Aerohive Point-to-Point Mesh

Creating a Wireless Mesh Link between Two Sites

This guide explains how to connect the networks at two sites across a wireless backhaul mesh link. You will learn how set up two AP245X access points with 60° sector antennas. You initially configure both APs at the main site, which is assumed to have an established network with an Internet connection. After you finish configuring the devices, you then install one AP at the main site, point its sector antenna toward the location where the sector antenna of the AP will be mounted at the secondary site, and then power it up. You then install the AP at the secondary site, point its sector antenna back towards the antenna of the AP at the main site, and power it up. You can then deploy a network at the secondary site and link it to over the backhaul mesh through the network at the main site and out to the Internet.

This guide is based on HiveManager NG 11.22.3.1 and HiveOS 8.0r1 for the AP245X.

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Introduction

The goal of the configuration here is to provide Internet access to users at a site without an Internet connection by forming a wireless mesh link to another site with such a connection. Outbound traffic from the secondary site can then flow over the wireless link, across the network at the main site, and out to the Internet. This solution can help with cases such as these:

- A school adds a separate annex to its primary building
- A hotel property includes a main building and another building with guest rooms
- A company expands from one office building into a nearby building to gain more office space

Configuration Workflow

Assuming that the network at the main site is already in place and you now want to add a secondary site that reaches the Internet over a wireless mesh link to the main site, the goal now is to set up the link between the two sites. To accomplish that, use the following workflow:

1. Set up maps for the main and secondary sites and assign the two AP245X devices to the appropriate maps.
2. Put both AP245X devices on the network at the main site, power them up, and onboard them so that you can configure them from your HiveManager NG account.
3. Configure radio profiles, device templates, and device-level settings, and upload the configurations to the APs. The configuration of their 5 GHz radios, which are the ones they will use to form a backhaul mesh link with each other, includes a manually set channel, as opposed to one chosen dynamically. They will not use their 2.4 GHz radios and will not provide network access to any wireless clients.
4. With both APs still on the main site network, cable an external 60° sector antenna [AH-ACC-60-ANT-KIT] to each of them and point the antennas toward each other. Make sure that they can form a mesh link.

5. Install the AP245X with Eth0 in uplink mode at the main site, connect it to the network again, and power it up. Aim its antenna toward the spot where the external antenna of another AP245X will be located at the secondary site.

**Note:** The recommended maximum distance between the two AP245X devices forming the mesh link is 200 meters. For longer distances, Aerohive recommends using AP1130 devices (see below).

6. Move the AP245X with Eth0 in Bridge-802.1Q mode to the secondary site and install it so that it will form a mesh link back to the AP245X at the main site. Its 5 GHz radio is set to the same channel as that of the AP245X at the main site. Likewise, its 2.4 GHz radio is not used and it does not provide clients with network access.

7. Power up the second AP, adjust the antennas at each site if necessary, and ensure that the second AP can form a CAPWAP connection with HiveManager NG. Check that the RSSI is -72 dBm or better for both APs on the mesh link and that the SNR is 25 dB or better.

8. Set up the internal APs and switches to create a network at the secondary site.

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### Using AP1130 Devices for Long-Distance Point-to-Point Mesh

Whereas the AP245X works well when forming mesh links up to approximately 200 meters, the **AP1130** is an outdoor 802.11ac access point with several device-specific features for forming long-distance point-to-point mesh links. It supports a dual-band 2.4 GHz/5 GHz sector antenna ([AH-ACC-1130-ANT-SEC]) and a 5 GHz directional antenna ([AH-ACC-1130-ANT-18]). You can use the specially designed buzzer and signal strength LED indicator when fine tuning sector or directional antennas for long-range links up to approximately 10 kilometers, depending on the terrain. Before beginning the tuning procedure, the two AP1130 devices must have already established themselves as peers and formed a mesh link.

1. Set the ACK timeout behavior depending on the distance between the two APs:
   
   ```
   interface wifi1 radio range <number> (Range: 300-10000 meters; Default: 300 meters)
   ```

2. Start the procedure by entering the following command on the local AP:
   
   ```
   exec antenna-alignment interface wifi1
   ```

   The local AP transmits antenna alignment request frames to its peer every second by default (interval range: 1-30 seconds). In response, it receives ACK and antenna alignment data frames. The sender displays the following data in its console:

   - The Tx power of the request frame the sender transmits to its peer
   - The RSSI value in dB of the response frame it receives from its peer
   - The RSSI of the sender's transmitted request frame that the peer reports in its response

3. Adjust the angle of the antenna and check if the signal strength improves.

   In addition to displaying data, the AP1130 sounds a buzzer that audibly indicates the signal strength by increasing the volume and frequency of beeps as the signal gets stronger. The buzzer keeps beeping until the antenna alignment procedure ends, which automatically times out after 60 seconds. You can manually end it by entering CTRL + C in the console.

   The AP1130 also provides visual feedback through its Signal Strength LED indicator. When there is no signal or an omnidirectional antenna is used, the LED is off. If it detects a weak signal, the LED glows steady amber. If it detects a strong signal, the LED glows steady white.

   **Note:** Although the maximum Tx power that HiveManager NG allows is 20 dBm, you can enter the following command to increase it up to 30 dBm on the AP1130 if necessary (and if the local regulatory domain allows it):

   ```
   interface wifi1 radio power <number> (Range: 1-30 dBm)
   ```

   If you can achieve a good signal by tuning just one antenna and the mesh link is relatively short, that is sufficient. However, for longer distances, it is good to tune the antennas at both ends. In this case, two people, one by each AP1130, can communicate by cell phone (or Skype or something similar) and coordinate how they are adjusting their antennas.
Creating Maps

If you already have a map for the main site, create a new map for the secondary site. Otherwise, if you do not have a map for the main site, create maps for both. These maps are not only useful for planning purposes, they are necessary for assigning device templates to the APs forming the mesh link based on their locations.

Note: If you already created a location, building, and floors for the main site, you can skip the first four steps.

1. Click Maps > + Add > Location, enter a name, and then click Save.
2. Click the Add icon (+) next to the name of the location you just created, select Building, type Main-Site in the Name field and its full address in the Address field, and then click Save.
3. Click the Add icon (+) next to Main-Site, select Floor, configure the RF parameters for a floor as described in the Adding Floors section of the Creating a Network Map and Network Plan topic in the HiveManager NG Help, and then click Save.
4. Repeat the previous step for as many floors as required at the main site.
5. Click the Add icon (+) next to the name of the location, select Building, type Secondary-Site in the Name field and its full address in the Address field, and then click Save.
6. Click the Add icon (+) next to Secondary-Site, select Floor, configure a floor for the secondary site location, and then click Save.

When you are done, you will have maps for all the floors in both buildings, similar to the screen capture shown on the right.

Assigning the AP245X Devices to the Maps

It is important to assign APs to their respective maps so that you can assign the appropriate device template to each one based on their locations.

1. Click Monitor > Devices and then click the Assign link in the Location column for the AP245X at the main site.
   Note: If you do not see the AP, clear any saved filters that might be hiding it (or apply a filter to show it). If there is more than one page of devices, check if the AP is on another page.
2. In the Assign Devices dialog box that appears, select the floor at the main site where the AP is (or will be) located, click-drag the AP icon into its proper position, and then click Assign.
3. Repeat the previous steps to assign the other AP245X device to a map at the secondary site.

Configuring a Radio Profile

Create a radio profile for the Wifi1 interface (linked to the 5 GHz radio) on the AP245X access points that form a mesh link between the two sites. This radio will be in backhaul mode.

You can use the default radio profile—or any radio profile—for the Wifi0 interface, which is linked to the 2.4 GHz radio. Because it will be in access mode but will not host any SSIDs, the interface will be inactive. This is so that all its resources will be devoted to transmitting and receiving wireless traffic over its backhaul link.

A few notes about the settings of the radio profile for the mesh link:

- You use a 20 MHz channel to reduce interference, which is more prevalent with wider channels.
- Manually setting a U-NII-3 channel (channel 161) avoids DFS while taking advantage of the greater transmit power allowed in the U-NII-3 band. (If U-NII-3 channels are not available in your region, choose a channel with the highest output power allowed.) A static channel also accelerates the initial meshing of the two APs.
• Because no clients will access the radio, you disable settings designed to enhance client connectivity.
• Similarly because you set the channel manually, you also disable settings that assist with automatic channel selection strategies.
• Finally, because the APs use sector antennas for a point-to-point link, you disable MU-MIMO, which primarily helps with multiple user capacity.

Click Configure > Common Objects > Radio Profiles > Add, create the following radio profile for the mesh link:

Name: Mesh-link
Description: For a backhaul mesh link between sites
Supported Radio Modes: ac
Maximum Transmit Power: 20 dBm
Maximum Number of Clients: 1
Neighborhood Analysis
  Background Scan: Off
Channel Selection
  Channel Width: 20 MHz
  Use the last known power and channel during the AP boot up process: Off
  Dynamic Channel Switching: Off
Organizing Radio Usage
  High Density Configuration: Off
  Client Load Balancing: Off
  Radio Load Balancing: Off
  Weak Signal Probe Request Suppression: Off
  Safety Net: Off
Radio Settings
  Beacon period: 100 TUs
  Enable short guard interval: (select)
  Enable Aggregate MAC Protocol Data Units: (select)
  Enable Frame Burst: (select)
  Enable Transmit Beamforming: (clear)
  Enable MU-MIMO: (clear)
Backhaul Failover
  Backhaul Failover: Off
Miscellaneous Settings
  Use the default settings.
WMM QoS Settings
  Use the default settings.
Presence Server Settings
  Presence Analytics: Off (default)
Sensor Mode Scan Settings
  Use the default settings.
Defining Two AP245X Device Templates

You create two device templates for the APs forming the mesh link between the two sites. The difference is that the Eth0 interface on the AP245X at the main site is in uplink mode while the Eth0 interface on the AP245X at the secondary site is in 802.1Q bridge mode. By creating an assignment rule, you assign the appropriate template to each AP within the same network policy according to its location.

Main Site

1. Click **Configure > network_policy_name > Wireless Settings > Device Templates > Add > AP245X**.
2. In the Template Name field enter **MainSite-Mesh-AP245X**.
3. Select **Eth0** and **Eth1** in the diagram of the AP245X ports and then click **Assign > Create New**.
   
   **Note:** Although you only use Eth0 as an uplink in this configuration, you can prepare Eth1 to be the uplink if you choose to do that at a later date. Remember that the AP245X still needs to be powered by PoE on Eth0.

4. In the **New Port Type** section that appears, enter the following and then click **Save**:
   
   **Name:** AP245X-Uplink
   
   **Description:** Uplink settings for the AP245X at the main site
   
   **Port Status:** On
   
   **Port Usage Settings**
   
   - **Port Usage:** Uplink Port
   
   - **Optional Settings** – **Identify clients connected to this port as wired clients:** Off
   
   - **Wired Connectivity** – **User Authentication:** Off (default)
   
   - **MAC Authentication** – **MAC Authentication:** Off (default)

   **Traffic Filter Management**
   
   Use the default settings.

5. In the **Trunk VLANs** dialog box that appears, enter the native (untagged) VLAN in your network and then include all the VLANs to which wireless and wired users will be assigned in the Allowed VLANs field.

6. Leave the default radio profile for Wifi0, which is radio_ng_ng0. The 2.4 GHz radio, which is linked to the Wifi0 interface, will not be used.

7. Clear your previous selections of Eth0 and Eth1 by clicking **Deselect All Ports** and then select **WIFI1**.

8. Click **Assign > Choose Existing**.

9. In the **Radio Profile Assignment** dialog box that appears, select **Mesh-link** and then click **Save**.
The device template for the AP245X at the main site looks similar to the following:

10. To save the AP245X device template and return to the Device Templates page, click Save at the bottom of the page.

**Secondary Site**

1. Click Add > AP245X.
2. In the Template Name field enter SecondarySite-Mesh-AP245X.
3. Select Eth0 in the diagram of the AP245X ports and then click Assign > Create New.
   
   **Note:** Leave Eth1 defined as an uplink port, which it is by default. If you ever decide to provide a direct internet connection to the secondary site, the port will be ready.

4. In the New Port Type section that appears, enter the following and then click Save:
   
   **Name:** AP245X-Bridge-802.1Q  
   **Description:** Bridge-802.1Q settings for the AP245X at the secondary site
   **Port Status:** On
   **Port Usage Settings**
   
   **Port Usage:** Bridge-802.1Q
   
   **Optional Settings** – Identify clients connected to this port as wired clients: Off (default)
   **User Access Settings**
   
   If the management VLAN is 1, use the default settings. The default user profile defines the management VLAN for the AP245X. The APs and switches behind the AP245X apply user profiles and VLANs to user traffic.
Traffic Filter Management
Use the default settings.

*Note: When you put Eth0 in Bridge-802.1Q mode, the AP automatically changes its default AMRP MAC route to the wifi1 interface. Also note that the maximum number of MAC learning entries per Ethernet interface is 128.*

5. In the Trunk VLANs dialog box that appears, enter the native (untagged) VLAN in your network and then include all the VLANs to which wireless and wired users will be assigned in the Allowed VLANs field.

6. Leave the default radio profile for Wifi0, which is radio-ng-ng0. The 2.4 GHz radio, which is linked to the Wifi0 interface, will not be used.

7. Clear your previous selection of Eth0 by clicking Deselect All Ports and then select WIFI1.

8. Click Assign > Choose Existing.

9. In the Radio Profile Assignment dialog box that appears, select Mesh-link and then click Save.

The device template for the AP245X at the secondary site looks similar to the following:

![AP245X Template](image)

10. To save the AP245X device template and return to the Device Templates page, click Save at the bottom of the page.
Applying an Assignment Rule

Two templates for the same device model are now in the network policy:

- AP245X
- AP245X

HiveManager NG automatically makes the first device template you created the default. For HiveManager NG to distinguish the two templates so it can apply them separately, you must configure an assignment rule for the second one. When the condition set forward in that rule is met, HiveManager NG applies that template to AP245X models. At all other times when the condition is not met, it applies the default template.

1. Click the **Add an assignment rule** icon ( ).
2. In the **Assignment Rule** panel, enter a name and description for the rule and then click **Add > Device Location**.
3. In the **Location** dialog box, navigate to the location of the AP245X at the secondary site and then click **Select**.
4. In the **Assignment Rule** panel, click **Save**.
Configuring Device-Level Settings

To conserve device resources for transmitting user traffic over the mesh link between sites, disable all SSIDs on the AP245X devices. You also specify antenna types for the WiFi0 and WiFi1 interfaces and set a static channel for the backhaul radio.

Main Site

1. Click Monitor > Devices and clear or apply any saved filters to show the two AP245X devices.
2. Select the host name of the AP at the main site.
3. Click Interface Settings, enter the following—and check settings received from the network policy—and then click Save:

   **Wireless Interfaces**

   **WiFi0**
   - **External Antenna:** Omni
   - **Radio Mode:** 802.11g/n (read only)
   - **Radio Profile:** radio_ng_ng0
   - **Radio Usage:** Client Access
   - **Channel:** Auto
   - **SSIDs:** Off

   **WiFi1**
   - **External Antenna:** Sector 60 degree
   - **Radio Mode:** 802.11ac (read only)
   - **Radio Profile:** Mesh-link
   - **Radio Usage:** Backhaul Mesh Link (make sure Client Access is cleared)
   - **Channel:** 161
   - **Transmission Power:** Manual; 20 dBm
   - **SSIDs:** Off

   **Wired Interfaces**

   **ETH0 and ETH1**
   - **State:** On
   - **Port Type:** AP245X-Uplink (read only)
   - **Native VLAN:** (the native VLAN set in the MainSite-Mesh-AP245X device template)
   - **Allowed VLANs:** (list of allowed VLANs set in the MainSite-Mesh-AP245X device template)
   - **Transmission Type:** Auto
   - **Speed:** Auto
Secondary Site

1. Click **Back to device list** and clear or apply any saved filters to show the two AP245X devices.
2. Select the host name of the AP at the secondary site.
3. Click **Interface Settings**, enter the following—and check settings received from the network policy—and then click **Save**:

   **Wireless Interfaces**

   **WiFi0**
   - **External Antenna**: Omni
   - **Radio Mode**: 802.11g/n (read only)
   - **Radio Profile**: radio_ng_ng0
   - **Radio Usage**: Client Access
   - **Channel**: Auto
   - **SSIDs**: Off

   **WiFi1**
   - **External Antenna**: Sector 60 degree
   - **Radio Mode**: 802.11ac (read only)
   - **Radio Profile**: Mesh-link
   - **Radio Usage**: Backhaul Mesh Link (make sure **Client Access** is cleared)
   - **Channel**: 161
   - **Transmission Power**: Manual; 20 dBm
   - **SSIDs**: Off

   **Wired Interfaces**

   **ETH0**
   - **State**: On
   - **Port Type**: AP245X-Bridge-802.1Q (read only)
   - **Native VLAN**: (the native VLAN set in the MainSite-Mesh-AP245X device template)
   - **Allowed VLANs**: (list of allowed VLANs set in the MainSite-Mesh-AP245X device template)
   - **Transmission Type**: Auto
   - **Speed**: Auto

   **ETH1**
   - **State**: On
   - **Port Type**: Uplink Port (read only)
   - **Native VLAN**: Enter the same native VLAN as that for ETH0.
   - **Allowed VLANs**: Enter the same set of allowed VLANs as that for ETH0.
   - **Transmission Type**: Auto
   - **Speed**: Auto
Uploading the Configuration

After configuring the maps, radio profiles, AP245X device templates, and device-level settings, upload the configuration to the two devices, which are both still at the main site.

1. Click Configure > network_policy_name > Deploy Policy and then select the check boxes for the two APs that will form the backhaul mesh link with each other. You might have to clear or add any filters, change the number of items shown per page, or view other pages until you can see them.

2. Click Upload, enter the following in the Device Update dialog box that appears, and then click Perform Update:

   Update Network Policy and Configuration: [select]
   
   Complete Configuration Update: [select; do a complete update the first time; after that you can perform delta updates]
   
   Activate after [ ___ ] seconds: [select; enter 5]

Setting Up AP245X Devices at Both Sites

After you upload the network policy to both APs and disabled their 2.4 GHz radios, you can test that they can form a mesh link and then set up the APs at both sites.

1. With both APs still connected to the network at the main site, cable an external 60° sector antenna (AH-ACC-60-ANT-KIT) to the 5 GHz antenna connectors on each of them and point the antennas toward each other. Check that they can form a mesh link.

2. Disconnect both APs from the network.

3. Mount the AP245X with Eth0 in Uplink mode at the main site and angle its sector antenna toward the location where the antenna of the AP245X at the secondary site will be.

4. Disconnect the AP245X with its Eth0 interface in Bridge-802.1Q mode from the network at the main site.

5. Take the AP to the secondary site and mount it there.

   Note: For AP245X mounting instructions, see the AP245X Hardware User Guide. For sector antenna installation instructions, see the Aerohive AP245X Sector Antenna Installation Guide.

6. Reconnect the AP at the main site to its network so that it receives power to its Eth0 port through PoE. Similarly, connect Eth0 on the AP at the secondary site so that it receives power from a switch that provides PoE to connected devices.

7. Aim their antennas at each other and adjust their angles until they form a stable wireless connection. Strive to have a SNR of 25 dB or better and an RSSI of -72 dBm or better.

8. Deploy the remainder of the network at the secondary site.