HAP101 Wi-Fi HaLow Access Point

Quick Start Guide

Version: 1.5

1. Component Checklist

Check if all components are available before wiring:

- HAP101

- 1 x Wi-Fi HaLow antenna (longer)

- 2 x 2.4GHz Wi-Fi antenna (shorter)

- 12V DC power adapter

- DC Power connector

*   *If internet access is required, a router functioning as a DHCP server should be set up.*

2. Installation and Wiring

When mounting HAP101 on a vertical surface, please ensure that the device is oriented with the LED indicators pointing down. This positioning allows the LEDs to be visible to the user on the ground.

1. Use two Metric M3 x 8mm machine screws to fix HAP101 (screw anchors might be necessary);

2. Tighten the screws and gently swing the device to make sure it is fastened;

3. Install the shorter antennas to the WLAN antenna connectors (*silk screened as WLAN1 and WLAN2/BT*);

4. Install the longer antenna to the Wi-Fi HaLow antenna connector (*silk screened as HaLow*);

5. Connect the Ethernet port of HAP101 to a LAN port of a router using an Ethernet cable (cat 5 at the minimum), when necessary;
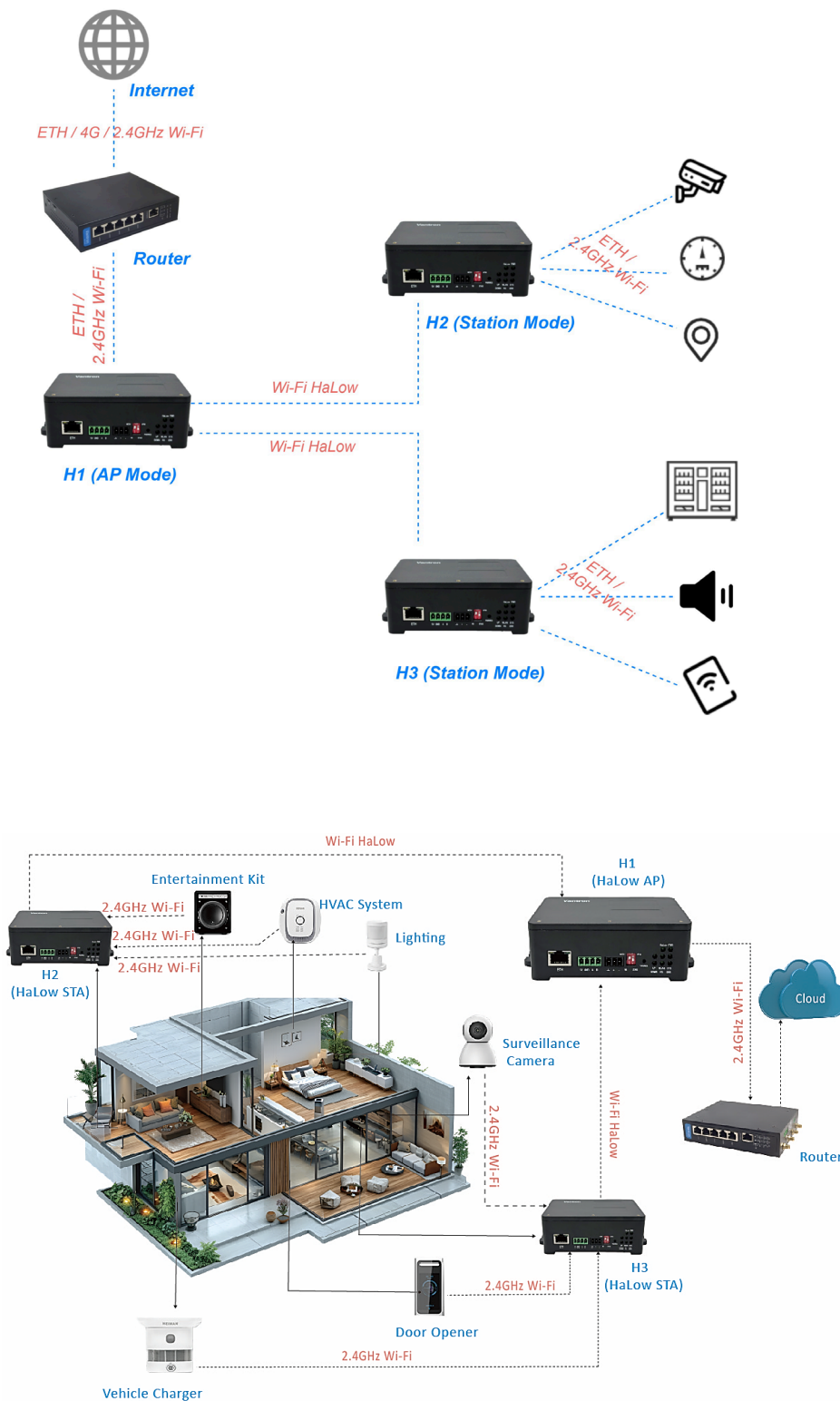

6. Plug the DC power connector into the power terminal of the device and connect it to the power source using the 12V DC adapter to start it.

3.   Network Architecture

3.1   Standard HaLow Connection

3.2   HaLow Mesh Connection

HaLow mesh uses Wi-Fi HaLow in a self-organizing, multi-hop mesh network. When an HAP101 operates in **Mesh** mode, it supports both HaLow mesh and AP features. This allows it to establish a mesh network with other HaLow devices in Mesh mode, while also enabling HaLow devices in Station mode to connect to it.
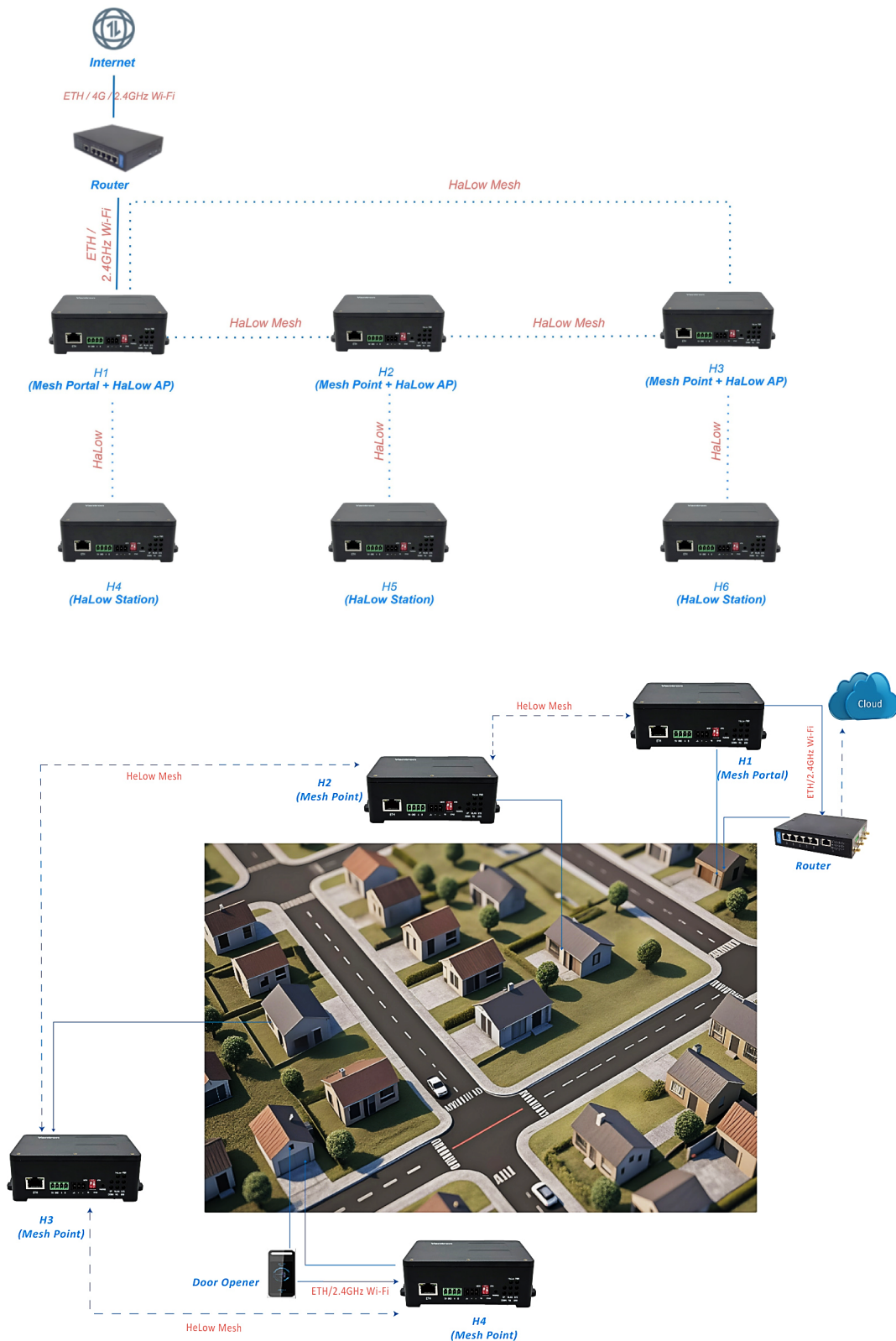
4.   Pairing Two HAP101 Devices

You have multiple options to pair two HAP101 devices via Wi-Fi HaLow. Choose the one that best suits your situation.

4.1   HaLow DPP Pairing (via Hardware Setup)

DPP (Device Provisioning Protocol) specifically refers to the fast provisioning of HAP101 devices for a **standard HaLow connection**. The DIP switches and Pair/Restore button enable a HaLow DPP pairing quickly via hardware setup.

The definition of the DIP switches is as follows.

Switch 1	Switch 2	Description
Non-Mesh [**Standard HaLow mode**]	AP/Portal	The device operates as a HaLow AP
	STA/Point	The device operates as a HaLow station
Mesh [**HaLow mesh mode**]	AP/Portal	The device operates as a mesh portal
	STA/Point	The device operates as a mesh point

HaLow DPP pairing configurations on an **AP-mode HAP101 (H1)** and **Station-mode HAP101 (H2)** are outlined below:

Device	Switch 1	Switch 2	Pair/Restore Button Action	Result
H1	Non-mesh	AP/Portal	1. Short press the Pair/Restore button to enter the pairing mode;	Pairing mode enabled in the HaLow AP mode
H2	Non-mesh	STA/Point	2. No button action in 3 seconds to confirm the mode.	Pairing mode enabled in the HaLow station mode

Steps:

1. After both H1 and H2 have enabled the DPP pairing mode as instructed in the table above, wait for the devices to pair;

*   *Make sure the time interval between button actions on H1 and H2 is within 120 seconds.*

2. Upon successful connection, the HaLow indicators on both devices will enter the 'netdev' mode: The UP indicator on **H1** and the DOWN indicator on **H2** will blink at a frequency of 4Hz for 3s and later turn solid green.

The devices will **exit** the pairing mode if:

a.   HaLow connection between H1 and H2 is successfully established; or

b.   The Pair/Restore button is pressed within 3 seconds after the device enters the pairing mode; or

  c. The second device does not enable the pairing mode in **120 seconds** after the first device does;

  d. HaLow connection between H1 and H2 fails.

4.2   Pairing via Station Setup on the Web Portal

Typically, each HAP101 operates in both HaLow AP and 2.4GHz Wi-Fi AP mode **by default**, with a fixed LAN IP of 172.18.2.1. When switched to HaLow station/client mode, the LAN IP will change to 172.18.3.1, ensuring proper IP allocation.

To connect a station-mode HAP101 (**H2**) to an AP-mode HAP101 (**H1**) via Wi-Fi HaLow using the web-based management portal, **simply configure H2**.

1. Power on the devices;

2. Connect the host computer to the 2.4GHz Wi-Fi of **H2** using the default SSID and password provided on the device label as shown below;

```
HaLow WLAN MAC: XX:XX:XX:XX:XX:XX
WLAN MAC: XX:XX:XX:XX:XX:XX:XX
WAN MAC: XX:XX:XX:XX:XX:XX
WLAN Login IP: 172.18. 2.1
User name/Password: admin/XXXXXX
WLAN SSID: XXXXXX
WLAN Password: XXXXXXXX
HaLow WLAN SSID: XXXXXX
HaLow WLAN Password: XXXXXXXX
```

3. Use the default **Login IP** provided on the device label of **H2** as the address for the management portal login;

```
HaLow WLAN MAC: XX:XX:XX:XX:XX:XX
WLAN MAC: XX:XX:XX:XX:XX:XX:XX
WAN MAC: XX:XX:XX:XX:XX:XX
WLAN Login IP: 172.18. 2.1
User name/Password: admin/XXXXXX
WLAN SSID: XXXXXX
WLAN Password: XXXXXXXX
HaLow WLAN SSID: XXXXXX
HaLow WLAN Password: XXXXXXXX
```
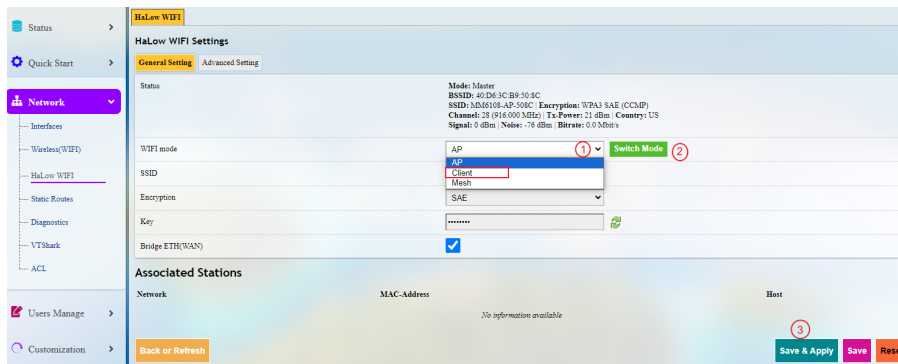
4. Log in to the management portal using the username and password on the device label;

```
HaLow WLAN MAC: XX:XX:XX:XX:XX:XX
WLAN MAC: XX:XX:XX:XX:XX:XX:XX
WAN MAC: XX:XX:XX:XX:XX:XX
WLAN Login IP: 172.18. 2.1
User name/Password: admin/XXXXXX
WLAN SSID: XXXXXX
WLAN Password: XXXXXXXX
HaLow WLAN SSID: XXXXXX
HaLow WLAN Password: XXXXXXXX
```

 * *For higher permissions on the management portal, log in as a superuser:*

  Super user: root   //   password: rootpassword

5. Navigate to **Network > HaLow WIFI** and switch the HaLow mode of **H2** to **Client**, then wait a few seconds to allow the change to apply;


＊ *The LAN IP of the device will change to* ***172.18.3.1*** *when the HaLow mode switches to* ***Client***.

6. Reconnect the host computer to the 2.4GHz Wi-Fi of **H2** and log in to the management portal using the **new** WLAN IP: 172.18.3.1;

7. Check the device label of **H1** for the HaLow WLAN SSID and password for HaLow connection;
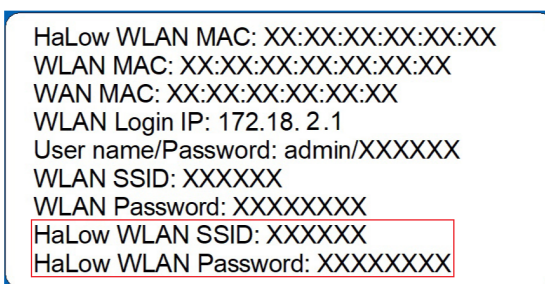
8. Navigate to **Network > HaLow WIFI > General Setting** in the management portal for **H2**. Under the **Wifi Client Setting** tab, select the SSID of **H1** from the list and enter the password for HaLow connection;
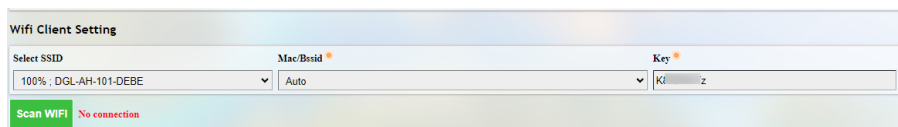
9. If the target SSID is not included in the HaLow SSID list, click the **SCAN WIFI** button to refresh the list;

10. Save and apply the settings;

11. When **H2** successfully connects to **H1** via Wi-Fi HaLow, the connection status will be displayed next to the **SCAN WIFI** button;
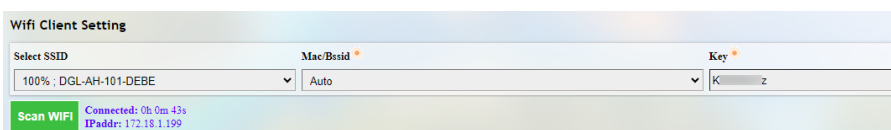
12. You can check the network quality in the **Status** section.
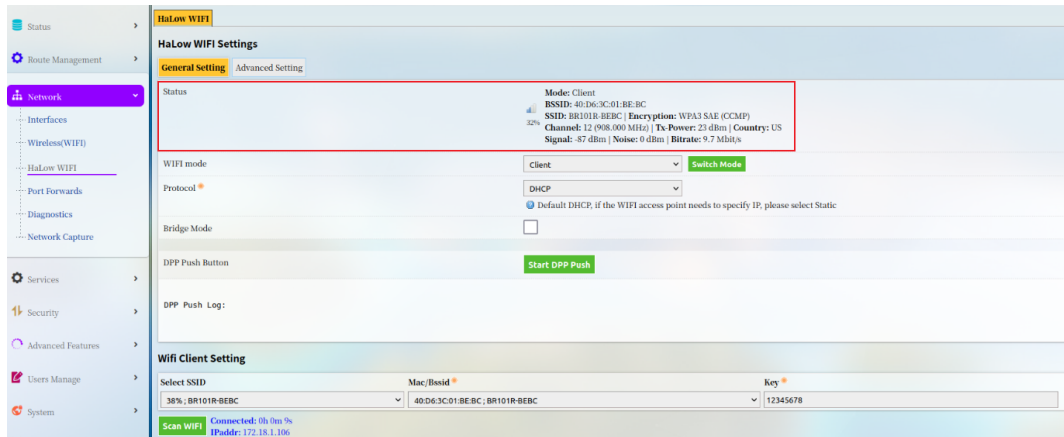
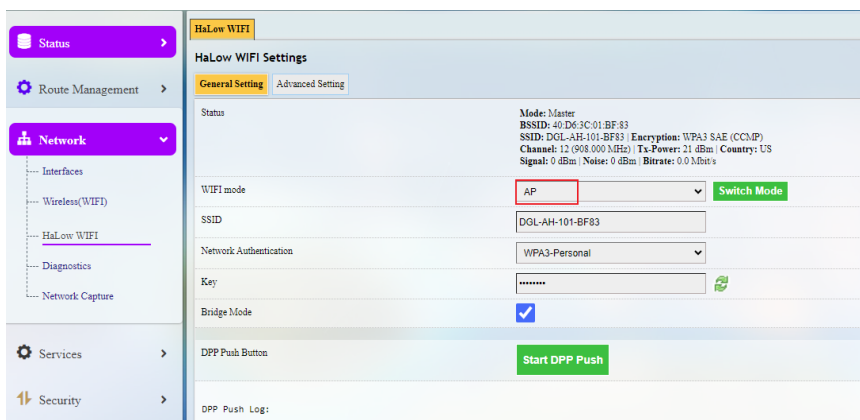* *The **Signal** value reflects the quality of the network connection:*

Ideally, the value should be above -75dBm (e.g. -70dBm).

Values below -95dBm (e.g., -100dBm) suggest that the connection is nearly unavailable.

4.3   HaLow DPP Pairing (via Software Setup)

As mentioned before, **DPP** (Device Provisioning Protocol) specifically refers to the fast provisioning of HAP101 devices for a **standard HaLow connection**. You can pair an AP-mode HAP101 (**H1**) and a station-mode HAP101 (**H2**) on the management portal, regardless of the **physical** settings of the devices.

1. Connect a host computer (PC1) to **H1** via 2.4GHz Wi-Fi and log in to the management portal for H1 using the device's WLAN IP (refer to steps 1~4 in 4.2);

2. Connect another host computer (PC2) to **H2** via 2.4GHz Wi-Fi and log in to the management portal for H2 using the device's WLAN IP (refer to steps 1~4 in 4.2);

3. Navigate to **Network > HaLow WIFI** separately on both management portals;

4. Keep the settings of **H1** unchanged;

5. Switch the HaLow mode of **H2** to **Client**;

   * *You will need to re-log in to the management portal for H2 using the new WLAN IP address: **172.18.3.1** when its HaLow mode switches to **Client**.*

6. Click the **Start DPP Push** buttons on both management portals simultaneously;

7. Wait for the devices to pair;

8. Upon successful connection, the HaLow indicators on both devices will enter the 'netdev' mode. The UP indicator on H1 and the DOWN indicator on H2 will blink at a frequency of 4Hz for 3s and later turn solid green;

9. The DPP push log indicates the success or failure state of the connection.


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5. Throughput Testing

The throughput testing allows users to assess the network quality more intuitively.

1. Connect a station-mode HAP101 (H2) to an AP-mode HAP101 (H1) via Wi-Fi HaLow through any of the methods set out in section 4;

2. Connect a host computer (PC1) to H1 via 2.4GHz Wi-Fi (refer to steps 1~4 in 4.2);

3. Connect another host computer (PC2) to H2 via 2.4GHz Wi-Fi (refer to steps 1~4 in 4.2);

4. Log in to VantronOS for H1 and H2 respectively on PC1 and PC2 using the device's WLAN IP;

*   *Login address for H1: to **172.18.2.1;** Login address for H2: to **172.18.3.1.***

5. Navigate to **System > Terminal** in VantronOS and **enable** Web Terminal to activate the terminal for both devices;
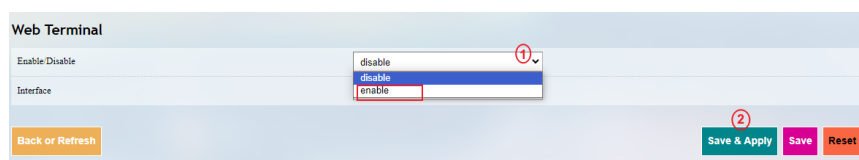
6. Click the link to open the terminal and log in as the root user;

*   *User:* root*; password: rootpassword*

7. Use H1 as the server and H2 as the client, then input the following commands in pair on PC1 and PC2, respectively for the throughout testing;

iperf3 -s	// PC1
iperf3 -c 172.18.2.1 -t 30	// PC2 (HaLow IP of H1 & duration in seconds)

Alternatively, you can reverse the roles of H1 and H2:

iperf3 -s	// PC2
iperf3 -c 172.18.2.100 -t 30	// PC1 (HaLow IP of H2 & duration in seconds)

8. Test results shown in H1 and H2:

```
root@VantronOS-508B:~# iperf3 -s
warning: this system does not seem to support IPv6 - trying IPv4
-----------------------------------------------------------
Server listening on 5201
-----------------------------------------------------------
Accepted connection from 172.18.2.100, port 56946
[  5] local 172.18.2.1 port 5201 connected to 172.18.2.100 port 56950
[  8] local 172.18.2.1 port 5201 connected to 172.18.2.100 port 56952
[ 10] local 172.18.2.1 port 5201 connected to 172.18.2.100 port 56954
[ ID] Interval           Transfer     Bitrate
[  5]   0.00-1.00   sec    182 KBytes  1.49 Mbits/sec
[  8]   0.00-1.00   sec    129 KBytes  1.05 Mbits/sec
[ 10]   0.00-1.00   sec    103 KBytes   845 Kbits/sec
[SUM]   0.00-1.00   sec    414 KBytes  3.39 Mbits/sec
- - - - - - - - - - - - - - - - - - - - - - - - -
[  5]   1.00-2.00   sec    117 KBytes   962 Kbits/sec
[  8]   1.00-2.00   sec    287 KBytes  2.35 Mbits/sec
[ 10]   1.00-2.00   sec    223 KBytes  1.83 Mbits/sec
[SUM]   1.00-2.00   sec    628 KBytes  5.14 Mbits/sec
- - - - - - - - - - - - - - - - - - - -
[  5]   2.00-3.00   sec   0.00 Bytes  0.00 bits/sec
[  8]   2.00-3.00   sec    663 KBytes  5.43 Mbits/sec
[ 10]   2.00-3.00   sec    551 KBytes  4.52 Mbits/sec
[SUM]   2.00-3.00   sec   1.19 MBytes  9.95 Mbits/sec
- - - - - - - - - - - - - - - - - - -
[  5]   3.00-4.00   sec    402 KBytes  3.29 Mbits/sec
[  8]   3.00-4.00   sec    598 KBytes  4.90 Mbits/sec
[ 10]   3.00-4.00   sec    498 KBytes  4.08 Mbits/sec
[SUM]   3.00-4.00   sec   1.46 MBytes  12.3 Mbits/sec
- - - - - - - - - - - - - - - - - - - - - - - -
[  5]   4.00-5.00   sec    233 KBytes  1.91 Mbits/sec
[  8]   4.00-5.00   sec    219 KBytes  1.80 Mbits/sec
[ 10]   4.00-5.00   sec    255 KBytes  2.09 Mbits/sec
[SUM]   4.00-5.00   sec    707 KBytes  5.79 Mbits/sec
- - - - - - - - - - - - - - - - - - - - - - -
[  5]   5.00-6.00   sec    106 KBytes   869 Kbits/sec
[  8]   5.00-6.00   sec    419 KBytes  3.43 Mbits/sec
[ 10]   5.00-6.00   sec   0.00 Bytes  0.00 bits/sec
[SUM]   5.00-6.00   sec    525 KBytes  4.30 Mbits/sec
- - - - - - - - - - - - - - - - - - - - - - - -
```

```
root@VantronOS-40A2:~# iperf3 -c 172.18.2.1 -t 60 -P 3
Connecting to host 172.18.2.1, port 5201
[  5] local 172.18.2.100 port 56950 connected to 172.18.2.1 port 5201
[  7] local 172.18.2.100 port 56952 connected to 172.18.2.1 port 5201
[  9] local 172.18.2.100 port 56954 connected to 172.18.2.1 port 5201
[ ID] Interval           Transfer     Bitrate         Retr  Cwnd
[  5]   0.00-1.00   sec    761 KBytes  6.23 Mbits/sec   28    105 KBytes
[  7]   0.00-1.00   sec    570 KBytes  4.67 Mbits/sec   34   82.0 KBytes
[  9]   0.00-1.00   sec    481 KBytes  3.94 Mbits/sec   34   76.4 KBytes
[SUM]   0.00-1.00   sec   1.77 MBytes  14.8 Mbits/sec   96
- - - - - - - - - - - - - - - - - - - - - - - - -
[  5]   1.00-2.00   sec    318 KBytes  2.61 Mbits/sec  181    153 KBytes
[  7]   1.00-2.00   sec    700 KBytes  5.73 Mbits/sec   43    192 KBytes
[  9]   1.00-2.00   sec    577 KBytes  4.73 Mbits/sec   92    225 KBytes
[SUM]   1.00-2.00   sec   1.56 MBytes  13.1 Mbits/sec  316
- - - - - - - - - - - - - - - - - - - - - - - - -
[  5]   2.00-3.00   sec   0.00 Bytes  0.00 bits/sec   68    195 KBytes
[  7]   2.00-3.00   sec    954 KBytes  7.82 Mbits/sec   62    308 KBytes
[  9]   2.00-3.00   sec    445 KBytes  3.65 Mbits/sec  192    198 KBytes
[SUM]   2.00-3.00   sec   1.37 MBytes  11.5 Mbits/sec  322
- - - - - - - - - - - - - - - - - - - - - - - - -
[  5]   3.00-4.00   sec    700 KBytes  5.73 Mbits/sec   29   14.1 KBytes
[  7]   3.00-4.00   sec    573 KBytes  4.69 Mbits/sec   55    134 KBytes
[  9]   3.00-4.00   sec    891 KBytes  7.30 Mbits/sec   50    320 KBytes
[SUM]   3.00-4.00   sec   2.11 MBytes  17.7 Mbits/sec  134
- - - - - - - - - - - - - - - - - - - - - - - - -
[  5]   4.00-5.00   sec   0.00 Bytes  0.00 bits/sec   36    127 KBytes
[  7]   4.00-5.00   sec    636 KBytes  5.21 Mbits/sec  289    164 KBytes
[  9]   4.00-5.00   sec    509 KBytes  4.17 Mbits/sec  184    215 KBytes
[SUM]   4.00-5.00   sec   1.12 MBytes  9.38 Mbits/sec  509
- - - - - - - - - - - - - - - - - - - - - - - - -
[  5]   5.00-6.00   sec    445 KBytes  3.65 Mbits/sec  123    212 KBytes
[  7]   5.00-6.00   sec   0.00 Bytes  0.00 bits/sec  160    123 KBytes
[  9]   5.00-6.00   sec   0.00 Bytes  0.00 bits/sec   89    288 KBytes
[SUM]   5.00-6.00   sec    445 KBytes  3.65 Mbits/sec  372
- - - - - - - - - - - - - - - - - - - - - - - - -
```

9. Move the devices dynamically to different positions to test the HaLow connection throughput in the same way.