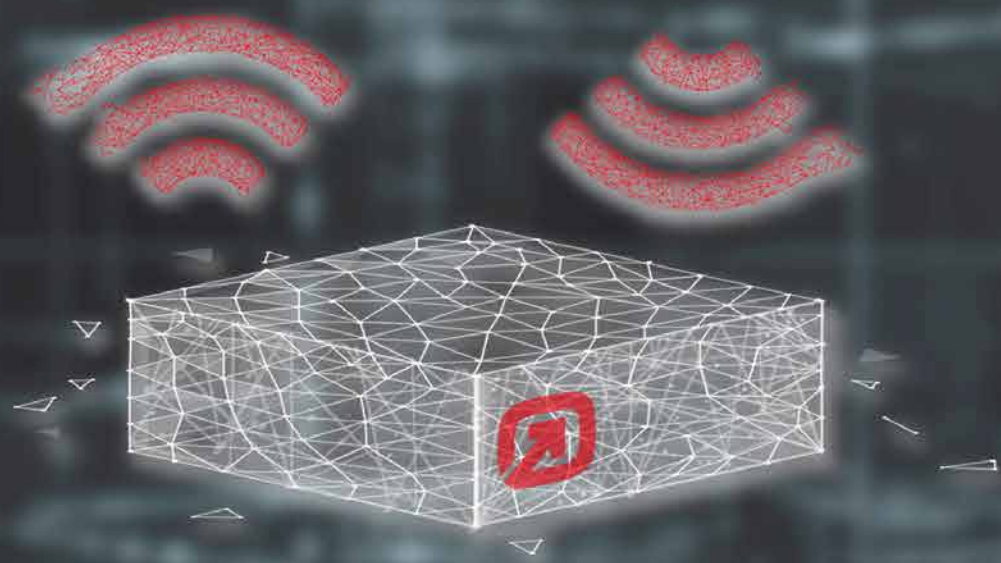
- short range (< 1 m)
- only providing a “point-in-time” location
- installation requires significant planning
- infrastructure can be expensive

EXAMPLES OF USE:

- [tracking of disposables](#)
- [asset tracking in logistics](#)
- [analysis of consumer behavior in a supermarket](#)



Combination of RFID and UWB for identification and localization of goods



2 | Hardware for Indoor Positioning



To address a client's need for a reliable indoor tracking solution, we rely on our own hardware: infsoft Locator Nodes 1100, infsoft Locator Nodes AoA 1200, infsoft Locator Nodes 1400, infsoft Locator Beacons, infsoft E-Ink Display Beacons, and infsoft UWB Tags. We also describe the highly versatile BLE tags (Bluetooth 4 / 5) as well as systems for condition monitoring.

For our hardware products we offer flexible mounting options, which are sold separately. The mounts are magnetic and have additional boreholes for fixed installation.

infsoft Locator Nodes 1100

With the Locator Nodes 1100, infsoft is providing a modular component for tracking and analysis purposes. Integrated



infsoft Locator Node 1100 © infsoft GmbH

into the central data hub – the infsoft LocAware platform® – the Locator Nodes 1100 allow for a comprehensive detection of different device types, enabled through the modular system with different sensors.

Beside the consumer standards Wi-Fi and Bluetooth Low Energy (BLE), the infsoft Locator Nodes 1100 are able to address high-precision needs with Ultra-wideband (UWB) and can also be equipped with an RFID reader. Data correlations with external camera systems and self-positioning via GPS in mobile scenarios are further capabilities. In addition to positioning, infsoft Locator Nodes 1100 are also able to communicate with Bluetooth devices via back channel, allowing bidirectional exchange of information.

Complementary sensors

Locator Nodes 1100 can detect all mobile, Wi-Fi-enabled devices (such as smartphones, laptops, wearables) within a building and track them via server (without an app). This works across all mobile operating systems and due to the use of a hash algorithm (SHA-1) in compliance with data protection requirements.

Moreover, the infsoft Locator Nodes 1100 enable a detection of Bluetooth Low Energy (BLE) beacons, which can be attached to persons or goods. They enable location analytics and indoor tracking and can also function as beacon controllers to monitor fixed beacons, for example in the

context of a client-based indoor navigation, and to carry out possible reconfigurations.

Equipped with an integrated Ultra-wideband (UWB) module, Locator Nodes 1100 can also achieve a high-precision localization of less than 30 cm, which is often used in industrial applications. With this technology, the position of for instance forklifts and trucks or the storage location of goods can be determined precisely and with low latencies.

The use of RFID (radio-frequency identification) is suitable for a selective object identification. The RFID reader of the Locator Nodes 1100 offers a cost-effective tracking option, especially with high quantities in pallet tracking. Intelligent connections with additional sensors can detect and optimize storage location and service life.

The addition of imaging systems such as CCTV cameras plays an important role in security and logistics. Connected to the Locator Nodes 1100, a correlation between camera image and position data can be established (for example based on Wi-Fi, BLE or UWB).

In mobile application scenarios, infsoft Locator Nodes 1100 can also be equipped with a GPS module, which determines

the current location of the Locator Node. The built-in complementary sensor system thus not only enables the detection of goods in a static space context, but also completely flexible.



Mount for Locator Node 1100/1200 © infsoft GmbH

Communication

- Wi-Fi
- Ethernet (PoE)

optional:

- LoRa
- UMTS

Sensors

- Wi-Fi
- Bluetooth Low Energy (BLE)
- Ultra-wideband (UWB)

optional:

- RFID
- external CCTV camera
- GPS

infsoft Locator Node 1100 © infsoft GmbH

Seamless integration

The Locator Nodes 1100 require a power supply and network connection and are transferring the scanned data to the insoft LocAware platform®, a secure and scalable cloud solution. Using the various tools then allows to view positions, analyze movements, or use location-based services.

Integration with third-party systems such as Cisco (CMX, DNA Spaces, MSE, Meraki), HP Aruba or Xirrus is also possible.

Examples of use for insoft Locator Nodes 1100:

- [management of tugger trains](#)
- [tracking and analysis of emergency drills](#)
- [load carrier tracking](#)



Videos

- [RTLS made easy – insoft Locator Node](#)
- [Features of the insoft Locator Node](#)

insoft Locator Nodes AoA 1200

Angle of Arrival (AoA) is an emerging technology that indicates the direction of the signal sources and can be used for tracking assets as well as for indoor positioning and



insoft Locator Node AoA 1200 © insoft GmbH

wayfinding. insoft Locator Nodes AoA 1200 use Angle of Arrival for real-time measurement of the direction of a radio signal emitted by a mobile 2.4 GHz transmitter (a beacon). Based on the angle and signal strength determined, it is possible to calculate the position of an object equipped with such transmitter with an accuracy of 1 to 3 meters. This opens up opportunities for numerous use cases and makes server-based BLE solutions a favorable alternative to cost-intensive Ultra-wideband (UWB) applications – as long as no centimeter accuracy is required. In addition to the angle measurement, Locator Nodes AoA 1200 provide the full range of functions of the insoft Locator Nodes 1100.

Measurement of signal direction

insoft Locator Nodes AoA 1200 deployed in the area of interest detect incoming signals from a mobile transmitter operating on 2.4 Ghz (e.g. BLE beacon). The data are sent to the insoft LocAware platform®, where the device's position is computed.



Visualization of angle measurement (AoA)

By using AoA technology, even just one Locator Node enables determining the direction of movement of a person or object. This is an important factor for applications such as access control or door control in protected areas.

Using insoft Locator Nodes AoA 1200 can reduce the number of required hardware for a localization project.

Deploying a minimum of three Locator Nodes AoA 1200 (triangulation) allows for continuous positioning and substantially improves accuracy and reliability.

Examples of use for insoft Locator Nodes AoA 1200:

- [vehicle tracking in crash test facilities](#)
- [tracking of goods in logistics](#)



[insoft Locator Node AoA 1200](#)

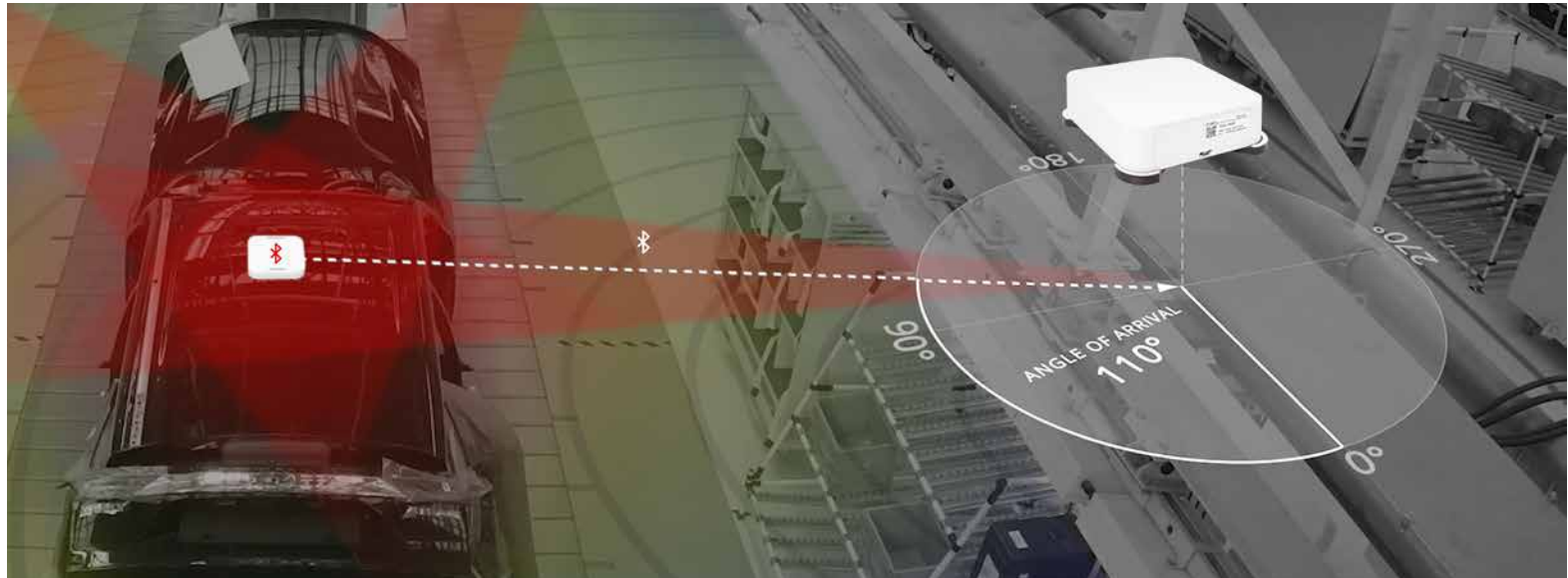
insoft Locator Nodes 1400

insoft Locator Nodes 1400 are hardware components that can receive Wi-Fi and Bluetooth Low Energy (BLE) signals from mobile transmitters. This enables positioning of Wi-Fi tags and beacons attached to objects or carried by people, as well as the localization of Bluetooth or Wi-Fi capable mobile devices. The gateway function allows communication between different types of devices and the cloud and enables bidirectional information exchange between insoft Locator Nodes 1400 and Bluetooth transmitters such as insoft E-Ink Display Beacons.

In order to determine the position of an asset or a person, the Locator Node 1400 collects the data it receives from a transmitter and forwards the information to the insoft LocAware platform®. Here, the data is processed and the transmitter's location is determined. Connecting systems from third-party providers such as Cisco (CMX, DNA Spaces, MSE, Meraki), HP Aruba or Xirrus is also possible.

Examples of use for insoft Locator Nodes 1400:

- [management of hospital beds](#)
- [identification of storage boxes](#)



Communication

- Wi-Fi
- Ethernet (PoE)



Sensors

- Wi-Fi
- Bluetooth Low Energy (BLE) 4 / 5

insoft Locator Node 1400 © insoft GmbH



Mount for Locator Node 1400 © infsoft GmbH

[infsoft Locator Node 1400](#)

infsoft Locator Beacons

Integrating infsoft Locator Beacons into your RTLS infrastructure enables easy monitoring of your beacons' location and can significantly reduce hardware effort and cost for your beacon-based tracking system.



infsoft Locator Beacon © infsoft GmbH

infsoft Locator Beacons are fixed, battery-powered hardware components that can be easily integrated into a network infrastructure consisting of infsoft Locator Nodes and Bluetooth Low Energy (BLE) beacons. Long battery life and low installation and maintenance requirements make them an ideal solution for various object tracking applications. Due to small latencies, areas monitored by Locator Beacons are subject to time-delayed tracking, making the application particularly suitable for large building structures (e.g. hospitals, offices) where real-time localization is not required in all areas. In important zones, live tracking is realized thanks to infsoft Locator Nodes that are deployed there.

In addition to asset tracking, infsoft Locator Beacons can also serve as a beacon infrastructure for indoor navigation and location-based services.

The radio-based Locator Beacons are programmed to detect Bluetooth signals at regular intervals (e.g. every 2 minutes), which are transmitted by nearby, mobile Bluetooth Low Energy beacons that are used for object tracking. The Locator Beacons report this information to infsoft Locator Nodes in proximity. The Locator Node's Wi-Fi or Ethernet is used to transmit the collected data to the infsoft LocAware platform®, where the information is intelligently processed and made available to the infsoft backend tools (e.g. infsoft Tracking, infsoft Analytics). The use of infsoft Locator Beacons reduces the number of infsoft Locator Nodes needed to be installed and thus the wiring effort. Locator Beacons can also act as repeaters and pass the scan data among themselves in the process of transmitting it to the Locator Node. This minimizes the number of required Locator Nodes to one per floor or even one per building.

When used simultaneously for client-based applications, infsoft Locator Beacons broadcast Bluetooth signals that are detected by mobile devices (e.g. smartphones) and are used for positioning based on a signal strength measurement.

Examples of use for infsoft Locator Beacons:

- [indoor navigation and asset tracking in hospitals](#)
- [asset inventory in office buildings](#)



Mount for Locator Beacon © infsoft GmbH

[infsoft Locator Beacon](#)



infsoft E-Ink Display Beacons © infsoft GmbH

infsoft E-Ink Display Beacons

infsoft E-Ink Display Beacons deliver look and utility of paper encompassing good readability, very wide viewing angles, design freedom, robustness, and low power consumption. Combining E-Ink displays and Bluetooth Low Energy (BLE) technology enables transferring content flexibly to the display as well as visualizing and tracing the device's location.

In order to display content on the infsoft E-Ink Display Beacon, the desired device and content are selected in the infsoft CMS tool or a corresponding app ("infsoft E-Ink Writer"). Via Bluetooth, the content is transferred to the display. The content can not only be updated manually, but also automatically – using the infsoft Automation tool to define corresponding conditions.

For positioning, the infsoft E-Ink Display Beacon sends BLE signals to infsoft Locator Nodes that are installed in the area. The Locator Nodes process the provided data and send it to the infsoft LocAware platform®, where it is intelligently processed.

Beacons with E-Ink displays are a perfect fit for electronic shelf, door or product labels. Businesses are offered the ability to wirelessly update content on the displays quickly and efficiently, without needing to print paper tags and deploy personnel to change them manually. In real time, E-Ink beacons can display product information, status, inventory levels, barcodes, and much more. In production and logistics, for example, when assets are traced along

the process chain, the display can be rewritten automatically with the current status and individual information such as instructions on the next work step.

Examples of use for infsoft E-Ink Display Beacons:

- [information display for hospital beds](#)
- [digital room signage in office buildings](#)
- [tracking and labeling of containers in production](#)



Mount for E-Ink Display Beacon © infsoft GmbH

[infsoft E-Ink Display Beacons](#)

insoft UWB Tags

insoft UWB Tags are small Ultra-wideband components that enable tracking objects, people and vehicles indoors. They are also suitable for analyzing walking routes. Much like insoft Locator Nodes, they work with server-based installations, which means that the position is determined on a server (cloud-based).

insoft UWB Tags can be used in different application scenarios. Ultra-wideband enables asset tracking in industrial environments with an accuracy of 10-30 cm.

Based on the Time Difference of Arrival (TDoA) method, the position of the UWB tag is determined using a measurement of time differences. The UWB tag sends signals to installed insoft Locator Nodes in the environment. The distance between the tag and the Locator Nodes is calculated based on the signal run time. Since the distance between the Locator Nodes and the tag varies, the signal reaches each Locator Node at a different time. These time differences are the basis for the multilateration calculation used to determine the position of the UWB Tag. As a crucial factor, all Locator Nodes require direct line-of-sight, as they have to synchronize with each other.



insoft UWB Tag © insoft GmbH

The system can either be set up in a server-based (visualization of positioning data in the backend, no display on a client) or client-based approach (visualization of positioning data on a client (smartphone) and transmission to the backend if necessary).

Examples of use for insoft UWB Tags:

- [indoor navigation & tracking of tigger trains](#)
- [tracking of emergency services](#)
- [improving order picking productivity](#)

BLE 4.0 / 5.1 Tags

BLE 4.0 / 5.1 tags are small Bluetooth hardware components ("beacons") that are used to locate people, objects or vehicles. BLE tags can not only be used in server-based procedures (asset tracking, position is determined on a



Bluetooth Low Energy beacons



server), but also in client-based applications (indoor navigation, position is calculated and visualized on a mobile device).

Bluetooth is the protocol of choice for implementing proximity solutions. Bluetooth Low Energy 4.0 is a proven, particularly energy-efficient standard that paved the way

for numerous RTLS and IoT solutions (beacon tracking, indoor navigation with beacons). Thanks to Angle of Arrival (AoA) technology, the new 5.1 version of the Bluetooth specification enables applications for direction finding and centimeter-accurate (server-based) positioning. As a result, even assets stored close to each other can be clearly identified. When using Bluetooth 5.1, however, it should be noted that a reliable localization can only be achieved with an existing line-of-sight between beacon and receiver hardware. Thus, the application makes particular sense for tracking systems in open areas (e.g. industrial halls).

Condition Monitoring Systems

Existing Real-Time Locating Systems (RTLS) can be enriched or extended with sensor data that provide operating and status information. The collection and transmission of this data (e.g. ambient temperature, humidity, illuminance, CO₂ concentration, physical presence) enables an innovative, holistic sensor data fusion and the realization of condition monitoring systems. insoft provides solutions using high-quality sensors for any requirement or application – from object detection to people counting up to energy savings and indoor air monitoring.

The condition monitoring devices integrate easily and seamlessly into insoft's software solutions. Wireless data communication to the insoft Locator Nodes is provided via Bluetooth Low Energy (BLE). The sensors are available in different options, e.g. as a stand-alone device or a built-in element in a BLE beacon ("sensor beacon"). Using the web-based insoft Sensors tool, you can display the sensor output signals.

insoft does not produce beacons itself, but will be happy to put you in touch with appropriate manufacturers.

Examples of use for BLE Tags (Beacons):

- [mobile app and navigation for company premises](#)
- [tracking of tools in automotive workshops](#)
- [utilization analysis in automotive paint shops](#)



Examples of use for BLE tags (beacons):

- [condition monitoring in pharmaceutical storage](#)
- [workplace occupancy sensing](#)
- [intelligent car parking management](#)

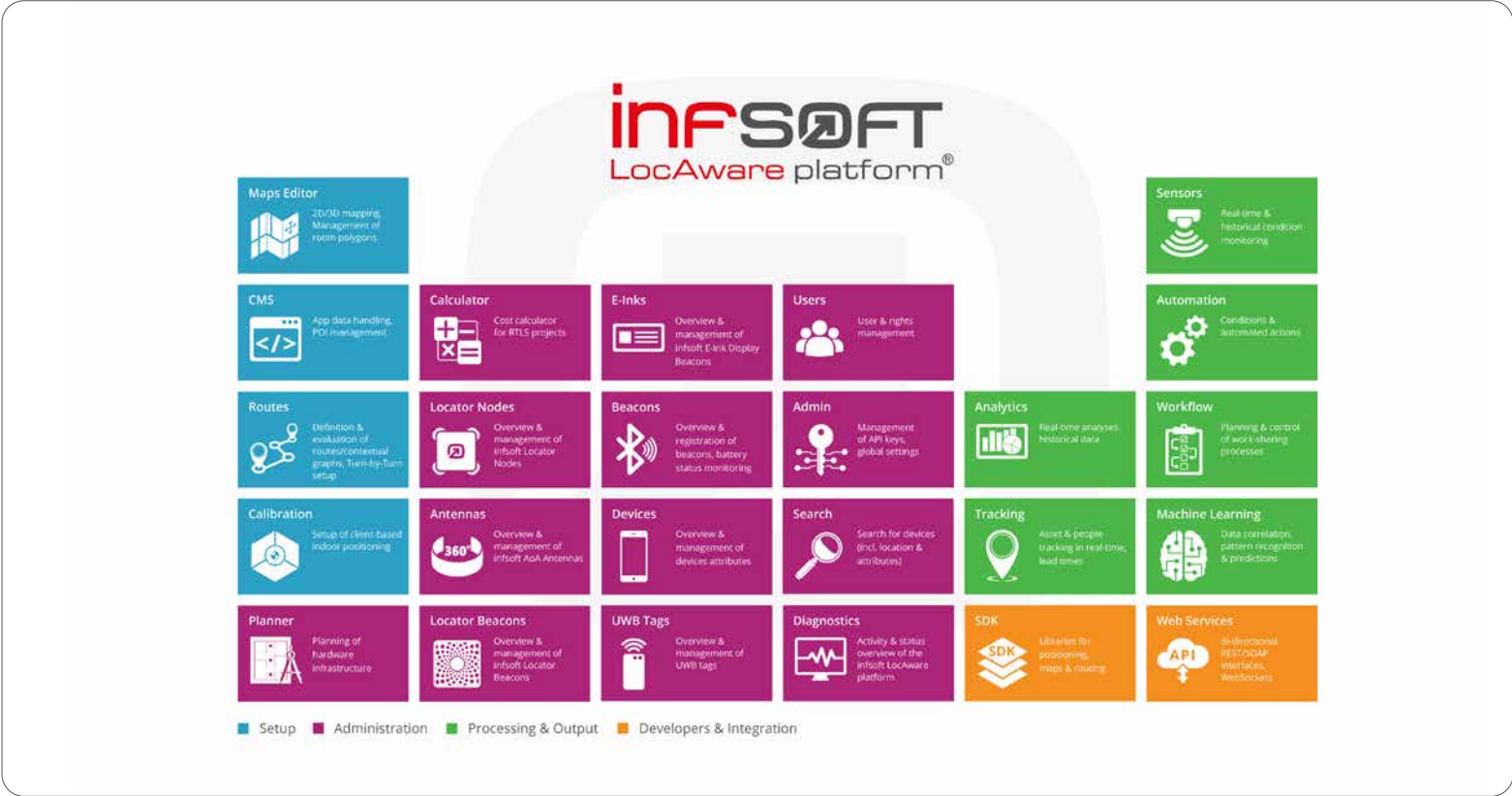
 [Using Beacons for Workspace Utilization Monitoring](#)



3 | Software – LocAware platform®

insoft Software Tools

insoft offers powerful software products that are bundled and linked in the insoft LocAware platform®.



insoft LocAware platform®

As a central data hub, the LocAware platform® represents the center piece of the insoft tools. All tools required for the setup and data management are bundled here and are accessible with single sign-on.

The web-based tools enable managing a location on all floor levels, analyzing traces through the building, managing devices, beacons and Locator Nodes as well as defining geo-based alerts.

Furthermore, all data from the LocAware platform® can be exchanged easily via interfaces (bidirectional connection) with third-party systems.

insoft's system architecture is cloud-based and convinces with performance, reliability and flexibility.

Setup of Indoor Localization

The setup tools include all the required features to set up an indoor positioning system – mapping, calibration, data management, and route definition.



insoft Routes



The insoft Maps Editor allows you to create your location with just a few clicks and then easily manage it afterwards at any time. You can set up outlines of the building, rooms, and custom patterns.

Closely related to the Maps Editor is the insoft CMS, which provides the information in list format. You can easily manage attributes for a large number of POIs, set information for different menu items and handle data with and without geo-reference.

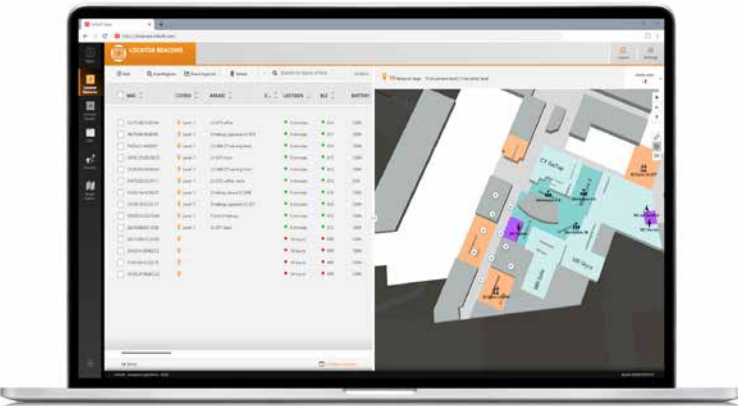
The insoft Routes tool allows you to create and test contextual pathway-relations. You can evaluate the routing (e.g. barrier-free) over several floors and check the priorities of different navigation graphs. The used map material is provided by the insoft Maps Editor.

insoft Calibration helps to set up the client-based indoor positioning based on Wi-Fi, beacons and sensor fusion. The tool has the following functions: creating calibration routes, managing beacon proximity UUIDs, visualizing detected signal transmitters, checking heatmaps that represent the signal strength, and filtering out access points or beacons that are not to be used for the project. The tool is linked to the insoft Calibration Apps and exchanges calibration information with them.

Administration of Indoor Localization

The insoft administration tools provide useful functions for managing the deployed indoor positioning system.

Within the Locator Nodes tool you can register and organize the insoft Locator Node hardware in your location. You can set up groups, push firmware updates to the nodes, configure scan intervals and check on the current scans of the Locator Node. The tool also provides an overview over any downtimes and can be configured with alert mechanisms.



insoft Locator Beacons

The Locator Beacon Tool can be used to manage the insoft Locator Beacon hardware used in the building. It is possible to register and maintain Locator Beacons, check their position on the map and monitor the battery status - including error messages such as downtime.

Data Processing & Output

insoft’s processing and output tools enable the intelligent use and evaluation of the collected data and help companies to optimize processes and improve decision-making.

insoft Analytics visualizes detected devices within the floor plans and enables real-time monitoring of motion profiles. You can measure frequencies in specific areas, create time- and location-related analyses and combine the system with insoft Automation to enrich your data. The live scripting engine can filter information or visualize data links in real time and in retrospect. The tool also provides heat map visualization and route tracing.

Real-time visualization of the position of specific devices is enabled by insoft Tracking. You can add attributes to a device (e.g. mail address, name etc.), organize devices in



insoft Tracking

groups and send push notifications to selected users. The engine can also be used for asset tracking and can be linked with other tools such as insoft Automation to define alerts when a device enters / leaves a defined area.

insoft Sensors visualizes condition sensing devices on the map and enables real-time monitoring of status information (e.g. light, temperature, pressure, humidity, CO₂, and presence based on infrared or ultrasound).

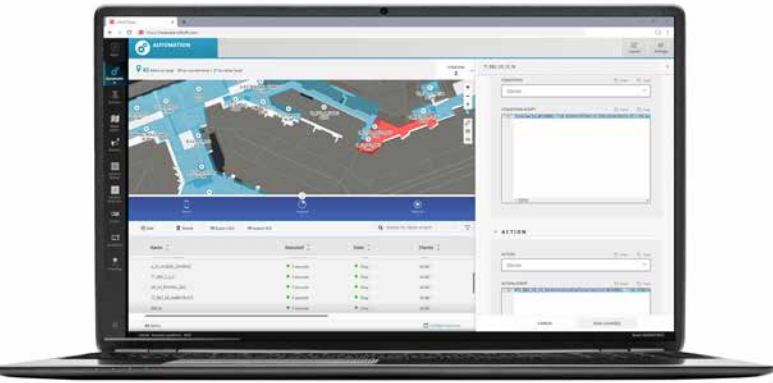
Using insoft Automation allows for the definition of various geo-based triggers along the process chain in real time. The automated actions to be triggered can include

insoft Analytics

alerts, notifications (push, email, ...), door locking / unlocking, just to name a few.

insoft Workflow enables the active planning, control and logging of work-sharing processes within RTLS (Real-Time Locating System) projects. Using the tool, all tasks that have to be carried out with the execution of organizational procedures can be registered and structured. Additionally, it is always possible to store geo-information.

insoft Machine Learning is a visual tool that allows creating user-defined machine learning models, train them within a very short time and use them in a wide variety of applications. The powerful environment processes position and/




insoft Automation



or sensor data and uses self-optimizing algorithms that can learn from experience. By recognizing patterns and regularities in existing data, values and results can be predicted.



insoft Sensors

 Software Videos

- [insoft Analytics](#)
- [insoft Tracking](#)
- [insoft Automation](#)

SDKs & Web Services

insoft’s technology is also available as plugins for integration into third-party apps. The plugins contain indoor positioning, indoor navigation & routing, 2D/3D building maps and GEOItems. The determined position is issued as virtual GPS coordinates and can be used as such in the app for your own purposes. The SDK (Software Development Kit) is currently available for the Android and iOS mobile operating systems and as an HTML5 plugin. In addition to a native implementation, the use of frameworks such as PhoneGap or Xamarin is also possible.



insoft’s products can also easily be adapted to different system environments. The insoft web services allow fast and efficient data integration via REST/SOAP interface.

insoft Developer Hub

The [insoft Developer Hub](#) gives developers access to the full range of functions of the insoft LocAware platform®. The hub provides API explorer capabilities, code samples and comprehensive guides and documentation to help start working with the platform as quickly as possible.



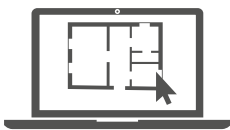
4 | Solutions & Products

insoft offers customized, comprehensive solutions and powerful products that allow for successful implementation of a Real-Time Locating System (RTLS).

Solutions

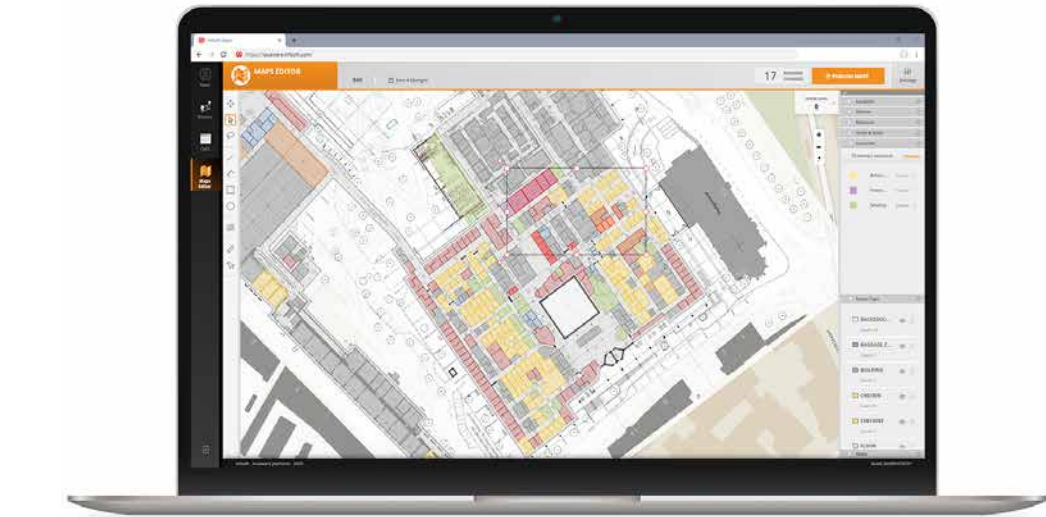
insoft offers the whole range of indoor positioning services: indoor mapping, indoor navigation, tracking, location analytics, and geo-based services.

Indoor Digitization



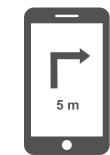
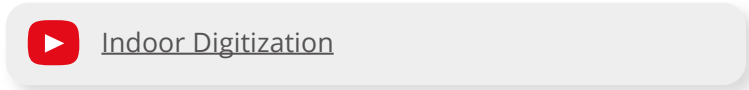
There are many ways indoor digitization can benefit buildings. Digital recording of interior spaces serves multiple customer requirements, such as easy orientation, efficient management of buildings, and connection of digitized processes and information with building structures, interior attributes and building facilities.

insoft offers an innovative, easy way to capture even large, complex indoor environments. Using the insoft Maps Editor, a location can be created with just a few clicks and can then be easily managed afterwards. Mapping a location is the first step in any indoor positioning project – and crucial for accessing the digital value of indoor spaces. It provides access to digital maps and to every layer of building information, allowing all indoor processes to be digitized.



insoft Maps Editor and a mobile app for indoor navigation

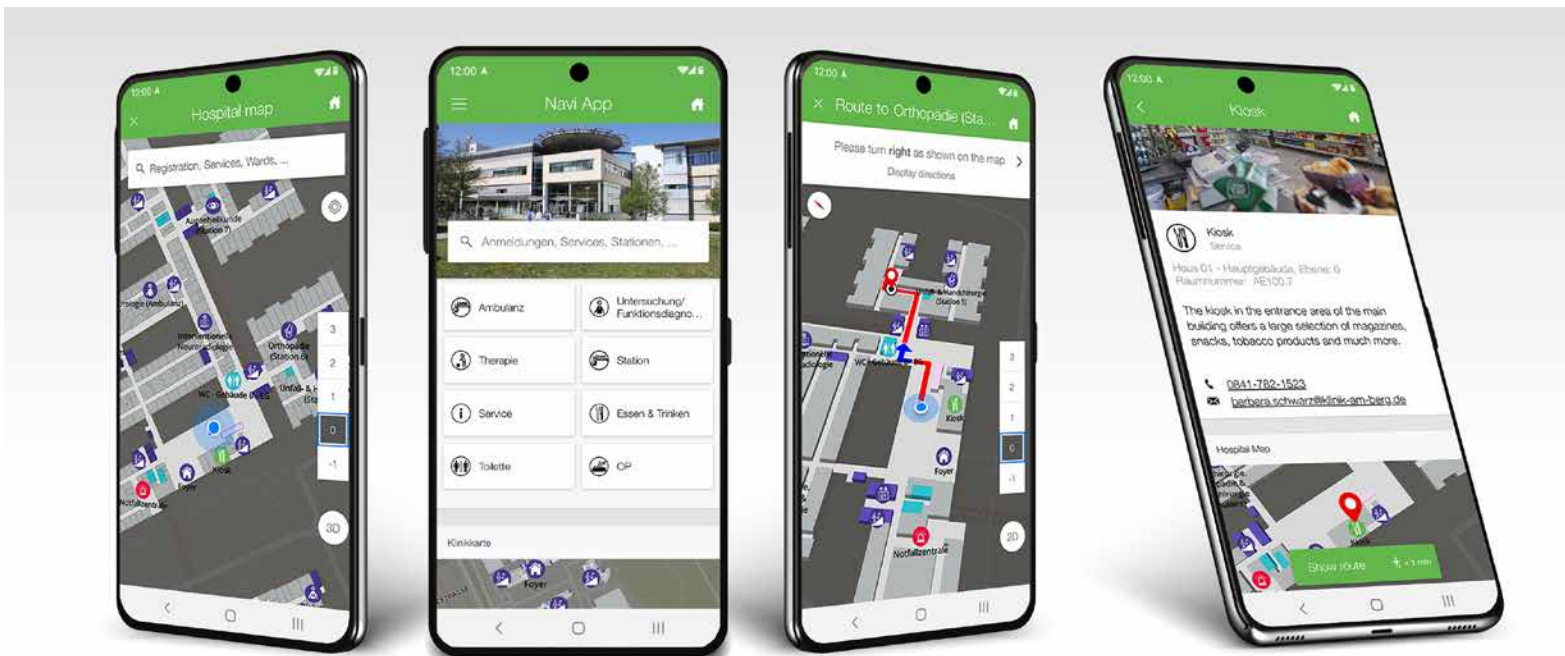
The integration of digital maps enables indoor navigation within a building. Besides that, it lays the foundation for the use of indoor tracking, indoor analytics, and geo-based services.



Indoor Navigation

Indoor navigation deals with wayfinding within buildings. Because GPS reception is normally non-existent inside buildings, other positioning technologies are used here when automatic positioning is desired. BLE beacons are used in most cases to create a so-called “indoor GPS”. Contrary to GPS, however, they also enable you to determine the actual floor level. Most applications require an “indoor routing” functionality that guides people precisely through a building and, in this way, automatically determines their position – very similar to the navigation systems that we use in our cars. A typical application is turn-by-turn navigation in an app (displaying directions on a digital map) used for train stations, airports, shopping centers and museums.

However, indoor navigation is also possible without automatic positioning – for example, when a digital building map is integrated into a website or in a digital signage system (multitouch kiosk/interactive terminal). In this case, no location hardware is required (Wi-Fi, beacons).



Indoor navigation with automatic positioning is normally used as a client-based application. This means that the position is determined directly on the smartphone of the user, which requires an app. The location is usually determined via beacons, in some cases via Wi-Fi. A feedback channel is also available, for example for sending push notifications.

Smartphone sensors are always called upon to refine the positioning function – for example, GSM, 3G/4G (LTE), magnetic field, compass, air pressure, barometer, accelerometer and gyroscope.

Because all insoft products are integrated into one platform, it is easy to enable additional features, for example route and visitor analyses.

Indoor navigation by insoft can also be integrated into existing apps: an SDK (Software Development Kit) is available for the Android and iOS mobile operating systems and as an HTML5 plugin.

Indoor navigation with beacons

Using beacons for indoor navigation is quite widespread because Bluetooth transmitters function across platforms and have an accuracy of 1-3 meters. The most well-known types are called iBeacon (from Apple) and Eddystone (from Google). Both operate using the BLE standard (Bluetooth Low Energy) and thus are very energy efficient.

Numerous hardware manufacturers market these small devices. A beacon should be placed every 7-10 meters depending on the desired accuracy. Beacons are the most popular hardware for indoor positioning due to their high level of flexibility and accuracy.

Indoor navigation with Wi-Fi

Indoor navigation using Wi-Fi provides an accuracy of 5-15 meters. The various signal strengths of several Wi-Fi access points are evaluated for this purpose. Positioning within the building, even over multiple floors, is made possible through specific shielding characteristics. The available Wi-Fi infrastructure can be used (e.g. customer hotspots, Wi-Fi-capable point of sale systems, routers) – the user only has to activate Wi-Fi on his/her smartphone, a connection is not required.

However, client-based positioning via Wi-Fi is not supported by Apple devices. Beacons are a good alternative if you want to include all smartphone users.

Indoor navigation with Ultra-wideband

Ultra-wideband has some significant advantages in industrial environments: high accuracy (10-30 cm), low latency times (position request up to 100 times/second), and accurate measurement of height differences.

For client-based positioning using Ultra-wideband, insoft UWB Tags are required. They transmit their position directly to the smartphone – either via a USB dongle which is directly plugged into the smart-phone or via Bluetooth.

However, the technique is a special solution which requires appropriate components and thus is mostly suitable for special industry applications. One possible use case are floor conveyors whose drivers should receive precise turn-by-turn directions. Because of their high speed, latency must be kept to a minimum.

Application examples of indoor navigation:

- [indoor navigation in a shopping mall](#)
- [visitor management in office buildings](#)
- [indoor navigation and LED identification of goods](#)

Indoor Tracking



Indoor tracking denotes the real-time localization of persons and objects within buildings. Depending on the application, insoft deploys indoor tracking based on different sensors.

Wi-Fi or BLE localization is cost-efficient and provides accuracies of up to a few meters. Ultra-wideband allows a very precise indoor tracking of people and objects. Passive RFID enables selective object identification. All solutions presented here also work seamlessly under the open sky in case the plant grounds are not uniformly covered by a roof.

Indoor tracking is normally implemented as a server-based application. No app is required because a back channel to the object to be located is not necessary in most cases. Special receiver hardware components, insoft Locator Nodes, are used here. The Locator Nodes can localize all Wi-Fi devices (smartphones, Wi-Fi tags and wearable Wi-Fi transmitters), Bluetooth Low Energy beacons (also available, for example, as wristbands or stickers), Ultra-wideband tags and RFID tags. In some cases, client-based positioning is used, e.g. when person tracking is part of an employee app. The



Object localization using the insoft Tracking tool

position is then determined directly on the user's smartphone and regularly sent to a server. An app is required in this case, and a feedback channel is available.

The intervals at which Bluetooth beacons, Wi-Fi or UWB tags send signals significantly affect the density and thus also the reliability of the acquired position data. A short interval which sends a signal every 20 to 350 milliseconds for positioning captures a person's or asset's path more precisely than a longer interval of 500 milliseconds or more. Short intervals are useful for quickly moving objects (e.g. vehicles) or high precision requirements. With long transmission intervals, the actual route cannot always be traced precisely, but battery life is significantly longer when using battery-powered tags/beacons.

insoft offers various web-based tools for managing the digital map and checking the status of beacons, for example. Indoor tracking by insoft can also be integrated into existing systems (e.g. apps). An SDK (Software Development Kit) is available for the Android and iOS mobile operating systems and as an HTML5 plugin.

Indoor person tracking



The indoor tracking of persons can make sense in several situations. On the one hand, it plays a major role regarding safety, e.g. for patients in high-risk categories or for the evacuation of employees from large company premises. On the other hand, it helps with the optimization of work processes, e.g. when the analysis and optimization of walking routes is desired.

Application examples of indoor person tracking:

- [personnel tracking in tunneling](#)
- [kid finder and crew monitoring on a cruise ship](#)
- [tourist tracking in ski resorts](#)

Indoor object tracking

The indoor tracking of objects is in great demand, particularly in the industrial sector. Here, it is often necessary to determine the current location of work equipment or goods. The RTLS systems from insoft are based on a detailed digital map that shows the current position of the object(s) and that can be displayed on all (even mobile) end user devices.

Application examples of indoor object tracking:

- [pallet tracking in logistics](#)
- [railway train tracking system](#)
- [process optimization in a car rental company](#)

 [Indoor Tracking: Project Procedure](#)



Indoor Analytics

The analysis software from insoft can be added to existing indoor positioning / indoor navigation systems

(client-based or server-based) or set up independently. The technology recognizes end user devices, Wi-Fi and Bluetooth transmitters, RFID and Ultra-wideband tags and measures the time spent in certain areas and which routes were used. This enables you to, for example, find out how many people pass a certain spot during the day or which hours of the day or week are the least busy. The movements of objects, e.g. work equipment, goods or products can also be measured along with the walking paths of visitors. The data is displayed in the form of diagrams and heat maps, enabling easy evaluation and further processing. insoft's analytics dashboards are highly flexible and can be customized to the individual needs of each client.



Insights on visitor behavior

insoft Indoor Analytics provides helpful information for business decisions. Heatmaps, route analyses and dwell times allow the targeted analysis of customer or visitor behavior. Indoor Analytics helps to improve customer/visitor satisfaction, product placement, personnel planning and the evaluation of marketing activities.



For example, a retailer can determine how successfully their current layout draws customers' attention to a specific offer. Operators of a shopping mall can make rents in different areas dependent on the respective visitor numbers. A museum director can establish which works of art are especially popular and whether optimization is necessary in the guided tours. Trade fair organizers can measure visitor numbers at individual points of the premises and set stand prices based on this information. The driving routes of machinery on factory grounds can be measured and visualized so that optimizations can be developed.

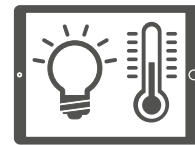
Data protection and technical requirements

When indoor navigation from insoft is being used, you can work directly with the analysis software. The mobile devices of users that have installed the corresponding app can send their position to the server on a regular basis. No personal data are captured, so that insoft Indoor Analytics can be used in compliance with data protection regulations.

If you are not using an indoor positioning system from insoft or you want to generate a wider database, then we recommend server-based data collection. insoft Locator Nodes are used for this. Thanks to their modular approach, they can not only track smartphones via server, but also beacons, Wi-Fi tags, Ultra-wideband tags or RFID tags.

Application examples of indoor analytics:

- [traffic flow analysis in cities](#)
- [analysis of visitor flows at a trade fair](#)
- [calculation of waiting times at an airport](#)



Sensors

Sensor technologies can provide records of controlled parameters that can be used for purposes such as condition monitoring, occupational safety, air quality or food safety. A network of wireless sensors ensures intelligent infrastructure management and enables valuable user experiences. Possible sensor data include temperature, humidity, CO₂, air pressure, motion, presence, vibration and much more. Integrated into critical systems, the sensors can provide cost savings, improved energy efficiency and reliable reporting.

Typically, a network of insoft Locator Nodes and wireless sensor devices is used to collect the environmental or presence data of interest. Beacons can also be equipped with sensor technology ("sensor beacons").

insoft's software solutions provide real-time trending, notifications to relevant personnel and automated reports. Alerts can be set up to automatically inform about situations that require attention. The web-based application insoft Sensors provides real-time access to the collected sensor data. Customizable dashboards help to assess current situations and long-term trends.

Application examples of sensor technologies:

- [cold chain monitoring in food logistics](#)
- [management of conference rooms](#)



Geo-Based Processes & Services

Location-based services are location-specific mobile services. They provide information or functions to smartphone users, depending on their location. Various methods can be used for indoor positioning within buildings to implement location-based services. A distinction is made here between reactive and proactive services. For reactive location-based services, the user searches for locations in the vicinity directly on his/her device, e.g. for ATMs at the airport. Proactive services "recognize" when a user enters a specific area and trigger an action – e.g. sending information or an offer to the user's smartphone. This is referred to as location-based marketing. An app is required for these services.

Geofencing in interior spaces

The triggering of an action when taking a specific path is called geofencing (combination of geography and fencing). This can also be used inside buildings without GPS reception.

Geofencing is quite interesting for marketing in shopping centers, airports, train stations and at trade shows, among others. Customers can be assigned anonymous "tags" that are based on their interests and behaviors. This could include characteristics such as age, gender, visited areas / stores and length of stay. This helps to provide customers with information, offers and coupons that are only relevant for them.

Process automation

Geofencing allows intelligent process automation. Using the insoft Automation Engine, you can define various geo-based triggers along the process chain, speeding up operation and streamlining processes. It is possible to, for example, configure emails and tasks, create alerts, and protect areas by triggering automatic door locking / unlocking.

When talking about geofencing, we need to distinguish between client-based and server-based positioning. With client-based positioning, the user has a corresponding app installed. A feedback channel is available that can be used to send messages to the user's device. With server-based positioning, the user cannot be addressed directly. However, interesting conclusions regarding interests and behaviors can be drawn from the location of numerous devices. Server-based positioning can also be used to trigger different actions along the process chain.

Application examples of geofencing:

- [content triggering in an app](#)
- [geo-based access restrictions](#)
- [safety for dementia sufferers](#)

insoft Products

In addition to customized solutions, insoft also offers out-of-the-box solutions with powerful features.

insoft Wayfinding



In large buildings or on wide campus areas, there are many destinations that visitors and employees want to reach. A smartphone app helps users to get to the desired location quickly and easily. insoft Wayfinding can be used in buildings such as hospitals, airports and office complexes across indoor and outdoor areas.

The use of our setup tools is included in the solution. With insoft Maps Editor, insoft CMS, insoft Routes and insoft Calibration, the application can be flexibly configured according to the customer's needs. Using our SDK (Software Development Kit) it is also possible to integrate the technology into existing applications.



insoft Wayfinding app

Digital 2D/3D Building Map

The app provides 2D and 3D maps of the individual floors of all buildings on the site. The user can see their own location as well as relevant destinations on the premises.

Turn-by-Turn Navigation

The user can be navigated to any destination on the site. Using turn-by-turn navigation, the user follows the directional instructions displayed in the wayfinding app.

Information on Points of Interest

In addition to the position of the destinations, further information about them can be found. This may include a brief description, opening hours and contact details.



Implementation

Bluetooth Low Energy (BLE) beacons (or insoft Locator Beacons) are installed at regular intervals throughout in the building. The beacons emit signals which are received by the users' smartphones. Based on the received signals, the position of the device is determined directly in the smartphone app.

Inside the app, the user can select a navigation destination and follow the directional instructions to their destination.



More information and cost examples:

- [insoft Wayfinding](#)



insoft Occupancy

Being able to reliably estimate the occupancy of areas inside a building can prove beneficial for managing busy environments such as offices much more efficiently. It is crucial for organizations to make good use of the available space, especially since office facilities represent one of the biggest cost factors for them. Using our smart out-of-the-box insoft Occupancy solution enables achieving a flexible, agile and space-efficient office portfolio in no time.

Our approach does not require the occupants to carry any devices with them. Instead, it relies on cost-effective BLE hardware that is easy to install and easy to maintain.

Workspace Occupancy Sensing

By equipping chairs with beacons with motion sensors, workspace usage can be easily monitored. Employees can profit from an app, especially when flexible office concepts are applied.

Occupancy Monitoring for Conference Rooms

Placing infrared sensors in conference rooms allows to reliably attain occupancy information for that room (occupied / not occupied) and detect changes in real time.



Dashboard: insoft Analytics software

Data Insights & Evaluations

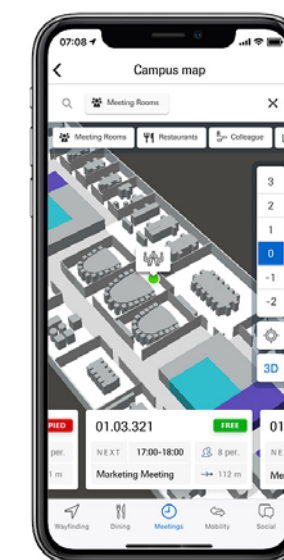
insoft Occupancy delivers highly useful data for corporate management to help determine if a workplace is meeting demand and make adjustments for optimal use of office space.



Implementation

Bluetooth Low Energy (BLE) beacons with built-in motion sensor capability are attached to the office chairs. A small number of insoft Locator Nodes 1400 are installed in the areas to be monitored.

In conference rooms, presence detectors (Passive Infrared Sensors, PIR) can be used to monitor occupancy.



insoft Workplace Experience app



More information and cost examples:

- [insoft Occupancy](#)



infsoft Workplace Experience

Diverse solutions and applications in intelligent offices lead to a more pleasant and productive working day for employees. From a business perspective, the main potential lies in saving costs and optimizing processes. In addition, it increases employee satisfaction and leads to higher productivity and lower fluctuation.

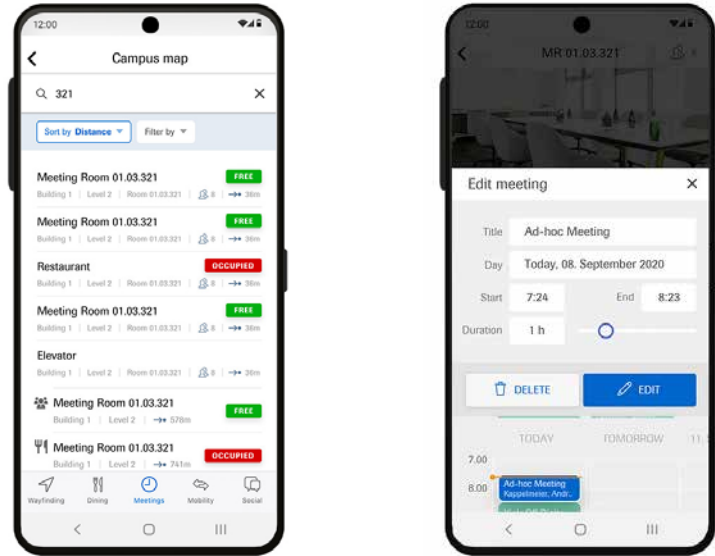
There are many features with which a digital employee app can enrich everyday working life.

Travel Information / Mobility

An app can be used to provide employees with greater convenience during their journey to work. By integrating parking garage information, company shuttle schedules and public transport, the user gets a quick overview of the possibilities for getting there.

Wayfinding

Navigation at the site facilitates orientation for employees, visitors, and guests. The basic function provides an interactive map of the entire site, including all buildings, which are available with all floors. This is supplemented by a search function including category assignments.



infsoft Workplace Experience app

Room Booking

Conference rooms can be booked and meetings can be organized. Information on equipment, capacity and utilization is also available. Additional added value is provided by



a wayfinding system, links to catering services, and sorting according to geographical distance.

Communication / Social Connection


With this feature, internal company events can be planned and the connection between employees can be strengthened. Various functionalities such as chat, personal profile, SkillFinder, and friends list can be added.

Dining & Food Options

Here you will find information about canteens, cafés, and snack and coffee machines on the company premises. Menus can be viewed, and navigation can be called up.

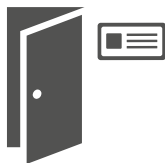
Implementation

Bluetooth Low Energy Beacons or infsoft Locator Beacons are installed on the premises. Employees install a mobile app on their mobile devices. The smartphones receive the Bluetooth signals from the beacons and use a signal strength measurement for positioning. The app can precisely guide the user to selected destinations using directional instructions. Push messages can be received via a back channel.



More information and cost examples:

- [infsoft Workplace Experience](#)



infsoft Room Signage

infsoft offers innovative electronic room signage systems based on battery-powered E-Ink display beacons. These modern and also very practical room signs simplify work processes and create transparency, as employees and visitors can view up-to-date information about ongoing and upcoming meetings at any time. The displays enable the automation of processes and a reduction in overall operating costs. With the help of the display beacons, not only office, seminar and conference rooms, but also treatment and patient rooms can be updated and easily managed at any time.



infsoft E-Ink Display 7.5 inch

The displays are centrally managed via an infsoft Locator Node 1400 and the displayed content is automatically updated via infsoft Automation. Room lists and schedules can be easily imported and displayed via interfaces to third-party systems (e.g. Google Calendar, Office 365). While sample templates are available for this product, individual layouts according to your own corporate design can be used as well.

The tricolor display is equipped with an LED indicator and uses fully daylight-compatible ePaper technology. The batteries last for about 5 years, even with several content updates a day. The battery status can be monitored using the software tool infsoft E-Inks. Due to the simple assembly, complete office buildings can be easily retrofitted with the room signs.

Implementation


Bluetooth Low Energy beacons with E-Ink display are placed next to the room doors. infsoft Locator Nodes 1400 installed in the building receive the signals of the display beacons and transmit them to the infsoft LocAware platform®.



Via Bluetooth, the content is transferred from an infsoft Locator Node 1400 to the E-Ink display to be labeled. The content on the display can be automatically updated using infsoft Automation.

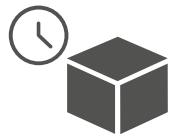


Dashboard: infsoft E-Ink software



More information and cost examples:

- [infsoft Room Signage](#)



insoft Lead Time Tracking

With its lead time tracking system, insoft has developed a powerful solution that monitors processes and documents each individual process step. The solution enables high process transparency, utilization optimization and adherence to delivery dates.

Depending on the industry, the concept of “lead times” can take on different forms. In logistics and manufacturing, the monitoring and optimization of lead times is pivotal to organizing all the processes along the supply chain. Knowing the precise lead time will allow you to commit to a specific delivery date. It is also key to prevent production line shortages. In healthcare, the application can help physicians and nurses reduce the amount of time and resources devoted to management purposes. Process tracking and automation can also be applied to various other sectors such as automotive, office, and retail.



Dashboard: insoft Tracking software

insoft Lead Time Tracking relies on cost-effective BLE hardware that is easy to install and easy to maintain. An interface to the in-house ERP software facilitates processes and automatically assigns asset details.

Asset Tracking

Mobile goods are tracked at relevant checkpoints. The current position and status can be viewed on a digital map. A dashboard displays dwell times at different process areas.

Digital Labelling

insoft E-Ink Display Beacons that are attached to the assets can be rewritten automatically with the current status and



individual information such as instructions on the next work step.

Geofencing

Process steps or asset statuses can be automatically updated via insoft Automation, e.g. if an asset enters or leaves a defined area or stays in a certain area for a specific amount of time.

Implementation

Bluetooth Low Energy beacons or beacons with a display medium (E-Ink Display Beacons) are attached to the assets to be tracked.

insoft Locator Beacons and a small number of insoft Locator Nodes 1400 are installed in the production area. The asset tags' Bluetooth signals are received by the Locator Beacons and sent to the insoft LocAware platform® via a Locator Node.



More information and cost examples:

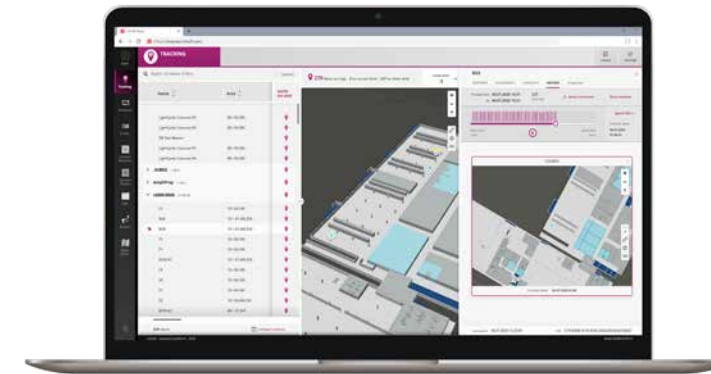
- [insoft Lead Time Tracking](#)



insoft MedEquip Tracking

insoft MedEquip Tracking supports health-care facilities in managing their mobile assets. Locating objects of different sizes ranging from hospital beds to endoscopes is equally possible. Besides the position of the assets (ward / patient room / bed preparation, etc.) additional information can be stored. Furthermore, an automatic update of the status (e.g. “unclean” or “in use”) is possible using geo-based triggers. The user can view and evaluate all collected data in insoft's Analytics software in real-time and over time. This creates transparency regarding the availability of medical equipment and beds.

The position is generally determined via BLE beacons, which are attached to the assets. With modern beds, however, it is also possible to establish a connection to the software that is integrated in the bed. This allows the analytics dashboard to automatically display information such as to which height the bed is set or whether it is currently occupied.



Dashboard: insoft Tracking

Localization

The solution enables reliable room- and area-specific positioning of mobile medical equipment and hospital beds. The localization can be carried out seamlessly across all floors of the building.

Geofencing

Geofencing allows automatic status changes or notifications as soon as an asset enters a certain area. For example, a cleaned bed can receive the status “clean” when it arrives in an allocated zone for clean beds.

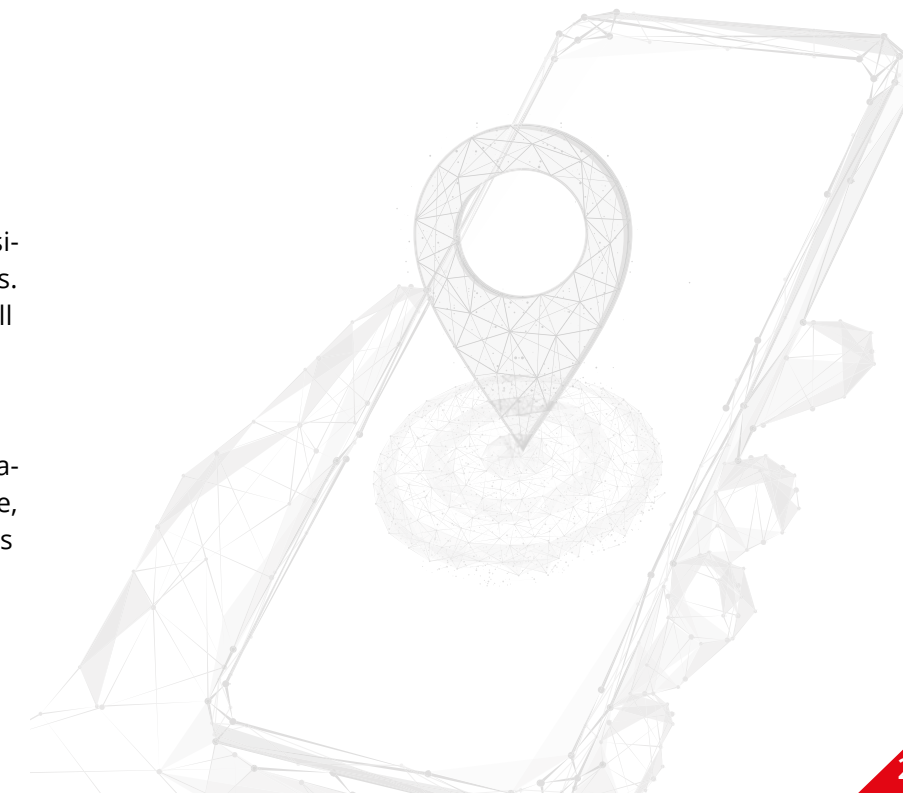


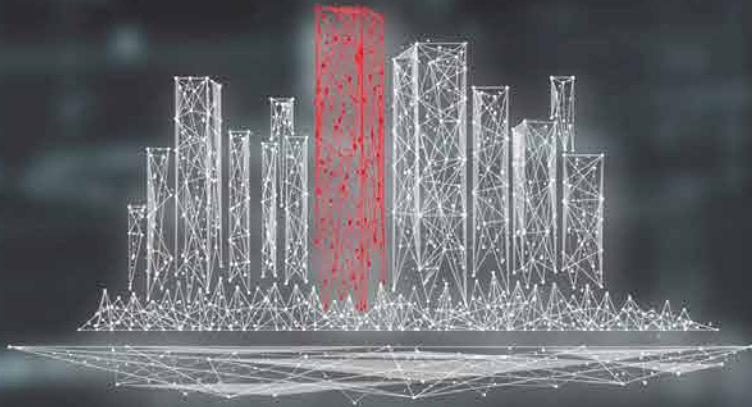
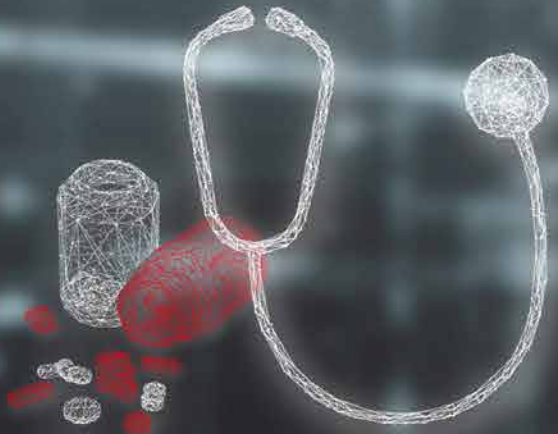
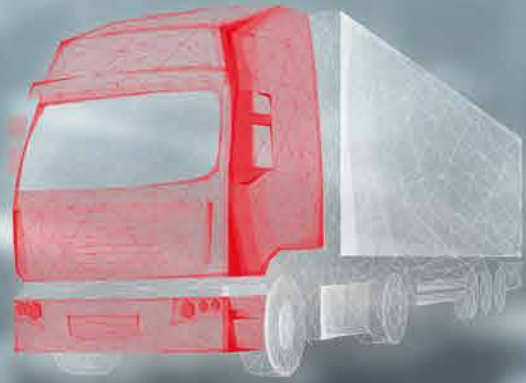
Analyses

In addition to location and status information, a comprehensive dashboard provides the user with valuable insights into the utilization and usage of all assets. Grouping and filtering of object types is also possible.

Implementation

Bluetooth Low Energy (BLE) beacons attached to the assets send out signals that are received by insoft Locator beacons mounted in the building. These signals are forwarded to an insoft Locator Node and sent to the insoft LocAware platform® where the position is determined.





5 | Industries & Examples of Use

Indoor positioning and services are not restricted to any specific industry – the fields of applications are limitless. Nonetheless, you can point out several industries that are particularly embracing this technology and its benefits.

Industrial Applications & Logistics

infsoft offers tracking solutions in complex industrial areas. A Real-Time Locating System (RTLS) provides location-relevant data for operators, making the logistics process faster and smoother. An RTLS can not only help with productivity enhancement, but also with real-time decision support and the identification of hidden costs.

Advantages for operators

infsoft provides you with solutions for the monitoring of mobile goods. Whether it is pallets, forklifts, robots or equipment inside complex industrial areas – the tracking solution detects all required goods and allows for seamless tracking. One possible application scenario is tracking pallets along the supply chain in order to monitor the whole process including incoming and outgoing goods, amount, delivery date as well as actions at the point of sale. All data can be accessed at any time via a web-based portal or a standalone app and can also be integrated into existing ERP systems.

Advantages for security administrators

infsoft's indoor tracking solutions offer an operations control system for plant security, which sends the positions



of staff and objects to the control center in real time. Security services staff who is located in the vicinity of certain events can be directly assigned to patrols. An alert function notifies the control center as soon as a security-relevant area is entered by a non-authorized person. Thanks to the analysis of movement profiles inside and outside the building, detailed data is available that can be used to undertake refinements to the security concept. Should goods, equipment and vehicles leave a certain area without permission, a warning mechanism can be triggered via geofencing (theft protection). Furthermore, user-specific areas can also be created with individual access authorization.



Vehicle and equipment monitoring at an airport using Bluetooth Low Energy (BLE) and GPS

Travel & Transportation

When business or leisure travelers go on a trip, they want to keep the waiting times to a minimum and make good use of it. Operators of airports and railway stations want to offer passengers a trouble-free and comfortable stay. Shops and restaurants wish for passengers who have enough free time to consume. All of those needs can be better satisfied by infsoft's branch solutions.

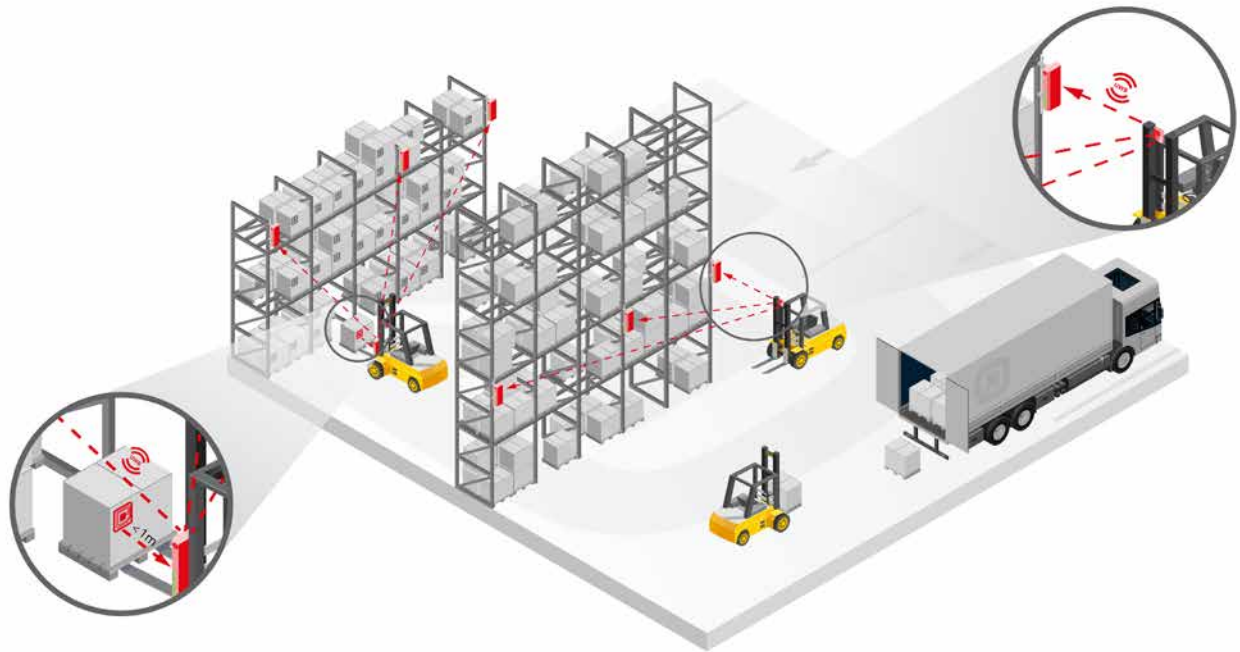
Advantages for passengers

People who travel infrequently may need support in complex infrastructures like airports or railway stations. This is where the benefits of indoor navigation become apparent. It shows the exact routing from starting position to the terminal or railway platform. It is even possible to implement intermodal door to door navigation. When passengers cover the distance quickly, there still remains enough time to discover shops or take a break in a restaurant. Merchants can push tailored advertising directly to the smartphone and offer a lot of added value for the customer.

Platform/gate changes or delays cause less stress if the passenger is informed as early as possible. Apps can accomplish this through push notifications and real-time updated timetables. Back from the journey, the app helps passengers to find back to their car or public transportation.

Advantages for stores and restaurants

Merchants can push custom-fit offers directly to the smartphone of interested clients: For example, those who have already visited this or similar shops. This allows, for example, discounts to be sent for the favorite shops of individual users. In addition, operators learn a lot about visitor flows in or nearby the store. Large shops can also use indoor localization for asset tracking, for example in order to improve theft protection or logistics.



Tracking of floor conveyors and goods using Ultra-wideband (UWB) and RFID

Advantages for airport operators & station managers
The advantages for merchants and passengers listed above improve customer satisfaction. Using indoor location analytics, operators can even get detailed information about the stream of visitors. These data can be used as a substantial argument when leasing floor space. It can also help your security staff: As soon as somebody enters a restricted area or when certain areas are overcrowded, predefined actions can be triggered.

In addition, a tracking system provides real-time location information about vehicles and equipment and contributes to improving operational productivity at an airport or railway station. Such a solution can be implemented



indoors and outdoors and ensures safe and efficient operation and the best possible utilization of equipment (this can include motorized and non-motorized assets, e.g. ground support equipment, cleaning machines and baggage carts). Operators can be alarmed if speed, idle, or location violations occur, can get reports based upon the assets' historical activities, review utilization, and identify underutilized assets.



Intermodal travel planning using Bluetooth Low Energy (BLE)

Healthcare & Pharmaceutical

Indoor positioning systems can not only be beneficial for patients, but also for hospital operators: Mobile medical equipment can be found quicker, staff is being relieved, hygiene rules controlled, itineraries analyzed, appointments coordinated and costs reduced.



Advantages for patients and visitors
Most people who enter a hospital want to reach their destination (e.g. the emergency room, the cafeteria, a treatment room or a patient room) as fast and as easy as possible. An app for patients meets these requirements. In a clear 2D or 3D map, the user can see his/her current location

and navigate to a chosen destination – barrier free, if desired. An integrated calendar reminds him of treatment appointments in time and shows the way there. When an appointment is postponed, a message is being sent – this way, everyone's waiting time becomes shorter. Additionally, all services which a hospital offers can be integrated (for example meal selection, TV and phone card booking). The growing sector of medical tourism can profit from these applications as well, since they facilitate orientation in foreign environments.

Advantages for hospital operators
infsoft's solutions follow the internet of things (IoT) approach. More and more things are interconnected and facilitate people's work. Tracking mobile equipment, for example medical devices and hospital beds, ensures preventative maintenance, inventory control and prevents loss and theft. An indoor positioning system for hospitals can be integrated into third-party systems, for example hospital information systems. Possible applications include coordination of appointments and waiting times (leading to saving of time for doctors and patients), monitoring of patients, indoor navigation for patients and visitors, transmission of patient data across several medical stations, control of hygiene regulations, and relief of triage nurses in the emergency room.



Monitoring and asset tracking in the healthcare sector using Bluetooth Low Energy (BLE)

Offices & Smart Buildings

Indoor positioning and indoor navigation can make the management of large offices a lot easier. Visitor and invitation management, workplace management and access control systems, among other features, can lead to simplified internal processes and reduced costs.



Advantages for companies

Using an indoor positioning system can create added value for staff and visitors. Visitors can be routed directly to their respective contacts (invitation management). Optional tracking of the movement profile can be realized without

breaching data protection policies. In addition, a location memory function for cars (car finder) and the integration of public transport facilitate the arrival. In order to help visitors and new employees orientate themselves in the foyer, the maps can be integrated into terminal solutions.

In a control center, you have a comprehensive overview of your staff's location and can therefore delegate tasks more efficiently. Available staff near a location can directly be assigned tasks using push notifications. Furthermore, additional geo-based information can be collected and forwarded, meaning that, for example, a length of stay analysis can be realized.

Advantages for employees

Within an indoor navigation app, users can search for the offices of individual employees or unoccupied meeting rooms, which can be booked and navigated to. Using the "Colleague Finder" function, employees can share their location with each other and thus better coordinate their work. Company news, messaging, canteen plans and a parking space finder are other useful features.

Automotive & Assembly

Mainly due to the high-quality standards that are demanded in the production cycle, the automotive industry is highly advanced in the adoption of precision automation technology. Indoor positioning is one such technology that has made significant forays into the industry. Dealerships and service centers can also benefit from indoor localization since it helps making the customer journey as smooth as possible.



Advantages for manufacturers and suppliers

infosoft's solutions span the entire automotive manufacturing chain. They may be used for vehicle identification and tracking, quality control in production or asset management. A Real-Time Locating System (RTLS) increases

manufacturing flexibility and access to real-time production information. A precise tracking solution can allow for a smooth production process and make sure that supplying material to the assembly workstations runs smoothly. Workers can check at any time whether they are still on schedule. Automatic calculations determine whether a material supply will be delayed, which makes it possible to initiate countermeasures in due time.

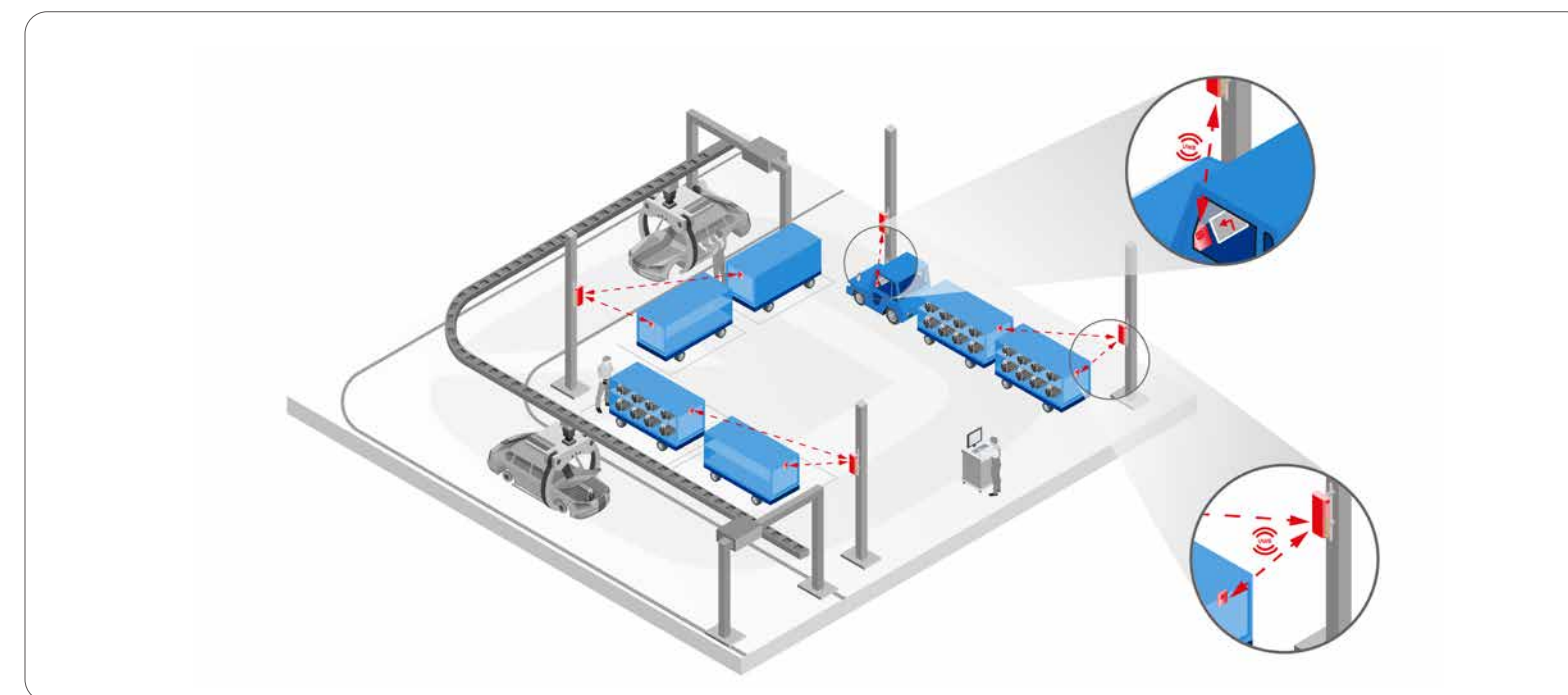
Advantages for dealerships, workshops and service centers

Car dealerships and service centers can optimize internal processes and customer experience by the use of an indoor positioning system. If the arrival of a car of an (existing) customer is captured, a message can be triggered that is sent to responsible employees who can make preparations to ensure an optimal client experience. Furthermore, the status of a vehicle within the repair / maintenance process can be tracked, which allows a more efficient organization of the maintenance procedures.

Salespersons can get access to the current position of individual cars via app and can use a filter to browse cars that meet certain criteria. The time a car has been standing in the showroom is measured and automatically influences the selling price in all digital systems. Data about itineraries and dwell time of clients can also be accessed. Thus, it is possible to determine which days and times are most popular and which cars attract a lot of interest.



Location-based employee services using Bluetooth Low Energy (BLE)



Process optimization in automotive manufacturing using Ultra-wideband (UWB)

Mining & Construction

Indoor tracking can be used during construction, maintenance and cleaning of tunnels and constructions. Tracking solutions by insoft provide real-time location information on people, equipment and vehicles. This increases the overall safety of the workplaces in tunnels. At the same time, the implemented technology facilitates an efficient coordination of work processes.

Benefits for operators

Indoor tracking of personnel, equipment and vehicles facilitates an efficient coordination of work processes. Locating workers allows an effective and efficient deployment of personnel. It can be ensured that workers are only assigned to areas or undertake tasks for which they have sufficient training and authorization. Tasks and alerts can be automatically generated and transmitted to a worker's smart-phone if desired. In addition, vehicles and equipment can be tracked and thereby coordinated efficiently.

Benefits for workers

When carrying out construction, cleaning and maintenance work, a tracking system ensures increased personal safety for the workforce. In case of an accident, the person affected can be located via indoor tracking. Furthermore,



mechanisms can be configured that inform the control center whenever a worker or a vehicle enters or exits a defined area.

In case of an emergency like a fire or the emission of dangerous gases, all persons in the tunnel or on the construction site can be evacuated quickly and safely.

Retail & Consumption

insoft's solutions can offer operators, shops and customers real added value. They help retailers to increase sales, profits and customer satisfaction. A good mall navigation app improves the shopping experience and increases revenues. Location analytics provide reliable data concerning visitor flows in the building.

Advantages for customers in shopping centers

Shopping center apps improve the shopping experience. Its functionality is not limited to display the latest offers and a list of shops and points of interest. It can also guide customers there – if desired even with means of augmented reality. Additionally, it can recommend offers that might be interesting for them – based on previous stays or purchases.

Advantages for mall operators

A mall navigation app can help customers have a better shopping experience – with the help of routing or location-based marketing. For example, an offer or a coupon can be sent to the smartphone of a customer who is near a certain store. This kind of information is customized and offers him individual added value instead of bothering him with unsuitable advertising.

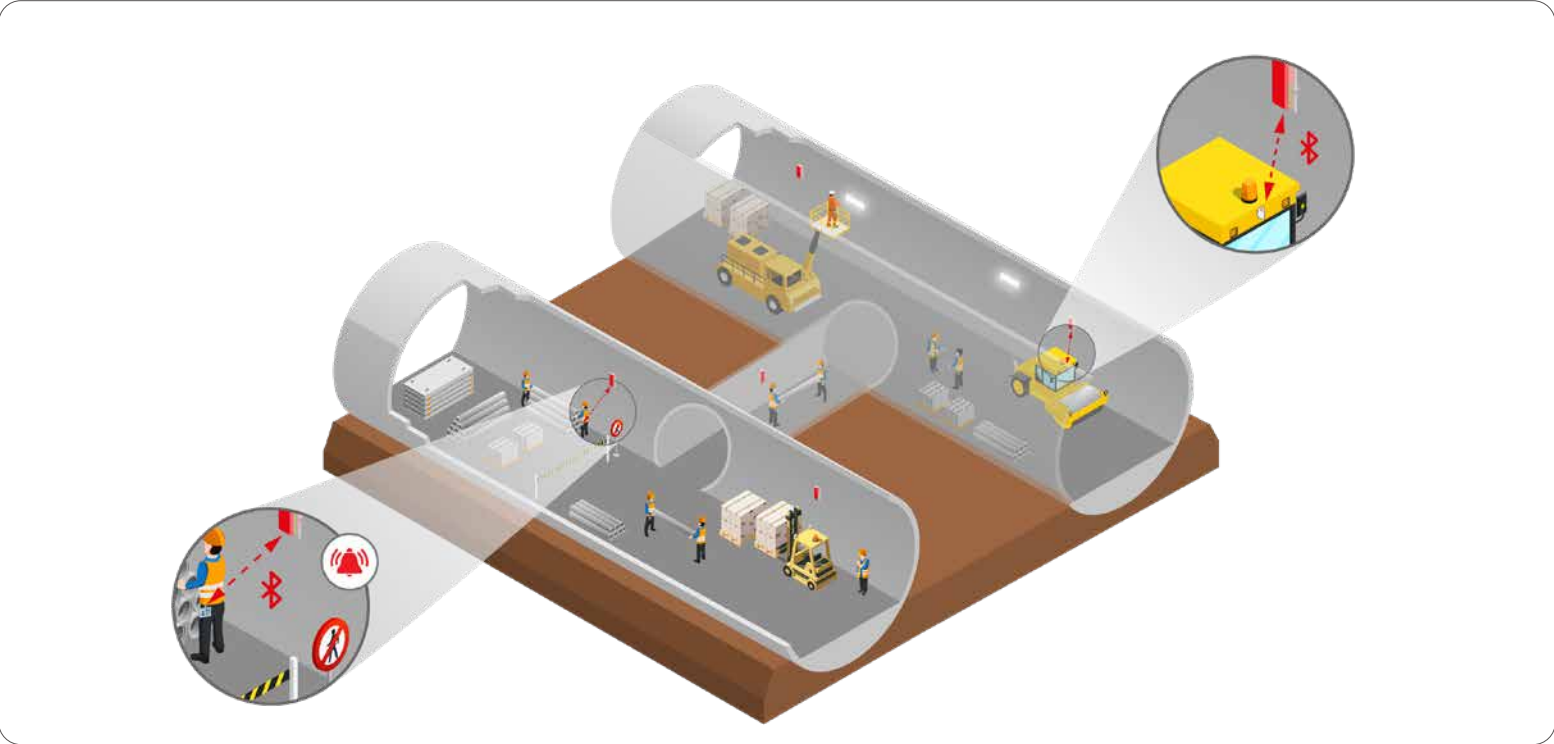
Using indoor location analytics, mall operators can measure and analyze visitor flows easily. The security department



can also take advantage: They can receive a message when people enter restricted areas or when certain sectors are overcrowded.

Advantages for shop owners

Shop owners can easily learn a lot about their clients: How many visitors are near my store at a certain time, how many enter it? How do they move inside? Additionally, they can make use of precisely targeted location-based marketing: For example, purchasing incentives can be sent on the smartphones of a selected group.



Asset and personnel tracking in tunneling using Bluetooth Low Energy (BLE)



Indoor navigation and person tracking in a shopping mall using Bluetooth Low Energy (BLE)

Leisure & Tourism

The tourism industry is constantly trying to find new ways to attract and retain customers. The use of Real-Time Locating Systems (RTLS) offers the opportunity to stand out from the competition, promote additional sales and improve the travel experience for customers. Mobile apps connected with positioning technologies are particularly promising.

Benefits for travelers

In the tourism sector, intermodal navigation is becoming increasingly important. Ideally, travelers can plan their entire journey with one app – from their own front door via a taxi to the right track/gate and to the hotel at their destination. Another trend is indoor navigation at large train stations, airports or on cruise ships. The concept of providing services is particularly important during the journey: Passengers can, for example, be notified if their flight is delayed, if the gate changes, if there are queues at check-in or when boarding begins.

In touristic destinations, app users can be localized by beacons and receive location-specific information on attractions and events. Similarly, museum or zoo apps can provide information and interactive content on nearby exhibits and animals and enhance the visitor experience.

Benefits for tourism facilities

Destinations face the challenge of distinguishing themselves from the masses by setting individual focuses. If,



for example, a destination app can access a guest's preferences and current location, it is possible to submit relevant offers during the entire customer journey that will make his or her holiday unforgettable.

The hotel industry can also benefit from targeted, digital service. If the reception desk already knows about the guest's preferences before arrival, it can score points with "surprise quality" – for example, if the guest's favorite drink is prepared at check-in. The guest data can also be transmitted digitally, eliminating the need to fill out forms. If the system works with beacon technology, the check-in process can be initiated automatically upon arrival and the guest can receive a welcome message and individual offers to book. Other possible features of a hotel app include mobile door opening or the ability to report problems or malfunctions.



Digital services for hotel guests and staff using Bluetooth Low Energy (BLE)

About infsoft

infsoft GmbH, located in Großmehring near Ingolstadt (Germany), has been offering solutions for indoor navigation, indoor analytics, indoor tracking, and location-based services since 2005. In addition to comprehensive solutions for major clients, infsoft also provides developers with access to its core technologies via scalable Software Development Kits (SDK), enabling integration with third-party applications. infsoft's client base includes Frankfurt Airport, Swiss Federal Railways (SBB), UNIDO, Siemens and Roche.

Indoor positioning systems enable better orientation in complex buildings and allow new applications in the field of geo-based solutions and location-based marketing. "Smart connected locations" is infsoft's guiding principle. All backend tools and collected data are linked and exchanged in the infsoft LocAware platform® to create added value – going far beyond the blue dot on a map.



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