IndoorPlus+ Real Time Location System (RTLS)
Solution Description

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PEOPLE AND TECHNOLOGY, Seoul, Republic of Korea; Zurich, Switzerland
www.pntbiz.com

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1 PEOPLE AND TECHNOLOGY

1.1 Introduction

PEOPLE AND TECHNOLOGY (PnT) is a leading provider of **advanced geolocation intelligence and smart sensing solutions**, catering to a wide range of clients in the corporate, private and public sectors as they navigate their digital transformation journey. Leveraging cutting-edge technologies such as Real-time Location System (RTLS), Internet of Things (IoT), and Artificial Intelligence (AI), PnT focus improving operational efficiency, enhancing safety and security, and ensuring compliance with policies.

Our flagship solution suite, IndoorPlus+, encompasses a broad spectrum of applications, including among others: real-time asset tracking and utilization, people safety monitoring, enhanced access control visibility, cold chain equipment management, contact tracing, navigation solutions, or flow optimization.

With an efficient and cost-effective deployment strategy that prioritizes simplicity, we seamlessly integrate with existing communication infrastructure to leverage past investments. Our unified platform facilitates smooth integration among multiple applications, eliminating isolation and standalone silos. Trusted by enterprises across diverse sectors such as Healthcare, Manufacturing, Smart Offices, Banking, Education, Energy, Utilities, Public Administration, Defence, and Military, PnT addresses a wide array of use cases.

PnT is relying on local partners to expand its operations and provide innovative and reliable solutions. It is headquartered in Seoul, South Korea, and its EMEA subsidiary, PEOPLE AND TECHNOLOGY AG, is based in Zurich, Switzerland.

1.2 References

PEOPLE AND TECHNOLOGY has multiple references in various market segments with implementations and large deployments on production/manufacturing sites, headquarters or offices, data centers, hospitals, banks, building construction sites, power plant and utilities…

Figure 1: Some references in various industries

In the healthcare market, PnT has deployed IndoorPlus+ solutions in more than 70 hospitals, ranging from well-established organizations to brand new facilities.

Figure 2: Some references in Healthcare

2 INDOORPLUS+ SOLUTION ARCHITECTURE

The architecture of IndoorPlus+ solution enables the seamless and gradual implementation of multiple applications, catering to diverse use cases, all while utilizing a unified backend and core software platform.

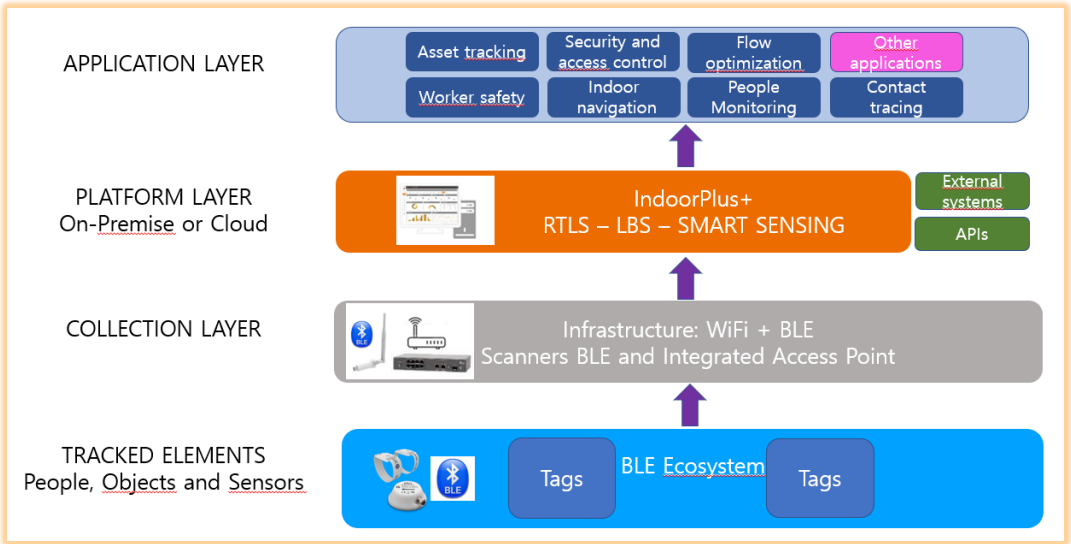


Figure 3: General architecture

Moving from bottom to top, the architecture consists of the following layers:

- **TRACKED ELEMENTS**: every object/asset or person that must be geolocated and/or monitored is equipped by a particular **BLE Tag** – Tags are in general selected according to

the use case(s) and the type of object/person. A smartphone or tablet could be also turned into a “soft” BLE Tag.

- **COLLECTION LAYER**: in generic terms, it is the network of “Collection Point Devices” (**CPD**) that collect and forward BLE signals emitted by registered tags to the back-end platform. CPDs are typically BLE-enabled Wi-Fi Access points (AP) from various vendors but it can be also dedicated BLE scanners or gateways (like USB BLE/Wi-Fi dongle or POE BLE/LAN wireline scanner) that performs the same task. PnT works with a heterogeneous set of CPDs to leverage as much as possible the existing infrastructure on customer site (e.g., deployed BLE Wi-Fi APs delivered with already built-in/embedded BLE chipsets)
- **PLATFORM LAYER**: provides key core functionality such as
    - Real-time data collection and processing module
    - Geolocation engines module with various algorithms
    - Storage modules (real-time and historical)
    - Communication module to support APIs and interfaces with external systems.
    - User Interfaces modules for O&A (Operations and Administration) functions to configure and administer the platform.
    - alarm management module for notification
    - APIS for integration with other systems
- **APPLICATION LAYER**– Depending on use cases, particular front-end applications can be provided as web-application(s) or mobile app(s) to provide specific end-user functionalities and business logics**.**

3 SOLUTION COMPONENTS

3.1 BLE Tags for “Things”

Aside from their low power consumption, BLE devices offer a significant advantage due to their availability in various forms and types. PnT has conducted extensive testing and validation on numerous BLE devices to evaluate their adherence to industry standards like iBeacon and Eddystone, as well as their interoperability with IndoorPlus+.

PnT does not engage in the production of BLE Tags; instead, we depend on a vast and global network of suppliers within our ecosystem.

In respect of the application and usage, the tags can be selected from one of the following categories:

3.1.1 BLE-Tags for Assets

Tags for Assets are selected based on the type of asset and the environment in which they will be used. For example, large objects that move in indoor (e.g., warehouse) and outdoor areas, may need tags with a robust housing, water and dust proof. They are typically fix mounted with screw or tag brackets. Smaller items could use thinner tags sticked or glued.

3.1.2 BLE-Tags for People

Tags for people are available in numerous formats. The tags can be integrated as part of a cardholder used to hold Card-ID, it could be also the employee, contractor or visitor card ID itself. Moreover, these tags may include additional features, such as an SOS button, enabling the holder to trigger an alarm when needed. Other wearable options include bracelets, collars, lanyards, and wristbands.

Wearable devices can provide information on environmental or bio-signals along with regular advertising information that will be used for location.

3.1.3 BLE- Sensors

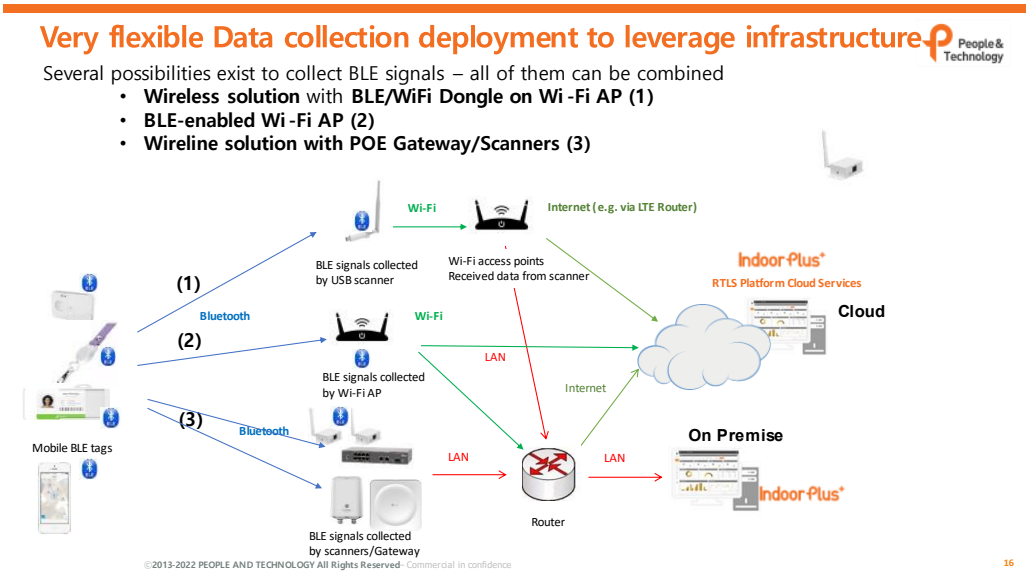
Sensors can be integrated with the mobile tags, but in many applications fix installed sensors may be needed too. BLE-sensors allow the real-time monitoring of many parameters, including compliant conditions, vital signs and environmental conditions like dust, humidity, temperature, air quality, dangerous gasses, etc.

3.2 Collection Points Layer

PnT architecture design choices are to provide the maximum flexibility depending on customer requirements.

When possible or authorized, it can leverage the existing network infrastructure to avoid additional deployment of overlay BLE collection points. PnT has integrated its RTLS platform with BLE-enabled Wi-Fi Access Points (AP) leveraging on the AP built-in BLE radio capability.

If this is not feasible or not even desired, PnT offers hardware equipment called BLE scanners, which can be either wireless or wireline. PnT works with also a combination of various BLE-enabled infrastructure to maximize flexibility for the customer.



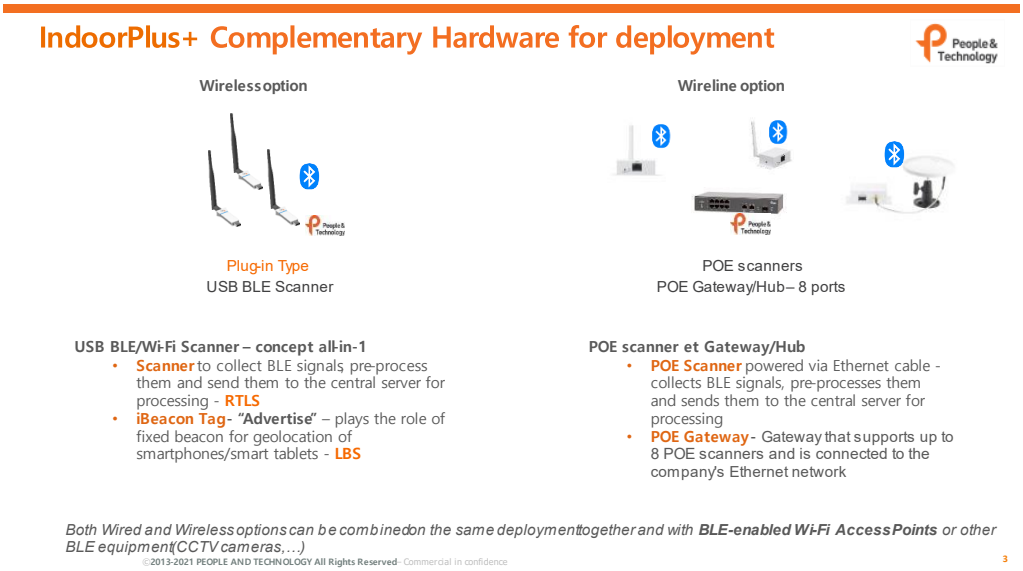
3.2.1 Wi-Fi network equipment vendors

Various other equipment providers are available with direct integration, Cloud integration, integration over MQTT protocols.

For the list of Wi-Fi access points equipment and integration details, please refer to latest **PnT Wi-Fi Access Points interoperability guide document** showing the different equipment models supported.

3.2.2 Complementing data collection infrastructure

Wi-Fi Access points layout may not always be optimised for geolocation. Adding a few points of collection can be done by added a few Wi-Fi APs but also with BLE dedicated data collection points, so called “scanners”.



PnT does provide two types of scanners.

- Wireless scanners: The **USB BLE Scanners (IP-BS-US)** are USB dongle devices that can operate on any USB Type-A port. The USB port just provide power to the scanner. The data transmission towards the IndoorPlus+ backend relies on a Wi-Fi data connection. Therefore, the USB Scanners are used in combination with a Wi-Fi network.
- Wired scanners: (**IP-BS-LS**, also called **POE BLE Scanners**). When Wi-Fi network is not available, the Wired Scanners can be deployed. Those scanners are connected over a dedicated data link, with a scanner Gateway. The Wired Scanners are powered from the Gateway over the data link cable. The Gateway must be connected to a LAN switch which provides POE and data connection towards the IndoorPlus+ backend.

3.2.3 Dedicated BLE

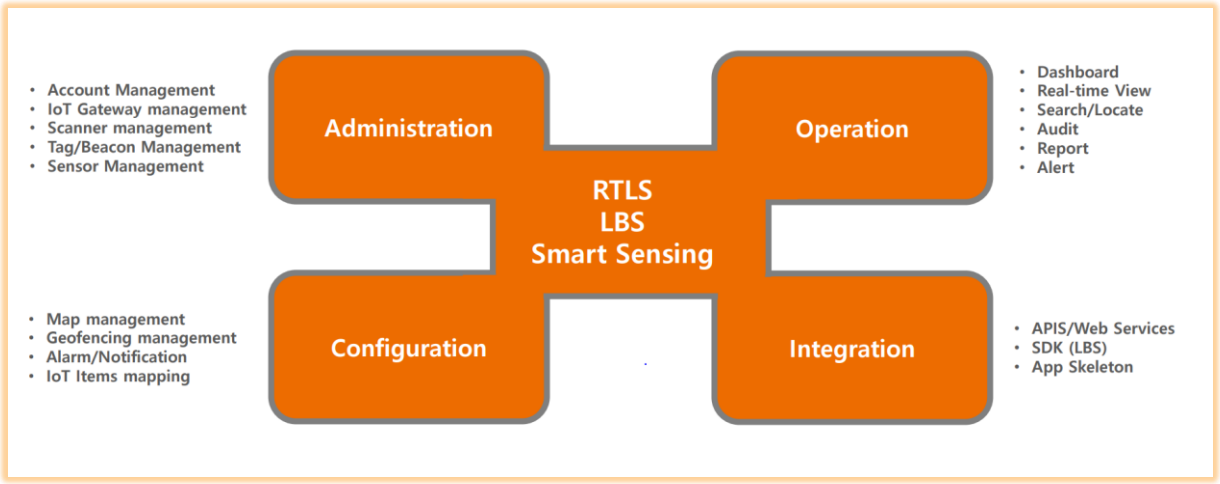
If required, and thanks to its either its own wireless scanners or wired scanners or 3rd party similar equipment, PnT can implement a fully dedicated BLE data collection layer, independent from other network equipment.

3.3 Back-end Platform

The IndoorPlus+ Core Application platform comprises various software components that empower essential functions such as Location Based Services (LBS) for smart devices like smartphones or tablets, Real Time Location Services (RTLS), and Smart Sensing solutions.

These modules are tied to specific services or functionalities:

- Data collection and processing module,
- Geolocation engines module with various algorithms,
- Storage modules (in memory, real-time and historical),
- Communication module to support APIs and overall interfaces with external systems,
- User Interfaces modules for platform management and configuration functions and core UI functions.



3.3.1 IndoorPlus+ Operations and Administration Management Functions

Main IndoorPlus+ functions are available either directly on the platform thru a **web-based front-end console** or via **APIs** so that it can be interfaced or integrated to other systems.

Through a web application, the main functions available can be spitted into self-explanatory categories:

- Administration
- Configuration/Set-up
- Operation

Integration is available through the access to documented APIs and the enablement of API access in the system.

The IndoorPlus+ user interface does support features required to configure, administrate, and operate an RTLS solution:

The following description is not exhaustive but intend to cover some of the major features available.

3.3.2 Administration

The administration and service setting features of the IndoorPlus+ backend, include the following functions:

Login and account management:

- User Accounts and Roles management
- Log-in/logout functions
- Password recovery (OTP)

Infrastructure Administration

- Site maps and site hierarchy.
  The site hierarchy is organised with multiple levels. This enables the mapping of complex facilities and location services can be operated for example from a centralized control point. For example, in case of a country wide service, the site hierarchy levels could be nested as: Region -> City -> Campus -> Building -> Floor
- Registering Collection Points:
  Wi-Fi Access Points, PnT USB Scanners, PnT POE Scanners and Gateways, 3d party BLE Gateways or Collection Point devices are registered individually or in bulk.
- Registering sensors and sensor ranges:
  IndoorPlus+ does support a wide number of BLE sensors. Sensor devices can be associated (mapped) with monitored Items, which can be grouped on multiple categories. For each sensor, the system will track in real time the sensor value against configurable sensors thresholds defining *normal, warning, and critical* value ranges of the sensor.

3.3.3 Configuration:

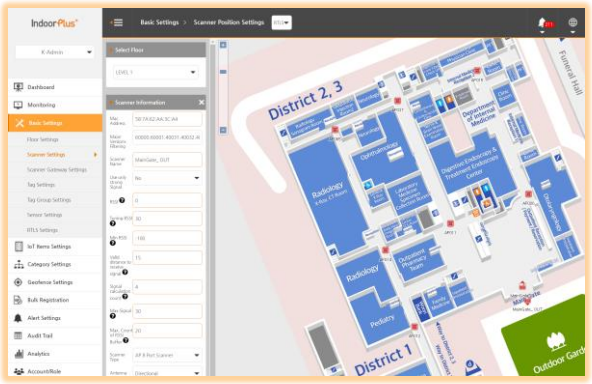
The backend configuration functions allow the registration of the data that is required for an RTLS or LBS service, including site maps, data capturing layer, BLE beacons, tags, and sensors, as well as tracked objects and person information.

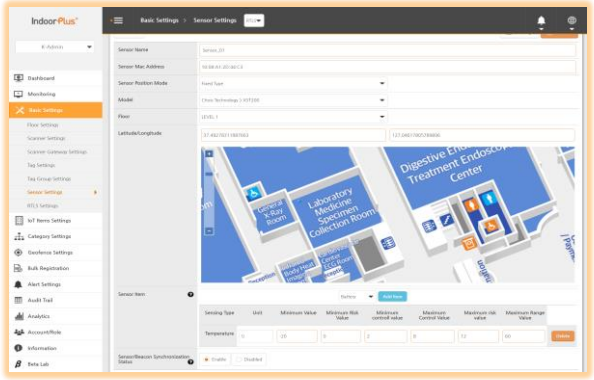
- Map management: importing, replacing, or deleting maps from various formats.
- Setting Geofences – geofences are virtual areas, meaning placing a virtual boundary on a digital map; this boundary creates a zone to track various movements like entrances, exits, duration of stay, …
- IoT items mapping
  - Registration and Mapping IoT items (people, physical devices) with tags

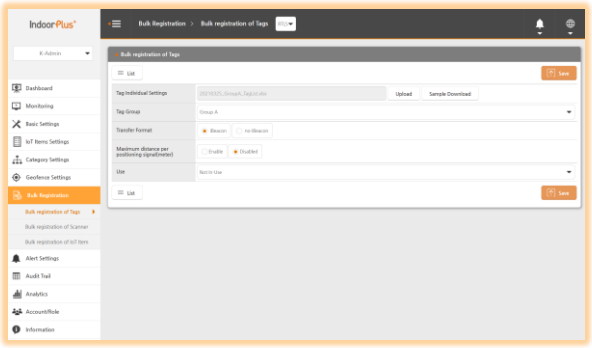
- Defining IoT items categories: Categories Management

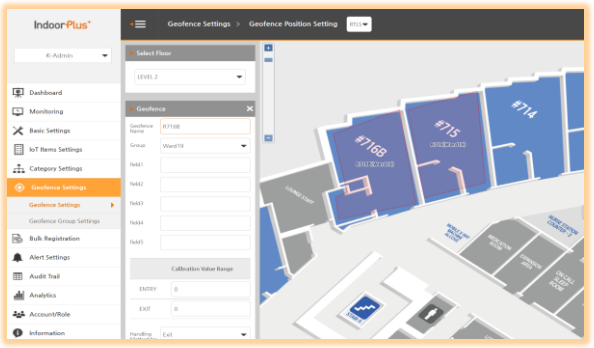
- Alerts management
  - Setting alert thresholds to trigger notification.

Registration can be done via the user interface or via APIs, Bulk registration is possible to speed up data entry on large set of items.





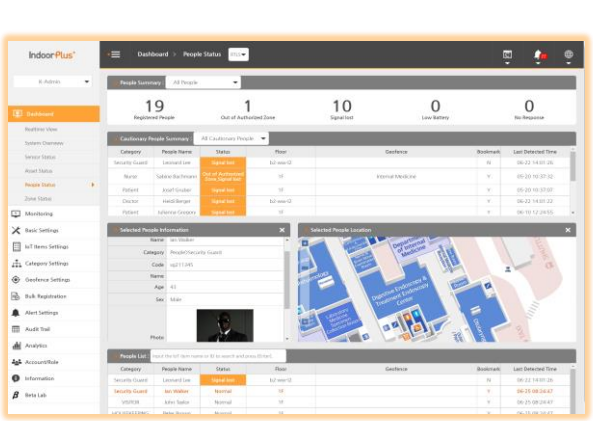




3.3.4 Operation

The IndoorPlus+ Web-based console does support a number of predefined dashboards providing an overview on the system status and health check, as well as some core functionalities related to tracked items , e.g. Asset Status, People status, and sensor monitoring.

3.3.4.1 System Health Status Dashboard and Tracked Items Status Dashboard



3.3.4.2 Location and Monitoring:

IndoorPlus+ does provide several functions for

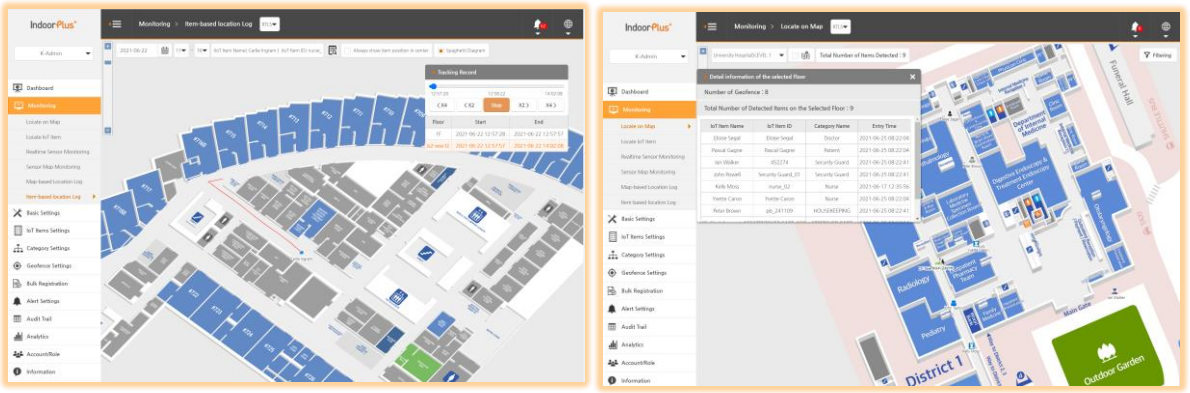
- real time location of items on a map
- real-time search of any tracked item.
- audit of historical data, so called location logs, enabling to “play back” and display the path of any tracked item.

Authorised system user can quickly get answers to typical questions like

- Who or What is right now in a particular zone?
- Who or What was in a particular zone at any given time?
- Where is now a particular item (asset/person)?
- Where was a particular item at any given time or during a certain period of time?

In terms of real-time location and monitoring the functionality can be grouped in several menus:

- Locate by Zone/Floor (real-time location, all items on the selected area)
- Location Audit by Item (display stored position records for the selected Item)
- Sensor Monitoring, by Type (display current status value of the selected sensors)
- Sensor monitoring by Zone/Floor (display the current status and value on the map)



Geofence Log

All the information related to particular geofences/virtual zones.

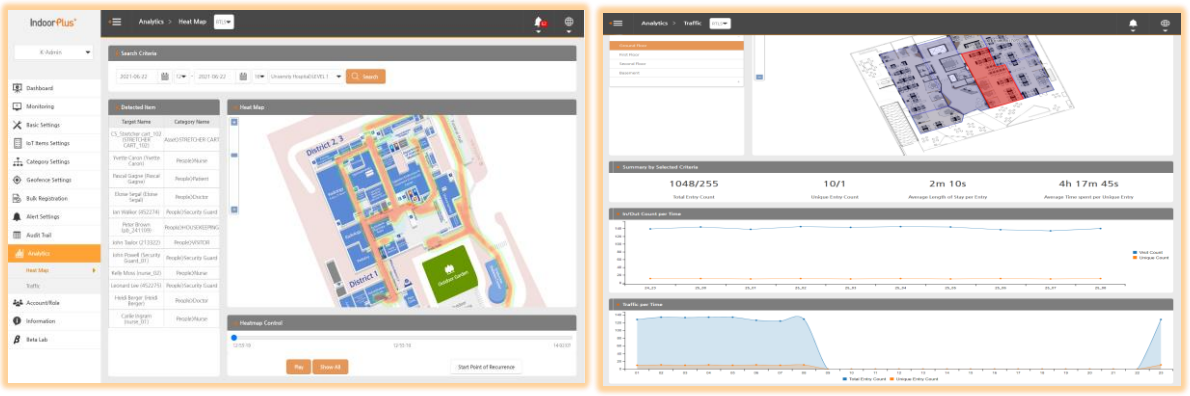
- Presence
- In/out events

Sensor Log

- recorded sensor value and status.

Analytics examples

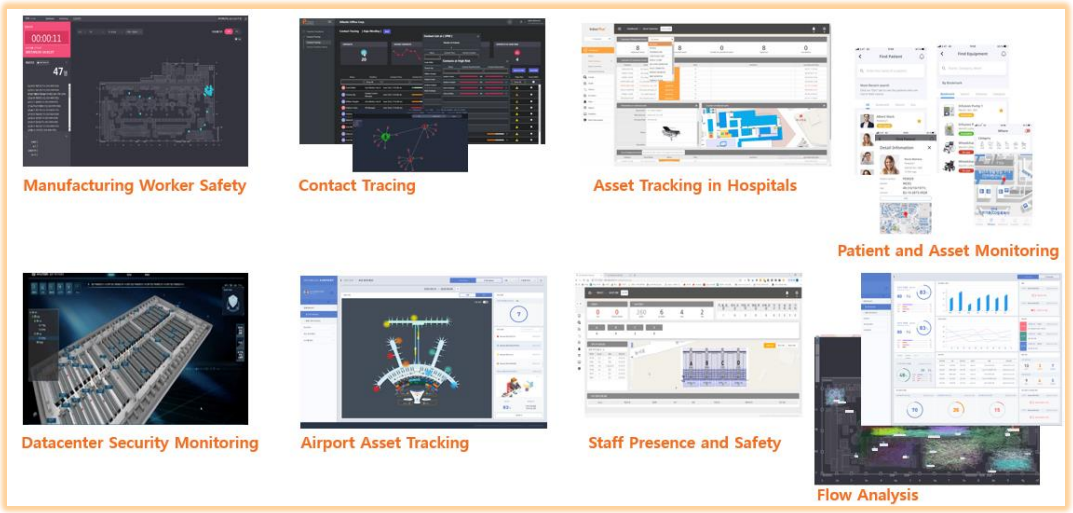
- Heatmap and Geofence data



3.4 Examples of Application Modules and Front-end Applications

Various applications modules can be made available, customized, or developed based on a defined set of APIs toward the back-end platform and to provide use-case specific user interface.

Below are a few examples among many different use cases.

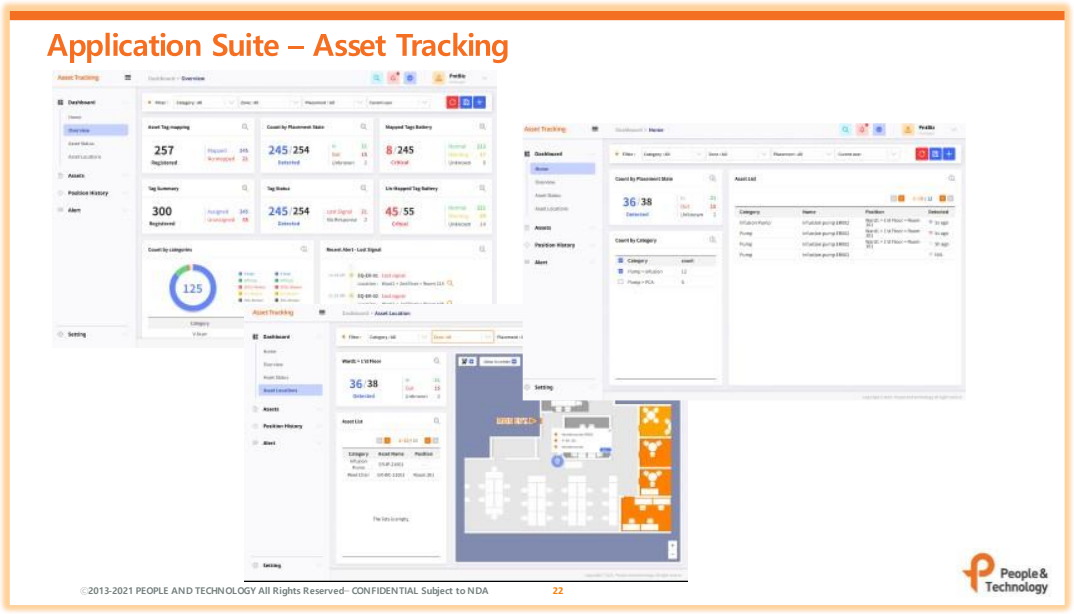


PnT offers certain application modules, while partners and system integrators have the flexibility to create tailor-made software modules to meet specific needs. Clients and end-customers also have the option to either develop their own modules or integrate specific functions into their existing operation centers or dashboards through a set of clearly defined and documented APIs.

3.4.1 Asset tracking

Asset tracking provides key functionalities to locate, search and find important and valuable assets within facilities.

Assets can be tracked in real time while stored historical data can be used according to various criteria (day, timeslots, …) to retrieve particular situation or location.



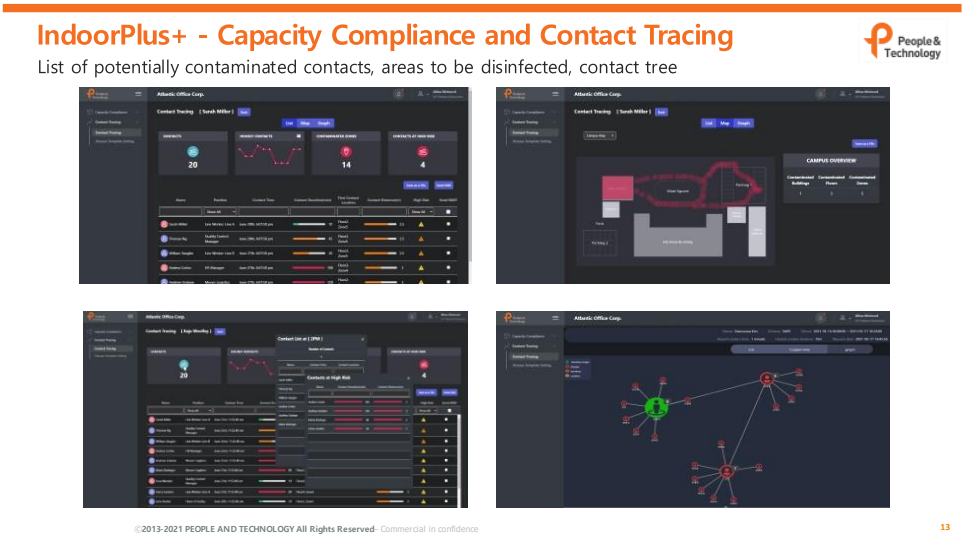
All the assets should be equipped with the proper BLE Tags to be monitored by IndoorPlus+ Various reports can be made available also on Asset Usages.

The key buildings blocks of the applications are:

- **Configurable dashboards**, providing an overview on the location and tracking state of the assets. The dashboards are automatically updated when filters are applied, this enabling the user to further customize his dashboard view (e.g., asset status dashboard can be filtered by ownership and asset category). Further, the dashboards are linked with the search functions, so that items can be located just by selecting them on the dashboard.
- **Asset Search**, allow to quickly find tracked assets on the map of the facilities. The search functions can be filtered for a particular location or for a particular asset.
- **Location Logs** functions allow analysis and visualization of historical location data, thus enable to analyze incidents or to track the path of any tracked asset according to some criteria.

3.4.2 Contact Tracing

An off-the-shelf **Contact Tracing application module** is available to address demands related to retrieving potential clusters or group of people that may have been in contact with an infected person –
Developed in relation to pandemics like SARS or Covid19, the configuration can be adjusted to fit various parameters that may differ from one case to another like contact distance, duration of contact, …



Typical functions are

- List of people in contact
- Degree of contacts
- Zones visited by the potential infected person in order to guide staff for cleaning and disinfection.
- Various statistics

The application is available and restricted to particular “need to know” personal to prevent any misuse of information -
Various reports can be made available either on desktop application or as reports to be stored or printed out.

The application offer also functionality like capacity area compliance so various areas can be defined in the facilities or buildings as geofences, then real-time monitoring of such geofences and number of people entering, leaving or staying for a certain period of time in these areas help monitor the respect of particular rules when necessary – notification can be sent according to pre-defined criteria to prevent over-capacity.

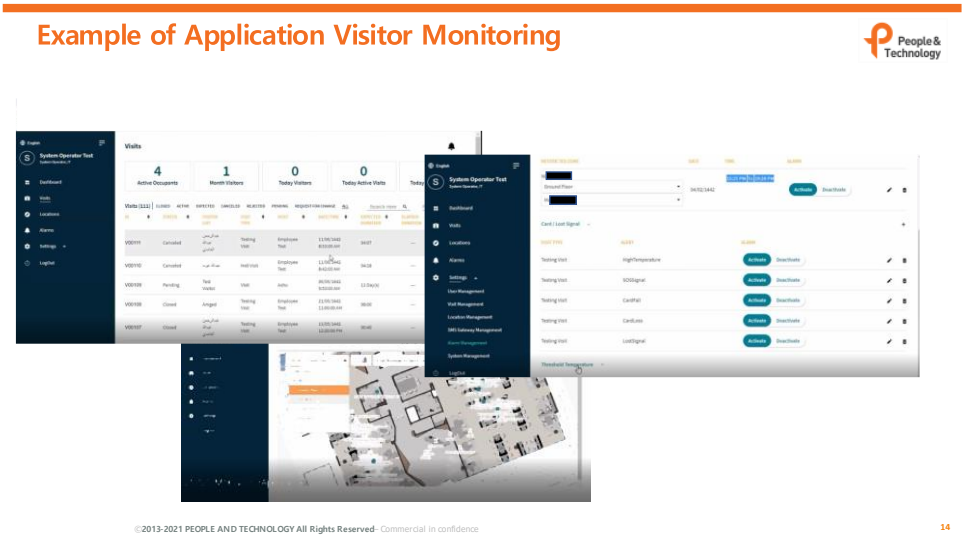
3.4.3 People / Card-ID Monitoring

Card ID tracking is just a particular instance of “asset tracking.” Where the asset is the card.
Various categories can be defined.

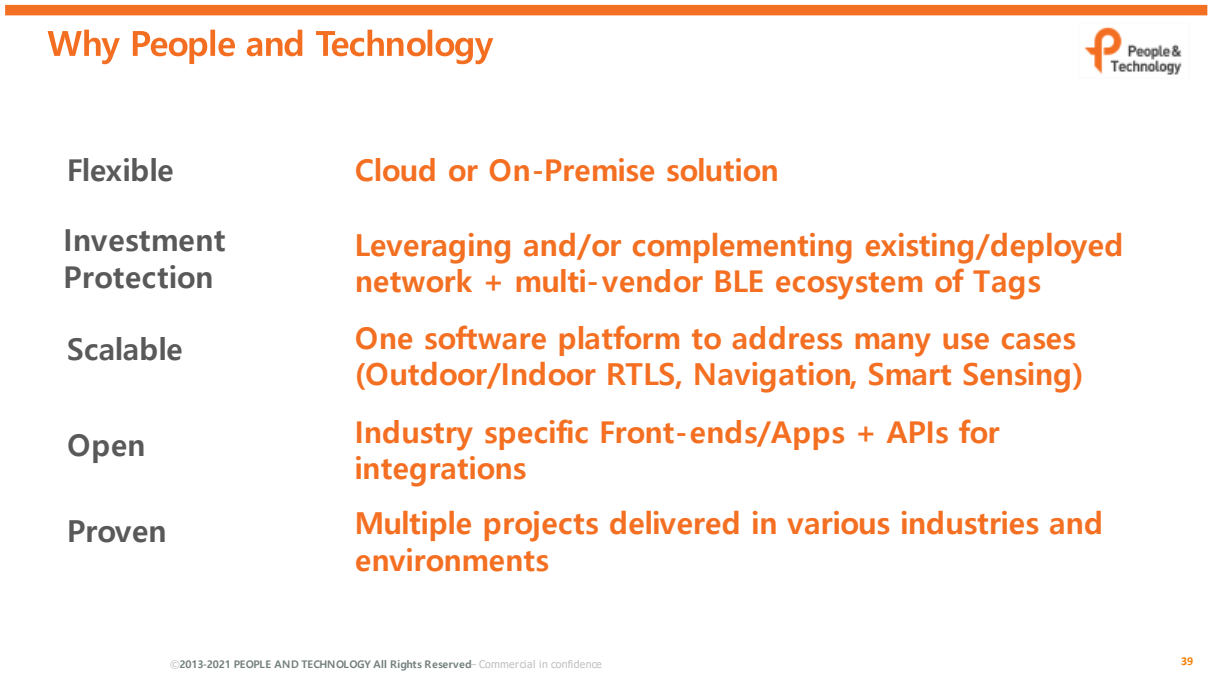
3.4.4 Visitor monitoring

Visitor monitoring is typically an application developed by partners as it may require to take into account a particular workflow defined by the end-customer like: Check-in/Check-out process, dynamic allocation of a tag for the duration of the visit, definition of visitor category with particular monitoring rules and authorized, storage rules…

Example of application developed by partners



4 KEY CHARACTERISTICS



4.1.1 Flexible deployment – Cloud or On-premises

To address customer requirements, IndoorPlus+ back-end platform can be deployed on Public Cloud (e.g., Amazon Web Services aka AWS), private Cloud or on-premises.

Independently of the type of deployment, the connectivity between the data collection layer, which is always deployed at customer facilities, and the back-end platform is mandatory.

In terms of network bandwidth consumption, IndoorPlus+ can work with low transmission rates per collection point. For each project, PnT provides a network configuration requirement (domains, protocols and ports), so that the data network can be configured to assure optimal performance of the backend and the frontend applications.

IndoorPlus+ software is fully virtualized and can run on dedicated servers, as well as, virtual machines.

4.1.2 Hybrid Data Collection Layer

Collection data acquisition is an important aspect of a geolocation project. IndoorPlus+ incorporates several data acquisition methods and sources which greatly facilitates the implementation of our solution. This includes fix deployed beacons and smart tracking devices, simple tracking tags and fix deployed scanners, or a combination of both.

In respect of the Collection Point Devices, IndoorPlus+ leverages all the capability of existing infrastructure, including BLE-enabled Wi-Fi access points, BLE-enabled security devices, and 3rd party IoT BLE gateways. Such infrastructure can be complemented with PnT own BLE scanners devices.

IndoorPlus+ includes signal compensation mechanism to equalize the scanning characteristic of the supported Collection Point Devices, thus making possible that several types of scanning devices can be freely combined to build a **multi-vendor, multi-device data collection layer** thus reducing the cost and the time to set up an IndoorPlus+ based RTLS solution.

4.1.3 High Scalability

IndoorPlus+ platform is designed and engineered to run on virtualized environment or on dedicated hardware.

IndoorPlus+ utilizes auto-scaling when hosted on the cloud, like AWS, to maintain system performance as tracking demands increase. For on-premises deployments, PnT provides specific hardware sizing recommendations, which depend on project size and objectives. Key factors include the number of tracked items, required Collection Point Devices, and location update frequency.

IndoorPlus+ core functions can operate on dedicated servers or VM instances with load-sharing mechanisms to prevent hardware strain and ensure high availability. Large-scale deployments have proven the resilience and scalability of the IndoorPlus+ architecture.

4.1.4 Security

IndoorPlus+ is designed with the highest standards for application and data security.

For data transfer, IndoorPlus+ relies on HTTPS and SSL encrypted connections. Further the system only accepts and process data from registered BLE-scanners and BLE devices.
API Access Management and authentication token are required to access the system API.

Regarding the access to the application, the system administrator can manage the access rights to each of the features of the system, grouping users under dedicated user profiles. Further the user account will be block when several incorrect logins are attended. IndoorPlus+ also keeps a log for all the login attempts of the users.

4.1.5 Open – bi-directional Integration with 3rd Party Applications: API s

IndoorPlus+ architecture is open. It is designed to be easily integrated with 3rd party application that support REST API. PnT can integrate IndoorPlus+ with any external application or system, provided there is a well-documented description of the interface.

From external systems, management and configuration functions are available thru APIs so IndoorPlus+ functions can be fully or partially integrated in Operation Centers, Command Centers or dashboards.

When authorized, 3rd party application can access location and sensor data over API functions. Location and sensor event, like “entering a geofence” of “sensor value in critical range” are notified in real time over the system Interlocking API. In addition to “data”, IndoorPlus+ provide several methods for embedding its maps real time location and audit function in 3rd party application. For example, the real-time location function can be embedded into a third-party web service using iframe or popup window.

For APIs, please refer to PnT latest version of APIs description document detailing the various API functions available as well as usage examples.

4.1.6 Proven and reliable

Thanks to numerous sizeable projects successfully delivered, IndoorPlus+ RTLS system is proven and reliable in various environments from hospitals to manufacturing, from clean to more harsh environments and conditions, from small to very large deployments, and with very diverse and multi-vendor data collection networks.

5 CONTACTS

People and Technology
2F, Youngchang Building, 27 Samsung-ro 95-gil, Samsung-dong, Gangnam-gu,
Seoul 06159 – South Korea
sales@pntbiz.com

People and Technology AG (EMEA)
Olgastrasse 10
8001 Zürich – Switzerland
sales@pntbiz.com
www.pntbiz.com