

# LEICA BLK ARC-UI

How to use v2.0.0



# LEICA BLK ARC-UI

AUTONOMOUS LASER SCANNING MODULE



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# LEICA BLK ARC-UI

AUTONOMOUS LASER SCANNING MODULE



## INTRODUCTION

BLK ARC, where ARC stands for Autonomous Reality Capture, is the first autonomous laser scanning module fully designed for integrations with robotic platforms. The autonomous journey of the BLK ARC begins with capturing 3D data in any area where a robotic carrier can go, and at the same time using this accurate laser scanning data for robot's navigation.

The first robotic integration of BLK ARC is with the Boston Dynamics SPOT robot. Users can simply plan automated scan path and BLK ARC will command the robot to scan whenever and wherever needed. BLK ARC can be easily integrated across many industries and that is why this device was designed for use on many different robotic platforms and carriers.

## GENERAL WORKFLOW FOR BLK ARC ON SPOT

1. Required 3<sup>rd</sup> party components:
  - a. Spot robot from Boston Dynamics
  - b. Spot Core from Boston Dynamics
  - a. There are 3 methods described how to manage networking with Spot and enable online connection for upload to HxDR. It can be done using 3<sup>rd</sup> party WiFi dongle plugged into Spot CORE or existing WiFi network in reach of robot and tablet with BLK ARC-UI or ethernet connection with docking station. Please refer to **Networking with Spot** chapter for more details.
2. Mount BLK ARC module on the Spot using dedicated accessories GAD126, GAD127 and GAD128
3. Mount GA03 on the Spot using dedicated accessory GAD130 (only for outdoor missions, see details in *overview on possible workflows*)
4. Install BLK ARC-UI on Spot Core using Portainer
5. Create an offline mission file in Cyclone 3DR software
6. Upload the mission file to BLK ARC-UI and complete the mission in the field



All required documentation can be downloaded from:

<https://myworld.leica-geosystems.com>

# LEICA BLK ARC-UI

## INSTALLATION OF BLK ARC-UI



### GENERAL INFORMATION

The installer can be downloaded from <https://myworld.leica-geosystems.com>  
Before starting the installation, make sure you have BLK ARC mounted on the robotic carrier properly.

For detailed instructions on how to mount BLK ARC on Spot robot check the **Leica BLK ARC and GAD126/GAD128 Installation Guides**. For detailed instructions on how to mount GA03 on Spot robot check the **Leica GA03 and GAD130 Installation Guide**. All documents are attached to accessories or available to download from <https://myworld.leica-geosystems.com>. It is always recommended to use the latest firmware of BLK ARC in a combination with the latest version of BLK ARC-UI.

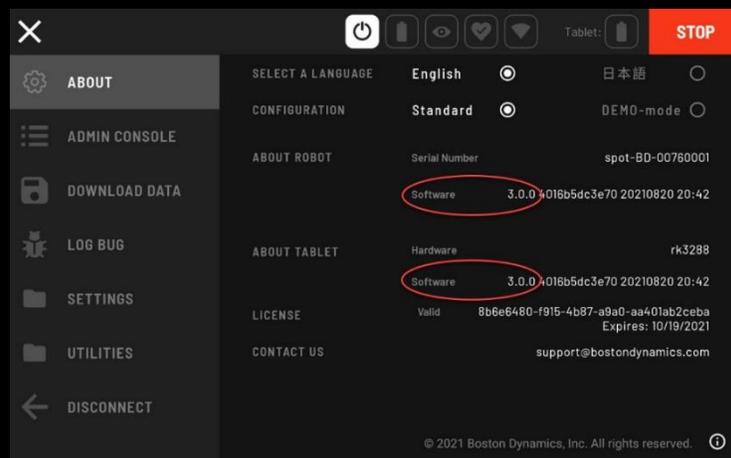
### SPOT VERSION CHECK

Required 3<sup>rd</sup> party components are Boston Dynamics Spot robot and Spot CORE.  
BLK ARC-UI is compatible with Spot v3.2.x. Make sure that your Spot, Spot CORE and Boston Dynamics Spot App are upgraded to version 3.2.x and Portainer version 2.1.1 or newer, before starting the installation of BLK ARC-UI.

### Check in the Spot App

On the Boston Dynamics controller (Spot App) open the **About** section and check if robot and tablet are running the same software versions compatible with BLK ARC-UI. Make sure that the Spot CORE has also a compatible version installed.

*Example:*



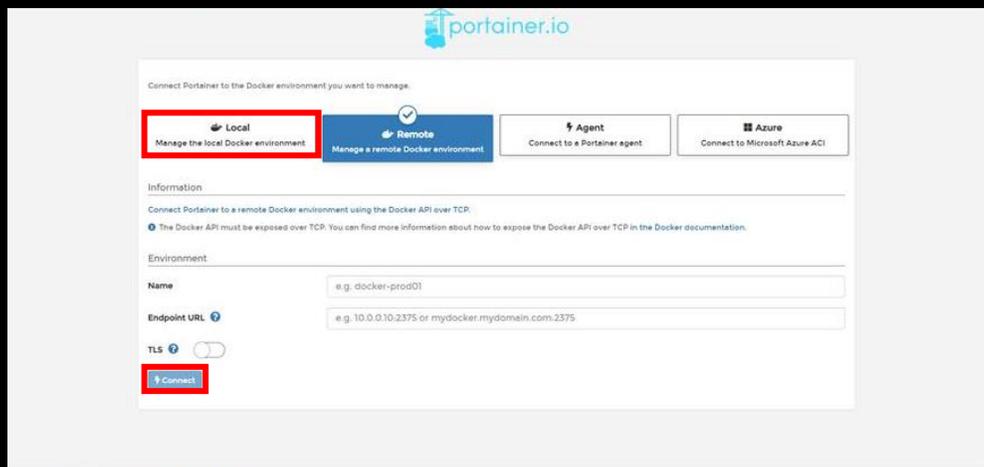
## PORTAINER ACCESS AND USER ACCOUNT

1. Extract the folder with installer. You should now have the following two files:
  - blkarc-ui\_v2.0.0\_xxx.tar
  - blkarc-ui\_v2.0.0\_xxx.yml
2. Connect your computer to the carrier. The easiest way is to connect directly to the robot's Wi-Fi access-point.

More information about the network-setup can be found in the documentation of Spot provided by Boston Dynamics.

3. Open your preferred browser and type this address:
  - <https://192.168.80.3:21900>
4. A security risk warning might appear. If you get this warning, click **Advanced...** and **Accept the Risk and Continue**
5. If you use Portainer for the first time, you will be asked to create an account. If so, create your account.

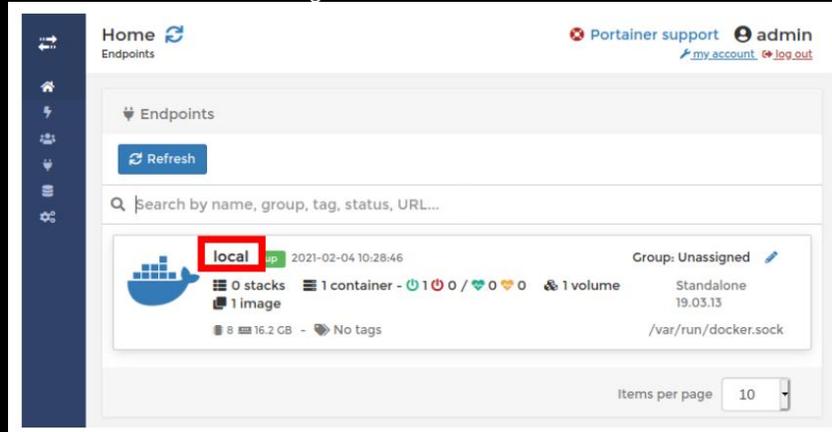
Additionally, after logging in, a screen will show up asking to connect to an environment. Select **Local** and confirm by selecting **Connect**



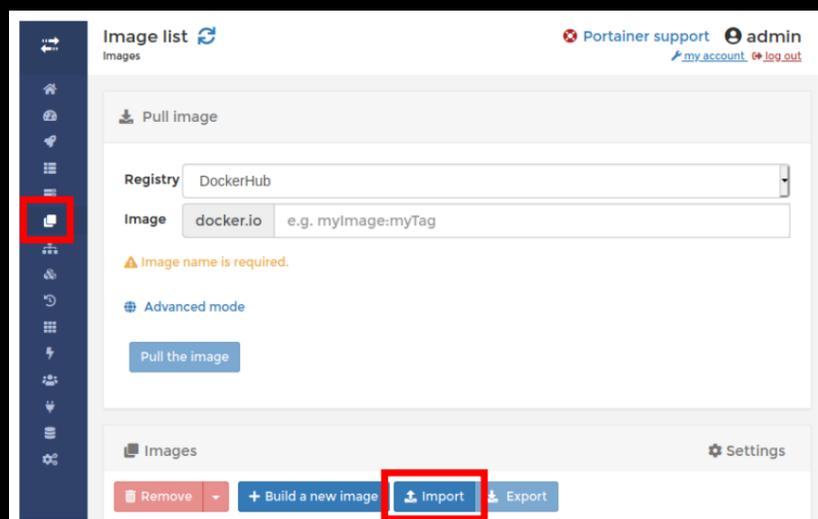
6. If you have used Portainer before, login with the account you have previously defined.

## DOCKER IMAGE IMPORT

1. After successfully logging in in the previous section, you should see the following screen. Click on **local** marked on the image



2. On the next screen navigate to Images on the left side of the screen. In the screen which appears now click on **Import**

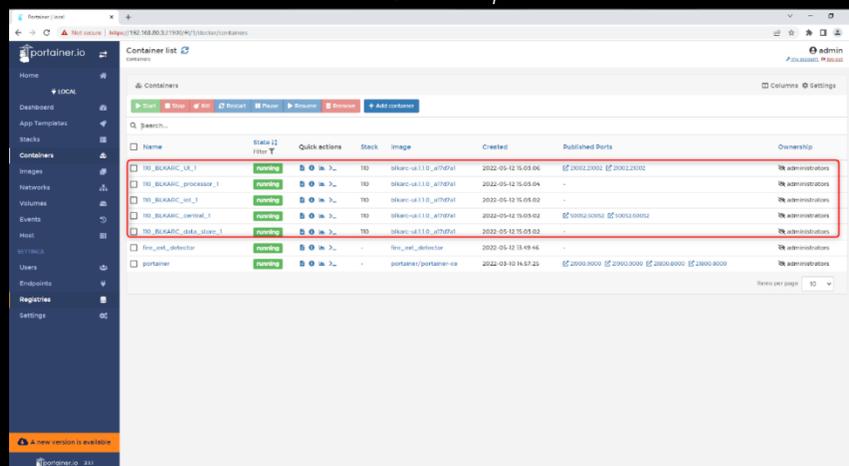


3. Under **Select file** select the file **blkarc-ui\_v2.0.0\_xxx.tar**, which you downloaded previously and click on **Upload**

**IMPORTANT:** Please note that the upload might take several minutes. Do not interrupt this process by clicking anywhere else. A successful upload will be indicated by a small pop-up and the progress wheel of the Upload button will go away.

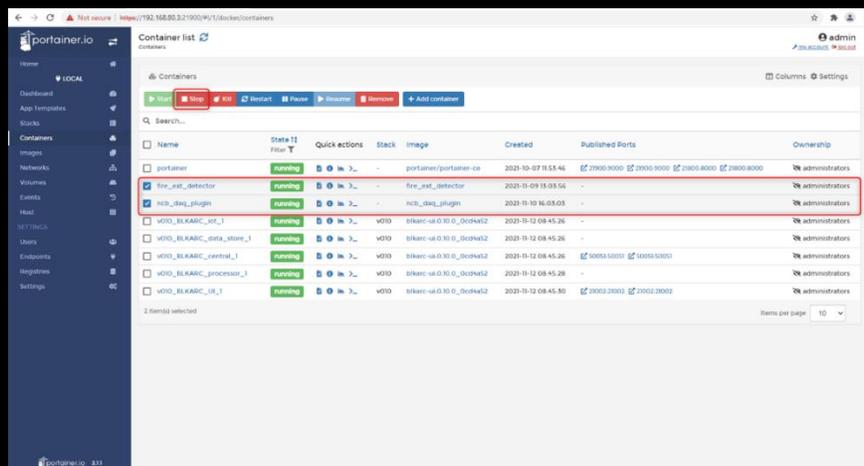
# STACK CONFIGURATION

- On the left side of the screen navigate to **Stacks**. In the screen which appears now click on **+Add stack**
  - Enter the name **blkarc-ui** (the name must consist of low case alphanumeric characters, '-' or '\_')
  - Then select **Upload – Upload from your computer**
  - In the bottom press **Select file** and select the file **blkarc-ui\_v2.0.0\_xxx.yml**, which was downloaded previously
  - In the very bottom of the page, select **Deploy the stack**
- All stacks of BLK ARC-UI should now appear in the Stack list on the Stacks page
- Example:*



**IMPORTANT:** In case the Stack cannot be deployed and Portainer gives you an error, open Containers panel, select two containers below and **Stop** them:

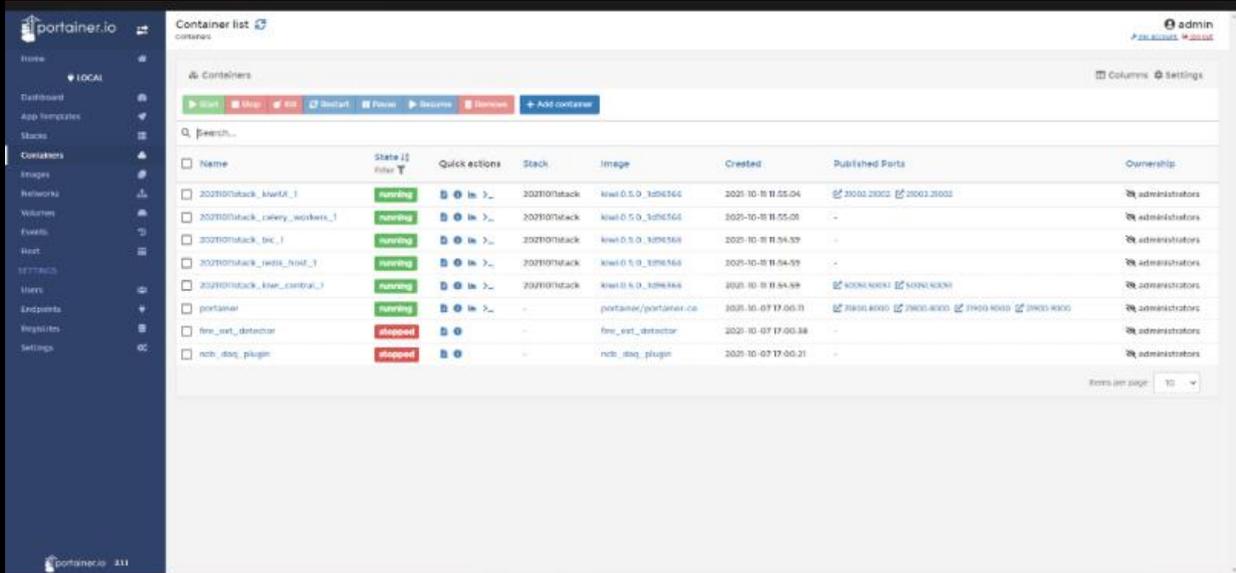
- Fire\_ext\_detector
- Ncb\_daq\_plugin



It might also be required to delete the failed containers manually before trying again.

## CONTAINERS CHECK

Once the stack is properly configured, on the left side of the screen navigate to **Containers** and check if the following containers are running, and at the same time the following containers are stopped as in the picture:



Name	State	Quick actions	Stack	Image	Created	Published Ports	Ownership
2021010stack_blkarc_1	running	[stop] [refresh] [restart] [logs]	2021010stack	k8s:0.5.0_329c565	2021-10-15 11:55:04	2002:2002   2002:2002	administrators
2021010stack_cademy_workshop_1	running	[stop] [refresh] [restart] [logs]	2021010stack	k8s:0.5.0_329c565	2021-10-15 11:55:05	-	administrators
2021010stack_blk_1	running	[stop] [refresh] [restart] [logs]	2021010stack	k8s:0.5.0_329c565	2021-10-15 11:54:59	-	administrators
2021010stack_nginx_proxy_1	running	[stop] [refresh] [restart] [logs]	2021010stack	k8s:0.5.0_329c565	2021-10-15 11:54:59	-	administrators
2021010stack_k8s_central_1	running	[stop] [refresh] [restart] [logs]	2021010stack	k8s:0.5.0_329c565	2021-10-15 11:54:59	4000:4000   4000:4000	administrators
portainer	running	[stop] [refresh] [restart] [logs]	-	portainer/portainer-ce	2021-10-07 17:00:11	9000:9000   9000:9000   9000:9000   9000:9000	administrators
fire_ext_detector	stopped	[start] [logs]	-	fire_ext_detector	2021-10-07 17:00:18	-	administrators
web_debug_plugin	stopped	[start] [logs]	-	web_debug_plugin	2021-10-07 17:00:21	-	administrators

## DE-INSTALLATION OF BLK ARC-UI

1. To de-install BLK ARC-UI connect your computer to the carrier and access Portainer in the same way as during installation
2. Navigate to **local**
3. On the left side of the screen go to **Stacks**. Select **BLK ARC-UI** and **Delete**
4. On the left side of the screen go to **Images**. Select **blkarc-ui\_v2.0.0\_xxx.tar** and **Delete**

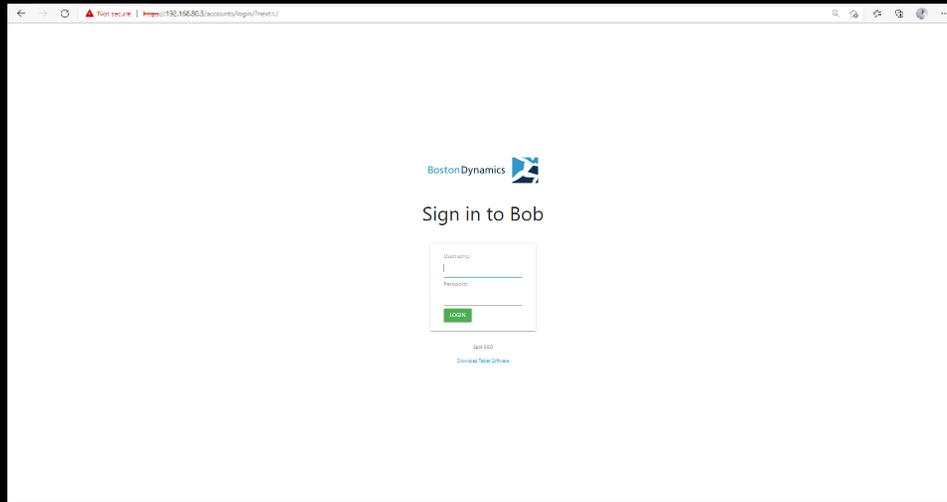
## DE-INSTALLATION OF BLK ARC-UI

1. In order to upgrade to new version of BLK ARC-UI please de-install the old one and follow the steps on how to install new version starting with an empty setup.

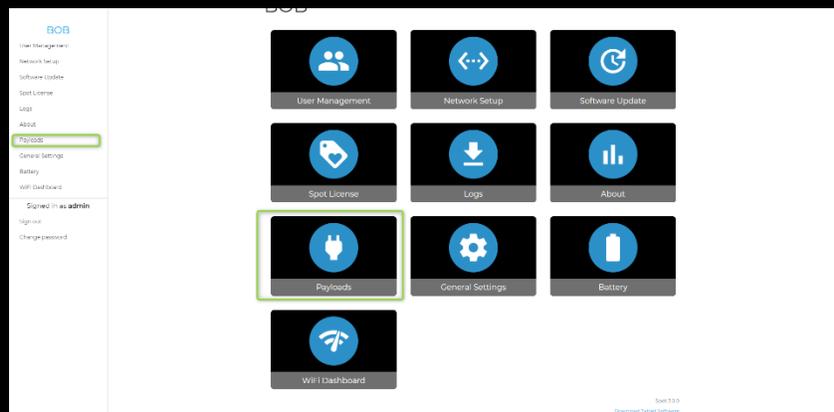
## PAYLOAD AUTHORIZATION

To properly register the payloads, after successful installation of BLK ARC-UI, it is recommended to follow the steps below:

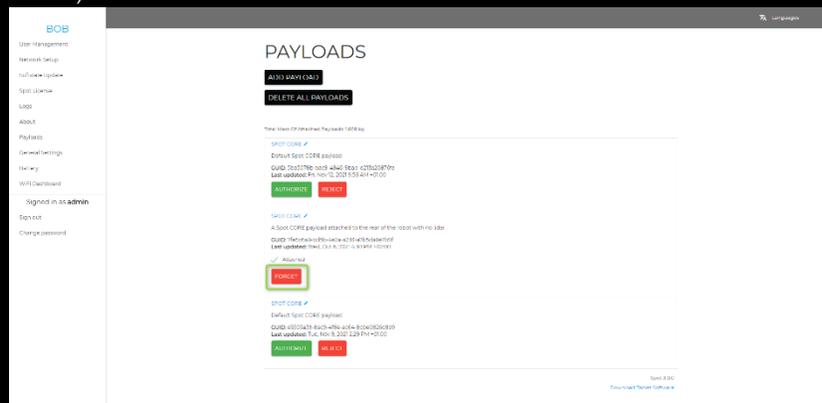
1. Access Admin Console via <https://192.168.80.3>



2. Go to Payloads



3. Forget/Reject all existing payloads (including older payloads for BLK ARC or UAX Connect or Spot CORE)



4. Restart Spot
5. After reboot, the latest payloads will appear. Access Admin console again, and Authorize new payloads for BLK ARC and Spot CORE

Not secure | https://192.168.80.3/payloads

ALICE

- User Management
- Network Setup
- Software Update
- Spot License
- Logs
- About
- Payloads
- General Settings
- Battery
- WiFi Dashboard

Signed in as **admin**

Sign out

Change password

## PAYLOADS

**ADD PAYLOAD**

**DELETE ALL PAYLOADS**

Total Mass Of Attached Payloads: 0.000 kg

[LEICA BLK ARC](#) ✓

A BLK ARC mounted on Spot.

**GUID:** 85475fd3-f24e-404d-bc5e-92147ce18256  
**Last updated:** Fri, Nov 12, 2021 10:53 AM +01:00

**AUTHORIZE** **REJECT**

[SPOT CORE](#) ✓

Default Spot CORE payload

**GUID:** e5505a39-8ac9-4f8e-ac64-8cbe0826c8b9  
**Last updated:** Fri, Nov 12, 2021 11:01 AM +01:00

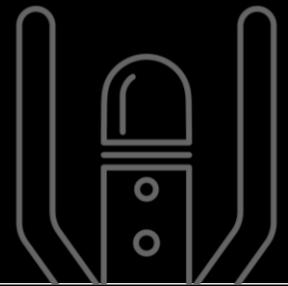
**AUTHORIZE** **REJECT**

Spot 3.0.0

[Download Tablet Software](#)

# LEICA BLK ARC-UI

NETWORKING WITH SPOT



## GENERAL INFORMATION

This chapter will guide you through the required steps to manage networking with your Spot robot.

There are different options to connect Spot CORE to the internet, the following table should give you a quick overview of the available options:

WiFi Dongle	Spot's WiFi	Spot's Ethernet
<p>A USB-WiFi-Dongle is directly inserted into Spot CORE. This Dongle is used to connect to a pre-existing WiFi-Network, which provides the Internet-Access.</p> <p>Controlling Spot doesn't depend on an external network.</p> <p>Spot still hosts its own WiFi, which can be used to access BLK ARC-UI through the well-known IP 192.168.80.3.</p> <p>Network-Speed depends a lot on the WiFi-Dongle and drivers used.</p> <p>3rd party WiFi dongle is required.</p>	<p>Spot's own WiFi is configured in Client-Mode, which means that it connects to a pre-existing WiFi-Network on the outside.</p> <p>No additional 3rd party hardware is necessary.</p> <p>It is possible to control Spot using BLK ARC-UI from wherever you have access to this WiFi Network.</p> <p>Knowledge of the WiFi-network required, in order to setup the connection correctly.</p> <p>Depends on a stable external WiFi.</p> <p>A new IP has to be used to connect to BLK ARC-UI (and all other applications on Spot (Cockpit, Portainer, ...))</p>	<p>Spot and the docking-station each have an Ethernet-Port, which can be used to connect Spot to a preexisting network by cable.</p> <p>Fastest possible upload-speeds.</p> <p>Spot still hosts its own WiFi, which can be used to access BLK ARC-UI through the well-known IP 192.168.80.3.</p> <p>Upload is only possible while Spot is docked or while having an ethernet cable plugged in. This means no upload during operation.</p> <p>Knowledge of Ethernet-Network required in order to setup the connection correctly.</p>

## TOOLS

There are several tools used throughout this guide to set-up the network correctly. This section should give you a brief overview. Scroll up to this section whenever one of the tools is mentioned in the sections below.

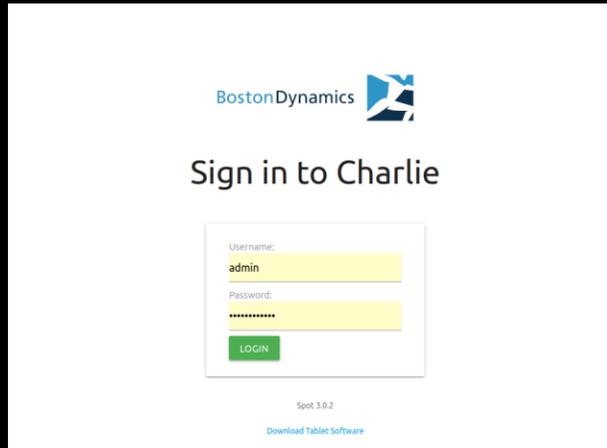
### 1. Spot's Admin Console

This is a browser-based interface running on Spot (directly on Spot, not on Spot CORE). It provides access to all necessary settings on Spot, handles Spot's networking, lets you download logs and offers much more. In this guide we will use the **Network Setup** page.

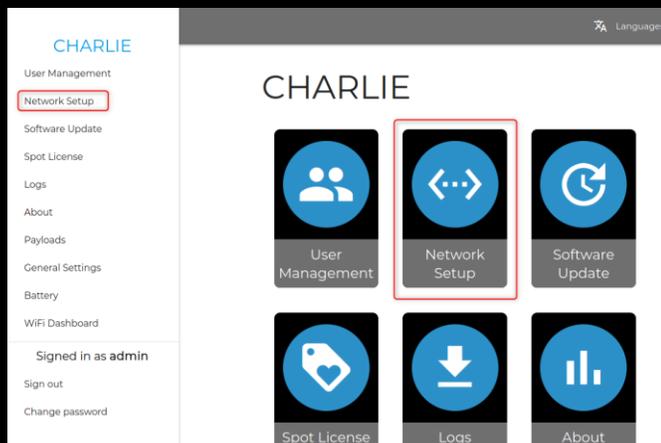
More information on the Admin Console can be found in the [documentation provided by Boston Dynamics](#).

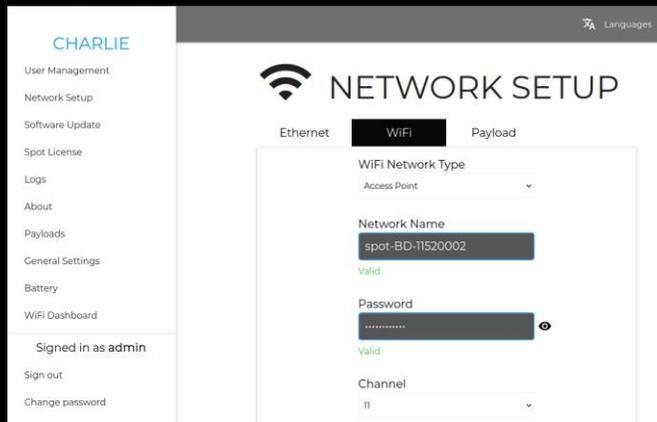
## Steps to reach the Network-Page of the Admin Console

1. You can reach the Admin Console by connecting your computer to Spot and entering the corresponding IP-Address without any Port
  - a. If you are connected to Spot by using Spot's WiFi network (spot-BD-xxxxxxx), this IP should be <https://192.168.80.3>



- b. In this guide you will learn about connecting Spot with different networks. Based on these networks the IP used to access the Admin-Console will be different. Please use the IP introduced by the section dealing with your current connection type
2. The first time you try to access the **Admin Console** it might be that the browser asks you if you trust the page. Confirm the risk knowledge and proceed to the page
  3. Login using the **admin** account of your Spot. The corresponding password was given to you with the delivery of the robot. The default one is written in the battery-compartment of Spot.
  4. Click on **Network Setup**





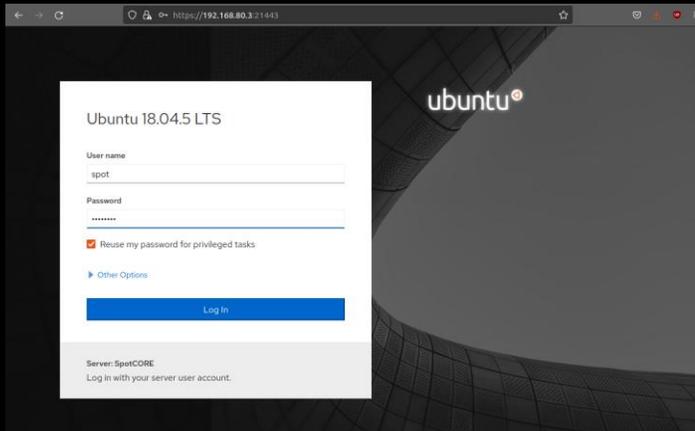
## 2. Cockpit

This is a browser-based interface running on Spot CORE (not on Spot itself). It can be used to change settings on Spot CORE, offers networking-options, Logs, and has a terminal to directly access Spot CORE without SSH. In this guide we will use the **Networking** page.

More information on Cockpit can be found in the [documentation provided by Boston Dynamics](#).

### Steps to reach the Networking-Page on Cockpit

1. Make sure Spot is running and Spot CORE is connected and authenticated on the rear payload-port of Spot
2. Reach **Cockpit** by connecting your computer to Spot and entering the corresponding IP-Address on port **21443**
  - a. When connected to Spot by using Spot's WiFi network (spot-BD-xxxxxxx), this IP should be <https://192.168.80.3:21443>
  - b. In this guide you will learn about connecting Spot with different networks. Based on these networks the IP used to access the Admin Console will be different. Please use the IP introduced by the section dealing with your current connection type
3. The first time you try to access **Cockpit** it might be that the browser asks you if you trust the page. Confirm the risk knowledge and proceed to the page
4. Login using the credentials of your Spot CORE. Boston Dynamics provided these credentials when you got your Spot CORE delivered

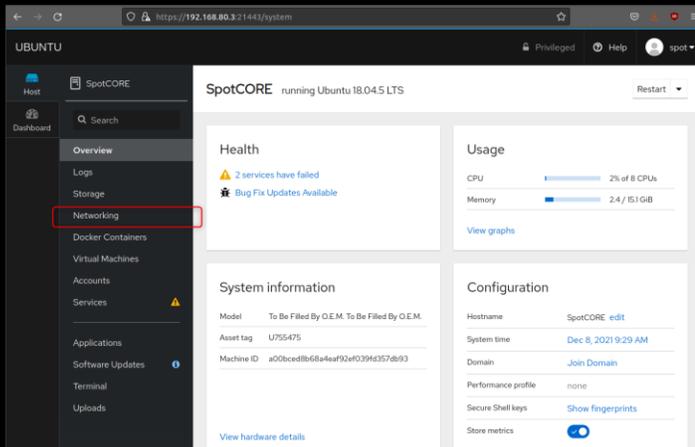


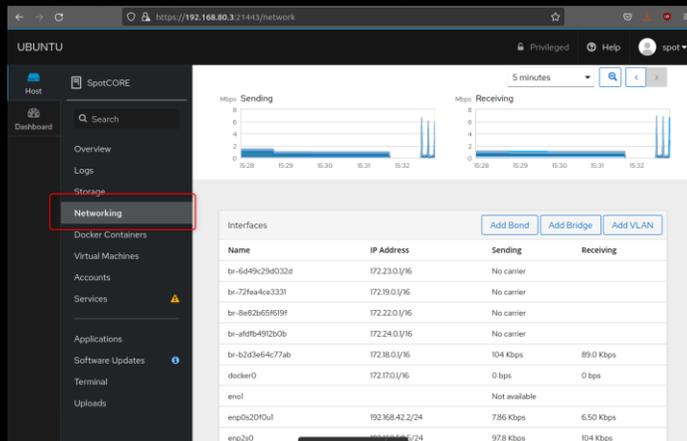
Usually when you login for the first time or if you performed a Spot CORE's factory reset, default credentials are:

Username: *spot*

Password: *password*

5. Click on **Networking**





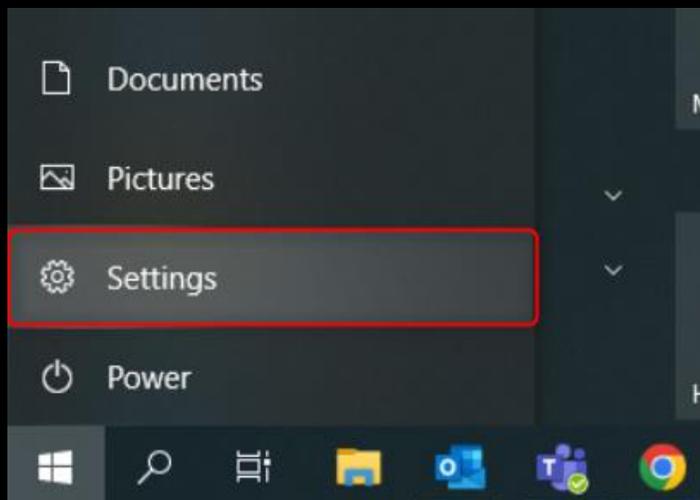
### 3. Find the Default Gateway / Route

To correctly route the internet traffic from Spot to the outside world, Spot needs to know about the **Default Gateway (Default Route)** of the network. This is the IP of the device on the network which is connected to the internet. For a WiFi-Network this would be the WiFi-Router's address. This section provides you with an overview on how to get the Default Gateway for WiFi- and Ethernet-Connections on Windows.

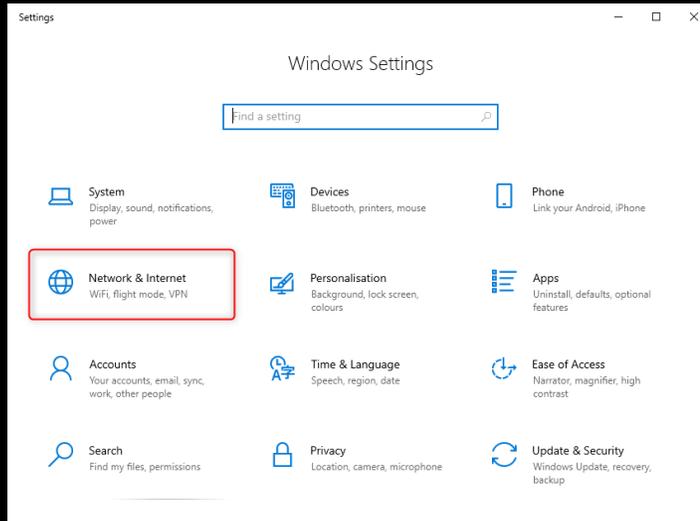
#### a. WiFi-Network on Windows

Instructions on how to find your WiFi-Network's Default Gateway on Windows

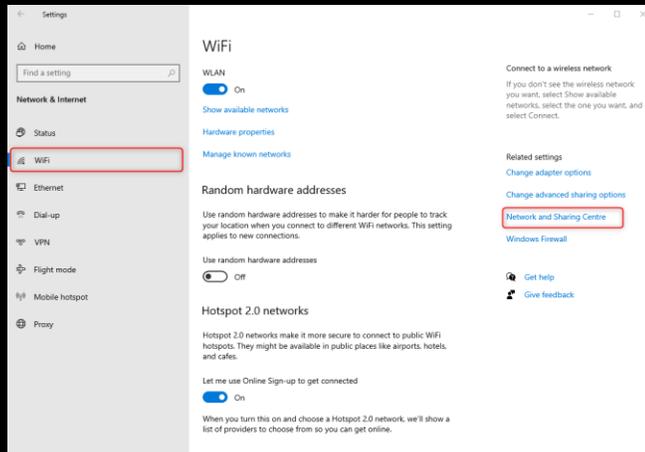
1. Open the **Settings** (Windows icon → Settings)



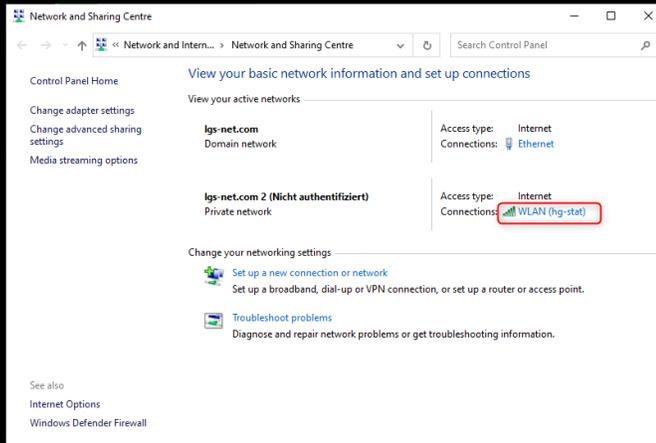
## 2. Go to Network & Internet page



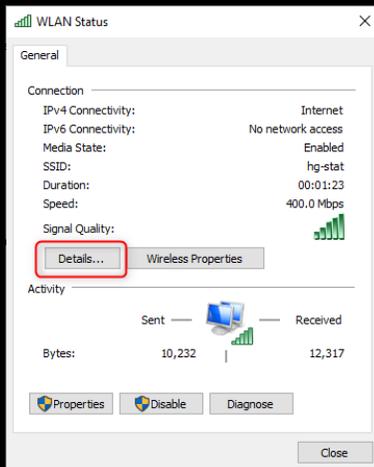
## 3. Go to the WiFi page and open the Network and Sharing Center



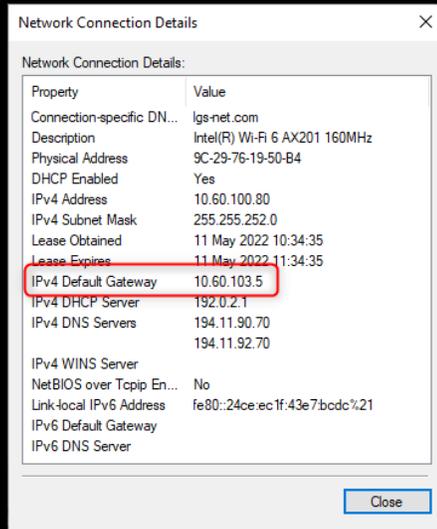
#### 4. Select your WiFi-Connection



#### 5. Click on Details...



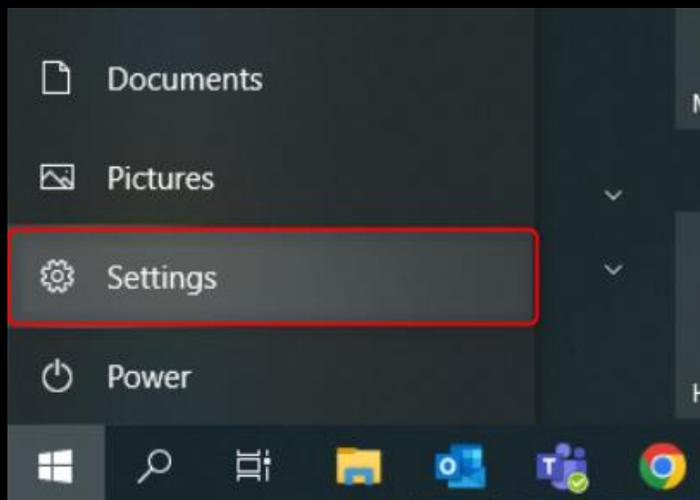
## 6. Find IPv4 Default Gateway



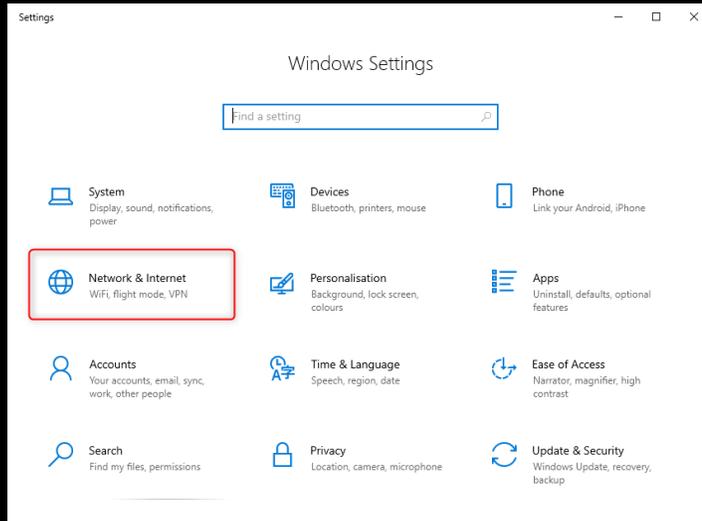
## b. Ethernet-Network on Windows

Instructions on how to find your Ethernet-Network's Default Gateway on Windows

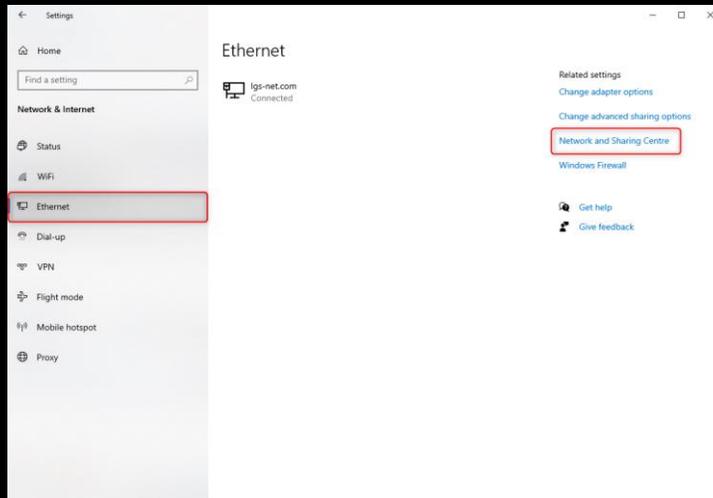
1. Open the **Settings** (Windows → Settings)



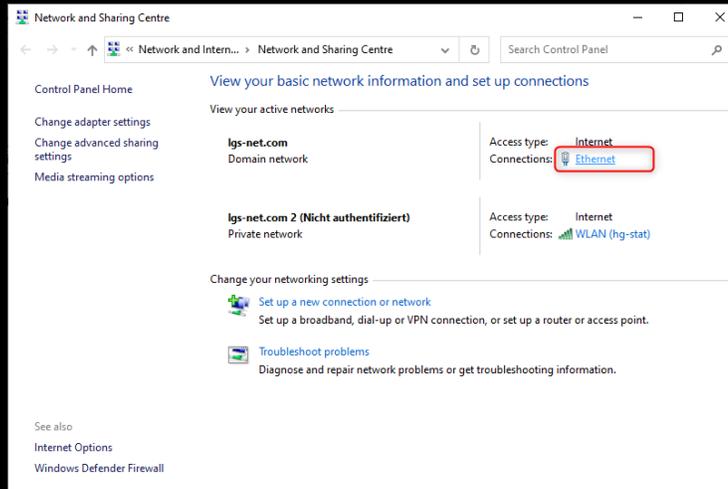
2. Go to **Network & Internet** page



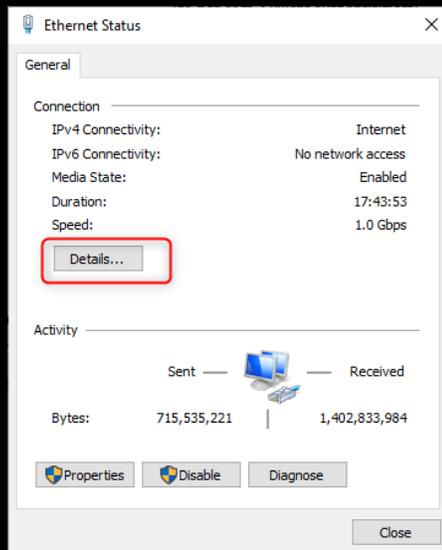
3. Go to the **Ethernet** page and open the **Network and Sharing Center**



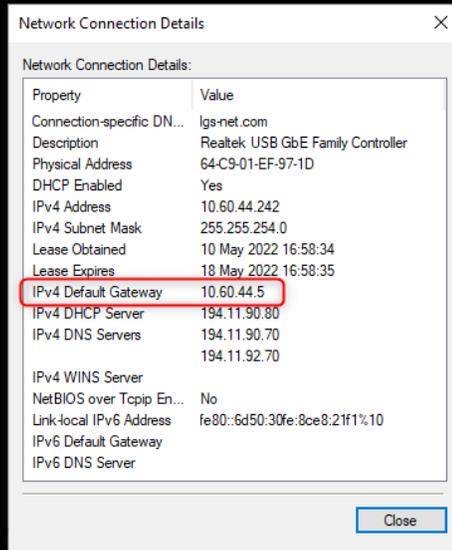
#### 4. Select your Ethernet-Connection



#### 5. Click on Details...



## 6. Find IPv4 Default Gateway



## OPTION 1: SETUP INTERNET CONNECTIVITY BY USING A WIFI USB-DONGLE

To enable Internet connection on Spot CORE using this method, it is necessary to use an external **WiFi USB-Dongle** that must be connected to the Spot CORE.

Examples of recommended WiFi USB-Dongles

- TP-Link TL-WN823N
- TP-Link TL-WN725N

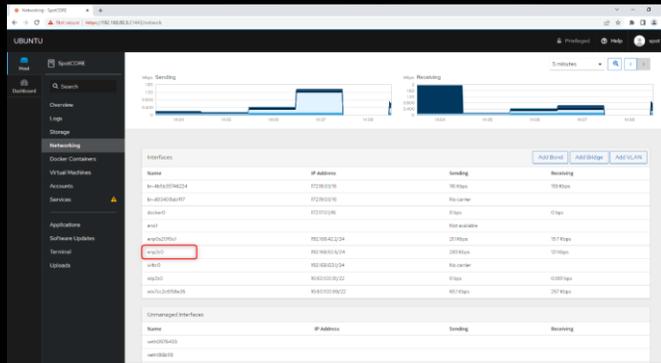
Although a suitable WiFi dongle has been used, the maximum WiFi speed may still not be achievable with the pre-installed driver on the Spot CORE.

**Important:** To setup the network, it is required to do a one-time configuration through the Boston Dynamics Cockpit and enable the network connection on Spot CORE. Please refer to this [link](#) for detailed instructions.

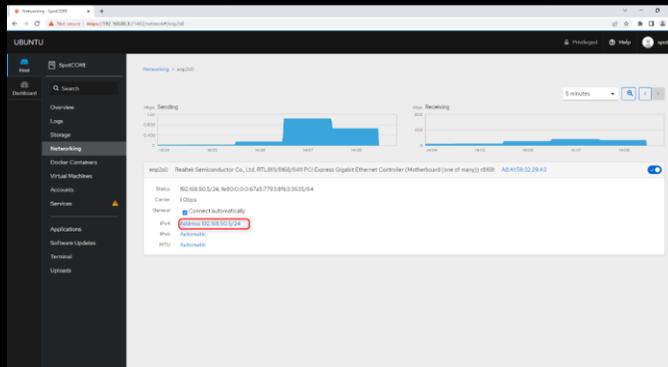
### Instructions on how to setup Internet Connectivity by using a USB-Dongle

1. Plug the USB-Dongle into one of the USB-Ports of Spot CORE. Make sure the dongle is connected to the Spot CORE before starting the Spot robot
2. Start Spot
3. Make sure there is no Gateway defined in **Cockpit**:
  - a. Go to cockpit's **Network** page

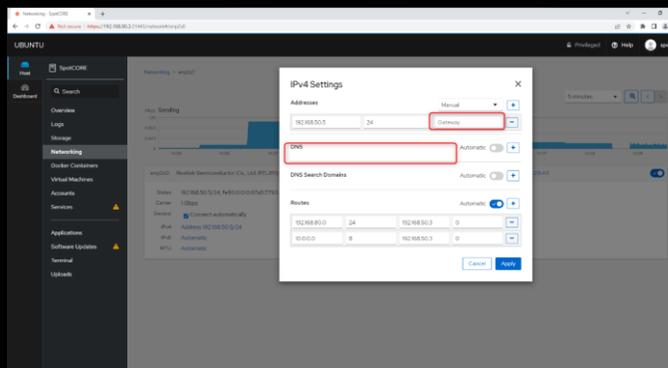
b. On the networking page click on the Interface **enp2s0**



c. Click on the text next to **IPv4**

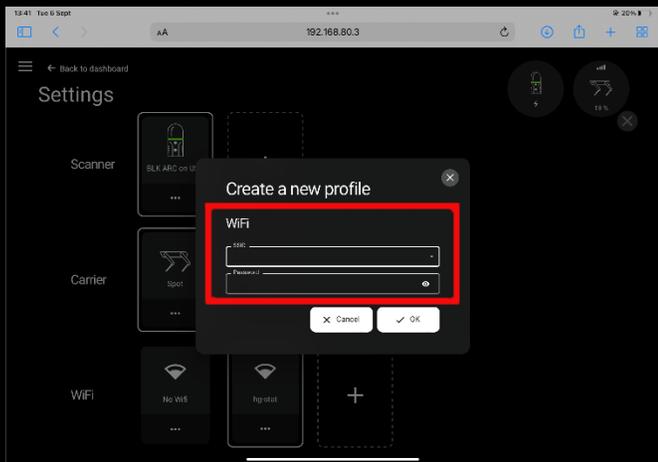
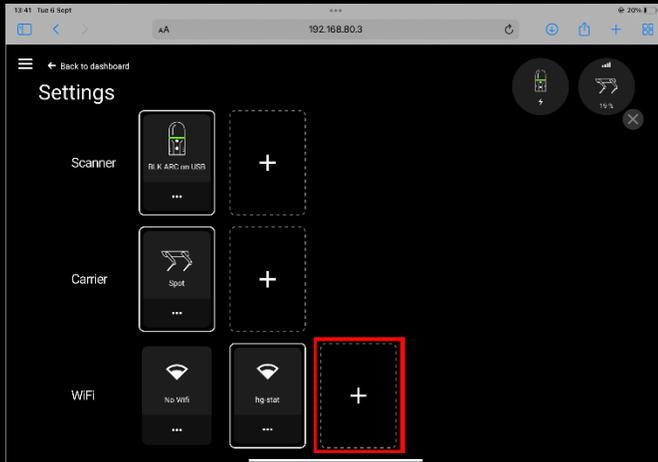


d. Make sure there is no entry in the field **Gateway** and no entry in **DNS**. Delete if something is in there. The window should look like the picture below

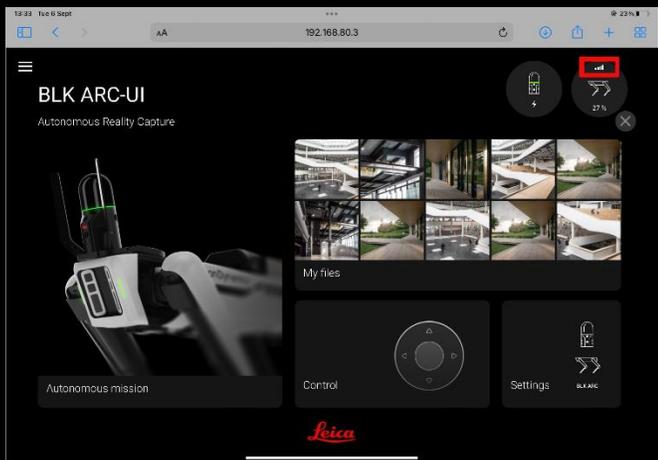


e. Click on **Apply** to save these settings

4. Go to BLK ARC-UI, select Settings and **press add on WiFi**. A pop-up window will open and it will be possible to select the **SSID** and write **Password** of your WiFi-Network



- Once connection is established the icon should appear above Spot icon in the top right corner.



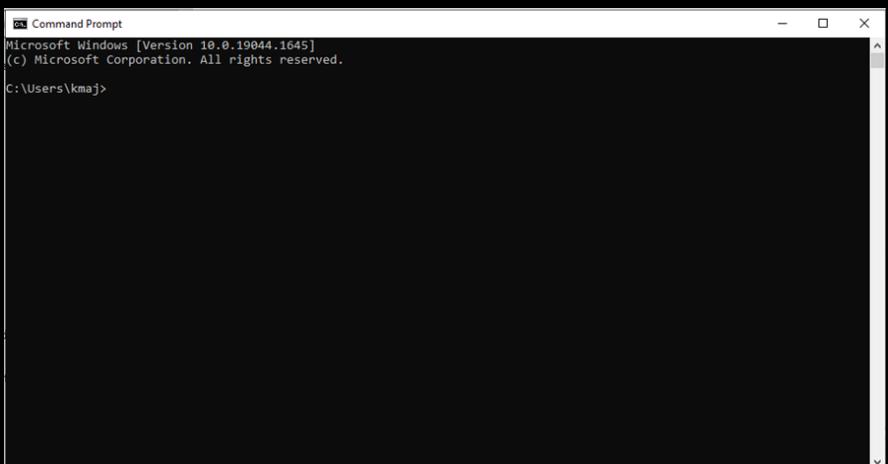
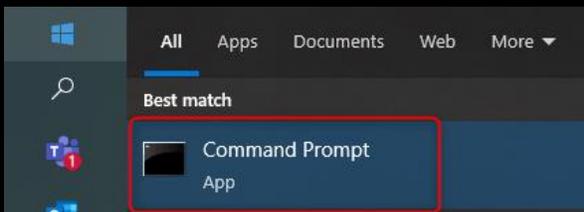
- Enjoy upload of your files to HxD R!

## OPTION 2: SETUP INTERNET CONNECTIVITY BY USING SPOT'S WIFI

**WARNING:** Changing the WiFi-Connection to Client-Mode will stop Spot's own WiFi-Network. You will only be able to access Spot on the new IP-address you assign in this section from within the same network. It might be wise to first look for a backup-connection to connect to spot, like plugging in an Ethernet cable between your laptop and Spot.

### Instructions on how to setup Internet Connectivity by using Spot's WiFi

1. Find a unique IP-address to use on your WiFi-Network:
  - a. Search your WiFi-Network's **Default Gateway**. Remember it, as you will need it again further below
  - b. Select an IP-Address for Spot:
    - i. This address needs to be on the same domain as your **Default Gateway**. This means that the first three blocks of numbers in the IP need to be the same
    - ii. The fourth block needs to be unique in your network. It is recommended to choose a rather high number between 75 and 250. Let's take **99** as an example
    - iii. For a sample **Default Gateway** of **10.62.254.2** your selected IP would now be **10.62.254.99**
    - iv. Check that there is no device on this IP:
      1. Connect your computer to the WiFi-Network you later want to connect Spot to
      2. Open a terminal (search for CMD under windows)



3. Ping the IP-Address you selected and make sure there is no reply (for example: ping 10.62.254.99)  
If no device is on this IP, you should get an output like **Destination host unreachable**

```

Microsoft Windows [Version 10.0.19044.1645]
(c) Microsoft Corporation. All rights reserved.

C:\Users\kmaj>ping 10.60.103.99

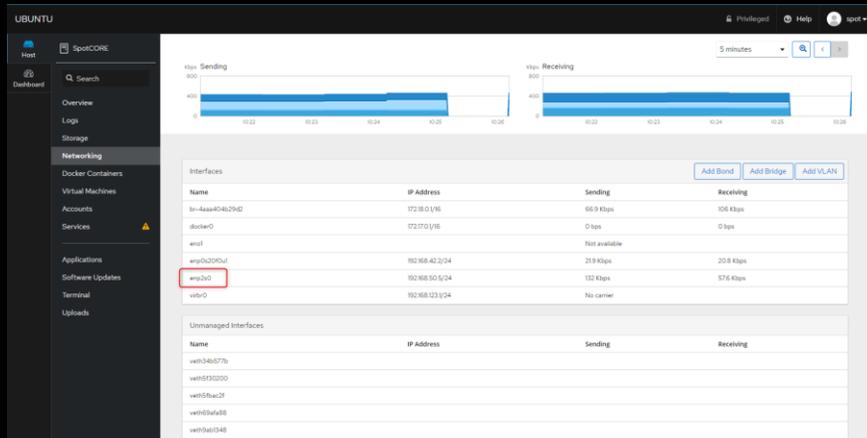
Pinging 10.60.103.99 with 32 bytes of data:
Reply from 10.60.100.35: Destination host unreachable.
Reply from 10.60.96.200: Destination host unreachable.
Reply from 10.60.96.200: Destination host unreachable.
Reply from 10.60.96.200: Destination host unreachable.

Ping statistics for 10.60.103.99:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

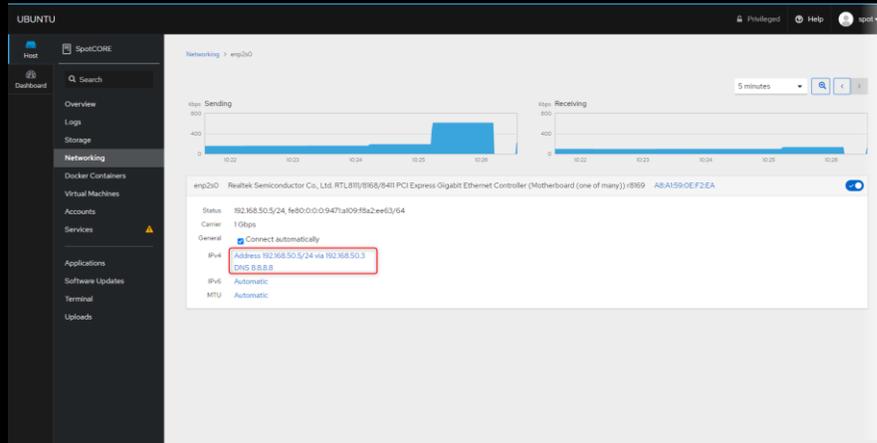
C:\Users\kmaj>

```

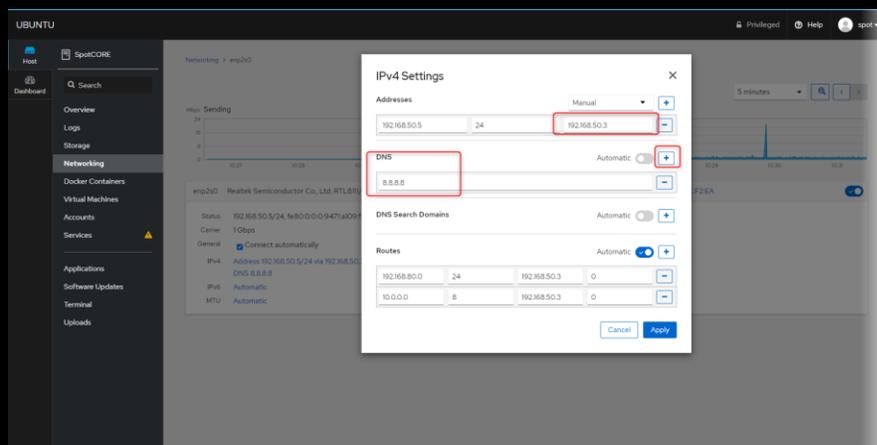
4. **Important:** Ideally you contact your network administrator and ask him to assign a fixed IP-Address for Spot directly on your router! This would be the proper way!
2. Remove the WiFi-Dongle if it was still plugged into Spot CORE
  3. Connect your computer to Spot's WiFi (spot-BD-xxxxxxx) or the network currently used to connect to Spot
  4. Setup the Gateway on Spot CORE in order to route internet-traffic from Spot CORE to Spot:
    - a. Go to Cockpit's **Network** page
    - b. On the networking page click on the Interface **enp2s0**



- c. Click on the text next to **IPv4** (text might look different)

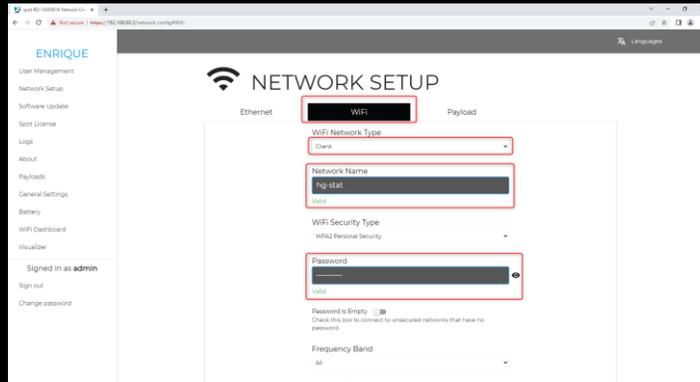


- d. Write **192.168.50.3** into the **Gateway**. Click the **+** symbol under **DNS** to add a new entry. Write **8.8.8.8** into the text-field

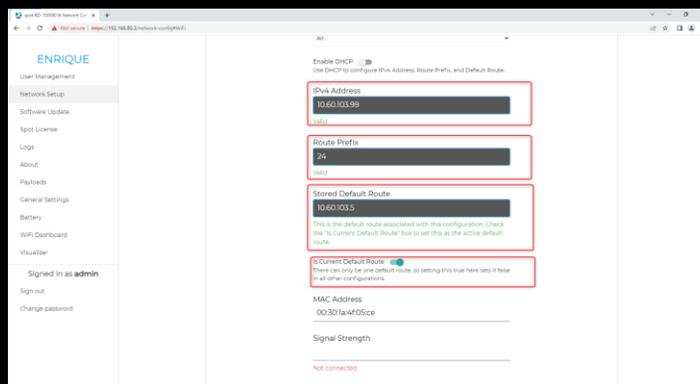


- e. Click on **Apply** to save these settings
5. Change the WiFi-Network on Spot's Admin Console:
- Go to the **Network Setup** page on Spot's Admin Console.
  - Go to the **WiFi** tab
  - Change the **WiFi Network Type** from **Access Point** to **Client**
  - Enter the name of your WiFi-Network under **Network Name**

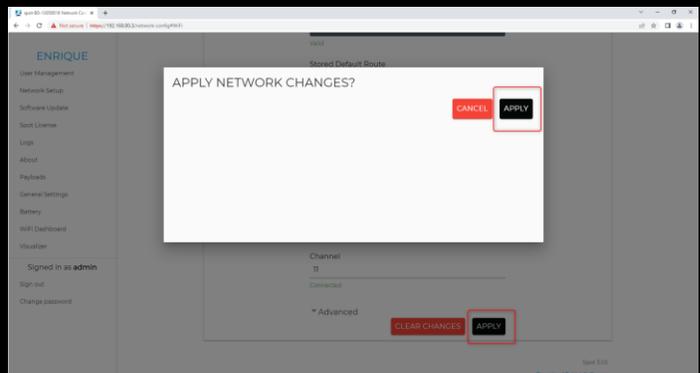
- e. Enter the Password under **Password**



- f. Enter the IP-Address you chose in the beginning of this section under **IPv4 Address**  
g. Enter **24** under **Route Prefix**. Depending on your network this could also be a different number. Please ask your network administrator  
h. Enter the **Default Gateway** under **Stored Default Route**  
i. Slide the lever to specify this connection as your Default Route under **Is Current Default Route**

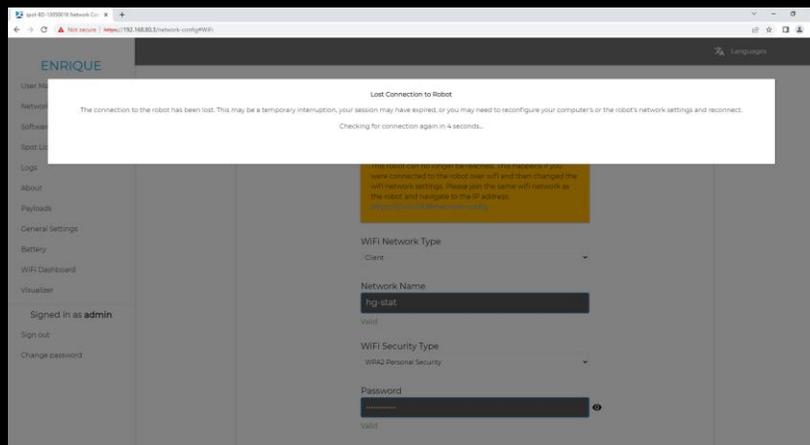
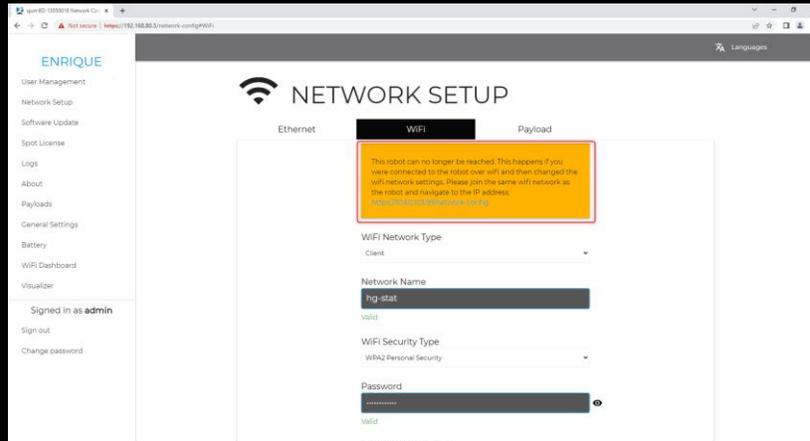


- j. Apply the settings by pressing on **Apply**



If you have some issues with applying these settings, you should try to log out and log in.

6. Check that everything works:
  - a. Wait for ~1 minute in order to give Spot time to connect to the network. The previous page will no more be reachable and you should have lost the WiFi-Connection to Spot, as Spot has changed to Client-Mode



- b. Connect your computer to the same network you specified for Spot
- c. You should now be able to reach the **Admin Console** by entering the **IPv4-Address** you specified further above (for example <https://10.62.254.99>)
- d. You should be able to reach **BLK ARC-UI** by additionally entering the port **21002** (for example <http://10.62.254.99:21002> (http, not https))
- e. You reach **Portainer** under port **21900** (for example <https://10.62.254.99:21900>)
- f. You reach **Cockpit** under port **21443** (for example <https://10.62.254.99:21443>)
- g. And finally you should be able to upload to HxDR from BLK ARC-UI

### Instructions on how to revert Internet Connectivity from using Spot's WiFi (change WiFi back to Access-Mode)

1. Make sure there is no Gateway defined in Cockpit:

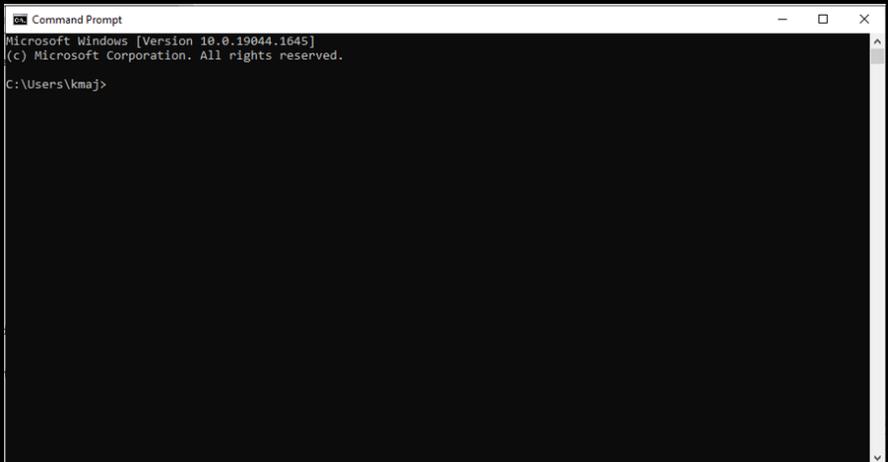
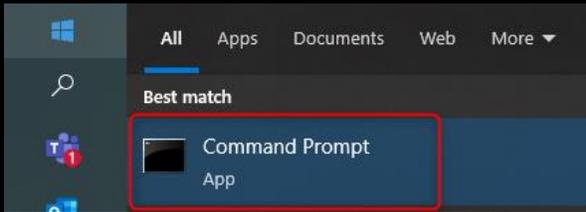
- a. Go to Cockpit's **Network** page (as described above, using the IP defined above, for example <https://10.62.254.99:21443>)
- b. On the networking page click on the Interface **enp2s0**
- c. Click on the text next to **IPv4**
- d. Make sure there is no entry in the field **Gateway** and no entry in **DNS**. Delete if something is in there
- e. Click on **Apply** to save these settings
2. Change the networking in the **Admin Console** back to Access-Mode:
  - a. Go to the **Network Setup** page on Spot's Admin Console (as described above, for example <https://10.62.254.99>)
  - b. Go to the **WiFi** tab
  - c. Change the **WiFi Network Type** from **Client** to **Access Point**
  - d. Apply the settings by pressing on **Apply**
  - e. Wait a minute to allow Spot to reconfigure its WiFi and then connect to Spot as usual:
    - i. Connect to Spot's WiFi
    - ii. For example access <https://192.168.80.3> to get to the **Admin Console**

## OPTION 3: SETUP INTERNET CONNECTIVITY BY SPOT'S ETHERNET

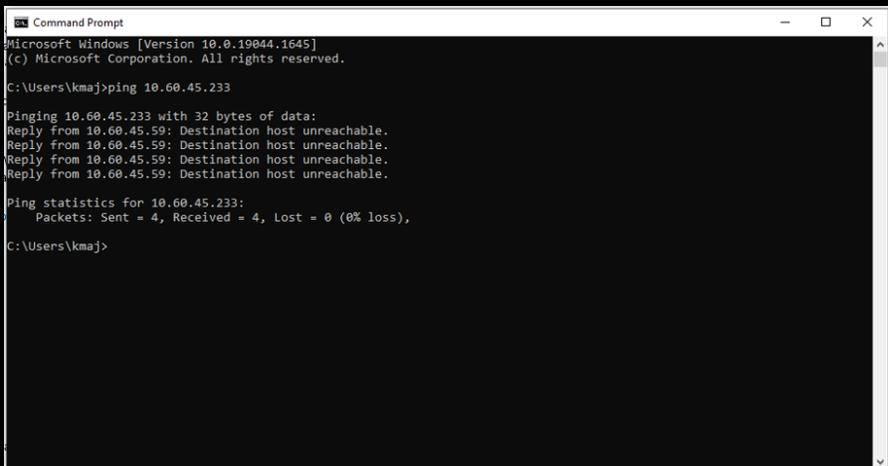
### Instructions on how to setup Internet Connectivity by using Spot's Ethernet

1. Find a unique IP-address to use on your Ethernet-Network:
  - a. Search your Ethernet-Network's **Default Gateway**. Remember it, as you will need it again further below.
  - b. Select an IP-Address for Spot:
    - i. This address needs to be on the same domain as your **Default Gateway**
    - ii. This means that the first three blocks of numbers in the IP need to be the same.
    - iii. The fourth block needs to be unique in your network. It is recommended to choose a rather high number between 75 and 250. Let's take **233** as an example.
    - iv. For a sample **Default Gateway** of **10.62.80.70** your selected IP would now be **10.62.80.233**
    - v. Check that there is no device on this IP:
      1. Connect your computer to the Ethernet-Network you later want to connect Spot to

2. Open a terminal (search for CMD under windows)

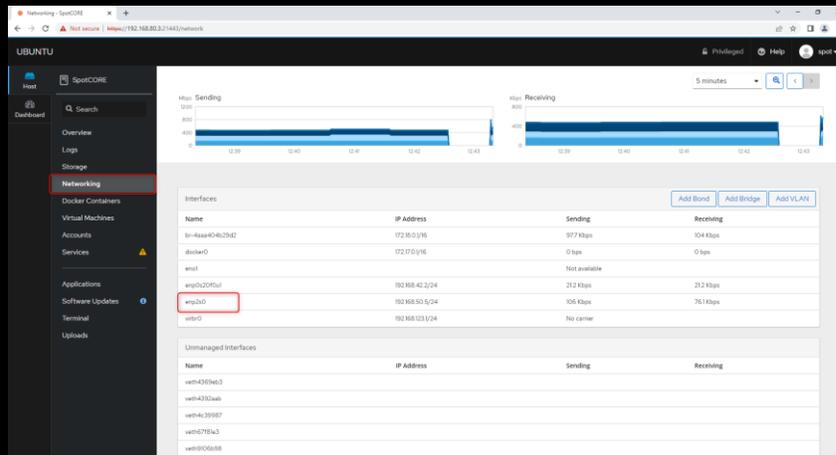


3. Ping the IP-Address you selected and make sure there is no reply. (for example: `ping 10.62.80.233`)  
If no device is on this IP, you should get an output like **Destination host unreachable**

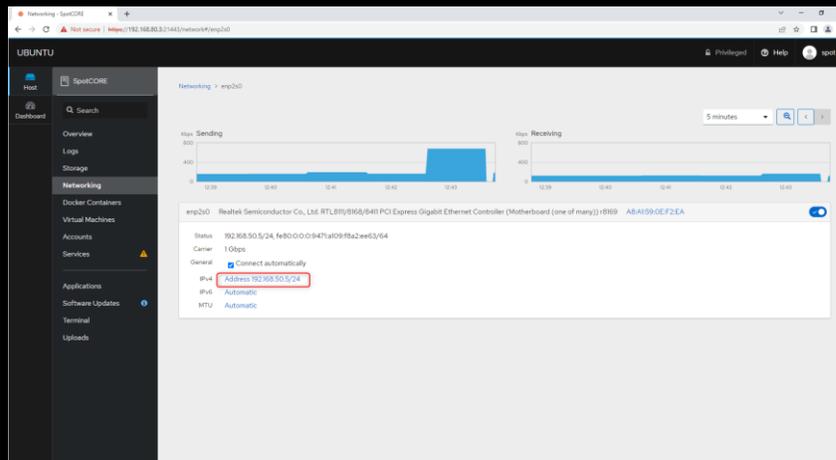


4. **Important:** Ideally you contact your network administrator and ask him to assign a fixed IP-Address for Spot directly on your network!  
This would be the proper way!
2. Remove the WiFi-Dongle if it was still plugged into Spot CORE

3. Connect your computer to Spot's WiFi (spot-BD-xxxxxxx) or the network currently used to connect to Spot
4. Setup the Gateway on Spot CORE in order to route internet-traffic from Spot CORE to Spot:
  - a. Go to Cockpit's **Network** page
  - b. On the networking page click on the Interface **enp2s0**

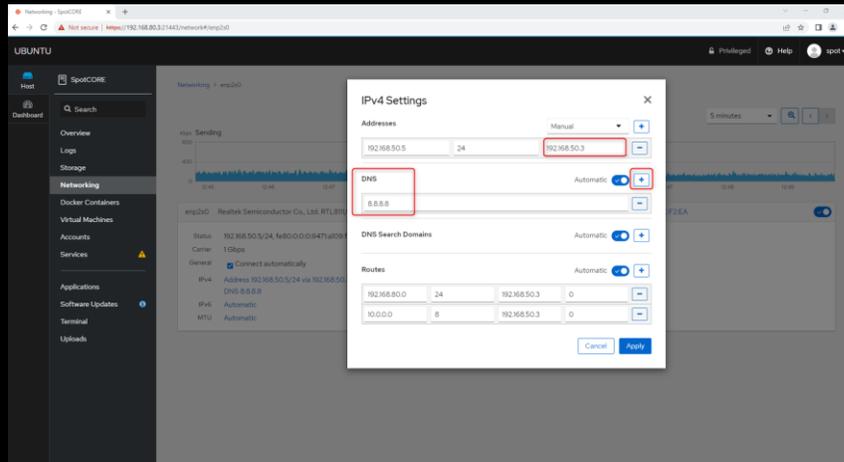


- c. Click on the text next to **IPv4**

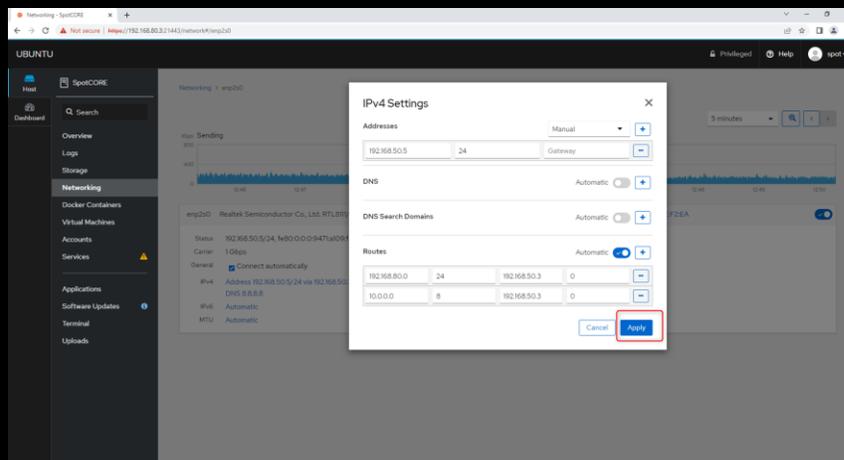


- d. Write **192.168.50.3** into the Gateway

- e. Click the + symbol under **DNS** to add a new entry. Write **8.8.8.8** into the text-field. The window should now look as in the picture

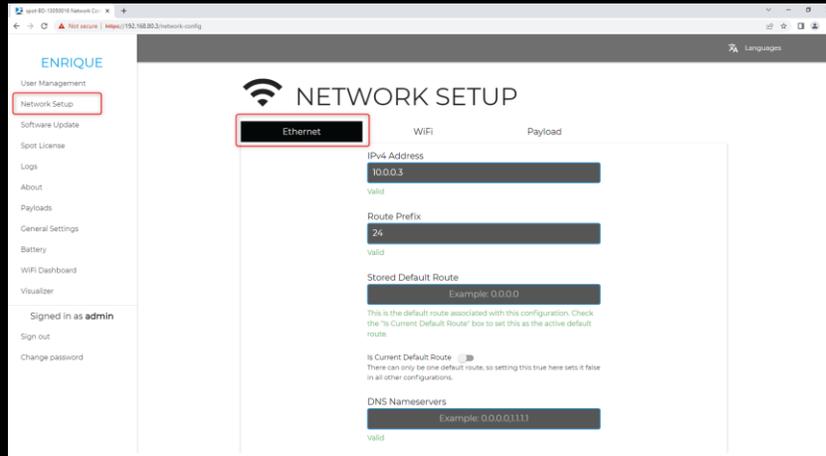


- f. Click on **Apply** to save these settings

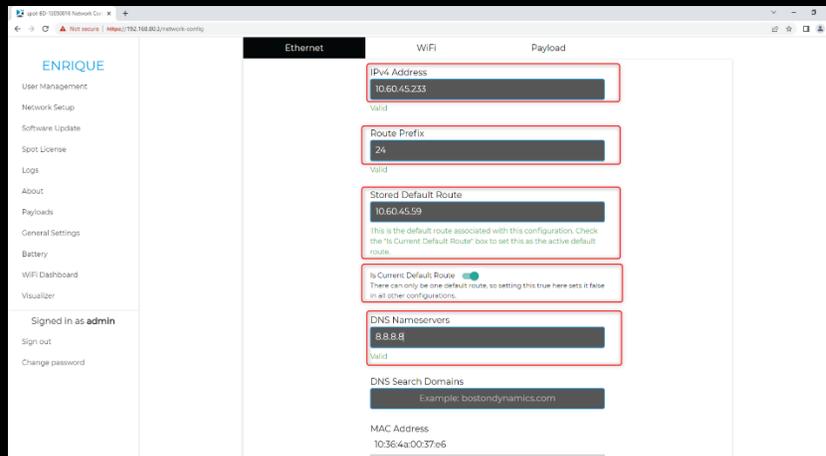


5. Change the Ethernet-Network on Spot's Admin Console:  
a. Go to the **Network Setup** page on Spot's Admin Console

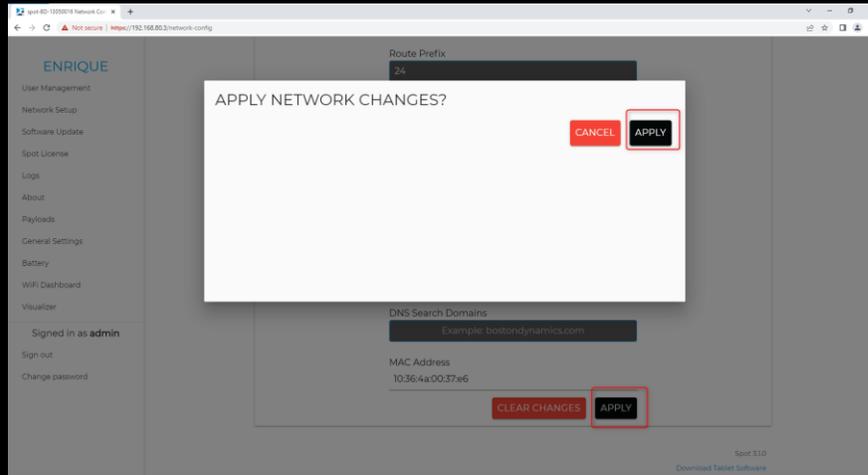
- b. Go to the **Ethernet** tab



- c. Enter the IP-Address you chose in the beginning of this section under **IPv4 Address**  
d. Enter **24** under **Route Prefix**. Depending on your network this could also be a different number. Please ask your network administrator  
e. Enter the **Default Gateway** under **Stored Default Route**  
f. Slide the lever to specify this connection as your **Default Route** under **Is Current Default Route**  
g. Enter **8.8.8.8** under **DNS Nameservers**



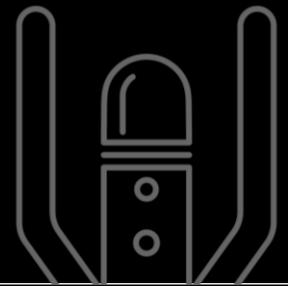
- h. Apply the settings by pressing on **Apply**



6. Check that everything works:
- Wait for ~1 minute in order to give Spot time to connect to the network
  - Connect your computer to the same network you specified for Spot
  - You should now be able to reach the **Admin Console** by entering the **IPv4-Address** you specified further above (for example <https://10.62.80.233>)
  - You should be able to reach **BLK ARC-UI** by additionally entering the port **21002** (for example <http://10.62.80.233:21002> (http, not https))
  - You reach **Portainer** under port **21900** (for example <https://10.62.80.233:21900>)
  - You reach **Cockpit** under port **21443** (for example <https://10.62.80.233:21443>)
  - And finally you should be able to upload to HxDR from BLK ARC-UI

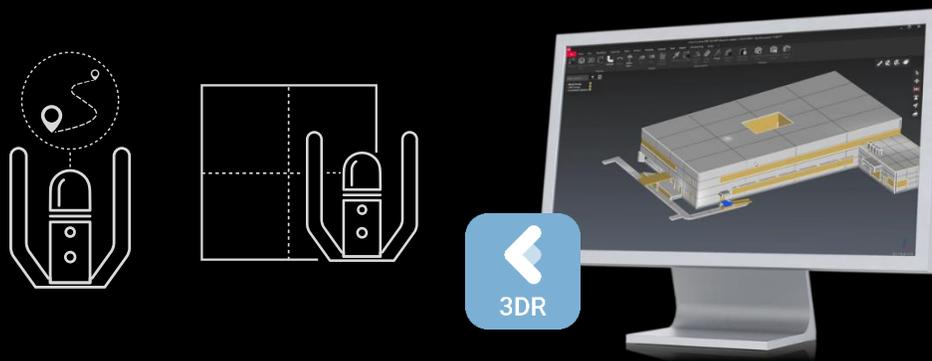
# LEICA BLK ARC-UI

## OFFLINE MISSION PLANNING



It is recommended to use Cyclone 3DR for offline mission planning for BLK ARC. The dedicated scripts for BLK ARC are pre-installed in Cyclone 3DR v2021.2 and later or can be downloaded from <https://myworld.leica-geosystems.com> together with the BLK ARC-UI.

Use available scripts for defining the UCS (User Coordinate System) and draw the path in a fast and compatible way. The mission can be quickly exported and ready for further use with the BLK ARC. Below you will instructions on how to use both scripts.



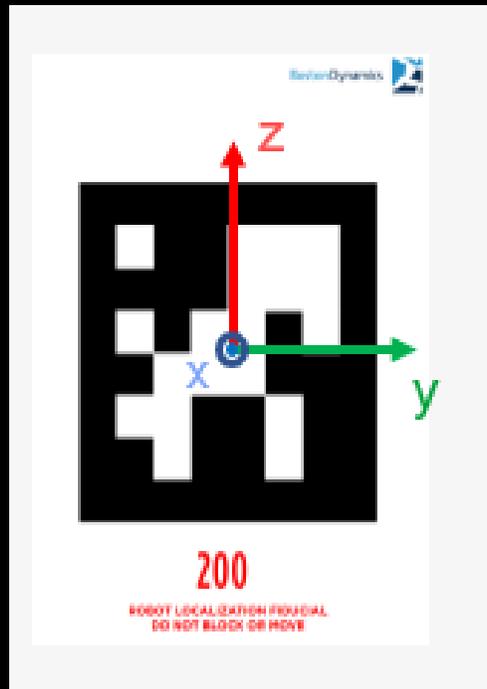
## GENERAL INFORMATION

To create a mission, an input data of the existing environment is required. This data can be in a form of a point cloud, BIM model or floor plan.

For the planned mission to be executed, it is necessary to define one common point between the virtually planned mission and the real environment. For this purpose, Fiducial 200 (printable template attached) must be placed near the pre-defined starting point of the mission, where the robot will initialize.

The fiducial will be detected by Spot cameras. To achieve best results, follow best practices regarding how/where to mount a fiducial (for detailed instruction please refer to this [link](#)).

The first step to plan an offline mission is to locate the **Fiducial 200** in an available point cloud, BIM model or floor plan. Fiducial 200 contains information that will allow to automatically orient the UCS (User Coordinate System) according to the diagram below:



After that, a path which the robot will follow can be drawn. Then, it is possible to add pre-defined static scan positions. The final step is to export the path file in \*.json format, which can later be imported into BLK ARC-UI.

In addition, starting with BLK ARC-UI version 1.2.0, you can export a supporting \*.obj file for live **pose optimization** during missions. It improves localization during missions, reduces drift, especially in longer missions or where fiducial has not been detected accurately.

The BLK ARC-UI version 1.3.0 allows you to benefit from **visual initialization of the mission** for repetitive walks. It requires an additional 3D map file that can be generated automatically from a B2G file (coming from BLK ARC or BLK2GO) within HxDR platform. The detailed instruction on how to prepare the files, how to execute missions and what is the dedicated workflow can be found below.

The BLK ARC-UI version 2.0.0 allows you to **start and finish mission at the docking station**. In this case the any dedicated fiducial from Boston Dynamics can be used that is mounted on docking station. The number of the fiducial does not need to be specified in path planning.

## OVERVIEW ON POSSIBLE WORKFLOWS

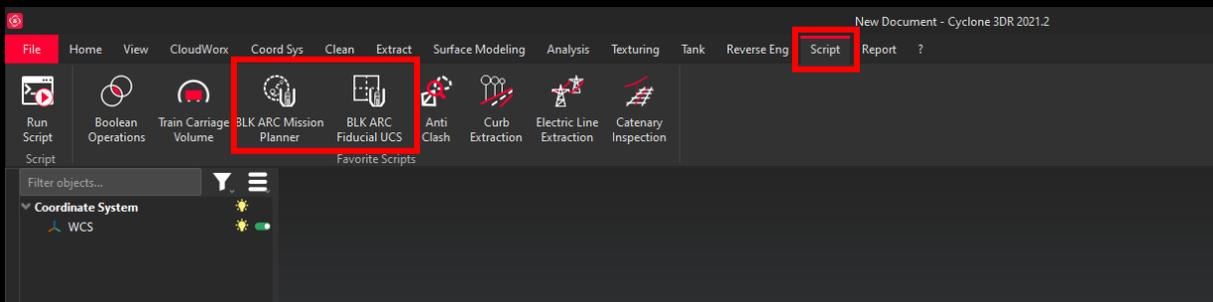
Options	Required files	Steps
<b>Workflow 1</b>  Autonomous mission	- Input file for path planning (accepted files: 2D CAD, 3D BIM, 3D point cloud, 3D mesh) - Mission file (*.json)	<u>In the office:</u> -Import your input file for path planning into Cyclone 3DR -Perform mission planning and export mission file (*.json) Step 1: define UCS = Fiducial position; Step 2: draw the path  <u>On site:</u> -Place real fiducial on site -Load mission file (*.json) into BLK ARC-UI -Place robot in front of fiducial and start mission  <u>Important:</u> -Good light conditions on site when robot is detecting fiducial with cameras -Precise fiducial placement during path planning and on site
<b>Workflow 2</b>  Autonomous mission with pose optimization	- Input file for path planning (accepted files: 3D BIM, 3D point cloud, 3D mesh) - Mission file (*.json) - 3D model (*.obj) for pose optimization (3D mesh created out of point cloud or BIM model)	<u>In the office:</u> -Import your input file for path planning into Cyclone 3DR. -Perform mission planning and export mission file (*.json) Step 1: define UCS = Fiducial position; Step 2: draw the path. -Export 3D model in *.obj file.  <u>On site:</u> -Place real fiducial on site. -Load mission file (*.json) into BLK ARC-UI. -Load 3D model (*.obj) into BLK ARC-UI and attach to specific mission. -Place robot in front of fiducial and start mission.  <u>Important:</u> -WCSs between mission file and 3D model for pose optimization need to be the same. 3D model must be exported in WCS from Cyclone 3DR. -3D model for pose optimization needs to be complete meaning covering the whole area of the mission.
<b>Workflow 3</b>  Autonomous mission with pose optimization and visual initialization for repetitive capturing	-Mission file (*.json) -Input file for path planning must be 3D mesh or point cloud based on *.b2g file -3D model (*.obj) for pose optimization based on *.b2g file -3D map (*.bytes) for visual initialization created in HxDR based on *.b2g file	<u>On site:</u> -Collect scan (*.b2g) on site that covers the area where repetitive mission will take place (data can be collected with handheld BLK2GO or BLK ARC).  <u>In the office:</u> -Collected scan (*.b2g) file upload to HxDR. -Download created 3D map (*.bytes) and 3D model (*.obj) from this scan. -Import downloaded *.obj file for path planning into Cyclone 3DR (do not move or change WCS of *.obj!). -Perform mission planning and export mission file (*.json), remembering that it is possible now to plan a mission that starts and ends at a docking station. Step 1: define UCS = Fiducial position; Step 2: draw the path <u>On site:</u> -Load mission file (*.json) into BLK ARC-UI -Load 3D model (*.obj) into BLK ARC-UI and attach to specific mission -Load 3D map (*.bytes) into BLK ARC-UI and attach to specific mission -Place robot close to starting position and start mission <u>Important:</u> -WCSs of mission file and 3D model for pose optimization need to be the same as scan (*.b2g) used for 3D map (*.bytes) -If visual initialization fails due to poor lighting condition or lack of features, use real Fiducial for traditional mission start as a fallback solution
<b>Workflow 4</b>	-GA03 & GAD130 (hardware)	<u>On site:</u>

Outdoor missions with GA03	-Internet connection on tablet/iPad with BLK ARC-UI to display map background	-Once GA03 is connected, start mission, and calibrate the GNSS module outdoors -Tap points on the map to create a path and assign actions, which the robot will follow and execute
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## CREATE A PROJECT IN CYCLONE 3DR

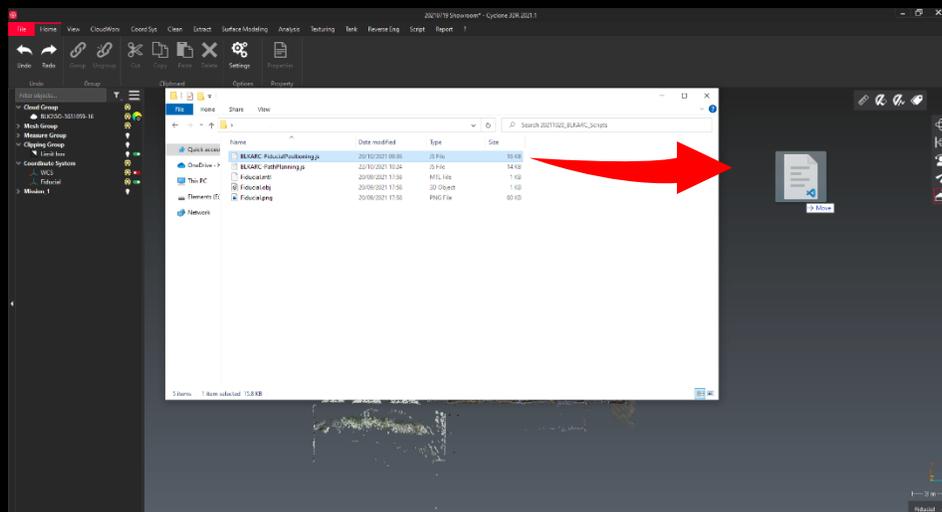
Create a new project in Cyclone 3DR and import the input data. Adjust the display options to your preferences (hide BIM model elements, add limit box, or limit plane).

If you are using Cyclone 3DR v2023.1 or later, go to the **Script** tab and select **BLK ARC Fiducial UCS** and later **BLK ARC Mission Planner** to run the scripts.

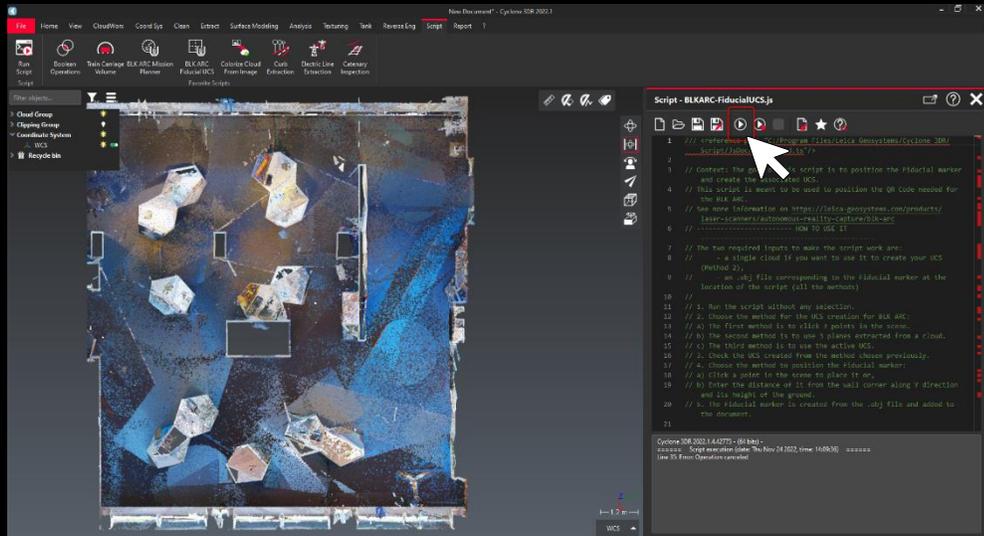


For older version of Cyclone 3DR, the scripts can be downloaded from <https://myworld.leica-geosystems.com>

To load the script simply drag & drop **BLK ARC Fiducial UCS.js** file.



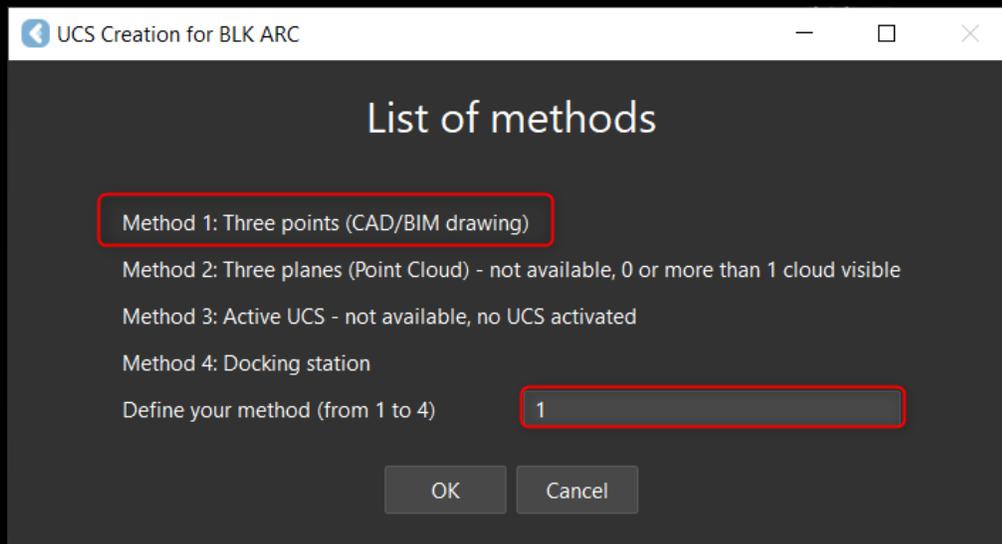
Press **Play** to start. Follow the instructions described below or in the wizard displayed in Cyclone 3DR user interface. Once the Fiducial is defined properly, repeat the steps for **BLK ARC Mission Planner.js**.



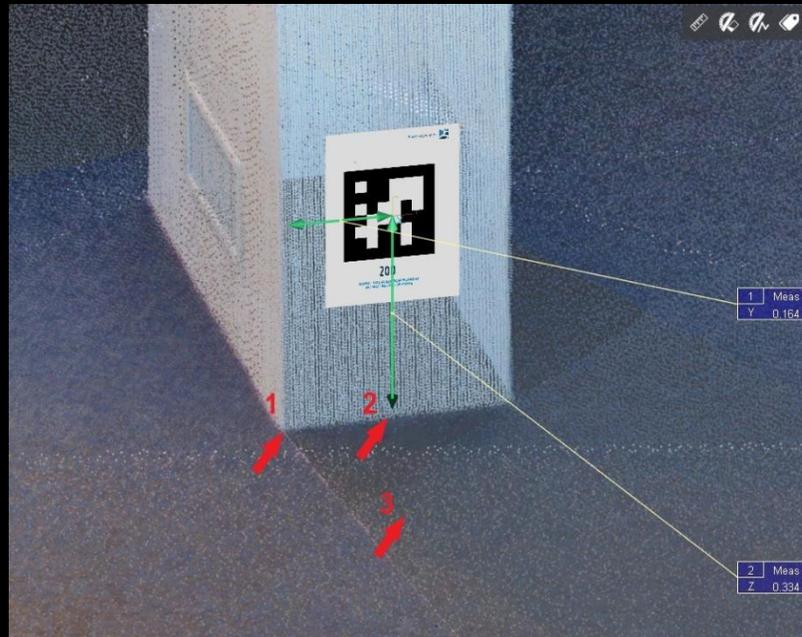
## BLK ARC FIDUCIAL UCS – METHOD 1: THREE POINTS (CAD / BIM)

In the next steps the instruction for Method 1 will be explained.

1. Define the input data.

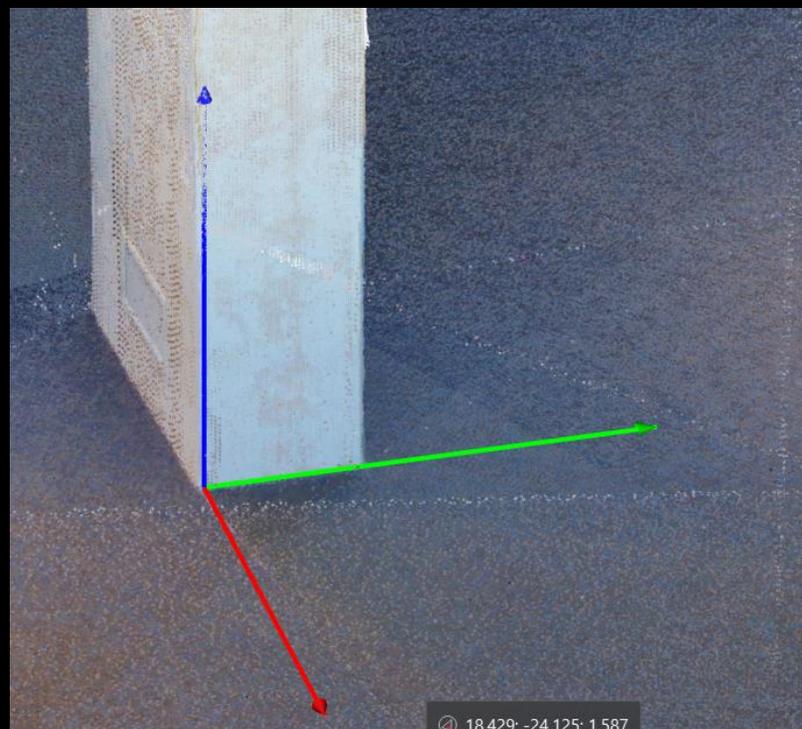


2. Following the instructions below, pick 3 points:
  - a. One point in the corner taken as a reference (1),
  - b. One point on the edge between the wall and the floor (2),
  - One in front of the wall where Fiducial is located (3).



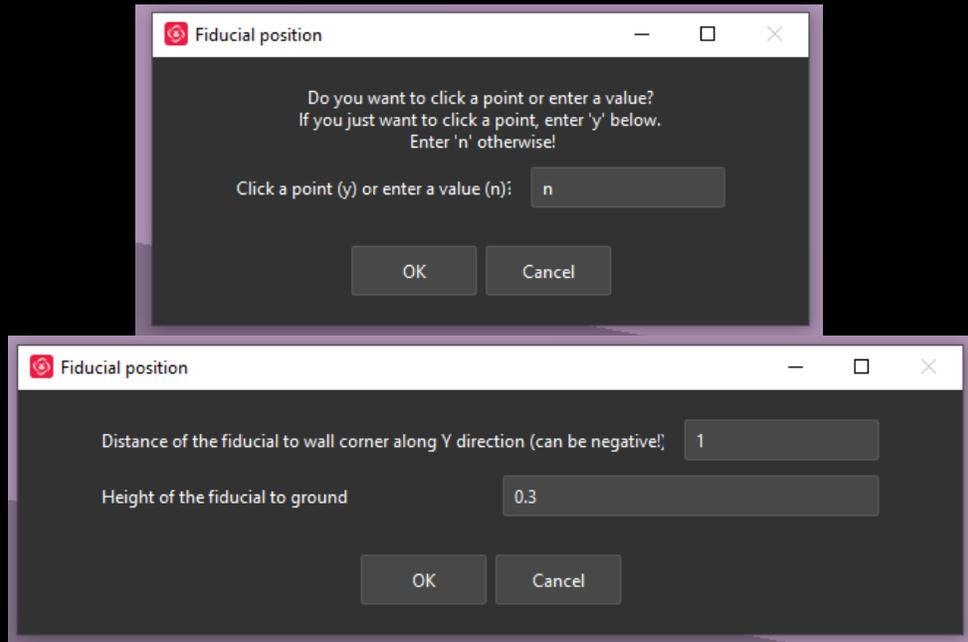
3. UCS will appear. Check if the directions are correct:

- a. X axis should be oriented external to the wall.
- b. Y axis should be horizontal, aligned to the wall and pointing right.
- c. Z axis should be oriented vertically (upward).

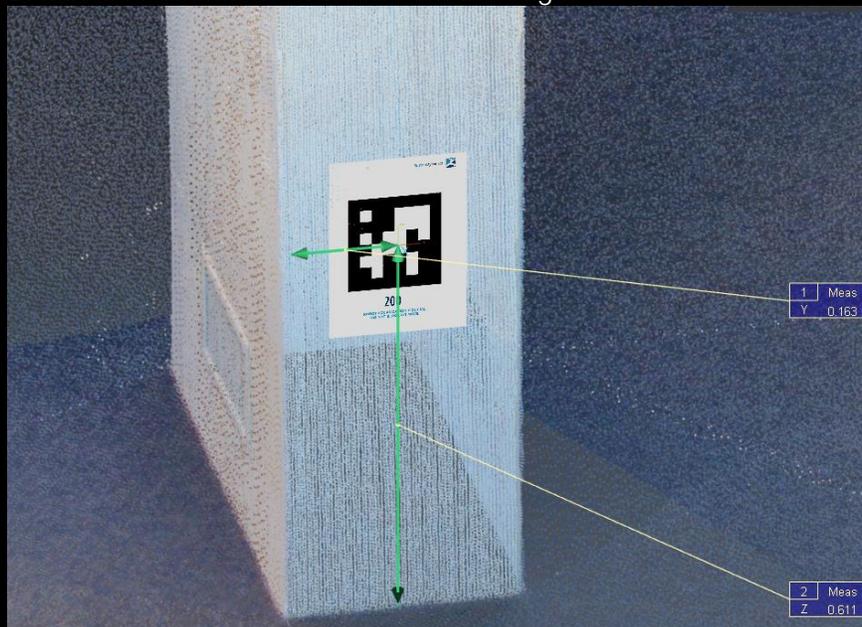


If any of the conditions above is not respected, restart the script, and repeat steps 1-3 (press ESC to close the script).

4. Move the Fiducial to the correct position. There are two options available:
  - a. Click a point on the model (y).
  - b. Manually enter the offset in relation to the Y and X axes (n):
    - Y axis → Length on the selected surface
    - Z axis → Height from the floor



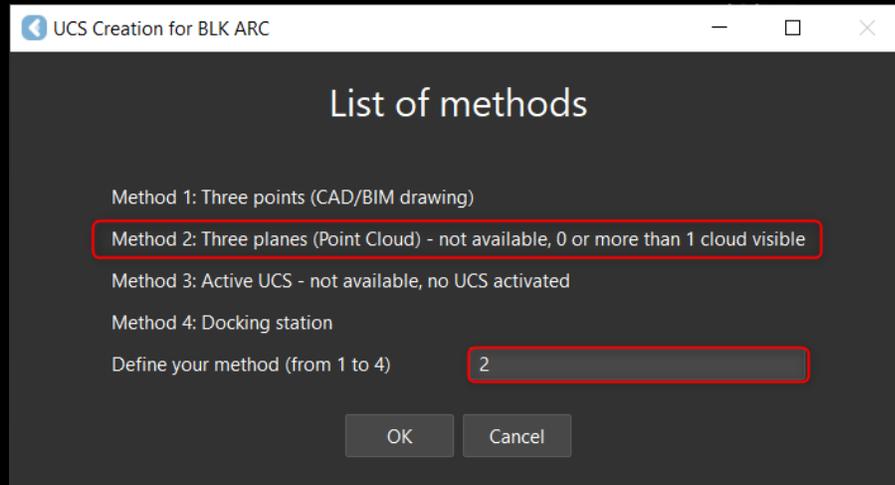
5. As an output available are:
  - a. Properly oriented UCS
  - b. Properly placed Fiducial mesh
  - c. Distances calculated / entered from the edges



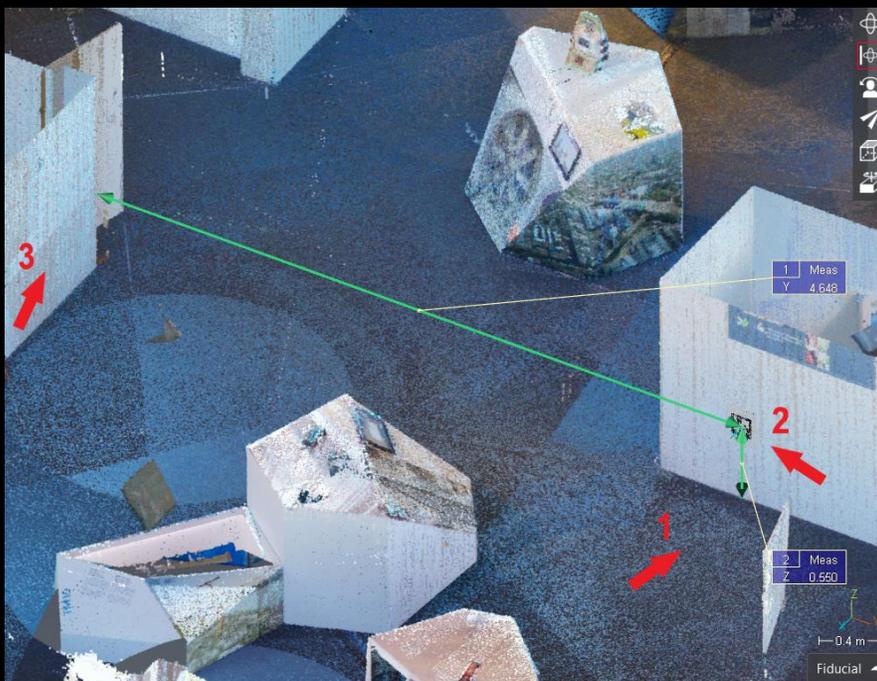
## BLK ARC FIDUCIAL UCS – METHOD 2: THREE PLANES (POINT CLOUD)

In the next steps the instruction for Method 2 will be explained.

1. Define the input data



2. Following the instructions below, pick 3 points:
  - a. One point on the floor in front of the Fiducial (1)
  - b. One point on the wall where the Fiducial is located (2)
  - c. One point on a corner wall (3)



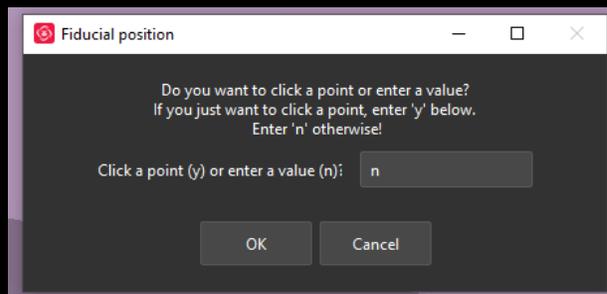
3. UCS will appear. Check if the directions are correct:
  - a. X axis should be oriented external to the wall
  - b. Y axis should be horizontal, aligned to the wall and pointing right

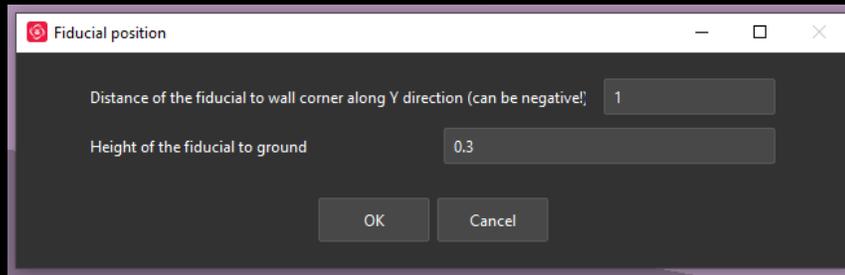
- c. Z axis should be oriented vertically (upwards)



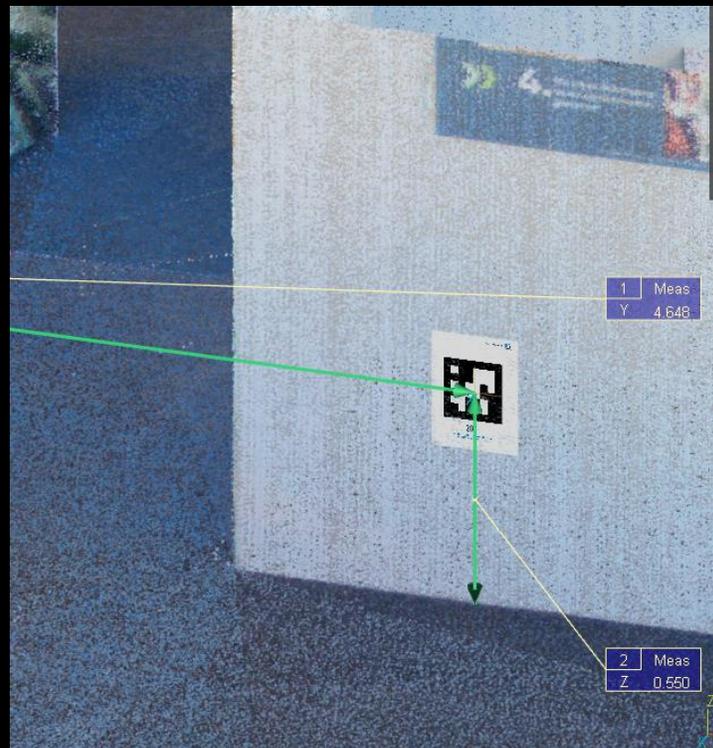
If any of the conditions above is not respected, restart the script, and repeat the steps 1-3 (press ESC to close the script).

4. Move the Fiducial to the correct position. There are two options available:
- Click a point on the model (y).
  - Manually enter the offset in relation to the Y and X axes (n):
    - Y axis → Length of the selected surface
    - Z axis → Height from the floor





5. As an output available are:
  - a. Properly oriented UCS
  - b. Properly placed a Fiducial mesh
  - c. Distances calculated / entered from the edges



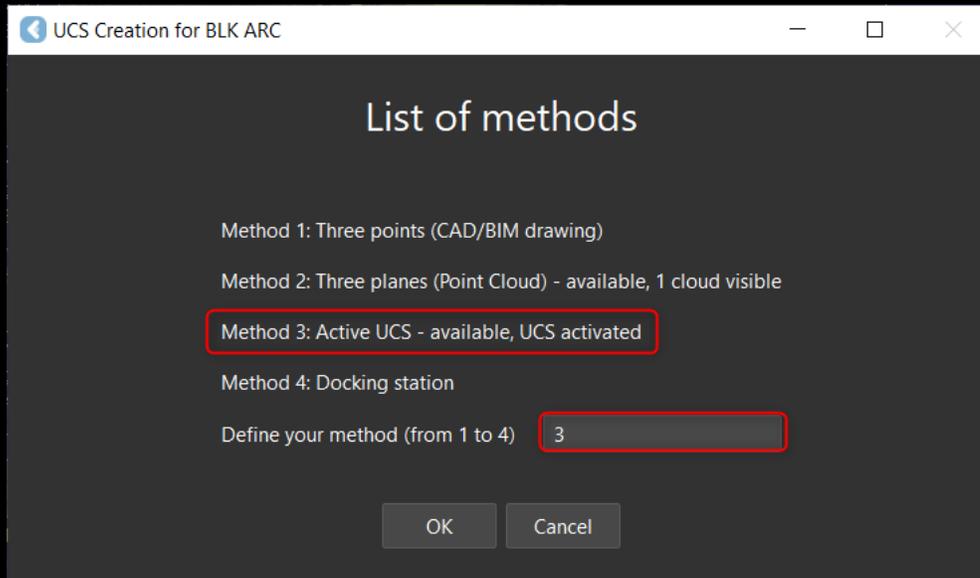
## BLK ARC FIDUCIAL UCS – METHOD 3: ACTIVE UCS

In case the user prefers to manually set the UCS using the existing tools in the Cyclone 3DR, method 3 allows the automatic adaptation of the previously created UCS.

In the next steps the instruction for Method 3 will be explained.

1. Manually set a UCS that meets the following requirements:
  - a. X axis should be oriented external to the wall
  - b. Y axis should be horizontal, aligned to the wall and pointing right

- c. Z axis should be oriented vertically (upward)
2. Run the script and define the input data.



3. As an output available are:
  - a. Properly placed Fiducial mesh

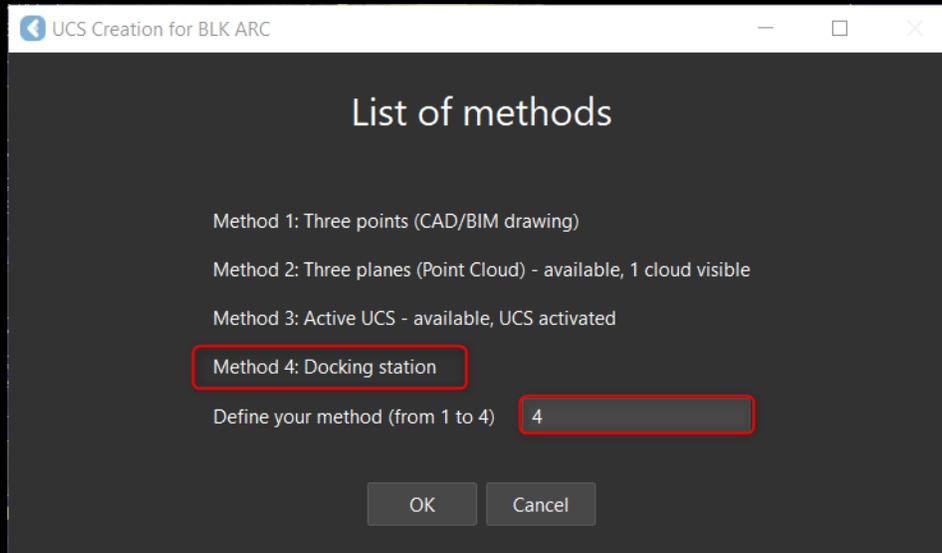


## BLK ARC FIDUCIAL UCS – METHOD 4: DOCKING STATION

Method 4 is designed to use for missions with a Docking Station available.

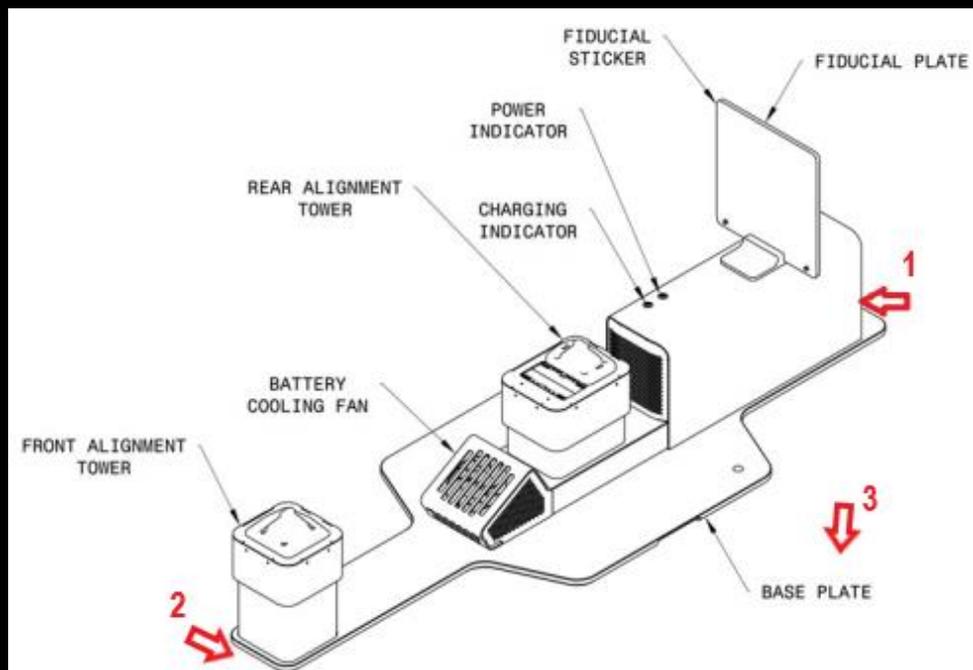
In the next steps the instruction for Method 4 will be explained.

1. Define the input data

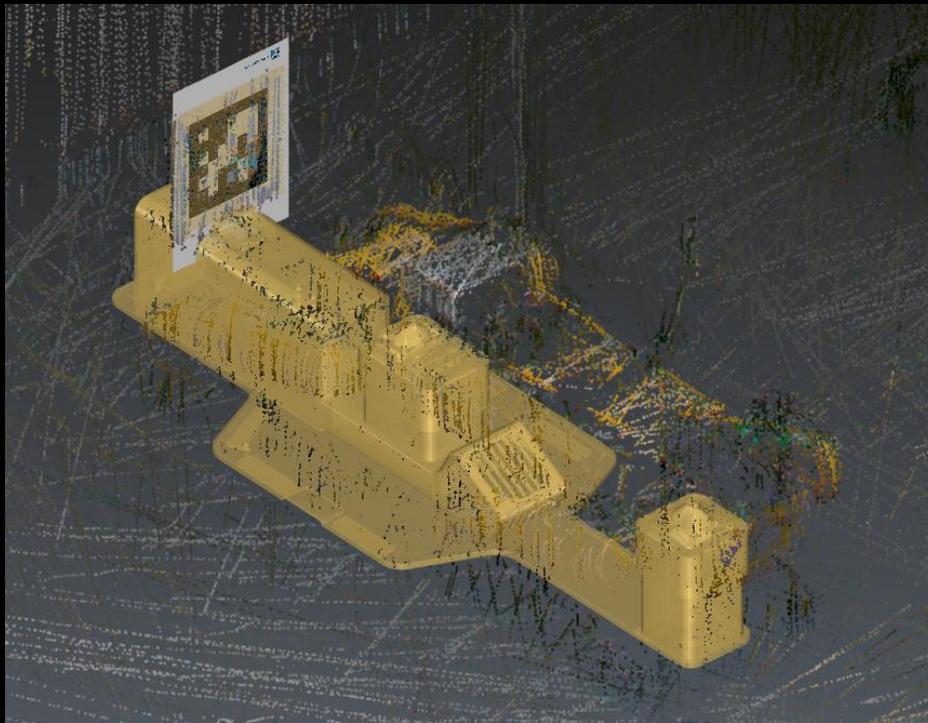


Following the instructions below, pick 3 points:

- One at the back of the docking station
- One in front of the docking station
- One on the left side of base plate



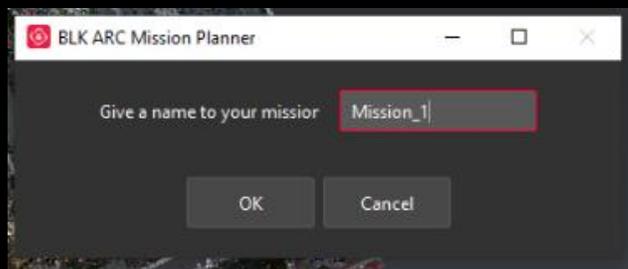
6. As an output available are:
  - a. A projection of docking station
  - b. Properly placed Fiducial mesh



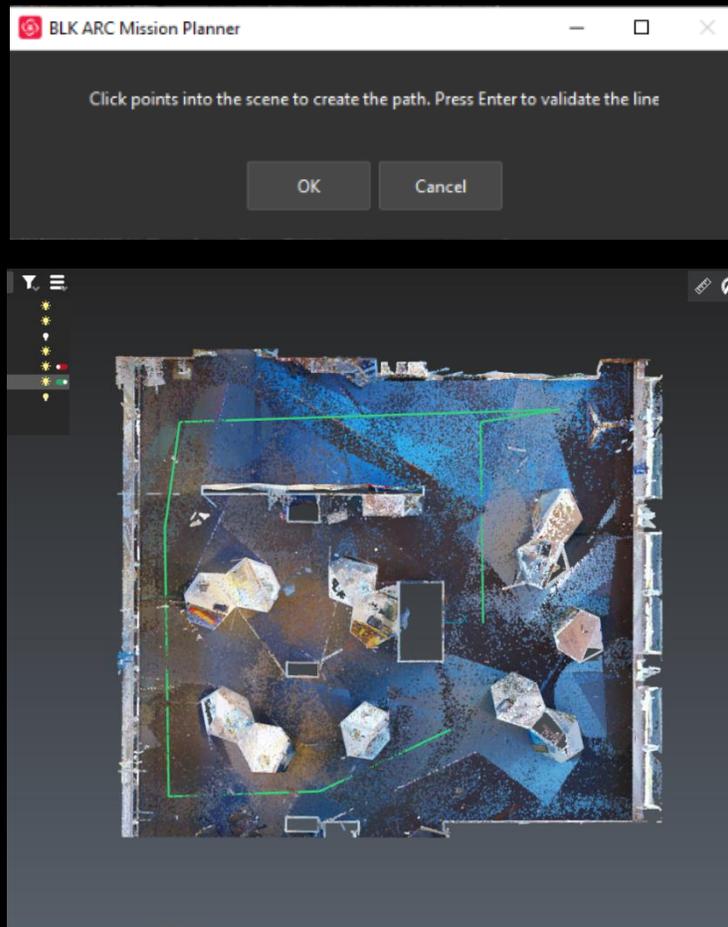
In case the projection is not placed correctly, undo the process (ctrl+z) and repeat the steps above until the result is satisfactory.

## BLK ARC MISSION PLANNER – MISSION WITHOUT DOCKING STATION

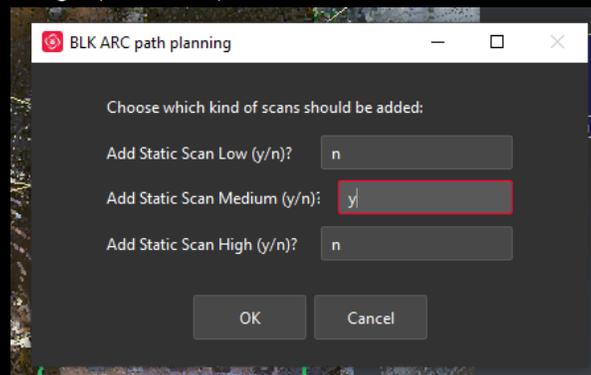
1. Start **BLK ARC Mission planner** and define a name of the mission.



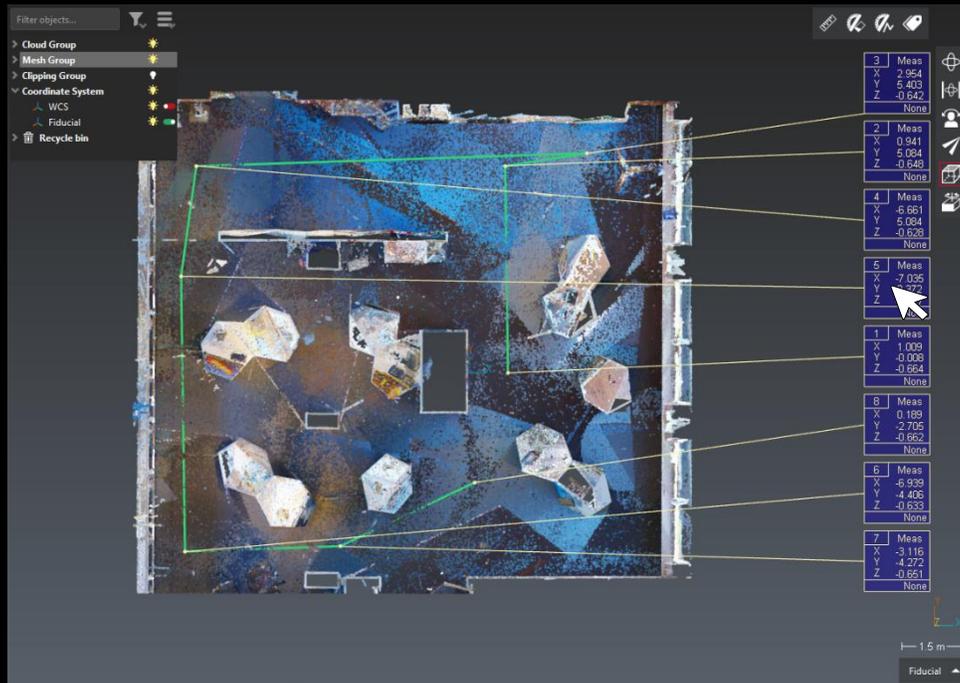
2. Start drawing point by point the path which the robot will follow. Remember to draw from start to finish. The first waypoint should be near the Fiducial. When the path is completed, confirm by clicking **Enter**.



3. When the path is drawn, you can define static scan poses on desired waypoints. Choose the types of scans required, remembering that it is possible to select multiple options.
  - a. **None** (default: walk through point)
  - b. **Static Scan Low** (10s scan)
  - c. **Static Scan Medium** (30s scan)
  - d. **Static Scan High** (60s scan)



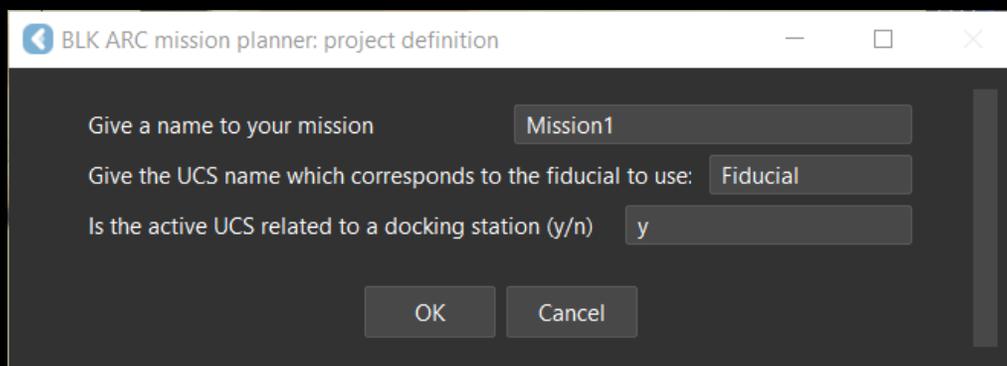
4. Select the labels for points where the BLK ARC should take a desired scan. Press Enter to finish.



5. At the end of the process, you will be prompted to confirm the choices or to restart the selection of the scans.
6. Once the path is confirmed, a message will appear with the approximate duration of the mission.
7. Lastly, save the \*.json file locally on your computer.

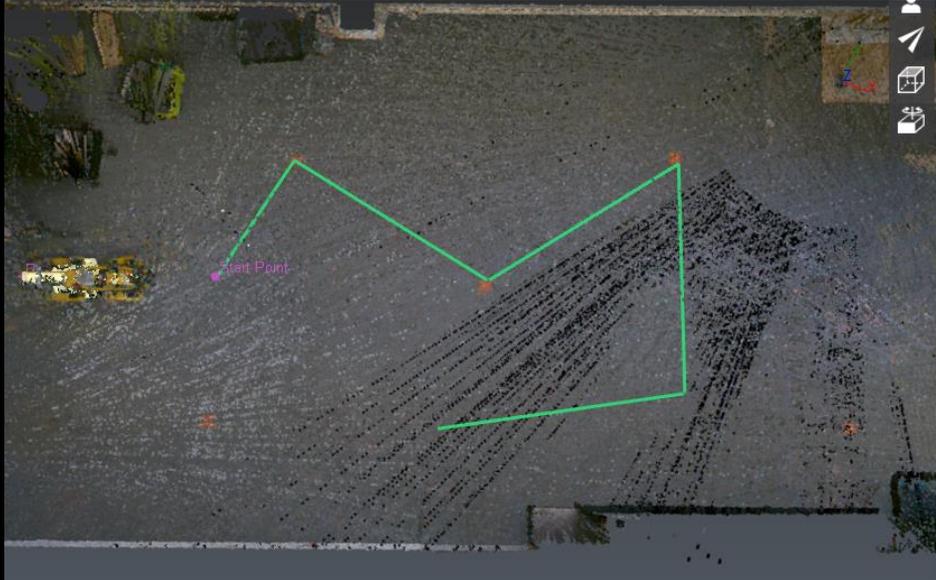
## BLK ARC MISSION PLANNER – MISSION WITH DOCKING STATION

Start BLK ARC mission planner and define the name of the mission, name of the UCS and confirm, that the active UCS is related to docking station (y).



Draw a path, point by point, remembering that the first waypoint will be placed automatically close to the docking station. Press Enter to validate.

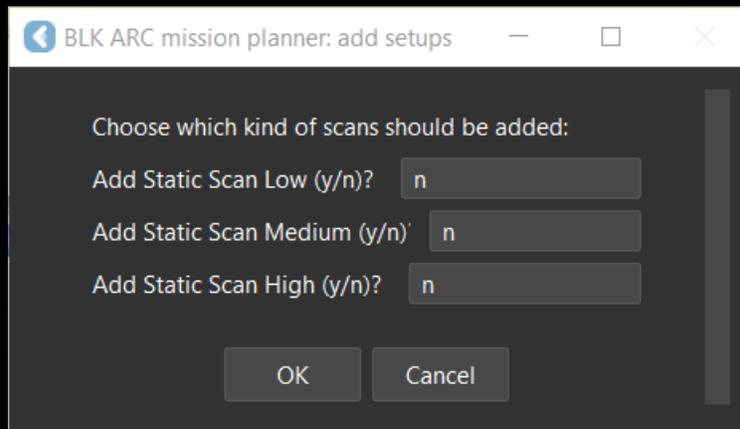
**Important:** Do not close the path.



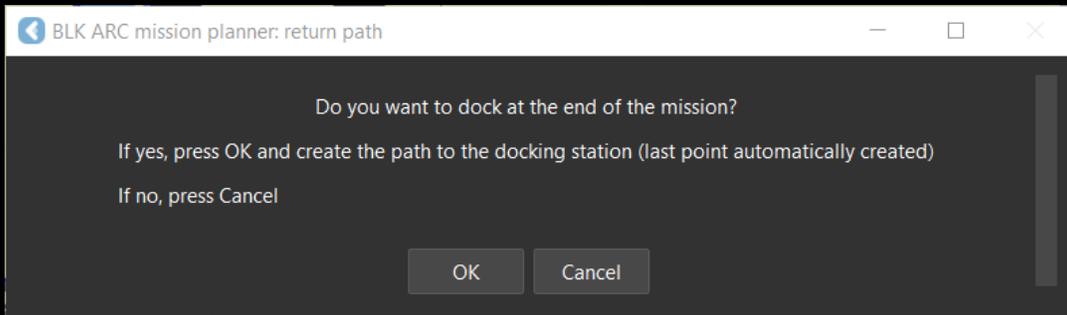
If desired, choose the type of statics scans to be performed and then specify their positions by clicking on the waypoints labels. It is possible to select multiple options.

Available scan types:

- a. **None** (default: walk through point)
- b. **Static Scan Low** (10s scan)
- c. **Static Scan Medium** (30s scan)
- d. **Static Scan High** (60s scan)



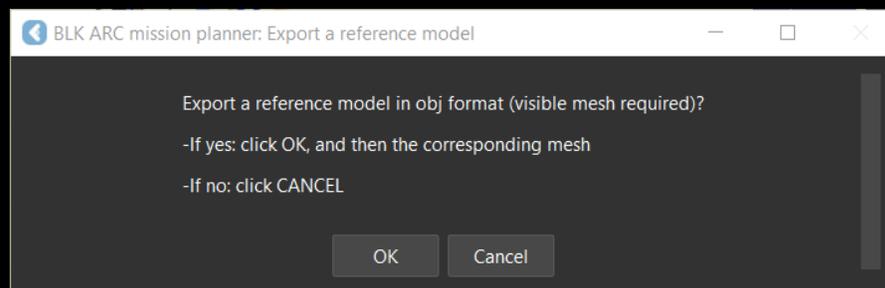
The window below will pop up – press ok to dock at the end of the mission, then create a path leading to the docking station.



Then, an information with the estimation of mission duration will appear. After pressing OK, you will be prompted to specify where to save the \*.json file, select desired folder.

The window below will appear. Press OK if you want to export \*.obj file as a reference model for the mission.

**Important:** Reference model is required to perform a mission with docking station.

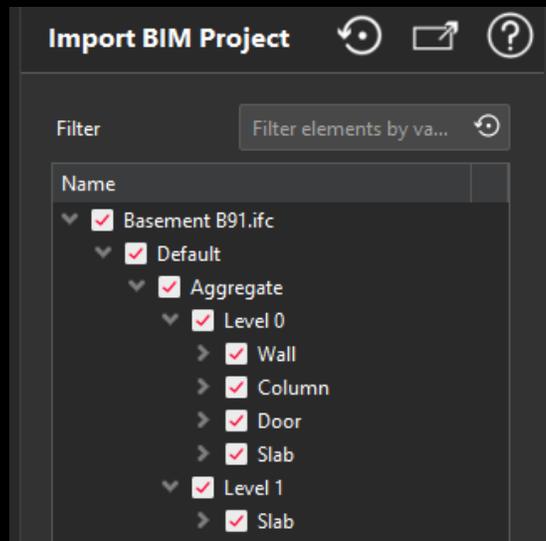


## EXPORT 3D MODEL (\*.OBJ) FOR POSE OPTIMIZATION

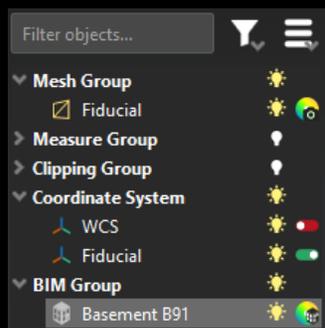
BLK ARC-UI version 1.2.0 introduces the **Pose Optimization**, that allows the carrier to improve the quality of the navigation system and the procedure of locating the fiducial in the real world. It is necessary to upload an \*.obj file in the correct coordinate system to use the feature. It is mandatory to locate the fiducial in the digital model and plan the mission in the same file to assure proper functioning. The \*.obj file can be exported from a BIM model or can be based on a mesh model. For details see the following sections.

### EXPORT 3D MODEL (\*.OBJ) FROM BIM MODEL (\*.IFC)

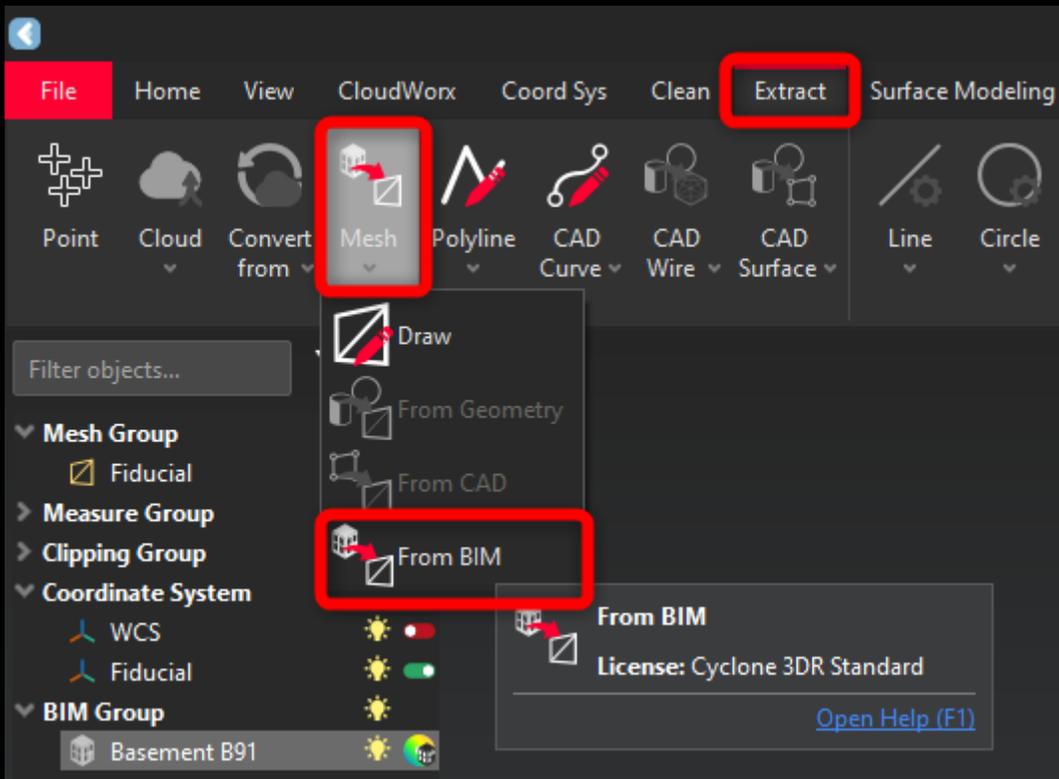
1. Import the IFC model into Cyclone 3DR.
2. In the BIM model, select all (and only) classes of the floor you need



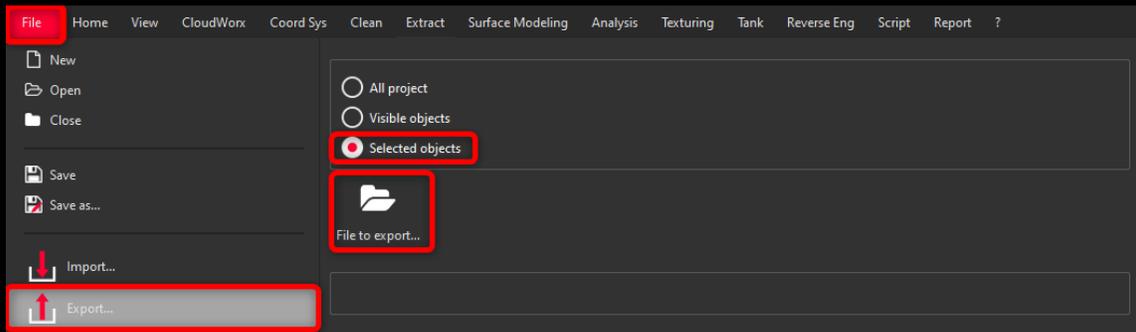
3. Create the UCS with **BLK ARC Fiducial UCS** script (see section “*BLK ARC FIDUCIAL UCS – METHOD 1: THREE POINTS (CAD / BIM)*”)
4. Create the path with **BLK ARC Mission Planner** (see section “*BLK ARC MISSION PLANNER*”)
5. Once the mission is defined, DO NOT MOVE the model
6. Select the BIM model



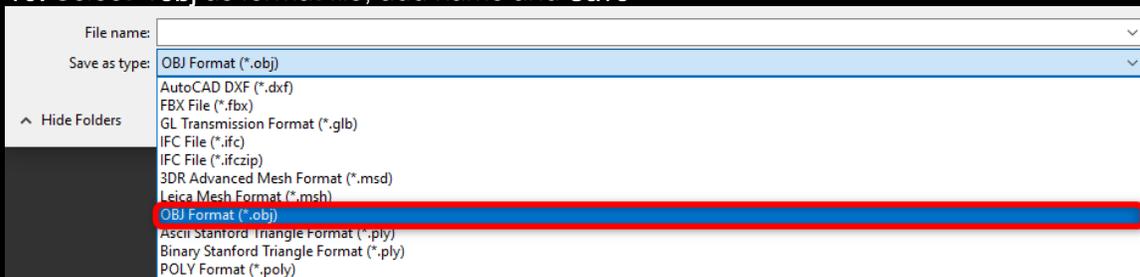
7. Go to **Extract** menu, select **Mesh** and press **From BIM**



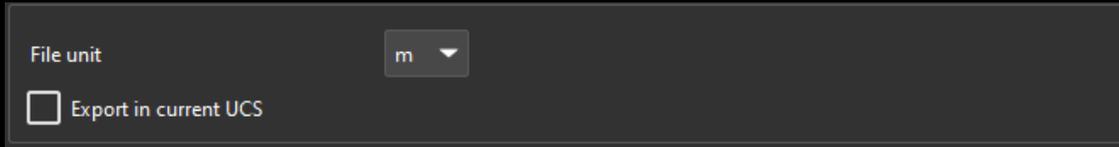
8. Select the BIM model
9. Go to File menu, select **Export...**, press **Selected object** and then **File to export...**



10. Select \*.obj as format file, add name and **Save**

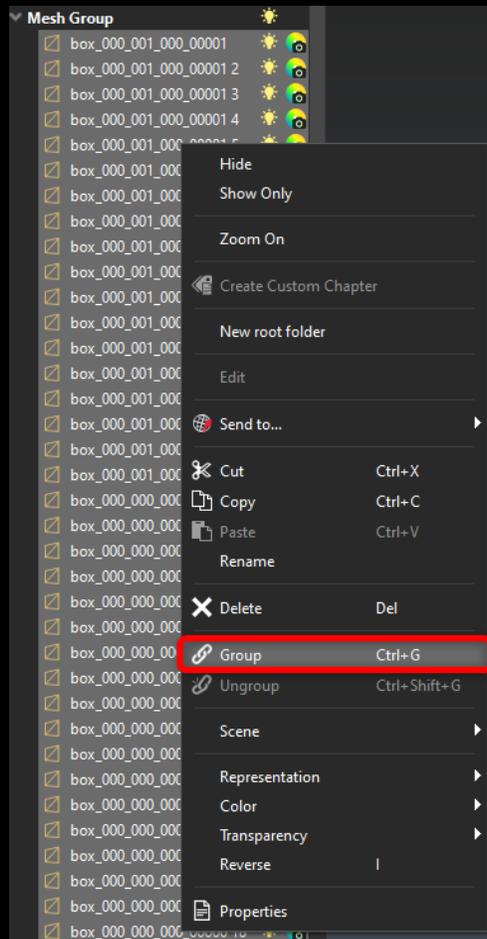


11. Before export make sure that the unit is set to **meters (m)** and that **Export in current UCS** is NOT selected



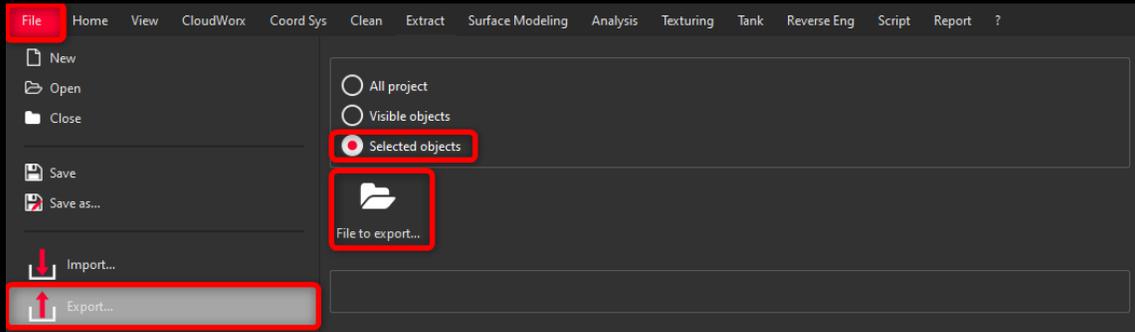
## EXPORT 3D MODEL (\*.OBJ) FROM MESH

1. Import mesh model into Cyclone 3DR. Mesh can be created in HxDR from b2g file or in any other software
2. Create the UCS with **BLK ARC Fiducial UCS** script (see section “*BLK ARC FIDUCIAL UCS – METHOD 1: THREE POINTS (CAD / BIM)*”)
3. Create the path with **BLK ARC Mission Planner** (see section “*BLK ARC MISSION PLANNER*”)
4. Once the mission is defined, **DO NOT MOVE** the model
5. Select all and only the meshes you are interested in
6. Right click and press **Group** to create a unique mesh



7. Select the mesh

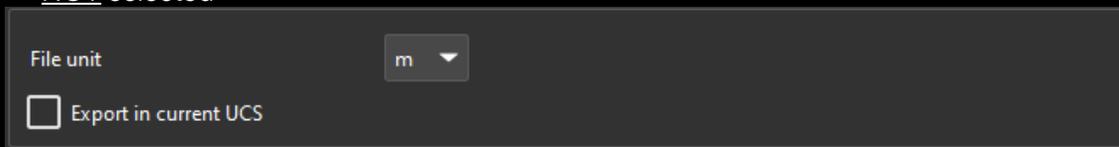
8. Go to **File** menu, select **Export...**, press **Selected object** and then **File to export...**



9. Select **\*.obj** as format file, add name and **Save**



10. Before export make sure that the unit is set to **meters (m)** and that **Export in current UCS** is **NOT** selected



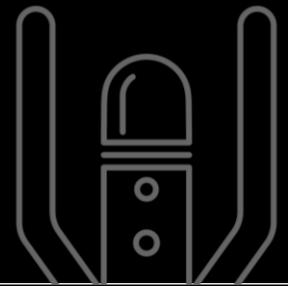
EXPORT 3D MAP (\*.BYTES) FOR VISUAL INITIALIZATION

Coming soon!

This manual will be updated and made available as soon as it is available on the HxDR platform.

# LEICA BLK ARC-UI

## BLK ARC-UI OPERATIONAL GUIDE



BLK ARC-UI is a browser-based user interface dedicated for operating BLK ARC Laser Scanner integrated by Leica Geosystems with robotic carriers, such as Boston Dynamics Spot robot.

### How to access BLK ARC-UI on Spot

1. Connect from any device (smartphone, tablet, laptop) to Spot's WiFi network.  
Spot CORE must be mounted and have installed BLK ARC-UI (detailed instruction can be found in the chapter *Installation*)
  - Operating system does not matter on the mobile device (Android, iOS, Windows)
2. Use any web-browser to access BLK ARC-UI (Safari, Chrome, Firefox) and type the address:
  - <http://192.168.80.3:21002/>  
(if Spot's WiFi set to Access-Mode – please see Networking chapter)

**Important:** It is recommended to open and use BLK ARC-UI in a single tab. During operation, make sure that BLK ARC-UI is open on one mobile device at the same time.

It is recommended to use BLK ARC-UI in landscape orientation and on the iPad Pro 11-inch screen for the best user experience.

# HOW TO USE BLK ARC-UI

The following instructions will guide you through the screens available in BLK ARC-UI.

## Dashboard

### 1 – Status of connected devices:

For the robot, the battery status is displayed. If the icon is greyed-out it means that there is no device connected.

If the GNSS status icon is:

-Greyed out it means that there is no antenna available.

-If there is a red light – the antenna is connected but there is no connection established, -If the light is orange – the antenna is connected but the quality of the solution is weak.

-If the light is green – the antenna is connected, and the quality of the solution is good.

The number on the top right of the GNSS icon represents number of satellites the device is connected to.

### 2 – Logs and BLK ARC-UI details can be accessed from the Hamburger menu.

3 – Settings - in this panel a user profile can be created. The active profile must contain the appropriate scanner + robot configuration and may contain credentials to an external WiFi network to transfer data to HxDR.

4 – Autonomous mission – this tool allows to upload, execute, and control your pre-planned mission for BLK ARC (detailed instruction can be found in the chapter *Offline mission planning*).

5 – My files – this panel contains all information about the data collected with BLK ARC and it allows to transfer / download / process / view / upload to HxDR.

6 – Control – this panel allows to control the BLK ARC laser scanner independently manually and/or robotic carrier.

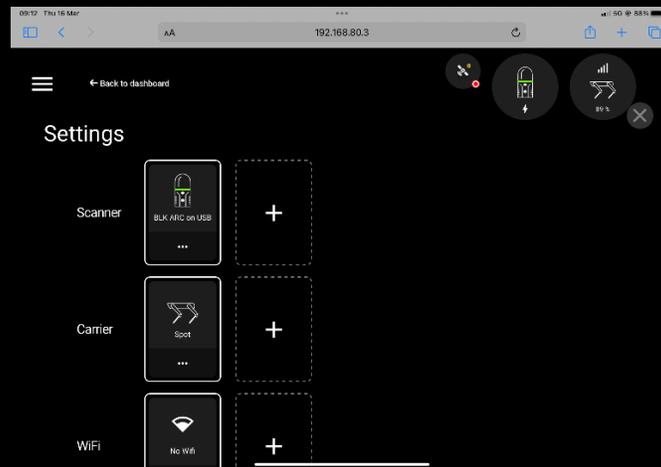


## Settings (3)

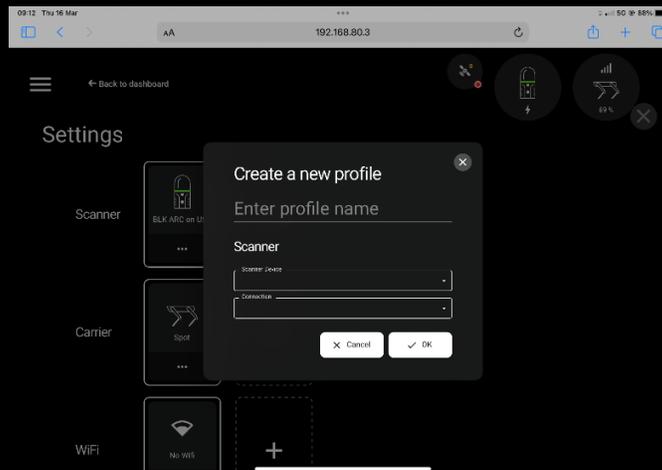
In the **Settings** tab it is possible to create, edit and activate different options for the Scanner, Carrier and the WiFi.

Default settings:

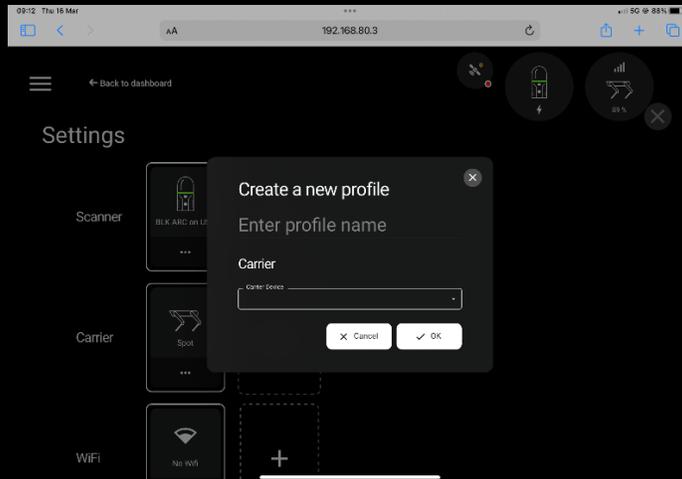
- Scanner - the BLK ARC, connected via USB,
- Carrier- the Spot Robot,
- No WiFi credentials are stored.



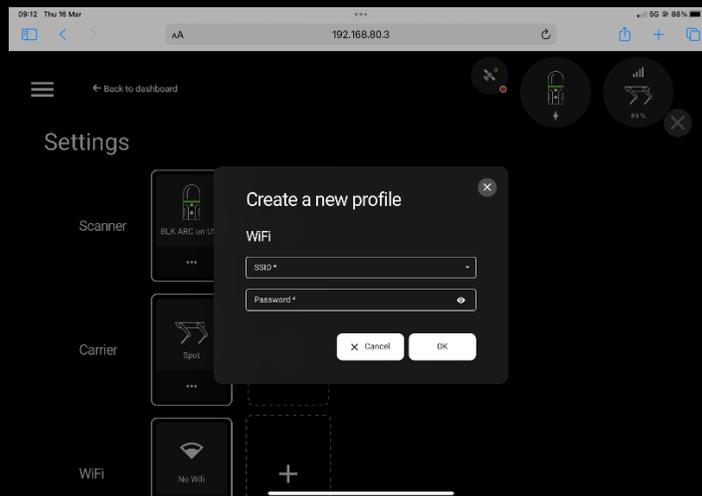
It is possible to change the type of connection of the scanner, by triggering the plus button in **Scanner** section and then selecting a different option of connection (it will require to mount an external WiFi dongle).



In the **Carrier** tab, it is possible to define the model of carrier you are connected with.



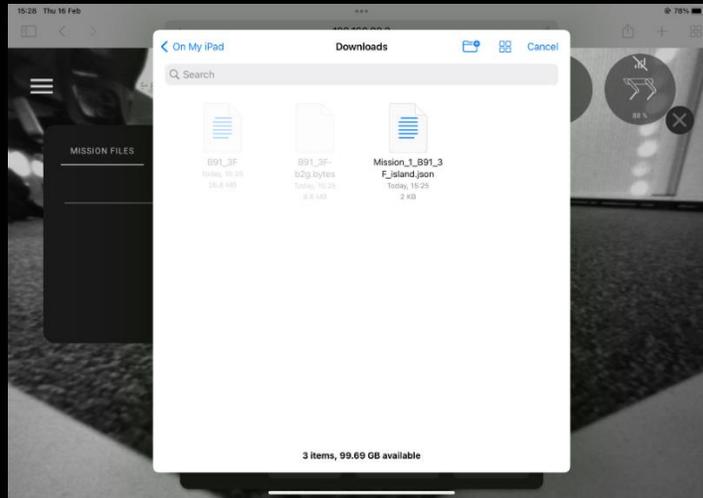
To enable Internet connection on Spot CORE, it is necessary to use **an external WiFi dongle** that must be connected to the Spot CORE. The credentials of the available WiFi network must be defined in WiFi. Please check **Networking** chapter for more details.



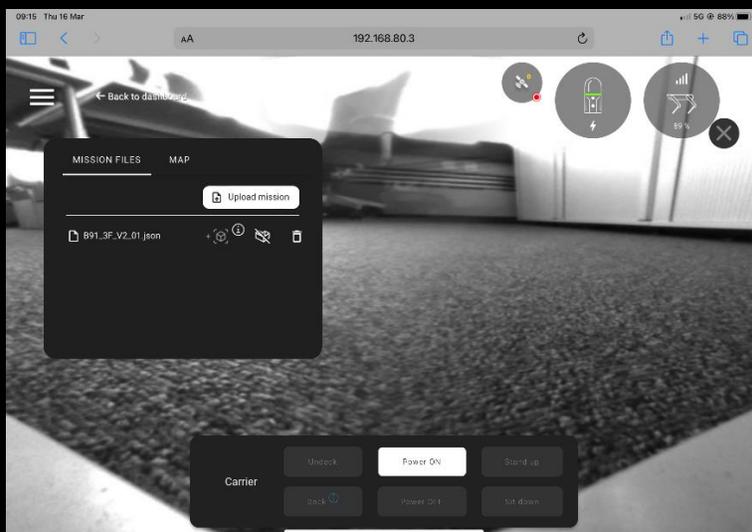
## Autonomous mission (4)

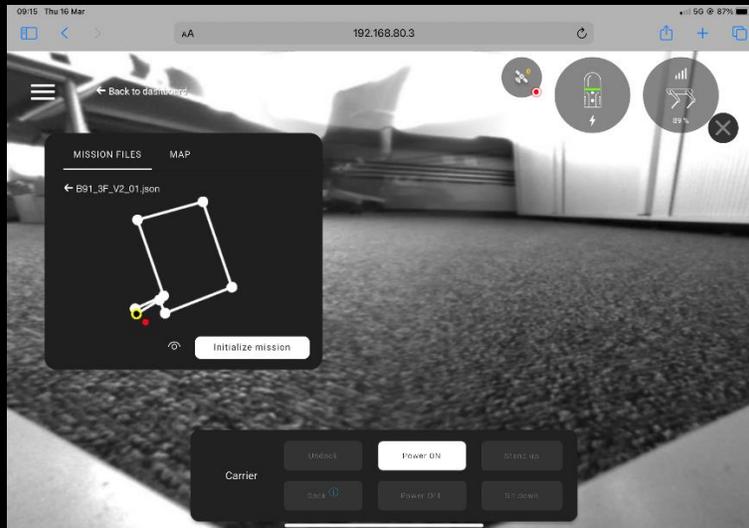
### Autonomous mission without GA03

The predefined mission can be uploaded (\*.json file) to BLK ARC-UI in this panel. Select **Upload mission** button and select the mission file from your local drive. All mission files are stored on Spot CORE. For detailed instructions on how to create a mission file please refer to **Offline mission planning** chapter.



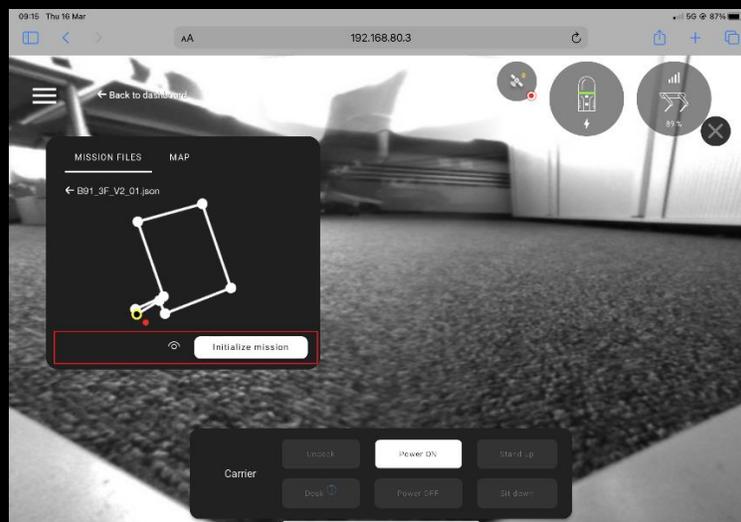
Once the file is uploaded, choose the mission from the list. The preview of the selected mission will appear.





By default, each mission requires a continuous connection between BLK ARC-UI and the robot's WiFi. This means that every time you close the tab with BLK ARC-UI, lock the screen of your mobile device or disconnect from the robot's WiFi, the robot will sit down, and the mission will be interrupted.

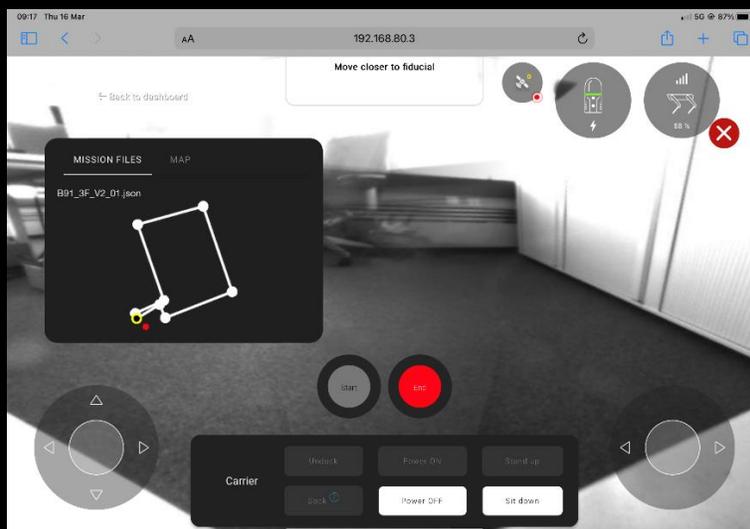
**Important:** In controlled and safe environments (on your own risk), it is possible to turn on **Unobserved mode** by selecting the icon and run a mission where a connection between the robot's WiFi and the remote device is not required. When running mission in Unobserved Mode, the mobile device with BLK ARC-UI may be disconnected from the robot's WiFi after starting the mission. Once the mission is selected, with or without the Unobserved Mode enabled, simply select the **Initialize Mission** button to begin. After that, the robot will power on. The status of the mission is displayed at the top of the screen.



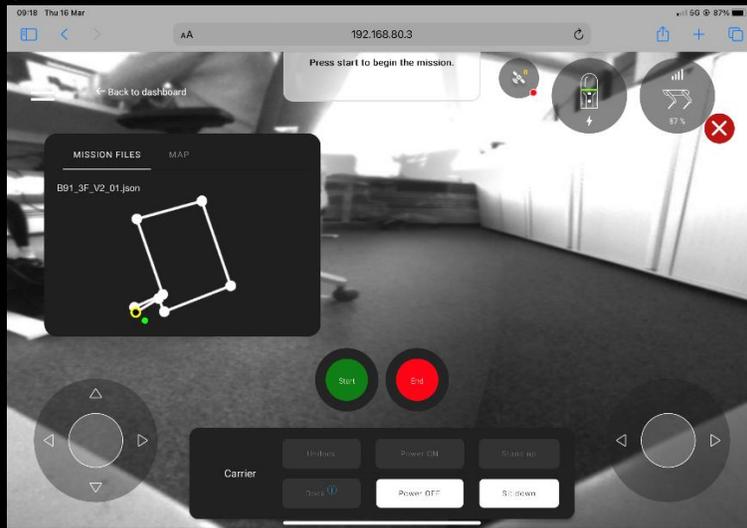
When the robot is running, the **E-Stop** is activated in the top right corner. For an emergency stop of the carrier, press, and hold the red cross icon. As soon as the button is released, the robot will sit down, and the mission will be aborted.



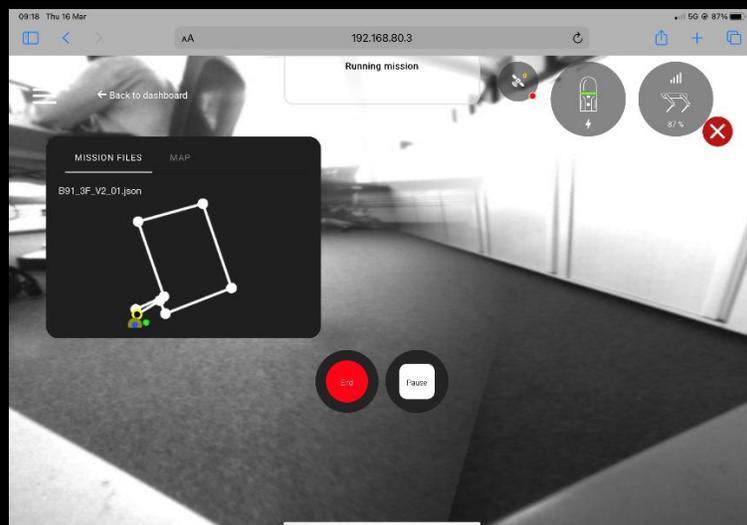
After powering on the carrier, the robot control panel appears. Use the remote joysticks to move the robot within the range where the fiducial can be detected.



When the robot will detect the fiducial, the **Start Mission** button is enabled. Once the mission has started, BLK ARC will initialize the scan (yellow LED blinking) and start scanning while the robot completes the mission.



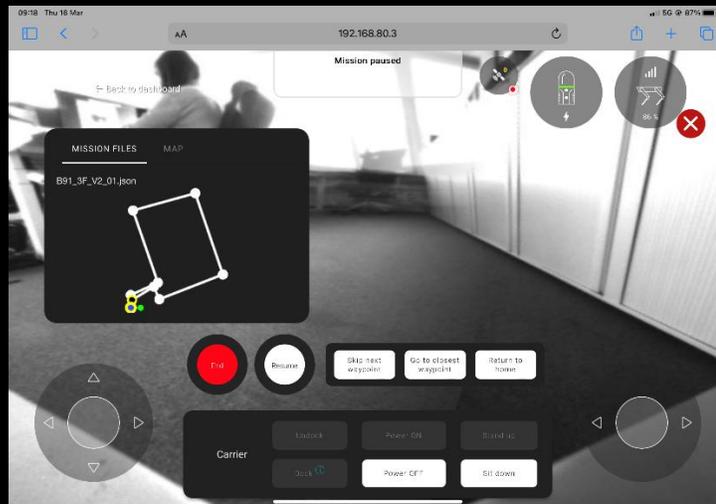
During the mission, the operator can **Pause** or **End** the mission. While the mission is paused, the **control panel** for the robot appears. The operator can manually move the robot and **Resume** the mission anytime. Please note, that in this case the BLK ARC module is continuously collecting the data.



In the mini map window, the red dot represents the position of the fiducial which hasn't been recognized yet. Once fiducial has been detected the dot changes its color to green. In the mission preview, the robot's current position is marked with a flashing blue dot. The planned trajectory is marked with white lines and dots. Yellow dots represent static scan positions. The next waypoint is marked with a black dot. The green part of the trajectory represents the part of the mission that has already been completed.

When the mission is paused, the user has the choice to navigate the robot using the joysticks if needed and utilize one of the following options:

1. **Skip next Waypoint** - the robot will skip the next waypoint and go directly to the following one. It is possible to skip multiple waypoints by selecting this function the desired number of times.  
**Important:** If the waypoint includes docking the carrier, that action will also be skipped.
2. **Closest Waypoint** - the robot will go to the nearest but not yet visited waypoint and continue the mission from there.
3. **Return to home** - the robot will return to home – to the point where the calibration was completed.



After selecting one of the options above, it is required to press **Resume** in order to continue the mission.

When the waypoint cannot be reached (for example there is an obstacle obstructing the waypoint), the robot will automatically skip it and go directly to the next one. Informing message will pop up on the screen.

When an obstacle is detected on the path, the robot will execute the Local Obstacle Avoidance functionality. It will attempt to plan an alternative path within +/- 3m from the original path and the current position of the robot.

**Important:** The Local Obstacle Avoidance does not detect dynamics or moving objects.

If that will not be possible, the carrier will stop and induce the **Return to Home** command after 10 seconds. In case this is not the desired behavior, the operator can **Pause** the mission and remove the obstacle or manually navigate the robot around it, then the mission can be resumed and will continue as planned, or **End** the mission.

Once the mission is completed, a feedback message will appear on the screen of the mobile device, the robot will sit down and turn off the motors.

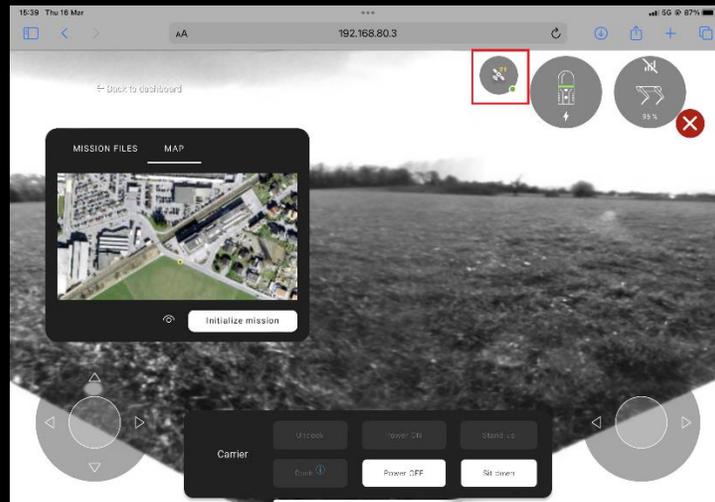
## Autonomus outdoor missions - GNSS

The BLK ARC-UI version 2.0.0 introduces outdoor missions with touch2go navigation, using combination of GNSS signal with GrandSLAM trajectory.

To run such missions the **Leica GA03** GNSS antenna and a mobile device displaying the BLK ARC-UI with **Internet connection** are required.

The GNSS connection must be established to be able to run an autonomus outdoor mission  
Connect the antenna to your SpotCORE and observe the status icon on the BLK ARC UI:

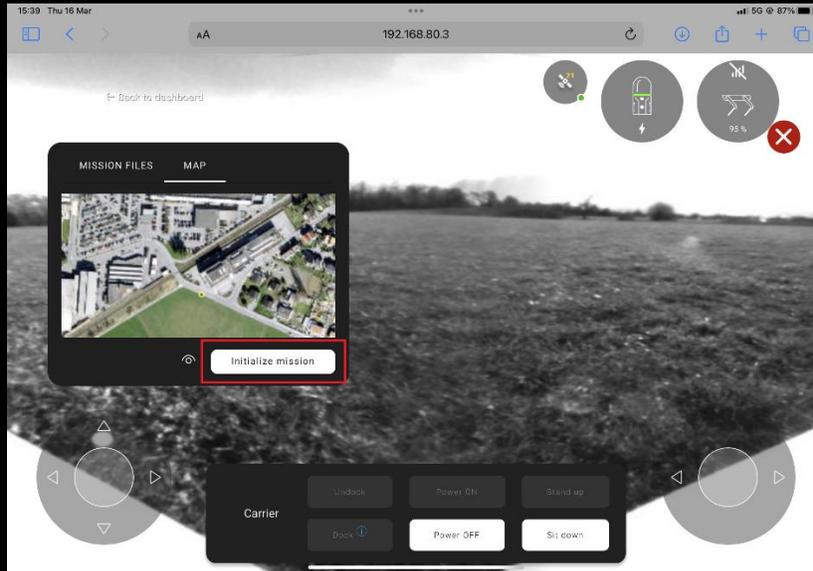
- if the Icon is greyed out – the antenna is not available
- if the icon has a red light – the antenna is connected, but there is no GNSS connection established
- When the light turns orange, it means that GNSS connection has been established, but the quality of the solution is weak.
- When the light on the status icon turns green – the quality of the solution is good.



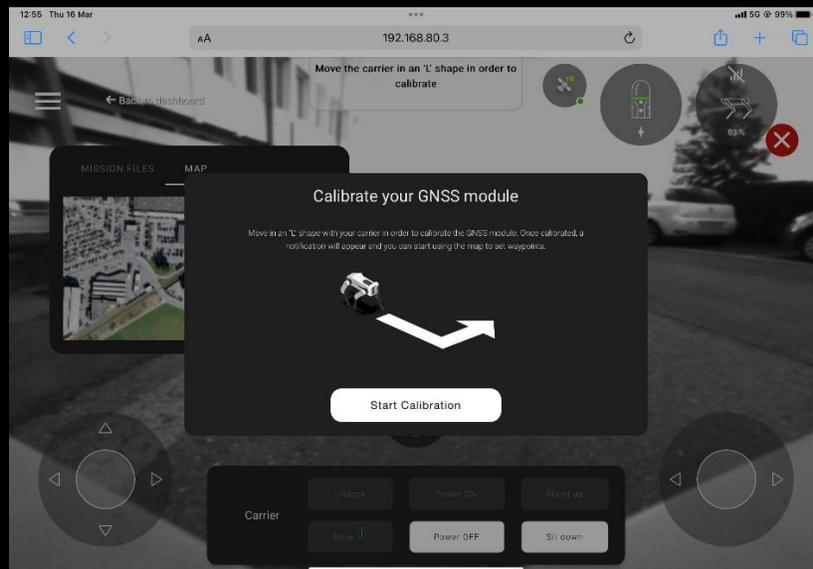
Ensure the best quality of the solution (green icon) before starting calibration of the GNSS module. To do so, move the carrier to best environment possible (open sky area). That will ensure the best mission performance.

It is important to keep in mind that well performed calibration is a key to a succesfull autonomus outdoor mission.

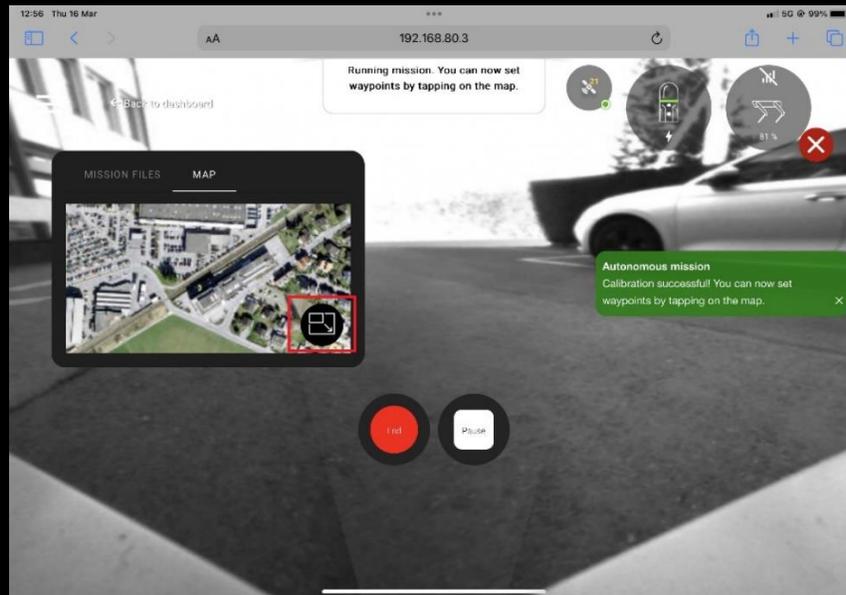
To start the mission, open the **Map** tab and press the **Initialize mission** button.



Press the **Start** button (the button will be available only when the GNSS connection has been established and the status is good (green icon). The scanner will initialize and then you will be prompted to calibrate the GNSS module. Move the carrier in an L – shaped path.



Once the calibration is completed, it will be possible to tap on the map to create waypoints. It is possible to maximize the Map tab for better path planning experience.



After setting a waypoint on the map, an action must be specified between:

- No action
- Static scan

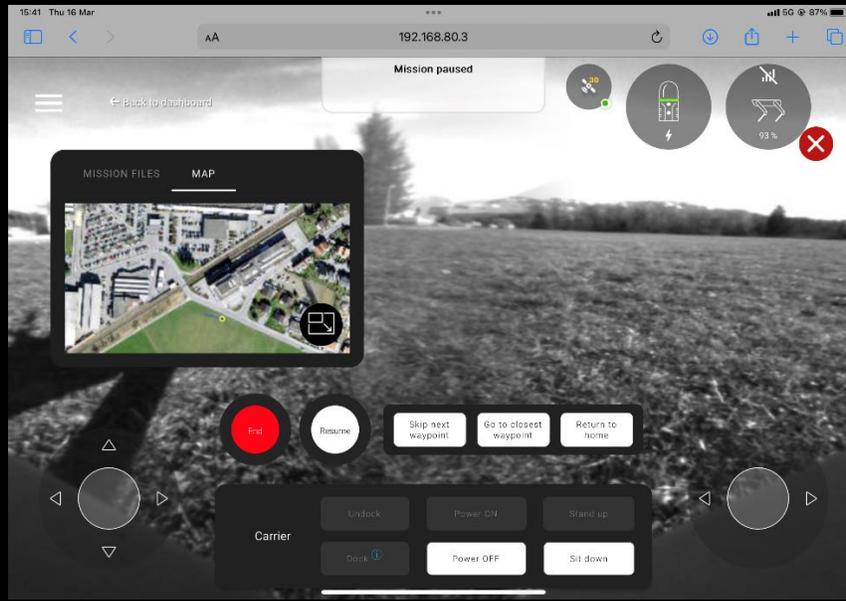
If static scans are desired it is possible to define their types (low, medium, high).

To delete a waypoint - long press on the desired waypoint.

**Important:** You can delete only one waypoint at a time, starting from the one most recently created. It is not possible to delete a waypoint that is already being approached by the carrier, but it is possible to skip it.

It is possible to **Pause** or **End** the mission at any point. After pressing the **Pause** button, the following options are available:

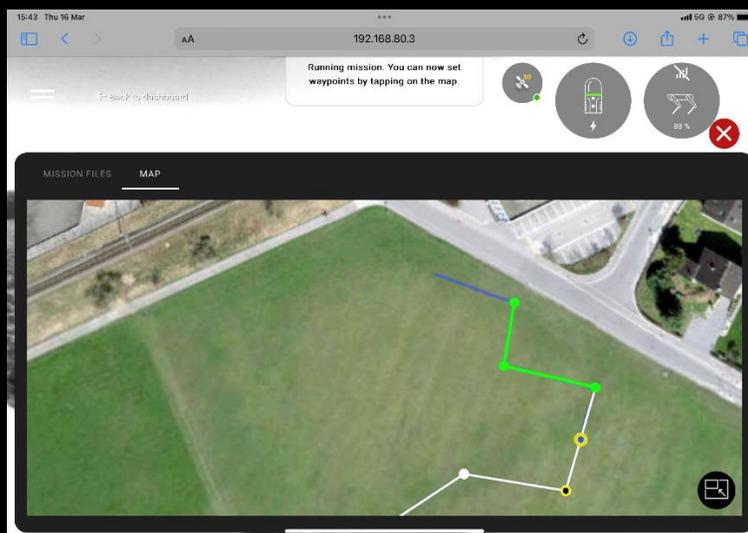
1. **Skip next Waypoint** - the robot will skip the next waypoint and go directly to the following one. It is possible to skip multiple waypoints by selecting this function the desired number of times.
2. **Go to closest Waypoint** - the robot will go to the nearest nearest but not yet visited waypoint and continue the mission from there.
3. **Return to home** - the robot will return to home – to the point where the calibration was completed.



After selecting one of the options above, it is required to press **Resume** in order to continue the mission.

The **Unobserved mode** mentioned in the **Autonomus Missions** paragraph, works and applies the same logic with the Autonomus Outdoor missions. It is important to remember, that this function should be used strictly in controlled and safe environment, and it is at user's risk to make that judgement.

In the **Map** window, the robot's current position is marked with a flashing blue dot. The planned trajectory is marked with white lines and dots. Yellow dots represent static scan positions. The next waypoint is marked with a black dot. The green part of the trajectory represents the part of the planned path, that has already been completed and the blue line represents the actual shape of the path the carrier had walked.



Use the following gestures to control the map:

- Press and slide with one finger to move the map in 2D plane,
- Use the pinch fingers gesture to zoom in and out,
- Use two fingers to rotate the map.

When the waypoint cannot be reached (for example there is an obstacle obstructing the waypoint), the robot will automatically skip it and go directly to the next one. Informing message will pop up on the screen.

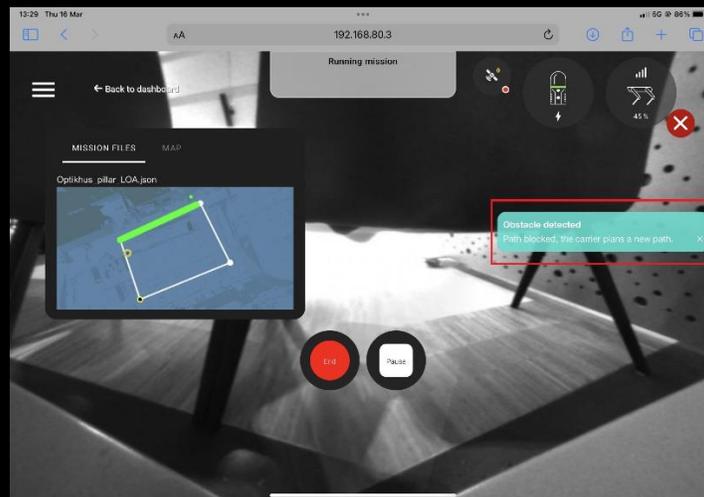
When an obstacle is detected on the path and it cannot be avoided within small distance and random walk, the robot will stop and if within 10 seconds the user will not take any action, the carrier will execute the **Return to Home** command. In case this is not the desired behavior, the operator can **Pause** the mission and remove the obstacle or manually navigate the robot around it - then the mission can be Resumed and will continue as planned or **End** the mission.

The user can end the mission at any moment by pressing the **End** button, a feedback message will appear on the screen of the mobile device, the robot will sit down and turn off the motors.

### Improved Local Obstacle Avoidance

If during the autonomous mission an obstacle is detected on the planned path, the robot will attempt to find an alternative path to get to the next waypoint, in a more efficient and intelligent way than previously.

The new solution uses live streamed BLK ARC LiDAR data to plan new path around an obstacle, in the real time. The feature bases on a local environment, it means that the new trajectory will be planned only within 3 meters from the original path and from the current position of the carrier.



When the carrier reaches an obstacle, it will stop, and a notification will pop up on a BLK ARC-UI. The robot will proceed planning the new path and if within 5 attempts it will not be able to find a way around, the **Return to Home** command will be triggered. Before it will be executed the user has 10 seconds to take an action to avoid that. This can be pausing the mission and manually walking the

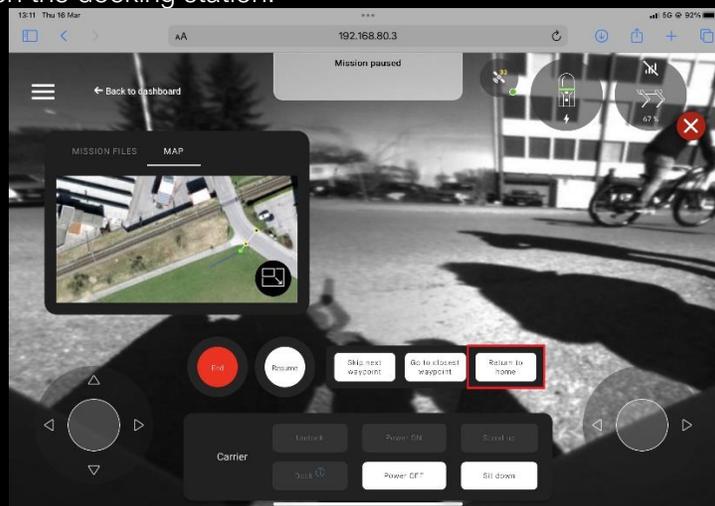
carrier around the obstacle, after that the mission can be resumed and will be continued as planned. Otherwise, the carrier will proceed returning to the starting point of the mission.

The upgraded Local Obstacle Avoidance functionality is currently not enabled for the **Outdoor Autonomous Mission**, but the previous solution still supports it.

## Return to Home command

The BLK ARC-UI version 2.0.0 introduces new command – Return to Home. The user can execute it during any autonomous mission.

Return to home practically means that the carrier will go back to the place where the mission has begun (beside the Fiducial or where the Visual Initialization succeeded). For the Autonomous Outdoor Mission it is the end of the calibration path (L), for missions with docking station – the robot will go back and sit on the docking station.



The **Return to Home** command will be executed automatically when the carrier will reach an obstacle on its path and will not be able to avoid it.

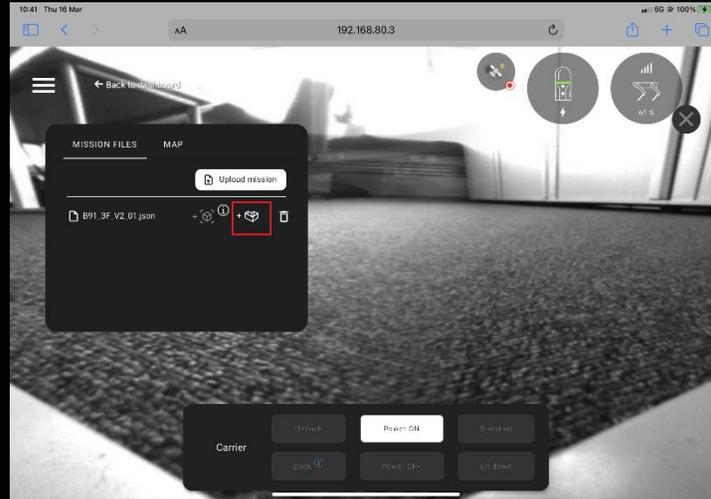
In more complex missions (with many loops) the carrier will follow the shortest path to return. For simple missions, where the path does not cross, the robot will revisit all the waypoints before reaching Home.

In cases where the E-Stop has been triggered during a mission – to perform the **Return to Home**, it is necessary to first press the **Power ON** button and then **Return to Home**, otherwise the mission will be aborted.

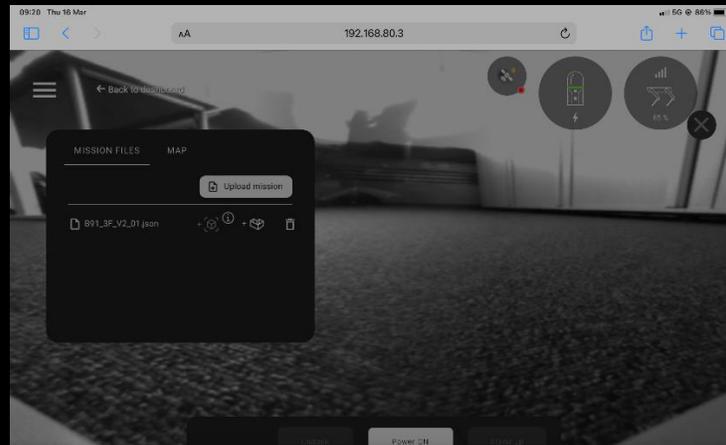
## BLK ARC Pose optimization

BLK ARC-UI version 1.2.0 includes additional pose optimization during autonomous mission, that allows the user to import an additional \*.obj file to optimize the current position of the carrier. This 3D model will improve the navigation of the robot during the autonomous missions and minimize the misalignment caused by inaccurate fiducial placement and/or its inaccurate detection when the mission starts. For detailed instructions on how to export an \*.obj file in the correct coordinate system, please refer to the **Offline mission planning** chapter.

Once 3D model is exported, attach uploaded earlier model by pressing the icon marked below, in the **Autonomous** mission panel.

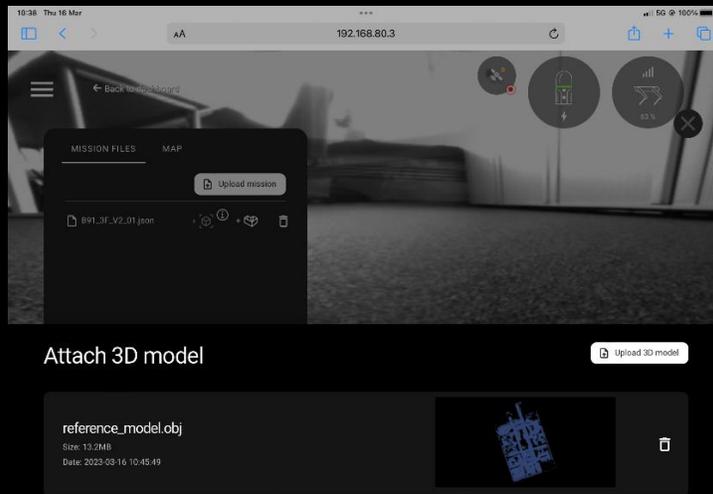
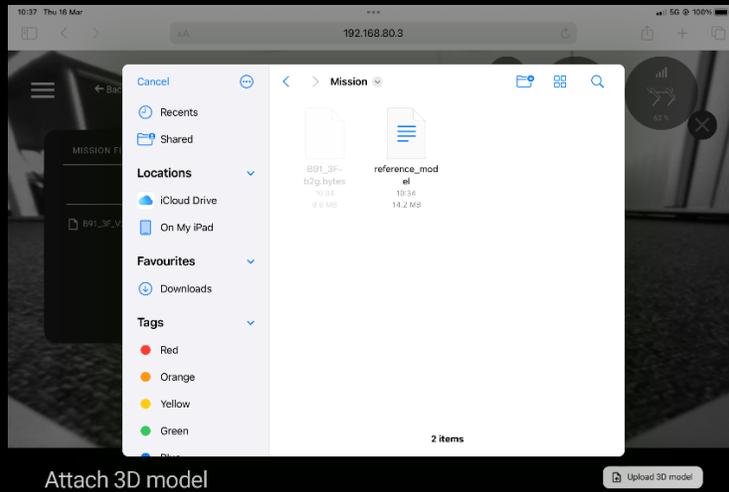


A side menu will appear on the bottom of the screen. In this menu you can either select a 3D model by clicking on the proper row or upload a new one. Once the model is uploaded, select the desired file by clicking on it. It is possible to use the same model for multiple missions, if they were planned on the same file. You can also navigate into preview of the 3D model.

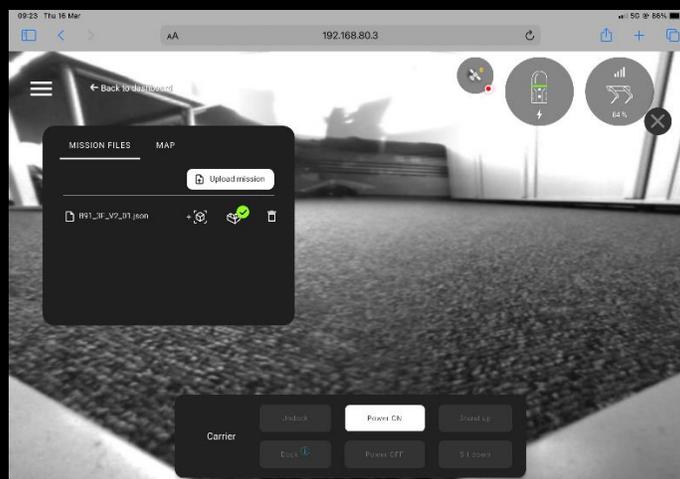


Attach 3D model

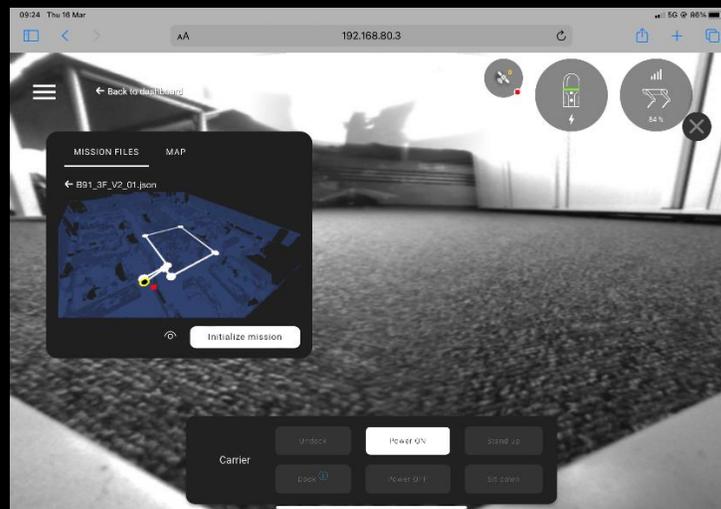
Upload 3D model



Once the 3D model is attached to the mission, the icon will change. To detach the model, you can press the icon twice. The icon will represent the current status.



Select the mission with the 3D model attached. **Mission visualisation** tab will show the preview of the mission aligned with the attached 3D model. If the map is not correctly aligned to the 3D model, check if the \*.obj was exported correctly and if proper \*.obj file is attached. **Initialize mission** in order to begin capturing the data.



During the mission, it will always be possible to pause it, skip the waypoint or go to the closest waypoint.

**Important:** Logs downloaded after a mission with the pose optimization will include the last *light version of a point cloud* used for pose optimization during last mission. In case any support is required, sharing logs including this data will allow to troubleshoot in case of unexpected behaviour.

### BLK ARC Visual initialization of autonomous mission

BLK ARC-UI version 1.3.0 allows to start a mission without a Fiducial being physically placed on site. For repetitive missions, the user can benefit from previously captured \*.b2g file to automatically create a 3D map (\*.bytes files) of the environment within the HxDR platform. Then it is possible to upload this 3D map file to the BLK ARC-UI and use it as a digital representation of the environment in which BLK ARC scanner can localize itself to start an autonomous mission.

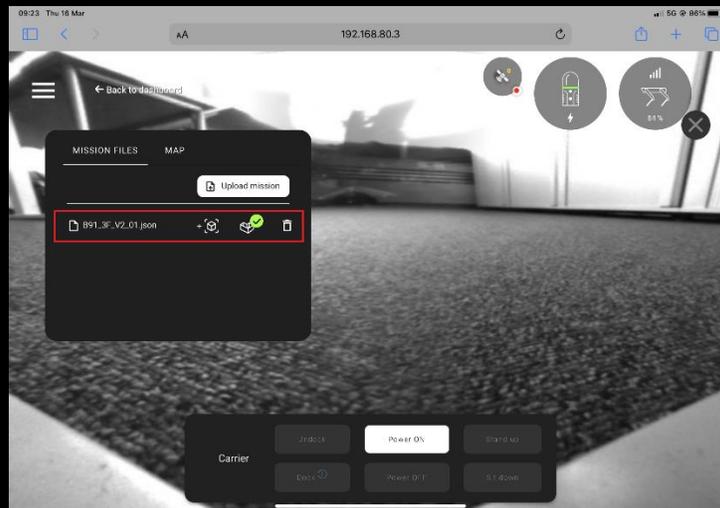
**Important:** Any \*.b2g file coming from BLK ARC but also BLK2GO can be used for the 3D map file (\*.bytes) creation.

For detailed instructions how to prepare 3D map file (\*.bytes) and corresponding mission files please refer to the **Offline mission planning** chapter.

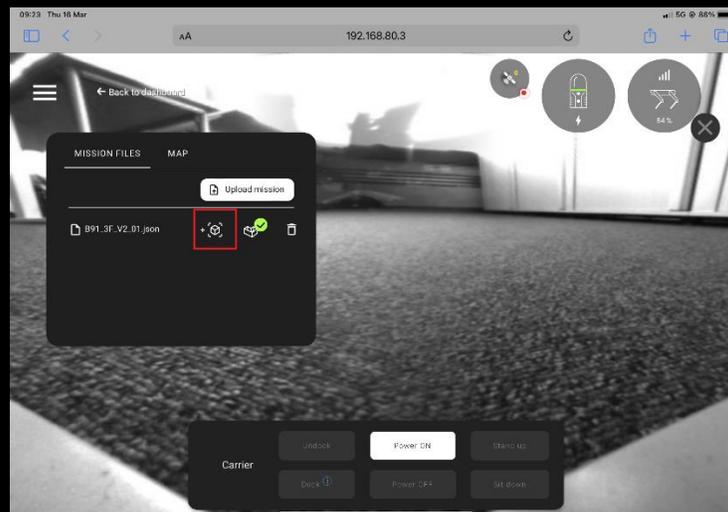
**Important:** Enabling the Visual Initialization is possible only together with the **Pose optimization**. It is highly recommended to use 3D model (\*.obj) and 3D map (\*.bytes) out of the same \*.b2g file downloaded and unchanged, directly from HxDR platform. If the 3D model is detached, the 3D map will be automatically detached too.

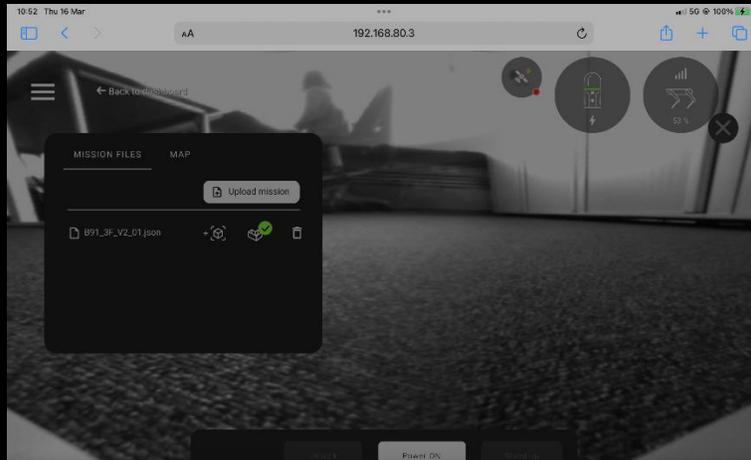
Below is the instruction on how to execute the mission using the **visual initialization** for autonomous mission in BLK ARC-UI.

First - load mission file (\*.json) and corresponding 3D model (\*.obj) for pose optimization. Make sure that both of the files are attached as shown on the picture below.



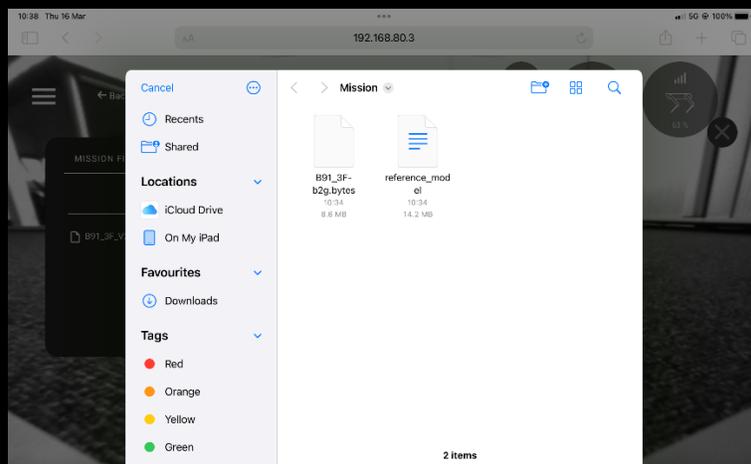
Press marked icon in order to upload & attach a 3D map to your mission file.  
**Note:** Icon for attaching 3D map is disabled if 3D model is not attached yet.





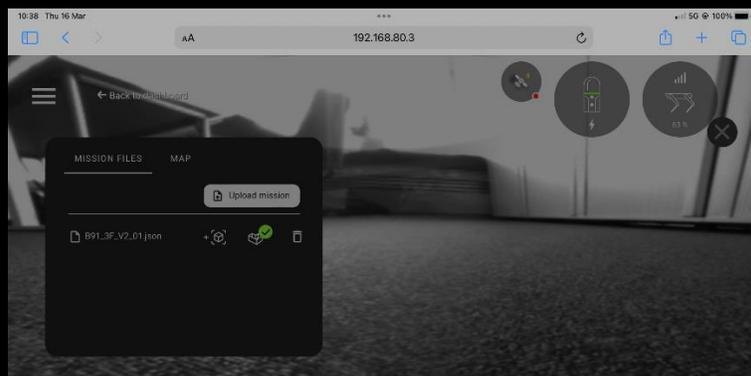
Attach 3D map

Upload 3D map



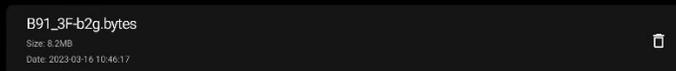
Attach 3D map

Upload 3D map

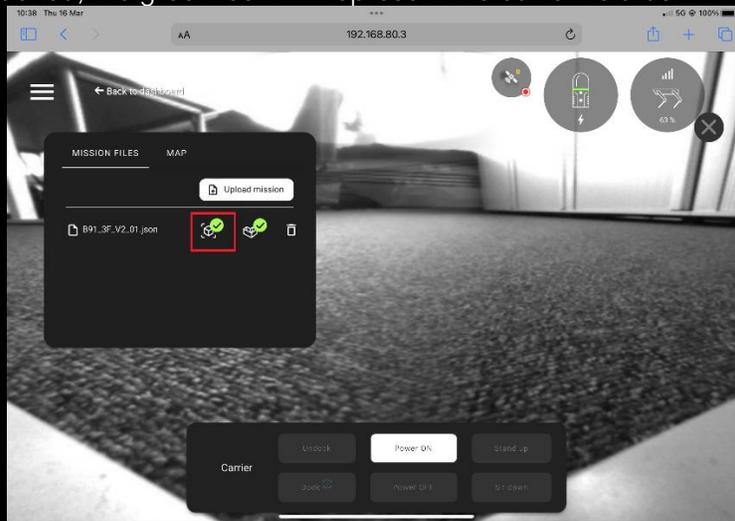


Attach 3D map

Upload 3D map



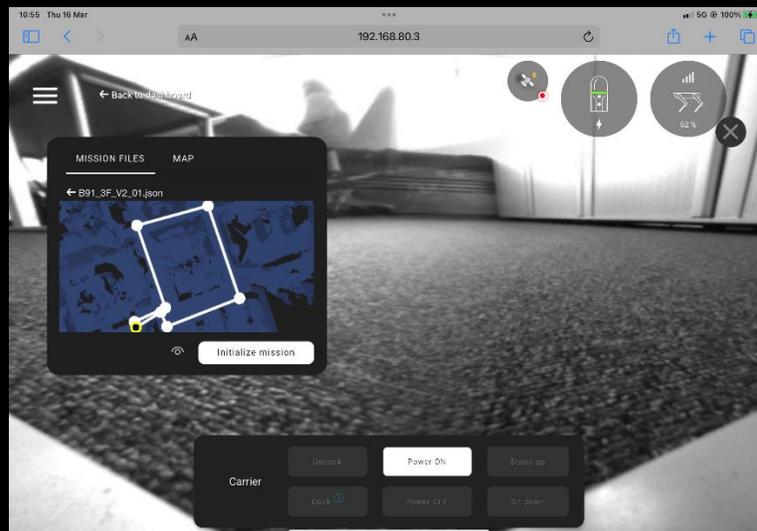
Once 3D map is attached, the green icon will represent the current status.



It is possible to use the same 3D map (\*.bytes) for multiple missions, as long as the missions were planned using the same files and cover the same and complete area.

Click twice on the visual initialization icon in order to detach 3D map.

Once all the files are attached, select the mission file and initialize the mission.



Place the robot near the first mission point. It is crucial that the front of the robot, precisely - the detail camera of the BLK ARC, is pointed towards the scene that contains visual features which coincide with the features within the scan file (\*.b2g) used for creating the 3D map.

After pressing the start button, the mission will begin as usual, i.e. the robot as well as the scanner will start additionally triggering a picture which will be used for visual initialization, after the initialization succeeded, the initial pose optimisation will be calculated and the mission will continue. In case the visual initialization fails, rotate the robot or move it around the first mission points to improve the vision of the scene and repeat.

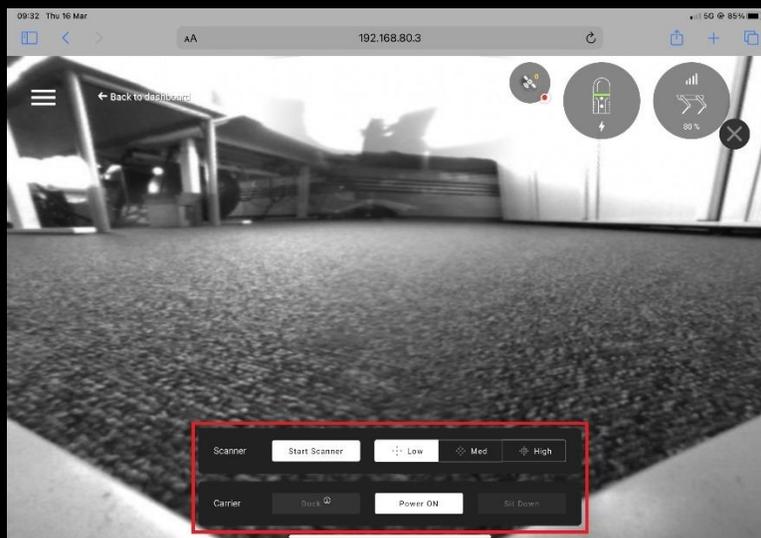
**Important:** The quality of the Visual Initialization depends on the quality of the image taken at the beginning of the mission as well as on the quality of the 3D map. This means that the best possible and the same lighting conditions should be ensured when collecting a scan for the 3D map and during the visual initialization.

In case the visual initialization fails after several attempts, it is still possible to run the same mission with the traditional method of starting the mission using Fiducial.

**Important:** Logs downloaded after a mission started with the visual initialization will include black and white pictures used for initialization of the mission as well as last *light version of a point cloud* used for pose optimization during last mission. In case any support is required, sharing logs including this data will allow to troubleshoot in case of unexpected behaviour.

## Control (5)

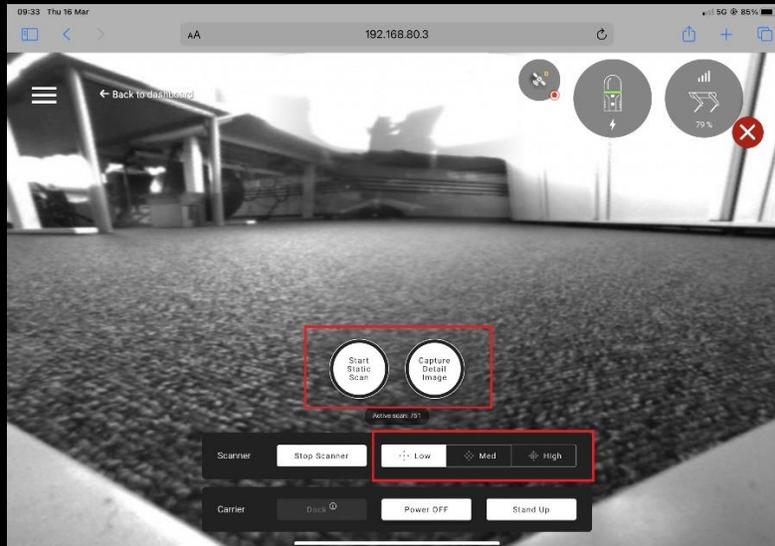
In addition to the mission planning panel, BLK ARC-UI allows the manual control of the robot and BLK ARC. **Start** the scanner and / or carrier to collect the data and use the **remote joysticks** to control the robot's motion.



**Important:** From the control panel, the scanner and robot can be operated independently. In this mode, BLK ARC does not provide the carrier with any navigational support, so this control panel can only be used to operate the robot.

If a docking station is available, the control panel also allows to dock and undock the robot. The buttons are enabled only when the robot is close to the docking station and can detect it.

To initialize a scan while the carrier is controlled manually the following workflow is recommended – start the carrier and move it to a standing position, move the carrier using joysticks to a place sufficient for scan initialization, start the scanner.



After the scanner has been initialized, it is possible to trigger static poses manually in the following modes:

- Low – 10 sec
- Med – 30 sec
- High – 60 sec

Please predefine the desired duration of a static scan before each static scan.



Make sure there is enough space around the robot during the static scans as the robot will move to the tripod position. During a static pose, the manual control panel will disappear to prevent unintentional movement commands. The countdown till the end of the static scan will be displayed. During tripod pose, the robot's collision avoidance is working and in rare cases, when collision is

detected, the robot may move. In such situation the static pose should not be used by the user in post processing. The dynamic scan collection will remain.

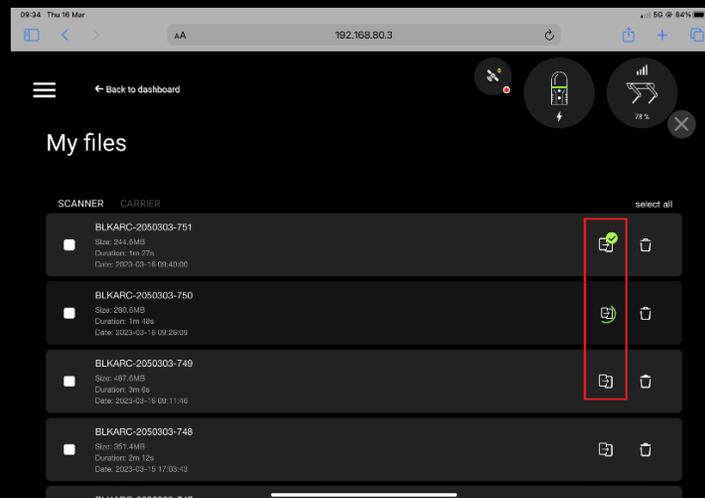
Once the static scan is complete, BLK ARC continues to collect the point cloud in dynamic mode and the operator can continue to manually navigate the robot.

The scanner does not take any detail images at the very beginning and at the very end of the static scan. Capturing detail images, is possible from a control panel using the **Capture Detail Image** button.

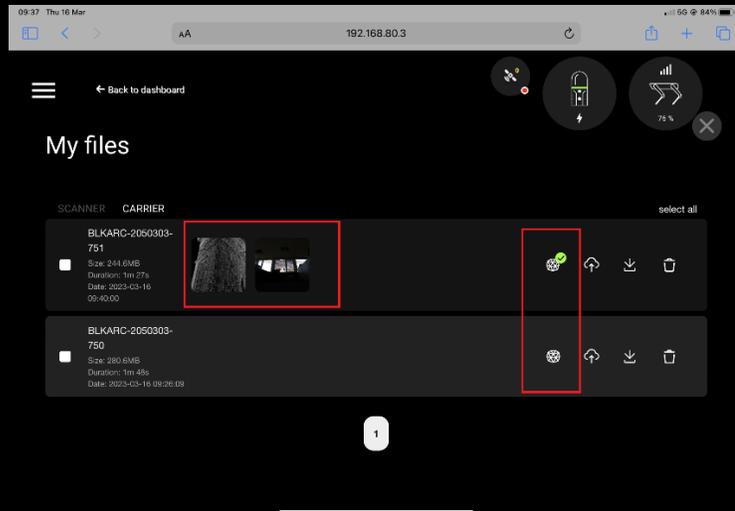
## My Files (6)

In **My Files** panel there are two tabs available:

- **SCANNER** –list of all scans available in the internal memory of BLK ARC module. To download / process / upload to the cloud select transfer icon. During the transfer the progress circle appears. Select delete icon to delete the scan permanently from the scanner. Please make sure to trigger the transfer of the scans from Scanner to Carrier only once the scan is finished.



- **CARRIER** –list of all scans that has been transferred from the scanner to the carrier. Once the file is transferred to carrier, it is possible to trigger the processing which will extract detail images, export e57 point cloud and will allow for further transfer of e57 to USB stick / upload to HxDR or download via browser.



On the left side it is possible to find detailed information about each scan, such as:

- Name of the scan
- File size (b2g)
- Duration of the scan
- Serial number of the connected device
- Date and time of a capture

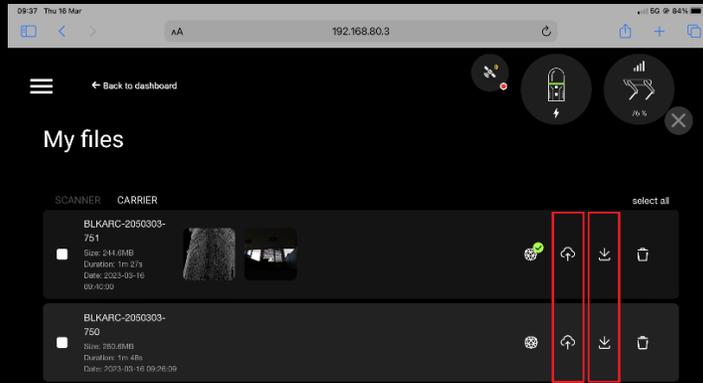
It is recommended to process one by one or a maximum of 2-3 files at the same time. Deleting a scan from a Carrier tab will delete the scan file only from the Spot CORE.

Once the file is available on the Spot CORE (b2g and e57) select **Upload to HxDR** icon to start uploading to the cloud server. For the first upload, the HxDR login page will pop up, enter your credentials, and continue.

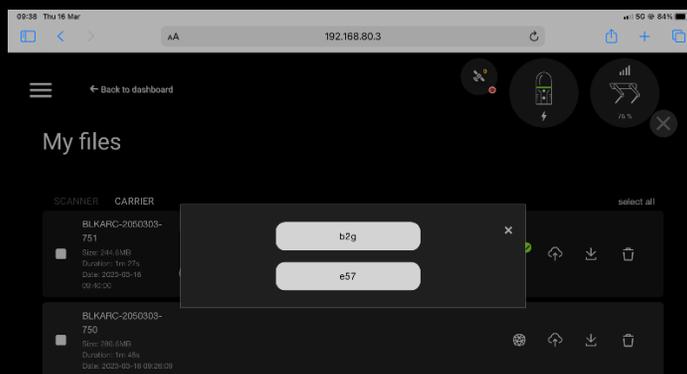
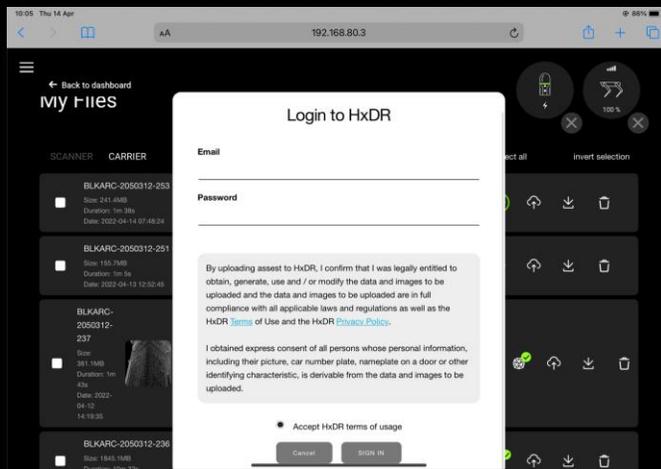
It is recommended to upload b2g files to HxDR for the best quality of a mesh.

BLK ARC-UI provides the option to download the b2g or e57 files (select the **Download icon**)

- **via browser** - using a WiFi connection between the robot and a mobile device on which the BLK ARC-UI is open
- **via USB** – from Spot CORE directly to the USB memory stick connected to the Spot CORE USB-A port. The USB stick must be connected to the Spot CORE before turning on the robot

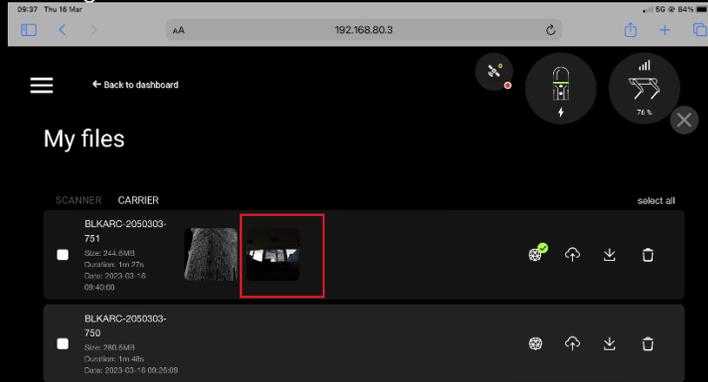


1

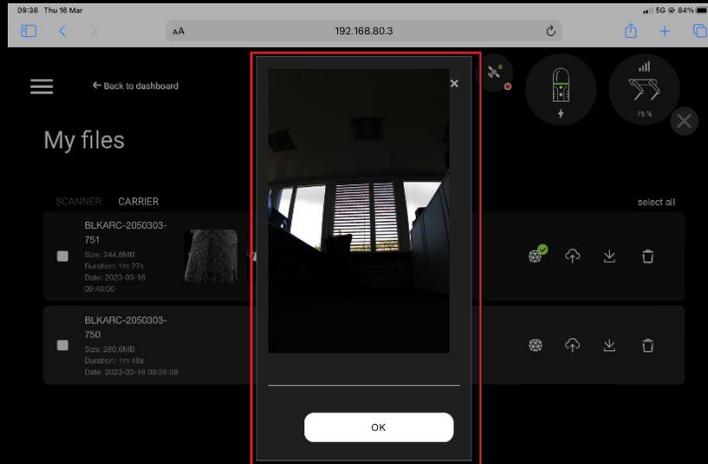


1

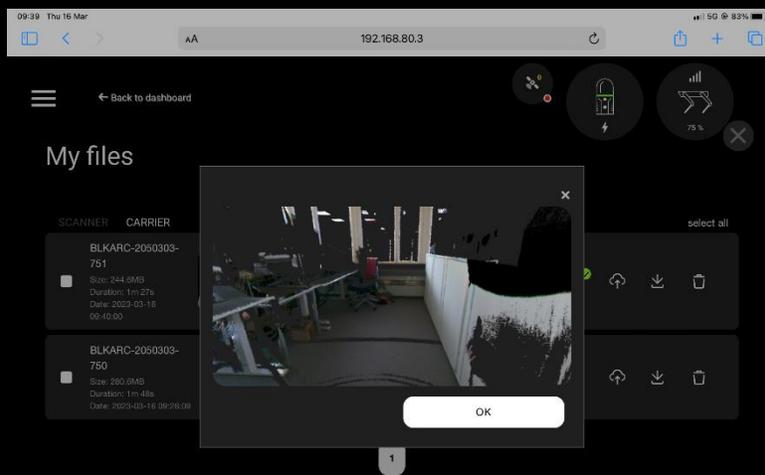
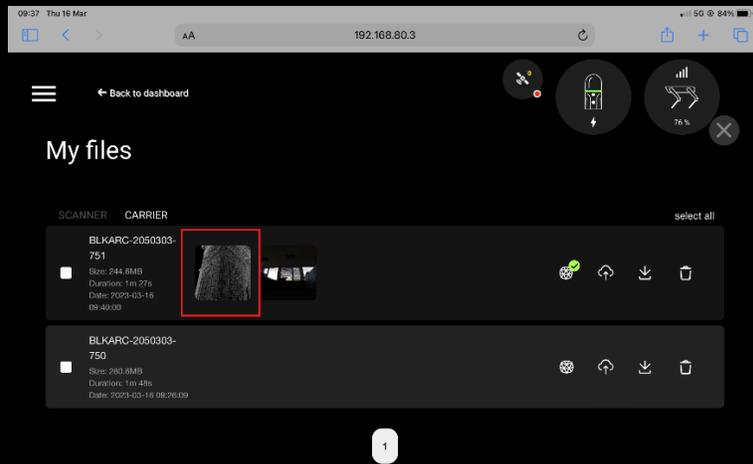
Once the b2g file is transferred from Scanner to Carrier and processed on Spot CORE, and if the detailed camera images have been captured with BLK ARC, the thumbnail will appear, making it possible to preview the image in BLK ARC-UI.



1



If the e57 file is available on Spot CORE, the point cloud preview is available in the BLK ARC-UI. Select the point cloud thumbnail on the left. This will open a window with a 3D preview of the colored e57 file.



On the touchscreen, use the following gestures to navigate in the point cloud:

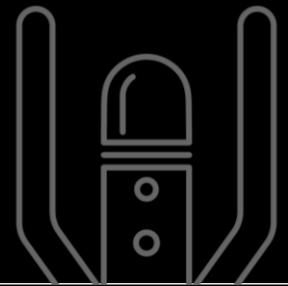
- use two fingers to rotate the point cloud freely
- use the swipe gesture with one finger to navigate through the point cloud
- use pinch finger gestures to zoom in and out of the point cloud.

Using the mouse to navigate, use the following commands:

- left mouse button for panning
- right mouse button for rotating
- scrolling the mouse for zooming.

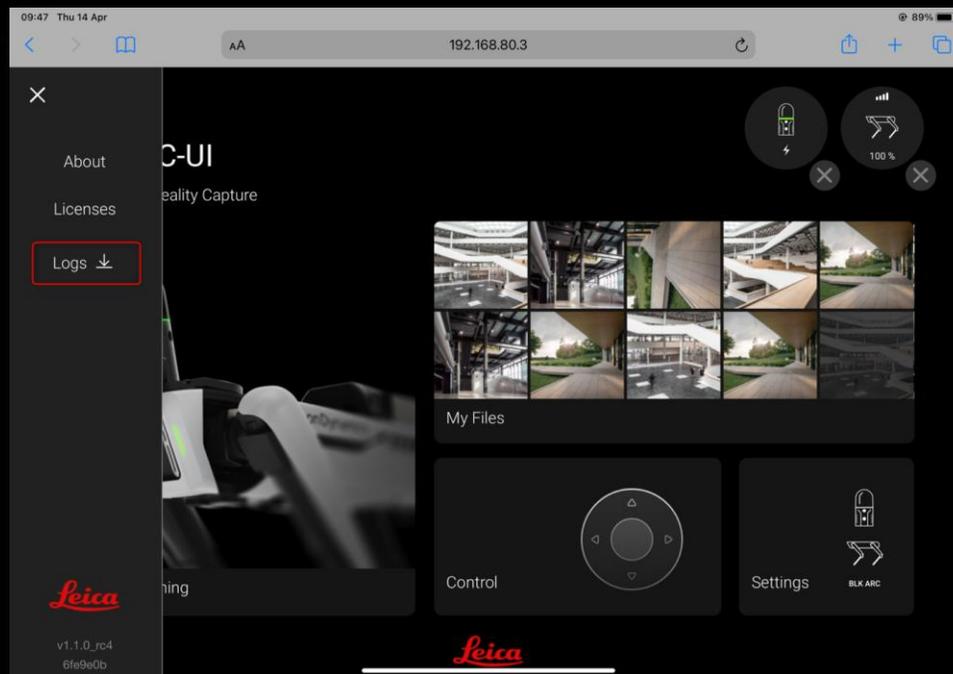
# LEICA BLK ARC-UI

## TROUBLESHOOTING



## STARTING, STOPPING THE SERVICE AND SAVING LOGS FROM BLK ARC-UI

Logs can be copied directly from BLK ARC-UI. Select the **Hamburger menu** → **Logs**. Download all logs and share with the support team.



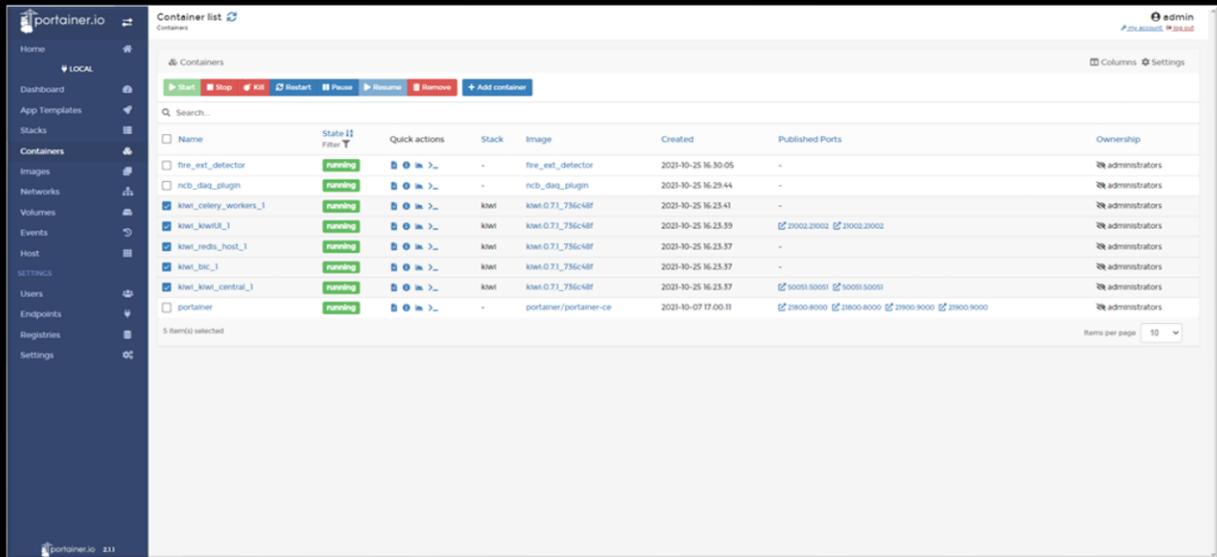
When contacting support team, please also download and share the logs from BLK ARC module (by connecting via WiFi to BLK ARC module directly and accessing 10.1.1.1 in the web browser).

If requested by support for troubleshooting:

The BLK ARC-UI service can be controlled by the Portainer.

Access the Portainer, navigate to Stacks and click on the previously generated stack named BLK ARC-UI. In the menu-bar of the container you can either control the service (start/stop/restart) or generate a log file using the following commands:

- **Restart:** Restart the software in the case an unexpected error occurred (similar to reboot Spot CORE).
- **Start, Stop:** Start or stop BLK ARC-UI. Stop can be used when the service is no longer required.
- **Document symbol:** Access the logs of the software. Once you open the logs, select all, copy and paste into empty text document. To ensure that all important logs will be attached, it is recommended to change Lines value into +100000 in the Log viewer settings. Logs should be copied for all Container that are running on the Portainer.



## BLK ARC DOES NOT CONNECT VIA CABLE

**Situation:** BLK ARC-UI is available, BLK ARC laser scanner is powered on (solid green LED ring), but BLK ARC-UI has no connection state with BLK ARC module (upper right corner in BLK ARC-UI)

1. Make sure both cables (power cable and USB) are connected. If you reconnect cables on a powered Spot, be sure to reconnect the power cable first and later USB - power must be supplied first; the USB cable also acts as a button press to start the device.  
Refresh the BLK ARC-UI, wait 10 seconds and check if that solves the problem.
2. In BLK ARC-UI, go to Settings and make sure that the active profile is set to **BLK ARC** device and **USB** connection type. Restart the robot.

Refresh the BLK ARC-UI, wait 10 seconds and check if that solves the problem.

3. Restart Stack file on Portainer (or all BLK ARC-UI containers).  
Refresh the BLK ARC-UI, wait 10 seconds and check if that solves the problem.

## BLK ARC-UI DOES NOT REFRESH

**Situation:** BLK ARC-UI is not displaying updated information, such as a live preview of the trajectory status during a mission.

1. Make sure that the WiFi connection between the mobile device with BLK ARC-UI is stable with robot's WiFi.
2. Refresh the page with BLK ARC-UI in the web-browser.

## BLK ARC-UI SOME BUTTONS ARE NOT RESPONSIVE AS EXPECTED

It is recommended to only operate BLK ARC-UI from one mobile device at a time. Also, close any other tabs opened in the browser.

## UPGRADING FIRMWARE OF BLK ARC MODULE

It is recommended to always do a restart of the system after upgrading the firmware of BLK ARC module and BLK ARC-UI (Spot, Spot CORE, BLK ARC).

## BLK ARC-UI AND TIME SYNCHRONIZATION ISSUE

If this issue happens, please restart **Stack** file on **Portainer**.

## “RUN MISSION” BUTTON BLOCKED BY CARRIER PANEL (CHROME BROWSER)

Go to Chrome browser’s settings and change the **Default site view** to **Desktop**.

## UPLOAD TO HXDR FAILS

If upload to HxDR fails after login:

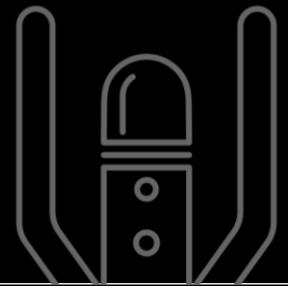
- Try again to upload the scan
- If the upload does not start, please restart the stack.

If ongoing upload to HxDR gets stuck:

- If the process is blocked and does not progress, please restart the stack.

# LEICA BLK ARC-UI

## BEST PRACTICES



## INTRODUCTION

The BLK ARC is a mobile device that uses SLAM technology, which means that best practices that affect the way the device captures its surroundings will ensure the best data capture results.

Check out below the best practices which should be followed, when using the BLK ARC on Spot.

## BEFORE YOU START

Make sure all your hardware is running the latest and compatible versions. The latest installers can be found at [myworld.leica-geosystems.com](https://myworld.leica-geosystems.com). The release notes describe all compatible necessary components.

LEICA BLK ARC-UI  
AUTONOMOUS REALITY CAPTURE

RELEASE NOTES  
BLK ARC-UI VERSION 1.1.0 – 12<sup>th</sup> MAY, 2022

These Release Notes contain important information about the Leica BLK ARC-UI new version 1.1.0.

It is highly recommended to always use the latest version of the BLK ARC-UI and BLK ARS2 firmware in a compatible configuration. Downgrade to older BLK ARC-UI versions to fix reported issues.

BLK ARC firmware	2.2.0
BLK ARC-UI	1.1.0
Cyclone SDR scripts for offline mission planning	1.0
Cyclone SDR	v2021.2 or later
Spot firmware	3.1.1
SpotOne firmware	3.1.0
Postlane	2.1.1 or later
Cyclone REGISTER 360	v2022.0.1 or later
Cyclone REGISTER 360 BLK Edition	v2022.0.1 or later

The BLK ARC-UI installer can be downloaded from [myworld@leica-geosystems.com](mailto:myworld@leica-geosystems.com) customer portal.

WHAT'S NEW

- **My Files** page – redesign and introduced two new tabs (Scanner and Carrier) for easier files management. Improvements in post-processing the files on the SpotOne.
- **Control** page – new docking and undocking functionality.
- **Control** page – remote button for detail image capture.
- **Autonomous missions** – improved performance while executing a mission, automated skipping of waypoints that cannot be reached because of the obstacle, improved local obstacle avoidance while obstacle is on the path between waypoints.
- **Static scans** – removed detail images captured at the beginning and end of every static pose.
- New icon of Internet connection status while using USB WiFi-Dongle for upload scans to HDR.

Leica Geosystems AG, Heerbrugg, Switzerland, 2022

Leica Geosystems BLK

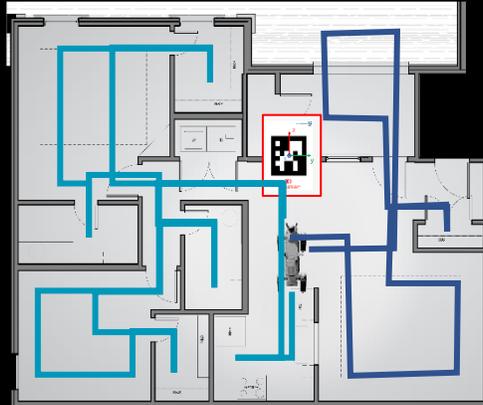
# BEFORE MISSION PLANNING

- Can a single mission cover the entire area?

Keep scan/mission time in mind. Missions should not be longer than the typical scan time. Hours are too long! Divide the mission into several parts if necessary.

The same fiducial can be used in multiple missions.

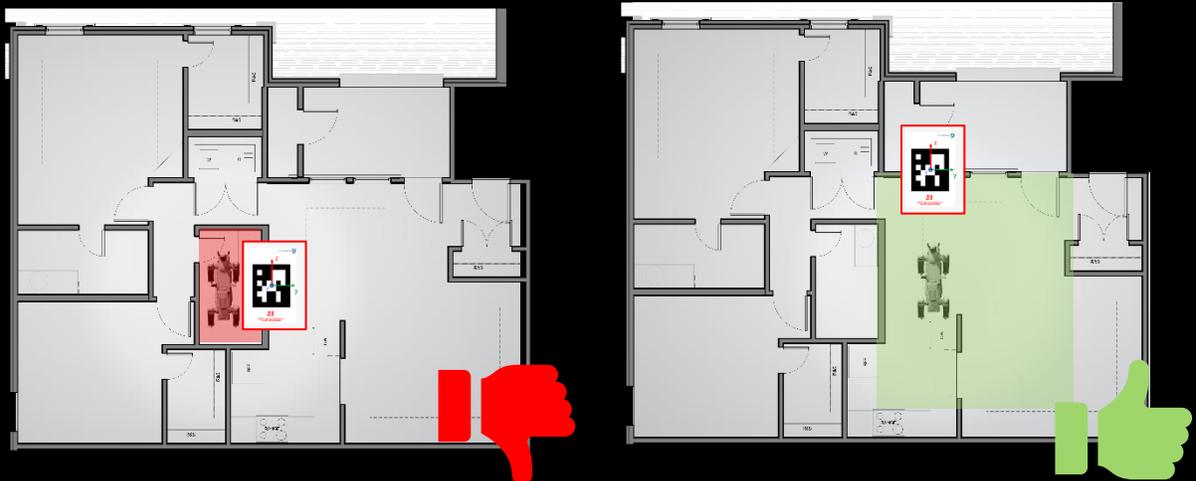
Ensure overlap between paths/scans for good post-processing registration.



- Where is the best place to put a fiducial? = Where is the best place to initialize a BLK ARC scan?

The scan initialization (moment when BLK ARC LED is blinking yellow when starting a scan) is a crucial step in data collection. It will be performed nearby your fiducial, therefore consider placing it in a SLAM-friendly place.

Keep in mind field of view and minimal distance for lidar.



For Spot it does not matter which of the cameras is used to detect a fiducial but consider detecting it with the backside camera especially when fiducial is placed in a corner.



Thanks to that BLK ARC will be positioned a bit further away from walls and possible obstacles, which will allow for capturing good quality data for better SLAM initialization. Please note that for BLK ARC LiDAR the minimum measuring distance is 50 cm.

To ensure best possible data capture results, start with providing best environment for the initialization. Make sure that the device is stable, the robot is not moving and there are no people standing or moving around close to the BLK ARC during initialization. Otherwise, the field of view of the device may get blocked and it will not be able to collect enough information for successful SLAM initialization.



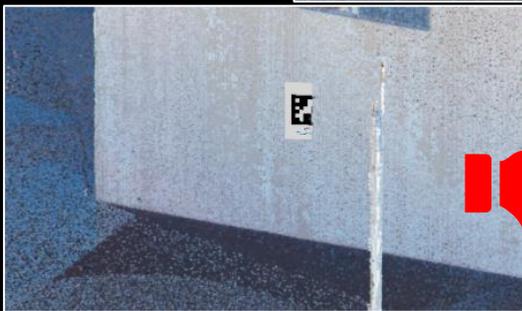
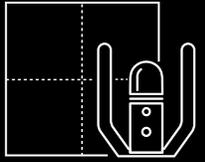
The initialization can take up to 30 seconds. Once LED turns green, the device is ready to be moved, and robot can start walking.

If BLK ARC cannot be initialized, due to unstable position or insufficient number of features around - the initialization process will be aborted, and the LED will turn yellow. In such case, restart the device, correct the position, and then re-try the scan.

# MISSION PLANNING

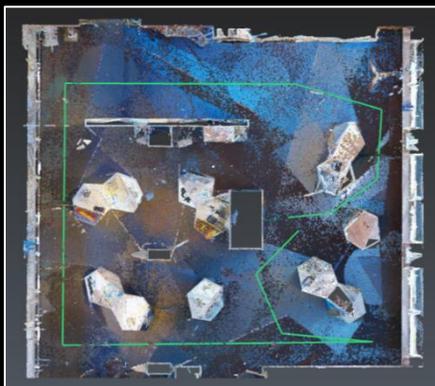
- Fiducial fitting – *BLK ARC Fiducial USC script*

Make sure the plane of the fiducial aligns well with the plane of the wall and properly defines the UCS.



- Draw obstacle free path – *BLK ARC Mission planner script*

There is no limitation to the length between 2 waypoints. Avoid waypoints in tight spaces or very close to glossy or transparent elements. Remember about some limitations of Spot's collision avoidance.



- Does the mission need to start and end in the very same point?

No. This can be considered a good practice for re-observation or other reasons such as keeping the Spot in one place where it rests.

## WHILE SCANNING

- **GrandSLAM is a key to your successful autonomous mission**

When running autonomous mission, the robot is being guided with trajectory from our SLAM solution. It means that the better the SLAM result, the better autonomous mission performance, therefore it is crucial to understand and respect all best practices related to SLAM.

BLK ARC is using GrandSLAM technology which is a combination of Lidar SLAM, IMU measurements and VIS (Visual Inertial System) tracking.

The GrandSLAM requires good lightning conditions and visual features present in the panoramic camera's field of view. If one of the requirements is not fulfilled, the VIS will be switched off and the device will run in Lidar SLAM mode only.

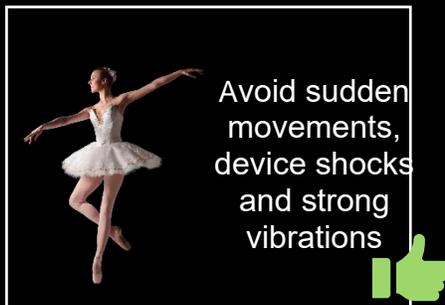
The accuracy and noise range will not be affected, however for the most reliable SLAM performance and especially in SLAM challenging environments (like mines, tunnels, large outdoor areas, long corridors) it is highly recommended to keep device running in GrandSLAM mode.

By default, each scan starts with the GrandSLAM, but once a fallback to the Lidar SLAM occurs, the device will not be able to retrieve the GrandSLAM within that scan.

Please note, that the same logic and behaviour applies to the handheld BLK2GO device.

Considering the GrandSLAM technical details mentioned above, it is recommended to:

Do not stress the IMU, that means move the robot as gently as possible when collecting data with the BLK ARC.



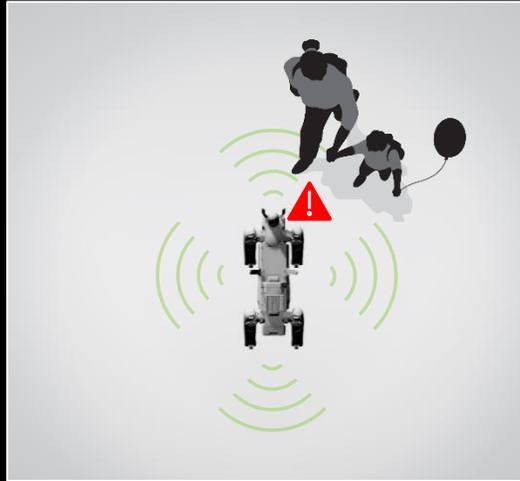
Keep the Lidar's field of view clear, so it can measure as much geometrical information as possible from many different directions.



Ensure the best possible lighting conditions while collecting data. If working in a dark environment, consider mounting additional artificial light source on the robot.



- Remember about safety



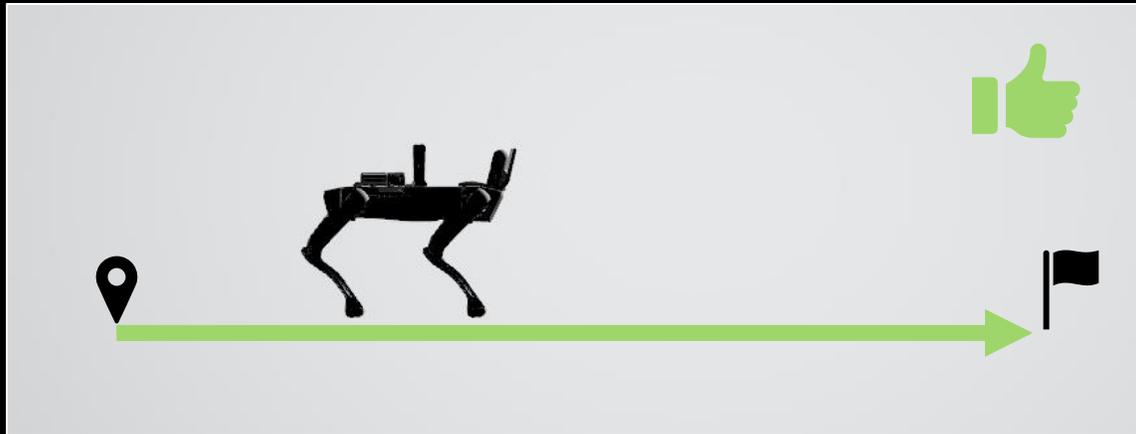
Spot can collide with people or objects. Operator and anyone nearby should assume that Spot may move unexpectedly at any time. Use Spot only in areas where a fall or collision will not result in an unacceptable risk.

The following conditions can hamper the robot's obstacle detection system, which may result in collisions:

Very thin obstacles	< 3 cm in thickness. For example, ladders and tripods.
High contrast environments	Spot's perception system has difficulty with high contrast environments such as very black materials against very bright backgrounds.
Clear materials	Spot cannot see transparent materials and may crash into glass doors and windows.
Short objects	Spot may step on paint cans, buckets, and other objects shorter than 30 cm even with obstacle avoidance enabled.
Moving objects	Spot cannot predict trajectories of moving objects. Do not operate Spot around moving objects such as vehicles, children, or pets.
Elevated obstacles	Do not walk Spot under ropes, tables, scaffolds, or low-hanging but elevated obstacles. These can collide with Spot or its payloads.
Inadequate lighting	Spot requires sufficient lighting to function properly. Even in well-lit environments, shadowy areas may be too dark for Spot to detect obstacles.

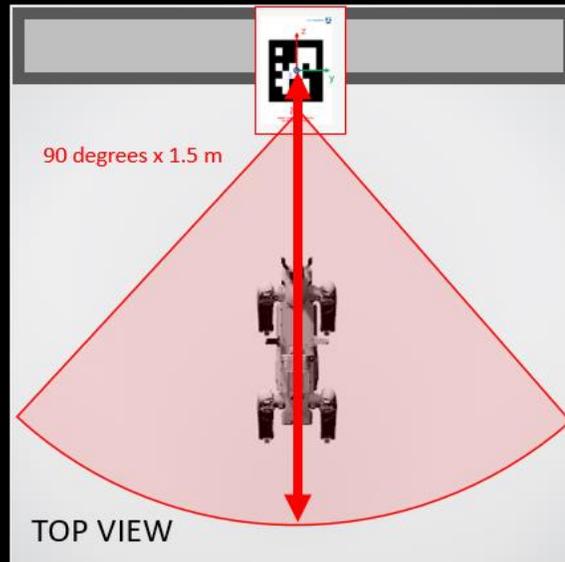
- Avoid following the robot too close

Beside safety aspects, moving objects/people close to the BLK ARC can cover field of view of the cameras and the LiDAR system what naturally causes more challenging conditions for SLAM. To ensure best point cloud quality, minimize the possibility of people walking by, as much as possible. As the Local Obstacle Avoidance function uses live streamed LiDAR data, moving people or objects too close to ARC may hinder the process of planning a new path carried out by the robot.



## STARTING MISSION WITH FIDUCIAL

- Ensure good lighting conditions and position the robot within the range to detect a fiducial.



## VISUAL INITIALIZATION OF AUTONOMOUS MISSION

- Ensure good light conditions when capturing reference scan and when initializing a mission.

The visual initialization is using images, so it is important to make sure the light conditions are good during:

- capturing a reference scan (\*.b2g) which will be used for 3D map creation within HxDR platform
- executing visual initialization to localize robot when starting a mission.

If artificial lights are available, make sure to turn all the lights on. It is vital to have the same source of light on when capturing reference scan and starting visual initialization.

If working with natural light only, the best results will be achieved if the weather conditions are similar. A good practice would be to capture the data during the same time of the day, if mission is outdoor.

- During initialization the BLK ARC needs to see meaningful scene.

When starting a mission with visual initialization, the BLK ARC will capture images with detail camera and use them for re-localizing inside 3D map prepared earlier based on scan (\*.b2g file).

Therefore, it is important to point the camera of BLK ARC towards a scene which contains many visual features and where these features are spread around, rather than placed on one single plane in 3D space. That will ensure highest success rate for visual initialization.

Important: Pointing the camera towards a source of light will make the image partially over or underexposed. Try to avoid it.



Well exposed image and with non-planar visual features will make visual initialization more successful.



# AFTER DATA CAPTURING

- Re-observation for reducing SLAM drift in post-processing

If you are scanning in a harsh environment where SLAM drift can occur, remember to revisit the same places during the scan, so that the re-observation can be calculated in postprocessing. Instead of having a large loop, it is better to plan path to have medium sized loops that cross each other with significant overlap.

