Guide to manually managing a mesh WiFi network.

Introduction

First off, much of this is only important for users who have a mesh network; that is, more than one Hub or IndoorHub, where at least one of those Hubs or IndoorHubs are Remote (not connected to the network with an Ethernet cable).

If you only have one Hub or IndoorHub in a location and no Remote Hubs or IndoorHubs, skip ahead to the "Specific Examples" section.

Your network will continue to work just as it has when AyrMesh.com stops working - you will not have to do anything. These instructions are strictly for when you want to change something on your network - the SSIDs, Encryption Keys, Mesh IDs and Mesh Keys, and/or the Channel.

Keep a Backup

Before you change anything on any AyrMesh device, write down its CURRENT configuration parameters so you can configure it back to that (working) configuration if needed. For example, if you forget to configure a WiFi device like a camera or an AyrMesh Receiver, it's much easier to configure the Hub back to the old configuration so the device will work again than to go take down the device, connect it to the router, configure it, and put it back.

General Principles

When your mesh network is controlled by a central controller like AyrMesh.com, there are a number of things that are taken care of automatically. You will have to remember to take care of these things yourself.

Order of change

One of the most important things to understand is that you have to be careful about the order in which you change the configuration of devices on your network. AyrMesh.com took care of this by delaying a new configuration on a Gateway Hub by 10 minutes to make sure all the other devices on the network "got the message" and made the change before the Gateway Hub.

The simple rule is "outside in," meaning that you have to configure the devices that depend on others for their signal - "outside" devices - BEFORE you configure the "inside" devices on which they depend. Specifically, start with the WiFi devices that are connected to the Hubs' signals (e.g. WiFi cameras, gate opener controllers, AyrMesh Receivers), then configure the Remote Hubs, and finally reconfigure the Gateway Hub.

For example, if you have a network with one Gateway Hub, three Remote Hubs, and two Receivers, you'll need to configure the Receivers first, then the Remote Hubs, and finally the Gateway Hub. If you have multiple "layers" of Remote Hubs, you have to start with the "furthest" layer first (the Hubs depending on other Remote Hubs), and then "work your way in" to the Gateway Hub, which you reconfigure last.

If you don't successfully follow the "Outside in" rule, you can leave remote devices in the field "hanging" - misconfigured with the old configuration so they can't connect to the Hubs with the new configuration. There are two ways to fix this if it happens: reconfigure the Hubs back to the old configuration and start over, or take down the remote devices and connect them directly to your router so they can be reconfigured.

What Matters and What Doesn't

The Mesh signal between the Hubs is a separate signal from the WiFi signal. The WiFi signal has an SSID and a "WPA" encryption key to control access by WiFi devices; similarly, the Mesh

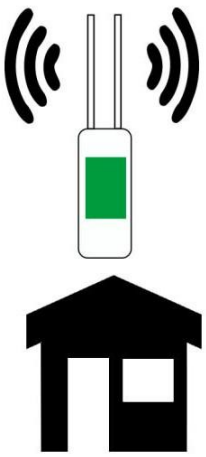
signal has a Mesh ID and a Mesh Key to control access by other Hubs. The mesh signal between the Hubs is controlled by that Mesh ID and Mesh Key; the WiFi SSID and encryption key doesn't matter at all. The Hubs in the mesh can all have different SSIDs and encryption keys if desired (not recommended) , but they do have to have the same Mesh ID and Mesh Key. Similarly, the Receivers don't have any meshing capability; they use the WiFi signal. They have to have the same SSID and Encryption key as the Hub(s) they are getting connecting to.

So, if you want to change the SSID on one or more Hubs, you will need to reconfigure the devices that are connecting to those Hubs, including AyrMesh Receivers, before you change the SSID. However, changing the SSID will NOT affect the mesh between the Hubs. If you want to change the Mesh ID or Mesh Key, you have to change all the Hubs (from the furthest away to the Gateway), but you don't have to adjust WiFi devices like AyrMesh Receivers.

The Channel matters for all of the devices - they all have to be on the same channel in order to work. Most WiFi devices will automatically scan for the channel, but you have to be sure the Hubs are all on the same channel. If you need to change the channel to avoid interference, again, use the "outside in" method: reconfigure the "outermost" Hubs first and work in toward the Gateway Hub.

Specific Examples

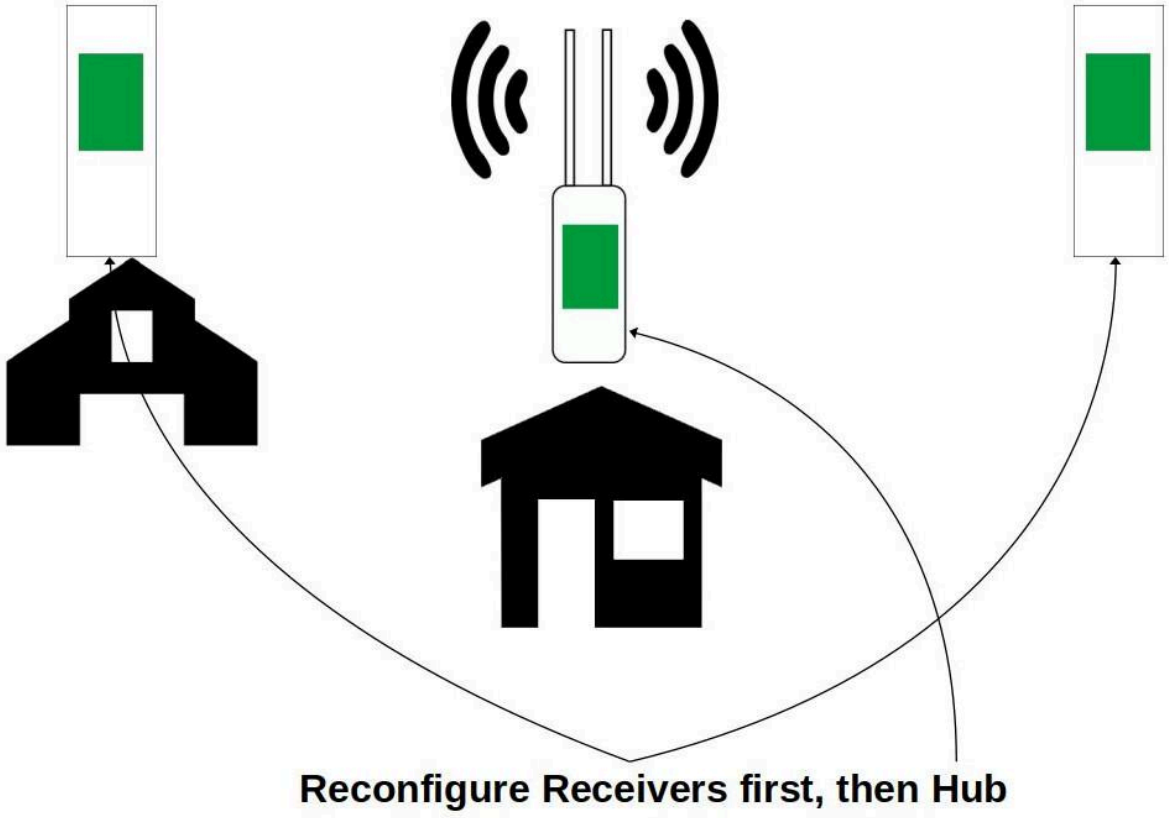
Just a Hub



If you just have one AyrMesh Hub and no other AyrMesh devices, configuration is pretty simple: you don't need to configure the meshing options, since it's not meshing with other Hubs; you only have to worry about the SSID, Encryption Key, and Channel settings.

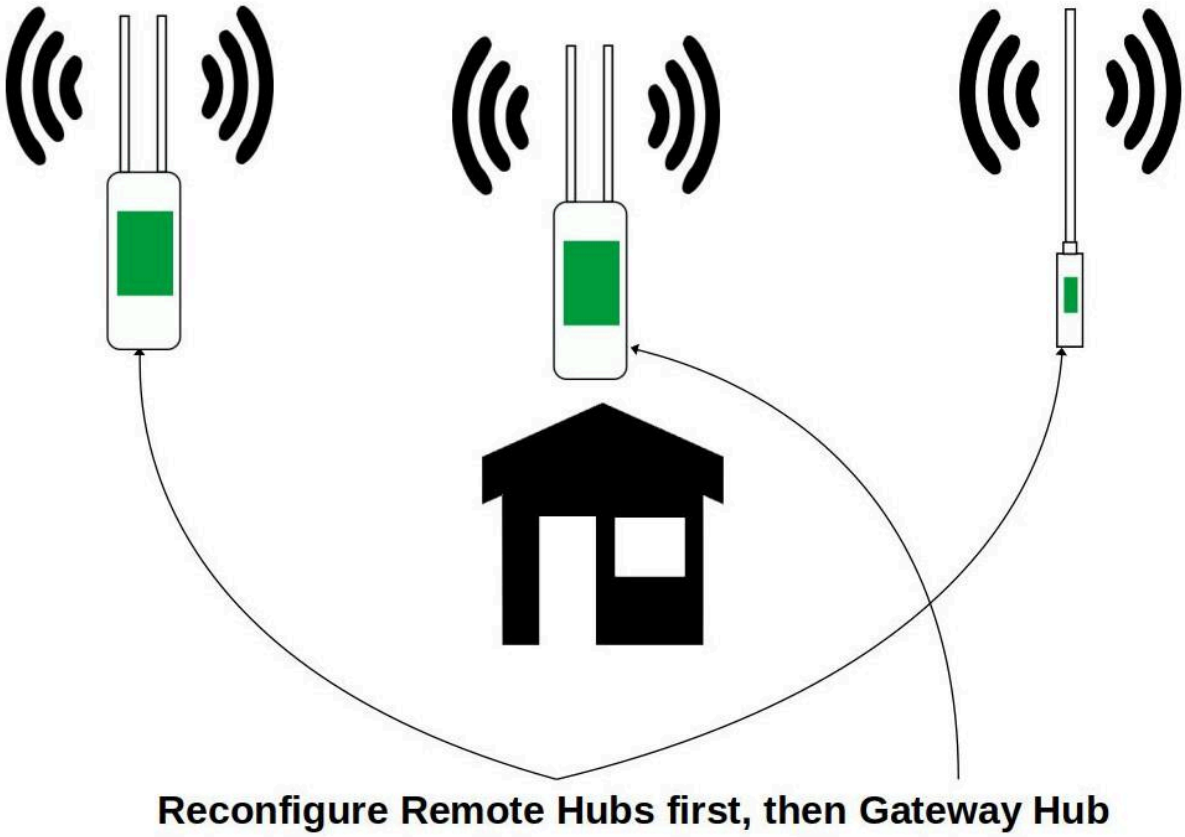
First, reconfigure any devices that connect to the Hub (cameras, etc.), and then just log into the Hub and reconfigure it. When you click "Submit" on the Hub's manual configuration page, it will reboot with the new configuration.

Hub and Receivers



If you have one AyrMesh Hub and one or more AyrMesh Receivers, the instructions are the same as for "Just a Hub" above, except, in addition to any other WiFi devices, you'll need to reconfigure the Receiver(s) before you reconfigure the Hub. The Receivers are really just WiFi devices, so they behave the same as any other WiFi "client" device (cameras, phones, laptops, etc.)

Multiple Hubs - Remote Hubs meshed with Gateway Hub

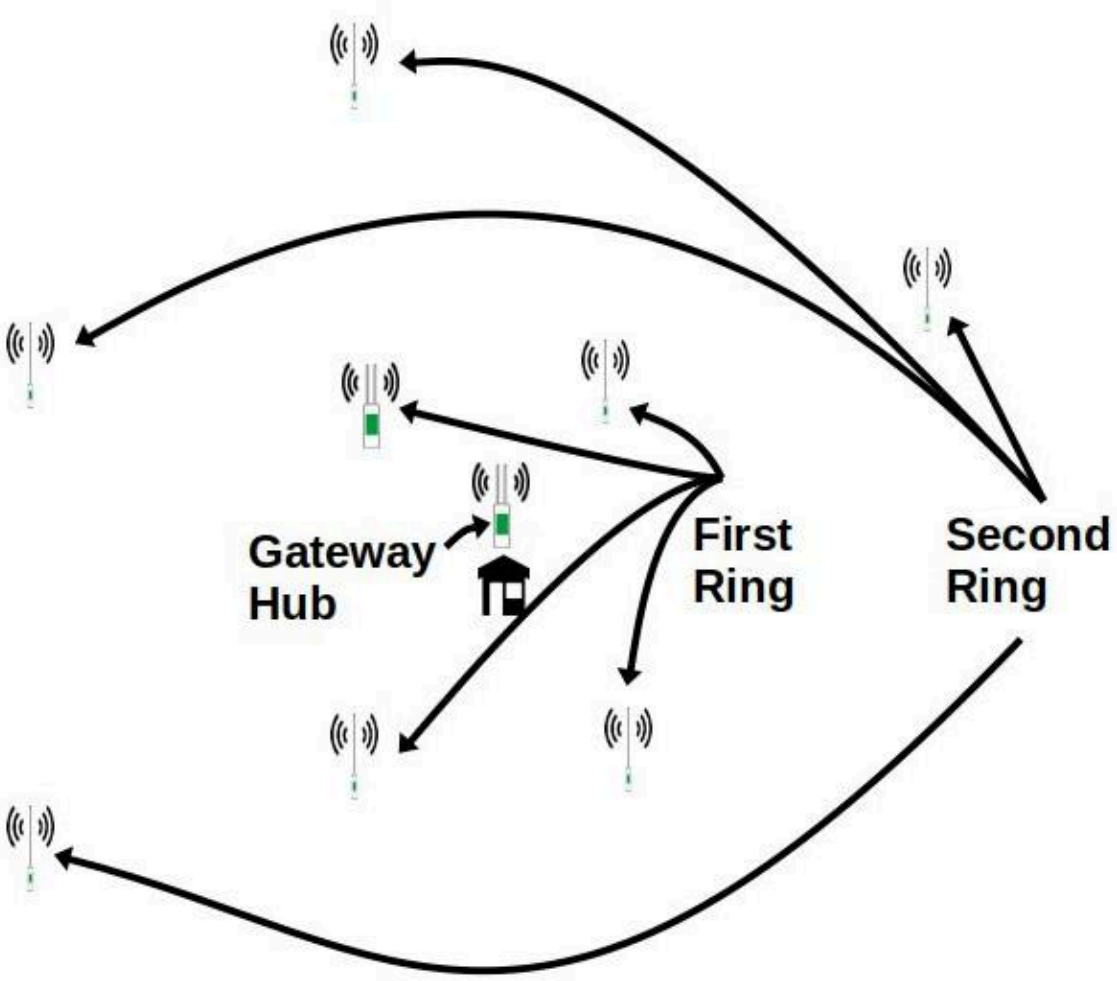


If you have a Gateway Hub and one or more Remote Hubs, then the question is whether you're changing something that matters or not. If you're just changing the SSID or encryption key, it won't affect the mesh between the Hubs - you can change the SSID and encryption key on the Hubs in any order. Just remember to re-configure the "client" devices (cameras, AyrMesh Receivers, etc.) before you reconfigure the Hubs.

If you are adjusting the Mesh ID, Mesh Key, or channel, you have to reconfigure the Remote Hubs first, and then reconfigure the Gateway Hub.

If you change both the WiFi parameters (SSID, Encryption Key) and the mesh parameters (Mesh ID, Mesh Key) at the same time, reconfigure the WiFi devices first (including AyrMesh Receivers), then reconfigure the Remote Hubs, and reconfigure the Gateway Hub last.

Multiple "Rings" of Hubs

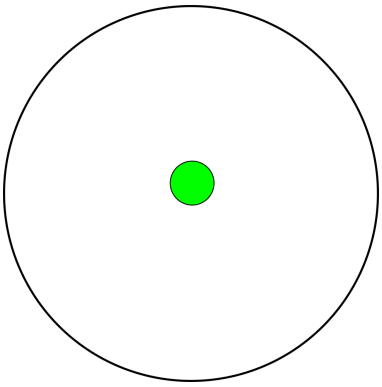


If you have Remote Hubs that depend on other Remote Hubs, you need to divide your network into "rings" - the Gateway Hub is the innermost ring, then the Remote Hubs that connect to the Gateway Hub are the first Remote ring. Hubs that depend on the signal of the first Remote ring are the second Remote ring, etc.

Following the "Outside in" rule, you start by configuring the Hubs in the outermost ring, then go to the next ring, and so on until you have configured all the Remote Hubs. Once they are all reconfigured, you can reconfigure the Gateway Hub and the network will "jump" back into action.

If a Hub is misconfigured, it will be absent from your network (unable to ping or access its web server) - you'll need to "roll back" the configuration of the Hubs "leading" to that Hub until it comes back onto your network, then reconfigure it and retrace your steps, reconfiguring Hubs back into the Gateway.

IndoorHubs



Most IndoorHubs are connected to a Receiver or a Remote Hub with an Ethernet cable; as such, they do not depend on the wireless signals from the Hubs. As such, they can be reconfigured any time; they will be connected to the network whenever the Receiver or Remote Hub they are wired to is connected to the network.

The IndoorHubs are meshing devices - as shipped, the mesh signal is turned off. Under the control of AyrMesh.com, they could mesh only with IndoorHubs, not with the outdoor AyrMesh Hubs. However, in manual mode, you can configure the meshing interface to mesh with any standard 802.11s meshing signal, including other IndoorHubs or the outdoor Hubs.

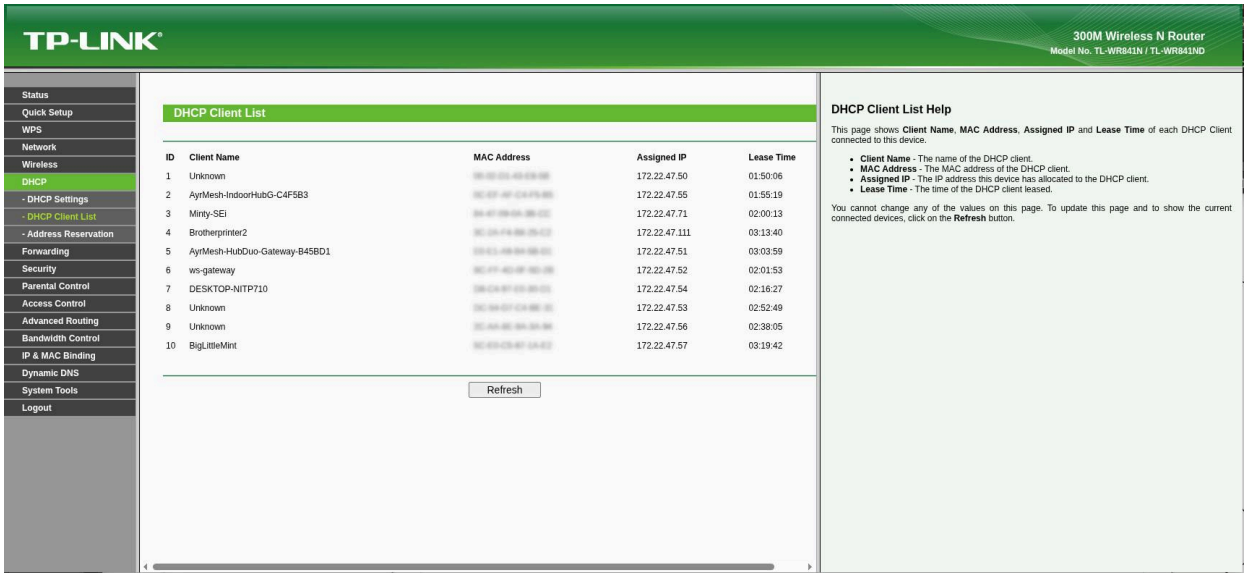
Obviously, use the meshing capabilities of the IndoorHubs with caution. The reason we shipped the IndoorHubs with meshing off is that meshing the IndoorHubs can create network loops very quickly. The reason we only enabled the IndoorHubs to mesh with other IndoorHubs is that, similarly, having them mesh with the outdoor Hubs can create network loops very easily. A good general rule is, if you're not sure what you're doing, move very carefully, and be ready to undo your last configuration (or two) if your network crashes.

Accessing the Configuration Menu

In order to configure your AyrMesh device, you have to connect to its internal web pages. To do that, you have to be on the same network segment as the device. So the device you're using to configure the AyrMesh products needs to be connected to your router, via Ethernet or WiFi. We suggest using a computer with a keyboard, but it can be done with a tablet or a phone - just make sure the tablet or phone is connected to your router's WiFi.

The first step is to find the IP addresses of your AyrMesh products. If they are still checking into AyrMesh.com, the local IP address will be shown on the information panel for the device (click on the product in AyrMesh.com).

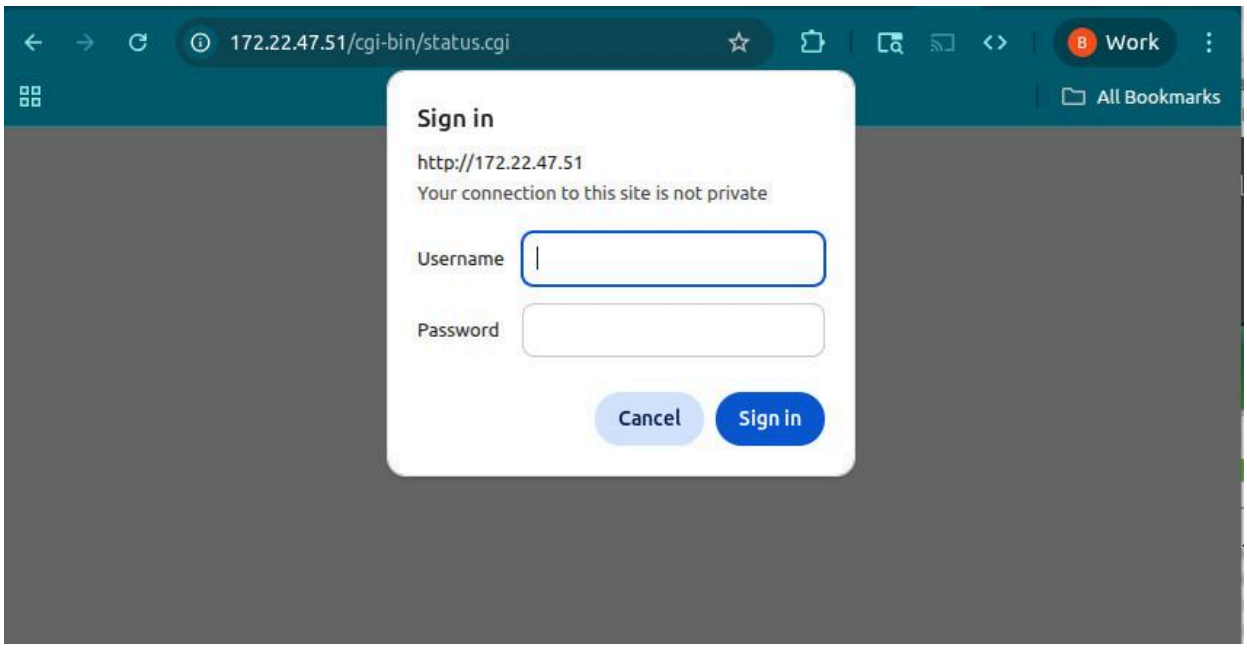
However, once AyrMesh.com is gone, you'll have to find the AyrMesh products on your network. The easiest way to do that is to look at the DHCP client table on your router; for example, here is the table on my router:



I have blurred out the MAC addresses for privacy, but you can see that my AyrMesh HubDuo is at 172.22.47.51.

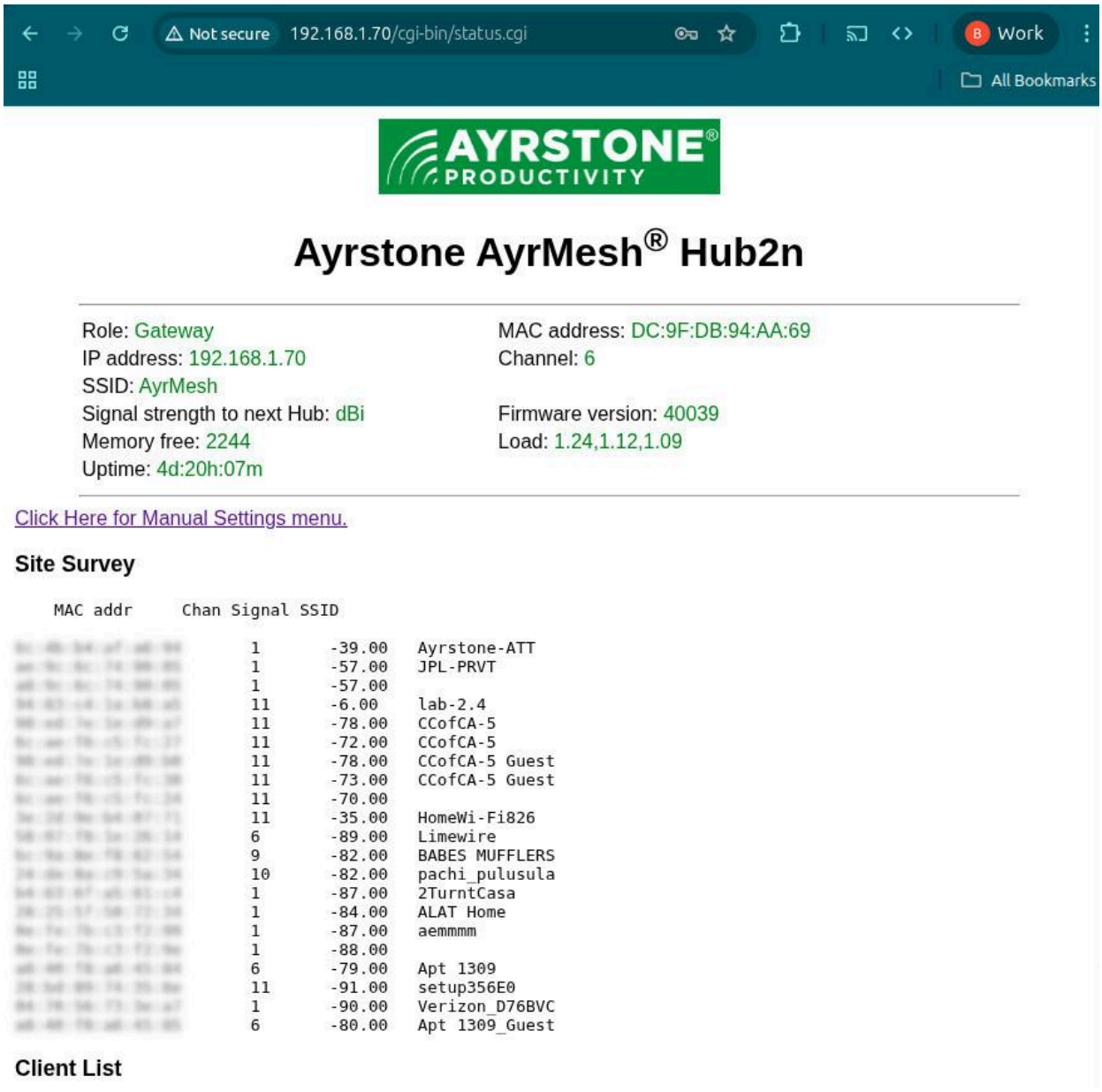
So I open a browser tab and type in the IP address - http://172.22.47.51. Note that some browsers will automatically add the "s" to make it https://172.22.47.51, which will NOT work. It has to use the unencrypted http option.

I get the login screen for the Hub:

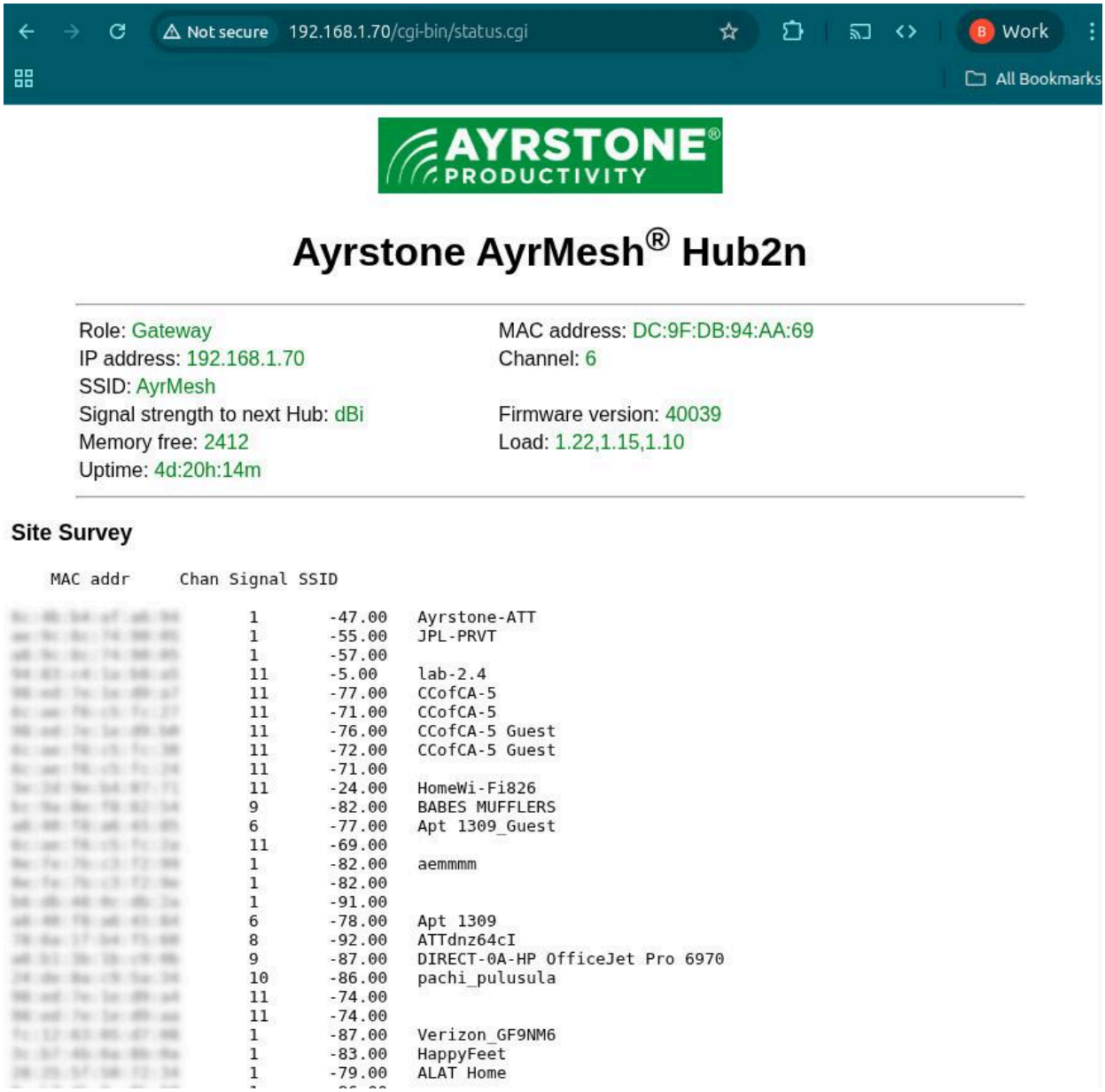


The username and password are the same as your account on AyrMesh.com; if you don't have an account on AyrMesh.com or you have reset the device, the default username and password are both "ayrmesh" (all lowercase letters).

Once you have logged in, you will see the "status" page. There are two versions of the status page; one has a link to the manual settings page:

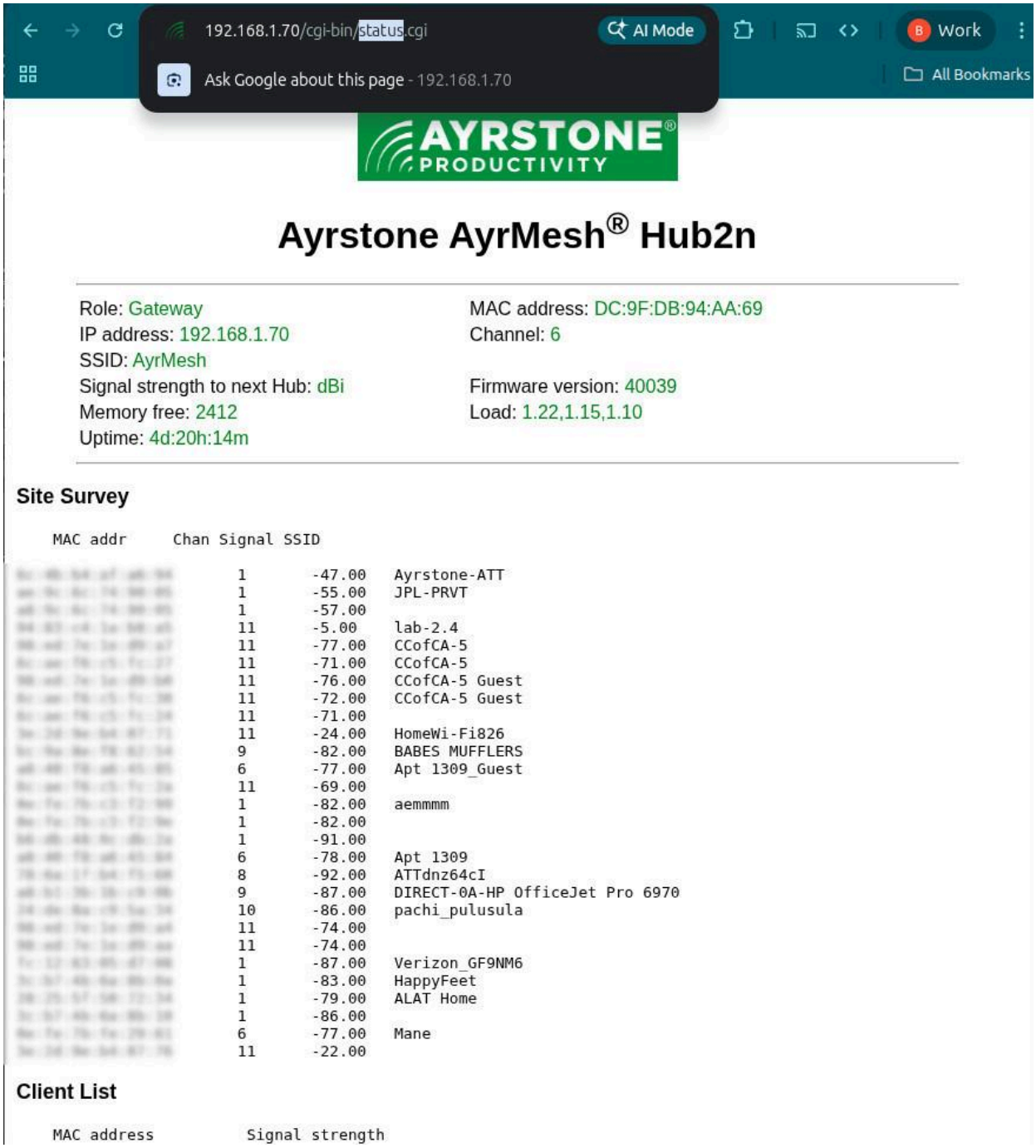


And one does not:

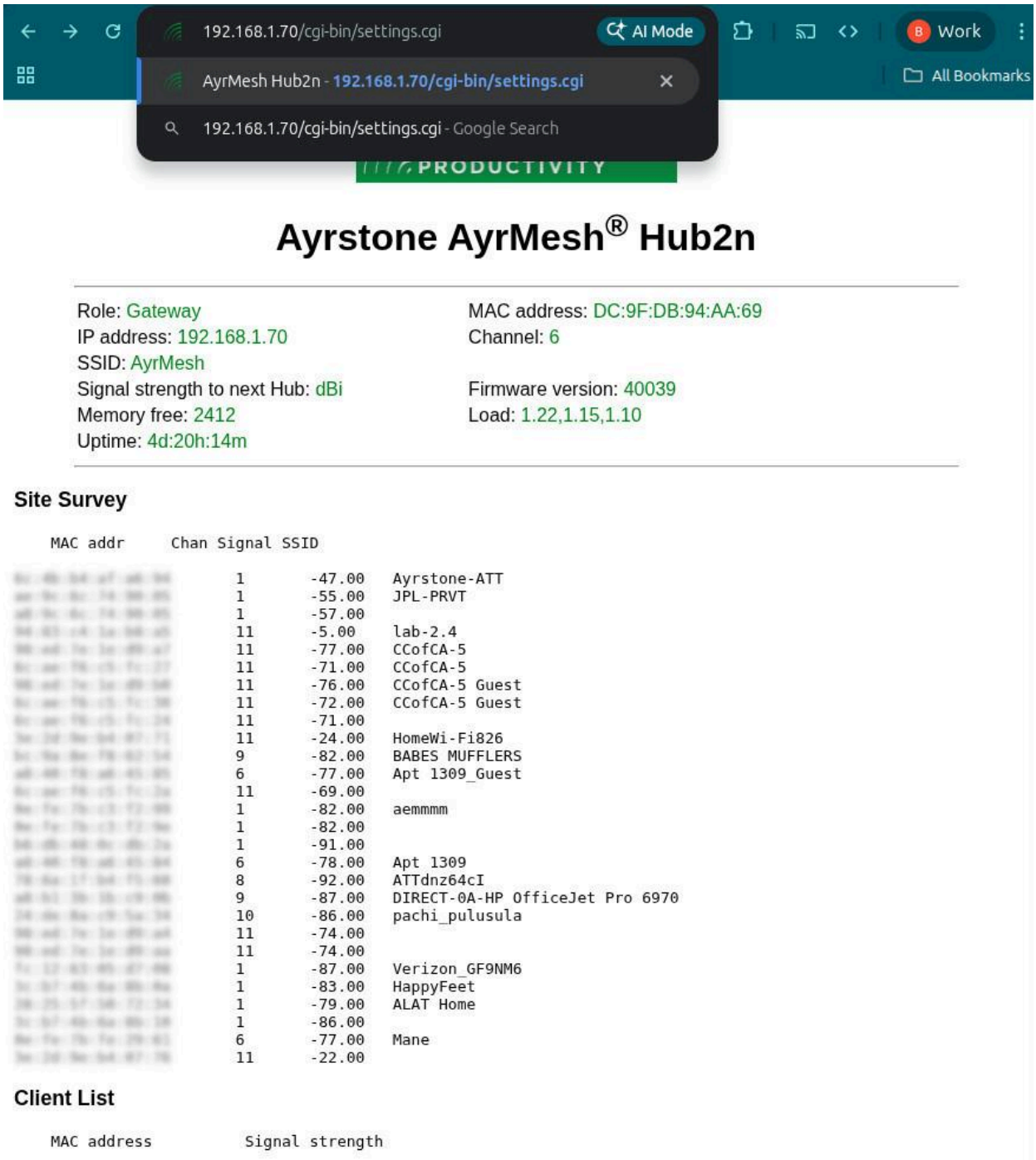


If you have a product with the link to the settings page, you can just click that link. If you have a product without the link to the settings page, you'll have to access it by changing the URL from "status.cgi" to "settings.cgi" - just click on the URL bar on your browser and edit the URL, then press the Enter key on your keyboard. This can be a bit tricky on a phone, and may take a few tries - it's why we recommend using a computer with a keyboard.

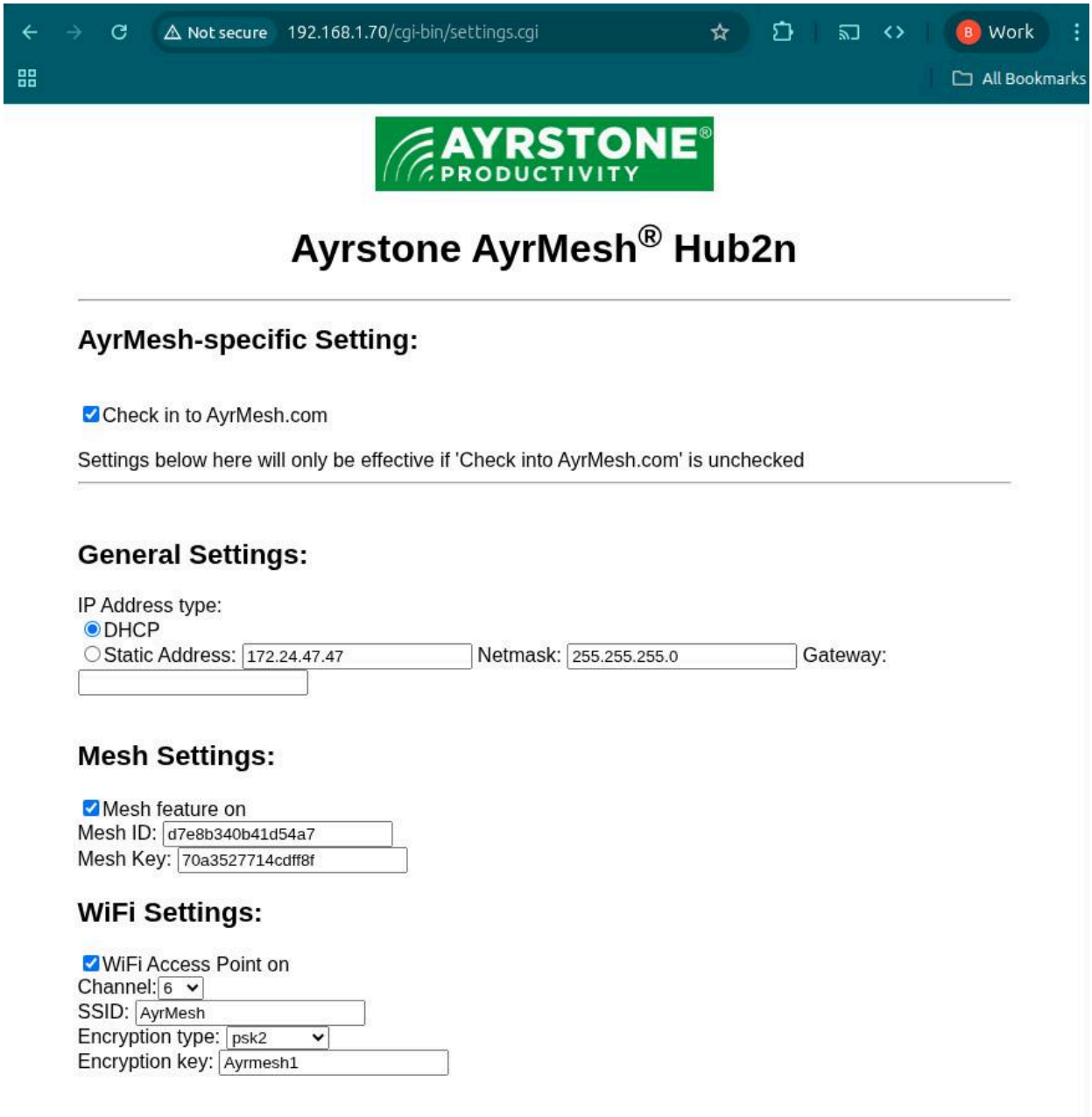
Editing the URL bar from status.cgi:



To “settings.cgi”



Whether you click the link or have to edit the URL, you'll end up on the settings page:

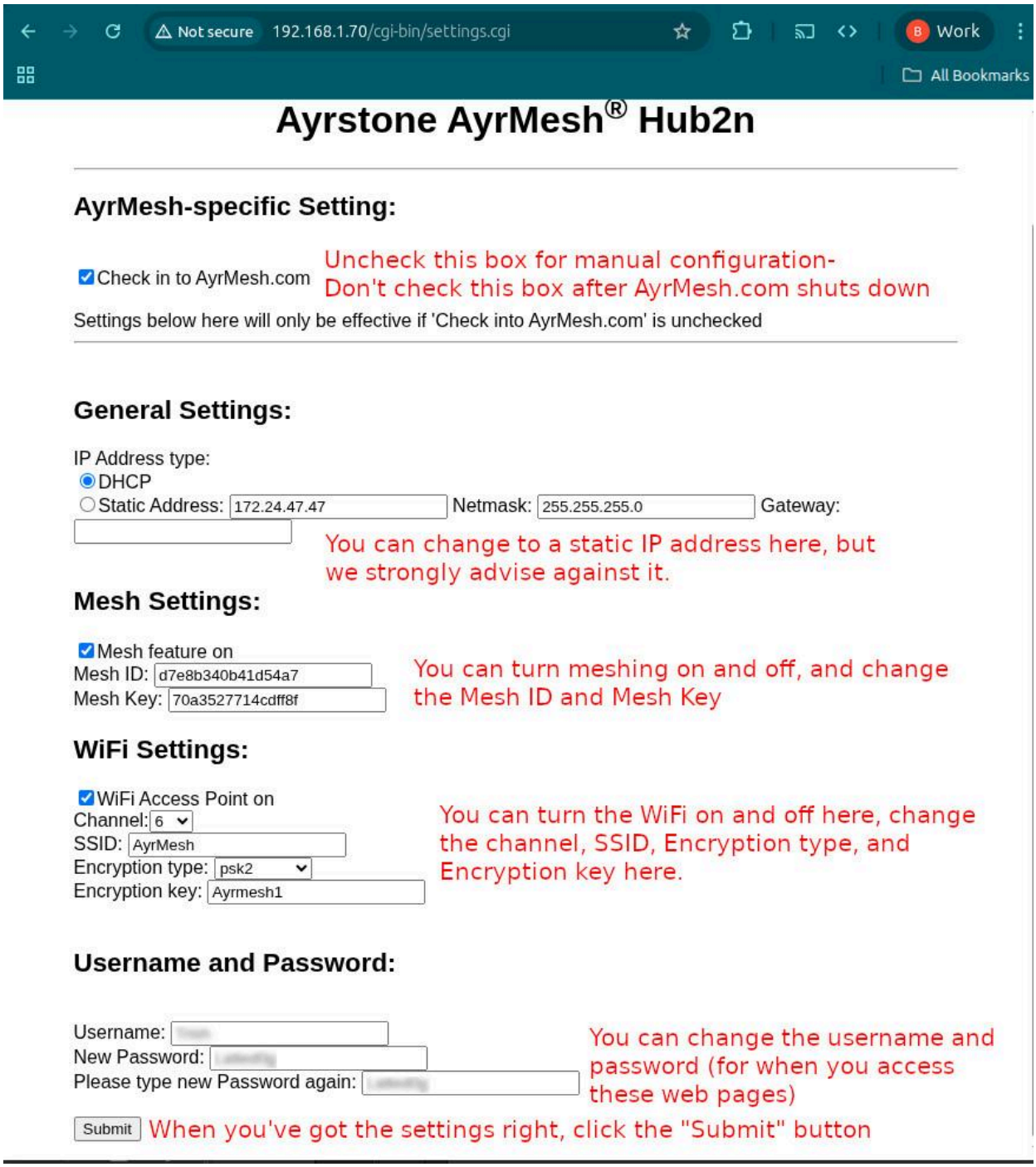


Reconfiguring Devices

These are specific directions for Reconfiguring each type of AyrMesh product. On each product, you can change several settings. First, you can change the network settings and set a static IP address (although that is firmly not recommended). Next, you can change the wireless settings, including WiFi (SSID, Encryption Key, and Channel for all devices), Meshing settings (Mesh ID and Mesh Key for meshing products), those settings for both bands for HubDuo devices, and, finally, username and password settings for access to the device.

AyrMesh Hub2 products (AyrMesh Hub2n, Hub2T, and Hub2x2)

This is the settings page for the Hub2 products:



First, you need to be sure the "Check in to AyrMesh.com" checkbox is NOT checked. When AyrMesh.com is not available, checking this box will just cause the Hub to reboot repeatedly.

Next, you can set the Hub to get its IP address automatically from your router via DHCP or to use a static IP address you can configure here. We STRONGLY advise against the use of static IP addresses if at all possible - there's no known reason to set a static IP address for an AyrMesh product, but, for a product that needs to have a consistent IP address we advise the use of DHCP reservations on your router.

The next two groups of settings pertain to the wireless settings on the Hub. The first is the Mesh Settings section. You can turn the mesh signal on or off - if you are just using the Hub as a non-meshing WiFi access point, you can turn the meshing off. This can make the Hub more efficient and more secure as a non-meshing access point.

The next section is the WiFi settings, including the channel. You can turn the WiFi off; in a mesh, turning off the WiFi disables wireless access, but still allows you to connect to the network with Ethernet via the Hub's LAN port.

However, to change the channel, the WiFi has to be turned on. If you want to change the channel and leave the WiFi off, change the channel with the WiFi enabled, then go back and disable WiFi. The use of a Hub with WiFi off is so rare that this is not likely to be a common occurrence.

You can change the WiFi access point's SSID and Encryption Key here. You can also change the type of encryption - unencrypted, WPA/WPA2 mixed encryption, or strict WPA2 encryption. We recommend ONLY using WPA2; we DO NOT recommend using any setting besides WPA2. The other options are only for legacy compatibility, and have been obsolete for over 10 years.

Note that encryption passkeys - both the WiFi Encryption Passkey and the Mesh Key - must be AT LEAST 8 characters long. Don't use spaces in the SSID, Mesh ID, or passkey, and we strongly suggest using only letters (upper- and lowercase) and numbers.

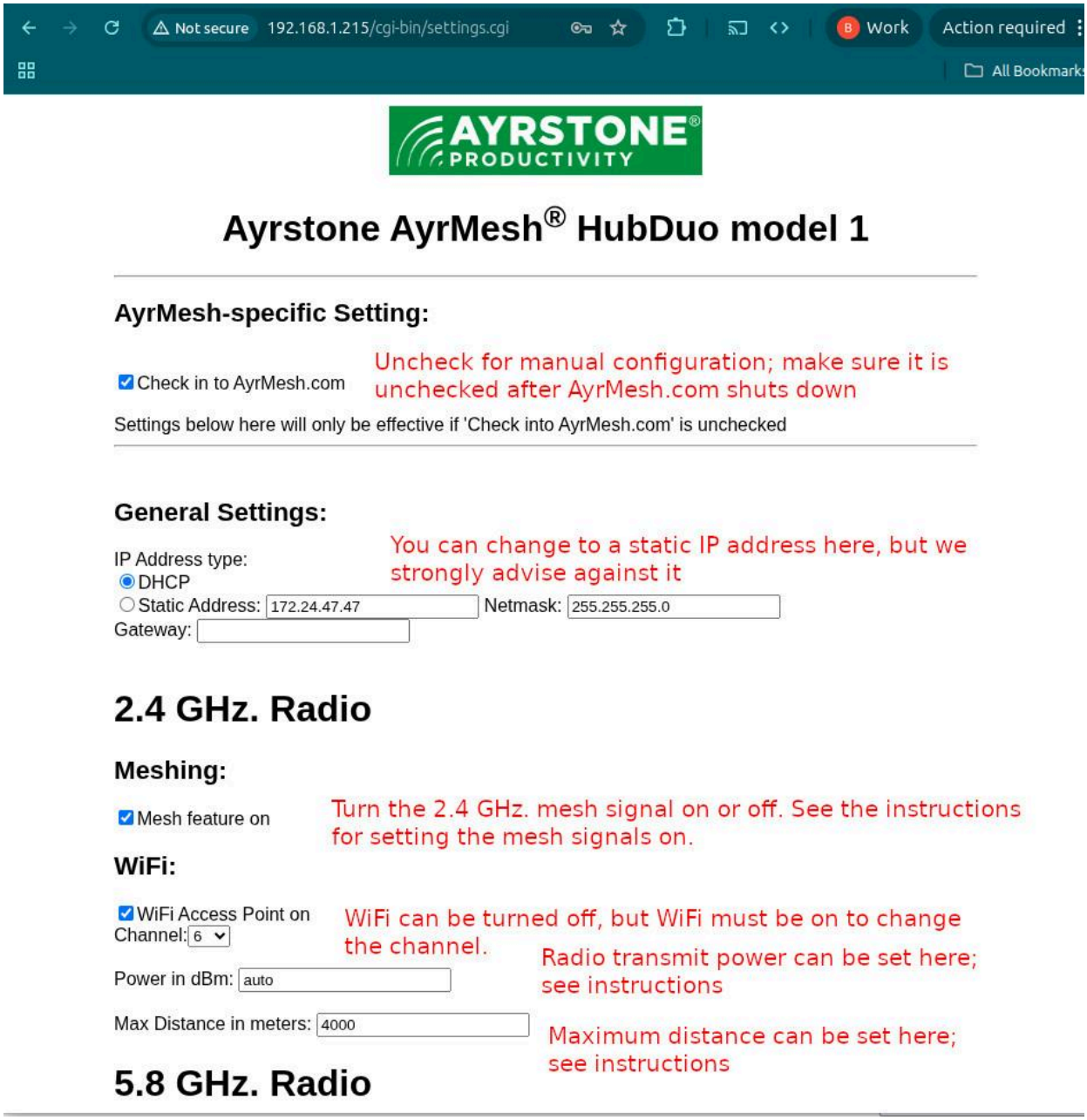
The final section allows you to change the username and password you use to access these web pages on the device.

AyrMesh HubDuo Products

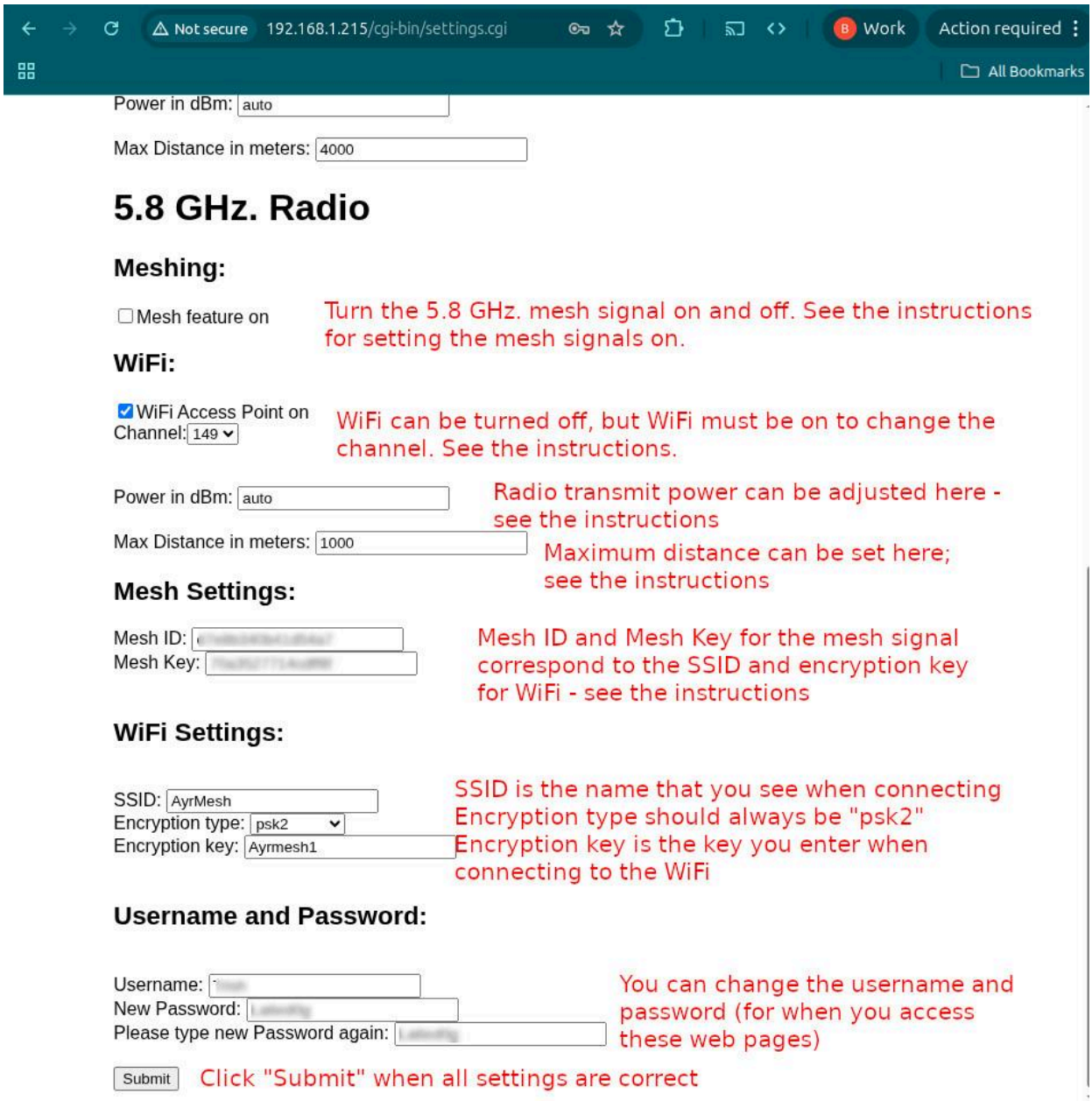
Because it is a dual-band device, configuration of the HubDuo is a little more complex. The first two options, checking in to AyrMesh.com and the IP address settings are the same.

After that, there are separate sections for the 2.4 GHz. radio and the 5.8 GHz. radio. In each section, you can choose to turn the WiFi and the mesh signal on and off, as well as set the channel.

You can also set two other parameters: the maximum Distance and the Power for each radio.



The section for the 5.8 GHz. radio looks very much the same:



Turning the Meshing on and off for each radio and adjusting the Power and Distance parameters on each radio can be helpful for more congested environments.

AyrMesh was originally designed for farms and ranches, where the Hubs would be between 1 and 2.5 miles apart, so the Hubs used maximum power and range. The Hub2 series used the Atheros 9000 series of chips, which enabled a feature called “DYNACK.” DYNACK allows the Hubs to automatically adjust the time they’d “wait” for an acknowledgement of a packet

from another Hub or a WiFi client, allowing them to optimize their performance while still allowing for very long-range links between Hubs.

The HubDuo uses a MediaTek chipset, which does not have this feature. By default, in "Normal Mode," the 2.4 GHz. radio has its mesh signal on and is configured to behave like the Hub2 series, with a maximum range of 4000 meters (about 2.5 miles) and maximum power output ("auto " - 26 dBm). This allows it to be fully compatible with the Hub2 products. The 5.8 GHz. radio is used only for WiFi; the mesh signal is off, the distance is set to 1000 meters, and the power is set to maximum (23 dBm).

However, in more congested environments, it's useful to turn down both the maximum distance and the power to avoid overwhelming nearby Hubs. "Close mode" uses the following settings for the 2.4 GHz. radio:

- Mesh off (No mesh on the 2.4 GHz. signal)
- WiFi on
- Maximum distance: 1000 meters
- Power: 20 dBm

And the following for the 5.8 GHz. radio:

- Mesh on (Hubs mesh on the 5.8 GHz. signal for higher bandwidth but much shorter range).
- WiFi on
- Maximum distance: 1000 meters
- Power: 20 dBm

There are also environments in which HubDuos are used for "close-in" coverage (around a central yard, for instance) and Hub2 units are used for "further out" - coverage for farm fields, for instance. In that case, the Hubs are configured differently between the Gatewasy Hub and the Remote Hubs. This is called "Hybrid mode" - the Gateway Hub is configured in "Normal mode" (see above), but both the 2.4 GHz. AND the 5.8 GHz. mesh signals are on. The Remote Hubs are configured in "Close mode" (again, see above), with only the 5.8 GHz. mesh signal on (NOT the 2.4 Ghz. mesh signal) and power and distance "turned down." The entire point is for a single Gateway Hub to serve as the gateway for both one or more Remote HubDuos "close in" and one or more Hub2 units "further out."

After the 5.8 GHz. radio settings are the Mesh settings (Mesh ID and Mesh Key) and the WiFi settings (SSID, Encryption Key, and Encryption key). Note that the Encryption type should always be "psk2" for WPA2 encryption. Mixed-psk encryption is obsolete; no device has been manufactured that cannot support WPA2 encryption for over 10 years. We do not recommend using unencrypted WiFi in any application.

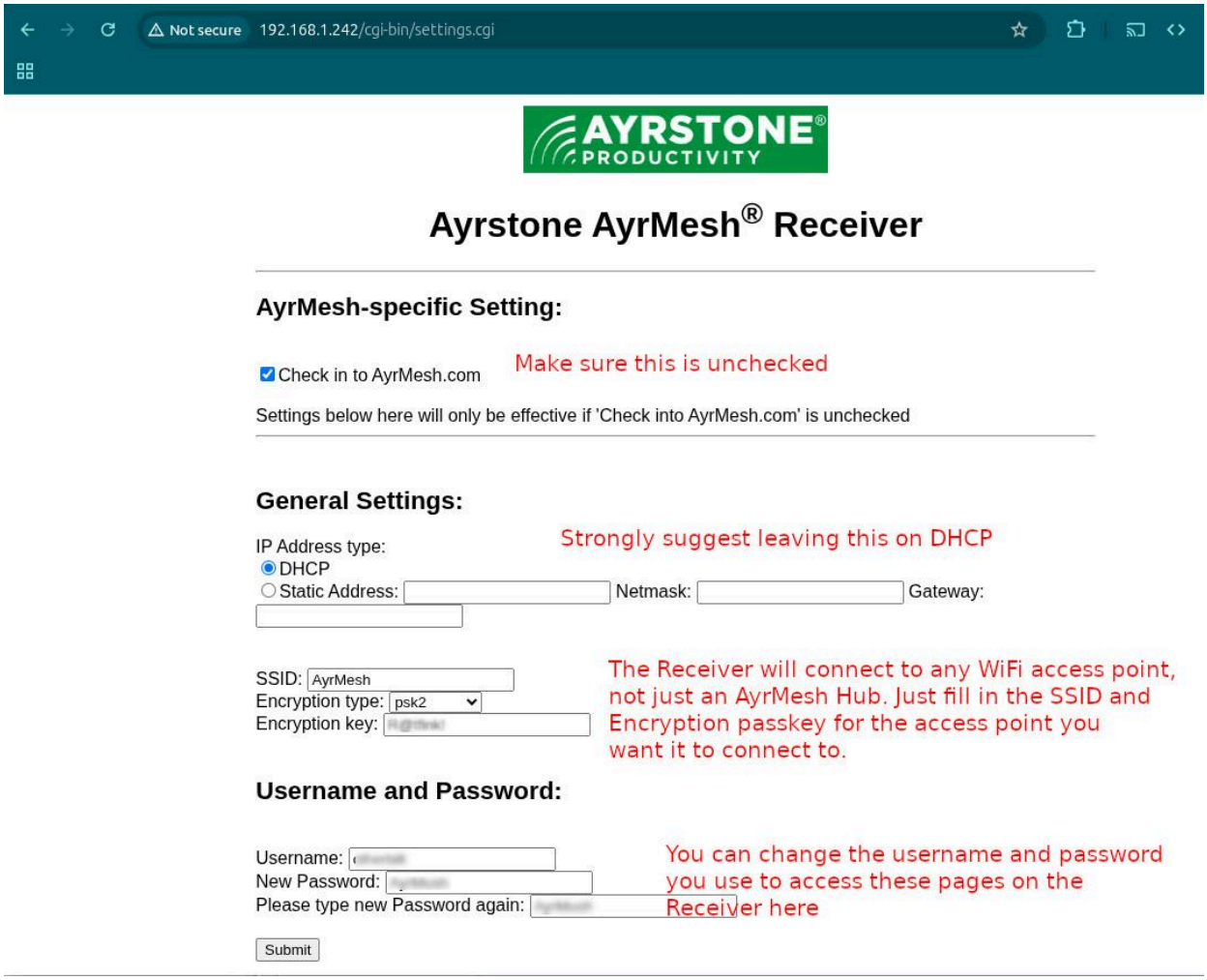
Note that encryption passkeys - both the WiFi Encryption Passkey and the Mesh Key - must be AT LEAST 8 characters long. Don't use spaces in the SSID, Mesh ID, or passkey, and we strongly suggest using only letters (upper- and lowercase) and numbers.

Finally, you can change the username and password you use to access the Hub's webpage.

When you are sure you have all the settings correct, click the "Submit" button on the bottom.

AyrMesh Receiver Products

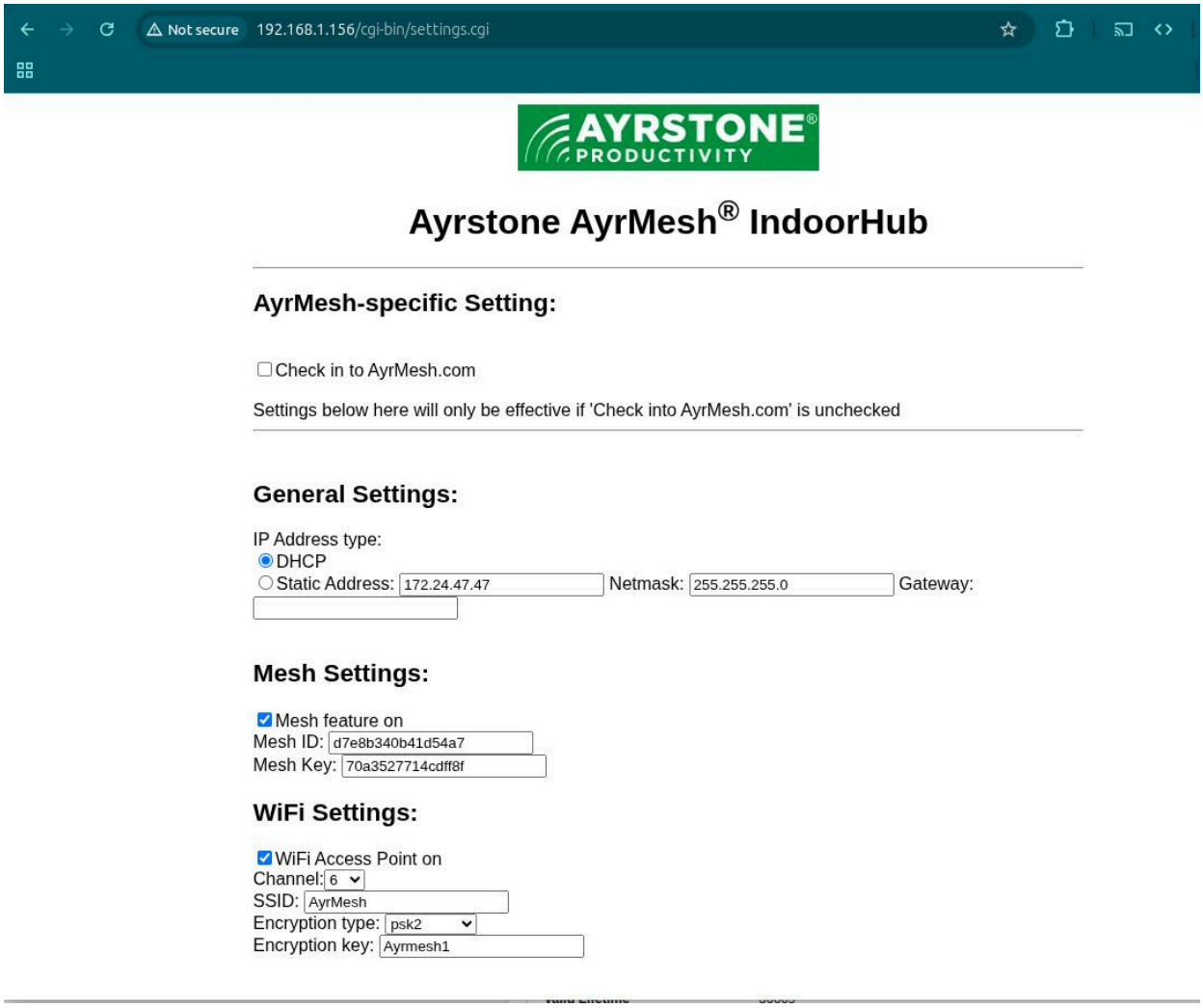
Logging into the Receiver and getting to the "settings.cgi" page is exactly the same as the Hubs. The Settings page is much simpler, though:



As noted, the Receiver will "connect" to any WiFi access point in range; just fill in the SSID and Encryption key and click the "Submit" button. If it is connecting to the Hub, of course, make sure to specify the same SSID and Encryption key as you set on the Hub.

AyrMesh IndoorHub and IndoorAP Products

The "settings.cgi" page on the AyrMesh IndoorHub and IndoorAP products look almost exactly like the Hub's Settings page; this is the top of the page:



Of course, the original AyrMesh IndoorAP did not have a meshing feature, so the "Mesh Settings" section is missing on that model.

Please note that, by default, the Mesh ID is the outdoor Hub's Mesh key, and the Mesh key is the outdoor Hub's Mesh ID. This was done so the IndoorHubs would mesh with each other, but the outdoor Hubs and the IndoorHubs would not mesh with each other, which could cause a variety of issues.

The current model of the IndoorHub, however, can be configured to mesh with the outdoor Hubs (Hub2 or HubDuo) if desired - I would not generally recommend it, and I'd just advise you to use that capability carefully. One of the standard features of the IndoorHub when it's "talking" to AyrMesh.com is that it automatically chooses a channel 5 channels away from the

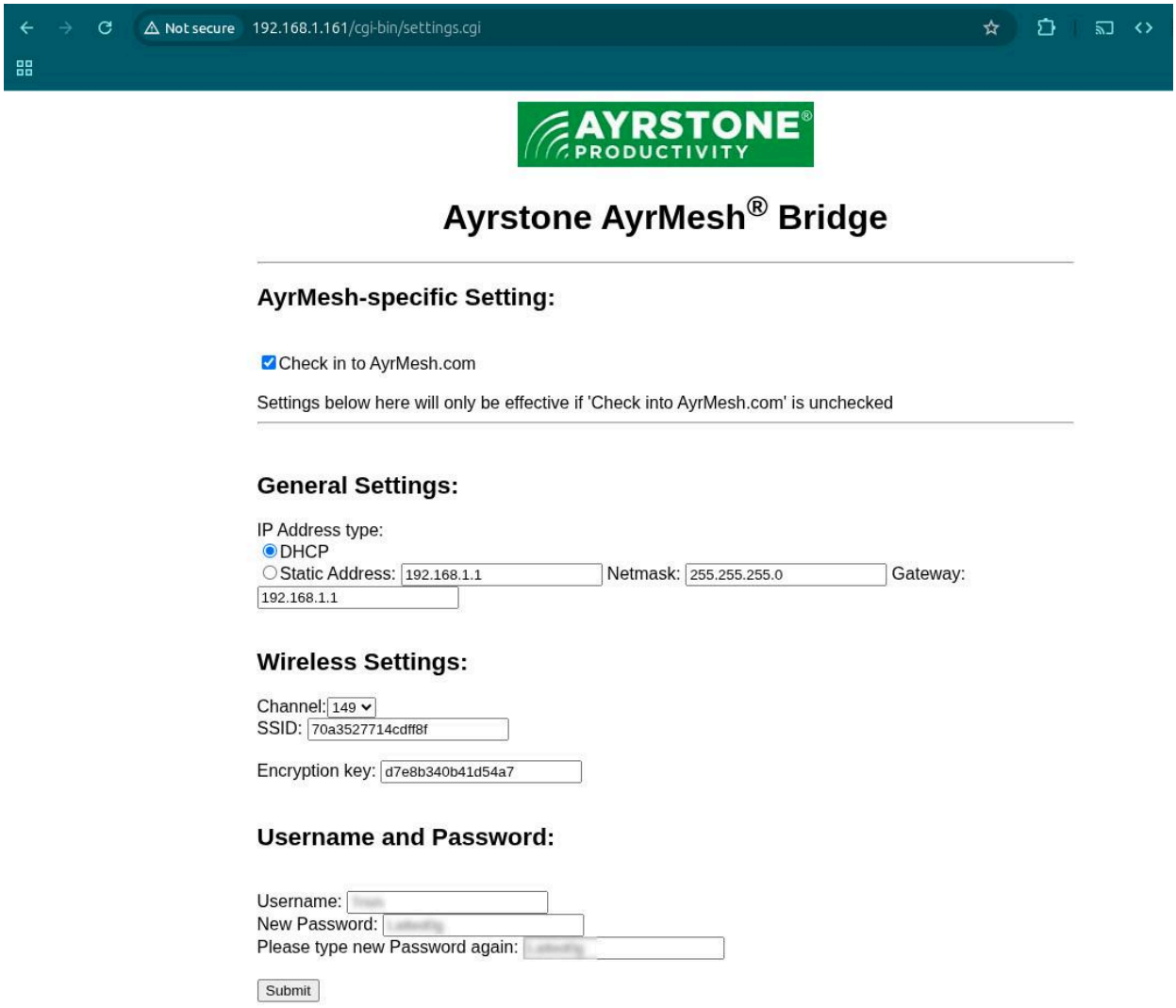
outdoor Hubs, to reduce interference. That is a practice that's strongly recommended (unless, of course, you want to have the IndoorHub mesh with the outdoor Hubs.)

Note that encryption passkeys - both the WiFi Encryption Passkey and the Mesh Key - must be AT LEAST 8 characters long. Don't use spaces in the SSID, Mesh ID, or passkey, and we strongly suggest using only letters (upper- and lowercase) and numbers.

One last note: the IndoorAP does not have meshing capabilities, as noted earlier. The old IndoorHub (little plastic device about the size of a credit card, powered by a USB port) can mesh with other old IndoorHubs, but it cannot mesh with the current IndoorHub (round device about the size of a frisbee, powered by Power over Ethernet) or the outdoor Hubs, because it never got the most modern meshing software. It was also a bit of a troubled design; the Ethernet port nearest the USB port tended to go bad after a while. The other Ethernet port (next to the LED), however, seems much more robust - I have one under my desk at home that has been running for years on the second Ethernet port.

AyrMesh Bridge Products

The AyrMesh Bridge products are very simple, you just need to set an SSID, passkey, and 5.8 GHz. channel:



The SSID and Encryption key can be anything you want (the key must be at least 8 letters or numbers, no spaces) - they just have to be the same on each "end" of the Bridge (both radios). Per the "outside-in" rule, reconfigure the Remote Bridge radio before the Gateway Bridge radio.

Final Note

MAKE SURE you double-check the settings before you click the "Submit" button. If the Hub does not work as expected after it reboots, see the "Reset Button" section below.

In particular, make sure SSIDs, Encryption passkeys, and channels are all set correctly, because, if they're not, devices will just fail mysteriously, and troubleshooting is time-consuming.

Reset Button

It is possible to configure AyrMesh products in a manner that you lose the ability to access the web pages to reconfigure it. If that happens, you have to do a "factory reset," which will reset it back to the factory settings.

There is a reset button on the bottom of every AyrMesh product. On some products, the reset button is recessed, so you may have to use thin tool (like a paper clip or a SIM card tool) to depress the reset button.

To do the "factory reset" on the product, press the button and hold it down for 20 seconds, ESPECIALLY if you're trying to use a static IP address (which, I'll note, is almost ALWAYS a bad idea). When you release the button, the Hub will reboot in its "Factory Fresh" state, with checking in to AyrMesh.com enabled and all the other settings disabled. The username and password are both "ayrmesh" - you'll have to use that to log back into the web page.

On the HubDuo, there are actually two different resets. If you hold the reset button down for 15 seconds, it only resets the wireless settings - other settings (like the networking configuration, username, and password) remain. If you hold the reset button down for 30 seconds or more, it will do a full factory reset.

General Notes on Managing the AyrMesh Network

If you're not careful, it's easy to have a product that ends up "abandoned" - unreachable, and, therefore, unusable (until it is taken down, reset, and re-configured.) Write down configuration information, especially Mesh ID and Mesh Key, so you are certain to configure everything in the network correctly.

Remember there should only be one Gateway Hub on your network. If you need to configure two Gateway Hubs, configure them on different channels and, preferably, with a different

Mesh ID and Mesh Key so they won't mesh and cause a network loop, crashing your network at the router. If you're setting up Remote Hubs, make sure to set them with the Mesh ID and Mesh Key for the Gateway Hub you are expecting them to work with.