Morse Micro




# HaLowLink User Guide

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# 1 What is a HaLowLink?

Your HaLowLink allows you to use Morse Micro's HaLow Wi-Fi to:

- easily set up a Router with a HaLow Access Point to create a new network which supports HaLow
- let other HaLow-enabled devices to connect to your existing network through a HaLow Access Point
- add a HaLow Extender so that existing non-HaLow devices (i.e. 2.4 GHz Wi-Fi and Ethernet Computers) can benefit from HaLow's range

It's flexible and powerful enough that it can perform all these roles. For more information on how these roles can be useful, see the Use Cases section below.

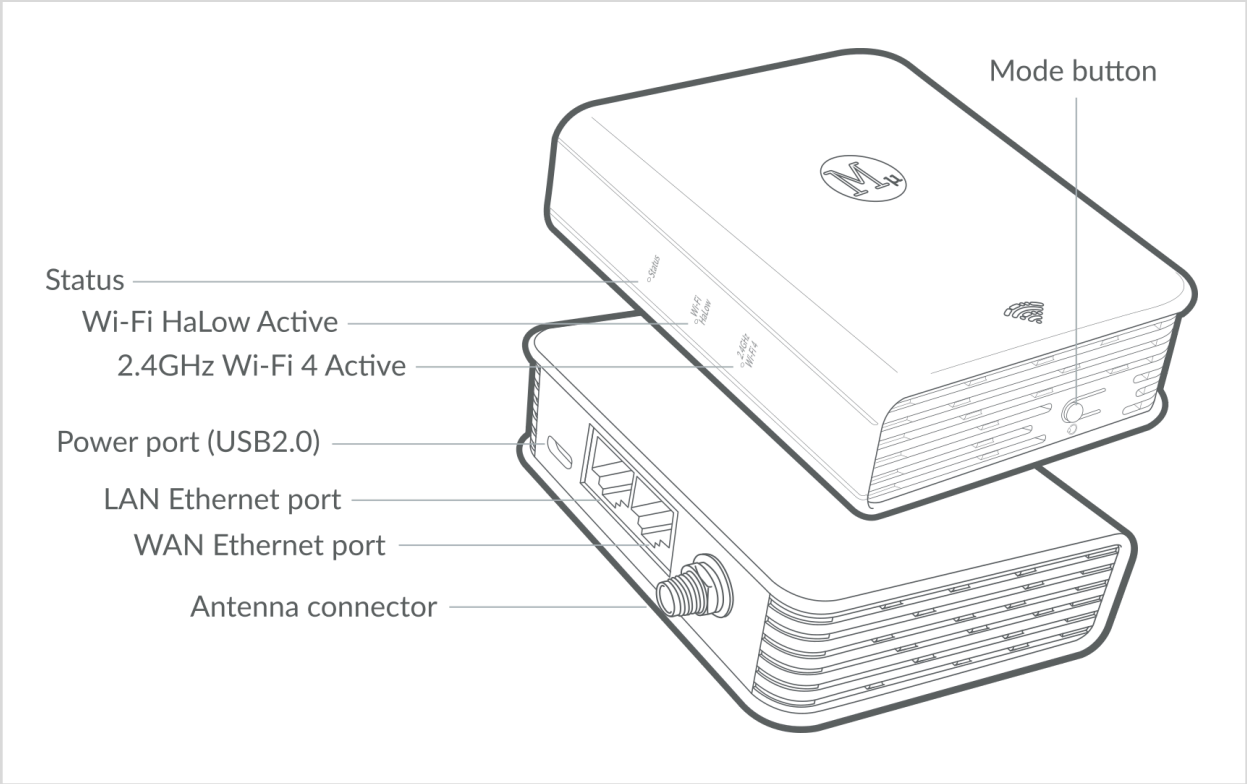



Figure: HaLowLink diagram

# 1.1 HaLowLink Models




Figure: HaLowLink 1 product image




Figure: HaLowLink 2 product image

This guide applies to both the **HaLowLink 1** and the **HaLowLink 2** models (pictured above). Both devices share the same core functionality and run the same HaLowLink variant of **Morse Micro OpenWrt** software (open-source versions are available at github.com/MorseMicro/openwrt).

The only critical differences between the two models are in the **hardware**. The primary upgrade is a transition from the Morse Micro **MM6108** HaLow chip in the HaLowLink 1 to the next generation **MM8108** chip in the HaLowLink 2.

The purpose of this guide is to provide a unified set of user instructions which apply equally to both models. If at any point in the future this guide is updated to include model-specific instructions, they will be explicitly identified. In all other cases, the term **HaLowLink** (without a model number suffix) will be used to refer to all models equally.

# 1.2 Important Security Notice

There have been some significant updates to the Morse Micro OpenWrt software in order to remain compliant with international cybersecurity requirements.

## 1.2.1 HTTPS-Only Access

The HaLowLink web interface, from Morse Micro OpenWrt 2.11.x onwards, is accessible only via HTTPS. Any attempt to connect using HTTP will automatically redirect to https://192.168.12.1. When you first connect, your browser may display warnings about the page being insecure. This is expected, because the HaLowLink uses an encrypted HTTPS session without a signed certificate. You must proceed through these warnings in order to continue accessing the device. This is safer than HTTP as all traffic will be encrypted.

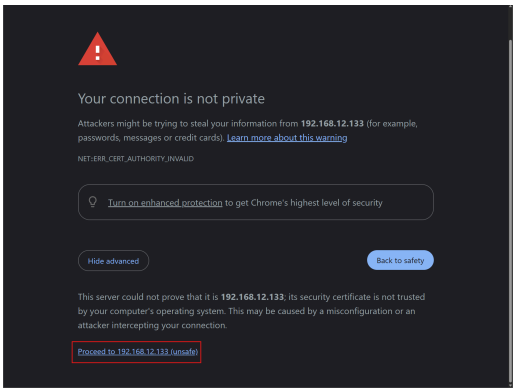



Figure: Chrome HTTPS warning page

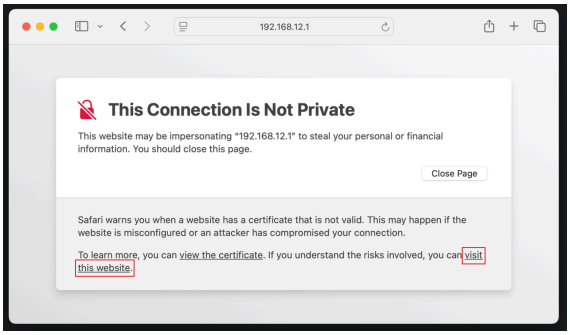



Figure: Safari HTTPS warning page

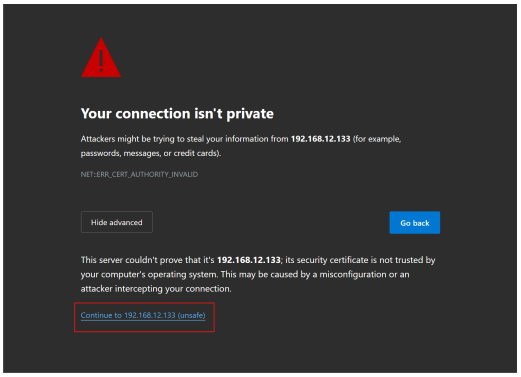



Figure: Edge HTTPS warning page

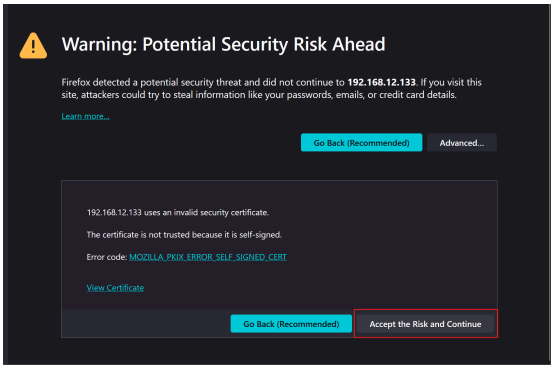



Figure: Firefox HTTPS warning page

## 1.2.2 SSH Disabled by Default

To enable SSH, navigate to the **SSH Access** tab on the Administration Page in Advanced Config.

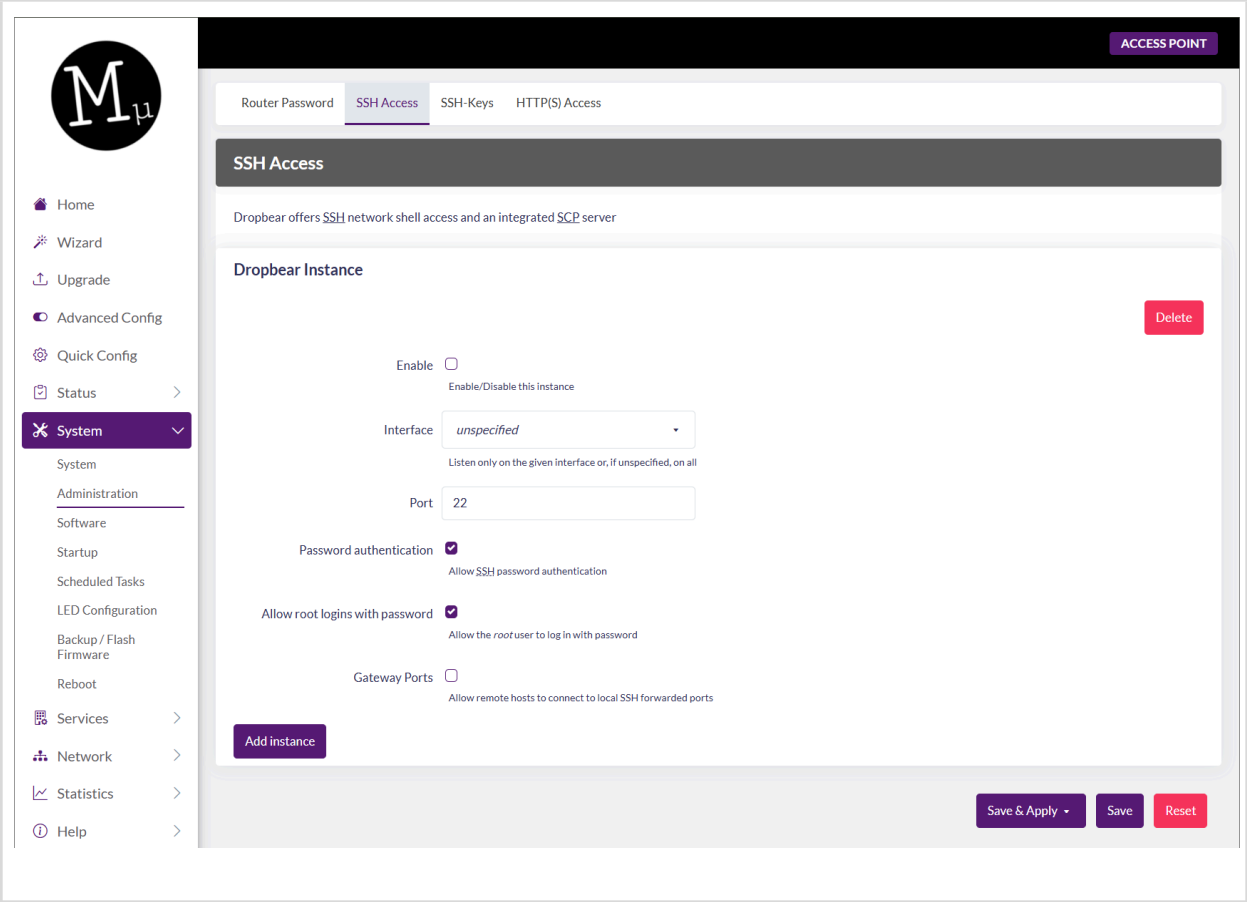



Figure: The SSH Access page

## 1.2.3 Software Updates

To maintain compliance with evolving cybersecurity requirements, updates for this device may be released more frequently and it is strongly recommended to regularly check for new updates via the Software Updates page.

### 1.2.4 Open Network Ports

The following table documents the open network ports and their associated services on the device. Each entry describes the functional purpose of the service and the security rationale for its exposure, with access restricted to trusted interfaces where applicable.

| Port | Protocol | Service (Daemon) | Purpose |
|---|---|---|---|
| 53 | UDP/TCP | DNS (dnsmasq) | Provides local DNS resolution required for basic network operation and is restricted to trusted network interfaces only. |
| 80 | TCP | HTTP (uhttpd) | Provides initial web access solely to redirect HTTP requests to the encrypted HTTPS management interface. No administrative functions or sensitive data are exposed over HTTP by default. |
| 443 | TCP | HTTPS (uhttpd) | Provides an encrypted web-based administrative interface (HTTPS/TLS). Administrative access is restricted to trusted LAN interfaces by default and requires user authentication except for unconfigured extenders. |
| 67 | UDP | DHCP Server (dnsmasq) | Provides DHCP services to assign IP addressing and related network configuration parameters to devices on trusted local network interfaces. |
| 5353 | UDP | mDNS (umdns) | Provides link-local multicast DNS functionality for name resolution and service discovery on trusted local network interfaces only. |
| 7681 | TCP | Terminal interface (ttyd) | Provides a web-based terminal interface for local device administration on trusted local network interfaces. ttyd does not provide a secure shell (SSH) session, and all terminal traffic is transmitted in clear text without encryption. The port is closed by default and is only opened when ttyd is explicitly enabled through the GUI. |

List of open network ports

# 1.3 Preset Configurations

Below are high-level descriptions of common configuration "presets", which are combinations of HaLow Mode and Network Mode, and can be configured via the Wizard page.

## 1.3.1 Router With a Wi-Fi HaLow Access Point

**This is the default mode of operation** for the HaLowLink. It has an IP address of 192.168.12.1, and hands out addresses to devices connected to the LAN side via Ethernet, 2.4 GHz Wi-Fi or Wi-Fi HaLow in this range. The WAN Ethernet port is the default uplink connection, and will obtain an address as a DHCP client. In this mode the HaLowLink is most similar to a typical home router/gateway, and it is not possible to access the web interface via the uplink connection.

## 1.3.2 Wi-Fi HaLow Access Point (AP)

Similar to access points (APs) available on the market, this allows you to add a HaLow Access Point to your existing network. You still use your WAN Ethernet port (which is more appropriately considered the "Uplink Ethernet Port" in this scenario) for the uplink connection, but any attached HaLow devices will use DHCP to obtain addresses on your existing network (i.e. home router) subnet. This means no traffic forwarding/NAT is required. **This is the most appropriate mode for most use cases**, as it makes it straightforward for anyone on your network to interact with HaLow connected devices.

It will also be possible to access the web interface via your existing local network by determining which IP is assigned to the HaLowLink. However, the 192.168.12.1/24 network will remain accessible on the LAN Ethernet port. This functions as a separate management interface independent of the existing network which makes it simpler to reconfigure.

*Note: if you want to ensure that the AP is fully bridged exactly like a normal Access Point product see Frequently Asked Questions.*

## 1.3.3 Wi-Fi HaLow Extender

Extenders generally receive a Wi-Fi signal and rebroadcast it. In Wi-Fi jargon, these devices are clients/stations rather than APs in regards to the HaLow network.

The goal of this mode of operation is to help get another device connected to a HaLow network. That device might be connected to the HaLowLink via Ethernet or 2.4 GHz Wi-Fi, and then the HaLowLink passes that traffic via HaLow, effectively extending the range of the non-HaLow device.

# 2 Getting Started

## 2.1 Initial Connection

Connect the provided antenna to the antenna connector first. Then connect your device to the HaLowLink.

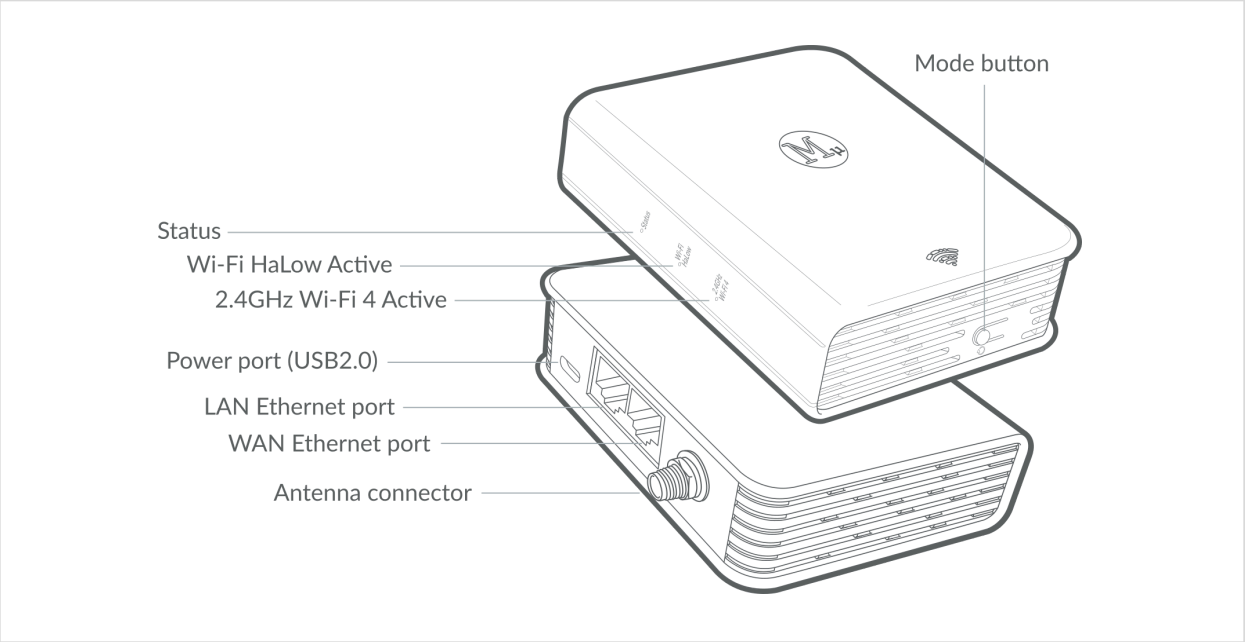



Figure: HaLowLink diagram

### 2.1.1 Using Ethernet

1. Connect your HaLowLink to power via the USB-C port using the provided power supply.
2. Connect your computer to the LAN port of the HaLowLink using the provided Ethernet cable.

### 2.1.2 Using Wi-Fi

1. Connect your HaLowLink to power via the USB-C port using the provided power supply.
2. Once the device is fully booted connect your computer or phone to the Wi-Fi network of the HaLowLink by scanning the QR-Code or using the Wi-Fi SSID/password on the label.

### 2.1.3 Using USB-C

Connect your HaLowLink to your computer directly using the USB-C cable provided. Ensure that the USB port on your computer can provide sufficient power.

### 2.1.4 Connecting to an Existing Network Using Ethernet

Optionally, if you want your downstream devices to have access to an existing network via your HaLowLink, connect an Ethernet cable from the WAN port of your HaLowLink to your home router (or any network with a DHCP server).

## 2.2 Login Page

Once you're connected to the HaLowLink, you can then use a web browser to connect to https://192.168.12.1. To login, use the Device Username and Password on the label; we recommend letting your browser save the password.

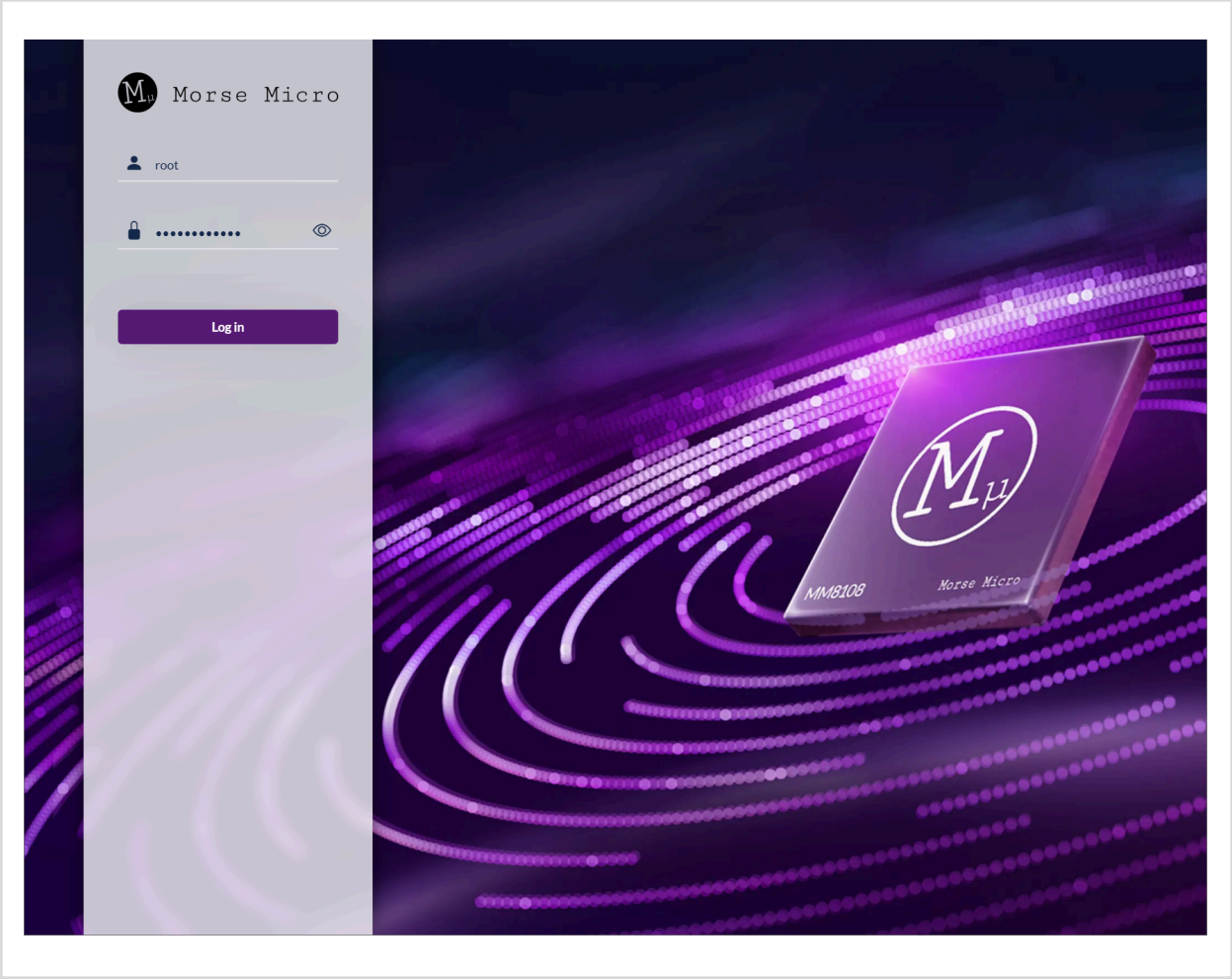



Figure: The Login page

You should now be able to see the **Home** page, where initially, you will see **0 Connected Devices** on your HaLow network.

## 2.3 Getting the Latest Software

In order to get the latest features, fixes and security upgrades we recommend checking for any updates as soon as you log in for the first time (see the Software Update section).

## 2.4 Home Page

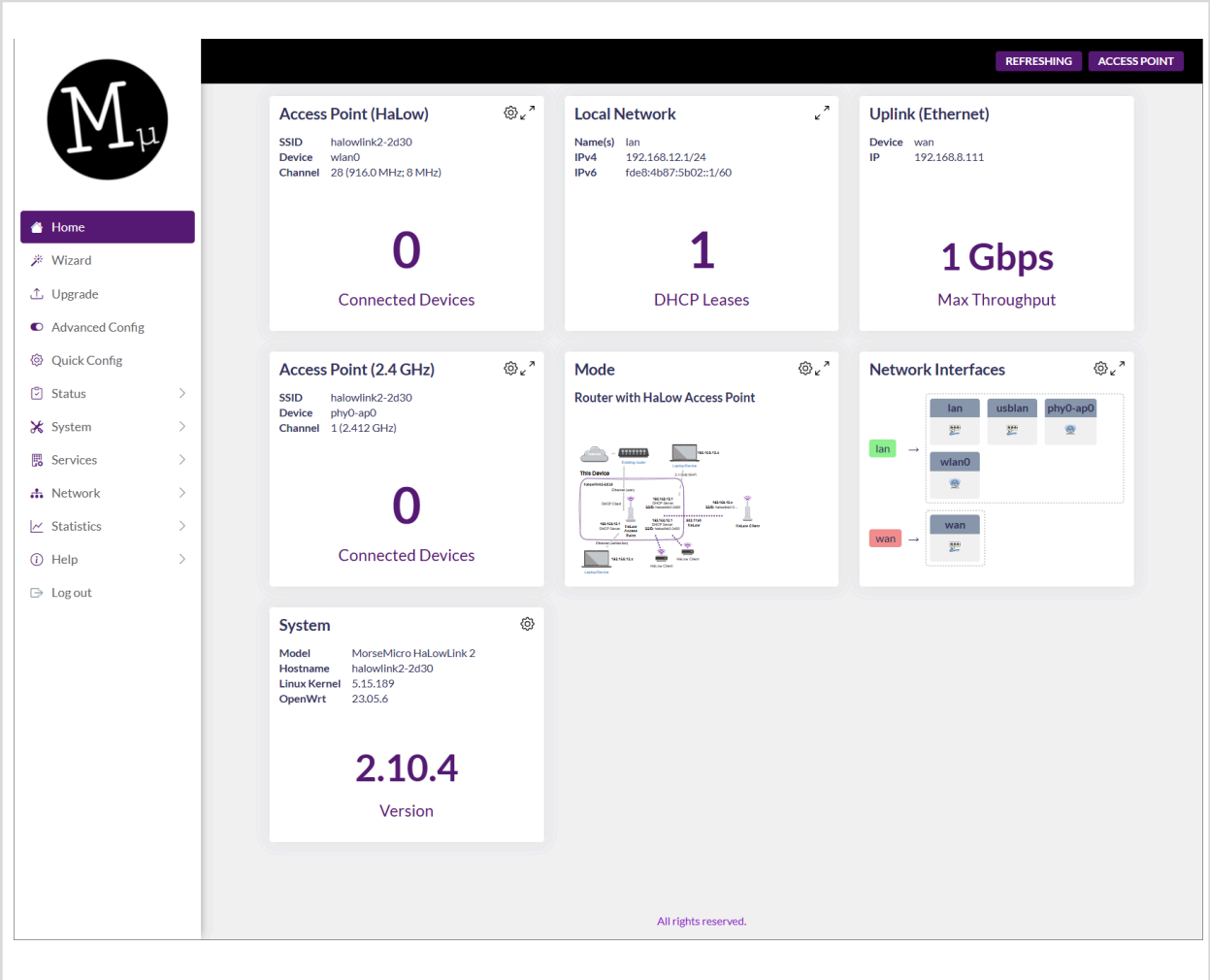



Figure: The Home page

The Home page will automatically update if changes occur in your network. To view more information, click on the large numbers on the card or on the ↙↗ icon in the top right. Make sure the **Uplink** card does not show as disconnected if you want your HaLow devices to have access to an existing network or the internet.

# 2.5 Wizard

As described in What is a HaLowLink? When you first power on your HaLowLink it will be a Router with a HaLow Access Point. If you'd like to change this mode, navigate to the **Wizard** page using the sidebar menu.

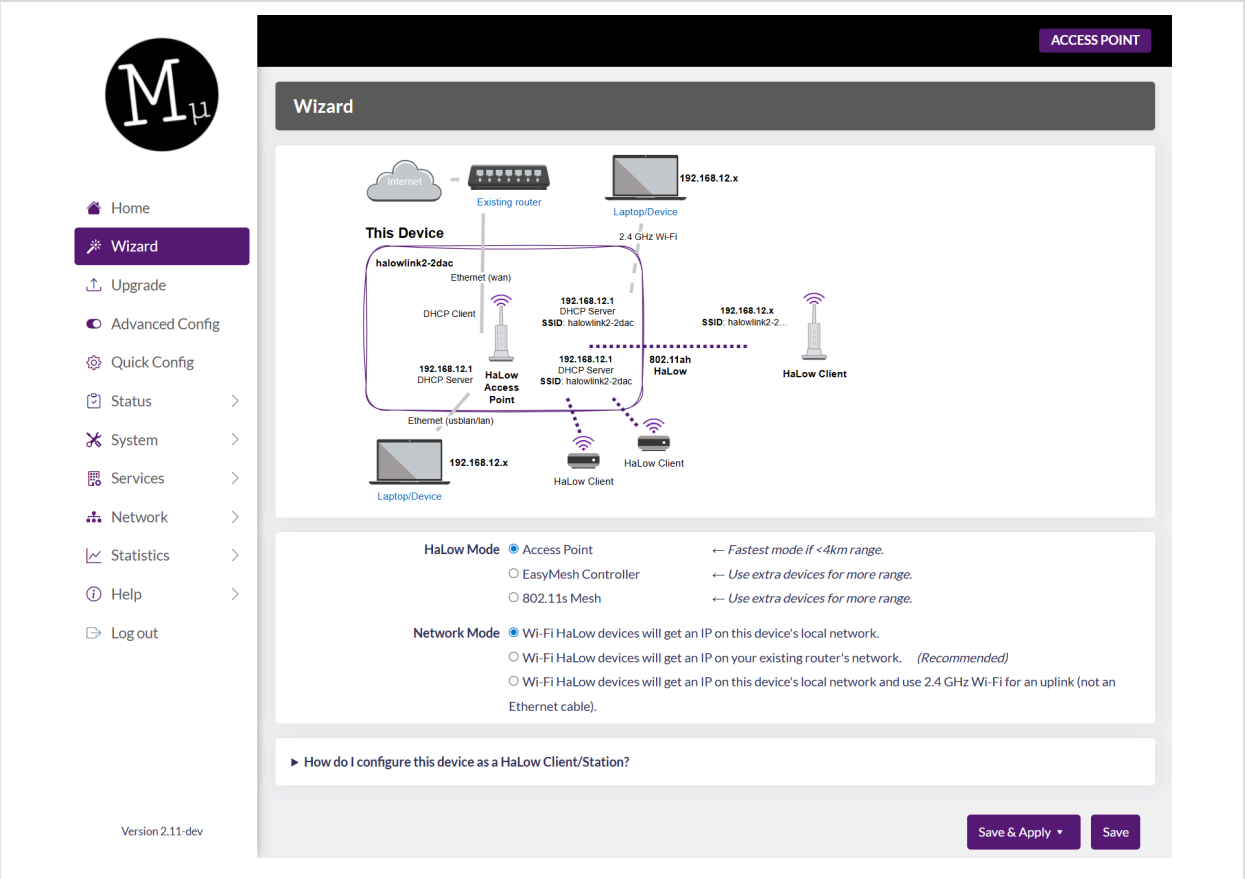



Figure: The Wizard page

You should see that the option **Wi-Fi HaLow devices will get an IP on this device's local network** is selected. This means that the device is acting as a router.

If you would like to change this, the wizard is the simplest way. It automatically handles the many underlying changes needed to switch between different common device configurations.

*Note: using the wizard assumes default config as a starting point, so it will overwrite customizations made outside of the wizard.*

## 2.5.1 Wi-Fi HaLow Modes

The **Wi-Fi HaLow Mode** options in the wizard control how the Wi-Fi HaLow network operates. By default, the device runs as an **Access Point** which is sufficient for most use cases thanks to Wi-Fi

HaLow's long range. If your particular scenario requires even greater coverage or more redundancy you can also use the wizard to configure a mesh, either EasyMesh or 802.11s Mesh, with multiple HaLowLink devices.

## 2.5.2 Network Modes

The **Network Mode** settings define how the HaLowLink will connect to the other networks (uplinks) such as your home's internet and how it will provide access to the downstream HaLow devices.

**Wi-Fi HaLow devices will get an IP on your existing router's network (recommended)**

In this mode the HaLowLink acts as an Access Point with an Ethernet uplink via the WAN Ethernet Port. HaLow devices will receive IP addresses from your existing network's DHCP server, allowing seamless integration with other devices on that LAN. The firewall will be effectively inactive and your existing router should handle security and routing.

If possible, we recommend selecting this option on your device. This will effectively change your device from a Router with a HaLow Access Point to a HaLow Access Point (AP) as described in What is a HaLowLink?

This option will only work, however, if you have connected your WAN port to your existing router and your HaLowLink has obtained an IP address. To confirm this is true, go to the **Home** page and make sure you have been assigned an IP on the **Uplink** card:

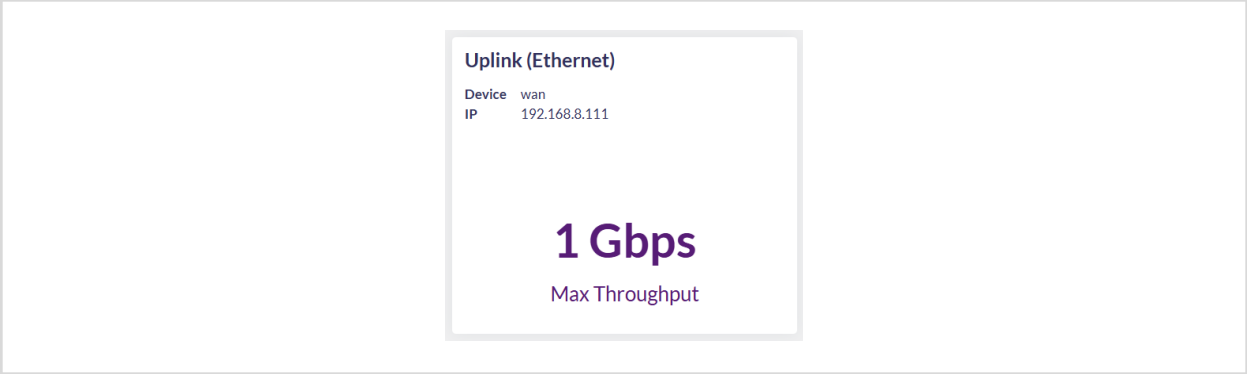



Figure: The Uplink card, with an active Ethernet connection

*Note: if you want to ensure your device is fully bridged in this Network Mode, see Frequently Asked Questions.*

*Use this option when you have a wired Ethernet connection to your HaLowLink WAN port and want HaLow devices to join your main network directly like normal devices.*

**Wi-Fi HaLow devices will get an IP on this device's local network (default)**

In this mode, the HaLowLink creates its own local subnet and DHCP service for HaLow devices. If connected to the **WAN Ethernet** port, devices may still reach the internet, but IP addresses come

from the HaLowLink itself rather than the upstream router. In this mode, the firewall is active and will block incoming connections on the **wan** interface whilst forwarding traffic originating from the **lan** out through that same **wan** interface.

*Use this for new or standalone HaLow networks rather than extending an existing network, for isolated test setups, or when you want control over the IP range.*

### Wi-Fi HaLow devices will get an IP on this device's local network and use 2.4 GHz Wi-Fi for an uplink (not an Ethernet cable)

In this mode, the HaLowLink acts as a router with a 2.4 GHz Wi-Fi uplink instead of an Ethernet connection to the WAN port. HaLow devices receive IP addresses from your existing Wi-Fi router. In this mode, the firewall is active and will block incoming connections on the **wan** interface whilst forwarding traffic originating from the **lan** out through that same **wan** interface. Once you have clicked **Save & Apply** in the wizard you will still need to provide the Wi-Fi credentials:

1. Navigate to the **Home** page and click the **Disconnected** cross on the **Uplink** card.

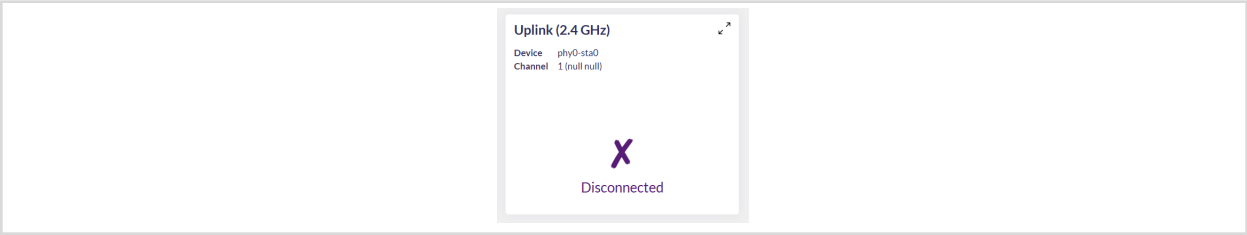



Figure: The Uplink card on the Home page, in a disconnected state

2. Search for your Wi-Fi network and enter your password, then save the credentials.

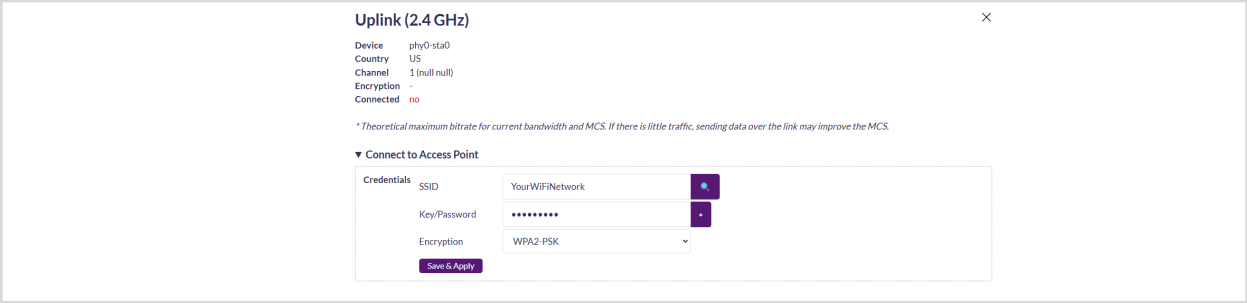



Figure: The expanded Uplink card on the Home page, in a disconnected state

3. Wait for **Connected** to change to **yes**. You should now see a tick on the Uplink card.

*Use this when Ethernet cabling to the external network is unavailable, but you still want HaLow devices to join your existing Wi-Fi LAN.*

# 3 HaLow Extender

*Note: you don't need to use the web interface to switch to **Extender** mode — this can be done directly with the **Mode** button.*

By default, your HaLowLink comes configured as a HaLow Access Point. However, it can also be used as a HaLow Extender when you have more than one HaLowLink device. This will let existing Wi-Fi and Ethernet devices make use of HaLow's long range.

To switch your HaLowLink into Extender mode:

1. Power on your HaLowLink and wait until the Status LED is solid (green or aqua).
2. Hold down the **Mode** button (pictured in The HaLowLink device Figure). The Status LED will first start flashing slowly green, and then start flashing quickly aqua. Release the button when it's flashing aqua.
3. Wait until the Status LED is **solid aqua** to indicate it's loaded and running in Extender mode.

## 3.1 Pairing

Pairing is designed to make connecting your HaLowLink Extender to a HaLowLink Access Point as simple as possible. When using this method, the Access Point automatically pushes the correct configurations to the Extender so you don't need to manually repeat settings on each Extender you add to the network.

For example, if you've used the Access Point Wizard to configure the AP as an EasyMesh Controller, every extender you pair will automatically be set up as an EasyMesh Agent. This eliminates the need to manually enter credentials or specify operating modes on each device, reducing errors and ensuring consistent, reliable configuration across your network.

In Extender mode your device will not be accessible at https://192.168.12.1. Instead, you should **pair** it to an existing HaLowLink by:

1. Pressing and immediately releasing the mode button on your HaLowLink Access Point (with a **green** Status LED). The Wi-Fi HaLow LED will begin slowly flashing to indicate it's ready to pair.
2. Pressing and immediately releasing the mode button on your HalowLink Extender (with an **aqua** Status LED). The Wi-Fi HaLow LED will begin slowly flashing to indicate it's searching for an Access Point to pair with.
3. Wait until the Wi-Fi HaLow LED on your HaLowLink Extender is **solid purple**. Your Extender has now stored the Wi-Fi credentials, and is ready to use!

If pairing fails, the HaLow LEDs will begin to flash quickly for 120 seconds to indicate the retry delay, a security feature to prevent brute force attempts and limit radio noise. After the HaLow LEDs stop flashing on both the Access Point and Extender, you can attempt the pairing again, beginning from Step 1 above.

# 3.2 Manual Extender Configuration (Alternative)

We recommend using standard Pairing whenever possible. However, manual configuration of a HaLow network SSID/password may be required in certain cases and we have provided a special portal for this purpose.

1. Factory reset the device and switch it into Extender Mode.
2. Connect to the device using one of the methods described in Initial Connection and navigate to https://192.168.12.1. You should see the special HaLow Extender Configuration portal (pictured).

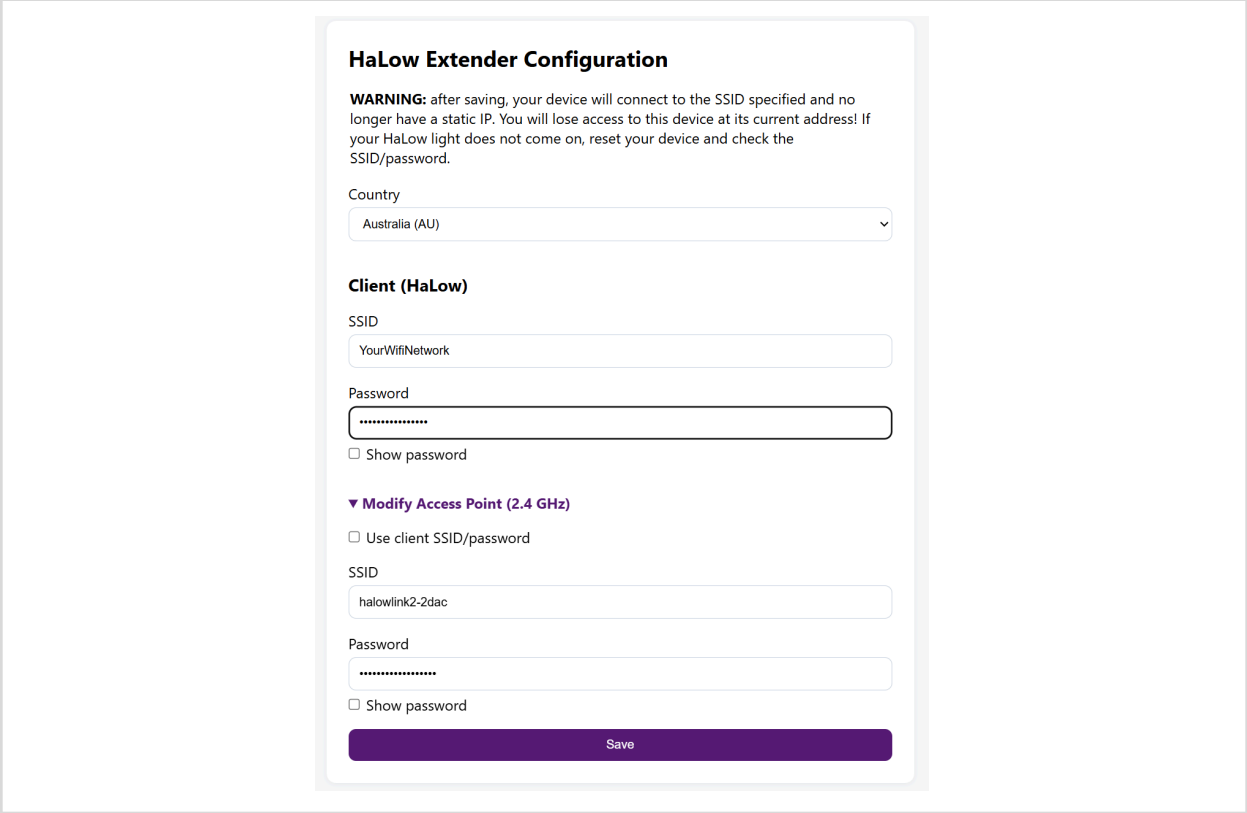



Figure: HaLow Extender Configuration portal

3. Fill out the form as necessary with the details of the HaLow network you intend to connect to.
4. (Optional) Modify the name of the 2.4 GHz Access Point hosted by the Extender.
5. Click **Save** and you should see a page telling you that the configuration is complete and that this portal will no longer be accessible, as the device has begun trying to connect to the HaLow network which you specified (pictured).

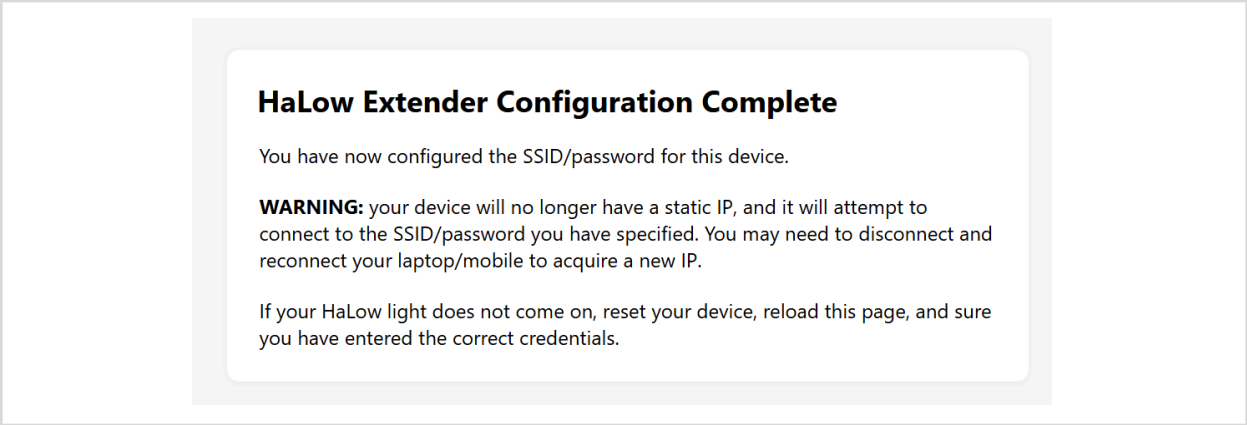



Figure: HaLow Extender Configuration Complete page

If the credentials are correct and the network is within range, your Extender should successfully connect to it and the **HaLow LED** will turn on. If the HaLow LED does not light up as expected, consider performing a factory reset and trying again.

## 3.3 Using Your Extender's Connection

You can connect devices to your Extender via an Ethernet cable or via 2.4 GHz Wi-Fi, and this will let them use the Extender's HaLow connection. For the Wi-Fi credentials, refer to the label **on your Extender**. These will not be the same as the credentials on your Access Point.

# 4 Mesh (Advanced)

***WARNING:*** *this is not currently supported in the EU or UK because regulatory rules require dynamic channel changing during operation. This is currently implemented on a per-device basis, but mesh devices in the same mesh must all have the same channel.*

Mesh technology allows the creation of multi-hop networks which can extend coverage and improve redundancy.

To set up a mesh simply configure your Access Point mode (green Status LED) HaLowLink as an EasyMesh Controller or a 802.11s Mesh peer by applying the relevant HaLow Mode option in the Wizard. When you pair additional HaLowLinks it will automatically push the corresponding 802.11s Mesh Point or EasyMesh Agent configurations to the Extender being paired with.

If you have configured your device in one of the mesh modes, avoid making significant networking changes in the UI as it is very easy to misconfigure. For EasyMesh specifically, some settings are managed automatically and are not made visible in the web interface.

## *4.1* Should I Use a Mesh?

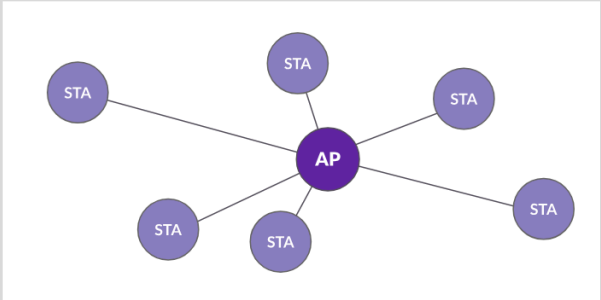



Figure: Default Access Point topology

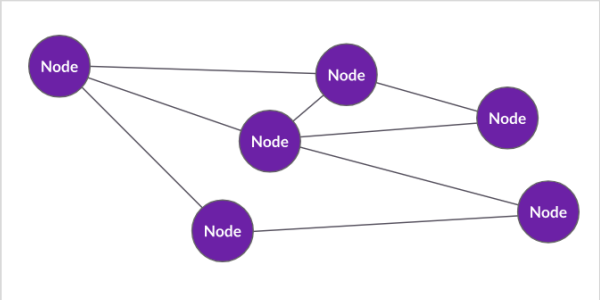



Figure: Mesh topology (conceptual)

Mesh networks allow the use of multiple HaLowLink devices to extend network coverage but are **complex and often misunderstood** and can even degrade network performance if deployed improperly. For most use cases, a single HaLow Access Point should provide more than enough coverage.

The limitations of mesh networks are:

- Each additional hop reduces the throughput by half
- The number of hops are limited
- There is a large amount of beaconing and control traffic overhead

You likely **do not need a mesh** if:

- Your existing AP + STA HaLow network already provides sufficient coverage

- You only have two (2) HaLowLink devices

You **can use a mesh** when:

- You have dead zones or unreachable areas.
- You need a reliable and redundant network with multiple paths more than you need speed.

### 4.1.1 HaLowLink Mesh Comparison

| Feature | EasyMesh | 802.11s Mesh |
|---|---|---|
| Best For | Smaller fixed networks which require greater coverage for end devices | Larger or complex topologies requiring advanced routing and redundancy |
| Example Use Case | Expanding coverage within a single building or site | Multi-building, industrial, or outdoor deployments needing fault tolerance |
| Controller & Topology | Controller-managed tree | Distributed peer-to-peer |
| Redundancy | Partial support with STA steering | Designed for multiple paths |
| Node Mobility | Designed for fixed devices only | Supported |
| Standards | Wi-Fi Alliance EasyMesh Standard | IEEE 802.11s |
| Co-located HaLow Access Points | HaLow STAs can connect to any AP node in network | 802.11s Mesh Gates can be manually configured with an AP |
| Maximum Peer Nodes | 4 | 10 |
| Maximum Hops | 2 | 4 |
| Performance | Lower latency single backhaul per tree | Slower due to higher overhead on multiple peer links |

Table 1: HaLowLink mesh comparison

# 4.2 EasyMesh

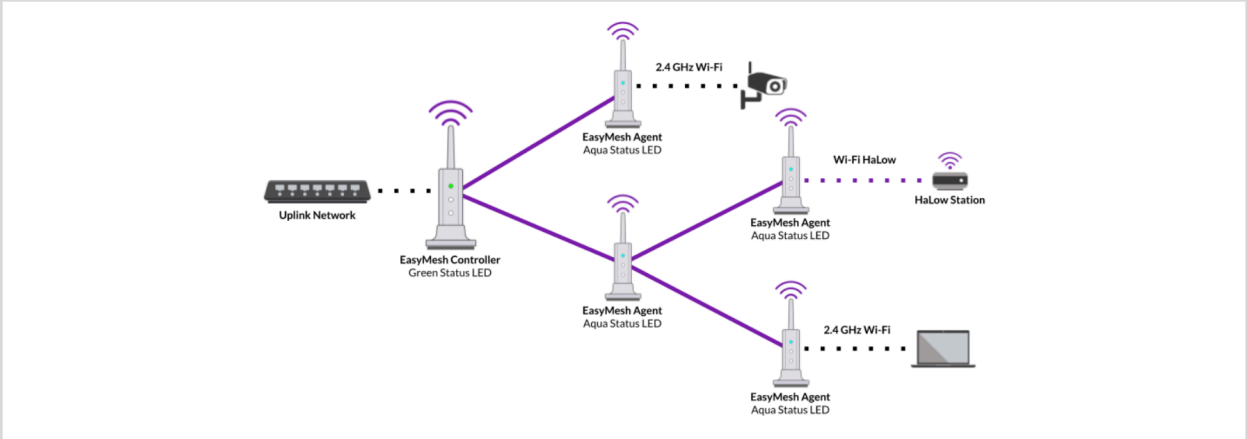



Figure: Example EasyMesh diagram

EasyMesh is a Wi-Fi Alliance Multi-AP solution for meshing together Access Points in a tree structure to extend coverage (but with reduced bandwidth available to clients). Configured as a HaLow Mode from the Wizard page, **EasyMesh Controllers** (green Status LED) discover, configure and monitor **EasyMesh Agents** (aqua Status LEDs), ensuring consistent SSIDs and channel information across the mesh.

Agents connect upstream towards the Controller as normal clients while simultaneously serving downstream clients as normal Access Points themselves, allowing any HaLow device with the correct credentials to connect. Agents can also onboard client devices onto the mesh via **Ethernet (any method)** and the built-in **2.4 GHz AP.**

You can use the **EasyMesh visualizer** by clicking on the **EasyMesh Controller** card on the Home page of the Access Point Mode device (green status LED), which will display the connected nodes:

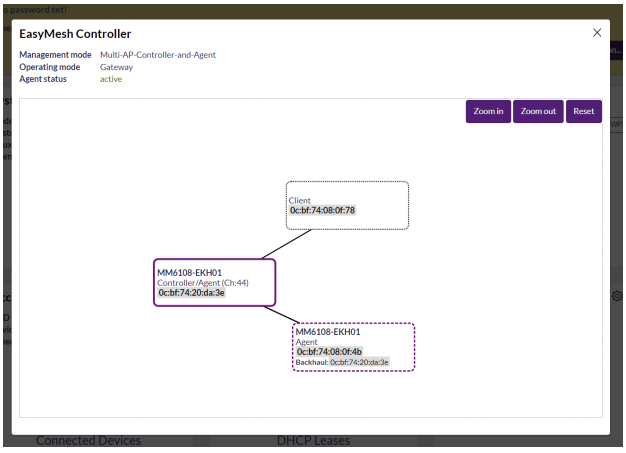



Figure: The EasyMesh visualizer

# 4.3 802.11s Mesh (beta)

*Note: 802.11s Mesh is a beta feature for experimental use, but not intended for production use yet.*

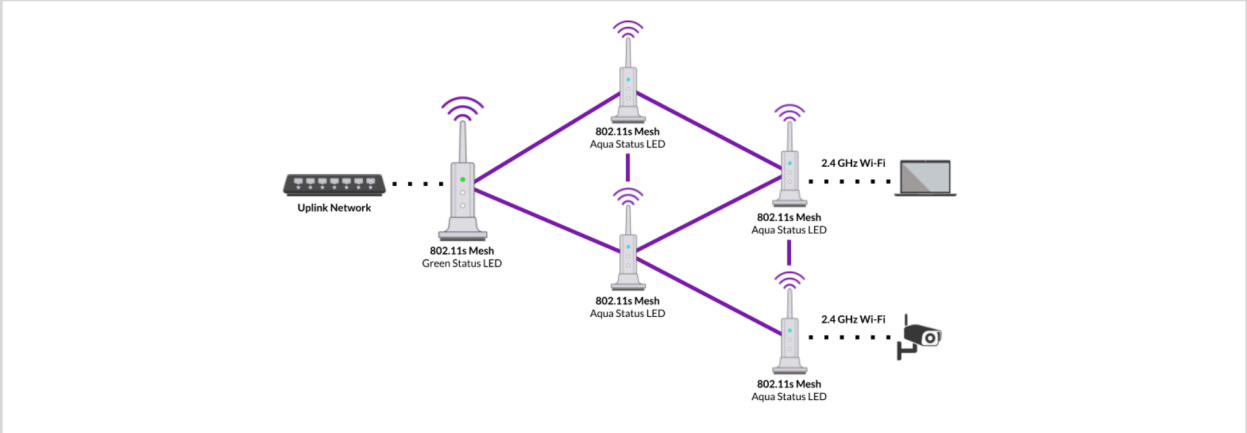



Figure: 802.11s Mesh diagram

802.11s Mesh is an IEEE Wi-Fi mesh which forms a truly distributed peer-to-peer multi hop Mesh Basic Service Set (MBSS). Configured as a HaLow Mode via the Wizard page, 802.11s Mesh networks aim to increase coverage, redundancy and range by establishing self-healing links between neighboring 802.11s Mesh nodes in the topology. Only mesh capable devices can join or make use of the functionality provided by the MBSS.

802.11s Mesh HaLowLink networks can be accessed via the **Ethernet (any port)** or the **2.4 GHz Wi-Fi AP** on the devices. Units with a green Status LED also run a co-located HaLow Access Point which can allow the mesh to be bridged to external HaLow networks.

You can use the **802.11s Mesh visualizer** by clicking on the **802.11s Mesh Topology** card on the Home page of any 802.11s mesh devices, which will display the topology as seen by that node.

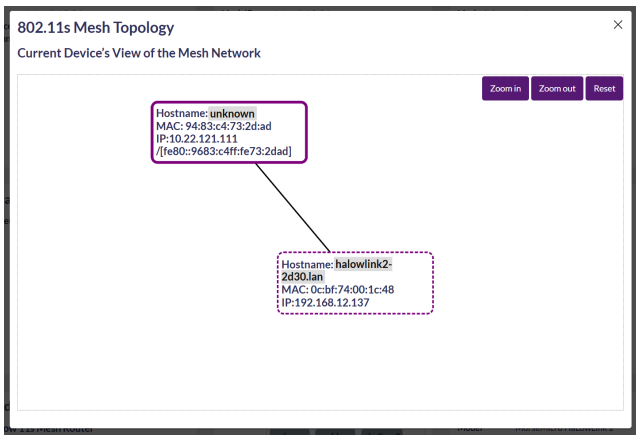



Figure: 802.11s Mesh visualizer

# 4.4 Pairing Extenders to a Mesh

As mentioned in the introduction, if you pair a HaLowLink Extender to a Mesh-enabled 'green' HaLowLink it will automatically become part of the mesh. That is, it will not be just a client, but either a **Mesh Point** or an **EasyMesh Agent**.

If you instead want to configure an Extender as a normal station/client device instead of a mesh peer, then you should do so via the Manual Extender Configuration (Alternative). The other implication of this is that a manually configured device will *not* automatically become part of the mesh. That is:

- Pair Extender (aqua) via push button -> becomes part of mesh
- Enter manual credentials on Extender via web interface -> normal client Extender mode

There are also some aspects to the default mesh configurations that may not be intuitive, as the role of the device changes.

## 4.4.1 EasyMesh

Once a device is configured as an Agent, the role of the mode button is now to onboard new devices to the mesh. This means that you can easily add more devices to your mesh from any of the already configured devices, but if you want to reconfigure your Extender entirely you should reset it before repairing. Also, the SSID of the original 'green' HaLowLink is propagated to all devices in the Mesh both for the 2.4 WiFi and the HaLow WiFi, such that the QRCode on your Extenders will no longer work to connect to the device but you will have a consistent SSID.

## 4.4.2 11s Mesh

Unlike EasyMesh, any Extender will NOT have an additional HaLow Access Point, as the HaLow interface will be exclusively used for the Mesh. The 2.4GHz Access Point on the Extender is unmodified, so that all Extenders will have a distinct SSID and key (by default the one encoded on the QRCode). In this mode, Extenders will not support any further pairing actions, and so must be reset to be repaired.

If you want to connect HaLow client devices that do not support 11s Mesh to 11s Mesh Extenders, you can manually add a HaLow Access Point via the Quick Config interface. This will also re-enable the pairing function of the mode button, allowing you (as with EasyMesh) to onboard additional Extenders via this existing Extender. You will still need to reset the device if you want to repair the existing Extender.

# 5 Restoring Factory Settings

A factory reset is useful if you:

- Don't want to use your HaLowLink as an Extender anymore.
- No longer have access to your device via the network after making configuration changes.
- Want to start fresh by configuring your HaLowLink for a new purpose

A factory reset always returns to **Access Point mode** (green Status LED), which is the default. To perform a factory reset:

1. Power on your HaLowLink and wait until the Status LED is either solid green or solid aqua.
2. Hold down the Mode button until the Status LED begins flashing slowly green, then release it.
3. Wait until the device resets and the status LED changes to solid green, indicating that it is running in Access Point mode.
4. You can now access your device at https://192.168.12.1 again, as described in Initial Connection.

*Warning: in Step 2, if you continue holding down the button until the status LED is flashing quickly aqua, the device will reset into Extender mode instead. (see the Extender section).*

# 6 Use Cases

These are some common use cases for the HaLowLink with some pointers on how to set them up. If you have previously configured your HaLowLink in some way, you may want to Restore Factory Settings before following these instructions.

## 6.1 Adding a HaLow Access Point to Your Existing Network via Ethernet

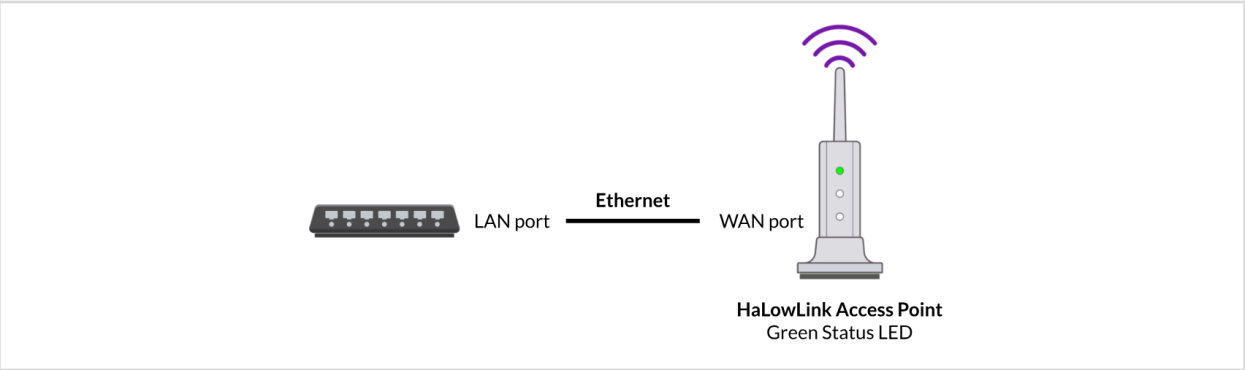



Figure: Adding a HaLow Access Point to Your Existing Network via Ethernet use case diagram

The primary use case for a HaLowLink is to add HaLow support to your existing network, allowing any HaLow-enabled client to work in the same way as any other Wi-Fi client.

1. Make sure your HaLowLink is in Access Point mode (green Status LED).
2. Connect the WAN port of your HaLowLink to your network; in the home, this usually means placing it next to your router and connecting the WAN port to a LAN port.
3. HaLow devices can then connect via the SSID/password printed on the sticker.

Although it will work as is for many use cases, for the best experience we recommend using the Wizard to set **Wi-Fi HaLow devices will get an IP on your existing router's network**, which will change it from a **Router with HaLow Access Point to a HaLow Access Point**.

# 6.2 Adding a HaLow Access Point to a Network via 2.4 GHz Wi-Fi

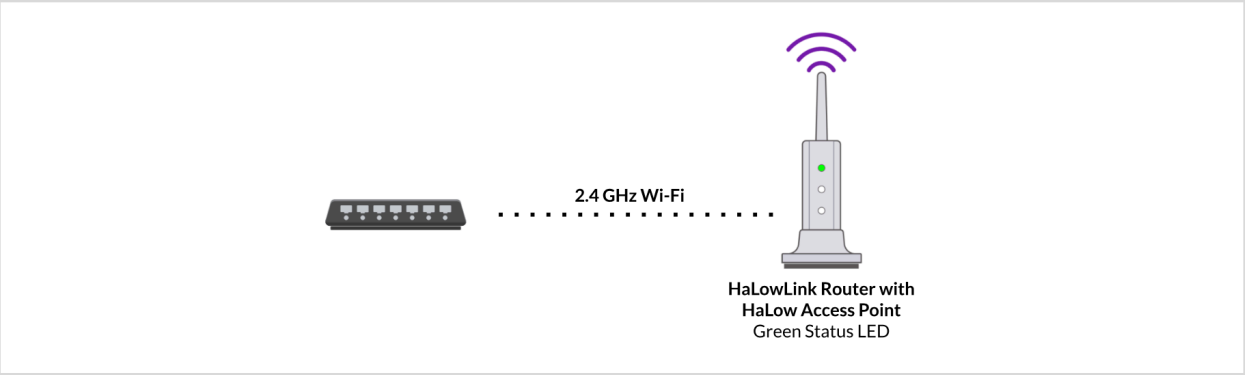



Figure: Adding a HaLow Access Point to a Network via 2.4 GHz Wi-Fi use case diagram

If it's not possible to connect your HaLowLink via Ethernet, you can connect your HaLowLink via 2.4 GHz Wi-Fi. You should only do this if Ethernet is not possible, as it will require your HaLowLink to act as a router, forwarding traffic from 192.168.12.x over the Wi-Fi link.

1. Make sure your HaLowLink is in Access Point mode (green Status LED). See Restoring Factory Settings if it's not.
2. Go to the Wizard in at https://192.168.12.1 and set the Network Mode to **Wi-Fi HaLow devices will get an IP on this device's local network and use 2.4 GHz Wi-Fi for an uplink (not an Ethernet cable)**, then go to the Home page to configure your credentials. For more details, see the Network Modes section above.
3. HaLow devices can then connect via the SSID/password printed on the sticker.

This may be particularly useful on networks you don't have administrator access to, and in fact the HaLowLink can act as a travel router in this situation, providing your own private network not just HaLow Access Point but also a 2.4 GHz Wi-FI access point and Ethernet connectivity.

# 6.3 Using HaLow to Extend an Existing Network - Virtual Wire

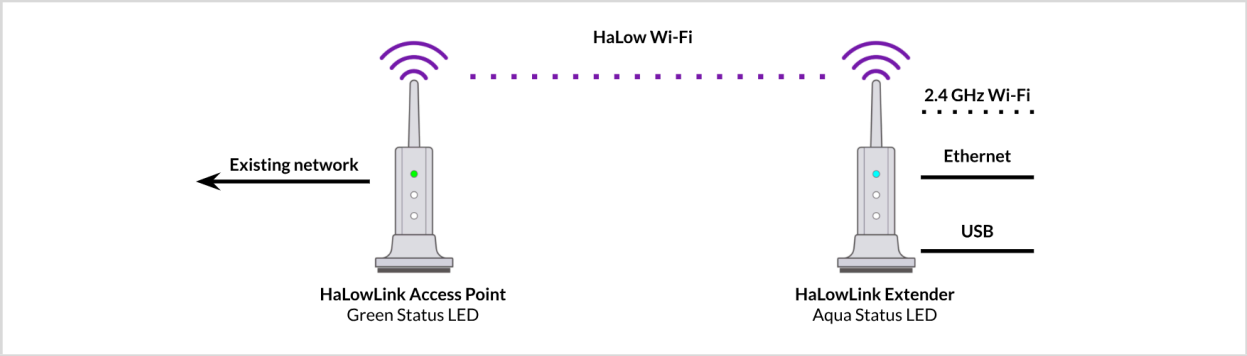



Figure: Virtual Wire use case diagram

This will require **two (2)** HaLowLink devices, and will make a HaLow link a transparent part of your network, functioning just like an Ethernet cable.

First, you should add a HaLow Access Point to your network (see 1 or 2 above). Once your network supports HaLow, you should follow the instructions in the Extender section above. In summary:

1. Make sure your HaLowLink is in Extender mode (aqua Status LED).
2. Pair your Extender with your Access Point by pressing and releasing the mode button on your Access Point, then pressing and releasing the mode button on the Extender. The HaLow LED will slowly flash, usually for around 10 seconds, before turning a solid purple on the Extender to show it's connected.
3. Now any device connected to the Extender - via USB, 2.4 GHz Wi-Fi, or Ethernet - will make use of the HaLow link to connect to your network. See (4), (5) and (6) below for more instructions.

## 6.4 Connect Your Computer to a HaLow Network via USB-C

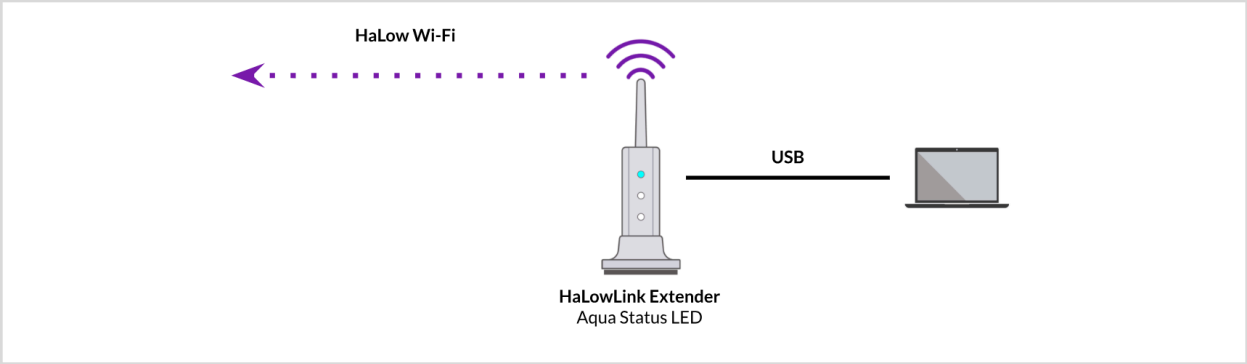



Figure: Connect Your Computer to a HaLow Network via USB-C use case diagram

Follow the instructions above in (3) to set up an Extender, then:

1. Connect your computer via the provided USB-C cable to your Extender (aqua status LED).
2. A new Ethernet adapter should appear on your computer. Make sure it's configured as a DHCP Client.
3. You can now send traffic via the HaLow link. Note that because it's an Ethernet connection, by default your computer will likely use it in preference to any existing Wireless connection. See the Troubleshooting section for more information.

## 6.5 Connect an Ethernet Device to a HaLow Network

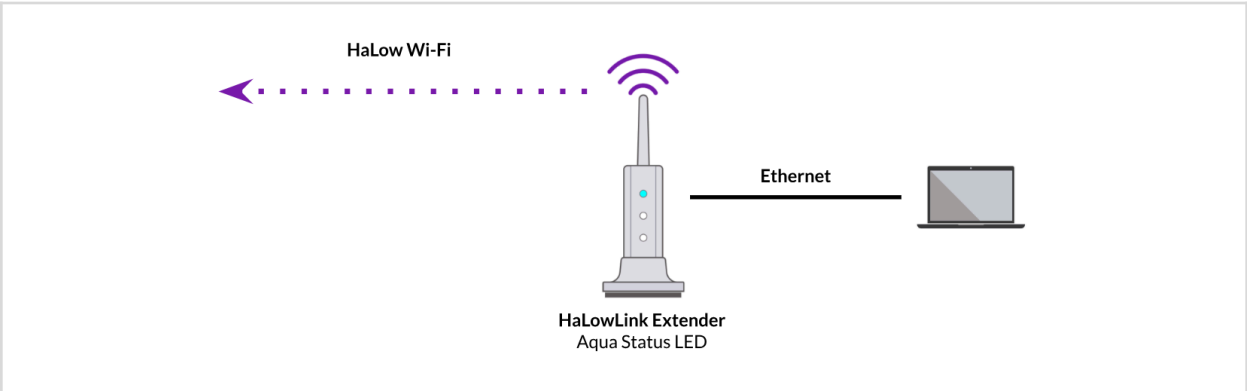



Figure: Connect an Ethernet Device to a HaLow Network use case diagram

Follow the instructions above in (3) to set up an Extender, then:

1. Connect your device via an Ethernet cable to your Extender (aqua status LED).
2. Your device should now acquire an address via DHCP.

# 6.6 Connect a Non-HaLow Wi-Fi Device to a HaLow Network

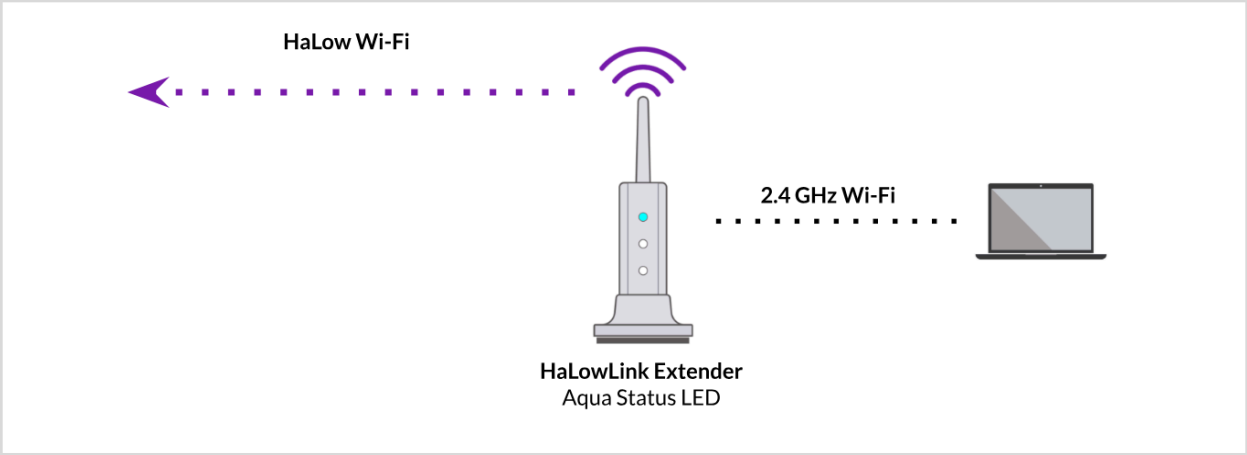



Figure: Connect a Non-HaLow Wi-Fi Device to a HaLow Network use case diagram

This could be a computer, tablet, phone, or any IoT device. Follow the instructions above in (3) to set up an Extender, then:

1. Set the SSID/password of the Extender (NOT the Access Point) via scanning the QR Code on the bottom of the Extender or copying the credentials from the same sticker.
2. Your device should now acquire an address via DHCP.

# 6.7 Experimenting with HaLow

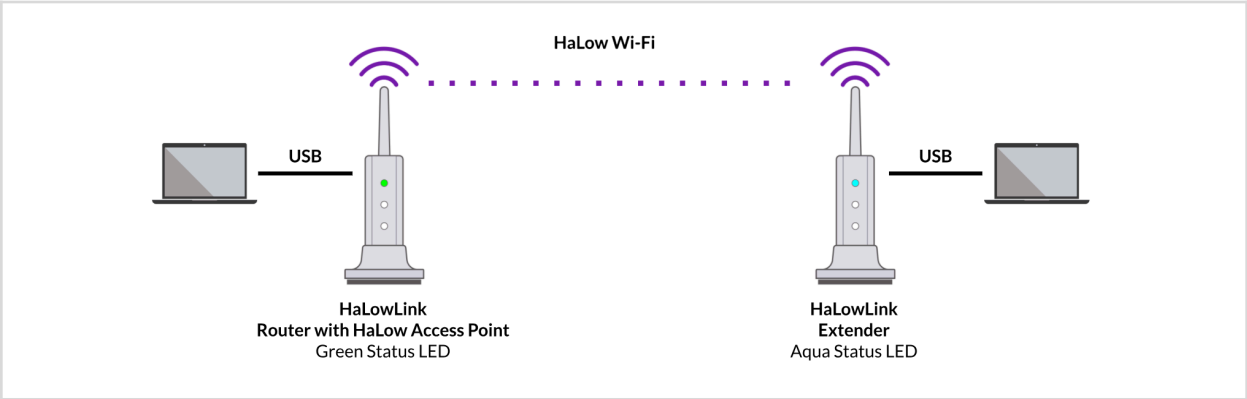



Figure: Experimenting with HaLow use case diagram

If you're currently just experimenting with HaLow's amazing range and penetration, the easiest way to test this out with a HaLowLink is to have two devices and two laptops, where the laptops provide power to the HaLowLink. This allows you to easily move around.

1. Connect one laptop via USB-C to your Router with HaLowLink Access Point (i.e. the factory default configuration), and go to https://192.168.12.1 (as described in Getting Started).
2. Connect another laptop to an Extender via USB-C, then set up the Extender as described in (3).
3. You should see the Extender appear on the Home page of the Access Point in the **Connected Devices**, and the **Local Network** card should show the IPs of both the Extender and your other laptop.

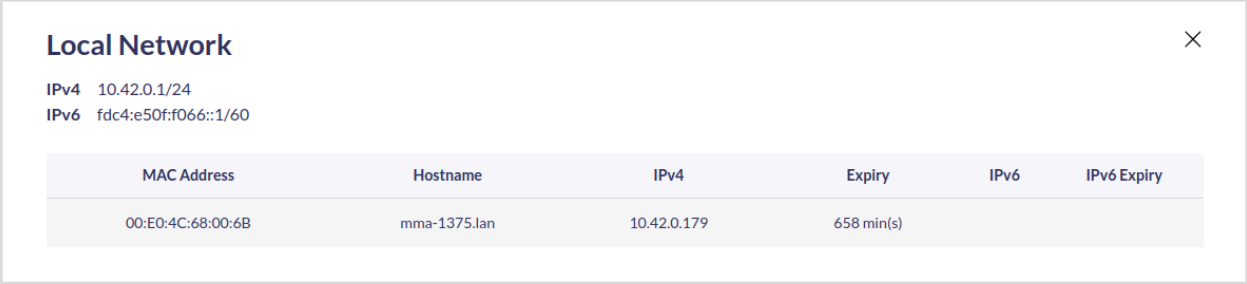



Figure: The expanded Local Network card on the Home page

4. You can now test out the connection from one laptop to the other via HaLow. For more information about how to do this, see Exploring HaLow Connectivity in the next section.

*Note: because the USB link is via Ethernet, by default your computer will likely use this in preference to any existing Wireless connection. See the Troubleshooting section for more information. If you're familiar with OpenWrt, you can stop this happening by configuring the DHCP server to return nothing for Option 3 (gateway).*

# 7 Quick Config

For most users the Wizard page will be sufficient to configure a HaLow Access Point (green mode), and an Extender (aqua mode) can be configured via the Mode button as described above. However, if you want to make simple minor changes to your configuration - such as changing your Wi-Fi password or encryption method, or setting a Static IP - you can do so via the **Quick Config** page. To help you understand the changes you're making, these will be reflected in the diagram at the top of the page as you make them.

*Warning: it is easy to change the configuration of your device here in a way that causes you to lose access to it, particularly if you're changing network interfaces. If this happens, see the section above on Restoring Factory Settings.*

## 7.1 Network Interfaces

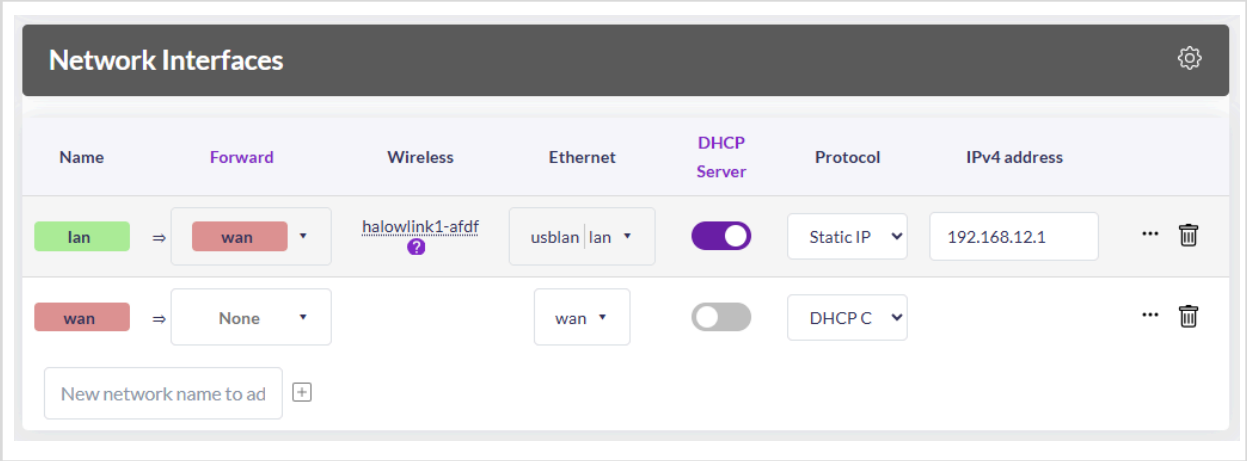



Figure: The Network Interfaces subsection on the Quick Config page.

This section lists the logical interfaces available on your router, each of which can be configured with either a Static IP (and potentially a DHCP Server) or as a DHCP Client. If you have multiple Ethernet ports or Wireless interfaces on the same network, a bridge will automatically be created. Note that to attach new Wireless interfaces to the network, you will need to use the Wireless section.

# 7.2 Wireless

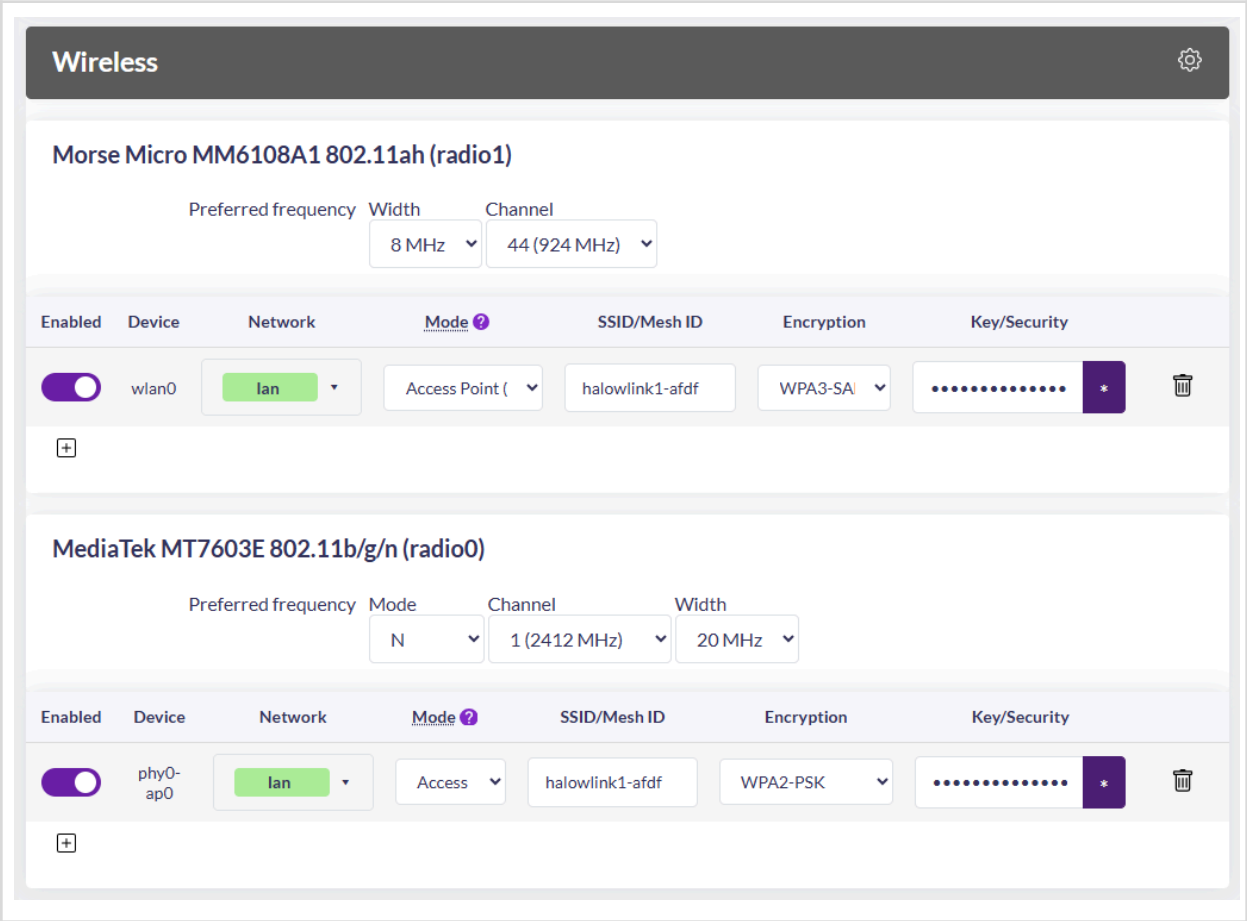



Figure: The Wireless subsection on the Quick Config page.

This will allow you to configure the Wi-Fi interfaces on your HaLowLink. Note that it is possible to create multiple interfaces for a particular radio.

# 7.3 Advanced Usage

The **Quick Config** page is designed to correspond to the underlying text based configuration and connect with the pages accessible via Advanced Config. If you have Advanced Config enabled, you can use the **cog icons** on the **Quick Config** to access these pages, which will allow you more flexibility in your setup. It will also allow you to simply **Save** rather than **Save & Apply**, which will let you view and apply or revert the proposed changes by clicking on the **Unsaved Changes** indicator at the top right.

For more about the underlying configuration format (known as UCI), see Configuring with the Command Line.

# 8 Advanced Config

The software running on your HaLowLink is based on OpenWrt, a Linux operating system targeting network connected devices. While the Wizard page provides basic preset configuration options, the Advanced Config section, accessible via the side menu, enables more advanced customizations. In the Advanced Config section (pictured below) the Quick Config page allows convenient access to frequently modified settings, whereas the other sub-menus within Advanced Config provide more granular and specific access to advanced functionalities.

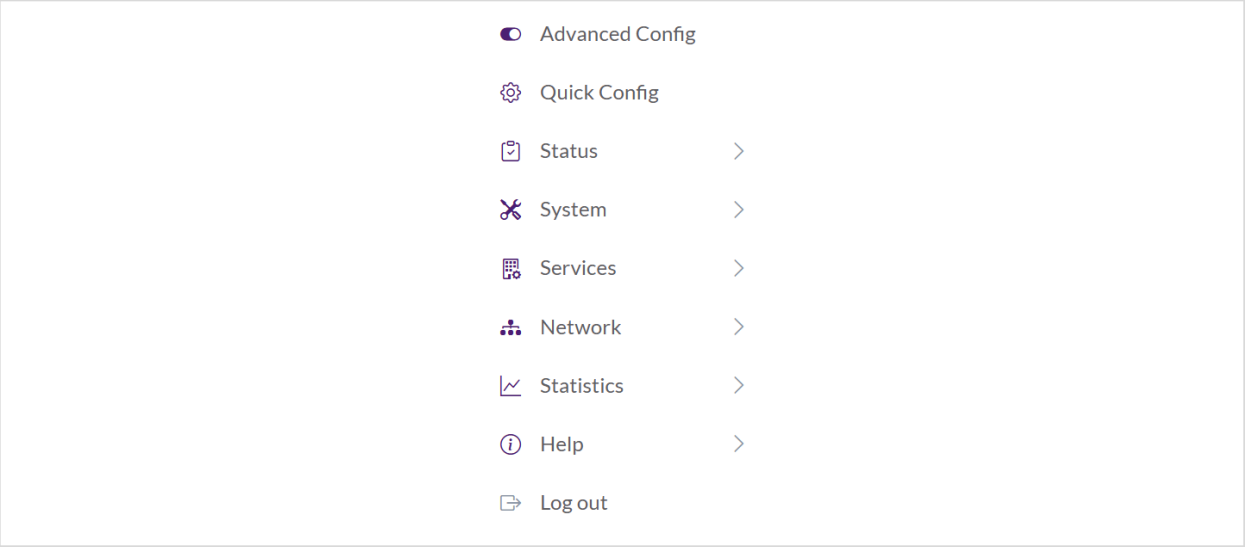



Figure: The Advanced Config menu.

This will allow you to view detailed information about your device, change low-level configuration, install additional software if you have an internet connection (via the **Software** page under the **System** sub-menu), and even access the Linux terminal from the Terminal page.

You can also directly connect to your device via **ssh** (must be enabled first) using the same username and password you used to login. This is printed on the label.

For more information about OpenWrt, see openwrt.org/start.

# 9 Exploring HaLow Connectivity

Your HaLowLink comes packed with useful utilities and pages to make the most of your HaLow connection. In particular, we recommend the following pages, which are only accessible once Advanced Config has been enabled.

## 9.1 Status

### 9.1.1 Channel Analysis

This will allow you to see the channels and signal strength of any other nearby HaLow networks. If there are many local HaLow networks, you may want to change the channel via the Quick Config page to avoid interference.

### 9.1.2 Realtime Graphs

This will show you a continuously updating graphical view of the link quality (see Wireless) as well as other critical system metrics while you have the page open.

## 9.2 Network

### 9.2.1 Diagnostics

This allows you simple access to command line tools to evaluate your network, including `iperf3` (to test bandwidth), `ping` and `traceroute` to explore connectivity, and `arp-scan` to discover all devices on the network. It also will show you the command it's executing, as you may also want to do this via the command line (see Terminal).

## 9.3 Statistics

### 9.3.1 Graphs

Your HaLowLink is running `collectd` to continuously monitor the behavior of the device. Some of the information here is similar to Realtime Graphs, but it's updated at a lower frequency and stored while the device is running rather than just while you're on the page. It's also possible to configure other devices to point to this (e.g. Extenders) to aggregate all your statistics in a single place.

# 9.4 Services

## 9.4.1 Terminal

For easy access to the Linux console, you can start a terminal on the device by going to Terminal. Note that you will have to re-enter your device password (refer to the sticker on the bottom of your HaLowLink).

*Note: The in-browser terminal does not work over HTTPS. To use it, follow the browser's warning link to disable this security feature.*

From the command prompt, you will have access to the standard Linux utilities included in OpenWrt and those already mentioned via the Diagnostics page, as well as some other useful programs such as:

| Utility | Purpose |
|---|---|
| `morse_cli` | Low level access to information from and settings on the Morse Micro HaLow chip. |
| `wavemon` | Terminal graphical program to monitor Wi-Fi signal strength and performance. |
| `nano` | Text editor, including syntax highlighting of UCI files. You may also use vi. |
| `tmux` | Terminal multiplexer, allowing persistent sessions and windows. |

Table 2: Useful Command Line Interface tools

## 9.4.2 Range Test

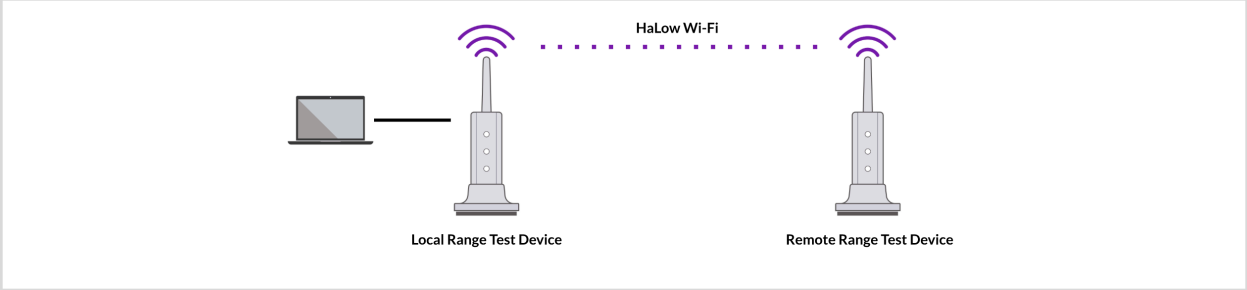



Figure: Range Test device setup

The Range Test application is designed as a simple way to analyse HaLow network performance by automating `iperf3` tests and collecting real-time statistics. It is a useful tool for quickly assessing signal strength, data throughput, and connection quality across different environments.

*Note: ensure that all devices under test are running the same version of Morse Micro OpenWrt.*

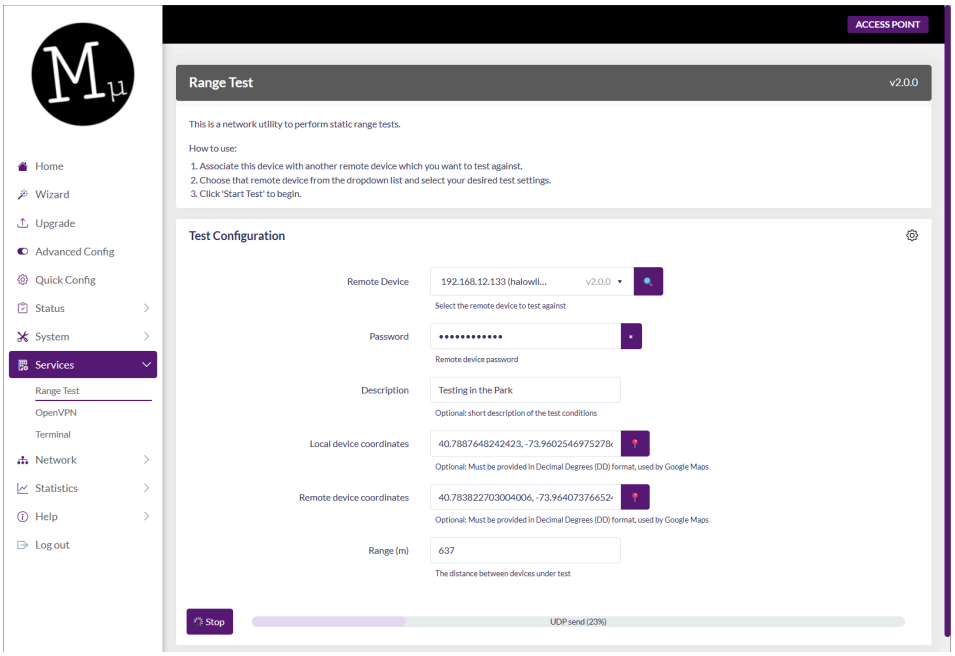



Figure: Range Test setup

To use the range testing tool:

1. Connect the devices being tested on the same HaLow network of any type outlined in this guide (Default AP/STA configurations are the most reliable).
2. Set up the devices in the desired locations and select a local device to connect a laptop to.
3. Select the IPv4 address from the **Remote Device** dropdown. If it does not appear on first load, click the 🔍icon to run another discovery. If this fails to find another device, you may enter a known IPv4 address into the **custom** field pictured.

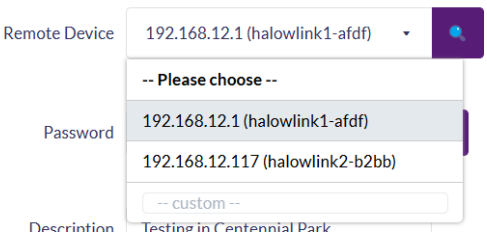



Figure: The Range Test setup Remote Device dropdown

4. Fill in the **Password** field using the remote device password (not the Wi-Fi password).
5. (Optional) Provide user notes about the test in the **Description** field.
6. (Optional) If you want to log the coordinates of the local and remote devices and have the range calculated automatically enter the decimal degree values into the local and remote device coordinates fields respectively. Right-click a location in Google Maps to copy its coordinates to your clipboard in the correct format.

7. Click **Start Test** and a progress bar will appear showing the status of the current test. This can be cancelled at any time by clicking the **Stop** button.

After the test completes, a row in the **Results Summary** subsection should appear, as pictured below. This result can be deleted by clicking the **trash icon**, or a JSON file containing all the raw data can be downloaded via the **Download** button, which is intended to help engineers with remote debugging. The **Download Results Summary (CSV)** button yields a CSV file of all the data represented in the results summary.

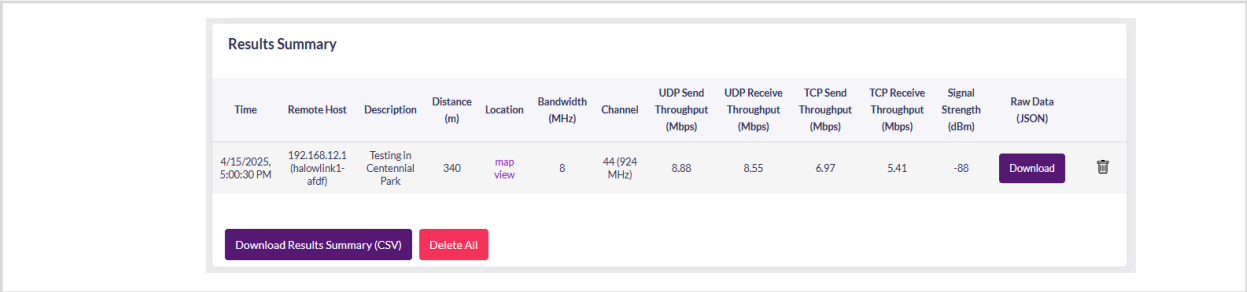



Figure: The Range Test results

*Note: test results are volatile to avoid overwhelming limited memory resources and will be deleted if power is removed or the device is rebooted.*

*Warning: if the throughput numbers are returning ~40 Mbps for UDP and 900+ Mbps for TCP then the test is likely defaulting to run over an Ethernet connection. This should be avoided.*

By clicking the **cog icon** in the top left corner of the **Test Configuration** subsection, the data directions, test length and protocols which will be tested can be modified.

The remote device will always act as the `iperf3` server and use the same command:

```
iperf3 -s -1 --json
```

The local device will always act as the `iperf3` client, running a command in the following format:

```
iperf3 -c <ip> <protocol> <direction> -t <time> -O <omit> --json
```

- **Protocol**: For UDP tests the protocol arguments become `-u -b 40M/30` whereas for TCP tests only `-Z` is set.
- **Direction**: For Send tests no arguments are set whilst Receive tests set the `-R` flag.
- **Time & Omit**: If Quick Tests are selected in the Advanced Configuration dialog, these arguments will become `-t 10 -O 2`. By default the tests will run for longer with `-t 70 -O 10` to allow 10 seconds for rate control to settle and get 60 seconds worth of usable data.

# 10 Configuring With the Command Line

The HaLowLink is an open device running Linux, and it is straightforward to gain direct access via either SSH (must be enabled first) or the Terminal page (accessible after enabling Advanced Config). Because it's based on OpenWrt, the primary mechanism of configuration is via UCI (openwrt.org/docs/guide-user/base-system/uci), which is fundamentally just a collection of files in `/etc/config` in a particular format.

## 10.1 Making Changes

This happens in 2 steps:

1. Set new values in UCI
2. `reload_config` to reload services

You can make changes to UCI via the `uci` command or by editing the files in `/etc/config`. For example:

```
nano /etc/config/wireless
```

Or:

```
uci show wireless
uci set wireless.default_radio0.mode=sta
uci commit
```

Doing a `uci commit` will cause the change to appear in `/etc/config/wireless`. Once you've made changes (via either of those methods), to make them take effect use reload_config. Other files/services that are likely to be useful for network config are `dhcp`, `network` and `firewall`.

Aside from the UCI documentation mentioned above, the most useful resource is clicking **Save** rather than **Save & Apply** in the UI, which is possible if you've enabled Advanced Config in the menu. This will allow you to go up the top right (**Unsaved Changes**) and view a sequence of uci set commands corresponding to the change you just made. For example, after setting a static IP:

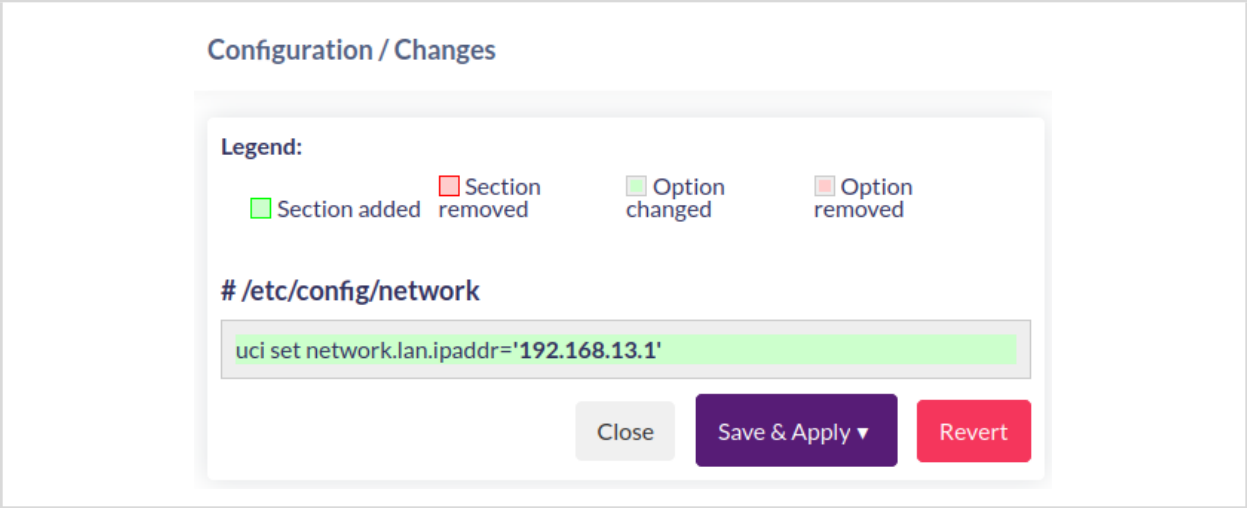



Figure: The Unsaved Changes dialog showing the incoming UCI modifications after setting a static IP

## 10.2 File/Service Structure

`wireless` contains the radio devices (`wifi-device`) and the interfaces connected to that (e.g. wlan0, wlan1 - caused by a `wifi-iface`). Any `wifi-iface` has a `network`, which refers to an `interface` in the network UCI file. This corresponds to the Wireless section on the Quick Config page.

`network` contains a mix of switches/bridges and logical interfaces; an `interface` in a network may point to a bridge, in which case multiple Ethernet ports or `wifi-ifaces` might be attached to it. Confusingly, the wireless interfaces are not directly mentioned here, only in the wireless file. This means it's possible to incorrectly configure a network `interface` by not having a bridge and having multiple `wifi-ifaces` refer to it. This corresponds to the Network Interfaces section on the Quick Config page.

`firewall` controls `nftables` - i.e. forwarding/masquerading as well as simple accept/reject. Firewalls have another level of indirection - zones - such that you can potentially put multiple network `interfaces` in one zone.

`dhcp` controls `dnsmasq` - i.e. **DHCP and DNS**. The usual setup is that there's always `dnsmasq` running, but if you don't want DHCP active on particular interfaces you set them to **ignore**.

## 10.3 Debugging

If you've made a change and it's not working the way you expect this command is useful for following the logs as they are generated:

```
logread -l 100 -f
```

This is the primary mechanism OpenWrt of reporting that something went wrong, since you won't see it running `reload_config`.

Note that if you've manually edited the files rather than using uci set it's possible you've made them invalid. Use `uci show` to confirm that the UCI library can still parse them.

## 10.4 Applying Configurations

As noted above, we recommend using `reload_config` to apply configurations. What this does is:

- check to see if any of the config files have changed
- trigger a reload on any services affected by these changes (i.e. not a restart)

There are other ways to do this.

- explicitly reloading a single service: `service <service> reload`
- explicitly restarting a single service: `service <service> restart`
- bringing down only the wifi interfaces and back up without restarting the network: `wifi down && wifi up.`

*Note: manually triggering a reload will pick up uncommitted changes.*

# 11 Software Updates

To update your software, use your browser to access the web interface (usually at https://192.168.12.1) as described in Initial Connection. Then select **Advanced Config**, and you should see the **Upgrade** page:

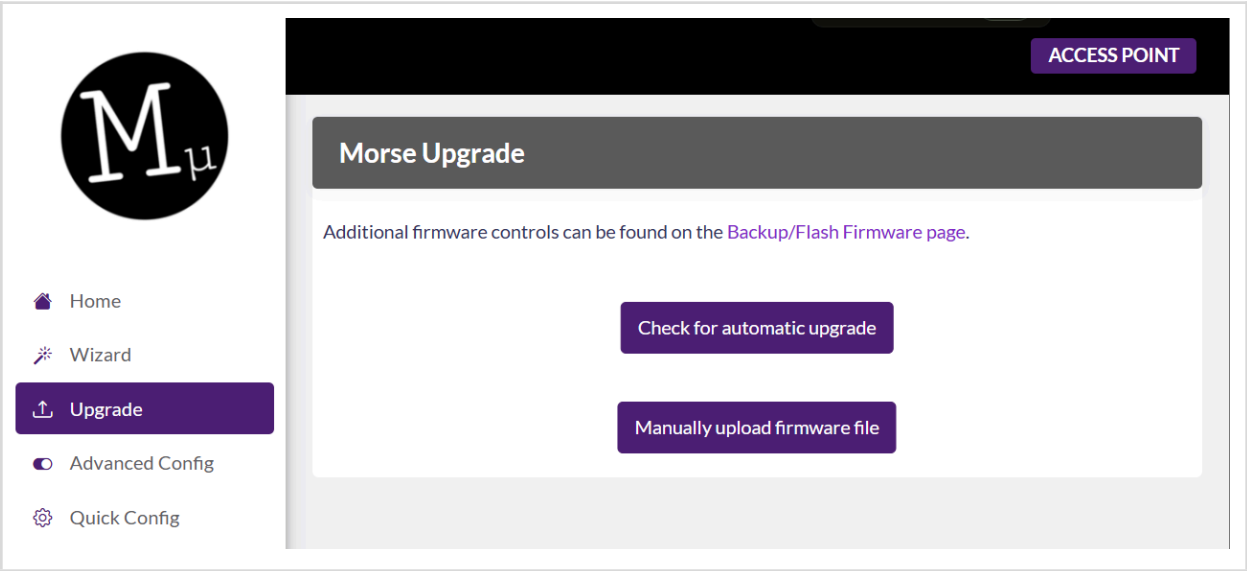



Figure: The Upgrade page

- The **Check for automatic upgrade** button will attempt to obtain the new version of firmware from the Morse Micro servers. This requires an available internet connection — either through the browser you are using to access the HaLowLink GUI or through the HaLowLink device itself via an uplink or otherwise (see Network Modes).
- The **Manually upload firmware file** button will let you upload any compatible firmware.

*Note: if your HaLowLink device has internet access, update notifications will appear automatically on the Home page within the Version card.*

# 12 Device Features

## 12.1 LED Indicators

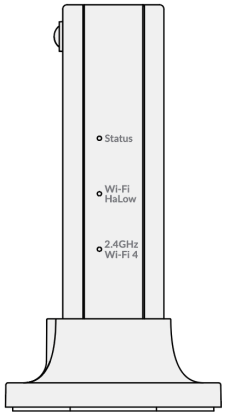



Figure: The LED indicators on the front of a HaLowLink device

### 12.1.1 Status LED

| Color & Behavior | Meaning |
|---|---|
| Yellow flashing | Factory reset in progress. |
| Yellow solid | Bootloader running. |
| Green flashing | OpenWrt booting into **Access Point** mode. |
| Green solid | OpenWrt is loaded and running in **Access Point** mode. |
| Aqua flashing | OpenWrt is booting into **Extender** mode. |
| Aqua solid | OpenWrt is loaded and running in **Extender** mode. |
| Blue flashing | OpenWrt is executing a software update (do not disconnect power when this is happening). |

Table 3: Status LED explanations

### 12.1.2 Wi-Fi HaLow LED

| Color & Behavior | Meaning |
|---|---|
| None | If your device is in **Access Point** mode this means that HaLow is currently **disabled**.<br><br>If your device is in **Extender** mode this means that your device is **not associated** via HaLow. |
| Purple solid | If your device is in **Access Point** mode this means that HaLow is currently **enabled**.<br><br>If your device is in **Extender** mode this means that your device is currently **associated** via HaLow. |
| Purple flickering | On both the Access Point and Extender, the Wi-Fi HaLow LED flickers to show HaLow traffic activity. The busier the link, the faster the LED will flicker. |
| Purple slow flashing | Pairing is in progress. |

Table 4: Wi-Fi HaLow LED explanations

### 12.1.3 Wi-Fi 2.4 GHz LED

| Color & Behavior | Meaning |
|---|---|
| Off | Either the power is off or the 2.4 GHz Access Point is not active. It can be re-enabled via the management interface or restored via a Factory Reset. |
| Green solid | The 2.4 GHz Access Point on the HaLowLink is currently active and available for devices to discover and connect to. |
| Green flickering | On both the Access Point and Extender, the Wi-Fi 2.4 GHz LED flickers to show 2.4 GHz traffic activity. The busier the link, the faster the LED will flicker. |

Table 5: Wi-Fi 2.4 GHz LED explanations

# 12.2 Ethernet/USB Ports

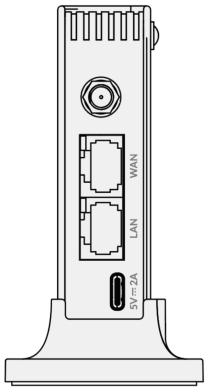



Figure: The ports at the rear of a HaLowLink device

## 12.2.1 Access Point Mode (Green Status LED)

Regardless of whether the HaLowLink is configured as a Router or just an Access Point, these roles are correct. That is, USB-C and LAN will always be on a separate network to WAN, and the WAN port should be connected to your router.

| Port | Role |
|---|---|
| USB-C | Either power only, or connect a computer to get a 192.168.12.x IP and access the management interface at https://192.168.12.1. |
| LAN | Connect a computer to get a 192.168.12.x IP and access the management interface at https://192.168.12.1. |
| WAN | Connect this to your existing network/router. |

Table 6: Access Point Mode port descriptions

## 12.2.2 Extender Mode (Aqua Status LED)

| Port | Role |
|---|---|
| USB-C | Either power only, or connect a computer to use the Extender's HaLow connection. |
| LAN | Connect a computer to use the Extender's HaLow connection. |
| WAN | Connect a computer to use the Extender's HaLow connection. |

Table 7: Extender Mode port descriptions

# 13 Frequently Asked Questions

## How can I make my HaLowLink Access Point behave exactly like a standard access point (fully bridged)?

If you have used the Wizard to change your Network Mode to the recommended **Wi-Fi HaLow devices will get an IP on your existing router's network** setting you will have effectively setup a normal bridged Access Point — **except for the lan management subnet** which still hosts the GUI at https://192.168.12.1. This management network is maintained for ease of reconfiguration, but can be removed.

If you want your HaLowLink Access Point to behave exactly like a consumer Access Point product (fully bridged), go to the Quick Config page and move all the devices and ports (LAN/2.4/USB) from the **lan** network onto the **wlan** network using the Network Interfaces section. This will allow you to connect devices to your normal network via the LAN Ethernet port, the 2.4 GHz Wi-Fi AP and even the USB-C port but will remove access to the separate **lan** management subnet.

Ideally, you should do this from the address assigned from your upstream network (i.e. not 192.168.12.1) to avoid losing access to the device. If you do use 192.168.12.1 you should use the **Apply Unchecked** option, as otherwise the changes will automatically revert unless you quickly access the UI via the other address in the same browser.

## How can I test mesh? (EasyMesh or 802.11s Mesh)

There are two recommended ways to observe mesh operation using **three (3)** HaLowLink devices:

1. **Confirm relaying through an intermediate node**: Move Device 1 and Device 2 far enough apart that they can no longer communicate directly before introducing Device 3 as a mesh peer. Successful communication between Device 1 and Device 2 in this state indicates that traffic is being relayed via Device 3.
2. **Demonstrate throughput improvement**: Similar to the above method, increase the distance between Device 1 and Device 2 until their throughput decreases significantly, then introduce Device 3 as mesh peer. An improvement in throughput confirms that the mesh path has been established.

## How can I test 802.11s Mesh Self-Healing when my HaLowLink nodes are too close together?

If you are unable to separate your HaLowLink 802.11s mesh devices sufficiently to observe the self-healing behaviour, this is expected. Wi-Fi HaLow's primary strength is its range!

To simulate greater distance between your HaLowLink 802.11s Mesh peers for testing purposes you can adjust the **RSSI threshold for joining** which prevents nodes from forming mesh links when the received signal strength is too weak.

1. Setup your 802.11s Mesh

2. In the Advanced Config menu, navigate to the **Wireless** page under the Network sub-menu.
3. Click **Edit** on the Mesh Point (pictured below)

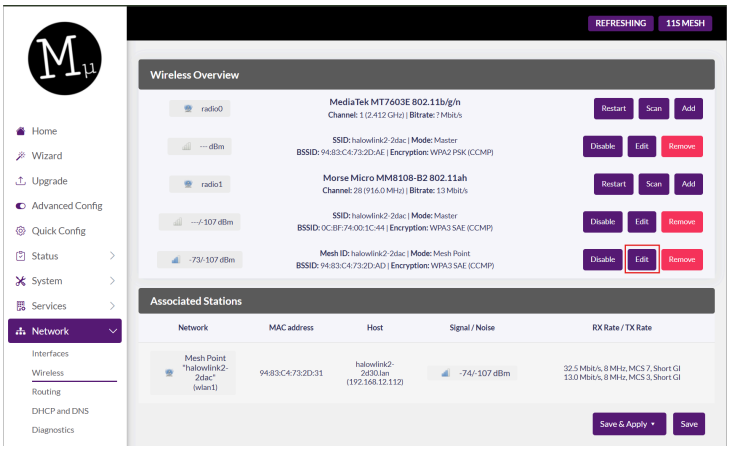



Figure: The Wireless page

4. Navigate to the **Mesh Settings** tab under the **Interface Configuration** sub-section.
5. Update the **RSSI threshold for joining** field (pictured) to define an appropriate minimum signal strength (RSSI) a node must detect to establish a peer link in the mesh.

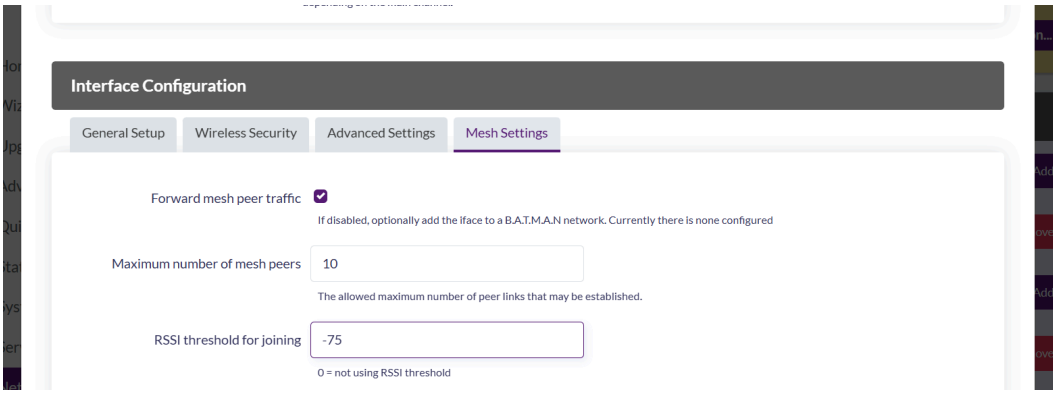



Figure: The advanced mesh settings

6. Click **Save** on the dialog and then **Save & Apply** on the Wireless page to apply these changes.

## How can I limit or increase the number of peers allowed in my 802.11s Mesh?

Follow the exact same steps from the previous question up to Step 3 (pictured). From there you can adjust the **Maximum number of mesh peers**. If you set this value to 2, it will force the mesh to form a linear chain topology, which is likely not useful.

## I changed the mode of an interface on the Quick Config page, and it's refusing to save or not working as expected.

*Note: before attempting any significant interface modifications on the Quick Config page, you should check that none of the Wizard configurations do not already meet your needs.*

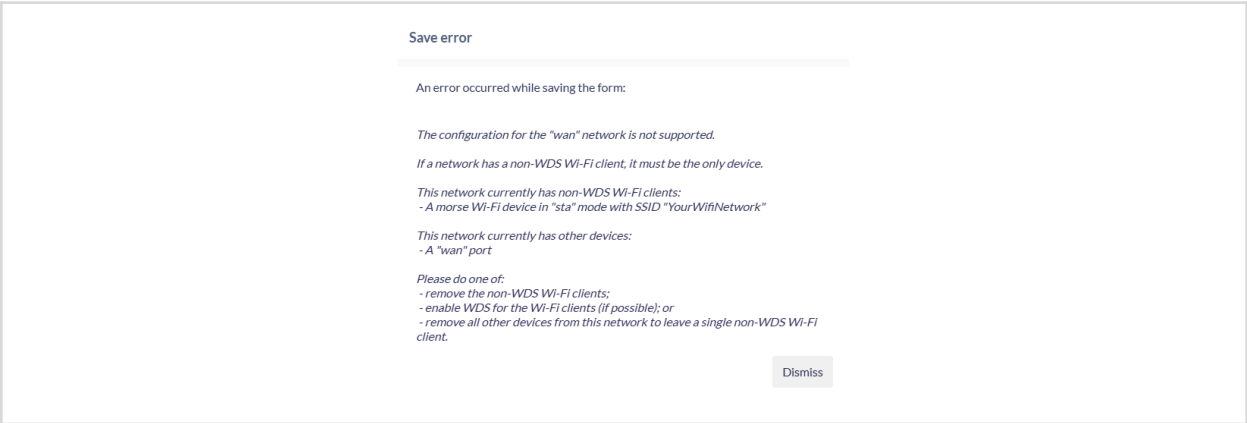



Figure: An example of the common WDS error message on the Quick Config page

This usually happens when trying to attach a non-WDS (Wireless Distribution System / 4-address mode) interface to a WDS bridge (e.g. adding a 2.4 GHz Wi-Fi Client to a HaLowLink Access Point).

For technical reasons, only one non-WDS interface (3-address mode) can exist on a bridge interface at a time. Any attempt to change this will cause errors to pop up on the Quick Config page when saving changes.

To provide more context to this error we can expand upon the recommended actions described in the example error message:

**1. Remove the non-WDS Wi-Fi client:** The error message describes the offending non-WDS Wi-Fi client which can be removed. In the example error message it specifies that the client on the **wan** network with the SSID "YourWifiNetwork" is causing problems (also pictured below). If this was just added/modified, we can reset the changes using the **Reset button** in the bottom right corner.

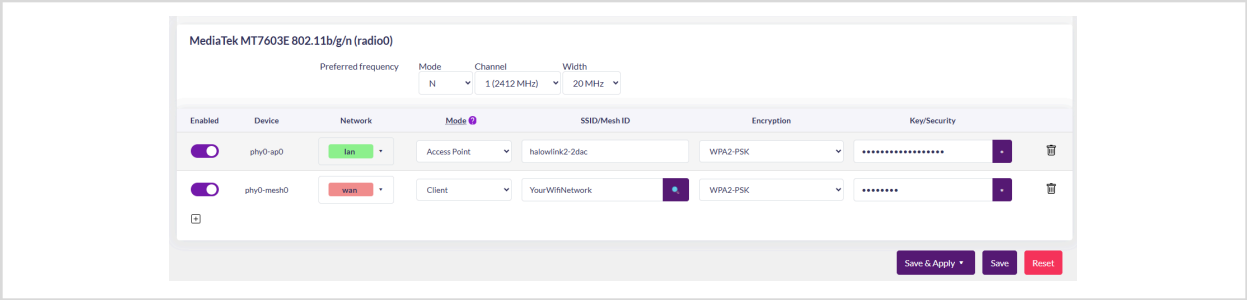



Figure: The common WDS error message on the Quick Config page

If the non-WDS client already existed before making the changes which caused the error message, you can simply delete the non-WDS client using the **trash button** (pictured above, not recommended) or move it to a new network where it is the only device. To create a new network interface, go to the Network Interfaces subsection on the same page and enter a new network interface name before clicking the **Add button** (pictured below):

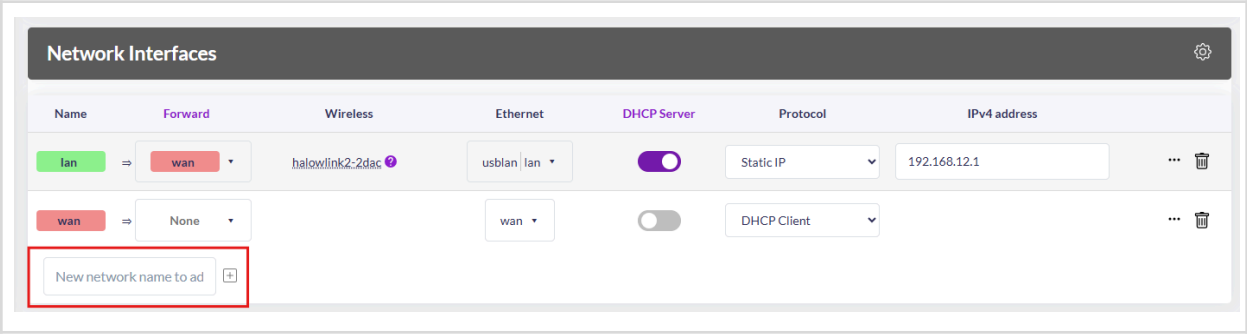



Figure: Creating a new network interface using the Quick Config page

You should also click the **Add Zone button** to create a new permissive firewall zone. The created network interface will be an empty WDS bridge which will allow the attachment of a singular non-WDS Wi-Fi client interface. You can now safely remove the offending non-WDS Wi-Fi client onto this new interface without deleting it. For example, see the non-WDS "YourWifiNetwork" 2.4 GHz Wi-Fi client moved to the newly created "24lan" network interface below.

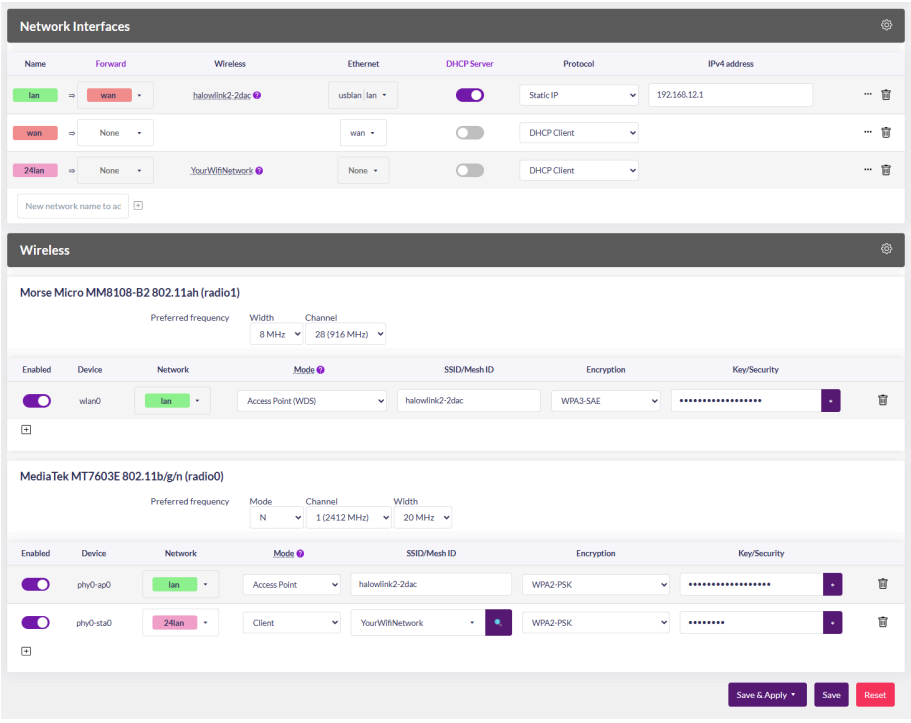



Figure: Assigning the non-WDS Wi-Fi as the only device on a new Network Interface

**2. Enable WDS for the Wi-Fi clients (if possible):** From the Wireless subsection you should be able to select **Client (WDS)** as a Mode for your **HaLow Wi-Fi client** devices only.

**3. Remove the all other devices from this network to leave a single non-WDS Wi-Fi client:** This option is simply the inverse of **Remove the non-WDS Wi-Fi client** and involves:

- De-selecting the Ethernet ports from the relevant dropdown in the Network Interfaces subsection. You may also want to select them on another network interface row to keep them in use.
- Moving the Wireless devices onto other network interfaces via the Wireless subsection. You can also delete them altogether if you want.

# 14 Troubleshooting

If you're having trouble with your HaLowLink, we recommend resetting Restoring Factory Settings. You can also reach out on the Morse Micro Community Forum to share your issue and get help from our experts and other users.

| Problem | Solution |
|---|---|
| The Status LED is not Illuminated. | There is a problem with power to the device. Check that the USB-C port on the HaLowLink is connected to the provided power supply or to a USB-C port on a computer. Do not use a USB-A to USB-C adapter. |
| The Status LED is still yellow after some time, or never stops flashing green after boot. | The flash partition is probably corrupt. To recover your HaLowLink, see Recovering from failed updates below. |
| I can't access the HaLowLink at https://192.168.12.1. | If the status light is **solid green** and you can't access your HaLowLink at https://192.168.12.1:<br>• Make sure your computer is connected to either the LAN or USB port of the HaLowLink.<br>• Check that your network connection is configured as a DHCP client, and has been allocated a 192.168.12.x IP.<br>• If you're failing to establish a network connection to your device, see Restoring factory settings.<br><br>If the status light is **solid aqua**, your HaLowLink is in Extender mode and will only be useful if connected to an Access Point. Simply connect other devices to it via Ethernet or 2.4 GHz Wi-Fi to use your HaLow-enabled network. You should not need to access its Web UI, but you may find its address in the DHCP lease table of your DHCP server. |
| I changed a configuration setting and now I can't access my HaLowLink, but I don't want to reset it. | If you need to access your HaLowLink as part of troubleshooting a complex configuration change, you can connect your computer to the LAN or WAN port and configure it with the following settings:<br>• **IP**: 10.22.121.110<br>• **Netmask**: 255.255.255.254 (if you can't set 255.255.255.254 due to OS limitations, use 255.255.255.0)<br><br>As long as your HaLowLink has a solid green or aqua light, it will be available at 10.22.121.111 (this is a secondary static IP |

| Problem | Solution |
|---|---|
| | assigned for diagnostic purposes). |
| I can see that the **Access Point** card has connected devices, but the **Local Network** card doesn't list them. | If you have configured your device as an Access Point only (i.e. the wizard option **Wi-Fi HaLow devices will get an IP on your existing router's network**), then these devices will appear in the DHCP lease table of the existing DHCP server on your network. The **Local Network** on the HaLowLink is being used primarily for easy access to the configuration, and will not have HaLow devices in it.<br><br>Alternatively, if you have temporarily lost power to HaLowLink Access Point your devices may not yet have refreshed their DHCP leases. They will eventually renew their leases when their lease time expires. |
| When I connect my computer to my HaLowLink Extender directly over Ethernet, my internet gets slower. | Because your computer has a wired connection to the HaLowLink, most operating systems will prefer this connection over any wireless connection. However, if you're using a HaLowLink Extender, this means you will be restricted to the maximum bandwidth over the HaLow link.<br><br>For your particular operating system, you should determine how to prefer your existing Wi-FI connection (e.g. via setting the HaLowLink connection to **local only**, removing the default route from the HaLowLink, or changing the route priorities). |
| When I connect my computer to my HaLowLink directly over Ethernet, my internet stops working. | This is the same problem as above, where your computer will prefer the HaLowLink connection over any wireless connection, but in this case it's probably your HaLowLink is not yet connected to the internet. For an Access Point, check the **Uplink** card on the homepage (which will report the WAN and 2.4 GHz state), and for an Extender check it has a purple light AND that the Access Point is correctly configured. |
| I changed the HaLow Mode or Network Mode of my HaLowLink, and my Extenders no longer work as expected. | If you make significant changes to your Access Point configuration, any attached Extenders might not continue to function as you expect. If you've just changed the Network Mode, we recommend power cycling your Extender to force it to reinitialize. If you've changed the HaLow Mode, you should follow the instructions in the Extender section to reset your device to Extender mode and redo the pairing procedure. |

| Problem | Solution |
|---|---|
| My connection isn't performing as I expect. | Check signal strengths on the Access Point by going to the **Home** page and clicking on the **Connected Devices** card.<br><br>For more detailed information about the signal you can navigate to the Realtime Graphs page.<br><br>To check if there are other HaLow networks interfering with your link, you can check the Channel Analysis page.<br><br>To run iperf3 or ping tests you can also use the Diagnostics page. |
| My Extender's HaLow Status LED is flashing quickly all the time even when I'm not using it. | Because the wireless and wired connection are bridged on the Extender, make sure you haven't created a network loop by connecting a LAN/WAN port of your Extender to the same network as your Access Point. To solve this, disconnect the incorrect Ethernet link. |
| I'm seeing strange or confusing behavior not mentioned above. | Make sure you have the latest firmware by enabling **Advanced Config**, going to the **Upgrade** page and then clicking **Check for automatic upgrade**.<br><br>If you would like to report an issue to Morse Micro, go to the **Support** page under the **Help** submenu, then click on **Create Archive**. You can then post this on the Morse Micro Community Forum and let us know what the problem was. |

Table 8: Troubleshooting common problems

## 14.1 Recovering From Failed Updates

If for some reason the software is corrupted or not booting - this is most often caused by loss of power during an update - the following procedure will allow a new image to be written to flash.

1. Remove all cables from the device.
2. Attach an Ethernet from the HaLowLink directly to your computer.
3. While powered off, press and hold the mode button on the HaLowLink.
4. Attach the power cable and turn on power and watch for the Status LED to turn yellow, then blink white 5 times.
5. Release the button, the LED should remain yellow.
6. Configure your network connection with the following static IP and netmask:
    a. **IP address**: 192.168.12.2
    b. **Netmask**: 255.255.255.0
7. Open a web browser on the computer and navigate to http://192.168.12.1.

   a. *Warning: if you get a **Page Not Found** error message during this step, ensure that your URL only contains the IP address, clear your cache and/or use an Incognito browser.*
8. Upload a firmware file and press **update firmware**. A progress screen similar to the figure below should appear.
   a. *Note: despite what the bold text and animated spinner might suggest, you can safely navigate away from this page.*

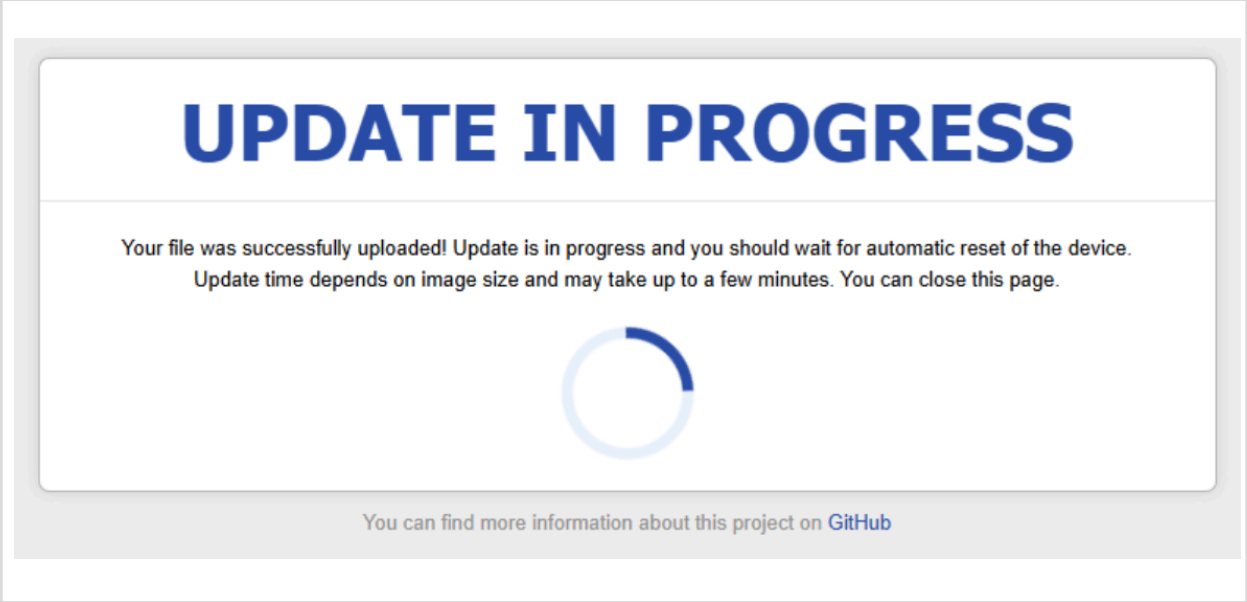



Figure: u-boot recovery upgrade screen

9. Do not remove the power until the device has installed the firmware and fully booted. You will see the following Status LED patterns to show the progress, in order:
   a. solid purple
   b. red/purple flashing
   c. solid purple
   d. solid red
   e. off (rebooting)
   f. flashing yellow
   g. solid yellow (the start of the normal boot process)

*Note: the entire process can take a while to complete (10+ minutes).*

# 15 Licensing and source

Much of the software included in the HaLowLink is covered by open source licenses, including the GPLv2. For complete licensing information, and access to the source code, go to morsemicro.com/halowlink.

# 16 FCC Compliance Statement

FCC ID: 2A74O-9A6140

**FCC compliance statement**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio/TV technician for help.

**FCC Radiation Exposure statement**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC ID: 2A740-F24F90

**FCC compliance statement**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio/TV technician for help.

**FCC Radiation Exposure statement**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

# 17 IC Compliance Statement

**ISED compliance statement**

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) L'appareil ne doit pas produire de brouillage;

(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**ISED Radiation Exposure statement**

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

Cet équipement est conforme aux limites d'exposition aux radiations IC CNR-102 établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

This radio transmitter IC: [6100A-HM593] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna Designation: Dipole Antenna, Gain: 2.34dBi

Le présent émetteur radio IC: [6100A-HM593] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci−dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

Antenna Designation: Dipole Antenna, Gain: 2.34dBi

**ISED compliance statement**

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) L'appareil ne doit pas produire de brouillage;

(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**ISED Radiation Exposure statement**

This equipment complies with IC RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

Cet équipement est conforme aux limites d'exposition aux radiations IC CNR-102 établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

This radio transmitter IC: [29791-737B5B] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna Designation: Dipole Antenna, Gain: 2.34dBi

Le présent émetteur radio IC: [29791-737B5B] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci−dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

Antenna Designation: Dipole Antenna, Gain: 2.34dBi

# 18 Simplified EU Declaration of Conformity

Hereby, Morse Micro Pty Ltd declares that the radio equipment type HaLowLink 2 is in compliance with Directive 2014/53/EU (RED).

The full text of the EU declaration of conformity is available at:
https://www.morsemicro.com/resources/declarations/EU Declaration of Conformity for MM-HL2-EXT.pdf

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