# HAP101 Wi-Fi HaLow Access Point



# Quick Start Guide

Version: 1.5

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## 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;
- 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.

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

The definition of the DIP switches is as follows.

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 | <ol> <li>Short press the Pair/Restore button<br/>to enter the pairing mode;</li> </ol> | Pairing mode enabled in the HaLow AP mode      |
| H2     | Non-mesh | STA/Point | <ol> <li>No button action in 3 seconds to<br/>confirm the mode.</li> </ol>             | 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.
- 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 webbased 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;



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



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

 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;

| Status >            | HaLow WIFI                       |                                                                                                                                                                                                                  |                         |
|---------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Status /            | HaLow WIFI Settings              |                                                                                                                                                                                                                  |                         |
| Quick Start >       | General Setting Advanced Setting |                                                                                                                                                                                                                  |                         |
| A Network           | Status                           | Mode: Maste<br>BSSDP. 4016-3C.8D8-503.C<br>SSDD: MA6104.AP.503C [ Encryption: WPA3.8AE (CCMP)<br>Channel: 32 (916:000 MHz) [ Jz.Power; 21 dBn ( Commy: US<br>Signal: 0.dBn ) Weiter: 6 dBn (Britter: 0.0 Mnt): 0 |                         |
| ···· Wireless(WIFI) | WIFI mode                        | AP (1) v Switch Mode (2)                                                                                                                                                                                         |                         |
| HaLow WIFI          | SSID                             | Client<br>Mesh                                                                                                                                                                                                   |                         |
| Static Routes       | Encryption                       | SAE                                                                                                                                                                                                              |                         |
| Diagnostics         | Key                              | ······                                                                                                                                                                                                           |                         |
| VTShark             | Bridge ETH(WAN)                  |                                                                                                                                                                                                                  |                         |
| ACL                 | Associated Stations              |                                                                                                                                                                                                                  |                         |
| -                   | Network                          | MAC-Address                                                                                                                                                                                                      | Host                    |
| 🖉 Users Manage 🔹 🕨  |                                  | No information available                                                                                                                                                                                         | 3                       |
| O Customization     | Back or Refresh                  |                                                                                                                                                                                                                  | Save & Apply Save Reset |

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



 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;

| Wifi Client Setting      |             |        |
|--------------------------|-------------|--------|
| Select SSID              | Mac/Bssid 📍 | Key 🖲  |
| 100% ; DGL-AH-101-DEBE 🗸 | Auto        | ✓ Ki z |
| Scan WIFI No 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;

| Wifi Client Setting                                    |             |       |
|--------------------------------------------------------|-------------|-------|
| Select SSID                                            | Mac/Bssid 🖲 | Key 😐 |
| 100% ; DGL-AH-101-DEBE 🗸                               | Auto        | ✔ K z |
| Scan WIFI Connected: 0h 0m 43s<br>IPaddr: 172.18.1.199 |             |       |

#### 12. You can check the network quality in the **Status** section.

| Status >                                  | HaLow WIFI                                            |                                                                                                                                                                                    |                         |
|-------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
|                                           | HaLow WIFI Settings                                   |                                                                                                                                                                                    |                         |
| Route Management                          | General Setting Advanced Setting                      |                                                                                                                                                                                    |                         |
| Network     Interfaces     Wireless(WIFI) | Status                                                | Mode: Client<br>al. BSDF: 40:06-03-08-BC<br>20% SSDF: 40:06-BE-BC<br>20% Channel: 12 (98:00) MHo] 175-Mover: 23 data [Count<br>Signal: 35 data [Noise: dilm] Bitrate: 37 Mahy<br>8 | ny: US                  |
| HaLow WIFI                                | WIFI mode                                             | Client V Switch Mode                                                                                                                                                               |                         |
| Port Forwards                             | Protocol *                                            | DHCP ~                                                                                                                                                                             | P, please select Static |
| Network Capture                           | Bridge Mode                                           |                                                                                                                                                                                    |                         |
| O Services                                | DPP Push Button                                       | Start DPP Push                                                                                                                                                                     |                         |
| 11 Security                               | DPP Push Log:                                         |                                                                                                                                                                                    |                         |
| O Advanced Features                       | Wifi Client Setting                                   |                                                                                                                                                                                    |                         |
| 🖉 Users Manage 🔹 🔹                        | Select SSID                                           | Mac/Bssid *                                                                                                                                                                        | Key *                   |
| C                                         | 38%; BR101R-BEBC                                      | 40:D6:3C:01:BE:BC ; BR101R-BEBC                                                                                                                                                    | 12345678                |
| System ,                                  | Scan WIFI Connected: 0h 0m 9s<br>IPaddr: 172.18.1.106 |                                                                                                                                                                                    |                         |

\* 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.

- 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);
- 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;

| Status >            | HaLow WIFI<br>HaLow WIFI Settings |                                                                                                                                                                                          |
|---------------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Route Management >  | General Setting Advanced Setting  |                                                                                                                                                                                          |
| Network             | Status                            | Moder: Manaer<br>BSSID: 20.05-57:00:18F-83<br>SSID: DOL8F-10:18F-83<br>Channet: 12:098:000 Miller) Tx-Prover: 21 dBm: (Country: US<br>Signal: 0 dBm: [Noise: 0 dBm; [Bitrate: 0.0 Milt's |
| ···· Wireless(WIFI) | WIFI mode                         | AP Switch Mode                                                                                                                                                                           |
| Hal ow WIFI         | SSID                              | DGL-AH-101-BF83                                                                                                                                                                          |
| Diamostics          | Network Authentication            | WPA3-Personal                                                                                                                                                                            |
| Natural Cantura     | Key                               | ······ <i>2</i>                                                                                                                                                                          |
| network capture     | Bridge Mode                       |                                                                                                                                                                                          |
| Services >          | DPP Push Button                   | Start DPP Push                                                                                                                                                                           |
| 1 Security          | DPP Push Log:                     |                                                                                                                                                                                          |

5. Switch the HaLow mode of H2 to Client;

| Status >            | HaLow WIFI HaLow WIFI Settings   |                                                                                                                                                                                                                        |
|---------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Route Management    | General Setting Advanced Setting |                                                                                                                                                                                                                        |
| Network V           | Status                           | Moder: Marrier<br>BSSID: 40:D6:20:01:BF:83<br>SSID: DGL: A43:101:BFS1: I fareyption: WPA3 SAE (CCCMP)<br>Chanad: 12:09(80:00:ME2) Tx-Parver: 21:dBmi Country: US<br>Signal: 0:dBmi [Noise: 0:dBmi ] Bitrate: 0.0 Monts |
| ···· Wireless(WIFI) | WIFI mode                        | Client Switch Mode                                                                                                                                                                                                     |
| HaLow WIFI          | Protocol ®                       | DHCP   Default DHCP, if the WIFI access point needs to specify IP, please select Static                                                                                                                                |
| ···· Diagnostics    | Bridge Mode                      |                                                                                                                                                                                                                        |
| Network Capture     | DPP Push Button                  | Start DPP Push                                                                                                                                                                                                         |
| O Services          | DPP Push Log:                    |                                                                                                                                                                                                                        |
| 1 Security          |                                  |                                                                                                                                                                                                                        |

\* 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;

| HaLow WIFI                       |                                                                                                                                                                                                                    |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HaLow WIFI Settings              |                                                                                                                                                                                                                    |
| General Setting Advanced Setting |                                                                                                                                                                                                                    |
| Status                           | Mode: Master<br>BSSID: 40:D6:3C:01:BF:83<br>SSID: DGL-AH-101:BF83   Encryption: WPA3 SAE (CCMP)<br>Channel: 12:080.000 MH2)   Tx-Power: 21 dBm   Country: US<br>Signal: 0 dBm   Noise: 0 dBm   Bitrate: 0.0 Mbit/s |
| WIFI mode                        | AP V Switch Mode                                                                                                                                                                                                   |
| SSID                             | DGL-AH-101-BF83                                                                                                                                                                                                    |
| Network Authentication           | WPA3-Personal                                                                                                                                                                                                      |
| Key                              | ······ <i>2</i>                                                                                                                                                                                                    |
| Bridge Mode                      |                                                                                                                                                                                                                    |
| DPP Push Button                  | Start DPP Push                                                                                                                                                                                                     |

- 7. Wait for the devices to pair;
- 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.

| DPP Push Log:                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                              |       |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--|
| <pre>&lt;2024-12-16 11:34:28&gt;<br/>&lt;2024-12-16 11:39:14&gt;<br/>&lt;2024-12-16 11:39:36&gt;<br/>&lt;2024-12-16 11:39:36&gt;<br/>&lt;2024-12-16 11:40:30&gt;<br/>&lt;2024-12-16 11:42:20&gt;<br/>&lt;2024-12-16 11:42:33&gt;<br/>&lt;2024-12-16 11:42:33<br/>&lt;2024-12-16 11:46:55&gt;<br/>&lt;2024-12-16 11:46:55&gt;<br/>&lt;2024-12-16 11:47:15&gt;</pre> | DPP PUSK Granected.<br>DPP PUSK Started.<br>DPP PUSK Started.<br>DPP PUSK Started.<br>DPP PUSK Started.<br>DPP PUSK Conceted.<br>DPP PUSK Started.<br>DPP PUSK Started.<br>DPP PUSK Started. |       |  |
| Wifi Client Setting                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                              |       |  |
| Select SSID                                                                                                                                                                                                                                                                                                                                                        | Mac/Bssid 🧶                                                                                                                                                                                  | Key 💌 |  |
| 52% ; DGL-AH-101-BDA5                                                                                                                                                                                                                                                                                                                                              | ✓ Auto                                                                                                                                                                                       | ~     |  |
| Scan WIFI Connected:<br>IPaddr: 172                                                                                                                                                                                                                                                                                                                                | 0h 2m 23s<br>18.1.107                                                                                                                                                                        |       |  |

# 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.**
- Navigate to System > Terminal in VantronOS and enable Web Terminal to activate the terminal for both devices;

| Web Terminal    |                   |                                |
|-----------------|-------------------|--------------------------------|
| Enable/Disable  | disable (1)       |                                |
| Interface       | disable<br>enable |                                |
| Back or Refresh |                   | (2)<br>Save & Apply Save Reset |

- 6. Click the link to open the terminal and log in as the root user;
- \* User: root; password: rootpassword
- 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    | (Hallow IP of H1 | & duration in | seconds)  |
|----------------------------|-----------|------------------|---------------|-----------|
|                            | // 1 62 1 |                  | a duration in | isceonasj |

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:

| rootĝVantronOS-5008:v# iperf3 -s<br>warning: this system does not seem to support IPv6 - trying IPv4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Server listening on 5201                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| Accepted connection from 172.18.2.100, port 56946<br>[5] local 172.18.2.1 port 5201 connected to 172.18.2.100 port 56950<br>[8] local 172.18.2.1 port 5201 connected to 172.18.2.100 port 56952<br>[10] local 172.18.2.1 port 5201 connected to 172.18.2.100 port 56954<br>[10] Interval Transfer Bitrate<br>[5] 0.00-1.00 sec 132 KBytes 1.49 Mbits/sec<br>[8] 0.00-1.00 sec 138 KBytes 1.49 Mbits/sec<br>[10] 0.00-1.00 sec 103 KBytes 3.49 Mbits/sec<br>[5] 0.00-1.00 sec 414 KBytes 3.39 Mbits/sec                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |
| [ 5] 1.00-2.00 sec 117 KBytes 962 Kbits/sec<br>[ 8] 1.00-2.00 sec 287 KBytes 2.35 Mbits/sec<br>[ 10] 1.00-2.00 sec 223 KBytes 1.83 Mbits/sec<br>[ 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<br>[8] 2.00-3.00 sec 663 KBytes 5.43 Mbits/sec<br>[10] 2.00-3.00 sec 551 KBytes 4.52 Mbits/sec<br>[SUM] 2.00-3.00 sec 1.19 HBytes 9.95 Mbits/sec                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| [ 5] 3.00-4.00 sec 402 KBytes 4.99 Mbits/sec<br>[ 8] 3.00-4.00 sec 498 KBytes 4.99 Mbits/sec<br>[ 10] 3.00-4.00 sec 498 KBytes 1.39 Mbits/sec<br>[ 5] 4.00-5.00 sec 233 KBytes 1.31 Mbits/sec                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| S1     4.00-5.00     sec     219 Köytes     1.80 Hölts/sec       [10]     4.00-5.00     sec     219 Köytes     1.80 Hölts/sec       [SUH]     4.00-5.00     sec     707 Köytes     5.79 Hölts/sec       [SuH]     4.00-5.00     sec     707 Köytes     5.79 Hölts/sec                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| [5] 5.00-6.00 sec 419 KBytes 3.43 Mbits/sec<br>[10] 5.00-6.00 sec 0.00 Bytes 0.00 bits/sec<br>[5UH] 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 172.18.2.100 port 5090 connected to 172.18.2.1 port 5201         [ 5] local 172.18.2.100 port 50952 connected to 172.18.2.1 port 5201         [ 7] local 172.18.2.100 port 50952 connected to 172.18.2.1 port 5201         [ 9] local 172.18.2.100 port 50952 connected to 172.18.2.1 port 5201         [ 9] local 172.18.2.100 port 50952 connected to 172.18.2.1 port 5201         [ 9] local 172.18.2.100 port 50952 connected to 172.18.2.1 port 5201         [ 9] local 172.18.2.100 port 50952 connected to 172.18.2.1 port 5201         [ 9] local 172.18.2.100 port 50954 connected to 172.18.2.1 port 5201         [ 9] local 172.18.2.100 port 50954 connected to 172.18.2.1 port 5201         [ 9] local 172.18.2.100 port 50954 connected to 172.18.2.1 port 5201         [ 9] local 172.18.2.100 port 50954 connected to 172.18.2.1 port 5201         [ 9] local 1.00 sec 750 KBytes 4.67 Multi/sec 24 180 KBytes         [ 9] local-1.00 sec 431 KBytes 3.54 Hbits/sec 48 22.0 KBytes         [ 9] local-1.00 sec 431 KBytes 3.54 Hbits/sec 46         [ 9] local-1.00 sec 431 KBytes 3.54 Hbits/sec 46         |  |
| [5] 1.00-2.00 sec 318 KBytes 2.61 Mbits/sec 181 153 KBytes<br>[7] 1.00-2.00 sec 700 KBytes 5.73 Mbits/sec 43 192 KBytes<br>[9] 1.00-2.00 sec 1.75 KBytes 4.73 Mbits/sec 92 225 KBytes<br>[SUM] 1.00-2.00 sec 1.56 MBytes 13.1 Mbits/sec 316                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| 5)         2.00-3.000         sec         0.000         bytes           7)         2.00-3.000         sec         9.245         Mbits/sec         62         308         Mbytes           [9]         2.00-3.000         sec         455         Mbits/sec         192         198         KBytes           [9]         2.00-3.000         sec         1.55         Mbits/sec         192         198         KBytes           [9]         2.00-3.000         sec         1.57         Mbits/sec         322           [9]         5.00-4.000         sec         5.73         Mbits/sec         29         14.1         KBytes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
| [7] 3.00-4.00 sec 573 KBytes 4.60 Mbits/sec 55 134 KBytes<br>[9] 3.00-4.00 sec 891 KBytes 7.30 Mbits/sec 50 320 KBytes<br>[SUM] 3.00-4.00 sec 2.11 MBytes 17.7 Mbits/sec 134<br>[SUM] 3.00-5.00 sec 0.00 Bytes 0.00 bits/sec 36 127 KBytes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| 7 7 4.00-5.00 sec 636 KBytes 5.21 Mbits/sec 289 164 KBytes<br>[9] 4.00-5.00 sec 509 KBytes 4.17 Mbits/sec 184 215 KBytes<br>[5M] 4.00-5.00 sec 1.12 MBytes 9.38 Mbits/sec 509<br>[51] 5.00 5.00 sec 4.15 KBytes 2.55 Mbits/sec 509                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 3)         5.000-5.000         sec.         4.03         5.001(15/sec.         123         A12 KBJTES           7)         5.00-6.000         sec.         4.000         bits/sec.         160         123         KBJTES           [9]         5.00-6.000         sec.         4.000         bits/sec.         160         123         KBJTES           [9]         5.00-6.000         sec.         4.000         bits/sec.         160         123         KBJTES           [9]         5.00-6.000         sec.         4.500         bits/sec.         160         123         KBJTES           [9]         5.00-6.000         sec.         4.500         bits/sec.         150         121         130         121         130         121         130         121         130         121         130         121         130         121         130         121         130         121         130         121         130         121         130         121         130         121         130         121         130         130         130         130         130         130         130         130         130         130         131         130         130         130         130 </td |  |

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