Indoor Positioning

Installation Guide

Version 3.5

Important Information
Notices

Topics:

- *Legal Notices*
- *Document Information*

This section contains document notices.

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Chapter 1
Introduction

Topics:

- *HERE Indoor Positioning h...*

This guide describes how to install, configure and verify the functionality of the HERE Indoor Positioning system:

- Getting the installation pre-requisites right
- The steps and the workflow, when deploying the HERE Indoor Positioning system
- Configuration and the installation of the **Bluetooth**™ beacons
- Important technical information about the HERE Indoor Positioning

HERE Indoor Positioning highlights

HERE Indoor Positioning service features are:

- High accuracy indoor positioning with floor and building detection
- Uses existing Wi-Fi infrastructure and/or **Bluetooth™** beacons

    - **Note:** Beacons supporting Eddystone™ [preferred] or iBeacon specifications are supported

    - **Note:** *iBeacon is a trademark of Apple Inc., registered in the U.S. and other countries*
- Accuracy better than 5 meters 50% of the time and >90% floor detection rate in a typical case
- Easy-to-use tools (*HERE Indoor Radio Mapper* and *HERE Radio Map Admin Tool*) to collect the radio data at the venue and to manage the radio data
- Radio data can be kept private or exposed publicly to the 3rd party developers
- Integrates seamlessly to other HERE services including HERE cell/Wi-Fi network positioning, HERE Maps, HERE Venue Maps as well as indoor and outdoor routing
- HERE Mobile SDKs for Android and iOS for application developers to access the location information indoors and outdoors
- Works in the offline mode meaning that no internet connection is required after the positioning data has been downloaded to the device to be positioned
- The position is resolved in the device preserving the user privacy

Chapter 2
Quick start

Topics:

- *Quick start workflow*

This chapter describes, how to get HERE Indoor Positioning functional in the most straighforward manner.

Quick start workflow

The following figure shows the most typical workflow for making HERE Indoor Positioning functional. Detailed information can be found in the referred chapters.

Figure 1: Quick start workflow
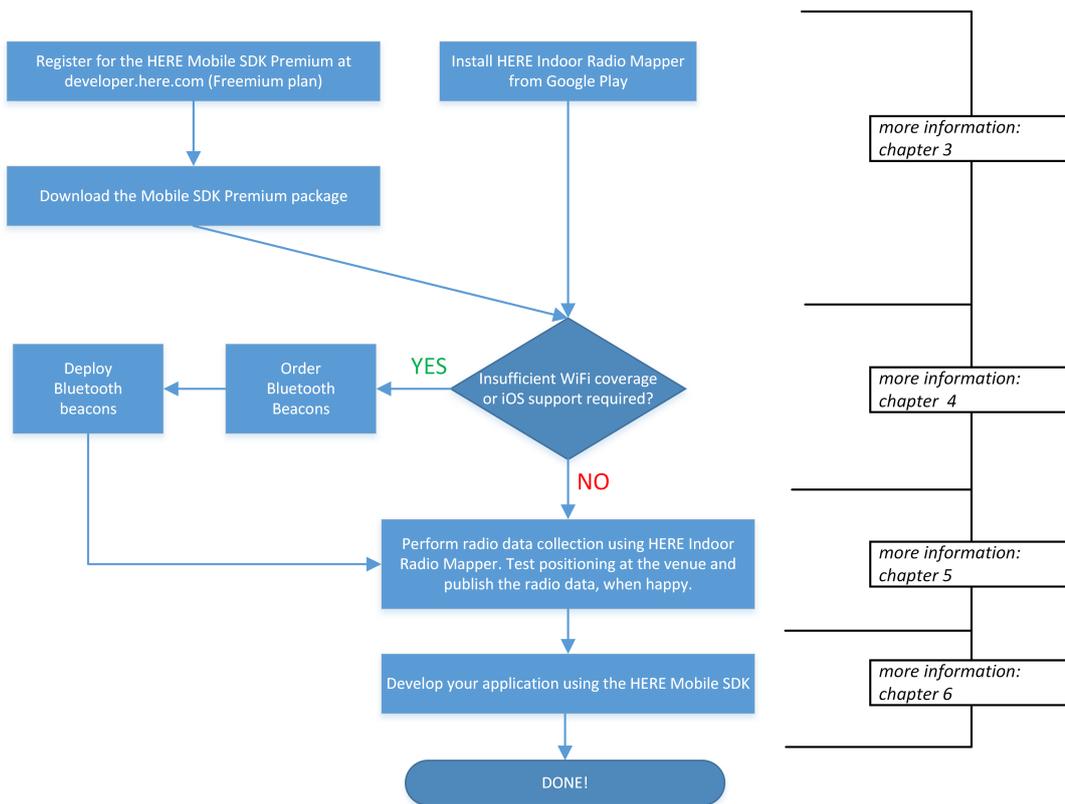
In practice, the deployment of the HERE Indoor Positioning consists of four simple steps:

1. Register and download the HERE Mobile SDK Premium for iOS and/or Android from *HERE Developer Portal*

   📄 **Note:** In case you are simply interested in trying out HERE Indoor Positioning without testing HERE Mobile SDK, skip this step and proceed to installing HERE Indoor Radio Mapper from Google Play. It is possible to use HERE Indoor Radio Mapper in *demo mode* without the SDK registration for testing purposes.

2. Install *HERE Indoor Radio Mapper* from Google Play to your Android device

3. Decide, whether you can use existing Wi-Fi or Bluetooth deployment, or if you need to deploy Bluetooth beacons at your site

4. Collect radio data at the site using the HERE Indoor Radio Mapper (an Android-based tool). The radio data collection allows us to create a map of the radio signal behaviour at the site, which understanding is then used, when estimating the device location. This signal strength map is called a *radiomap.*

5. Develop your application using the HERE Mobile SDK Premium for iOS and/or Android

Chapter 3
HERE Indoor Positioning Prerequisites

Topics:

This chapter guides you through the first steps in setting up the HERE Indoor Positioning.

Indoor Positioning requirements

To gain access to the HERE Indoor Positioning tools, documentation and HERE Mobile SDK, please do the following:

- Create a HERE Account *here*. To use HERE Service you need to register and create a HERE Account with username and a password. HERE Account is used as a login in the HERE Indoor Positioning tooling including HERE Indoor Radio Mapper and HERE Radio Map Admin Tool. HERE Account is also used when logging to *HERE Developer Portal*.
- Access *HERE Developer Portal* and sign-up for HERE Mobile SDK Premium for Android and/or iOS depending upon your needs. In the self-serve sign-up, you can choose between the Freemium and Pro business plans. The main difference between the two plans is that the Pro plan includes dedicated customer support and SLA.

  The sign-up provides you an access to the following HERE Indoor Positioning resources:

  - HERE Mobile SDK Premium for Android and/or iOS
  - `Application ID`, `Application Code` and the `SDK License key`, which are needed, when you develop an application using the HERE Mobile SDK

  📑 **Note:** In case you are simply interested in trying out HERE Indoor Positioning without testing HERE Mobile SDK, skip this step and proceed to downloading the HERE Indoor Radio Mapper. It is possible to use HERE Indoor Radio Mapper in *demo mode* without the SDK registration for testing purposes.

- Access Google Play Store from your Android device and search for *HERE Indoor Radio Mapper*. Install the application. This is the tool used in deploying HERE Indoor Positioning.
- After these steps, you are good to use both HERE Indoor Radio Mapper and the HERE Mobile SDK to enable and access indoor positioning at your venue. Moreover, *HERE Radio Map Admin Tool* is at your disposal for radio data management.

Indoor Map requirements

To map the radio environment in your venue using HERE Indoor Radio Mapper, you need an access to an indoor map of the venue. The indoor map can be one of the following:

- **HERE Public Venue Map**. The HERE Public Venue Maps are readily available in the HERE Indoor Radio Mapper tool, when you have the HERE Public Indoor Positioning license.
- **HERE Private Venue Map**. These Venue Maps are made on a customer request. Please contact your HERE representative to have a HERE Private Venue Map done for your venue, and to have it available for your HERE Account. After this, the HERE Private Venue Map will be available for your use in HERE Indoor Radio Mapper and also through the HERE Mobile SDK for the application development.
- **Your own custom image-based indoor map**. In this case you use an image that describes a floor in the building. The image needs to be available in some commonly used image format such as .jpg, .gif or .png.

  Before the image-based floor plan can be used, HERE Indoor Positioning needs to know, where in the World the building is. This process is called the *alignment* of the indoor map image to the geographical coordinates. The alignment is done in HERE Indoor Radio Mapper by inserting, scaling and rotating the

indoor map image on the HERE map or satellite image. Alternatively, you can input WGS-84 Latitude and Longitude coordinates in decimal format for two points in the image.

Completing the alignment enables seamless switching of positioning technologies between indoor and outdoor. Please refer to the *HERE Indoor Radio Mapper User Guide* for further details on using your own indoor maps during the radio data collection process.

Chapter 4
Preparing the Radio Environment

Topics:

This section provides information on setting up the Bluetooth radio environment at the venue. Bluetooth beacon requirements, deployment and installation are discussed in detail.

Wi-Fi or Bluetooth

You can use either Wi-Fi or Bluetooth beacons to support HERE Indoor Positioning. The use of Bluetooth beacons is mandatory in case iOS support is required, because Wi-Fi cannot be used in the iOS devices. Also note that typically Bluetooth beacons can provide better performance simply because Bluetooth beacons are specifically installed for positioning purposes quite densely. The Wi-Fi network coverage may have gaps and as the deployment is optimized for connectivity, and not for positioning, the positioning performance may vary quite a lot at different parts of the building.

Moreover, Wi-Fi network is subject to changes depending upon the connectivity needs, whereas specifically-installed Bluetooth beacon deployment can be assumed to be static. Note that whenever the radio environment changes significantly (e.g. due to Wi-Fi Access Points being moved from one place to another), the radio data must be collected again.

If you plan to use an existing Wi-Fi infrastructure, make sure that the Wi-Fi coverage is ubiquitous at your venue with preferrably more than five physical Wi-Fi access points observable throughout the venue or at least in the areas, where you want HERE Indoor Positioning to provide high quality location information. Please note that more than ten Wi-Fi APs is preferred for the optimal system performance. The higher the number of Wi-Fi access points, the better the system performance. Please refer to Chapter *Infrastructure Quality Analysis* on page 21 on how to analyze the radio infrastructure quality.

Sometimes you may want to use an existing Bluetooth beacon deployment to support HERE Indoor Positioning. While HERE does not recommend this and does not take responsibility for the possible performance problems with those beacons, it may still be possible to use the existing beacons. To make this successful, please familiarize yourself with the beacon requirements and HERE beacon deployment guidelines in this chapter to evaluate, if the existing deployment is compatible with HERE Indoor Positioning. For example, if your venue has an existing Bluetooth deployment for advertising purposes, extra care needs to be taken. Beacons in such deployments maybe transmitting at low power and they maybe moved from one place to another frequently. Both characteristics make such deployments unsuitable for HERE Indoor Positioning.

If you plan to use an existing Wi-Fi or Bluetooth deployment to support HERE Indoor Positioning, you can proceed to Chapter *Collecting And Managing Radio Data* on page 23. However, if you plan to deploy Bluetooth beacons, the rest of the chapter discusses the beacon configuration and installation.

Beacon Requirements

This section specifies the requirements and configuration for Bluetooth beacons that we require to be used with the HERE Indoor Positioning system.

HERE Indoor Positioning is the best compatible with *Eddystones* beacons, because the standard defines and supports telemetry messages for beacon monitoring. HERE Indoor Positioning is compatible also with *iBeacons* as long as the hardware and configuration requirements are met.

The requirements are divided into three categories, which are specified in detail in the next three chapters.

- General requirements

- Radio performance requirements
- Configuration requirements

General Requirements

The following table specifies the general requirements for the beacons and their casing.

Table 1: General requirements

Requirement	Value
Lifetime	The required lifetime depends on the use case. However, with our recommended configuration, 2000 mAh should be enough for a lifetime of three to five years.
Attachment	Sticky tape, screw or cable tie
Environment protection	Depends on the deployment environment • IP65: dust-tight, water resistant • IP66: dust-tight, waterproof • IP67: dust-tight, fully waterproof
Labeling	The beacon identifier must be visible on the casing for maintenance reasons. The beacon identifier consists of an Eddystone UID or an iBeacon UUID, a Major ID, and a Minor ID. In addition, the beacon MAC address needs to be visible. Both the beacon identifier and MAC address are expressed in the hexadecimal notation.

Radio Performance Requirements

Radio performance requirements can be considered as hardware requirements that will guarantee that the beacon hardware design is acceptable. The following table specifies the detailed radio performance requirements the HERE Indoor Positioning compatible beacons need fulfill.

Table 2: Beacon radio performance

Parameter	Value
Antenna	Antenna gain must not be less than -3dBi at frequencies corresponding to Bluetooth advertisement channels 37, 38 and 39 to any direction in the half sphere with the center line pointing orthogonally from the bottom of the beacon towards the beacon front center point.
Stability	Advertisement radiated power must be the same on all the advertisement channels within 1-dB tolerance at the nominal temperature (20 ˚C). The requirement shall be met over the beacon Tx power dynamic range.
Stability over lifetime	Advertisement power must be constant over beacon lifetime within 1-dB tolerance of the configured Tx power at the nominal temperature (20 ˚C). It is expected that the beacon shall stop advertising, if the configured Tx power level cannot be maintained. The requirement shall be met over the beacon Tx power dynamic range.
Temperature stability	Advertisement power must be constant over the operating temperature range within 2-dB tolerance. If operating temperature range has not been defined, the default range 0-40 °C shall be used. The requirement shall be met over the beacon Tx power dynamic range.

Parameter	Value
Radiated power accuracy	The radiated RF power accuracy must be within 1 dB, i.e. the RF circuit nominal power output must be radiated out at 1-dB accuracy at the nominal temperature (20 ˚C). The requirement shall be met over the beacon Tx power dynamic range.

Configuration Requirements

The following table specifies the detailed configuration that an Eddystone beacon needs to fulfill.

Table 3: Eddystone configuration requirements

Parameter	Value
Eddystone Namespace	See *Assigning the Eddystone Namespace*.
Eddystone Instance ID	See *Assigning the Instance IDs*.
UID advertisement power	0 dBm.
UID advertisement interval	852 ms.
Telemetry advertisement power	+5 dBm.
Telemetry advertisement interval	60000 ms, resulting in 1/70 interleaving of the telemetry message.
Telemetry contents	At least battery status
Mode	Non-connectable advertisement (broadcast only).
Other transmissions	Not allowed; no URL advertisement or other beacon modes like iBeacon packets.

Assigning the Eddystone Namespace

The Eddystone Namespace is a part of the Eddystone Unique Identifier (UID), which consists of a 10-byte Namespace (20 hexadecimal digits) and 6-byte Instance ID. A company can have multiple Namespaces for different purposes, e.g. there could be one namespace for beacons used for positioning purposes and other namespace for beacons used for advertisement purposes.

The Namespace can be derived from the company website URL with a suitable hashing algorithm, and if necessary, cropping the resulting hash. For example, HERE uses in its Eddystones the Namespace that is a hash of here.com:

```
ripemd128Hash (here.com) = 4adbd94ea8fd8a29ac48815dee7e55f3
```

The algorithm shown is for illustrative purposes only; you can use other algorithms too.

The 10-byte Namespace is obtained by removing the six bytes in the middle (<u>underlined</u> below):

4adbd94ea8<u>fd8a29ac48815</u>dee7e55f3

There are many ways to calculate hashes. One example is via command line, you can run the following command:

```
echo -n "{YOUR_COMPANY_WEBSITE_URL}" | openssl sha1
```

📄 **Note:** The above command has been verified on Linux, Mac OS X, and Windows (with MinGW).

Assigning the Instance IDs

While the Namespace is static for all Eddystones belonging to the company, the Instance ID must be unique to have a unique UID for each beacon.

The Instance ID is a 6-byte number with a range of $[0,2^{48}-1]$. The Instance ID can simply be a running number. However, some book-keeping is necessary to know the number to start at for the next order. When ordering beacons, it suffices to state the first Instance ID and instruct that the number increases by one for each beacon.

Beacon Constellation Deployment

The *beacon constellation deployment* refers to the process of installing a number of beacons to the venue to support HERE Indoor Positioning. The process consists of the following steps:

1. Beacon deployment planning
2. Site visit and plan refinement
3. On-site beacon installation
4. On-site installation verification
5. Infrastructure quality analysis during radio mapping
6. Deployment maintenance operations

Beacon Deployment Planning

Beacon deployment planning referes to planning beacon locations on an indoor map map. Good planning can save a lot of time at the site. The HERE recommended best practices include:

- Beacon locations are marked on the floor plan, which makes the actual deployment work simple and fast
- Use a high quality indoor map for deployment planning. The more details the map has, the better plan you are able to make.
- Having a good plan allows a larger group of technicians to make the actual physical deployment
- In open areas, cover the area edges with a beacon every 8-10 meters. In the middle of the area, make sure beacons are no further than 8-10m from each other. Similar guidance applies to corridors. As a rule of tumb, in an open area a beacon typically covers 80 to 100 square meters.
- In office spaces, consider installing a beacon in each room to have sufficient radio coverage. In office environment each beacon typically covers 30 to 50 square meters.
- The beacons must not be more than 3-4 meters from the floor.
- Deploy across the whole area without leaving any gaps. Also ensure that the building edges are covered with beacons. A good deployment plan allows for visual inspection, if all the areas have a sufficient number of beacons.
- When planning the deployment, take a note on the beacon geometry in addition to beacon density. For the best performance at a given location, there should be beacons in multiple directions so that signals are available from sides, front and back.
- For staircases, a good principle is to install one beacon on every floor and one beacon on the intermediate floor between two sections of stairs, if available.
- For large spaces (over 15 m x 15 m) that do not contain pillars or other structures suitable for beacon fastening, consider installing beacons to the ceiling to reduce inter-beacon distances.

- Note that the deployment plan is normative only, because HERE Indoor Positioning does not need to know the beacon locations. Therefore, the beacon locations only need to be planned approximately leaving the final tuning to the actual deployment phase.

The following figure shows an examplary beacon deployment in a part of the building. The beacons have been installed along the building edges as well as in most of the meeting rooms. In open areas the beacons have been fastened to the pillars.

Figure 2: Exemplary Beacon Deployment
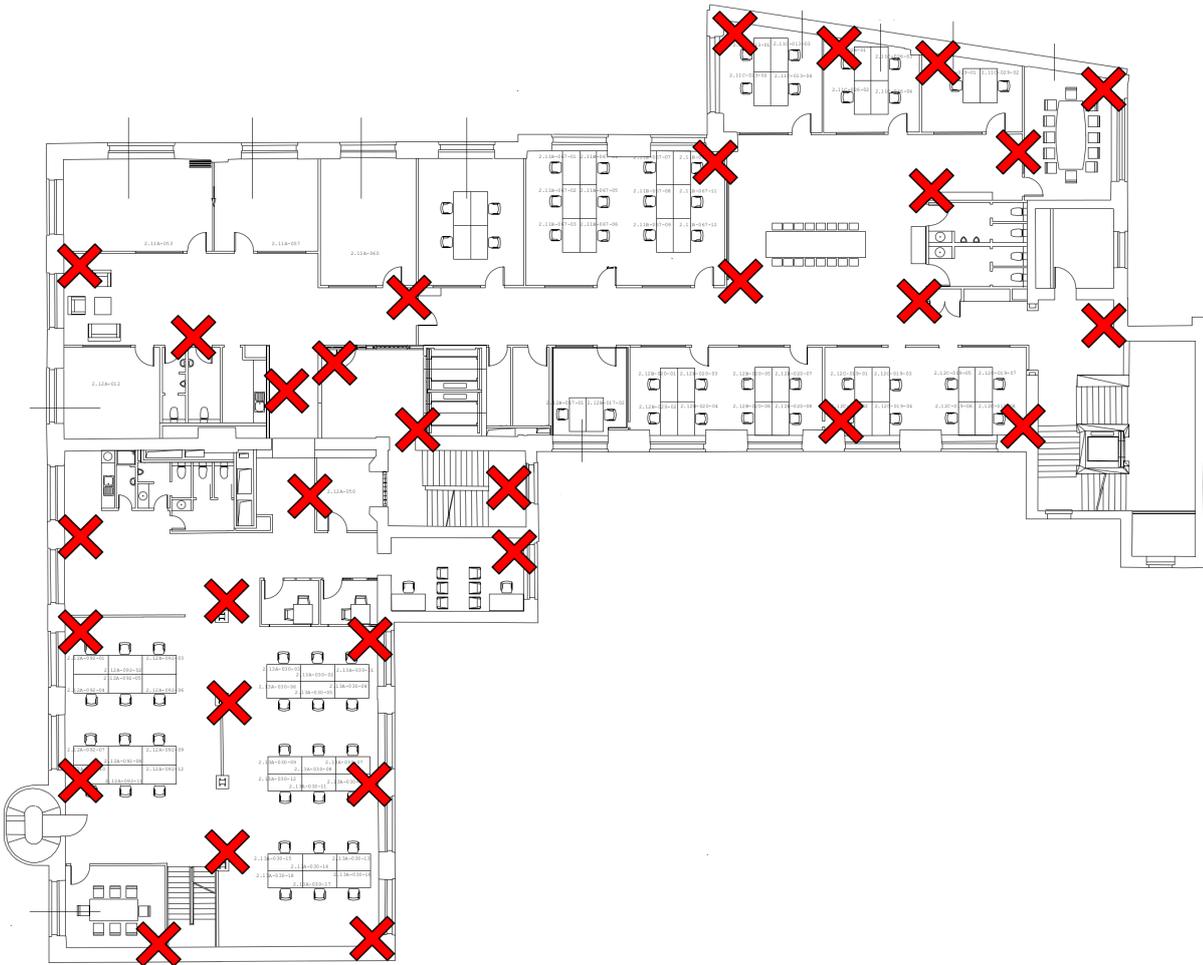
Beacon Deployment Tips

- Only use the beacon types recommended by HERE.
- Use the same beacon type for your whole deployment.
- Use the same battery type in all the beacons to ensure approximately equal battery lifetime for the whole constellation.
- Use beacons and batteries of the same age to ensure equal lifetime for the whole constellation.
- When ordering beacons based on the deployment plan, add 10% to have spares.

Site Visit and Plan Refinement

Make a site visit after the deployment planning to inspect and validate your plan. During the site visit:

- Verify that beacons can be installed to the planned locations.

- Make the necessary fixes to the plan.
- Observe the surface materials to decide the appropriate installation methods (tape, glue, screws, etc.)

Note that sometimes it is helpful to make the site visit already *before* the planning. Understanding how the venue looks like in practice, may significantly help in the deployment planning.

On-site Beacon Installation

When installing beacons, you should consider the following factors:

- **Location** – To maximize the area that a beacon covers, install the beacon in a way that nearby obstacles do not block beacon radio signals.

    For example, consider on which side of a pillar the beacon should be placed. One option is to have two beacons on the adjacent sides of the pillar to cover the area better with radio signals.

    > 📄 **Important:** Beacons must not be installed on any moving structures like elevators or any such mobile platforms. Install beacons on fixed structures that cannot be moved; the beacon position must be static all the time.

- **Height** – Install beacons at a height where neither furniture nor crowd can block radio signals. Typically 2.2 m from the floor should suffice. In public areas, where there is a risk of vandalism or theft, beacons should be installed slightly higher, between 2.5 to 2.8 m. For walls, keep a minimum of 5-cm clearance between the beacon and the ceiling.

    The beacons must not be more than 3-4 meters from the floor.

- **Orientation** – Very often the beacons have preferred orientation to which most of the signal is radiated. This is typically the front of the beacon. The radiation is typically the worst towards the direction of batteries - that side should face wall/ceiling.

- **Fastening** – Double-sided mounting tape can be used to fasten small beacons. The tape needs a clean and sleek surface, so we recommend attaching beacons on glass or metal rather than on unfinished concrete.

    Note that removing an installed beacon from painted wall or wallpaper may damage the surface. For a temporary installation, first put masking/painter's tape on the wall, then mount the beacon to the masking tape with double-sided tape.

    If tape does not stick to the mounting surface, you can use screws and/or glue to get solid fastening for beacons.

    Instead of tape, glue or screws, it is also worthwhile to check, if cable ties can be used to install beacons. Cable ties are fast to use and also easy to cut, when removing the beacons.

- **Conditions** – Installation should be done in dry and warm conditions, if possible. Cold and wet conditions may have an impact on fastening, especially when using tape. Pay particular attention when mounting beacons in cold areas (below 0°C) such as parking garages.

- **Changes** – You may need to make adjustments to the planned deployment for many reasons, e.g. there might be non-accessible areas. Technicians installing the beacons should be familiar with the planning guidelines so that adjustments can be made on-the-fly.

    Document the changes to the beacon deployment plan.

- **Unused beacons** – Remove any unused beacons from the venue immediately after the deployment before radio data collection. Take the extra beacons far enough or to e.g. RF chamber so that the extra beacons do not interfere with the radio data collection.

- Store the final (fixed) deployment plan for later use.

On-site Installation Verification

Approximately one week after installing the beacons, walk through the deployment area and inspect the beacon installation to at least visually verify that beacons are still fastened properly.

Infrastructure Quality Analysis

The Radio Data Collection, which is completed after the beacon deployment, is covered in Chapter *Collecting And Managing Radio Data* on page 23. Radio data is collected using HERE Indoor Radio Mapper.

HERE Indoor Radio Mapper has two features to verify the radio infrastructure quality. They are illustrated in the following figure. Please refer to *HERE Indoor Radio Mapper User Guide* for details.

· The *real-time quality indicator* is located on top of the map view. The indicator is updated all the time and shows in one glance the radio infrastructure quality (the indicator analyses the number of radio transmitters and their signal powers). If the indicator shows green, the radio infrastructure quality is sufficient ; red denotes insufficient infrastructure.

  Before the actul radio data collection, it is recommended to walk around the venue with HERE Indoor Radio Mapper and to observe the quality in real-time. Add beacons to problematic areas, if necessary. It is easy to do this before spending time on the radio data collection.

· Another, more throughout method, is to collect some radio data around the venue, and inspect the radio infrastructure quality. This is shown in the right hand side. Enabling the *Quality of infrastructure* shows the problematic areas in shaded black. More beacons need to be added to those areas.

📄 **Note:** The radio infrastructure quality analysis methods presented in this section are applicable to both Wi-Fi and Bluetooth.

Figure 3: Beacon Infrastructure Quality
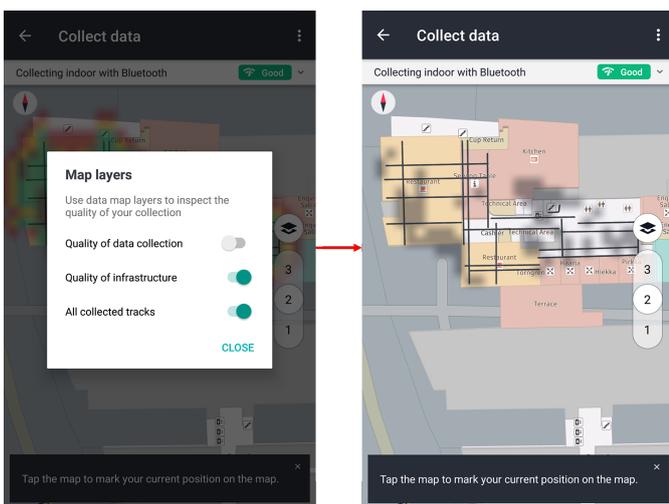
Deployment Maintenance Operations

If there is a need to install additional beacons, follow the guidelines in this chapter. After the installation, perform radio mapping and positioning testing in the area using the HERE Indoor Radio Mapper tool.

Sometimes beacons may fail, get lost or stolen. When you have located a failed beacon, remove it carefully to avoid damage to the underlying surface. Clean the surface from any old tape or glue and fasten the new beacon in the same position and/or direction. Perform radio mapping and positioning testing in the nearby area using the HERE Indoor Radio Mapper tool.

Storing Beacons

Beacons should be stored properly if they are **active**, i.e. transmitting Bluetooth signals. Unused active beacons should not be detectable in the deployment area. For this reason, consider the following guidelines:

- Do not leave any unused active beacons lying around on tables or anywhere else.
- Do not store any spare active beacons in the same building where the deployment was done.
- Find a proper place for the leftover active beacons, such as a storage location away from the building, preferably in a metal container to block electromagnetic radiation.
- If unused active beacons are not stored carefully, HERE Indoor Positioning may be unreliable or its performance may degrade.

▣ **Important:** Active beacons continuously transmit Bluetooth signals. It is extremely important that there are no unused active beacons in the building. Even though the transmitting power is low, it is possible for beacon signals to be received through ceilings and walls. Spare active beacons that may be moved from one place to another may disrupt HERE Indoor Positioning.

Reference Suppliers

The following table specifies the suppliers that we have used for our reference deployments. These beacons have been tested to have the radio quality required for high performance indoor positioning.

Table 4: Suppliers

Supplier	Product	Details
Minew Technologies, China	product name "i3"	2 AA batteries (2000-3000 mAh, 5 years lifetime[1]) IP65 dust-tight, water resistant

(1) According to the supplier's specifications

When ordering, you should provide the supplier with the following information:

- Beacon model
- Configuration requirements
- Namespace and Instance ID (UUID, Major ID and Minor ID for iBeacons) definitions
- Whether you require pre-installed batteries and a sealed case

Chapter 5
Collecting And Managing Radio Data

Topics:

This chapter summarizes the steps you need to perform at the venue to deploy HERE Indoor Positioning after the radio environment has been prepared as specified in the previous chapter. The Chapter also discusses inspecting and managing the radio data in the later phases.

HERE Indoor Radio Mapper

HERE Indoor Radio Mapper is an Android application that is used to collect the Wi-Fi and/or Bluetooth radio environment at a venue. *HERE Indoor Radio Mapper User Guide* describes the radio data collection workflow in detail and thus only a short summary is given below.

HERE Indoor Radio Mapper is available at Google Play for download. A training video is also available a the Google Play application page.

When you launch HERE Indoor Radio Mapper, you need to log in with your HERE Account credentials. After a successful login, you will be able to access all the HERE Venue Maps you are eligible to use. Firstly, this may include HERE Public Venue Maps assuming that your license includes HERE Public Indoor Positioning feature. You are free to collect radio data at any of these venues, provided that you have permission to do so.

Moreover, if you already have HERE Private Venue Maps associated with your account, those maps are shown in HERE Indoor Radio Mapper landing page automatically assuming that your license includes includes HERE Private Indoor Positioning feature.

You can also use your own custom image-based custom indoor maps, provided you import those images to HERE Indoor Radio Mapper and align those to the geograhical coordinate system. The alignment is needed for HERE Indoor Positioning to know, where in the World the building is to enable seamless switching of positioning technologies between indoor and outdoor. Refer to the *HERE Indoor Radio Mapper User Guide* for further details on the importing and alignment process.

HERE Indoor Positioning is a cloud-based system. This means that if there are multiple instances of the HERE Indoor Radio Mapper collecting radio data for the same account, all the instances see and can manipulate the same radio data. The radio data from all the instances is combined to create the radiomap to support indoor positioning. Importantly, in the testing phase all the instances test the same positioning data.

As an example, the image below shows the radio samples for a single Wi-Fi Access Point in a single floor in a venue. The data has been collected along the corridors. Color denotes the signal strength, with blue indicating low signal strength and yellow high signal strength. The data shown is very typical – the signal

from the access point can be heard quite extensively on the floor, where the access point is installed. Similar patterns are obtained for each Wi-Fi access point and/or Bluetooth beacon on each floor in the building.

Figure 4: Radio data for one Wi-Fi Access Point collected with HERE Indoor Radio Mapper

Before Collecting Radio Data

Before engaging in full scale radio data collection as instructed in *HERE Indoor Radio Mapper User Guide*, it is recommended to check the radio infrastructure quality first. This can save considerable amount time, when the issues in radio coverage are found out in the early phase.

The radio infrastructure quality can be examined as described in Chapter *Infrastructure Quality Analysis* on page 21.

Collecting Radio Data at Your Site

The process of collecting radio data in a part of a building consist of:

1. Displaying the appropriate indoor map (HERE Venue Maps or your own custom indoor map) in HERE Indoor Radio Mapper.
2. Walking, following a straight-line path, and clicking on the indoor map to indicate your location at regular intervals.
3. Checking the quality of the quality of the radio infrastructure and radio data collection.

The result is a record of radio samples that are geo-referenced to the correct location and floor in the venue and contain information, at each location, on the Wi-Fi Access Points and/or Bluetooth beacons and their signal strengths.

The above process must be repeated in each part of the building in which you want to set up HERE Indoor Positioning. The time required to collect the radio data for a whole building depends on the size and internal structure of the building. However, the process needs to be completed only once per venue, provided that there are no significant changes in the radio environment. The document *HERE Indoor Radio Mapper User Guide* provides detailed instructions and practical advice on how to use the tool.

Having collected the radio data, HERE Indoor Radio Mapper provides features to inspect the quality of both the radio data collection and radio infrastructure. Please refer to *Infrastructure Quality Analysis* on page 21 for further information.

When you are ready with the radio data collection, the radio data gets automatically uploaded to the HERE Indoor Positioning backend for further processing and analysis. The result of this analysis is an understanding of how the radio signals behave in the building. This understanding is called a *radiomap* for the venue.

Testing Positioning at the Site

You can test out HERE Indoor Positioning just a few minutes after the collected radio data has been uploaded to the HERE Indoor Positioning backend. HERE Indoor Radio Mapper will notify you once the data has been processed and testing can commence. Upon entering the Test view in HERE Indoor Radio Mapper, you can walk around the building and you can see HERE Indoor Positioning in action on an indoor map (either HERE Venue Map or your own custom indoor map).

In addition to the real-time positioning testing, you can also collect a *test track* allowing you to get quantitative feedback on the positioning quality at the venue. Again, please refer to the *HERE Indoor Radio Mapper User Guide* for detailed information regarding the testing features.

In case you detect that some areas have problems with positioning or insufficient radio data was collected there, you can easily collect further radio data at this time and test again.

Publishing the Radio Data

Once you are happy with the positioning performance when you walk around the building and run the test track, you need to publish the radiomap to production. Once publishing is complete, the positioning data is available for applications using HERE Mobile SDK users. Please refer to the *HERE Indoor Radio Mapper User Guide* for further details on publishing.

Upon publishing, the visibility of your data to the Mobile SDK -based applications depends on the indoor map type you are using:

• Private HERE Venue Map or your own image-based indoor map

The radio data is controlled by you and you can manipulate the radio data in both HERE Indoor Radio Mapper and HERE Radio Map Admin Tool as you wish. Indoor positioning based on your radio data is strictly available only for your own applications.

· Public HERE Venue Map

The radio data is controlled by you and you can manipulate the radio data in both HERE Indoor Radio Mapper and HERE Radio Map Admin Tool as you wish. Once you publish the data, all the applications, yours and others', using the HERE Mobile SDK Indoor Positioning feature will also be able to use indoor positioning at that public venue.

HERE Radio Map Admin Tool

While HERE Indoor Radio Mapper application provides some control over the radio data and positioning, the more powerful tool to inspect and manipulate your radio data is HERE Radio Map Admin Tool. You get access to HERE Radio Map Admin Tool as part of your HERE Indoor Positioning sign-up by default.

HERE Radio Map Admin Tool provides the following features:

· You see the buildings and the floors within those buildings for which your account has indoor positioning data

· You see the Applications IDs (`AppID`) for which your private indoor positioning data is available

· You see the radio data collected for a specific building on the building indoor map

· You see the different radio data collections on the indoor map as well as who made them and with which device

· You can enable, disable and delete the radio data collections as required

You can access HERE Radio Map Admin Tool from *indoor.here.com* by tapping **login** at the upper right corner or directly *here*. Once you have indoor map setup and you have collected radio data to your account, the radio data will be visible in the tool.

Chapter 6
Working with HERE Mobile SDK

Topics:

- *Using HERE Mobile SDK and …*
- *Testing HERE Mobile SDKs*

This section discusses accessing the indoor location information through HERE Mobile SDK.

Using HERE Mobile SDK and Indoor Positioning

HERE Mobile SDK offers a rich set of APIs including positioning, maps and routing. All of these features work both indoors and outdoors.

For positioning, there is a clean, single simple API that provides positioning information with the best available technology outdoors and indoors, depending upon *business features* in your license. The positioning information can be based on data from satellites (GPS, GLONASS, etc.), crowd-sourced global Wi-Fi and cellular networks data, or Wi-Fi and/or Bluetooth-based indoor positioning.

In summary, the positioning features of the HERE Mobile SDK include:

- High accuracy indoor positioning with building and floor detection using Wi-Fi and Bluetooth radios
- Cellular network positioning in GSM, CDMA, WCDMA, TD-SCDMA and LTE networks as well as global crowd-sourced Wi-Fi network positioning
- Positioning without network connectivity through the download of radiomaps from the HERE Indoor Positioning backend. As soon as the radiomap resides in the device, the device can position itself without network connectivity. The position calculation takes places in the device reducing latencies, improving the positioning accuracy and keeping the location information private within the device.
- Automatic radiomap management. When a device enters the vicinity of a building or radiomaps have been updated in the HERE Indoor Positioning backend, the new or updated radiomaps are downloaded to the device automatically. Also, old radiomaps are automatically cleaned.
- Automatic selection of the best available positioning technology. The selection is automatic between Wi-Fi and Bluetooth radiomaps (if both are available) as well as between indoor and outdoor positioning methods, if enabled in your HERE Mobile SDK license.
- HERE Indoor Positioning supports both private and public data. In case your venue is a private one (HERE Private Venue Map or your own custom indoor map), indoor location information is only available for your applications (identified by `AppIDs`). In contrast, indoor location information for public venues (HERE Public Venue Maps) is available for all the HERE Mobile SDK users with an appropriate license.
- Global positioning coverage and data hosting infrastructure for the optimal availability, reliability and user experience

The Positioning API provides access to the following position-related information:

- Location (latitude and longitude)
- Estimated location uncertainty in meters as the CEP68 value
- Speed and heading
- Floor level (floor index)
- Building name and ID:
  - If you use HERE Venue Maps, the building name and building ID are static and automatically assigned and managed by HERE
  - If you use an image-based custom indoor map, you need to set the building name when importing the custom venue to the HERE Indoor Radio Mapper. The building ID is generated automatically from the set name.
- Information on the used positioning technology (Bluetooth, Wi-Fi, cell, GNSS)

For detailed descriptions on the Positioning and other APIs, see the *HERE Android SDK Developer's Guide Premium Edition* or *HERE iOS SDK Developer's Guide Premium Edition* for details.

Testing HERE Mobile SDKs

The HERE Mobile SDK package includes an example application for both Android and iOS to test the HERE Indoor Positioning (and other positioning methods, too) quickly. It is assumed that the radio data has been collected at the venue as instructed and that the radio data has been published in HERE Indoor Radio Mapper for use by HERE Mobile SDK. Only then can indoor location information be accessed through HERE Mobile SDK.

📄 **Note:** If you are using your own custom image-based indoor map for radio data collection in HERE Indoor Radio Mapper, the map will not be reflected to HERE Mobile SDK. Custom image-based indoor maps are only meant for testing deployment and indoor positioning in HERE Indoor Radio Mapper.

Smoke test application (Android)

An Android tutorial project is available through *GitHub*. The project helps you to get your first HERE Indoor Positioning application up and running smoothly.

If your current location has indoor positioning coverage and you have everything setup correctly, location estimate from indoor positioning is displayed on the screen. The application shows the following:

• Location in Latitude and Longitude coordinates. If possible, verify that these match with your test site location.
• Position indicator on a map
• The floor level
• The building ID
• Location type is "INDOOR"

The HERE Mobile SDK indoor positioning smoke test is successful, if these details are visible.

Smoke test application (iOS)

Similarly to Android, there is also an example positioning project for iOS through *Github*. Please refer to the Positioning section in the *HERE iOS SDK Developer's Guide Premium Edition* to get HERE Indoor Positioning working.

Chapter 7
Technical Information

Topics:

This section provides technical information on the data flows in the HERE Indoor Positioning system. An important concept of radiomaps is discussed thoroughly: a radiomap is the description of the radio signal strength landscape in a venue and is generated based on the radio data collected with HERE Indoor Radio Mapper. The radiomaps and their usage are related to the available business features and indoor map types.

The Very High Level view

Conceptually, HERE Indoor Positioning can be reduced to three main components:

- HERE Indoor Radio Mapper that allows the user to collect, test and publish radio data at venues
- HERE Positioning Backend service that stores and processes the radio data
- HERE Mobile SDK that allows applications to access indoor positioning information

The following figure offers a conceptual representation of the data flows involved in HERE Indoor Positioning.

Figure 5: High level data flow in HERE Indoor Positioning
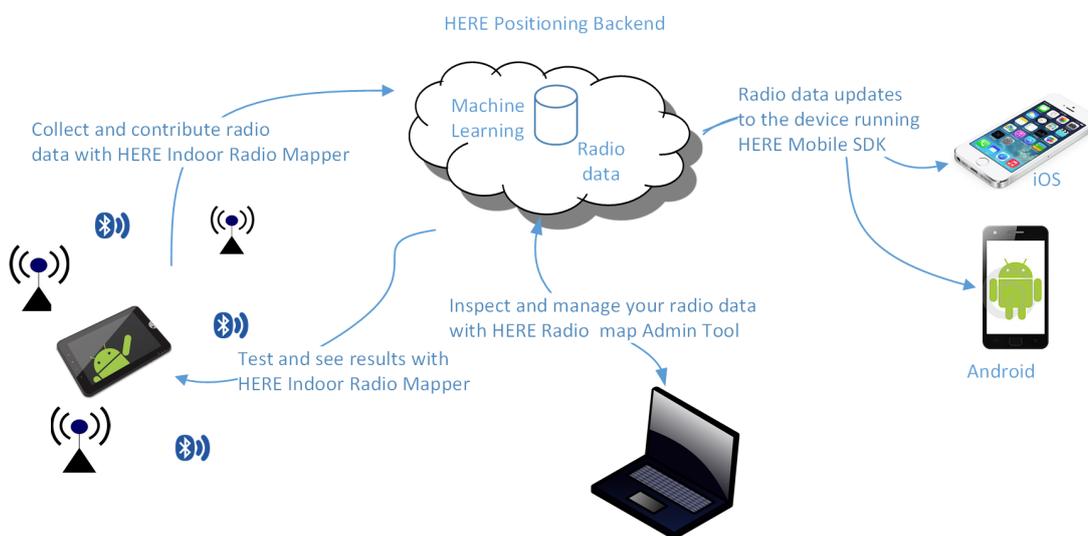
Radiomaps in HERE Indoor Positioning

A radiomap is the description of the radio signal strength landscape in a venue and is generated based on the radio data collected with the HERE Indoor Radio Mapper. There are three types of radiomaps in HERE Indoor Positioning system:

- *Draft Radiomap* – your own sandbox for testing and trialing
- *Private Radiomap* – a production radiomap containing your private radio data. The radio data you collect for your Private Venue Maps or your own indoor maps goes to this radio map upon publishing. Only your own applications can access the data.
- *Community Radiomap* – a production radiomap shared by all the HERE Mobile SDK users. The radio data you collect for Public Venue Maps goes to this radio map upon publishing. All Mobile SDK users can access this data.

Radio data collected with HERE Indoor Radio Mapper is initially included only in the Draft Radiomap when uploaded. Moreover, HERE Indoor Radio Mapper always accesses the Draft Radiomap when testing positioning. Once you are happy with the performance, you can simply publish the Draft Radiomap to the production (either Private or Community Radiomap) after which applications using HERE Mobile SDK

can access the indoor positioning data. Having done this, you are free to continue working with the Draft Radiomap in HERE Indoor Radio Mapper without affecting the positioning data utilized by the HERE Mobile SDK users until you decide to publish new radio data.

The HERE Mobile SDK accesses the production radiomap(s). The production radiomap(s) in use depend on the Business Features enabled in your subscription (see *Business Features*).

> 🗎 **Important:** The HERE Mobile SDK can also be configured to access the Draft Radiomap in the development phase. Please see the SDK Developer Guide for details.

Radio data flows across radiomaps

The diagram below presents the radio data flows across the radiomaps conceptually. Note that items of radio data can be discarded during the radiomap generation, if, for example, the algorithms that process the radio data detect that the data is too noisy.

Figure 6: Data flow high level view
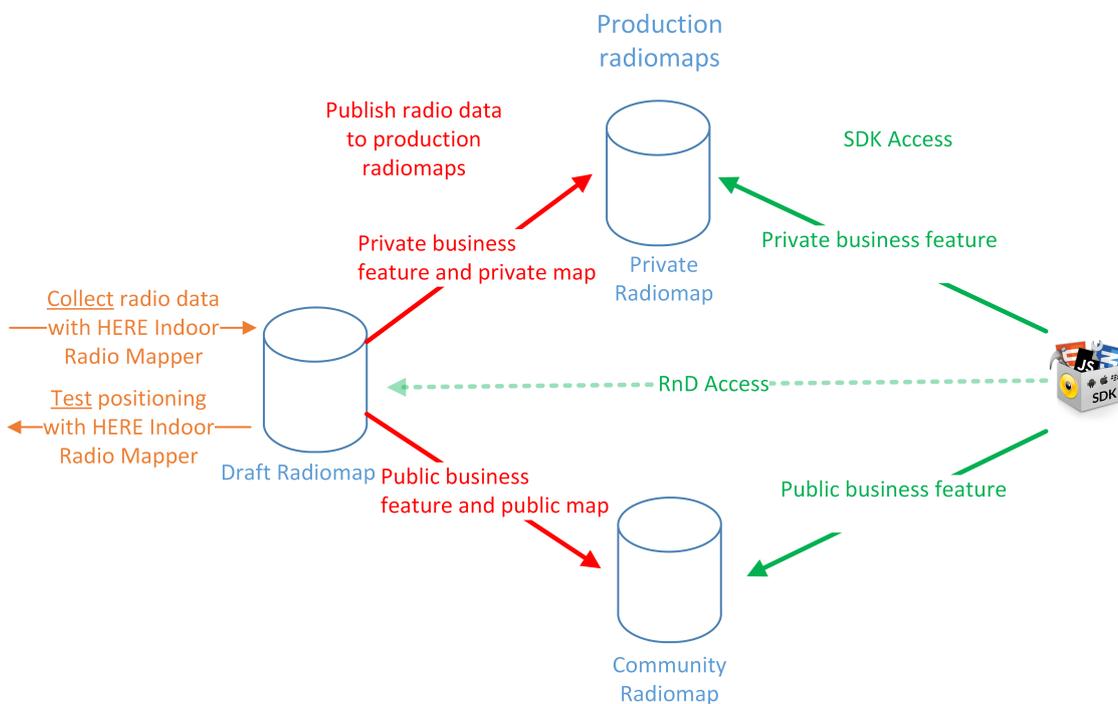
The important concepts of the radio data flow are:

- The Draft Radiomap is intended for testing. It allows HERE Indoor Positioning operators and developers to run trials on the system with no impact on the positioning performance for the end users that use production radiomaps via HERE Mobile SDK. The Draft Radiomap is account-specific, which means it is private to the account owner.

  When the radio data is collected with HERE Indoor Radio Mapper and uploaded to the HERE Indoor Positioning backend, the radio data is automatically assigned to the Draft Radiomap. Moreover, when testing positioning with the HERE Indoor Radio Mapper, the tool always uses the Draft Radiomap.

- The production radiomaps are the ones accessed by the end-user applications, i.e. the applications powered by the HERE Mobile SDK. To enable HERE Indoor Positioning to these applications, the Draft Radiomap needs to be published using the HERE Indoor Radio Mapper. At the publish, the Draft Radiomap gets synchronized to the production radiomap(s).

- There are two production radiomaps the difference being in their privacy level. The first one, the Community Radiomap, is available for all the HERE Mobile SDK users that have a license to access that radiomap. The other one, the Private Radiomap, is only for a specific set of `AppIDs` associated with your HERE Account. The Private Radiomap cannot be accessed by the other customers.
- Once the radio data is being published, the production radiomap to which the radio data goes to is controlled by your license and the type of the indoor map used for the radio data collection:
  - The Community Radiomap only accepts radio data that has been collected using HERE Public Venue Maps, and only when you have an active HERE Public Indoor Positioning feature included in your license. All Mobile SDK users can access this data.
  - The Private Radiomap only accepts radio data that has been collected using HERE Private Venue Maps or your own custom image-based indoor maps, and only when you have an active HERE Private Indoor Positioning feature included in your license. Only your own applications can access the data.
- The HERE Mobile SDK can be configured to access the Draft Radiomap for testing and development purposes for a limited number of devices. See HERE Mobile SDK Developer Guide for details.

Business Features

HERE Indoor Positioning supports two business features and their combination:

- *Private Indoor Positioning feature*

  With this feature you have access to all the tools (HERE Mobile SDK, HERE Indoor Radio Mapper). You can contribute radio data to the Draft Radiomap and Private Radiomap, and use the Private Radiomap in your application.

  This feature is included in both the Freemium and Pro business plans available at *HERE Developer Portal*.

- *Public Indoor Positioning feature*

  With this feature you have access to all the tools (HERE Mobile SDK, HERE Indoor Radio Mapper). You can contribute radio data to the Draft Radiomap and the Community Radiomap, and use the Community Radiomap in your application.

  This feature is included in both the Freemium and Pro business plans available at *HERE Developer Portal*.

- *Both features enabled*

  In case your license has both features enabled, you can contribute radio data to the Private Radiomap and Community Radiomap (depending upon the indoor map you use). By default, the HERE Mobile SDK chooses, which Radiomap to use. However, you can also explicitly control whether you want to use the Private Radiomap or the Community Radiomap in your application. See the *HERE Android SDK Developer's Guide Premium Edition* or *HERE iOS SDK Developer's Guide Premium Edition* for details.

- 📄 **Note:** Regardless of the business features in your HERE Mobile SDK license, the Draft Radiomap is at your disposal for development purposes in HERE Mobile SDK for Android. See the *HERE Android SDK Developer's Guide Premium Edition*.

Data Flows and Business Features

This section details the data flows within the HERE Indoor Positioning system. There are several factors affecting the data flows:

- Your business features
- Radiomap type (Draft, Private and Community) – access to the production radiomaps depends on your business features
- Type of the indoor map used in the radio data collection

The following tables outline the radio data flows depending on the business features, indoor map type and commercial status.

Table 5: Data flows for the Private Indoor Positioning feature

	Draft Radiomap	Private Radiomap	Community Radiomap
Data contribution options (the indoor map types allowed in radio data collection)	Supported options: • private Venue Map • image-based indoor map	Supported options: • private Venue Map • image-based indoor map	Not supported
SDK Access (radiomap types the SDK can access)	Optional access (Android-only, see the SDK developer guide)	Access	Not supported

📄 **Note:** Upon publishing radio data collected using the private indoor maps (Private HERE Venue Maps or custom image-based indoor maps) goes to the Private Radiomap.

Table 6: Data flows for the Public Indoor Positioning feature

	Draft Radiomap	Private Radiomap	Community Radiomap
Data contribution options (the indoor map types allowed to in radio data collection)	Supported options: • public Venue Map • image-based indoor map	Not supported	Supported options: • public Venue Map
SDK Access (radiomap types the SDK can access)	Optional access (Android-only, see the SDK developer guide)	Not supported	Access

📄 **Note:** Upon publishing the radio data collected using the HERE Public Venue Maps goes to the Community Radiomap. Radio data collected using custom image-based indoor maps cannot be published.

Table 7: Data flows for the Public+Private Indoor Positioning features

	Draft Radiomap	Private Radiomap	Community Radiomap
Data contribution options (the indoor map types allowed to in radio data collection)	Supported options: • public Venue Map • private Venue Map • image-based indoor map	Supported options: • private Venue Map • image-based indoor map	Supported options: • public Venue Map
SDK Access (radiomap types the SDK can access)	Optional access (Android-only, see the SDK developer guide)	Automatic	Automatic

📄 **Note:** Upon publishing the radio data collected using HERE Private Venue Maps or custom image-based indoor map goes to the Private Radiomap, and the radio data collected using HERE Public Venue Maps goes to the Community Radiomap.

Change of the Business Features

The following table shows the radio data behavior when you change from one set of business features to another set.

Table 8: Impacts to your data, when changing the business features

Old feature set	New feature set	Changes
Private	Public	Radio data collected for HERE Private Venue will be lost. Private Radiomap shall be cleared and the radio data collected for custom image-based indoor maps will only be available in the Draft radiomap.
Public	Private	You lose control of the radio data you have published to the Community Radiomap. Your Private Radiomap will be empty initially.
Private + Public	Private	You lose control of the radio data you have published to the Community Radiomap. Your Private Radiomap is unchanged.
Private + Public	Public	Radio data collected for HERE Private Venue will be lost. Private Radiomap shall be cleared and the radio data collected for custom image-based indoor maps will only be available in the Draft radiomap.

Chapter 8
# Enterprise User Management

Topics:

This chapter is about Enterprise User Management (EUM). HERE EUM is a HERE Indoor Positioning feature that allows binding multiple HERE Accounts to a single HERE Indoor Positioning customer.

Introduction

HERE Enterprise User Management is a mechanism to bind multiple HERE Accounts to a single HERE Indoor Positioning customer. This allows multiple users to contribute to the radio data collection and/or manage radio data using their own HERE Accounts instead of all the persons using the same company HERE Account.

The following schematic view details the dependencies between different objects.

Figure 7: Enterprise User Management Data Model
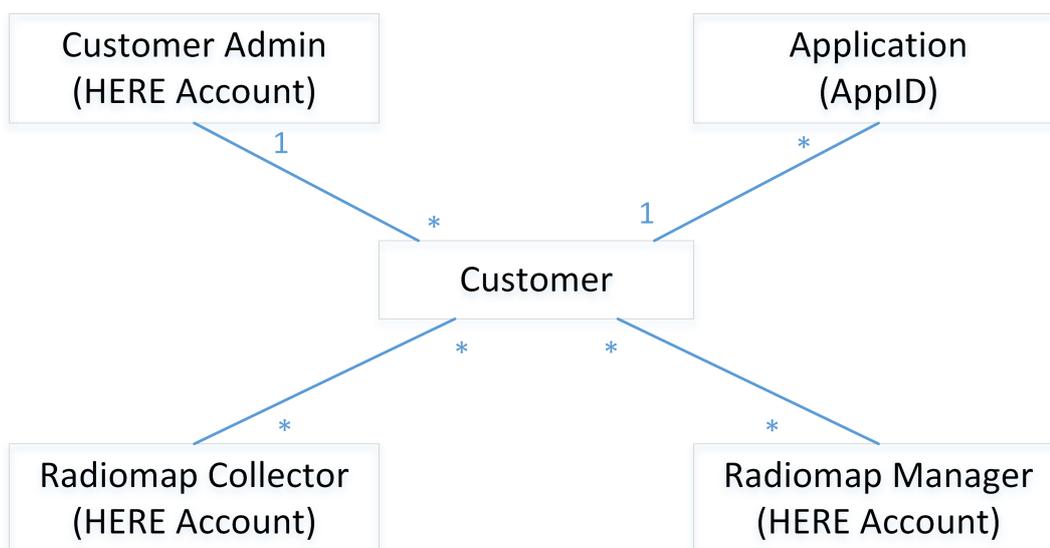
Each customer has a single Customer Admin that is set by the HERE personnel. Once a HERE employee assigns the Customer Admin, the admin gets the below invitation email. The invitation is accepted by clicking the Get Started -link and logging in to the HERE Developer Portal. After logging in, the Customer Admin can start assigning other HERE Accounts roles. Do also note that the Customer Admin must grant itself one of the roles to perform radio data collection and management.

The HERE EUM for HERE Indoor Positioning supports the following two roles:

- **Radiomap Collector:** This role has limited capabilities. The HERE Account having this role can collect radio data for the customer and operate (enable, disable, delete) the radio data collected by the role owner. However, the role owner cannot operate with the radio data collected by others. The role owner can, on the other hand, test the positioning performance using all the radio data. Moreover, this role owner cannot publish the radio data to production to be used by the HERE Mobile SDK. The role has access to all the Private Venue Maps owned by the customer.

- **Radiomap Manager:** This role has all the capabilities. The role can do everything that the Radiomap Collector can, but can also operate on the radio data collected by anyone for the particular customer. Moreover, the role owner can publish the radio data to production to be used by the HERE Mobile SDK. The role has access to all the Private Venue Maps owned by the customer.

Both roles can be given to an unlimited number of HERE Accounts.

Finally, the customer has one-to-many applications that are identified by `App IDs`. Customer Admin can create and destroy applications in HERE Developer Portal.

Note that the users with *Radiomap Collector* and *Radiomap Manager* roles automatically have an access to the HERE Venue Maps assigned to the Customer.

Figure 8: Invitation e-mail received by the Customer Admin

Wed 02-May-18 11:04 AM

HERE <account@here.com>

Welcome to HERE for Customer Admins

To
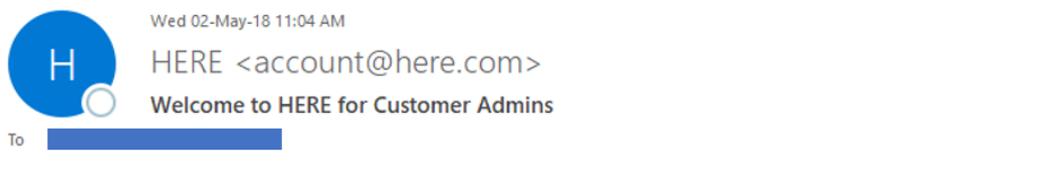
Welcome to HERE Indoor Positioning & Venues B2C and B2B

Hello,

You've been registered as the administrator of Indoor Positioning & Venues B2C and B2B.

If you have an existing HERE account please sign in using the link below so we can give you access to view the details of your application credentials and usage on HERE's Developer Portal.

If you don't have an existing HERE account, you'll need to create one so that you can use HERE's Developer Portal to view details of your application credentials and usage.

To get started, please click here.

Once you've logged in, you can view your dashboard and info about your application credentials by clicking on the dashboard icon next to your name in the top menu. You'll also find information about how to use HERE Platform, including documentation and examples, on the Developer Portal.

Have fun out there,

The HERE team

Assigning roles

Once the Customer Admin logs in to the HERE Developer Portal and accesses the Projects page, the Indoor Positioning project (*Indoor Positioning App*) is visible. At this stage there are no users, because nobody has yet been granted Radiomap Collector or Radiomap Manager roles.

Figure 9: Projects view in the Developer Portal
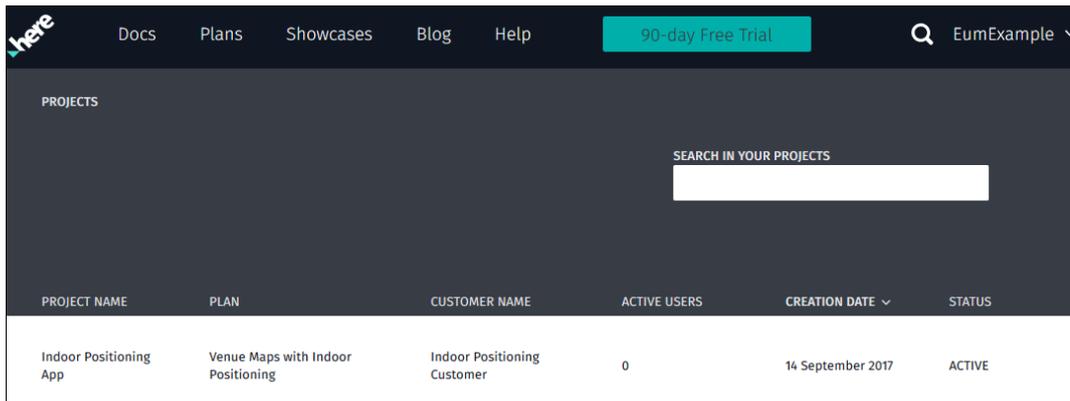
Clicking the project allows the Customer Admin to add the first application (Android or iOS) to the project. In the figure below, an Android application has been created. Creating an application provides the `App ID`, `App Code` and `SDK License Key` for the development purposes.

To add users to Radiomap Manager and Radiomap Collector roles, click the **Manage users** button in the lower right corner.

Figure 10: AppID created
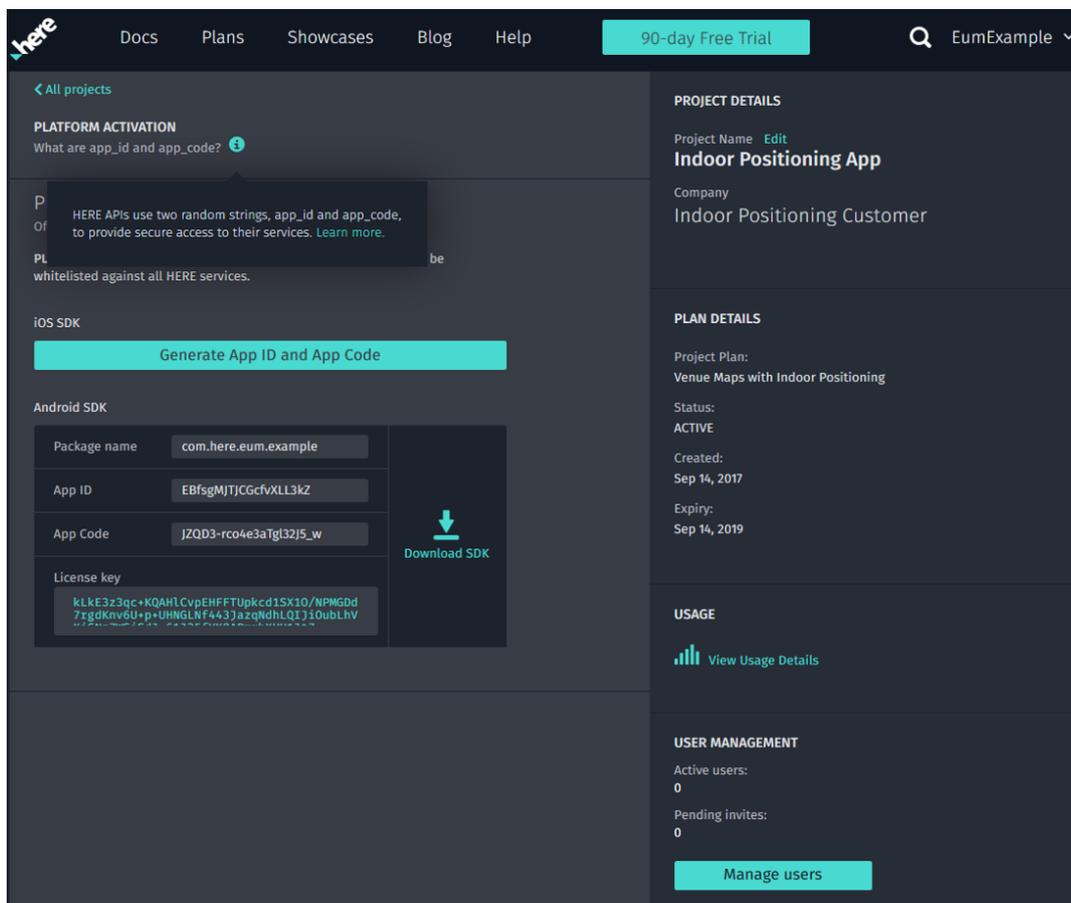
Clicking the **Manage users** takes Customer Admin to the user management view. Adding users to roles is done by clicking **ADD USER**.

Figure 11: Project with no users
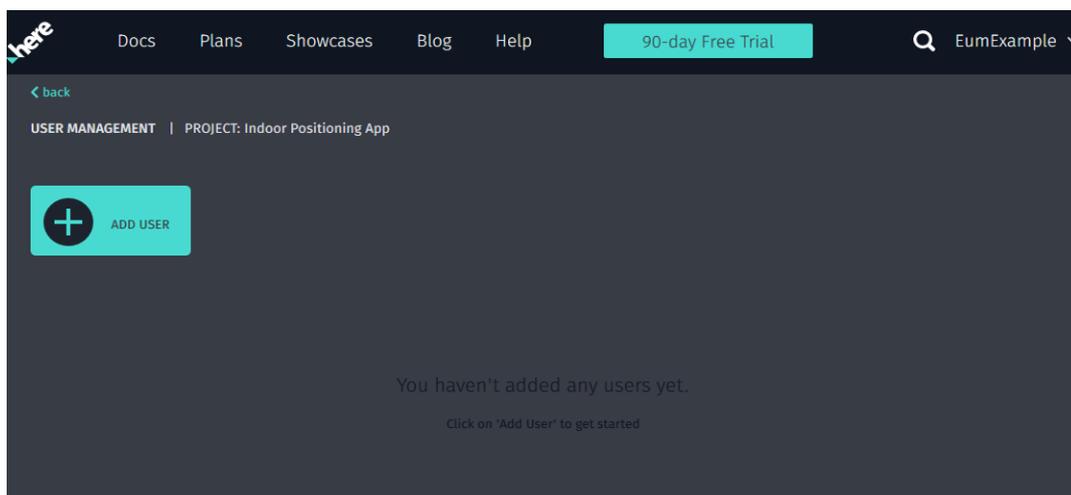
When adding users to roles, the email address of the person whom the role is granted is required. Moreover, the role to be given, either *Radiomap Collecter* or *Radiomap Manager*, needs to be selected.

Figure 12: Adding users to the project
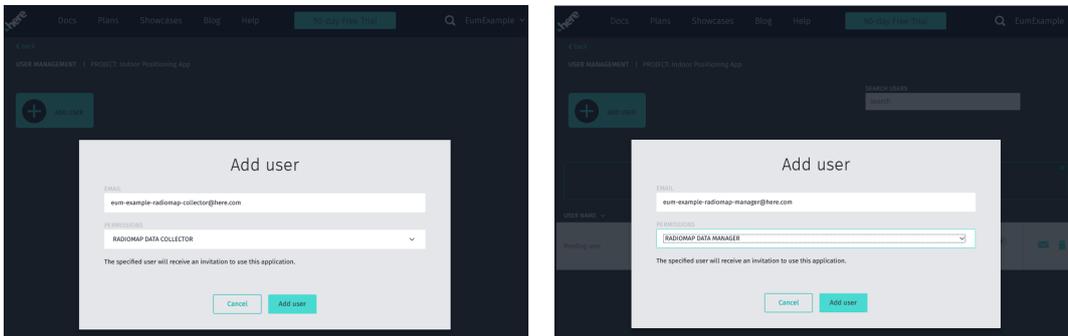
Having added users to roles, they can be seen as pending invites:

Figure 13: Pending invites
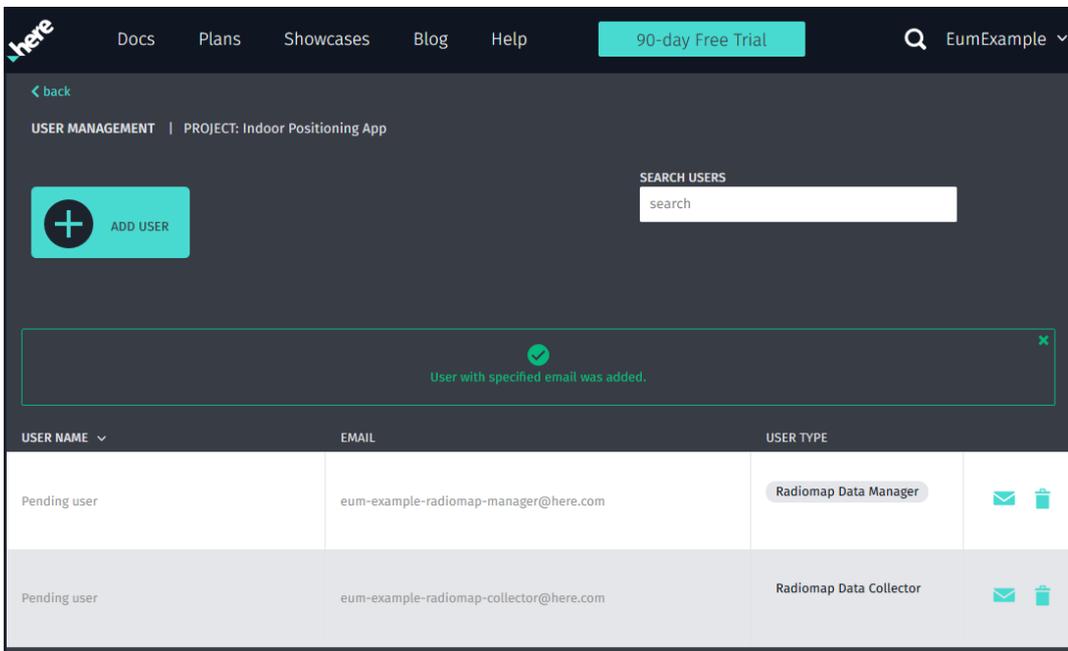
Accepting roles

After the Customer Admin grants the role to a user, the user will receive an invitation email:

**Figure 14: Radiomap Manager email notification**
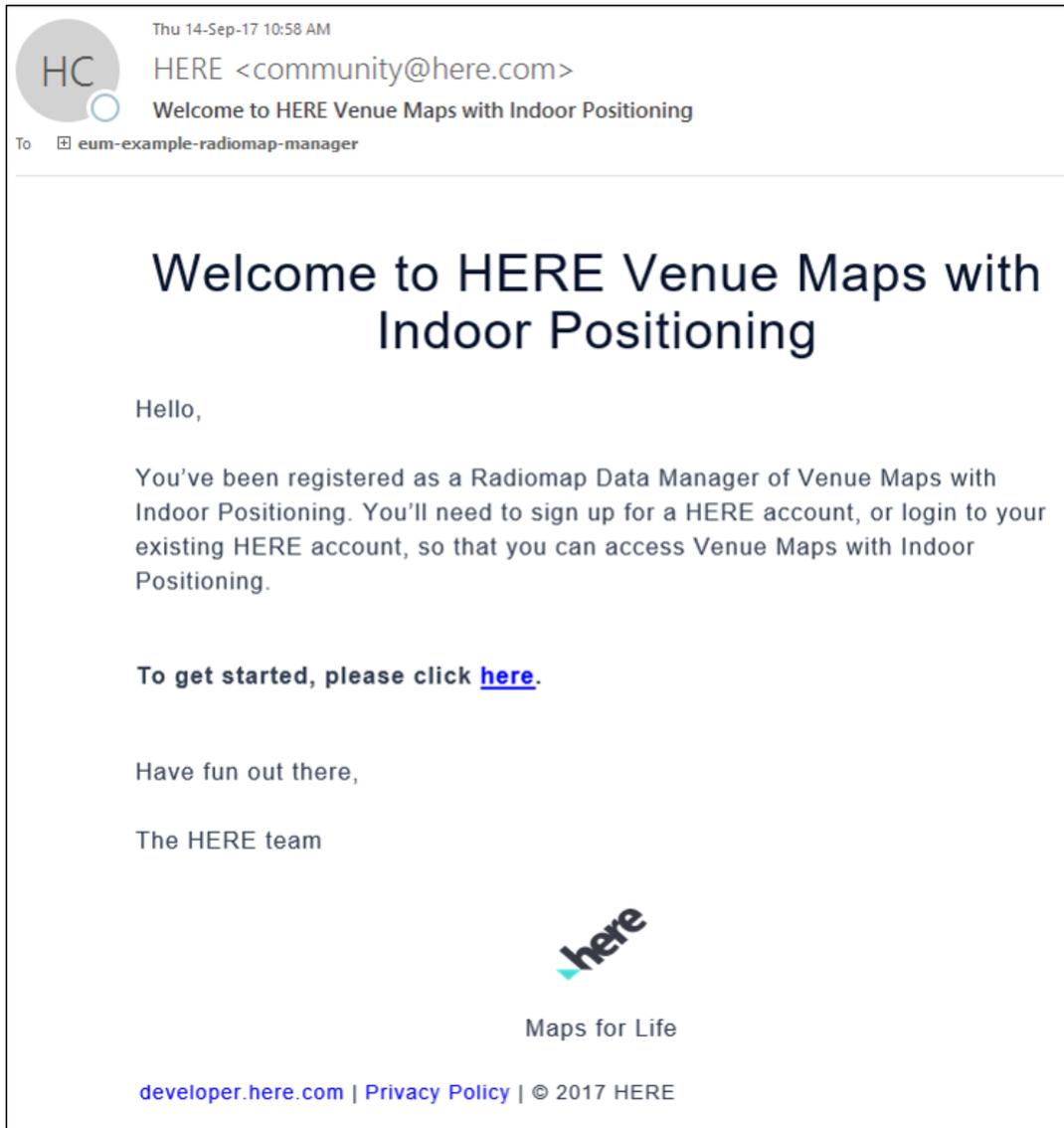
Clicking the Get Started -link takes the user to HERE Developer Portal sign in page:

Figure 15: Radiomap Manager login
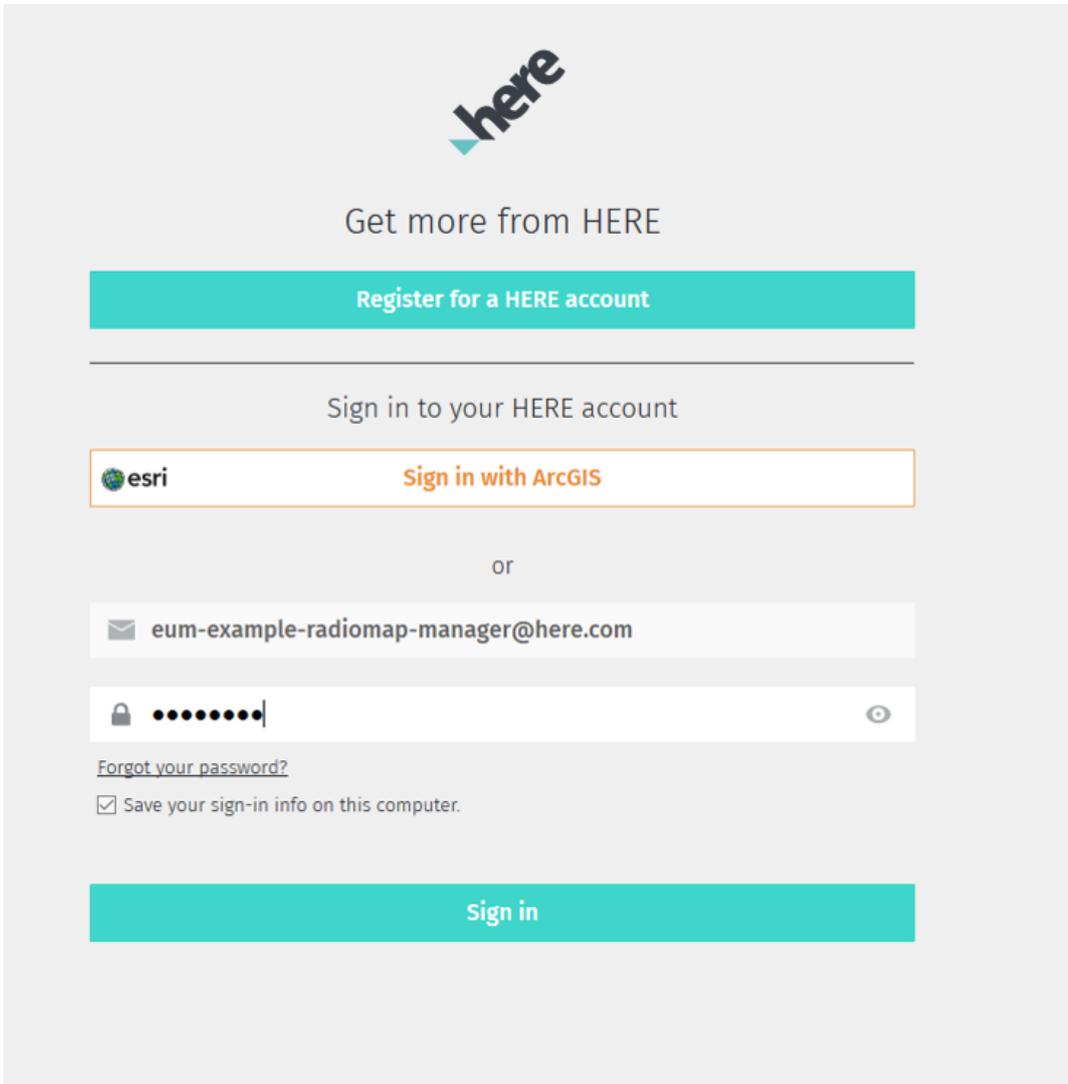
By logging in, the user accepts the role:

Figure 16: Radiomap Manager notification after acceptance
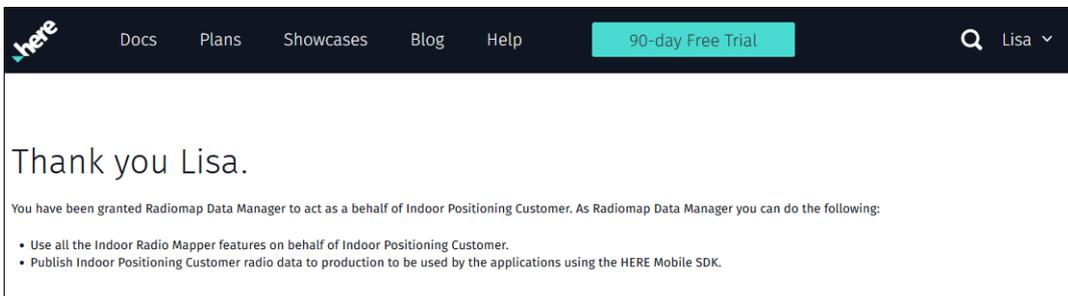
Management features

The following assumes that the *Radiomap Manager* invite was accepted by a user, but the *Radiomap Collector* invite sent to another user is still pending. In such a scenario, the **Projects** page in the HERE Developer Portal shows one active user for *Indoor Positioning App*, when the Customer Admin logs in:

Figure 17: Customer Admin projects view
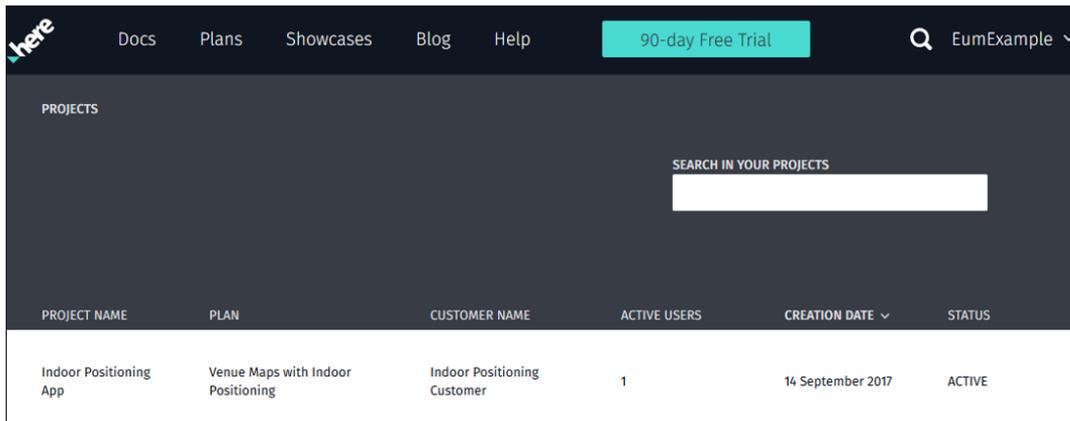
Upon entering the user management page for the project, the role owners can be seen and managed:

Figure 18: Customer Admin user management view with two users
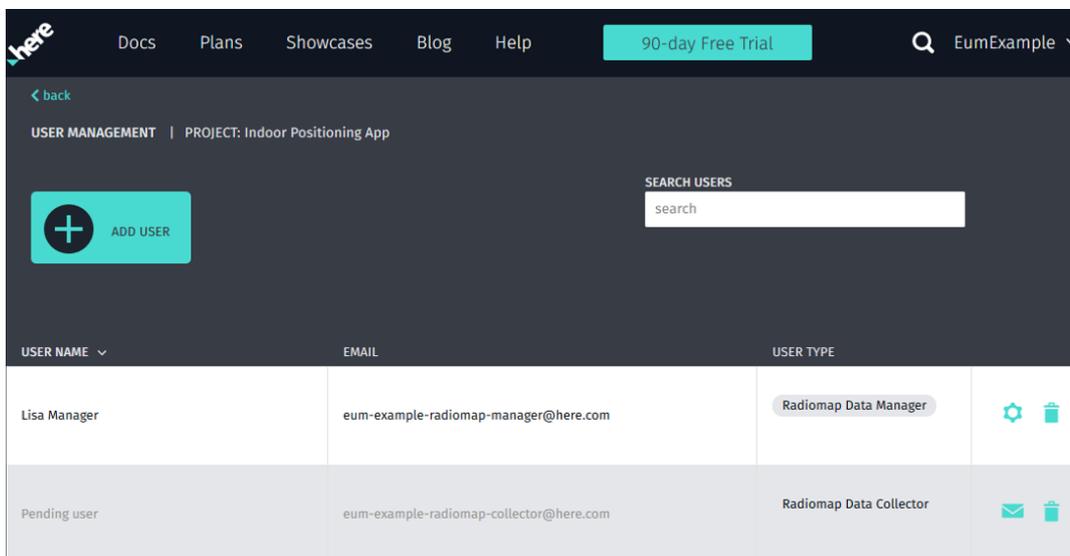
Finally, in case a role needs to be removed from a user, this is done by clicking the **trash can** icon in the appropriate row. Having tapped the icon, a confirmation is requested:

Figure 19: Deleting the permission
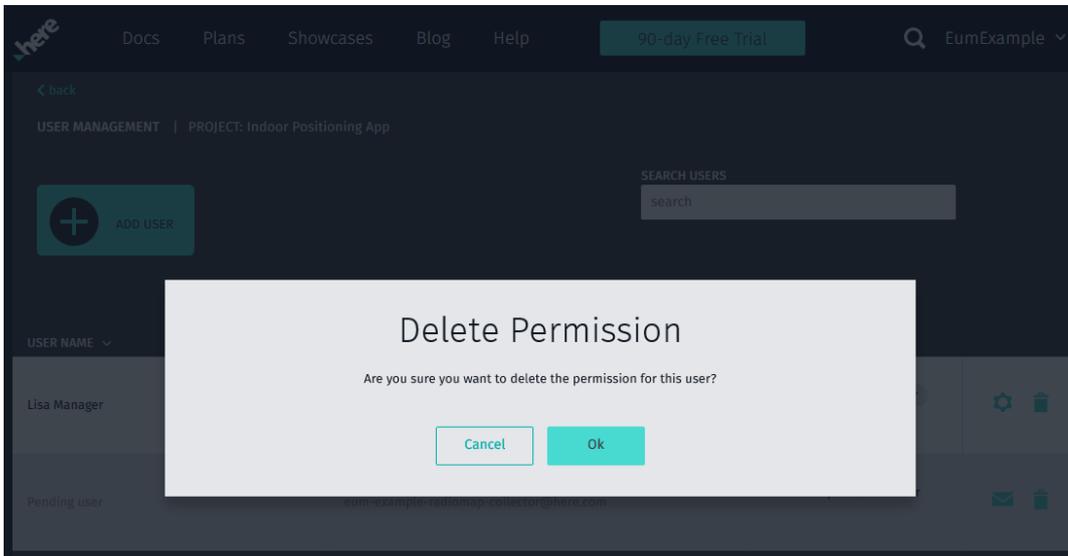
Chapter 9
FAQ

Topics:

The sections below contain frequently asked questions, grouped by category, reflecting issues users may have when setting up HERE Indoor Positioning.

Frequently Asked Questions on Beacons

Why does HERE recommend the use of Eddystone beacons?

The Eddystone standard defines a telemetry message that can be used to monitor the beacon health status without any proprietary techniques.

Can I use my own beacons?

HERE does not recommend this. While the configuration aspects are straghforward to verify, the hardware quality aspects may be an issue. When you are using beacons that we have not tested and certified, we cannot guarantee that e.g. radio and antenna performance are at the required level.

HERE does not provide support for enabling HERE Indoor Positioning using beacons unknown to HERE.

Can I use an existing beacon deployment?

Similarly to the above, HERE does not recommend using your existing deployment. The beacons may suffer from configuration, deployment location and hardware issues. To exemplify, if the existing beacon deployment has been installed for advertisement purposes, beacons in such a setup are typically moved from one location to another frequently. Such a beacon deployment is unsuitable to be used with HERE Indoor Positioning.

HERE does not provide support for enabling HERE Indoor Positioning using beacon deployments unknown to HERE.

Frequently Asked Questions on Beacon Deployment

Can I move a beacon that is already installed to a new location?

Currently it is not possible to move a beacon to a new location. Do not relocate or recycle beacons.

Can I remove a beacon that is already installed?

Yes you can, but make sure that the recommended beacon density remains.

How should I handle beacons that have been removed?

Always remove batteries from the beacon that has been removed or take the beacon to a storage away from the deployment area. Do not relocate or recycle beacons.

Is it possible to re-plan an existing beacon installation?

Re-planning requires some additional operations. The previously collected radio data needs to be deleted and new radio data collection needs to be performed after the beacons are redeployed.

What happens if the beacon deployment does not follow the recommended grid size?

A smaller grid size may only have a negligible positive impact on the quality of positioning. A larger grid size degrades positioning quality.

Which way should I orient the beacon?

Most typically beacons radiate most powerful towards the front of the beacon.

Can I deploy incrementally for a building, or do I need to do it all at once?

We recommend that you deploy across the whole building at once. This is because the radio signals penetrate quite well through the walls and ceilings. Thus any new deployment may disrupt the positioning service in the areas with earlier sub-deployments.

Can I deploy for only a part of the building?

It is possible, but some special considerations need to be taken into account, such as making sure to collect radio data in all the areas in which the beacon signals can be observed. This means collecting radio data over quite a large area around the actual beacon deployment. You may also have to visit parts of the floors above/below the beacon deployment.

Can I mix different beacon types in one deployment?

Yes it is possible, but we strongly discourage that. This may cause some difficulty for maintenance work, because of the different battery types and battery lifetimes, and so on.

What should I do if a beacon is constantly falling off from the wall?

Because of different types of wall surface, sometimes a beacon might not stick. Try a different tape or glue and check the surface purity. If the surface is really problematic, you may need to mount the beacon with scews. In addition, using cable ties is one reliable option for fastening beacons.

Is it enough to deploy beacons just inside the building?

There is no need to deploy beacons outside a building to make the positioning work inside a building. However, if you wish to use positioning outside as well, with a smooth transition from indoor to outdoor (and vice versa), it is worth considering deploying beacons outside. Or, at least indoors close to the outer wall or windows. This ensures that the signal penetrates well outside of the building. In this case, you should also remember to perform radio data collection outside of the building. See *HERE Indoor Radio Mapper User Guide* User Guide for further details on collecting radio data outdoors.

How can I prevent malicious people from reconfiguring my beacons?

The HERE recommended beacon configuration does not allow any connections to the beacon thus making remote reconfiguration impossible.

Frequently Asked Questions on Radio Data Collection

What are the recommended devices for the radio data collection?

HERE recommends to use the following devices in the radio data collection:

- Acer Iconia One 10 B3-A20B 32GB Wi-Fi edition
- Google Pixel XL

When is new radio data collection required?

Noticeable degradation in positioning performance is a clear sign that new radio data collection is required. However, it is essential to understand the root cause for the degradation. There may be several reasons to this:

- **Structural changes**. If the degradation is due to the structural changes in the building, then deleting the old radio data in HERE Indoor Radio Mapper and collecting new radio data is a must.
- **Radio node re-arrangement**. In case radio nodes are moved around in the building, again deleting the old radio data in HERE Indoor Radio Mapper and collecting new radio data is a must. Note that HERE Indoor Positioning can tolerate some changes, but if a large number of radio nodes is moved around, the radio data must be re-collected.
- **Losing or removing radio nodes**. Losing or removing a small number of radio nodes from a venue typically has a negligible effect on positioning performance. However, performance degradation is likely if a significant number of nodes is lost or removed, especially locally. Therefore, if you need to remove radio nodes, it is best to install new ones in their place and perform re-collection of the radio data.

The addition of new radio nodes does not compromise positioning performance. HERE Mobile SDK can observe the new nodes, but because they are not included in the radiomap, they are not used in positioning and thus do not affect location estimation. However, if you decide to perform radio data collection after adding a new radio node, ensure that you visit carefully the whole area covered by the new node. Also, you need to collect radio data in floors above and below in case the building structure allows radio signals to penetrate from one floor to another.

Can I use partial radio data collection to enable positioning in a small area?

You can do this, but it is not advisable if the users of the positioning service can access the floor above and/or the floor below the area of interest. Radio signals typically penetrate from one floor to another and thus, when a user passes above or below the area, the user device can observe the signals from the area of interest. There is a high likelihood of incorrectly locating the user on the wrong floor. To avoid such errors, it is best to collect radio data for the same area in the floor above and the floor below the area that was the primary target for positioning and, thus, radio data collection.

For example, if you collect radio data in a small area on the floor 5, cover approximately the same area on the floors 4 and 6 as well. Note, however, that this approach leaves open the possibility that a person moving on the floor 3 below the collected area is likely to be positioned to the floor 4. The best guarantee of correct indoor positioning is to collect radio data from the whole venue. However, if the venue has a single floor or the users can only access one floor, then partial radio data collection is sufficient.

If you opt for the partial radio data collection, please collect in a larger area than the part of the building where you require optimum positioning performance. Bear in mind, that devices observe radio nodes from the radiomap outside of the collected area, both before they enter that area and after they leave it. This may cause some transient issues, when moving from an area, where radio data has been collected, to an unvisited area.

To geofence in a small area, do I need to collect radio data in the whole venue?

Not necessarily. Please see the discussion of *partial radio collection*, because similar considerations apply in geofencing. This includes the likelihood that the partial radio data collection may produce good results, when users have access to only one floor.

Should I also collect radio data outside of the building?

If, in your use case, it is important that the positioning technology changes smoothly from indoor methods to outdoor methods (cellular, Wi-Fi, or GNSS), then it is advisable to collect radio data outside of your building. Refer to the *HERE Indoor Radio Mapper User Guide* for instructions on how to change the collection method between indoor and outdoor radio data collection.

Frequently Asked Questions on Positioning

What factors affect HERE Indoor Positioning performance?

HERE Indoor Positioning performance (accuracy) is a sum of many factors, including:

- The radio environment (density of radio nodes, variability of the signal strength field)
- Devices used in data collection (some devices have better scan quality)
- Device used for positioning (some devices have better scan quality)
- Building geometry (some buildings are more challenging e.g. for floor detection)

It is hard to quantify the impact of each of these to the observed performance. HERE Indoor Positioning algorithms are designed to mitigate the effects of the varying device characteristics.

When it comes to the radio environment, the best performance is typically achieved when five to ten Bluetooth beacons are observable in each scan, assuming that the beacon deployment is optimized for positioning rather than, for example, for advertising purposes. Similarly, when Wi-Fi is used, it is desirable to have roughly ten true physical Wi-Fi access points in each scan for the best performance. Now, very often the Wi-Fi access points in modern deployments are MIMO access points, which means that a single physical access point acts as multiple logical ones. Such logical access points do not significantly contribute to the positioning performance.

Where is the position estimate calculated?

The position estimate is calculated in the device itself. The HERE Mobile SDK only accesses the network to download the new or updated radiomap after which device can be used in the offline mode. All the required computations take place in the device resulting in less latency and better accuracy than network-based

solutions. The added benefit of this approach is user privacy, because no location information is sent from the device to the cloud.

How do you handle positioning technology changes?

The algorithms inside the HERE Mobile SDK handle the positioning technology changes automatically. The set of the location technologies available to the HERE Mobile SDK depends on:

- Your SDK license
- Device capabilities
- Operating System settings (for example whether Wi-Fi and/or Bluetooth are enabled)
- Positioning mode set via the API (indoor-only or hybrid)
- Operating System itself (in iOS we can only support Bluetooth-based indoor positioning)

What happens if a device moves from indoors to outdoors or vice versa?

The HERE Mobile SDK algorithms detect whether and when a device moves from an indoor space outdoors and switch from indoor positioning technology to, for example, GNSS. Similarly, when a device enters an indoor space, the switch to indoor positioning occurs automatically and seamlessly. Again, the set of outdoor positioning technologies at your disposal depends on the same factors as listed above.

Frequently Asked Questions on Indoor Maps

Why does HERE recommend the use of HERE Venue Maps instead of my own custom image-based maps?

HERE strongly recommends the use of HERE Venue Maps with HERE Indoor Positioning, for the following reasons:

- HERE Venue Maps are encoded using global geographical Latitude and Longitude coordinates. We guarantee the correctness of the coordinates as well as the proper alignment between the HERE outdoor maps and HERE Venue Maps. This further ensures that the coordinate systems used by the HERE outdoor positioning technologies and HERE Indoor Positioning match and the indoor-outdoor transition will work seamlessly.
- With HERE Venue Maps you save the hassle with aligning the floor plan images with the Latitude-Longitude coordinate system.
- HERE Venue Map floor indexing is standard and static.

However, in recognition that there are valid use cases for the use of custom image-based indoor maps, HERE Indoor Positioning supports their use in the Draft Radiomap and Private Radiomap, but note that radio data collected using image-based indoor maps cannot be contributed to the Community Radiomap.

Frequently Asked Questions on HERE Account

What happens to my data when my HERE Account is closed or my Indoor Positioning subscription ends?

If you delete your HERE Account, we will delete all your *private* data. However, HERE keeps any radio data you have collected for Public HERE Venue Maps.

If your HERE Indoor Positioning subscription ends, we will keep your data in storage for six (6) months. After this period, HERE will act as in the case of HERE Account deletion (see above).