ArcGIS Indoors IPS Setup Guide

June 2020

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Overview

This guide will walk you through the process of successfully implementing a BLE (Bluetooth Low Energy) based IPS for use with ArcGIS Indoors Mobile for iOS and Android. Esri Indoor Positioning is hosted on the legacy platform of the Esri R&D Center in Vienna, formerly known as indoo.rs. Therefore, this process may differ from other Esri workflows you might be accustomed to.

Account Creation

To start off the project, create an account on my-us.indoo.rs. Credentials are required to log in to the desktop and mobile applications used for pre-survey prep, survey, and post-survey validation. After your account has been activated (~2-3 hrs.), log in and navigate to the "Documentation" pane.

Install Desktop Application

The Measurement Tool, MMT, is the desktop application used to import, annotate and process maps for use in the Esri IPS survey applications. Download the MMT install file appropriate for your operating system.

indoo.rs platform	Applications	Admin ▾	Documentation	
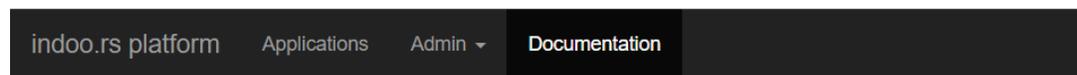
Documentation

Measurement Tool

Name	Version	Release	Download	Note
Installer Windows	4.7.0	03.08.2017	x86/x64	
Installer Mac	4.7.0	03.08.2017	zip	Supported: OS X 10.9, 10.10

Note: This pane also has useful guides and SDKs available for download.

Application Creation

With your account created and the MMT desktop application installed, the next step is to create an Application in the my-us.indoo.rs platform. An Application is typically equivalent to an organization and can consist of one or more Buildings. A Building, typically equivalent to a site or campus, is a series of maps created in the MMT desktop application and uploaded to the my-us.indoo.rs platform. From there, it can be accessed and managed on the web, as well as downloaded on device for surveying. The completed surveys are stored within the Buildings and processed at the Building level.
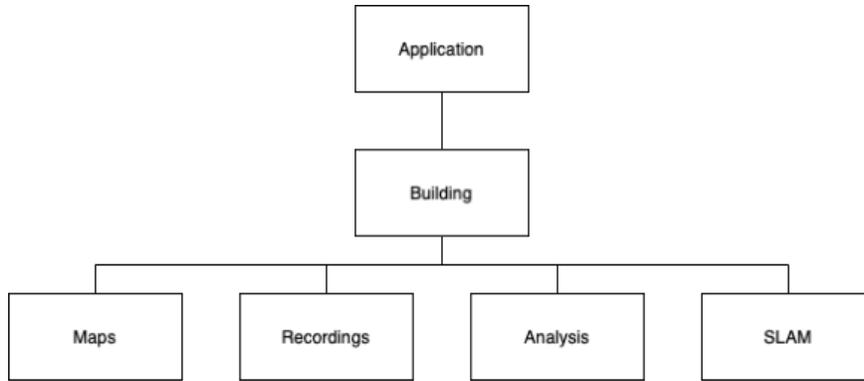
With this context, "Esri" would be an Application and "Esri Redlands" and "Esri St. Louis Regional Office" could be separate Buildings within that Application. While this would be the typical implementation approach, Application and Building organization can vary based on the management of the completed IPS. If the IPS for the Esri Redlands and Esri St. Louis Regional Office sites are to be managed and implemented by separate admins and teams, it would be more suitable to create two separate Applications and one Building within each.

To create an Application, navigate to the "Application" pane on the my-us.indoo.rs platform and hit New. Enter an appropriate name and hit Create.

Click on your newly created Application. Note the API key, also represented by a QR Code. This key is used to open your Application in MMT and the mobile survey applications, as well as link your completed IPS to your ArcGIS Indoors Mobile Map Package (MMPK). There are no buildings created yet. This process will be done in MMT.

ArcGIS Indoors Map Export

The basis for your Building will be maps in PNG format exported from ArcGIS Pro. These maps will be used in the survey applications as context for your recordings. We will export one map for each vertical order value in the Indoors data. All first floors of every building will be captured in one image, all second floors of every building will be in other image, and so on.

Steps to export a PNG from ArcGIS Pro:

1. Start ArcGIS Pro and create a New project.
2. Go to the Insert tab and select Import Map. Choose your ArcGIS Indoors MMPK.
3. Right click on the map layer in the Contents pane and select Properties.
4. Ensure the Rotation value is set to 0. Hit OK.
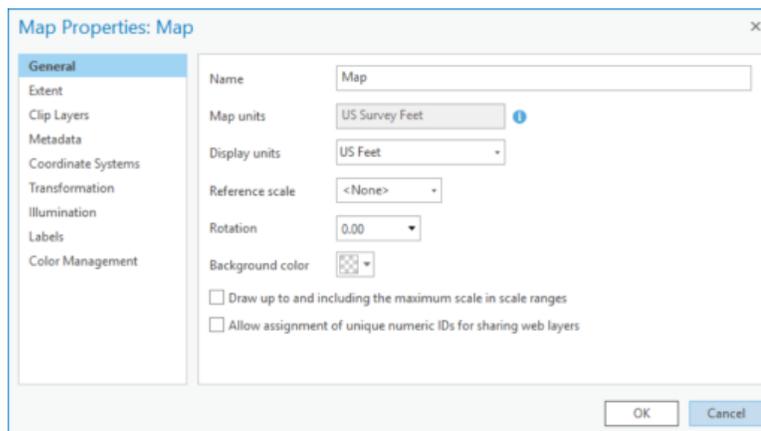
5. In the map, zoom to where all buildings to be surveyed are in view. Enable the range so that only the first floor visible.
6. Right click on the map layer in the Contents pane and select ''Set reference scale''. This ensures that the graphics are not generalized on export.
7. Optionally add a basemap for context. Be aware that adding a basemap will increase the size of the image.
8. For each visible layer in Contents, right click and set "Out beyond" to "None" in Properties
9. Zoom out again so the area you would like to export is fully visible
10. Right-click map layer in Contents (on the left side) and then Properties → Coordinate System → search for "3857" and press OK
11. Change vertical order (on the right side) to the level you would like to export

12. Share → Map (Export). Save as JPG, make sure to check "Create a World File" box, set DPI depending on size of your map (e.g. 500dpi for ESRI Redlands Campus) and Export
13. It generates two files. The first one is image and the second is a text file called World file. Save them in a location convenient to you.

Repeat for each level you want to export.

Attention: DO NOT scroll or CHANGE ZOOM between level exports! Otherwise the georeference does not match anymore

The World file describes the georeference of exported PNG file, and has information like the scale, coordinates and rotation in it. For us to use those coordinates to set up the building in the MMT, we need to convert the coordinates and calculate the scale in the coordinate system the indoo.rs platform uses.

Here a detailed description of the World File:

- 1st line is scale of pixel in UTM meters (X axis). This must be rescaled (see scale calculation))
- 2nd and 3rd line is rotation of raster. Both must be zero! If not step setting the rotation in the previous step was not successful.
- 4th line is scale of pixel in meters (Y axis). This value is almost always negative. It can be disregarded.
- 5th line is X coordinate of upper left corner of the PNG in EPSG:3857 WGS 84
- 6th line is Y coordinate of upper left corner of the PNG in EPSG:3857 WGS 84

How to calculate the coordinates and scale for use in the MMT:

1. Open the website epsg.io and be sure you are converting coordinates from *EPSG:3857 to EPSG:4326.*
2. Convert coordinates of upper left corner (5th and 6th line) to Longitude and Latitude and select decimal format. Note down the converted Longitude and Latitude.

3. Scale calculation:

> Final **scale** is [mm/pix]
>
> <<<
>
> utm_scale = 1st line of world file
>   PI = number pi
> **scale** = utm_scale * cos(Latitude * PI /180) * 1000
> <<<
>
> > Note: Set calculator to radians (Google Search uses radians by default). If not, remove PI/180 from calculation.

Note down the scale.

Now we are ready to start off the building creation in the MMT.

Building Creation

Open up the Measurement Tool and put in the credentials of your my-us.indoo.rs account, also fill in the API key that you find on the overview page in your Application on my-us.indoo.rs.
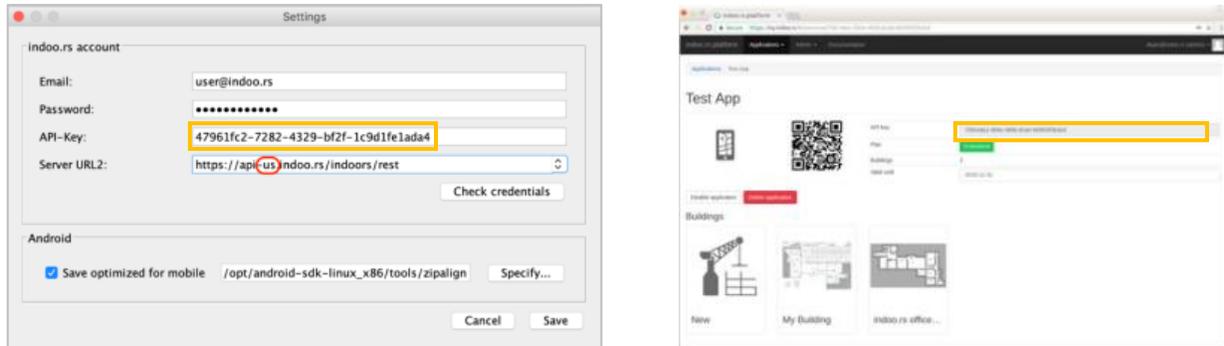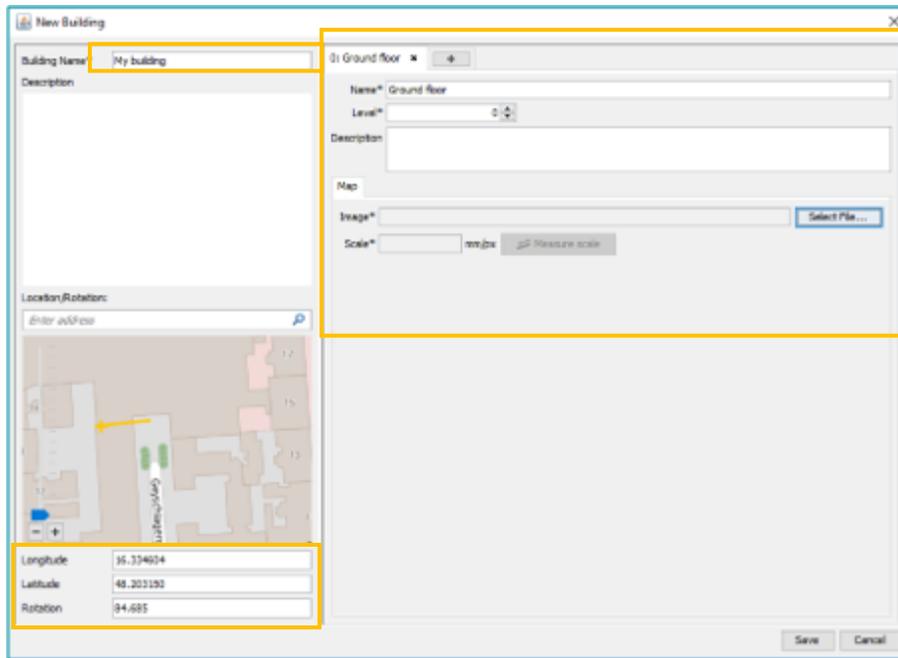

Change the Server URL2 to https://api-us.indoo.rs/indoors/rest.

Without clicking "Check credentials" press "Save"

You successfully connected the MMT to your Application on my-us.indoo.rs.

Now follow these steps to create your building:

1. Click on "*File*" → "*New*"
2. Fill in the following fields:
   a. Building Name
   b. Longitude (converted)
   c. Latitude (converted)
   d. Rotation (Always 90)

- Next you need to create one floor of the building (clicking on "+" sign)
    - Fill in the Name of the floor
    - Set the level (floor) of the map (This must correspond with the Vertical Order of the level in ArcGIS)
    - Upload the image of the first floor you exported
    - Set the scale (The one you calculated in the previous step)
    - Repeat for each floor of the building

After adding all floors, click "Save" and your first map is ready to be annotated

The only map annotation necessary in the MMT is the creation of "Inbound Zones". Those inbound Zones are necessary to improve the GPS fallback and guarantee that inside the building, GPS will not be used as a localization source. Click on the Zone Drawer and select the "Inbound" checkbox. Go ahead and draw a zone around the footprint of the building. If you have more than one building on your map draw a zone around each. Repeat for each floor.

All other necessary annotations like pathways and barriers are already in the indoors data model and will be applied once Indoor Positioning is configured in ArcGIS Pro.]

After the zones are done hit **File → Save to Cloud**. This will load the building file into your application on my-us.indoo.rs.

Now the building is ready to be surveyed, so we will continue looking into the Beacon Infrastructure.

Beacon Configuration (Kontakt.io)

This step is only applicable if you are using Kontakt.io beacons. This activity needs to be performed in physical presence of the beacons.

Beacons have 2 two parameters that need to be changed in order to function properly with an IPS Setup.

- TX Power Level – determines the strength of the Bluetooth signal emitted from the beacon
- Advertising interval – determines the interval that said signal is emitted

The ideal value for those parameters is **TX Power Level 2 with an advertising interval of 350ms.**

First, create an account on **https://panel.kontakt.io/signin.**

Activate your account and log in, you should now see your dashboard.
With your beacon shipment comes a small, green card with an Order ID on it.
Use that Order ID to Add Devices to your dashboard.
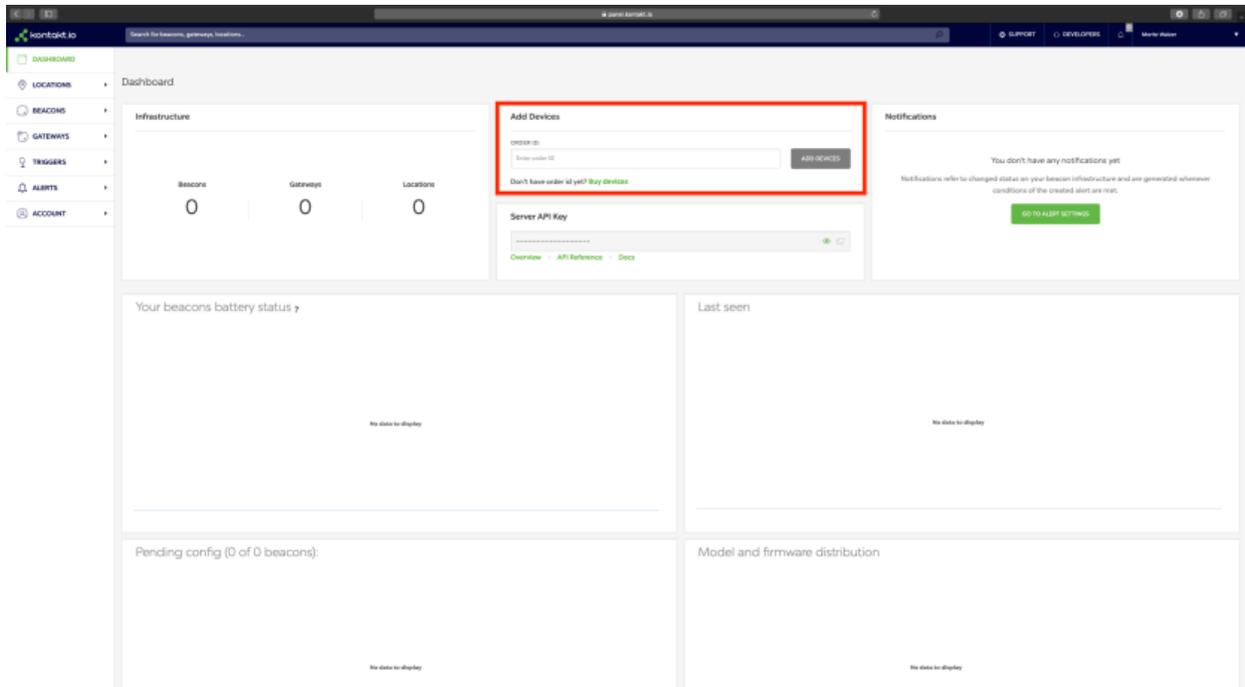
In the contextual menu "BEACONS" on the left, choose "Beacon list". Now you see a list of all your beacons and their configuration that were included in the order.

In this case we want to edit all our beacons to the same configuration, so you can tick the checkbox on the top left and hit "BULK EDIT".

As mentioned above, fill in the values for TX Power Level (2) and Interval (350). Hit "Save Changes".

Now that you saved the changes online, you must physically apply the configuration to the beacons with your mobile phone and the kontakt.io mobile app.

Download the Kontakt.io App from your applicable App Store and log in with your credentials.
Switch to the "Nearby" Tab.
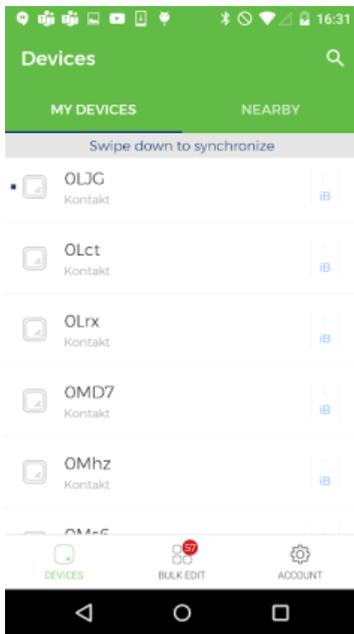
Beacons with a pending configuration will have a black dot next to them. Simply click on that beacon and hit "Apply Configuration" while being not more than 1m (3ft) away from the Beacon. Do that for all devices.

The beacons are now ready for placement!

Deployment Provisioning

Now it's time to get an idea of how much time and resources you will need in order to complete the beacons placement and recording process. Take following as an indication.

iBeacon placement (100 beacons / man-day)

Survey process (7000 sqm / man-day)

Beacon Placement

Each Beacon deployment will happen according to a Beacon Placement Plan provided by your Esri IPS consultant. This plan is generated on basis of the building's CAD files. It shows exactly where to place each Beacon in the building.

Note the following while placing the beacons:

- Above head level – walls/ceiling: 3-4m (10ft -13ft)
- Place all beacons roughly at the same height
- Use double sided tape
- Tape beacons on smooth and clean surfaces
- Walls and other obstructions affect the signal distribution
- Make sure to note down the 4 letter Beacon ID (Kontakt.io only) to the position either with a printed Beacon Placement Plan or alternatively create a feature class Project geo-database to have a better overview of your IPS assets using a survey tool like ArcGIS Collector. This will be useful when it comes to battery management or in case a beacon gets lost or needs to be serviced.

After all Beacons are placed accordingly, you can start the survey process.

Site Survey

For the site survey you will need another external tool, namely the "Mobile Toolkit" by Indoo.rs. Due to technical restrictions this Application is only available for Android devices.

Go ahead and download it from the Google Play Store.

Log in with the credentials you used for my-us.indoo.rs. Scan the QR code from the Application page to link the Mobile Toolkit to your application. Now we must change some settings for you to access your building and start the survey process.
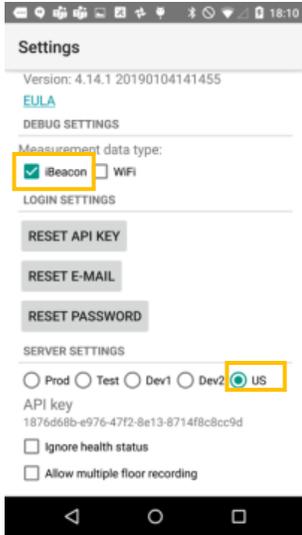
1. Tab the 3 Dot symbol on the top right corner and navigate to settings
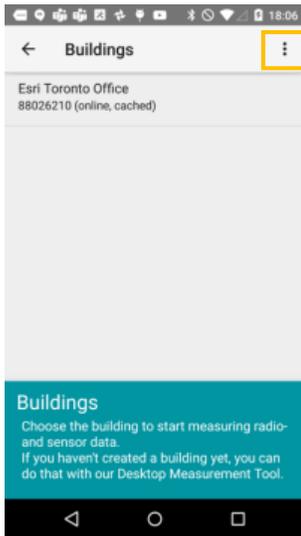
2. On the bottom there is an Info pane with a version number, tap on that version number 5 times until the advanced settings show up
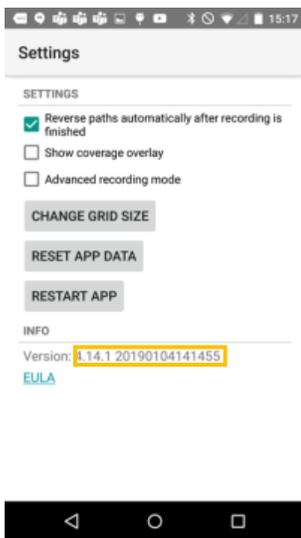

3. In server settings tick the checkbox "US"
4. Make sure only IBeacon is selected as Measurement data type

After that restart the app and refresh the screen, your Building should now show up!

Click on the building and wait for it to download. Now you should see your map in the Mobile toolkit. In the top left corner on the map is a health checker that indicates if all permissions are given to the app and if all sensors are ready to operate.
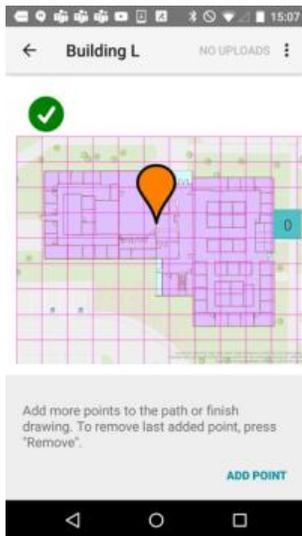
Tap on the symbol and make sure all smileys in clicking on them and follow the instructions given by the app.
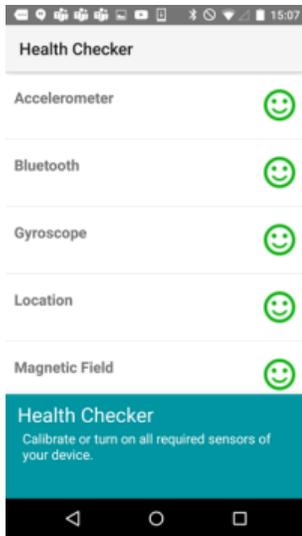
Familiarize yourself with the recording process with the video of the in the Documentation Pane of my-us.indoo.rs. (indoo.rs Mobile Toolkit).

Depending on the layout of your building there is different approaches on the survey strategy, here an example for an office environment on how to most efficiently cover each area.

Hallways

The Ground Truths should be on places that you can easily identify, in this example I used the beginning of each cubicle door as a point to confirm.

Cubicles/Rooms

Surveys from Cubicles or Rooms should preferably start in the corridor and then cover the whole area of the room, paths can overlap so feel free to walk in and out of a room in one go.

Important rules for surveying:

- Surveys must be at least 10 steps **and** 10 seconds long.
- Try to put Ground Truths 4-7m apart
- Consecutive Ground Truths must be on the same floor
- Always add a comment of name of the area you covered with each survey (e.g. Main Hallway east)
- Each area must be surveyed at least twice (In the settings is a feature that automatically reverses the path once you finished it, so you can directly survey the area in the other direction and therefore save time drawing the paths.)
- Walk slowly and in a steady speed
- Don't stop at Ground Truths, confirm them as you walk past
- Try to hold the phone naturally as you walk, your steps get detected and used as well.

Data Processing

1. Once the recordings for your building are uploaded, you are ready to turn the collected data into a radio map layer that can be used for localization.
2. To do this, head to my-us.indoo.rs, select your Application and Building and choose "SLAM".
3. Click "Start new job" to start our algorithms crunching your data into a map. Once finished, you can upload a new version of your building with just one click on the "Upload to cloud"-button next to your completed job.
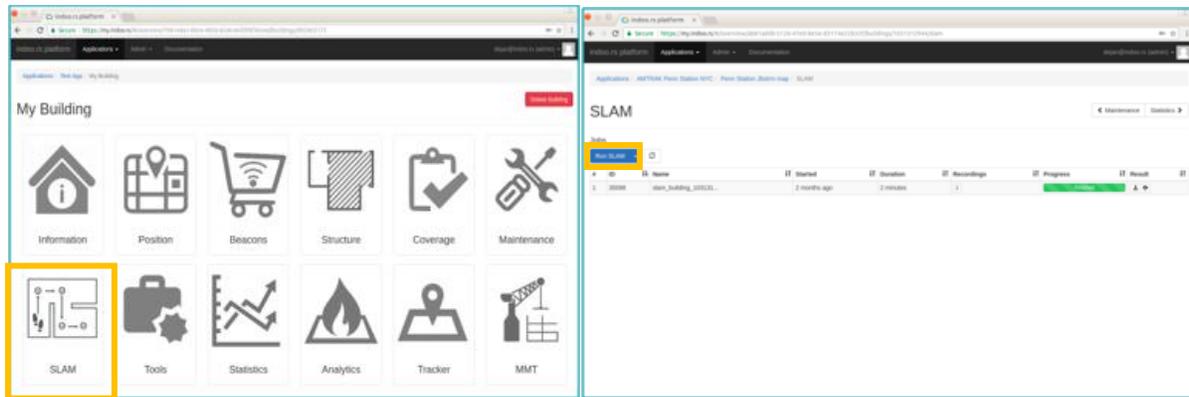
Configuring Indoor Positioning in ArcGIS Pro

Once the slam job is uploaded to the server you are ready to configure Indoor Positioning in ArcGIS Pro.

1. Navigate to the Geoprocessing pane and search for "Configure Indoor Positioning"
2. Use your Indoors Geodatabase as the Input workspace
3. Choose an encryption key to encrypt and decrypt values (Like a password)
4. Populate the API-Key field with the key from your application on my.indoo.rs
5. Populate the Building ID that links to the building with the completed slam job (You can find the Building ID on the info tab in your application on my-us.indoo.rs)
6. Hit run
7. Republish the MMPK
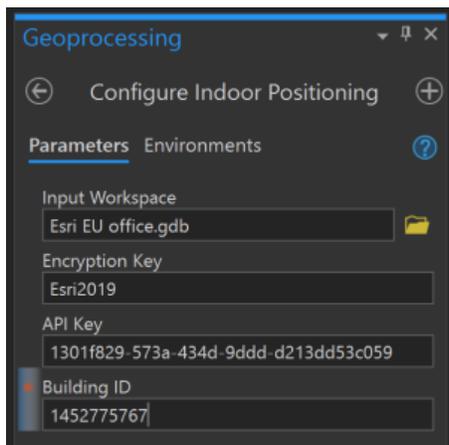
Your IPS is now ready to be tested with ArcGIS Indoors!