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How to configure a Starlink/LTE Dongle internet Uplink Connection

APPNOTE-35

Table of Contents

1 Scope

This guide provides a step-by-step process for setting up an internet connection for HaLow devices, specifically the EKH Evaluation Kits and HaLowLink1, covering various uplink options and configuration scenarios.

It covers configurations for various internet sources, including:

- Starlink: Connecting via Ethernet or Wi-Fi from the Starlink router.
- LTE Dongle: Setting up USB or Ethernet-based LTE modems.

Hardware & Software Requirements

1. 1 x EKH (Evaluation Kit) or HaLowLink1 running Openwrt version (2.7.0) or above.
2. HaLow Client Devices (e.g., cameras, IoT devices, or another HaLow station such as EKH or HaLowLink1)
3. Internet Source: (Any one of the following)
    a. Starlink (Ethernet Adapter + Router or Wi-Fi connection)
    b. LTE Dongle (USB or Ethernet-based modem)
4. Laptop (For configuring the HaLow device)
5. Router (For bridging or additional network management, if needed)
6. Power Supply (Sufficient power for all connected devices)

2. Theory of Operation
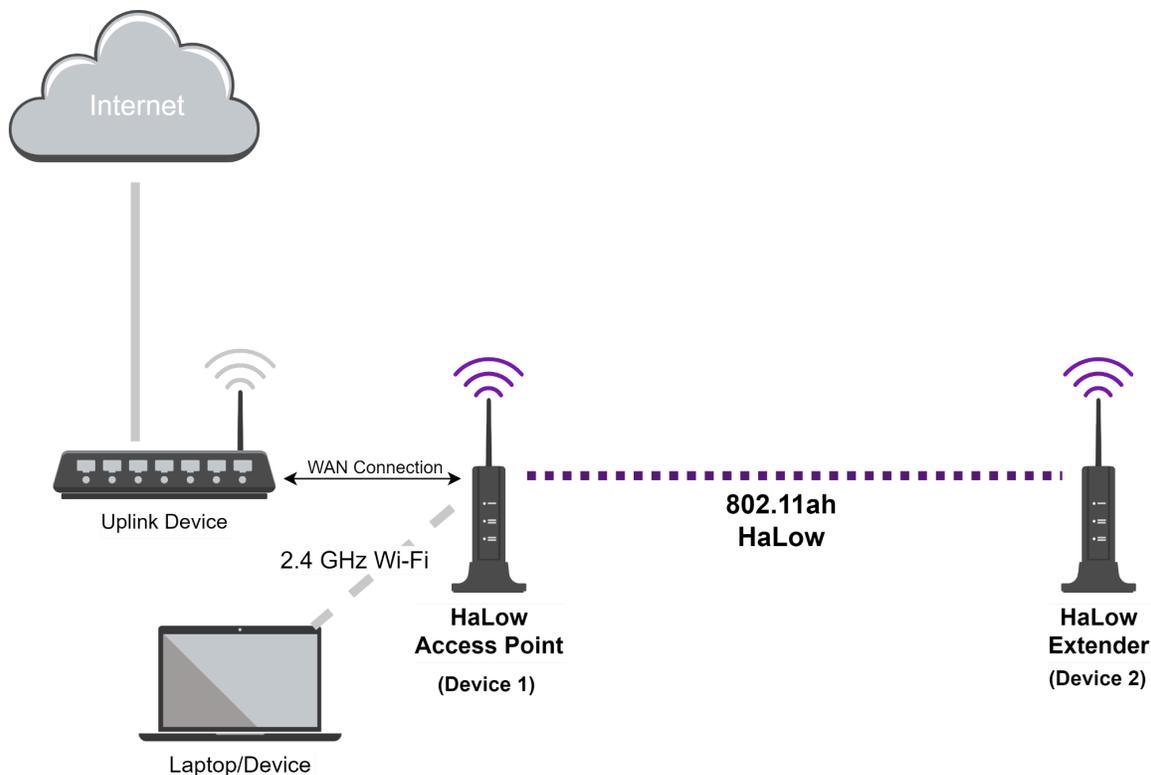
This guide explains how to configure the Uplink connection on a HaLow Access Point device to create a setup like the one shown in the image below.

In this setup, Device1 is configured as an HaLow Access Point, providing network access to:

- Device2, which acts as a HaLow client connected over the HaLow interface.
- A laptop, which connects to Device1's 2.4GHz Wi-Fi AP.

The HaLow Access Point uses a WAN uplink (Starlink, orLTE dongle) to provide internet access to both clients.

In a HaLow network, the HaLow Access Point (EKH Evaluation Kit or HaLowLink1) can be configured in two primary modes to handle internet connectivity:

Router Mode

- The HaLow Access Point acts as a router, using an external internet source (Starlink/ LTE dongle) as its WAN uplink.
- It creates a separate internal network (e.g: with IP address 192.168.12.x), where connected HaLow clients are assigned local IP addresses.
- NAT (Network Address Translation) is applied, meaning all client traffic is routed through the HaLow device before reaching the WAN.
- This mode isolates local devices from the WAN while providing controlled access to the internet.
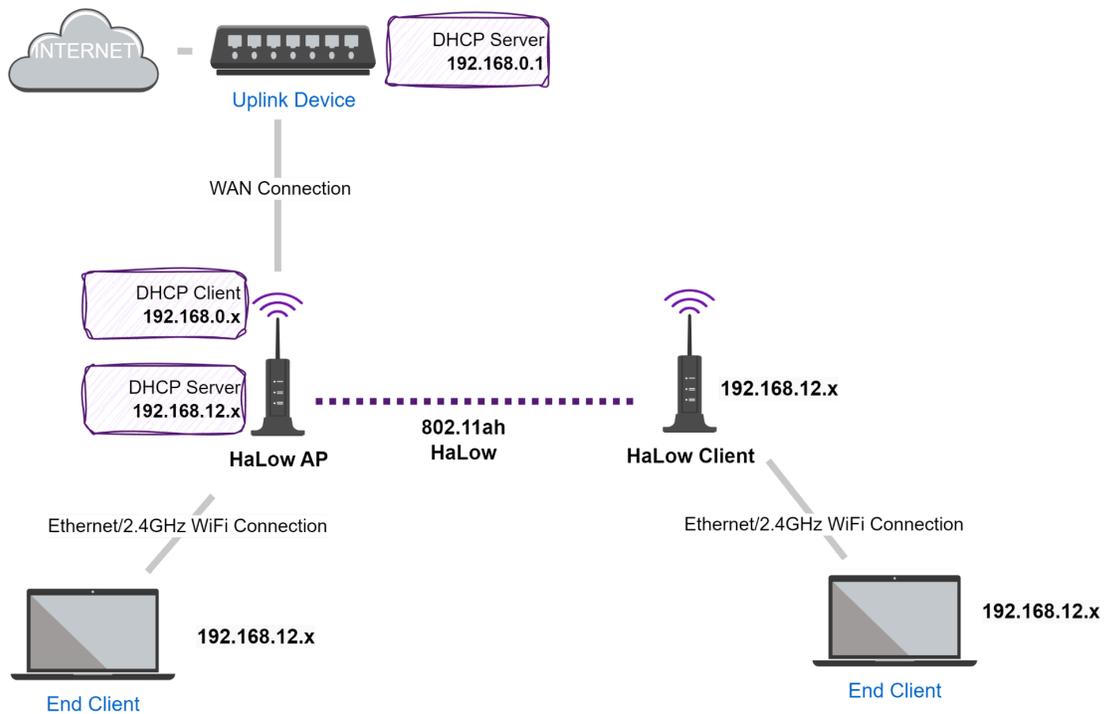
Bridge Mode

- The HaLow Access Point acts as a transparent bridge, extending the WAN network to all connected HaLow clients.
- Clients are assigned IP addresses directly from the WAN uplink (e.g., the Starlink modem or LTE network).
- There is no NAT, and clients can communicate directly with the external network.
- This mode is useful when HaLow devices need to be part of an existing network rather than managing their own.
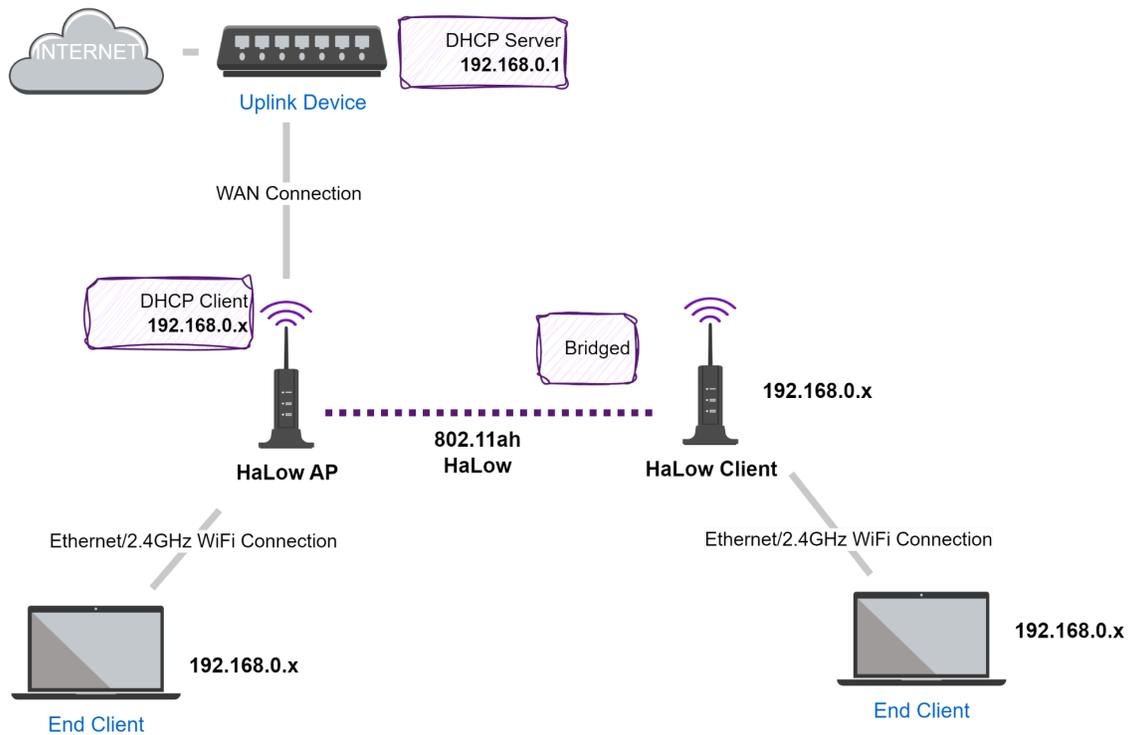
3 How to Configure

The configuration process is divided into the following steps:

1. Setting Up the WAN Uplink
    1.1. Starlink Uplink – Connect the HaLow Access Point to the Starlink Modem/Dish.
    1.2. LTE USB Dongle – Configure the HaLow Access Point to utilize an LTE modem.
2. Configuring the HaLow Network
    2.1. Routed to WAN (Router Mode) – HaLow Access Point performs Network Address Translation (NAT) between the WAN uplink and connected clients.
    2.2. Bridged to WAN (Bridge Mode) – HaLow Access Point directly forwards traffic to the WAN, placing all clients on the same network.

Each section will provide guidance on configuring HaLow Access Point based on the chosen uplink type and network mode.

The setup will use the Device1 (HaLow Access Point) in different network modes while maintaining the following configuration:

- Device1 (HaLowLink1 or Eval Kit) functions as the Access Point.
- Device2 operates as a HaLow client.
- A laptop is connected via Device1's 2.4GHz Wi-Fi AP.
- An uplink device (Starlink, or LTE USB dongle) provides internet access.

3.1 Setting Up the WAN Uplink

The goal of this step is to configure the HaLow Access point to establish an internet connection using one of the available uplink options. By the end of this step, the AP should be able to access the internet, ensuring that it can reach www.morsemicro.com.

3.1.1 Setup Starlink Uplink

The Starlink Standard Kit includes a Starlink Dish Antenna and a Router. There are two ways to connect your HaLow Access Point to Starlink:

#### 3.1.1.1 Connecting to the Starlink Router (Default Setup)

This section provides guidelines to connect a HaLow Access Point - either the HaLowLink1 or the Eval Kit (EKH03) - to the Starlink Router's Wi-Fi network.
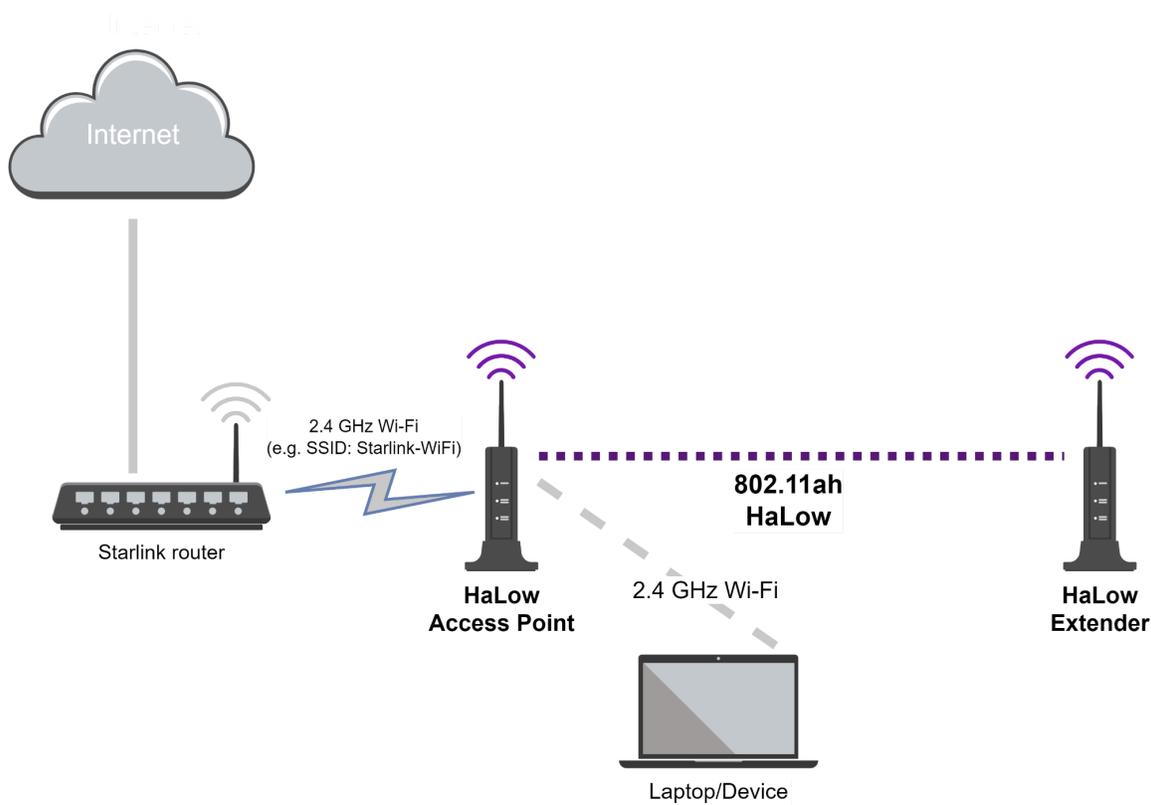
1. Set up the Starlink Router according to the official guidelines.
2. Ensure the router is broadcasting the correct SSID (e.g. starlink-AP).

Steps to connect HaLowLink1

3. Connect HaLow Access Point in this case which is a **HaLowLink1** as a client of the Starlink Wi-Fi network.
   3.1. Ensure the HaLow Access Point is in the right mode with its status LED showing green. Refer to the user guide to set up that mode.
   3.2. Connect your laptop to the HaLow Access Point via its 2.4 GHz Wi-Fi SSID which is found on the label of the device. (e.g. Wi-Fi SSID: HaLowLink1-af0f)
   3.3. Access the web UI at http://192.168.12.1, login using the "Device Password" and select the "Wizard" from the menu (direct link).
   3.4. Select the Network mode to use the 2.4GHz Wi-Fi uplink as shown in the image below.
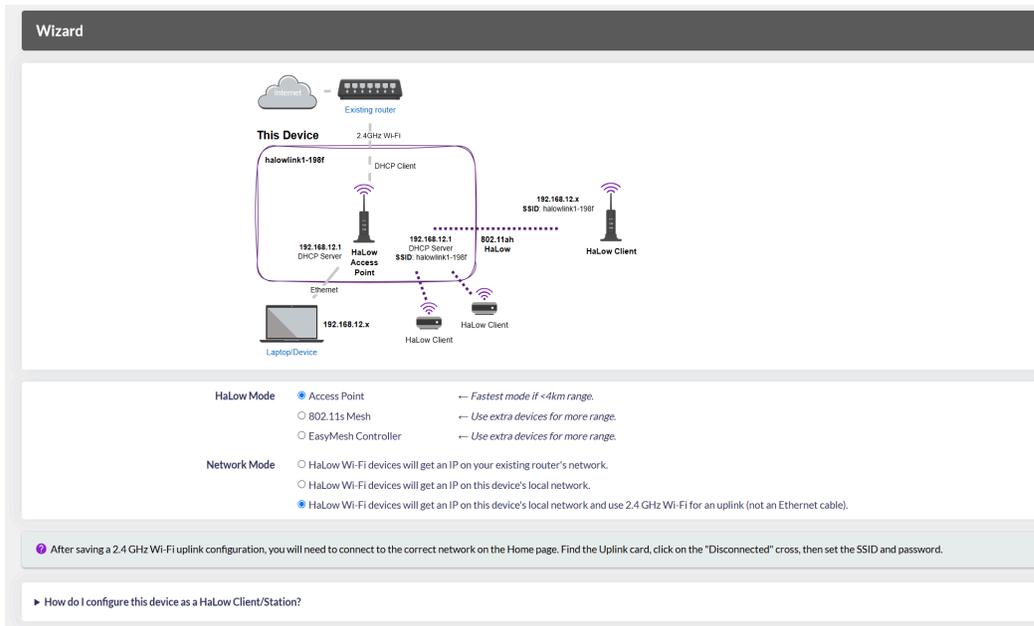
Note: If you select this option, the router mode is set as the default, as detailed in section 3.2.1.

3.5. Go to Home (http://192.168.12.1/cgi-bin/luci/admin/home)

3.6. Find the Uplink card, which should say "Disconnected"

3.7. Click the word "Disconnected" and provide the uplink network details (e.g. SSID: Starlink-WiFi, password: starlink-password)

3.8. Once connected proceed to section 3.1.1.3 to verify the device's internet connectivity.

Steps to connect EKH03

4. Connect the HaLow Access Point in this case which is an EKH03 as a client of the Starlink Wi-Fi network.

4.1. Ensure the EKH03 is configured as a HaLow Access Point. Refer to the user guide to set up that mode.

4.2. Connect your laptop to the HaLow Access Point via the LAN port using an ethernet cable.

4.3. Access the web UI at http://10.42.0.1, and select the "Setup AP/ STA Wizard" from the Wizard menu.

4.4. On the Access Point wizard, configure the HaLow network as per the user guide, and on the **Upstream Network** page choose the 2.4GHz Wi-Fi uplink as shown in the image below.

Upstream Network

- ○ None
- ○ Ethernet
- ◉ 2.4 GHz Wi-Fi

SSID	Starlink-WiFi	🔍
Encryption	WPA3-SAE	⌄
Passphrase	••••••••	*

❓ If you use a **Wi-Fi** upstream, fill in the Wi-Fi AP credentials. The HaLow connected devices obtain IP addresses from the DHCP server on this device, and this device uses NAT to forward IP traffic.

4.5. The traffic mode is set to router mode as the default, as detailed in section 3.2.1.

4.6. Apply the configuration on the final page.

4.7. Once connected proceed to section 3.1.1.3 to verify the device's internet

Starlink Mini Kit (Wi-Fi Only)

If you are using the Starlink Mini Kit, which has integrated Wi-Fi but no separate router, connect the HaLow Access Point directly to the Starlink Wi-Fi network as mentioned above in section 3.1.1.1.
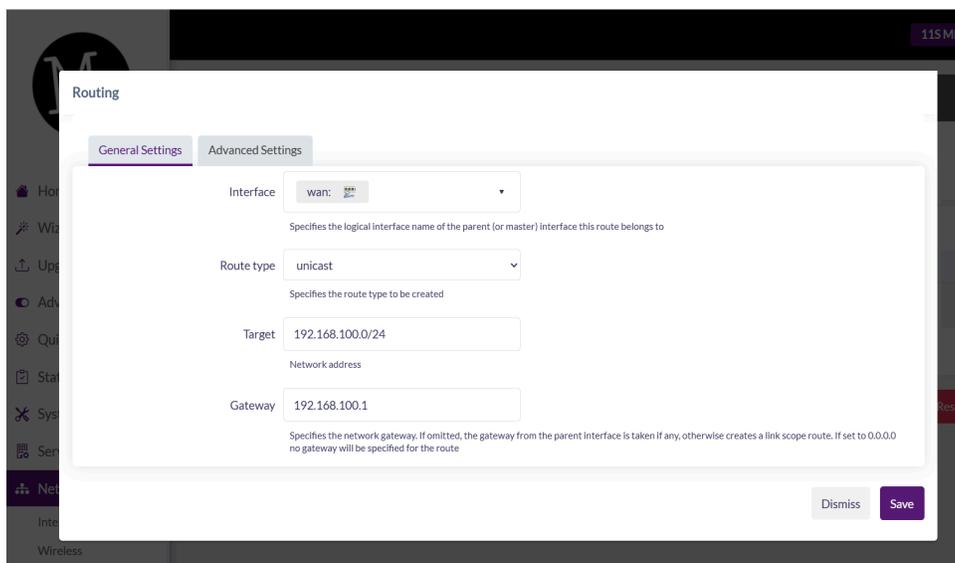
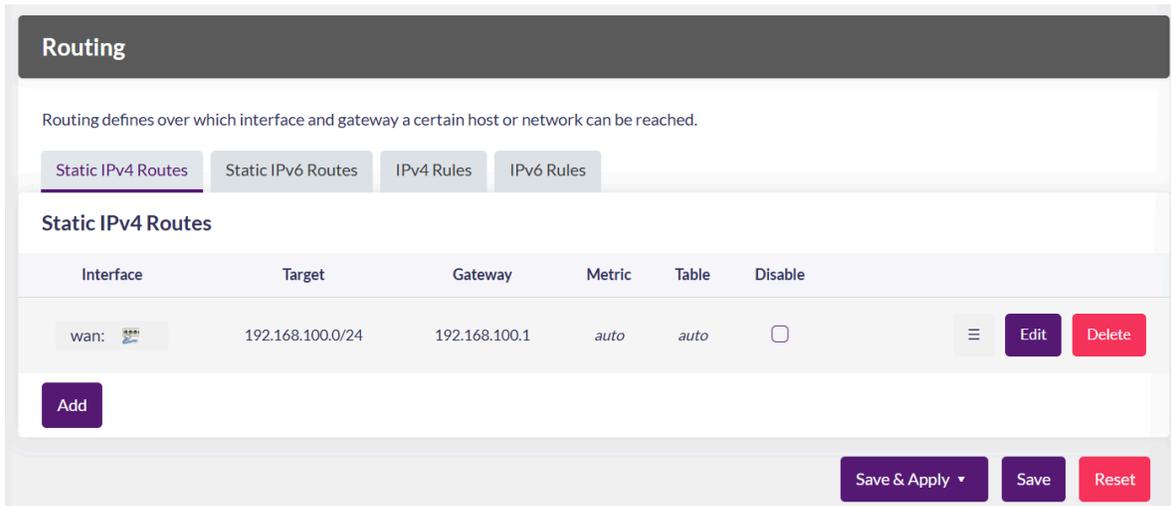## 3.1.1.2 Using HaLow Device as a Third-Party Router

The following section describes adding the HaLow Access Point as a third-party router to the Starlink router.

Note: In this configuration, bridge mode cannot be enabled on the HaLow Access Point.

The steps to configure are as follows,

1. Enable Bypass Mode on the Starlink router.
2. Connect HaLow AccessPoint as the third-party router, via plugging the ethernet cable to the WAN port of the device.
3. Creating a Static Route on the HaLow Access Point is a requirement for using the Starlink app. The following steps will demonstrate how to do this.
   a. Navigate to Advanced Config > Network > Routing page (http://192.168.12.1/cgi-bin/luci/admin/network/routes)
   b. Click on Static IPv4 Routes and click Add, then add the static route as suggested in the Starlink guide and hit "Save & Apply".

Routing

Routing defines over which interface and gateway a certain host or network can be reached.

| Static IPv4 Routes | Static IPv6 Routes | IPv4 Rules | IPv6 Rules |

Static IPv4 Routes

Interface	Target	Gateway	Metric	Table	Disable			
wan:	192.168.100.0/24	192.168.100.1	*auto*	*auto*	☐	≡	Edit	Delete

Add

Save & Apply ▼   Save   Reset

3.1.1.3 Verifying HaLow Access Point's internet Connectivity

To confirm that the HaLow Access Point can now connect to the internet through the 2.4 GHz uplink network, follow these steps:

1. Connect your laptop to HaLow Access Point's 2.4 GHz Wi-Fi (e.g. SSID: HaLowLink1-af0f).
2. Check your internet connection by loading a webpage like www.morsemicro.com. Ensure your laptop is not connected to a different network.

3.1.2 Setup LTE Dongle Uplink

This section describes how to configure a LTE USB Dongle for internet Access on Your HaLow Access Point.
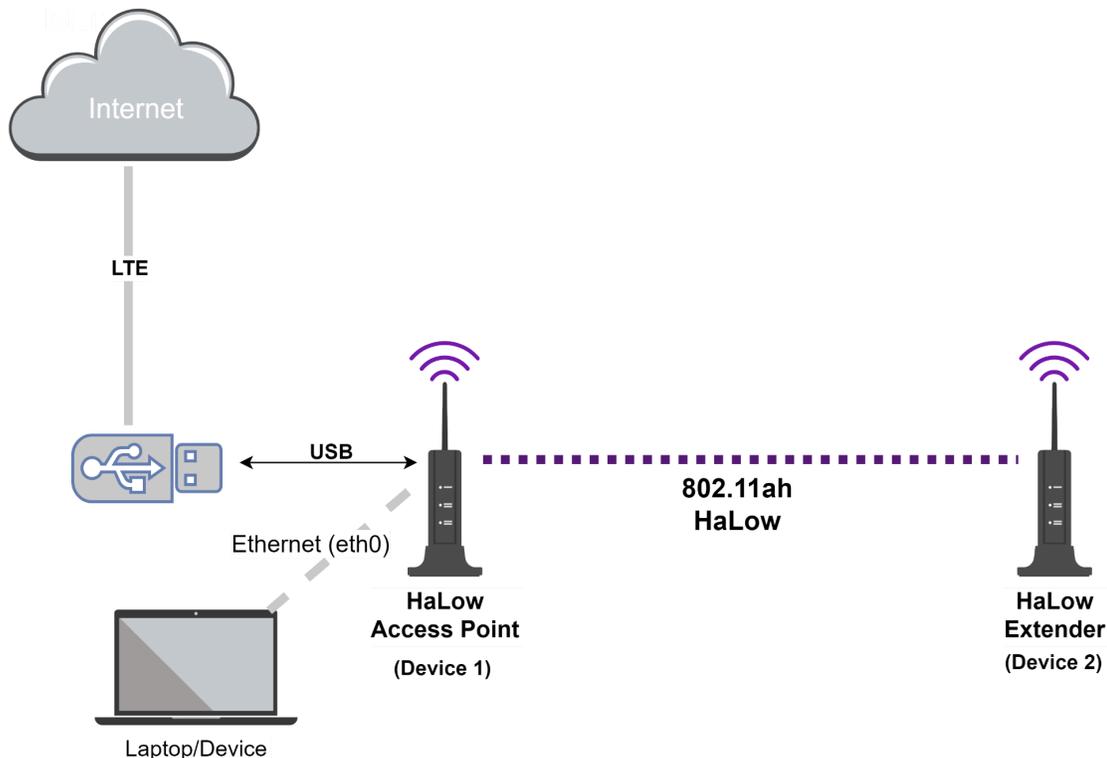
Note: USB LTE Dongles are not supported by the HaLowlink 1 due to the absence of a USB port. However, Evaluation Kits (EKH01, EKH03, or EKH-19) can be used to support this configuration.

Most LTE USB dongles on the market support NAT, and very few provide a public IP directly from the LTE provider. Neither scenario will impact how WAN is configured for the HaLow AP, unless the WAN interface is assigned an IP address.

Configuration Steps

The following configuration steps outline the process using the EKH01 as the HaLow Access Point (Device 1).

1. Connect your laptop to the HaLow Access Point via the Ethernet cable.
2. In a default state, you must be able to reach the device via http://10.42.0.1/ .
3. Plug-in the LTE USB dongle to the HaLow AP and ensure that the dongle initializes properly with any LED indications as directed by the provider.

For example, the "dmesg" logs indicate that a Huawei LTE USB dongle was connected to the EKH01.

```
134.008346] usb 1-1.3: new high-speed USB device number 3 using xhci_hcd
134.139441] usb 1-1.3: New USB device found, idVendor=12d1, idProduct=1f01, bcdDevice= 1.02
134.147801] usb 1-1.3: New USB device strings: Mfr=1, Product=2, SerialNumber=3
134.155118] usb 1-1.3: Product: HUAWEI_MOBILE
134.159478] usb 1-1.3: Manufacturer: HUAWEI_MOBILE
134.164262] usb 1-1.3: SerialNumber: 0123456789ABCDEF
134.171232] usb-storage 1-1.3:1.0: USB Mass Storage device detected
134.177909] scsi host0: usb-storage 1-1.3:1.0
134.421854] usb 1-1.3: USB disconnect, device number 3
134.828344] usb 1-1.3: new high-speed USB device number 4 using xhci_hcd
134.959267] usb 1-1.3: New USB device found, idVendor=12d1, idProduct=14db, bcdDevice= 1.02
134.967622] usb 1-1.3: New USB device strings: Mfr=1, Product=2, SerialNumber=0
134.974975] usb 1-1.3: Product: HUAWEI_MOBILE
134.979335] usb 1-1.3: Manufacturer: HUAWEI_MOBILE
135.054788] cdc_ether 1-1.3:1.0 eth1: register 'cdc_ether' at usb-0000:01:00.0-1.3, CDC Ethernet Device, 00:1e:10:1f:00:00
```

From the WebUI, go to Services > Terminal, Login to the device and enter "dmesg" on the terminal to view the logs as shown above.

Note: This indication may vary depending on the LTE dongle provider.

4. On the HaLow AP navigate to the Wizards page and select the standard HaLow AP/STA wizard.
5. Select Access Point and proceed to configure the right Wi-Fi credentials and appropriate channel information.
6. On the **Upstream Network** page select the **USB dongle**, if you do not see the option it is likely that the dongle was not initialized properly. Troubleshoot the dongle and try again.

7. Select the traffic mode as per the requisite, for more information on configuring the traffic mode refer to Section 3.2.
8. Apply the configuration and proceed to verify the internet connectivity..

Verifying HaLow Access Point's internet Connectivity

To confirm that the HaLow AP can now connect to the internet through the LTE uplink network, follow these steps:

On the Home page, the uplink card shows Connected as shown below:

Check your internet connection on your laptop by loading a webpage like www.morsemicro.com. Ensure your laptop is not connected to a different network via Wi-Fi.

3.2 Configuring the HaLow Network

The traffic mode of the HaLow network can be configured in two ways as aforementioned. This section explains the configuration details of each mode and what happens to the network flow in each mode.

The configuration wizards for HaLowLink1 and Evaluation Kits enable users to configure both router and bridge traffic modes. However, the available options may differ between different uplink choices. This section will explain how to configure both modes in HaLowLink1 and Evaluation Kits, using both the configuration wizard.

3.2.1 Routed to WAN (Router Mode)

3.2.1.1 Configuring HaLowLink1 in router mode

When configuring a HaLowLink1 device from the wizard page, selecting the options (either option 2 or 3) will make the HaLow client devices to obtain IP address on the device's local network and configures the HaLow Access Point to function as a router.

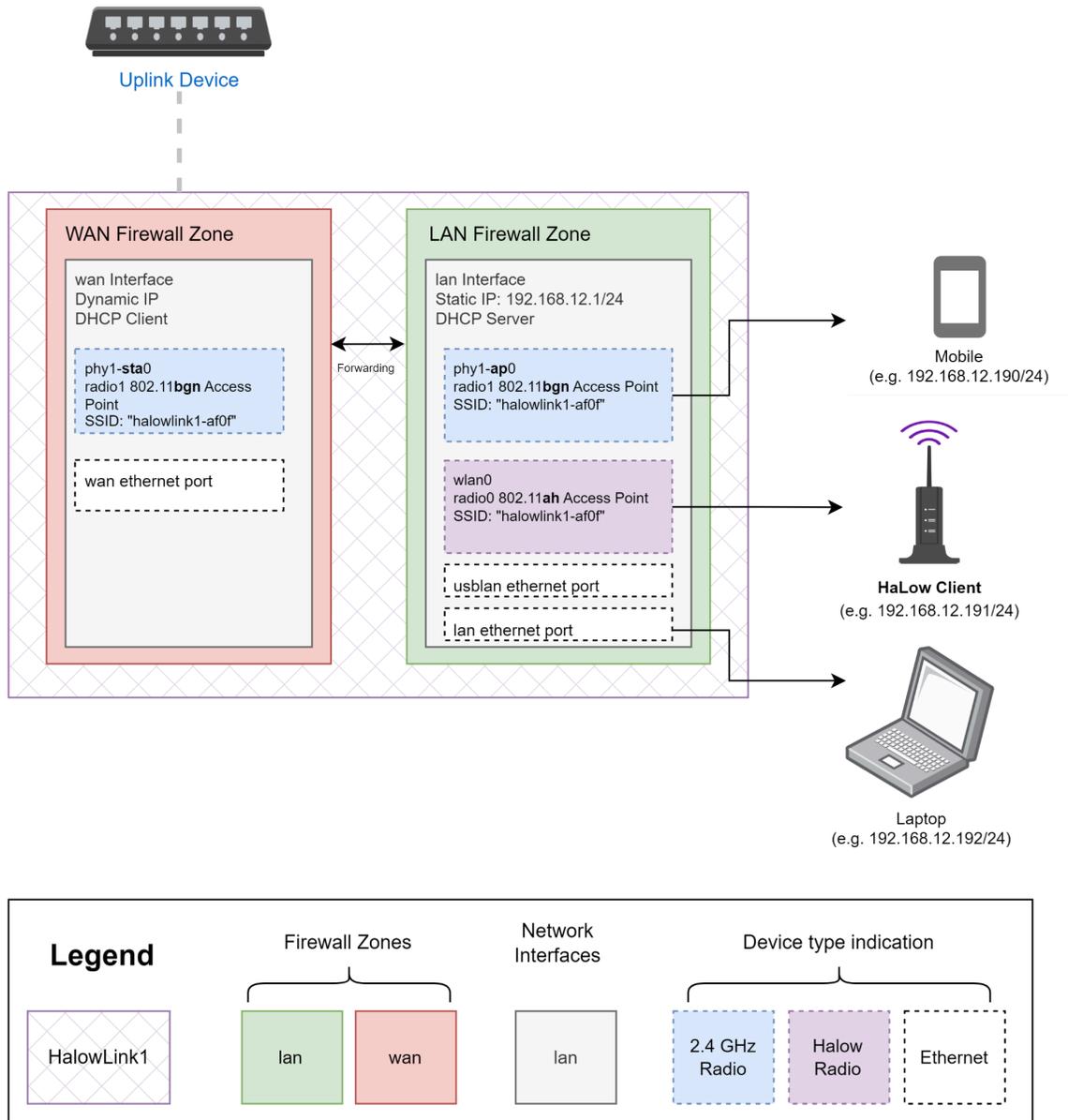The resulting network configuration on the device will be as depicted in the following diagram.

Figure 3.2.1

Network Flow

- The HaLow Access Point (HaLowLink1) can establish an internet connection in two ways:
    - Using option 3, through the WAN interface (phy0-sta0), when connected to the Starlink modem (as per section 3.1.1.1).

- ○ Using option 2, through the WAN ethernet interface, when the HaLowLink1 is used as a third-party router (as per section 3.1.1.2).
- Clients such as the Mobile, the HaLow client and the Laptop connect to the HaLowLink1 using the interfaces 2.4GHz Wi-Fi, HaLow and ethernet respectively.
- HaLowLink1 NATs traffic between the WAN uplink and the connected clients, enabling them to access the internet while remaining on a separate internal network.
- This setup ensures that all connected devices can communicate through HaLowLink1, which manages the routing and NAT functionality between the WAN and the local network.

3.2.1.2 Configuring Evaluation Kits in router mode

On the evaluation kit's wizard page, configure the kit to be an Access Point as per the user guide and while configuring the **Upstream Network**, set the **Traffic Mode** to Router or Router with firewall. Selecting this mode segregates the HaLow network from the upstream network, enabling traffic routing between HaLow clients and the upstream router.

For EKH03 or evaluation kits equipped with a 2.4GHz Wi-Fi radio, the HaLow network, Ethernet interface, and the 2.4GHz Wi-Fi Access Point are grouped under the LAN interface. The WAN uplink, configured as a 2.4GHz Station, is assigned to the WAN interface. This configuration aligns with the reference setup illustrated in Figure 3.2.1.

For evaluation kits without a 2.4GHz Wi-Fi radio, such as the EKH01, connecting an Ethernet cable to the WAN uplink and setting up the router mode results in the HaLow network being included in the LAN interface, while the Ethernet interface is assigned to the WAN network.

When using an LTE USB dongle as the uplink, the HaLow network, Ethernet interface, and the 2.4GHz Wi-Fi Access Point (if present) are incorporated into the LAN interface. The WAN uplink, identified as an Ethernet interface enumerated by the USB port, is added to the WAN network.

This configuration ensures proper interface grouping and traffic routing based on the evaluation kit's hardware and chosen uplink method.

3.2.2 Bridged to WAN (Bridge Mode)

The goal of bridge mode is to enable devices on both the HaLow and 2.4GHz networks to obtain IP addresses from the uplink connection (either Starlink Modem or LTE dongle). The LAN ethernet port can function as a management port or be configured to bridge to the uplink network.

Note: This mode is not supported when operating the Starlink Modem in bypass mode.

3.2.2.1 Configure HaLowLink1 in bridge mode

Ensure that the HaLow Access Point (HaLowLink1) establishes an internet connection through the WAN ethernet interface, by connecting to an uplink internet modem.
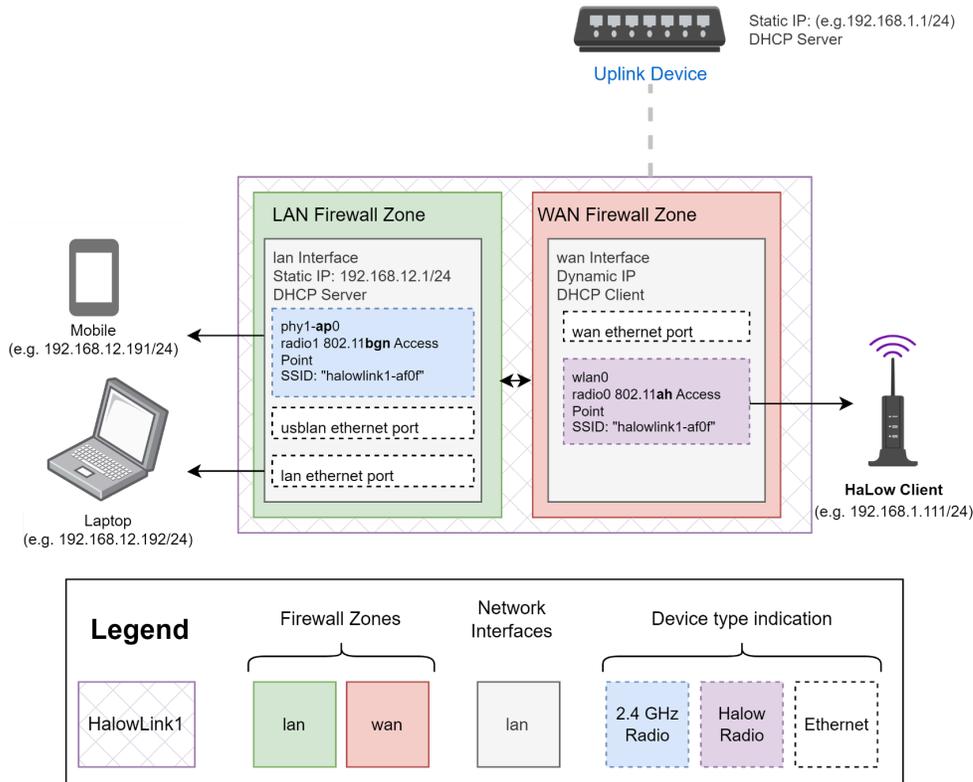

Figure 3.2.2

On the wizard page, select Option 1, to obtain IP on the existing router's (uplink router) network.
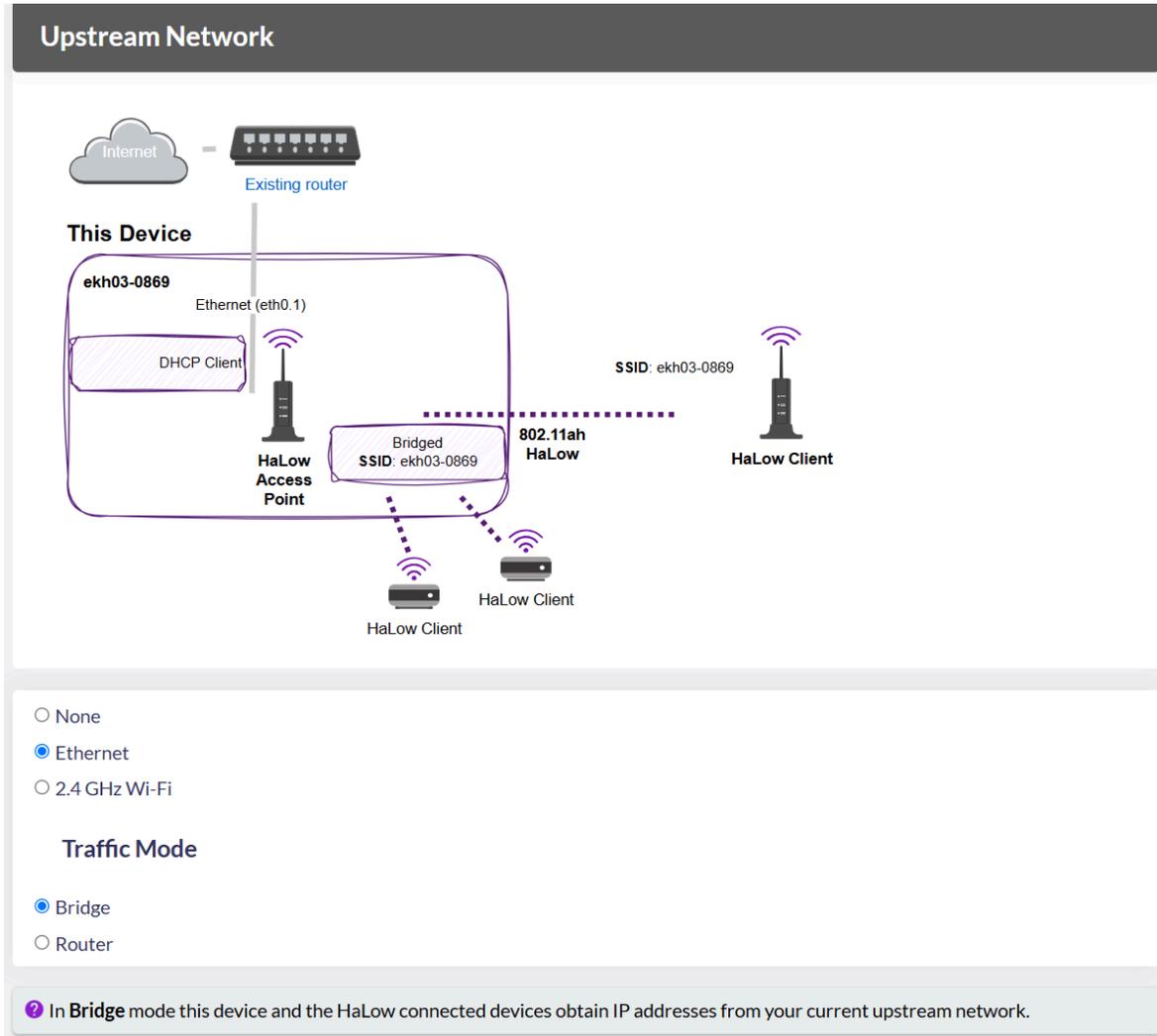
The resulting configuration is as depicted above in Figure 3.2.2.

Network Flow

- The WAN (bridged) network includes the WAN Ethernet interface and HaLow interface passing traffic transparently.
- In bridge mode, the LAN network which includes the Ethernet interface and the 2.4GHz Wi-Fi AP has a static IP 192.168.12.1 with a DHCP server for management.
- The HaLow interfaces function under the upstream network.

3.2.2.2 Configure Evaluation Kits in bridge mode

To configure the HaLow Access Point as a bridge, allowing traffic to flow between the HaLow client and other end clients (including the 2.4GHz Wi-Fi AP, if present), select 'bridge' as the traffic mode in the wizard on Evaluation Kits.

The resulting configuration is as follows.

Network Flow

- The WAN (bridged) network includes the WAN Ethernet interface and HaLow interface passing traffic transparently.
- In bridge mode, the Ethernet interface and the 2.4GHz Wi-Fi AP are bridges together with the HaLow interfaces and obtain IP addresses from the upstream network and pass traffic transparently.

4 Frequently Asked Questions (FAQ)

1 Why is the 2.4GHz Wi-Fi uplink not supported in Bridge mode?

The wizard on both the Evaluation Kits and the HaLowLink1 sets the device's traffic mode to Router by default and does not provide an option to configure Bridge mode through the wizard interface. This limitation exists because configuring bridge mode requires utmost caution due to specific restrictions that may prevent proper operation.

Notably, the 2.4GHz Station (STA) interface used for the uplink connection must be set to WDS mode to enable bridging. Additionally, the uplink Access Point (AP) that the device connects to must also support and be configured for WDS. Failing to meet these conditions will prevent the bridge configuration from functioning as intended.

2 Configure Ethernet interface to be bridged with the WAN

When the traffic mode is set to Bridge, the Ethernet and 2.4GHz Wi-Fi interfaces are not automatically bridged with the WAN network and, in most cases, remain on a separate network. However, if you choose to bridge the Ethernet interface to the WAN uplink, this can be done manually from the Quick Config page of the device. In the Network Interfaces section, remove the lan and usblan interfaces from the Ethernet section of the lan network and add them to the wan network as shown in the example provided.

Note: Making this change may result in the loss of connection to your device if you are connected through the lan or usblan interfaces of the HaLow Access Point. To regain access, you can either connect via the 2.4GHz Wi-Fi or identify the IP address assigned to the lan interface by the upstream uplink device and connect directly.

5 Revision History

Release Number	Release Date	Release Notes
01	2025-03-20	Initial release

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