Networking

- Spot Wi-Fi Range extender
- Network connection to Spot (WiFi)

Spot Wi-Fi Range extender

To-Do

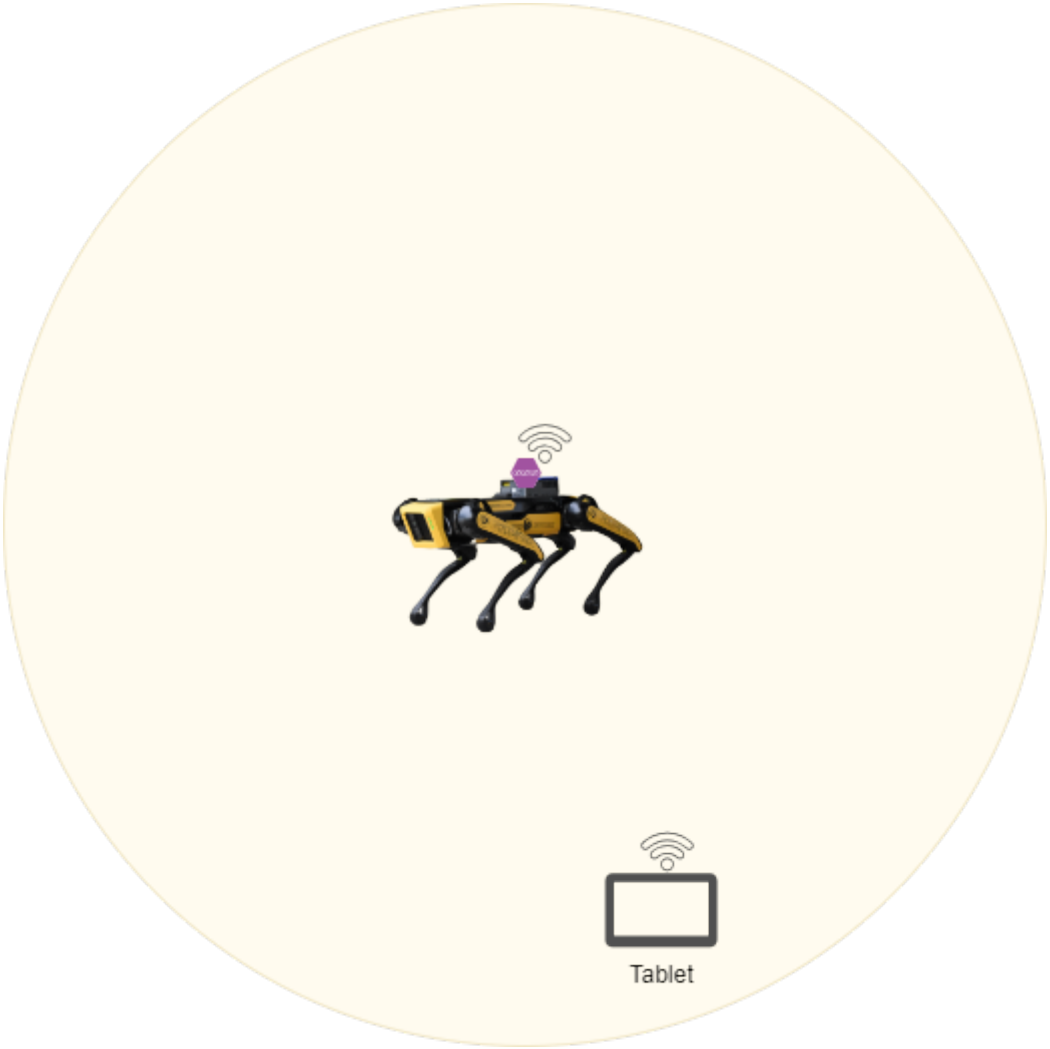
- Setup mesh network
- Test mesh network performance

Parts list

- Boston Dynamics Spot (If your following this guide I would certainly hope you have one or plan to get one)
- CORE I/O
- Wireless Access Point (WAP) (if your WAP has a 12v input you can use a barrel jack otherwise most use Power Over Ethernet (POE))
- Ethernet cable (you will need 2 cables if using a POE injector)
- POE injector
- Male Barrel jack.

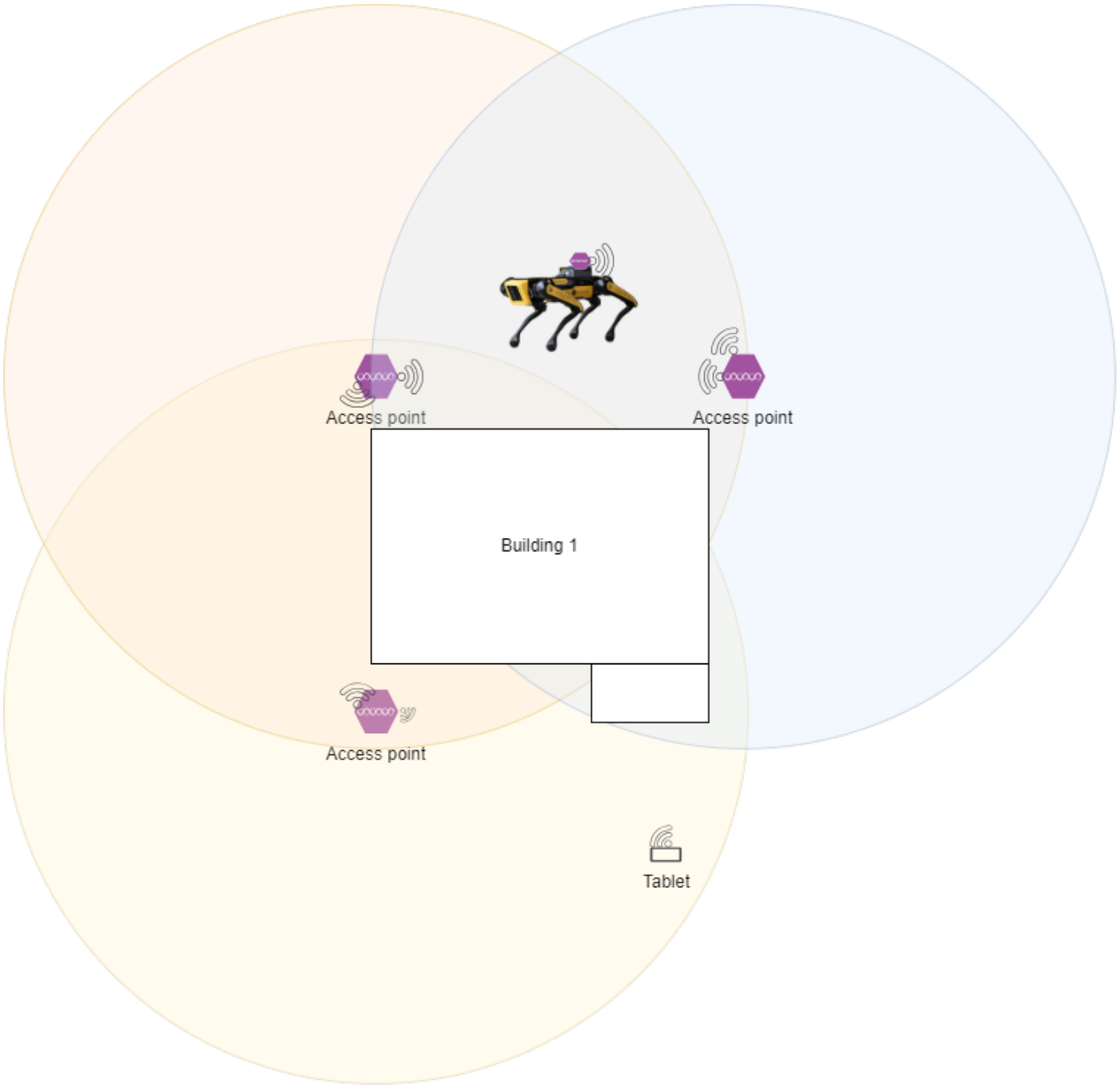
Topology

Single node



In the single node topology you can see we have one WAP that is mounted to Spot. This outdoor AP has a much greater range than Spots regular Wi-Fi allowing for the user to control him at much longer distances.

Multinode (mesh)



In a multinode topology we have multiple WAP's that connect together wirelessly to form a mesh network that cover a much larger area. In the case above we could cover the entire outside of the building without ever losing connection. This setup does include the WAP that is attached to Spot from the signal node topology because Spot will still benefit from the extra range.

> This setup may not be compatible with all standard WAP's as a mesh network is often an extra feature.

Setup

Spot

To configure a Spot to support either of the two setups above there is not much you need to do, however, here are a few suggested actions:

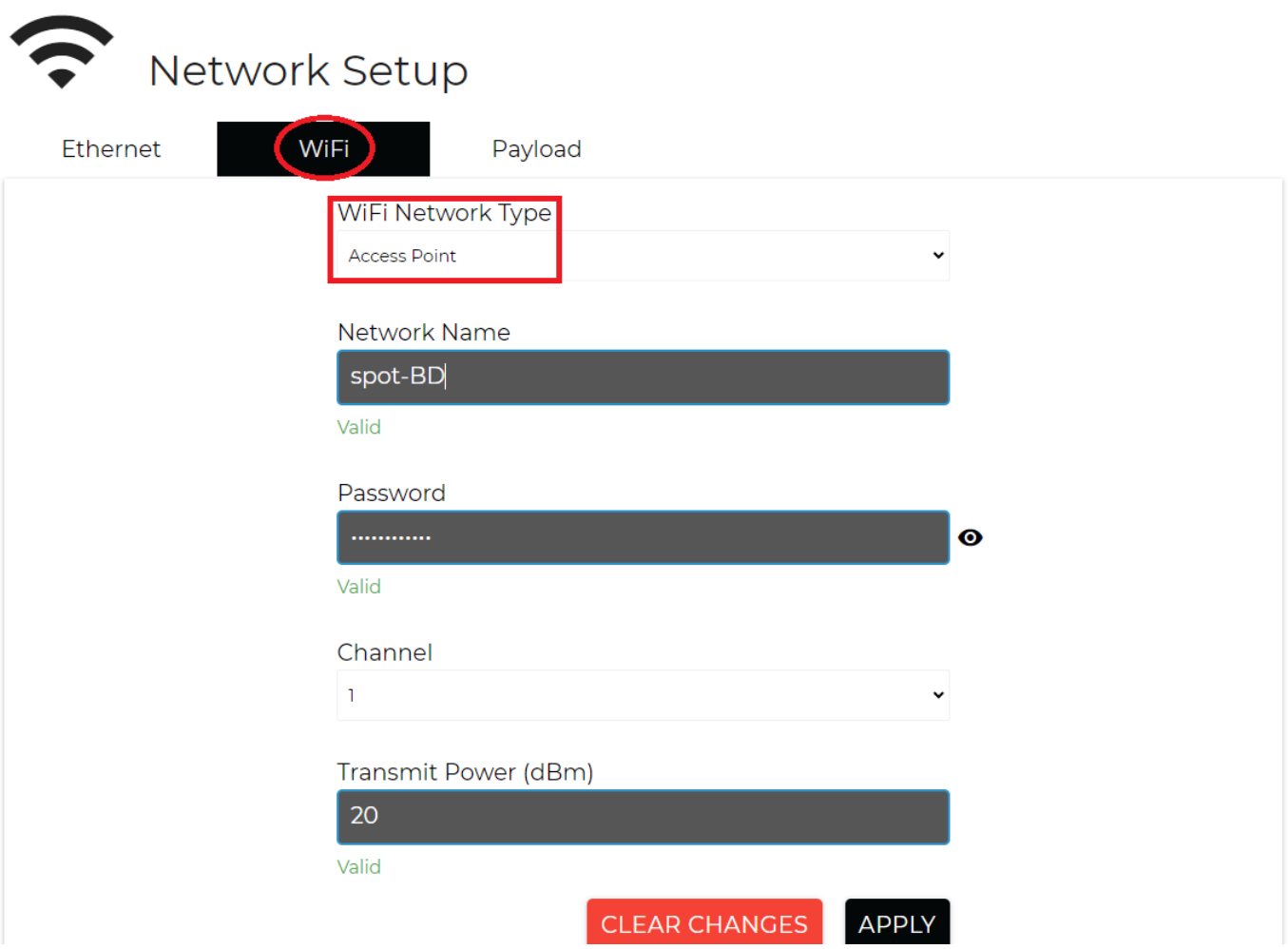
Stop spot from broadcasting his onboard network.

One way you can stop Spot from broadcasting is to change his Wi-Fi settings in the admin web portal at one of these addressees:

- https://10.0.0.3 (This is the Spot network for the rear RJ45 port)
- https://192.168.80.3 (This is Spot built in access point network)
- https://192.168.50.3 (This is the payload network address for spot. You will only use this one if you are connected to a network port on a Spot payload)

Once you have opened up the admin portal and logged in you should then navigate to the **Network Setup** page and then **WI-FI**. You will want to change the Wi-Fi Network Type to **Client mode.**

Password is provided but somebody else



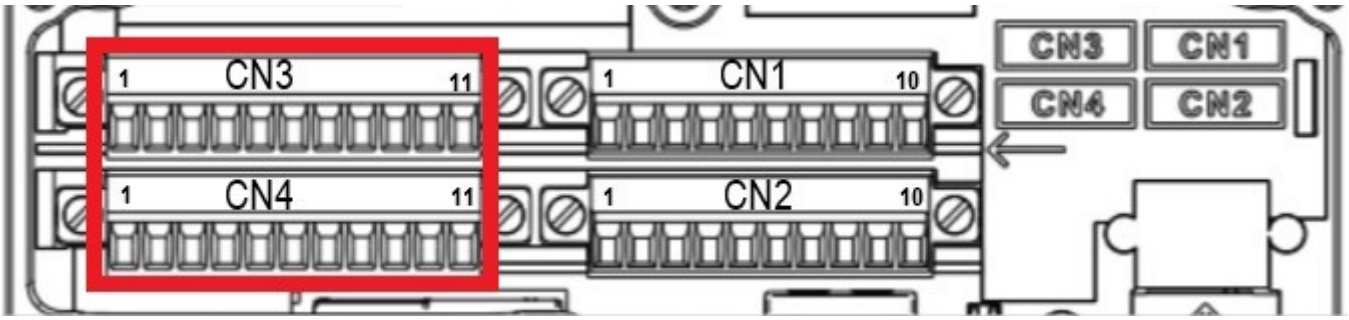
CORE I/O

1. To prepare the CORE I/O for either of the two setups above you need physical access to the CORE I/O. You also need to have the CORE I/O mounted to Spot. You need to remove the wire cover plate to gain access to the RJ45 jacks inside. You can use either of the two ports inside.

2. The second thing you need to setup is power for the WAP. You have two options:

Male Barrel Jack

If your WAP has a DC power input this would be the simplest method to power it from the CORE I/O.



You then need to locate the CN3 and CN4 terminal blocks under the CORE I/O cover. You will use one of these to connect the WAP to the regulated power that the CORE I/O provides.

> When you connect anything to the CORE I/O power outputs make sure you read the documentation!!

You will need to find the correct power outputs based on your WAP requirements. Here is a table of the connectors and their pinouts:

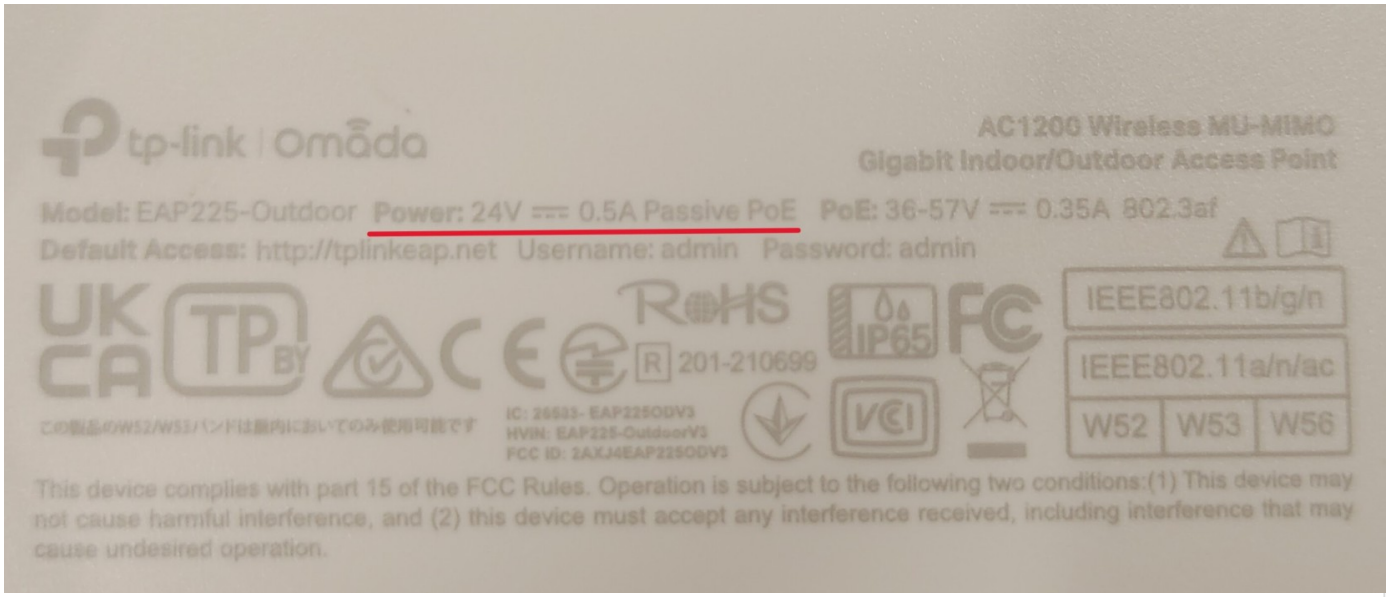
Pin Number	Connector (CN)1	CN2	CN3	CN4
1	Motor Loop Back	GPIO pin 1	48v unreg	48v unreg
2	Motor Loop Back	GPIO pin 2	24v output	24v output
3	Extra Loop Back B	GPIO pin 3	12v output	12v output
4	Extra Loop Back B	GND	12v output	12v output
5	Payload Loop Back	i2c serial SDA	5v output	5v output
6	Payload Loop Back	i2c serial SCL	5v output	5v output
7	Extra Loop Back A	PPS pulse	GND	GND
8	Extra Loop Back A	GND	GND	GND
9	GND	GND	GND	GND
10	GND	GND	GND	GND
11	-	-	GND	GND

Using a POE injector

To use a POE based WAP you need determine the type of POE your your device takes. You can either have Passive or Active POE.

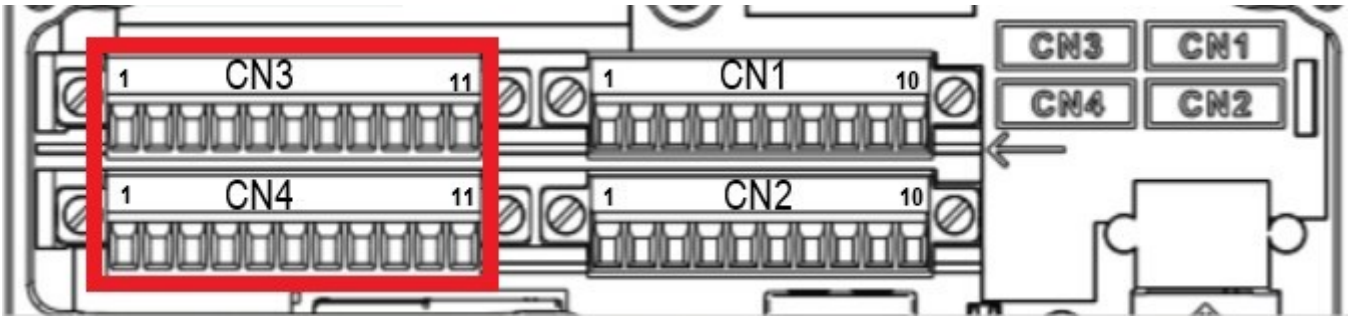
Passive POE

Passive POE works by inputting a specific voltage across 1 or 2 pairs of the 4 pairs of wire that make up a CATX wire. Below you can see the specification of the WAP we choose, which is 24v. There are 3 common standards for passive POE which are 24v, 48v, and 54v.



After you determine what your requirements you need to find a passive POE injector such as this one that takes a male barrel jack input.

You will to then need to provide power from the CORE I/O to the male barrel jack.



You then need to locate the CN3 and CN4 terminal blocks under the CORE I/O cover. You will use one of these to connect the POE injector to the regulated power that the CORE I/O provides.

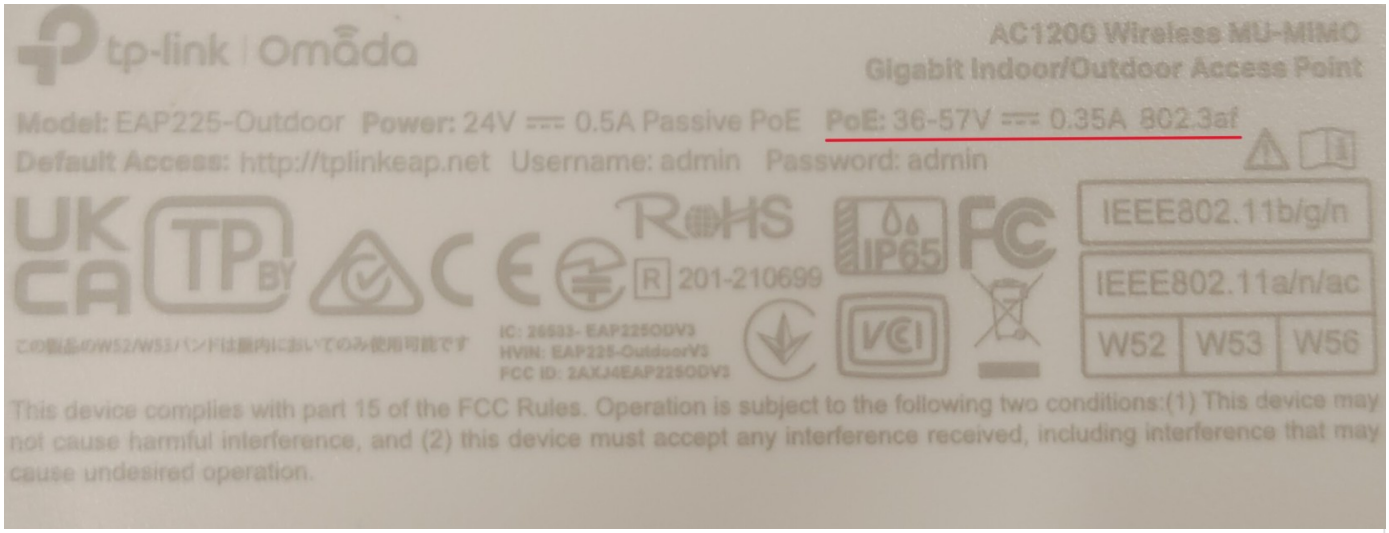
> When you connect anything to the CORE I/O power outputs make sure you read the documentation!!

You will need to find the correct power outputs based on your WAP requirements. Here is a table of the connectors and their pinouts:

Pin Number	Connector (CN)1	CN2	CN3	CN4
1	Motor Loop Back	GPIO pin 1	48v unreg	48v unreg
2	Motor Loop Back	GPIO pin 2	24v output	24v output
3	Extra Loop Back B	GPIO pin 3	12v output	12v output
4	Extra Loop Back B	GND	12v output	12v output
5	Payload Loop Back	i2c serial SDA	5v output	5v output
6	Payload Loop Back	i2c serial SCL	5v output	5v output
7	Extra Loop Back A	PPS pulse	GND	GND
8	Extra Loop Back A	GND	GND	GND
9	GND	GND	GND	GND
10	GND	GND	GND	GND
11	-	-	GND	GND

Active POE (Not Tested)

Active POE works by negotiating with client device, in our case the WAP, to determine what voltage and power the client needs. This is great because you can plug in any device that supports the standard used by your power device and it will automatically configure and power on. There are now multiple IEEE standards for POE.



You will need to find a device that takes DC input and provides at least the standard you need.

Wireless Access Point (WAP) setup

Going forward this setup will assume you have connected your WAP to power and connected the data cable to your laptop.

1. You will need to determine the IP address of you WAP. To do this you need will need to find the default IP address of your brand of device.
2. Once you have powered up your WAP for the first time you will want to log into the management portal. Most WAP's have a web portal located at the IP address of the device. This will be defined by default in most cases for each manufacturer, The default IP used by our device is 192.168.1.254.
   - Change the SSID of your network/s
     - This is so you can easily determine the in the future.
     - If you have a 5Ghz network and are using the Galaxy Tab 3 active tablet you will want to disable this or name the network separately as the Tab 3 active does not support 5Ghz and it may cause connection issues.
   - Change the default password for each SSID
     - Please do this for security and easy of use later.
   - Turn off any Band Steering functionality
     - Band steering can cause connection issues when in tries to force a device to the other network band and this can occur at any time.
   - Change the IP assignment settings so that the WAP has a static IP in the 192.168.50.0/24 range
     - You will need to change this to fit in the range of the payload network and spot uses the 192.168.50.0/24 range for payloads.
     - To leave room for actual payloads and their networked devices you will want to pick a Valid IP which includes 192.168.50.10 - 192.168.50.254 Once you have logged into the WAP you want to change a few settings to make it work with Spot:

Optional WAP setting Changes

- Turn off SSID broadcasting
  - This provides an extra basic level of security.
  - This will require you to do a little more configuration on the Controller and other devices you want to wirelessly connect to Spot.
-

1. After Changing the IP of the WAP you will lose connection and most likely have to navigate to the new assigned address

Network connection to Spot (WiFi)

Setting a static IP

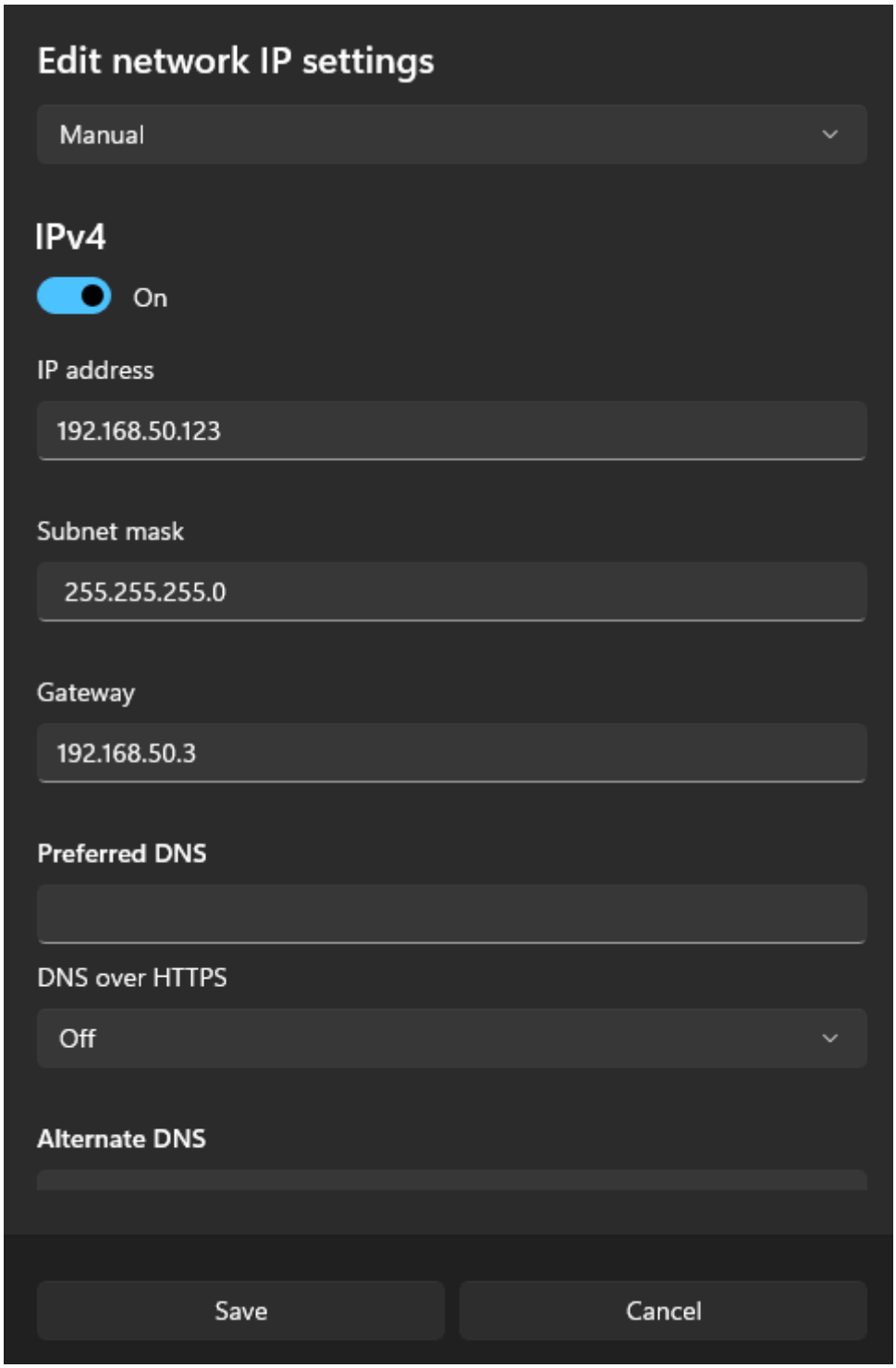
The first thing you will need to do if you want to connect to a Boston Dynamics Spot robot is connect to the robot over the network. The easiest way to do that is to connect to the robots WiFi network. You will quickly run into an issue with connecting. most devices will state "can't connect to this network". This is because there is no DHCP server running on the network so new devices will have no way of knowing how to talk to each other. You must set a static IP address manually.

Windows 11

1. Navigate to the settings on your computer. This can be found under the Windows start menu by clicking the gear icon labeled settings.
2. Select **Network & Internet** from the list on the left
3. Select **Wi-Fi,** then select **Show available networks** connect to spot, and then go back to **Wi-Fi**, from here select <**Network Name**> **properties**
4. Scroll down to the **IP assignment**, and select the **EDIT** button.
5. Change the drop-down from Automatic (DHCP) to **Manual** and toggle on **IPv4**
6. Enter the following settings:

Enter the following settings:

> IP address shown is most likely already used by a device. **There must not be multiple devices with the same ip on the network at one time.**



Windows 10

1. Navigate to the settings on your computer. This can be found under the Windows start menu by clicking the gear icon labeled settings.
2. Select **Network & Intenet** from the list.
3. Select **Properties** for your Ethernet adapter. If you have multiple Ethernet adapters, make sure you are selecting the correct one! Do NOT select the WiFi adapter.
4. Navigate to the section labeled **IP settings**. You should see IP assignment is set to Automatic(DHCP)
5. Select **Edit**
6. Change the drop-down from Automatic to **Manual** and toggle on **IPv4**

7. Enter the below IP address settings