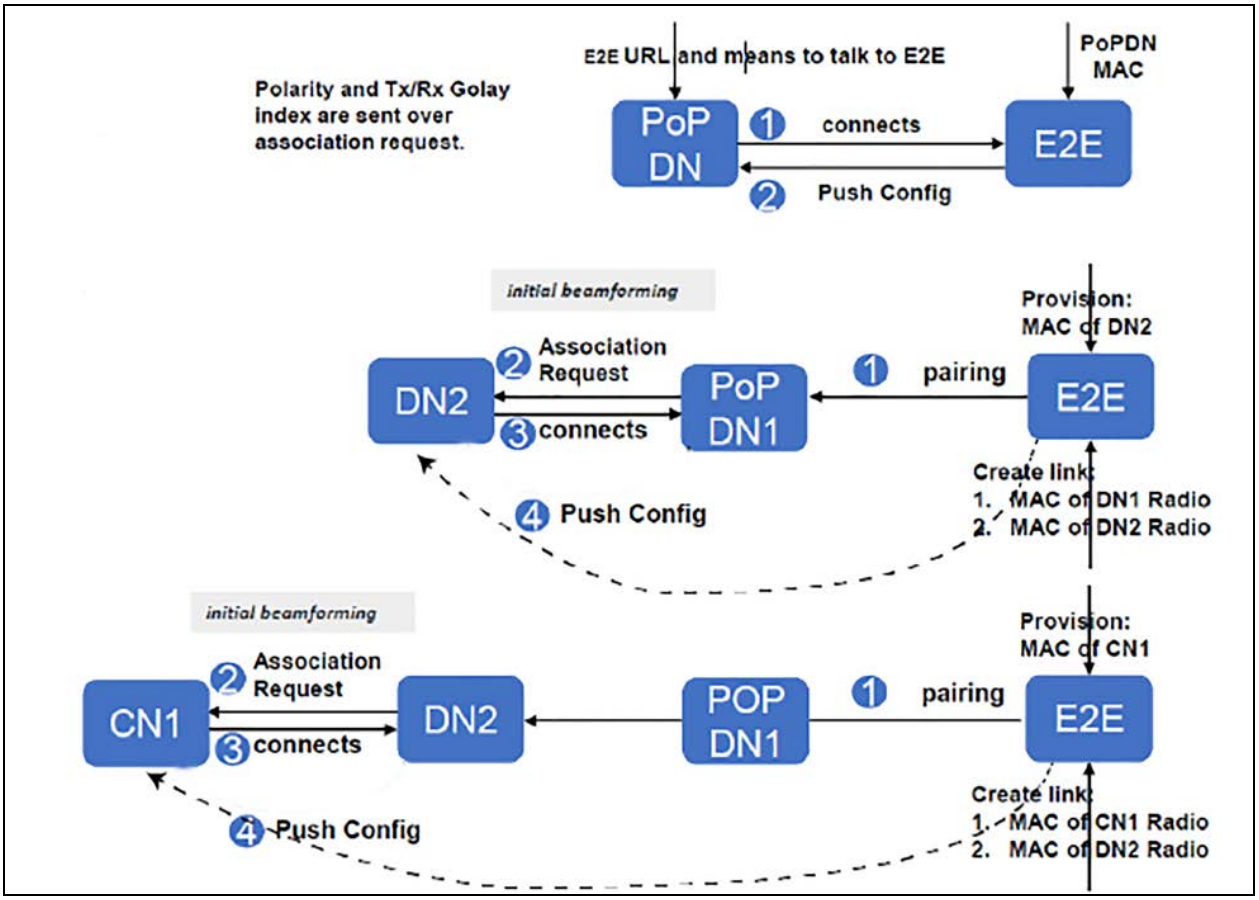
Configuring 60 GHz cnWave™

This topic explains how to configure 60 GHz cnWave products.

Nodes deployment

The configuration of cnWave nodes is handled automatically by the E2E service. However, the first PoP node must be configured manually since connectivity to the E2E controller has not yet been established. After establishing communication with the E2E controller, the nodes report a hash of their local configuration file, and the controller automatically pushes configuration changes to the nodes upon seeing any mismatches. The centralized configuration management architecture is implemented in which the E2E controller serves as the single point for configurations in the network.

Figure 151: *Nodes deployment*



Connecting to the unit

This section describes how to connect the unit to a management PC and power it up.

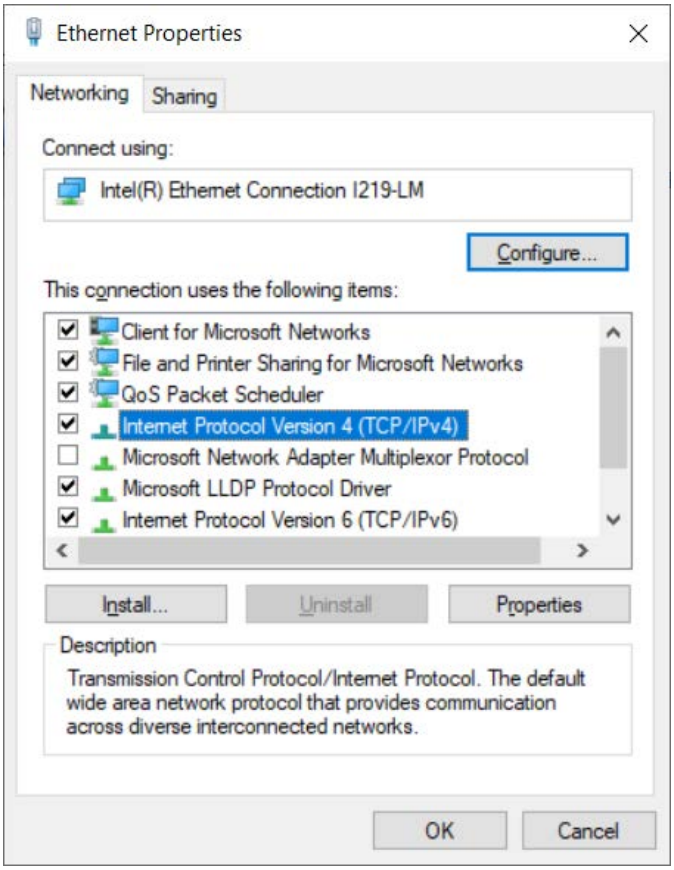
Configuring the management PC

Use this procedure to configure the local management PC to communicate with the 60 GHz cnWave devices.

Procedure:

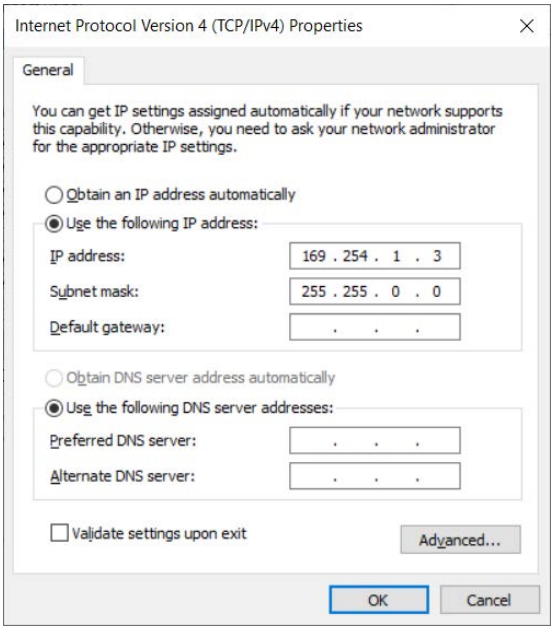
1. Select **Properties** for the Ethernet port. In Windows 7 this is found in **Control Panel** > **Network and Internet** > **Network Connections** > **Local Area Connection**.
2. Select **Internet Protocol Version 4 (TCP/IPv4)**.

   Figure 152: *The Ethernet Properties dialog box*



3. Click **Properties**.
4. Enter an IP address that is valid for the 169.254.X.X/16 network, avoiding 169.254.1.1 (for example: 169.254.1.3).

Figure 153: *The Internet Protocol Version 4 (TCP/IPv4) dialog box*



5. Enter the subnet mask value 255.255.0.0, and leave the default gateway field blank.

Connecting to the PC and powering up

Use this procedure to connect a management PC and power up the 60 GHz cnWave devices.

Procedure:

1. Check that the ODU is connected to the power supply (AC/DC according to the configuration).
2. Connect the PC Ethernet port to the LAN port of the PSU or AUX port (according to device configuration).
3. Open a web browser and type **169.254.1.1**.
4. When prompted, enter **admin/admin** to login to the UI and complete the configuration.

Using the web interface

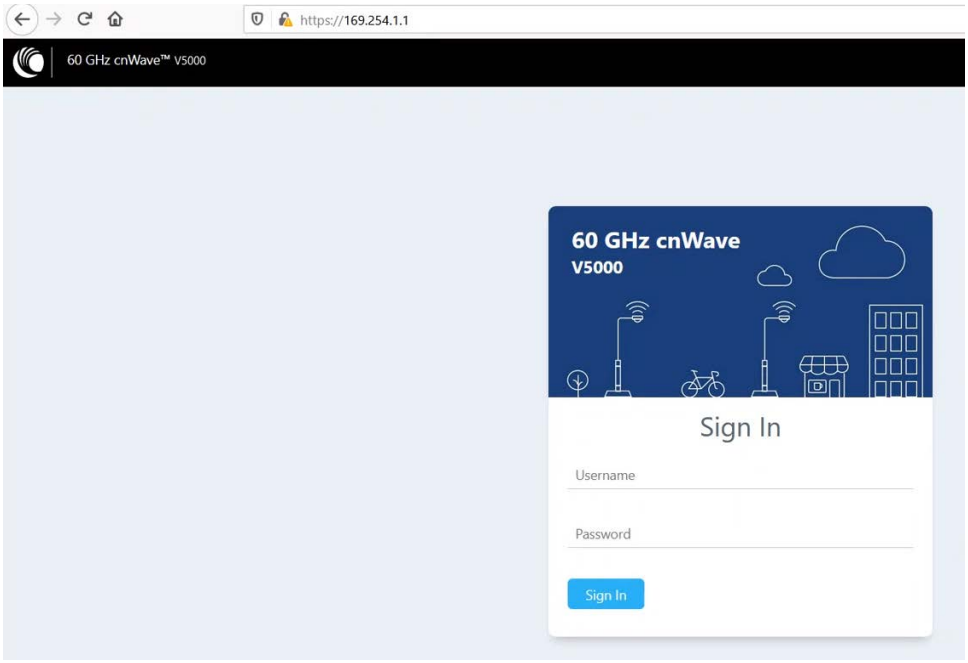
This section describes how to log into the 60 GHz cnWave web interface and use its menus.

Logging into the web interface

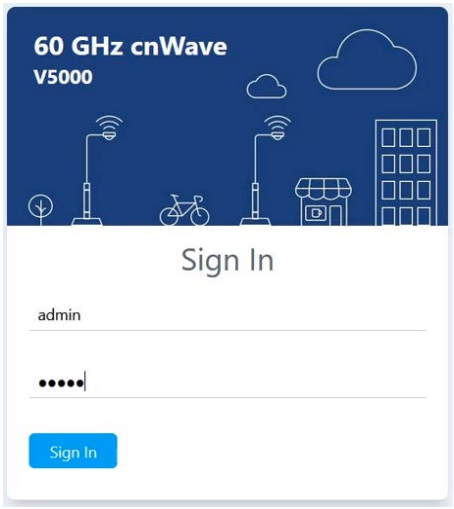
Use this procedure to log into the web interface as a system administrator.

Procedure:

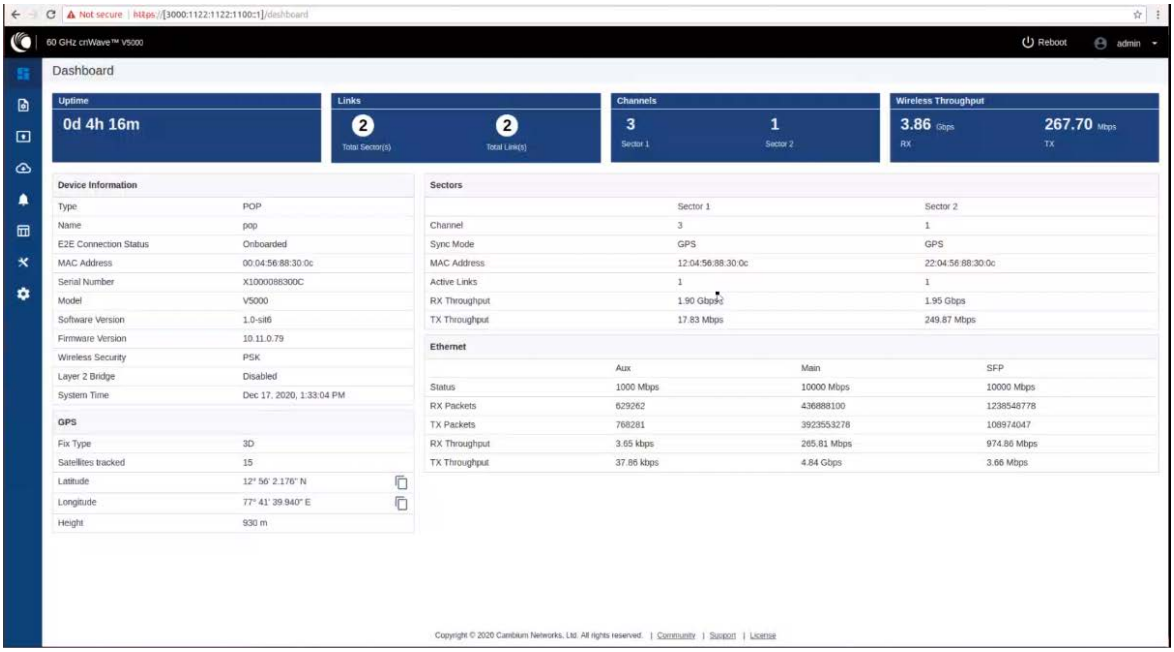
1. Start the web browser from the management PC.
2. Type the IP address of the unit into the address bar. The factory default IP address is **169.254.1.1** and press **Enter**.



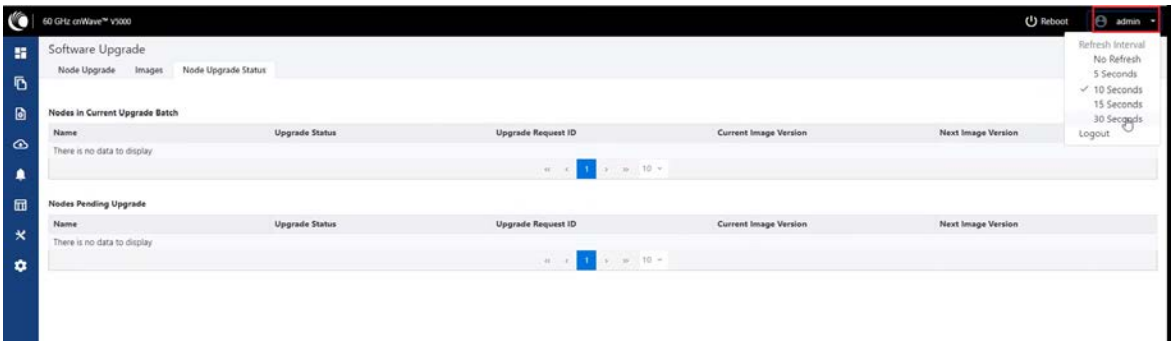
3. Type the username and password as **admin** and **admin**. Click **Sign In**.



The **Dashboard** page appears.



Users can select the refresh time interval. Click **admin** at the top-right and select the **Refresh Interval** from the drop-down.



The Dashboard contains the following options at the top:

- Uptime
- Links
- Channels
- Wireless Throughput

Uptime

Displays the total running time of the device.

Links

Displays the total number of active links which are connected to the 60 GHz cnWave™ device.

Channels

Displays the total number of channels (Sector 1, Sector 2, etc.,) which are connected to the 60 GHz cnWave™ device.

Wireless Throughput

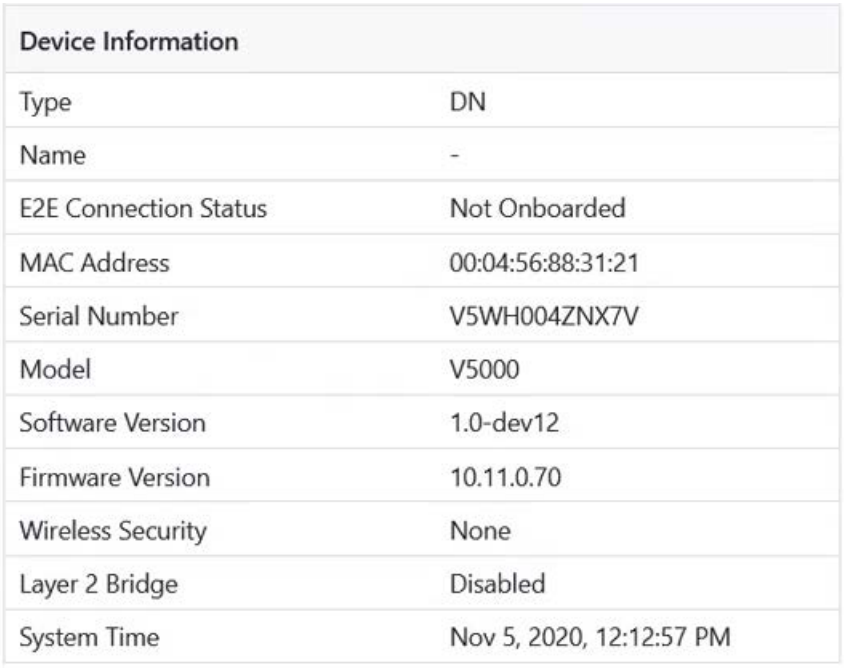
Displays the transmitting and receiving throughput values.

Dashboard elements

The **Dashboard** page consists of the following elements:

- Device Information
- GPS
- Sectors
- Ethernet

Figure 154: *Dashboard - Device Information*



Device Information	
Type	DN
Name	-
E2E Connection Status	Not Onboarded
MAC Address	00:04:56:88:31:21
Serial Number	V5WH004ZNX7V
Model	V5000
Software Version	1.0-dev12
Firmware Version	10.11.0.70
Wireless Security	None
Layer 2 Bridge	Disabled
System Time	Nov 5, 2020, 12:12:57 PM

Table 41: Elements in the Device Information section

Element	Description
Type	Displays type of the device. The device types are: • DN • PoP DN • CN
Name	Displays the name of the device.
E2E Connection Status	Displays the connection status of the E2E controller.
MAC address	Displays the MAC address of the 60 GHz cnWave device.
Serial Number	Displays the serial number of the 60 GHz cnWave device
Model	Displays the model of the 60 GHz cnWave device. The models are:

Element	Description
	• V1000 • V2000 • V3000 • V5000
Software version	Displays the software version used in 60 GHz cnWave device.
Firmware version	Displays the Firmware version used in 60 GHz cnWave device.
Wireless security	Displays the security type. The types are: • Disabled • PSK • 802.1X
Layer 2 Bridge	Displays bridge status.
System Time	Displays current time.

GPS

The **GPS** section displays the positioning information of the site.

Figure 155: *Dashboard - GPS*

Table 42: Elements in the GPS section

Element	Description
Fix Type	Fix Type
Satellites tracked	Number of registered satellites
Latitude	Displays latitude of the site
Longitude	Displays longitude of the site
Height	Displays height of the device

Sectors

The **Sectors** section displays the number of nodes added to the device and its information.

Figure 156: *Dashboard - Sectors*

Table 43: Elements in the Sectors section

Element	Description
Channel	Displays the channel information used by the sector
Sync mode	Displays the sync mode of the sectors
MAC address	Displays the MAC address of the sectors
Active links	Displays the number of active links in connected sectors
RX Throughput	Displays RX Throughput of the individual sectors
TX Throughput	Displays TX Throughput of the individual sectors

Ethernet

The **Ethernet** section displays information about Aux, Main, and SFP ports.

Figure 157: *Dashboard - Ethernet*

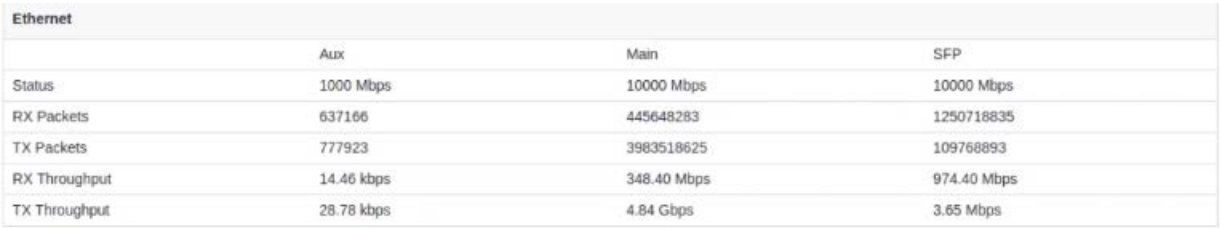


Table 44: Elements in the Ethernet section

Element	Description
Status	Displays the speed of Ethernet ports
RX Packets	Number of packets received
TX Packets	Number of packets transmitted
RX Throughput	Displays the RX Throughput of the Ethernet
TX Throughput	Displays the TX Throughput of the Ethernet

Enabling internal E2E Controller

E2E Controller handles important management functions such as link bring-up, software upgrades and configuration management.

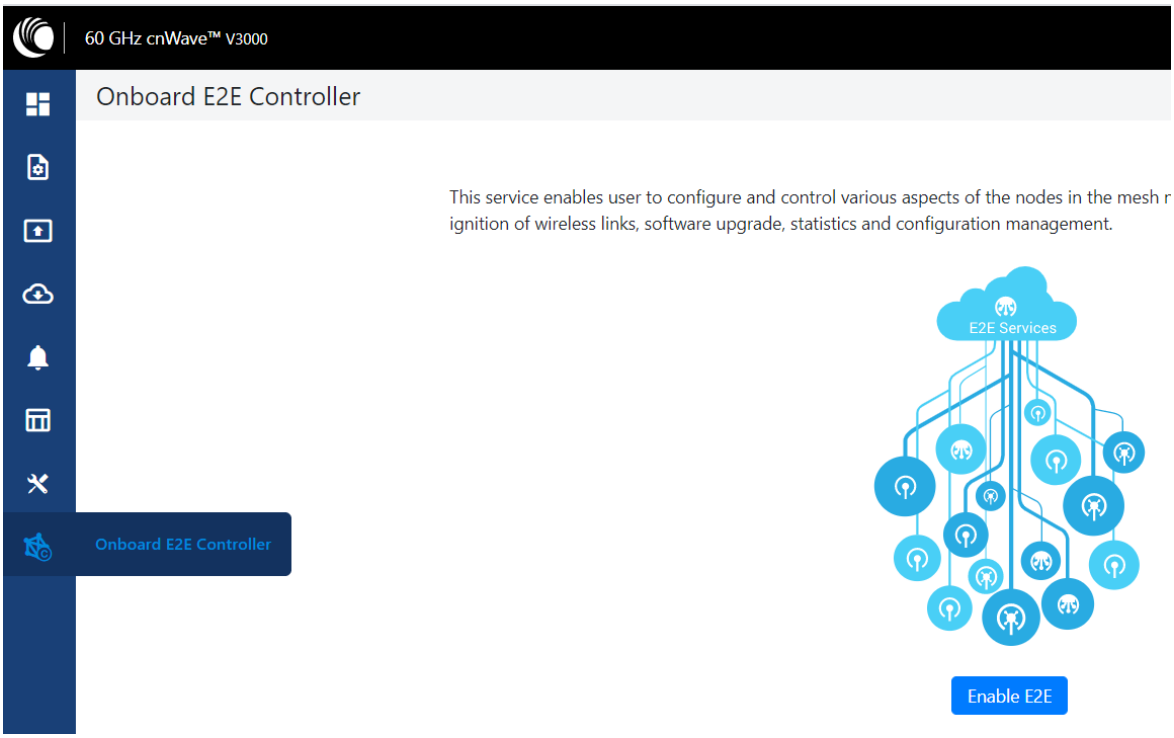
Note

The internal E2E controller is not required if you want to run the E2E controller On-Premise platform. For details, refer to the *60 GHz E2E Controller User Guide*.

Currently, the internal E2E controller is restricted to 31 nodes.

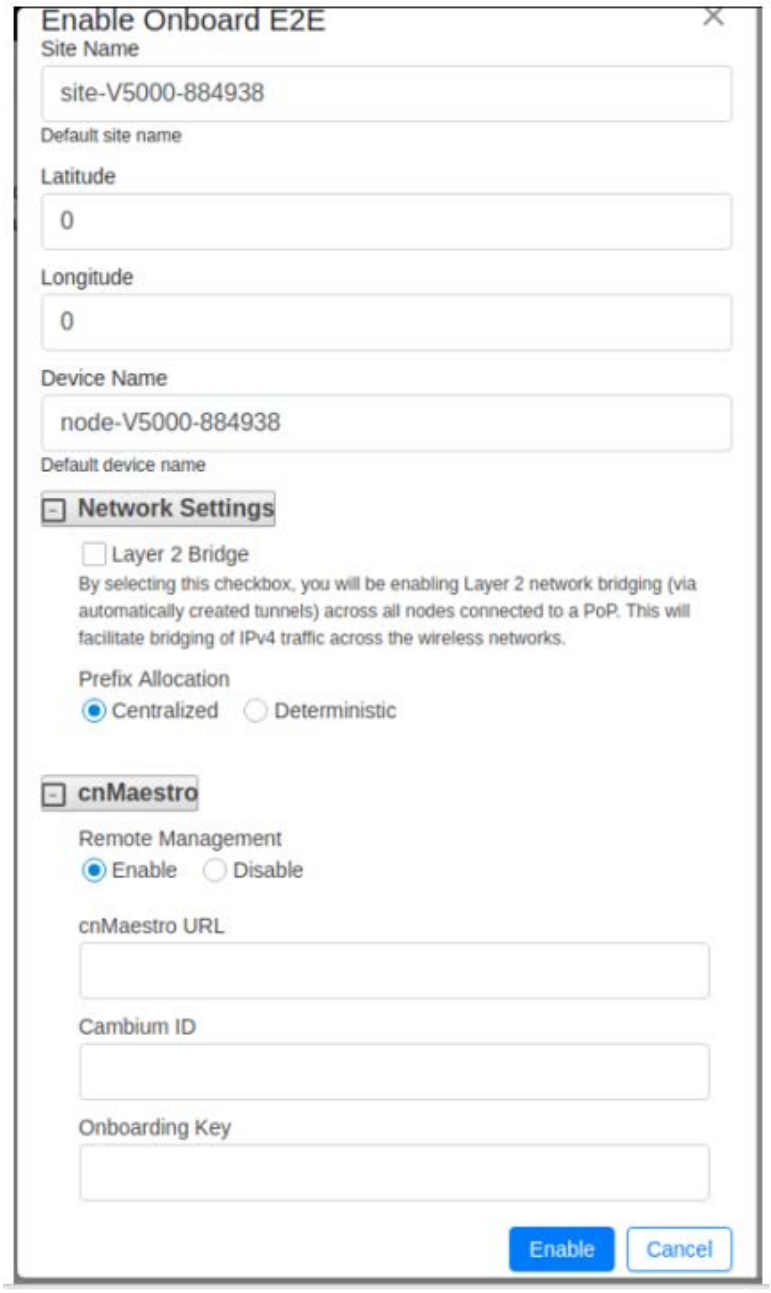
To enable E2E Controller to configure and establish the connection, perform the following steps:

1. Click the **E2E Controller** option on the left pane of the Dashboard.



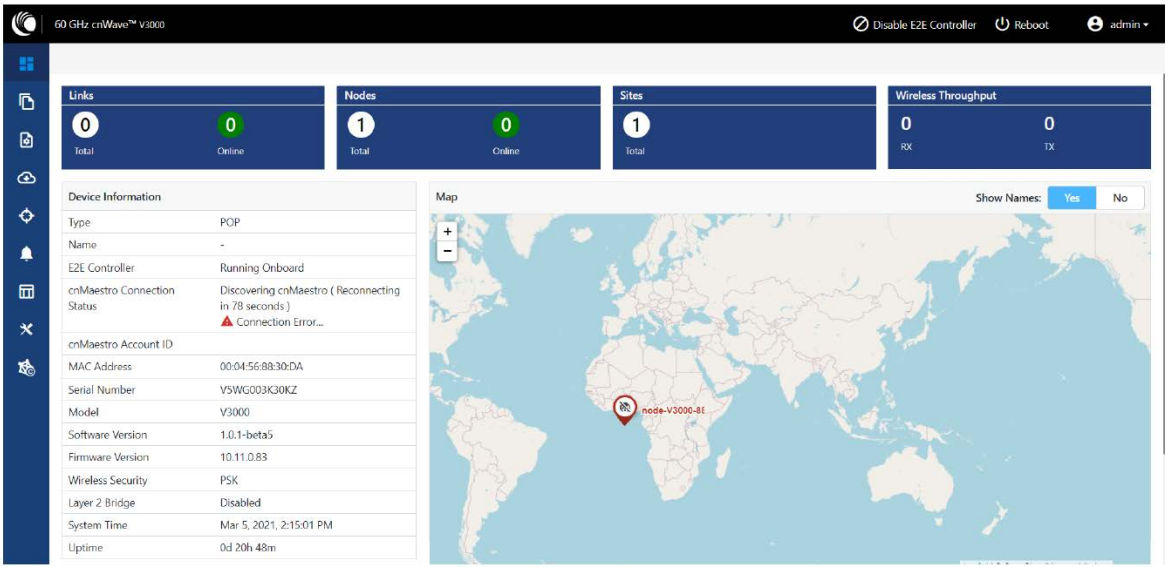
2. Click **Enable E2E**.

   The **Enable Onboard E2E** dialog box appears.

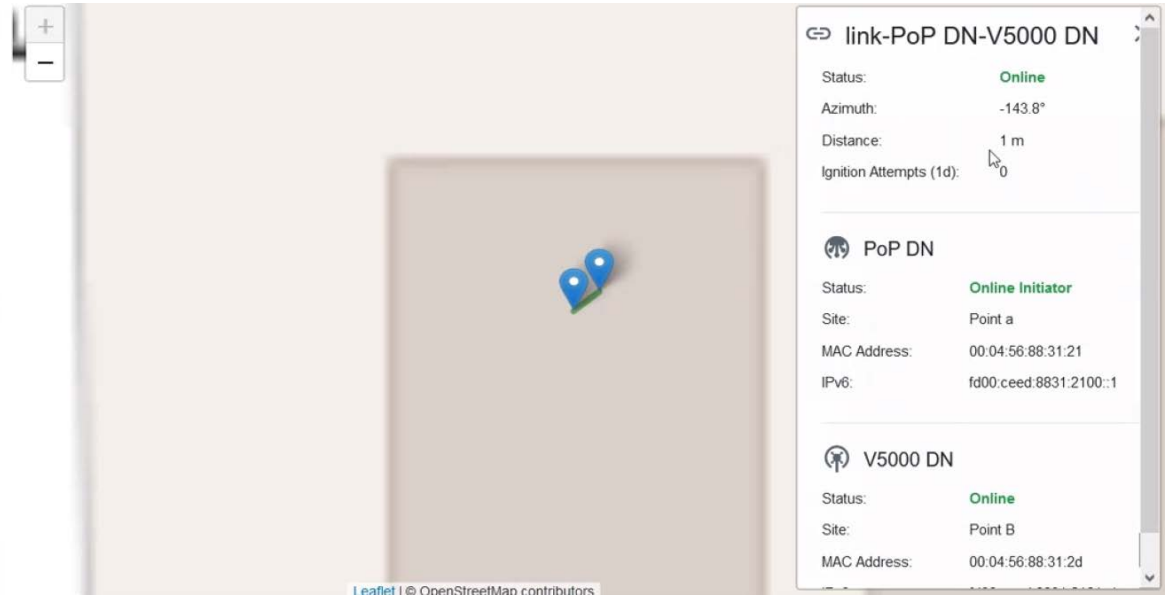


3. Enter the required details and click **Enable**.
4. After enabling E2E Controller, the dashboard displays the links, which are connected to the device.

Figure 158: *Dashboard*



Right-click on the site pin to see additional information about the site, as shown below:



Topology

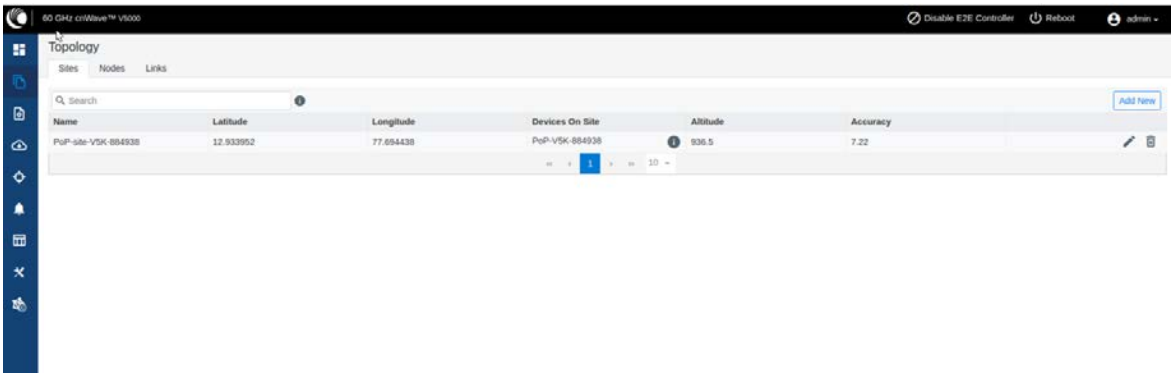
After enabling the E2E Controller, add Sites, Nodes and Links to establish the connection.

To add sites, nodes and links, perform the following steps:

1. In the main dashboard page, click **Topology** on the left navigation pane.

   The **Topology** page appears. By default, the **Sites** tab is selected, as shown below:

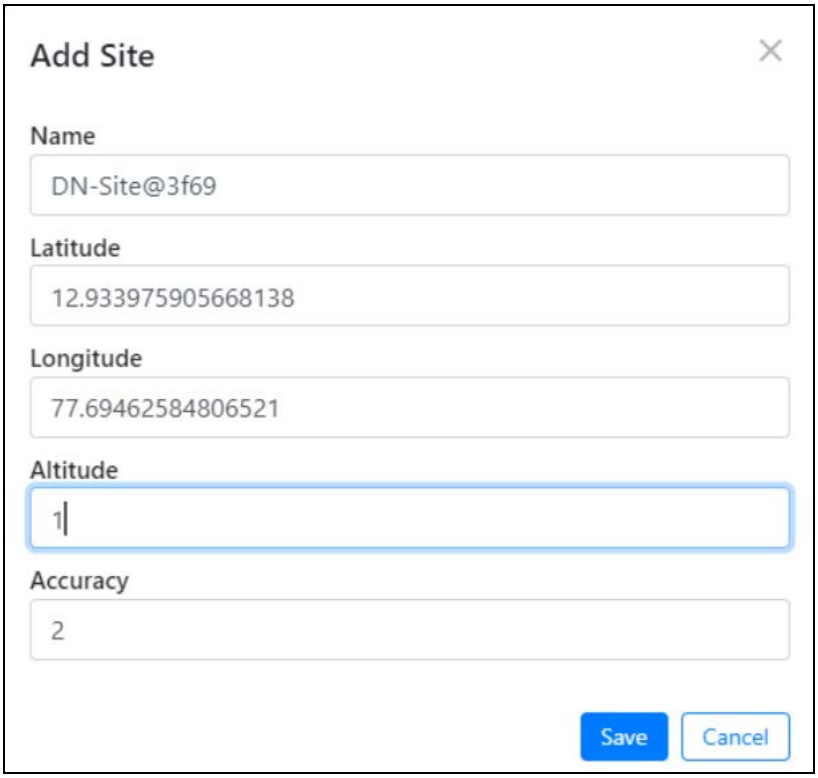
Figure 159: *The Sites page*



2. To add a DN site, click **Add New**.

   The **Add Site** dialog box appears, as shown below:

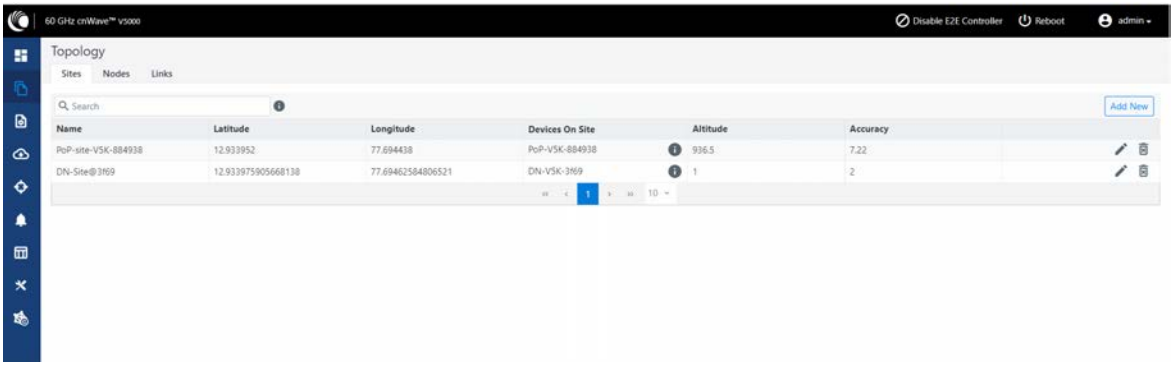
   Figure 160: *The Add Site dialog box*



3. Enter the Name, Latitude, Longitude, Altitude, Accuracy information, and click **Save**.

   The new DN site information gets added to the topology, as shown below:

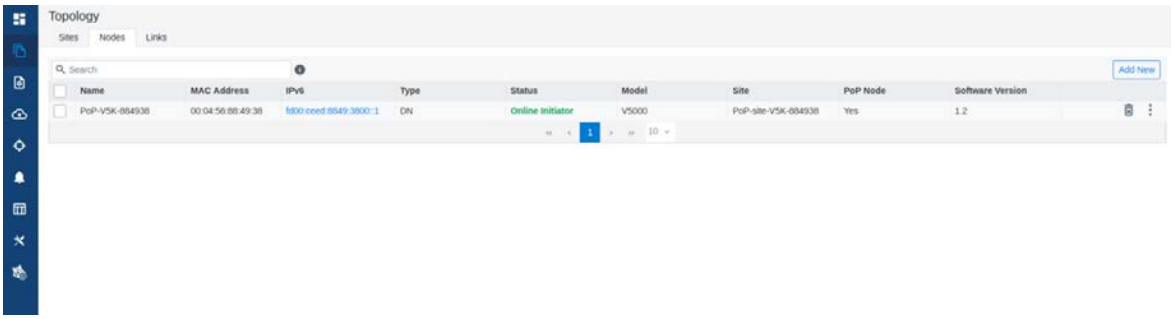
Figure 161: *The updated Sites page with new site details*



4. To add a DN node, click on the **Nodes** tab in the **Topology** page.

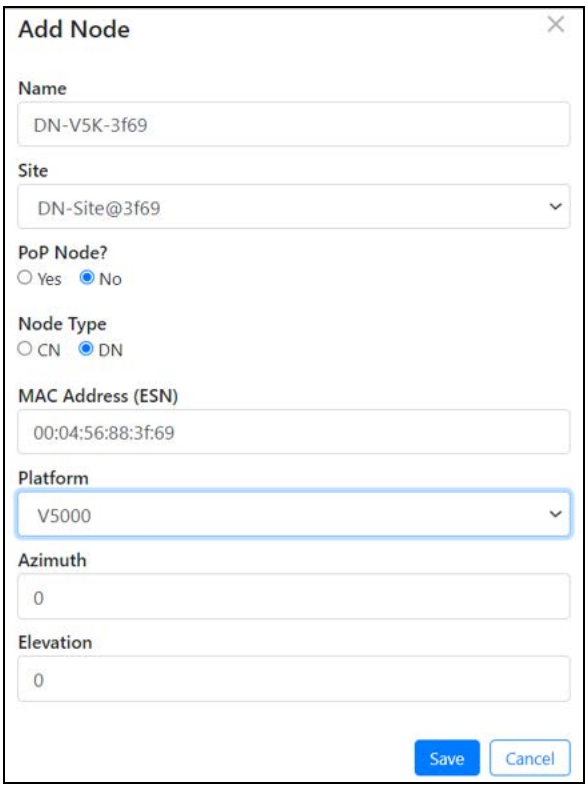
   The **Nodes** page appears, as shown below:

   Figure 162: *The Nodes page*



5. Click **Add New** and provide values in the **Add Node** dialog box, as shown below:

Figure 163: *The Add Node dialog box*



6. Click **Save**.

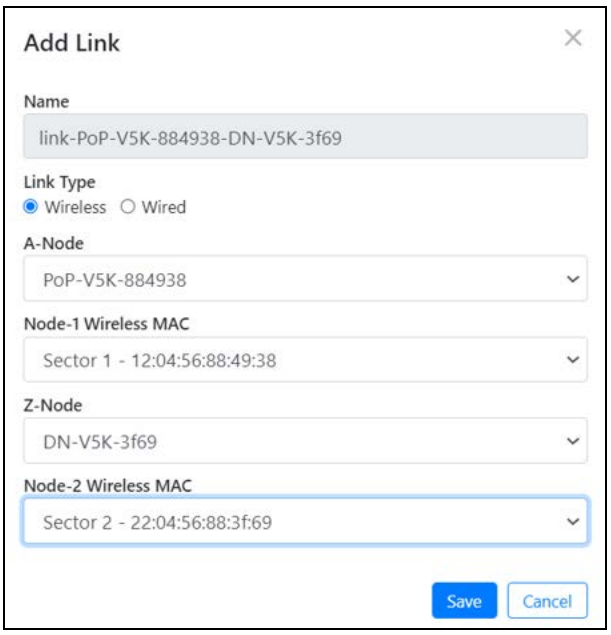
   The DN node gets added to the topology.

7. To add a link, click on the **Links** tab in the **Topology** page.

   The **Links** page appears.

8. Click **Add New** and provide values in the **Add Link** dialog box, as shown below:

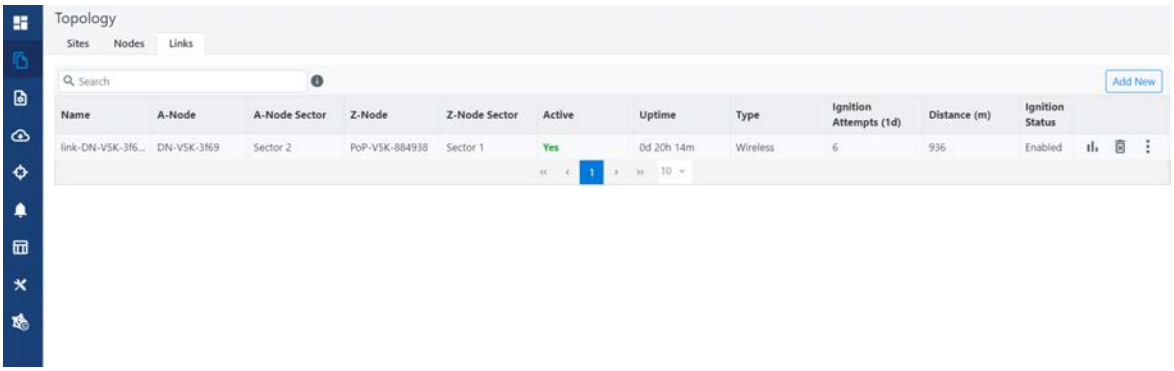
Figure 164: *The Add Link dialog box*



9. Click **Save**.

   The new link gets added to the topology, as shown below:

   Figure 165: *The updated Links page with the new link details*



Support for renaming nodes

A node can be renamed in the topology. To rename the node, perform the following steps:

1. From the dashboard page, navigate to **Topology** > **Nodes**.
2. Select the required node and click in the corresponding row. Then, select **Edit Node**.

   The **Edit Node** dialog box appears with information for the selected node.
3. Rename the node, as shown below:

Figure 166: *The Edit Node dialog box*

4. Click **Save**.

Configuration

The **configuration** page contains the following two configuration options:

- Network configuration
- Node configuration

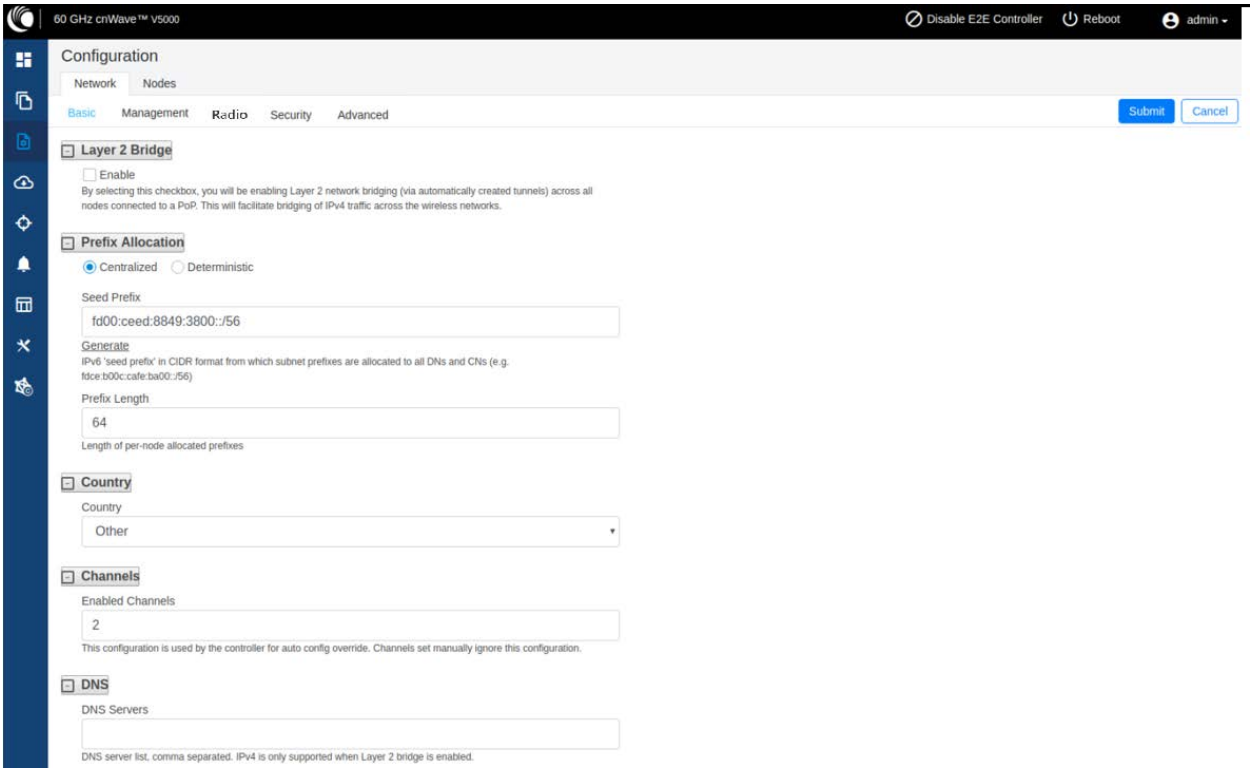
Network configuration

Network configuration is used to configure the network. Users can modify the network settings. It has **Basic, Management, Security** and **Advanced** options for the configuration. Settings under **Network** apply to all the nodes in the network. Some apply to the **E2E Controller**. Enter the required information and click **Submit** to configure the network.

The **Network** page contains the following tabs:

- Basic
- Management
- Radio
- Security
- Advanced

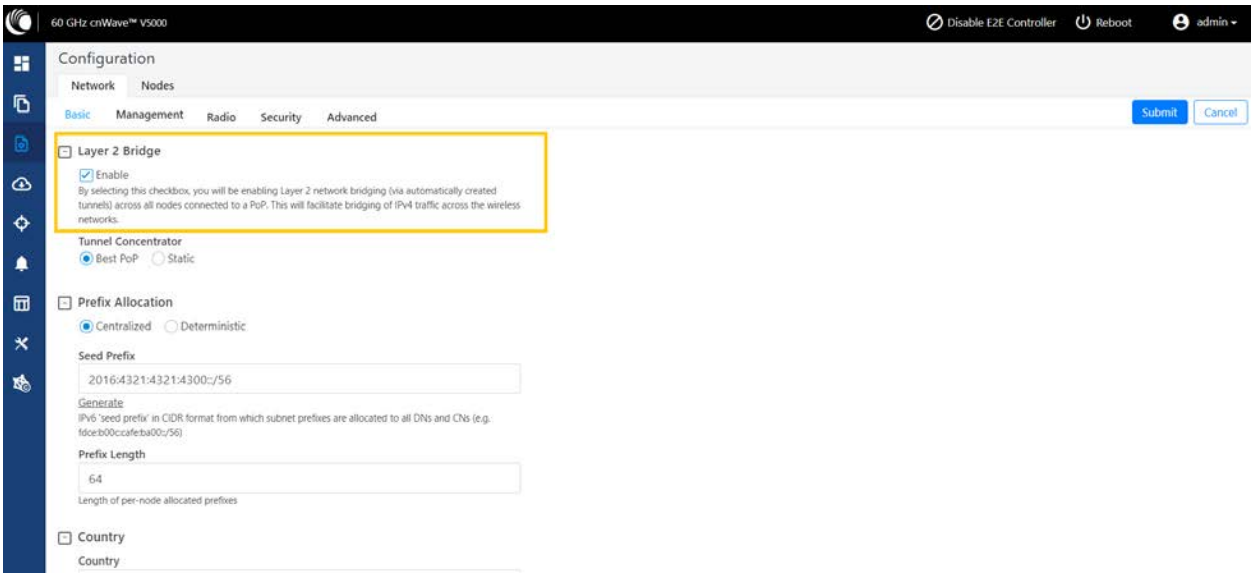
Figure 167: *The Network page with multiple tabs*



Basic

By default, cnWave is an IPv6-only network. By selecting this checkbox, Layer 2 network bridging is enabled (via automatically created tunnels) across all nodes connected to a PoP. This facilitates the bridging of IPv4 traffic across wireless networks.

Figure 168: *The Layer 2 Bridge section in the Basic page*



The **Tunnel Concentrator** does encapsulation and de-encapsulation of GRE packets. If **Best PoP** is selected, then the node selects the best PoP as a Concentrator. If **Static** is selected, then the user can configure the external Concentrator that can be Linux machine/router/PoP.

To configure the parameters on the Basic page, perform the following steps:

1. Click **Generate** under **Prefix Allocation** to generate a unique local seed prefix automatically.

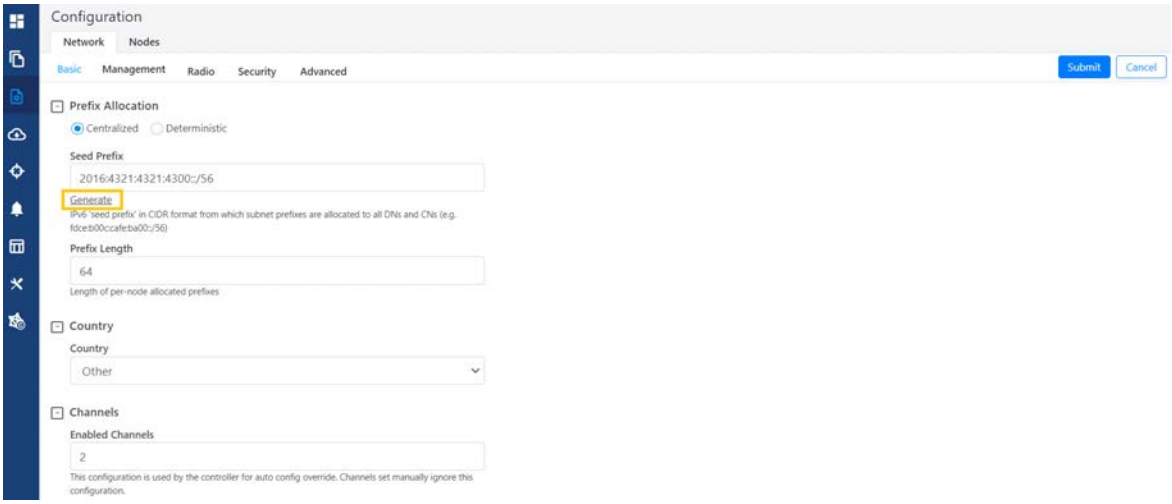
   cnWave networks are given an IPv6 **seed prefix** (e.g. face:b00c:cafe:ba00::/56) from which subnet prefixes are allocated to all DNs and CNs. There are two methods for allocating node prefixes with Open/R.

   Note

   PoP interface IPv6 address and seed prefix should not be in the same /64 prefix range to avoid the address conflict.

   - **Centralized (default)** - Centralized prefix allocation is handled by the E2E controller. The controller performs all prefix allocations, which prevents collisions and enables more sophisticated allocation algorithms. This is recommended for single PoP networks
   - **Deterministic** - Deterministic prefix allocation is also handled by the E2E controller. The controller assigns prefixes to nodes based on the network topology to allow PoP nodes to take advantage of route summarization and help load balance ingress traffic. This is recommended for multi-PoP networks.

   Figure 169: *The Prefix Allocation section*

   - **Seed Prefix**

     The prefix of the entire cnWave network is given in CIDR notation.

2. Select **Prefix Length, Country, Channels, DNS Servers**, and **Time zone** from the drop-down list.

   Prefix Length

   Specifies the bit-length of prefixes allocated to each node.

   Country

   Country for regulatory settings like the EIRP limit, allowed channels, and other elements.

   Channels

Indicates the channel number required for forming a link through an onboard E2E Controller or an external E2E Controller (if deployed).

By default, Channel 2 is supported. This parameter also supports a comma-separated list of channel numbers (for example: 2,3, 4,5), which you can give to a controller for auto configuration. Manual settings (which are made using the **Node** > **Radio** page) do not depend on this channel setting. This channel setting is useful, especially for PTP and small meshes that use a single channel for the entire network. In such a case, set the required channel number in this field and do not override the value that you set on the **Node > Radio** page. Modifying this **Channels** parameter is sufficient for the channel change.

DNS Servers

DNS server list is used for :

- Resolution of NTP Server host name (can be IPv4 when Layer 2 bridge is enabled)
- Given to IPv6 CPE as part of router advertisement

Time Zone

Time zone for all the nodes. System time in the dashboard, time field in the Events section, Log files use this timezone.

NTP Servers

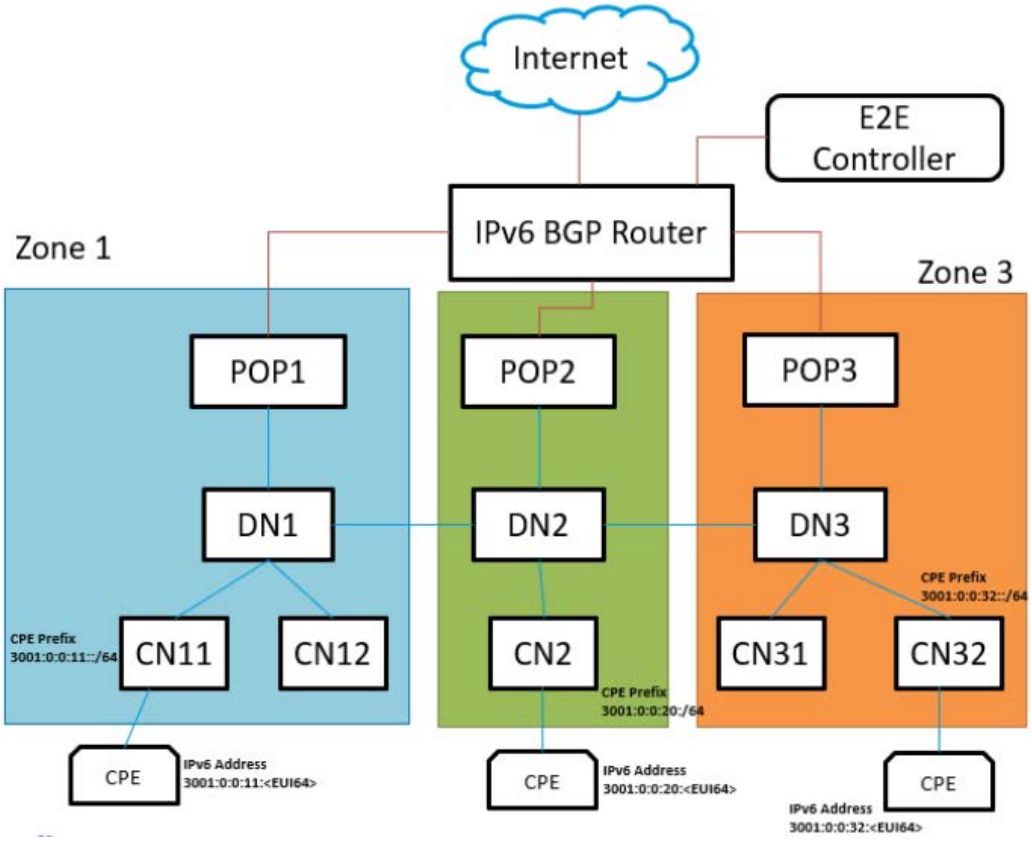
This is NTP Server FQDN or IP Address. All nodes use this NTP Server to set the time. Node time is important when 802.1X radius authentication is used as it requires certificate validation. The time is reflected in the dashboard, time field in the Events section, and Log files .

CPE Prefix Zoning

You can configure the **Summarized CPE Prefix** parameter using the **Basic** page.

The **Summarized CPE Prefix** feature restricts a PoP to advertise the IPv6 CPE prefixes of its zone alone, thereby allowing an upstream BGP router to select an optimal PoP for downstream traffic. Figure 170 is an example of multi-PoP Layer 3 IPv6 topology, which is used to explain the feature in detail.

Figure 170: *Multi-PoP Layer 3 IPv6 topology*



In Figure 170 (which is an example), consider the following points:

- Seed Prefix is 2001::/56.
- Deterministic Prefix Allocation (DPA) is enabled and has three zones.
- An operator wants CPE Address to be in different ranges than Seed Prefix. Therefore, the user traffic can be distinguished from the traffic generated by the cnWave nodes.
- Customized CPE prefix is used with the range 3001:0:0:00XY::/64, where X contains values from 1 to 3.
- IPv6 addresses of CPEs that fall in the range of 3001:0:0:00XY::/64 prefix.

Prior to the introduction of this feature, all PoP BGP Peers advertised all the customized prefixes.

In this example (as shown in Figure 170), PoP1 BGP advertises 3001:0:0:11::/64, 3001:0:0:20::/64, and 3001:0:0:32::/64 prefixes. Similarly, PoP2 and PoP3 advertise all the three prefixes. The upstream BGP router is not able to route the packets to the best PoP. With this feature, PoP advertises the prefix of its zone alone. In the example:

- PoP1 BGP is advertising 3001:0:0:11::/64.
- PoP2 BGP is advertising 3001:0:0:20::/64.
- PoP3 is advertising 3001:0:0:32::/64.

A summarized prefix (shorter prefix) comprising of all the customized prefixes must be configured. When a PoP is down, traffic flows through another PoP. In this example, the summarized prefix is 3001::/58 (six bits from 11 to 30).

The same concept is applicable when the DHCPv6 relay is used. In that scenario, CPEs obtain IPv6 address or delegated prefix directly from the DHCPv6 server.

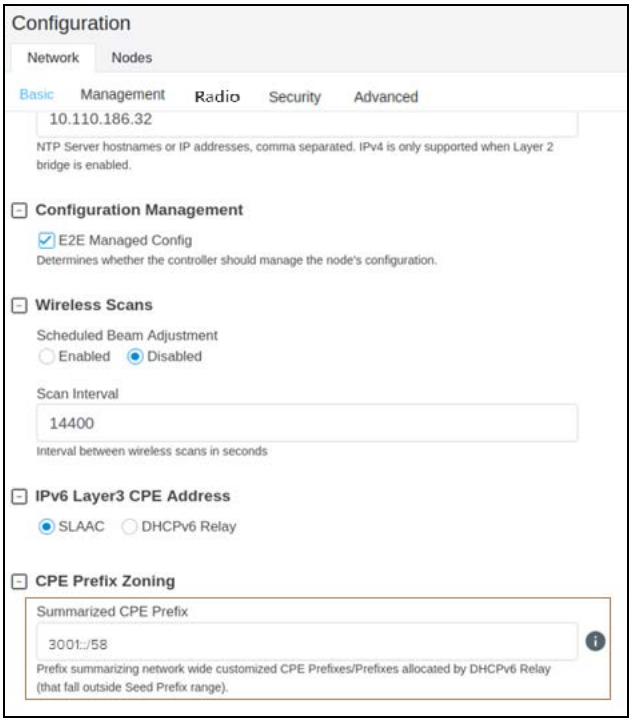
Configuring Summarized CPE Prefix

To configure the **Summarized CPE Prefix** feature, perform the following steps:

1. Navigate to **Network** > **Basic** from the home page.

   The **Basic** page appears. The **Summarized CPE Prefix** text box is available in the CPE Prefix Zoning section, as shown in Figure 171.

   Figure 171: *The Summarized CPE Prefix text box*



2. Type an appropriate value in the **Summarized CPE Prefix** text box.

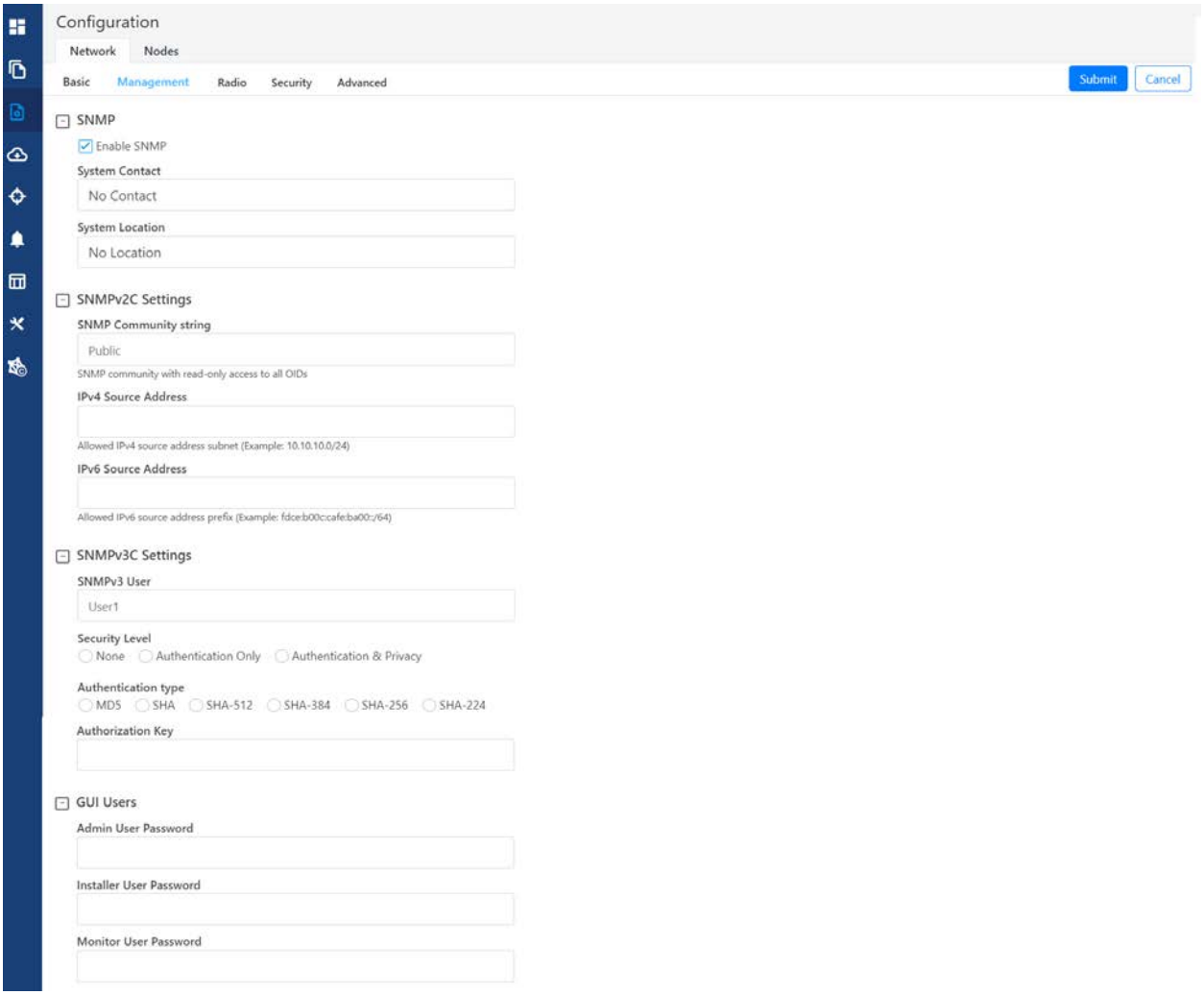
Note

Using a customized CPE prefix and not configuring the summarized CPE prefix can result in routing loops.

Management

On the **Configuration** > **Network** page, click **Management** and select SNMP, SNMPv2 Settings, SNMPv3 Settings, GUI Username and password.

Figure 172: *The Management page*



- **Enable SNMP** - Statistics can be read from the nodes using SNMP. This setting enables SNMP.
- **System Contact** - Sets the contact name as the System.sysContact.0 MIB-II variable.
- **System Location** - Sets the location name as the System.sysLocation.0 MIB-II variable.
- **SNMPv2c Settings**:
    - SNMP Community string - Supports read-only access to all OIDs.
    - IPV4 Source address - Specified, SNMP queries are allowed from the hosts belonging to this IPv4 address subnet.
    - IPV6 Source Address - Specified, SNMP queries are allowed from the hosts belonging to this IPv6 address prefix.
- **SNMPv3c Settings**:

- **SNMPv3 User** - Name of the SNMPv3c user responsible for managing the system and networks.
- **Security Level** - Following security levels are supported for network communication:
    - None - Implies that there is communication without authentication and privacy.
    - Authentication Only - Implies that there is communication with authentication only (without privacy).
    - Authentication & Privacy - Implies that there is communication with authentication and privacy.
- **Authentication Type** - Type of protocol used for the security of network communication. Example: MD5 and Secure Hash Algorithm) (SHA) are used for authentication.
- Authentication Key - A password for the authentication user.

- **For UI Users**:
    - Admin User Password - A password that you can set for GUI management.
    - Installer User Password - A password that you can set for the required installers.
    - Monitor User Password - A read-only password that you set for monitoring purposes.

Radio

The **Radio** page allows you to perform the following configurations:

- Wireless Scan scheduling for beam adjustment
- CN Channel scanning options
- Fast Acquisition
- Asymmetric TDD

Wireless Scan scheduling for beam adjustment

The **Scheduled Beam Adjustment** parameter, when enabled, allows you to make small adjustments to the selected fixed beam for optimal RF alignment in azimuth and elevation. You can select this schedule option using the **Scan Schedule Type** parameter (Day/Time or Interval schedule type).

To configure the **Scheduled Beam Adjustment** parameter, navigate to the **Wireless Scans** section on the **Configuration** > **Network** > **Radio** page (as shown in Figure 173).

A normal scan without the **Scheduled Beam Adjustment** setting does the following operations:

- Beam selection occurs only on wireless link acquisition.
- Disassociating and re-associating the link or otherwise causing the link to drop and re-acquire is needed to perform a new beam selection.
- Any degradation in wireless conditions does not trigger a new beam selection unless the link is dropped and reacquired.

The advantages of the **Scheduled Beam Adjustment scan** are:

- If the link is to acquire during heavy rain, then the optimal beam at that time may be suboptimal when the weather changes.

- If snow accumulation is present on the unit during acquisition, the optimally selected beam may be different when the snow has melted.
- Network-wide ignition in a dense deployment can cause interference when multiple nodes are acquiring. This interference can cause sub-optimal beam selection.
- Any physical change to alignment that is not severe enough to cause a link drop and subsequent beam scan can be corrected for.

The cost of Scheduled Beam Adjustment is:

- This feature causes a 50% throughput reduction for about 20 minutes, depending on the size of the network.
- Simple deployments (especially PTP links) without significant external factors such as snow may not benefit from regular beam adjustment.

To configure the wireless scan scheduling options using the device UI, perform the following steps:

1. From the home page of the device UI, navigate to **Configuration** > **Network** > **Radio**.

   The **Radio** page appears with the **Wireless Scans** section, as shown in Figure 173.

   Figure 173: *The Wireless Scans section*

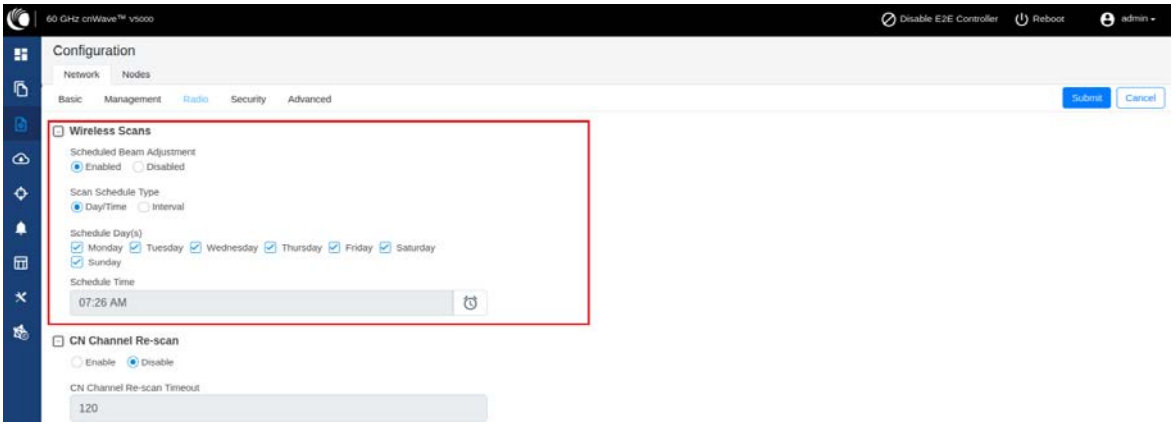


   Table 45 lists the parameters in the **Wireless Scans** section of the **Radio** page.

   Table 45: Parameters in the Wireless Scans section

Parameter	Description
Scheduled Beam Adjustment	Allows you to enable or disable the scheduled beam adjustment feature. This parameter, when enabled, allows you to make small adjustments to the selected fixed beam for optimal RF alignment in azimuth and elevation. You can select this schedule option using the **Scan Schedule Type** parameter.
Scan Schedule Type	Allows you to select the scan scheduling option for beam adjustment. This parameter supports the following scan scheduling options: • **Day/Time**: This schedule option allows you to select any day (or all days) of the week and time of the day.

Parameter	Description
	When you select the **Day/Time** option, the following parameters are applicable: • Schedule Day(s): Select the check boxes to choose the day(s). • Schedule Time: Use the icon to set the time of the day. Apart from the interval scans, you are allowed to select any day (or all days) of the week and time of the day. This setting enables you to schedule the scan during maintenance activities. • **Interval**: This scan schedule option allows you to set an interval (in seconds) for wireless scans. The default value is 3600 seconds.

2. Set the parameters based on your requirements, as shown in Figure 173.
3. Click **Submit** to save the changes.

CN Channel scanning options

When a CN loses its wireless connection, it initially scans the previously configured channel. This process speeds up the link acquisition in cases where the corresponding DN has not changed its channel. However, if the DN has switched channels, the CN scans all available channels, after a timeout period, to re-establish the connection.

Note

The advantages of CN channel rescan are:

- Moving the connected DN to a different channel is automatically detected by the CN when the configured timeout period expires.
- There is more flexibility in the topology as CNs can easily be reassigned to a different DN on a different channel without CN specific channel overrides.

The main reason to disable the CN channel rescan is to have the fastest possible network recovery following an event (for example, a software upgrade or network wide power cut). In networks, which have been fully deployed and where the configuration is not being changed, there may not be a requirement for channel rescan.

Using the device UI or the cnMaestro UI, you can configure the CN channel scanning options. These configurable options enhance the adaptability and responsiveness of your cnWave network, allowing it to better accommodate varying network conditions and configurations.

Using the device UI, perform the following steps:

1. From the home page of the device UI, navigate to **Configuration** > **Network** > **Radio**.

   The **Radio** page appears with the **CN Channel Re-scan** section, as shown in Figure 174.

Figure 174: *The CN Channel Re-scan section - Device UI*

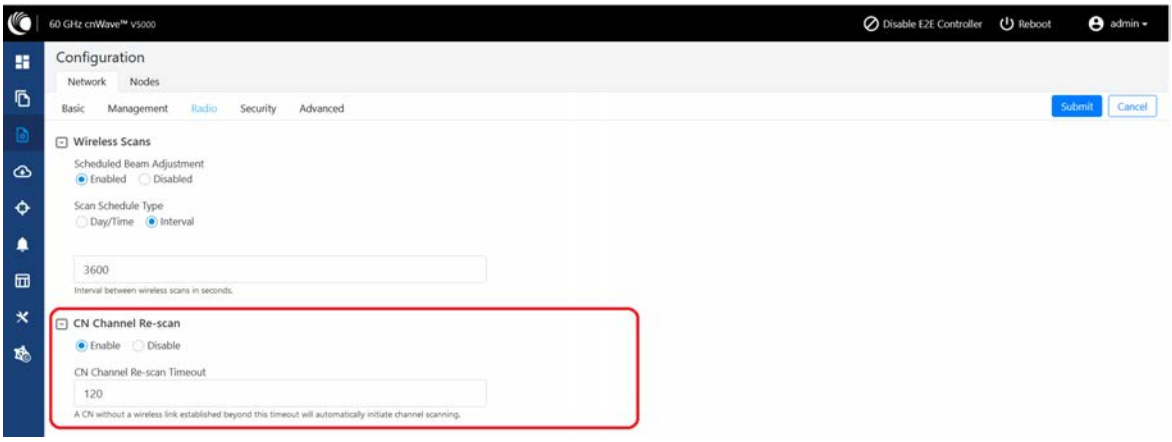


Table 46 lists the parameters in the **CN Channel Re-scan** section.

Table 46: CN Channel Re-scan specific parameters

Parameter	Description
Enable	By default, the **Enable** option is selected (enabled), as shown in Figure 174. This option allows you to disable the full channel rescan feature. When this option is selected, the CN scans only the configured channel while attempting to re-establish a lost connection. This option can be beneficial in stable environments where DNs are unlikely to switch channels frequently, thereby accelerating the reconnection process.
CN Channel Re-scan Timeout	When the rescan feature (**Enable CN Channel Re-scan**) is not disabled, you can set a custom timeout value (in seconds) for the CN before it initiates a full channel scan. This capability allows you to adjust the balance between quicker reconnection times (by scanning the configured channel) and broader network coverage (by scanning all channels after the timeout). By default, the value of this timeout option is set to 120 seconds. This option allows the value ranging from 120 to 3600 seconds

2. Set the CN channel re-scan functionality using **Enable** or **Disable** check boxes, as described in Table 46.

   By default, this parameter is enabled.

3. Set the required value (in seconds) in the **CN Channel Re-Scan Timeout** text box.

4. Click **Submit** to save the changes.

Fast Acquisition

During normal link acquisition, both ends of the wireless link scan multiple fixed beams to digitally steer the radio signal in the optimal direction and form a link. Aside from the Scheduled Beam Adjustment feature, the link then remains on these chosen beams and continues to point in this direction until the link is dropped and re-acquired, triggering a new beam scan.

Assuming both units stay in the same location, orientation, and the wireless conditions do not change, the same beams should be selected (in theory) every time the link is established. By saving this beam on the first successful link acquisition, the link up time can be greatly reduced by only scanning that single beam, instead of all available beams.

Reliable operation of **Fast Acquisition** requires a given responding node to know from precisely which direction to listen for an ignition attempt. A responding DN sector can potentially be ignited, from either of two igniting DNs, in different directions. Therefore, Fast Acquisition does not occur when a DN is igniting another DN and a full beam scan triggers instead.

A full beam scan, across all available fixed beams, at both ends of the link, and on all four supported channels, takes between 2 and 9 seconds to complete. A successful acquisition on a single beam on a single channel completes within 160ms approximately. A successful acquisition has the following advantages:

- Reducing the link acquisition time will reduce the overall time taken for full network recovery, following outages caused by software upgrade, configuration changes, and power cuts.
- During the beam scan, the maximum throughput capability of the scanning DN sector is halved. By reducing this time, the impact on other links sharing the same sector on the igniting DN is reduced.
- The interference profile across the network is vastly reduced, as the link is brought up only on the single optimal beam as opposed to transmitting on all available beams across the full scan range.

This section covers the following details of the feature:

Operation modes:

The **Fast Acquisition** feature supports the following three operational modes:

- Disable (default mode)
- Compatibility Mode
- Static Mode

For detailed information about each mode, refer to Table 47.

Use cases:

Consider the following use cases before configuring the **Fast Acquisition** feature:

- **What to do if a link is establishing with poor signal and requires a beam change?**
  - It is difficult to detect this scenario. Check the Beam Angle statistics for the link. This scenario may occur when the unit is moved, an obstruction has moved into or away from the radio path, or interference has been introduced or removed from the receiver.
  - To trigger a network wide rescan of all beams, reconfigure the Fast Acquisition setting to **Disabled** and back to Compatibility or Static after all wireless links have re-established.
  - To trigger a full beam scan on the next association for a single link, navigate to the **Topology** > **Links** UI page and select the link. Then, click **Clear Fast Acquisition Beams** and re-associate the link.
- **What to do if a link is failing to establish with either of the Fast Acquisition modes enabled?**

- All units delete their fast acquisition beams if they are offline for more than 50 minutes as part of the PoP reachability reboot.
- In **compatibility mode**, there should be no additional risk of failing link acquisition when compared to **Disabled** mode. Therefore, the cause is unlikely to be related to this feature.
- In **static mode**, if the saved acquisition beam is no longer valid, wireless link up may take a long time to succeed. This is the main disadvantage of this mode. Therefore, this mode must be enabled only for networks that are stable with all units fixed in location and without ongoing topology changes. If the fast acquisition beam is invalid for any reason, then use the **Clear Fast Acquisition Beams** control (available on the **Topology** > **Links** UI page) to trigger a full beam scan on the next association.

- **What interactions should be considered when using Fast Acquisition?**
  - DN channel rescan is not supported with the Fast Acquisition feature. Therefore, do not configure the DN channel rescan parameter.
  - When switching the role of a DN to CN, CN to DN, or relocating an existing node to another part of the network, the best practice is to factory default the node before the change. This action can be taken centrally from cnMaestro.
  - Backup CN links must not be used in combination with this feature.
  - Nodes straight from the factory, running pre-1.3.1 software, are not able to respond to a fast acquisition association. Therefore, when using the Static mode, there is a delay in achieving a successful linkup. The solution to this is to use either Disabled or Compatibility mode, or upgrade the node software to the latest before introducing into the network.

Note

cnMaestro 4.1.0 and later versions support the UI controls for configuring the **Fast Acquisition** feature.

The **Enable post acquisition beam refinement** feature is related to the Fast Acquisition feature. This feature (also previously known as Auto PBF) is present and enabled (by default) from Release 1.0.

The **Enable post acquisition beam refinement** UI control allows you to disable, if required. This feature fine tunes the beam selection, immediately, after a successful link acquisition for optimal performance. This can increase the link budget by up to 2dB. This feature is available on the **Configuration** > **Radio** page of the device UI and the cnMaestro UI. The following minor drawbacks of this feature might lead you to disable it (using the UI):

- The beam refinement scan lasts for 1.5 seconds. During this period, the transmitting DN sector operates at half capacity. You may not notice this behaviour.
- The beam refinement can cause interference during the scan to nearby links. The solution is to implement a channel plan (which takes this into account) but the option is there to disable.

Setting the Fast Acquisition mode

You can set the **Fast Acquisition** mode using either the device UI or cnMaestro UI.

Note

cnMaestro 4.1.0 and later versions support the UI controls for configuring the **Fast Acquisition** feature.

Device UI:

Using the device UI, perform the following steps:

1. From the home page of the device UI, navigate to **Configuration** > **Network** > **Radio**.

   The **Radio** page appears.

2. Go to the **Fast Acquisition** section on the **Radio** page.

   By default, the **Fast Acquisition** feature is disabled as shown in Figure 175.

   Figure 175: *Fast Acquisition settings- Device UI*

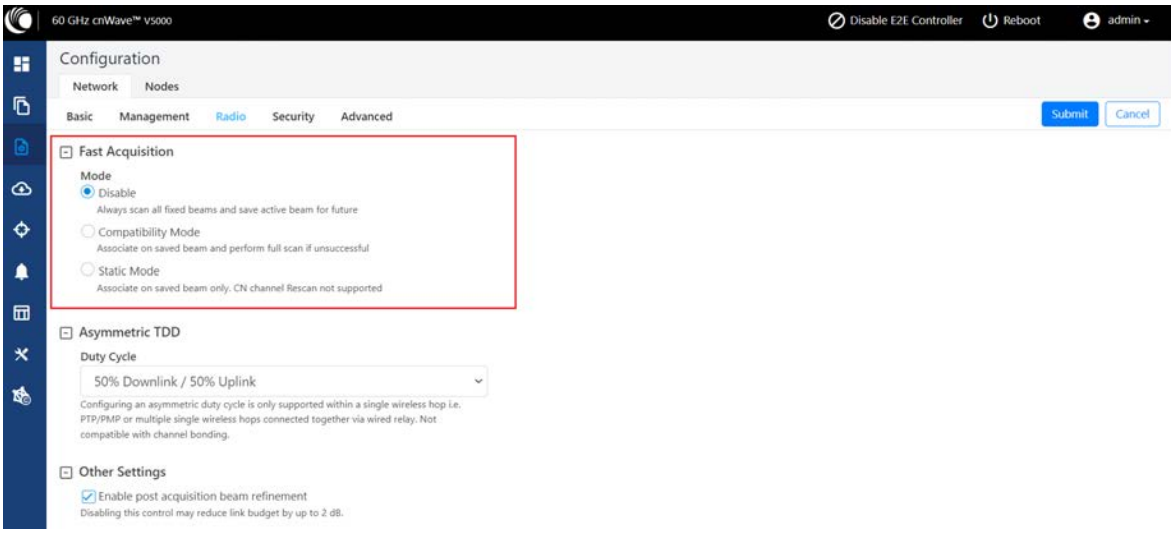


Table 47 describes the operation modes supported by the Fast Acquisition feature.

Table 47: Operational modes

Mode	Description
Disable (default mode)	In this mode, a traditional full beam scan is performed on every link up attempt. The only difference between the current and previous software is that this mode now saves the selected beam on the successful link acquisition for later use when **Fast Acquisition** is enabled.
Compatibility Mode	On every link up attempt, this mode checks to see if there is a saved beam available for the intended link and ignites on that single beam (if available). If this Fast Acquisition attempt fails, the association attempt immediately runs the full beam scan. This mode supports CNs configured for CN channel rescan because the full beam scan runs on all four channels. **Note**: The compatibility mode is recommended for most deployments as it offers the fast single beam acquisition where available and successful, whilst still offering the standard mode of acquisition for fallback.
Static Mode	In this mode, the initiator checks to see if there is a saved beam available for the intended link and ignites on that single beam (if available). If this ignition fails, the association also fails.

Mode	Description
	The static mode does not support the configuration of CN channel rescan. This gives the highest chance of success to fast acquisition without performing a full beam scan. In static mode, the fallback mechanism occasionally performs a full beam scan to prevent stranded nodes that cannot respond on the fast acquisition beam. However, this case occurs infrequently, due to which there is some delay before the successful link acquisition.

3. Select the required operation mode.
4. Click **Submit** to apply the changes.

cnMaestro UI:

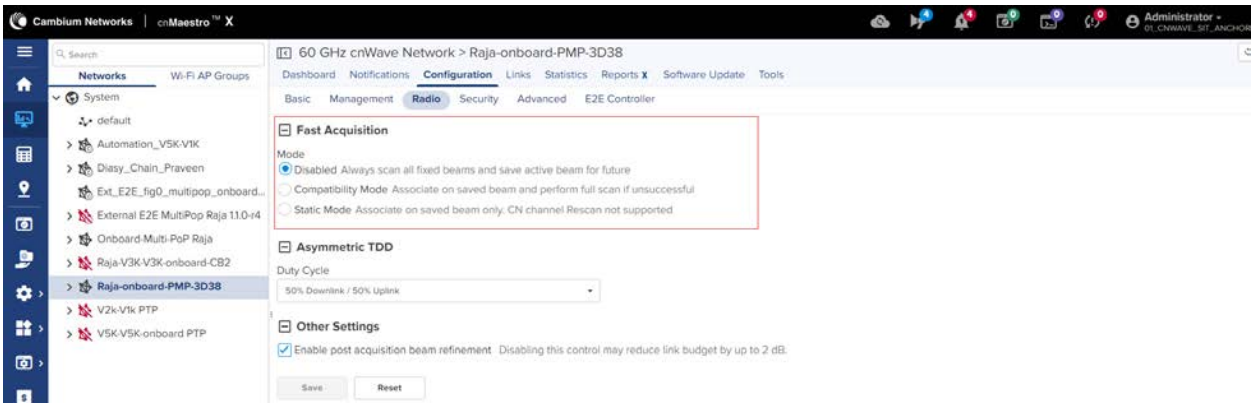
Using the **Monitor and Manage** > **Networks** > **Configuration** > **Radio** page of cnMaestro UI, you can select the required operation mode of the Fast Acquisition feature.

Note

cnMaestro 4.1.0 and later versions support the UI controls for configuring the **Fast Acquisition** feature.

Figure 176 displays the **Fast Acquisition** section located on the **Radio** page of cnMaestro UI.

Figure 176: *Fast Acquisition settings - cnMaestro UI*



For detailed information about each mode, refer to Table 47.

Asymmetric TDD

The asymmetric TDD feature allows you to configure an asymmetric duty cycle instead of the default 50% downlink/50% uplink. The supported duty cycle ratios, denoted by downlink/uplink timeslot allocation, are:

- 75/25
- 70/30
- 60/40
- 50/50 (default ratio value)

- 40/60
- 30/70

Single wireless hop limitations (Standalone PTP and PMP only):

The meshing technology is designed around a 50/50 duty cycle to allow efficient synchronised communication in multi hop networks. Using asymmetrical duty cycles across a multiple wireless hop network can be counterproductive and therefore, you must avoid this configuration.

Duty cycle ratio selection:

- For downlink biased traffic, for example - Internet video streaming, choose a high downlink ratio such as 75/25.
- For uplink biased traffic, for example - video camera backhaul, sensor backhaul, or data backup, choose a high uplink ratio such as 30/70.

Configuring the asymmetric TDD split ratio

You can configure an asymmetric TDD ratio using either the device UI or cnMaestro UI.

Device UI:

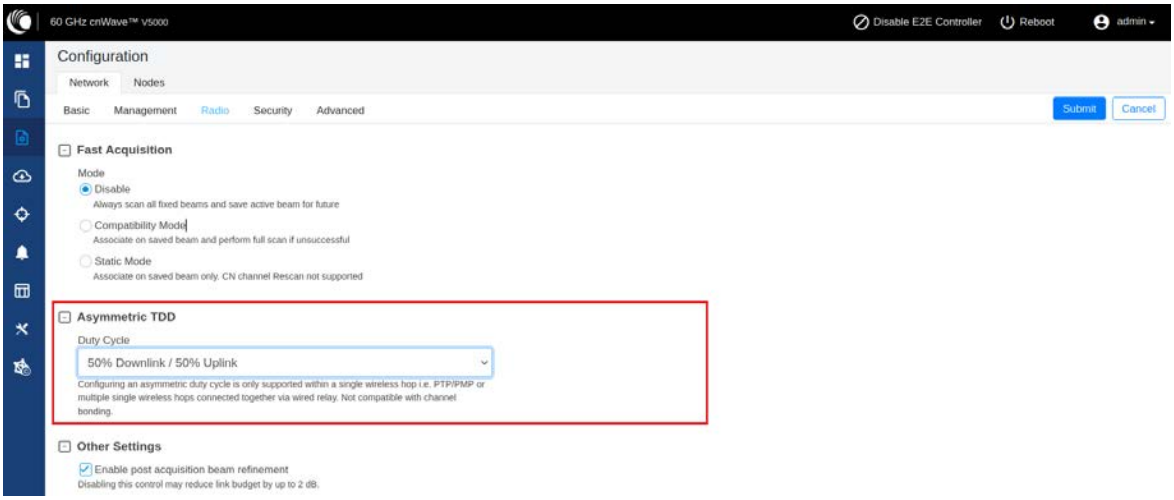
Using the device UI, perform the following steps:

1. Log in to the device UI and navigate to **Configuration** > **Network** > **Radio**.

   The **Radio** page appears.

2. Go to the **Asymmetric TDD** section on the **Radio** page, as shown in Figure 177.

   Figure 177: *The Asymmetric TDD section - Device UI*



3. From the **Duty Cycle** drop-down list, select the required duty cycle ratio.

   By default, the `50% Downlink / 50% Uplink` ratio is selected.

   When you modify the value of the **Duty Cycle** parameter, the **Confirm** message box prompts you to confirm the modification. You must click **Continue** to save the changes.

4. Click **Submit** to apply the changes.

cnMaestro UI:

Using the cnMaestro UI, perform the following steps:

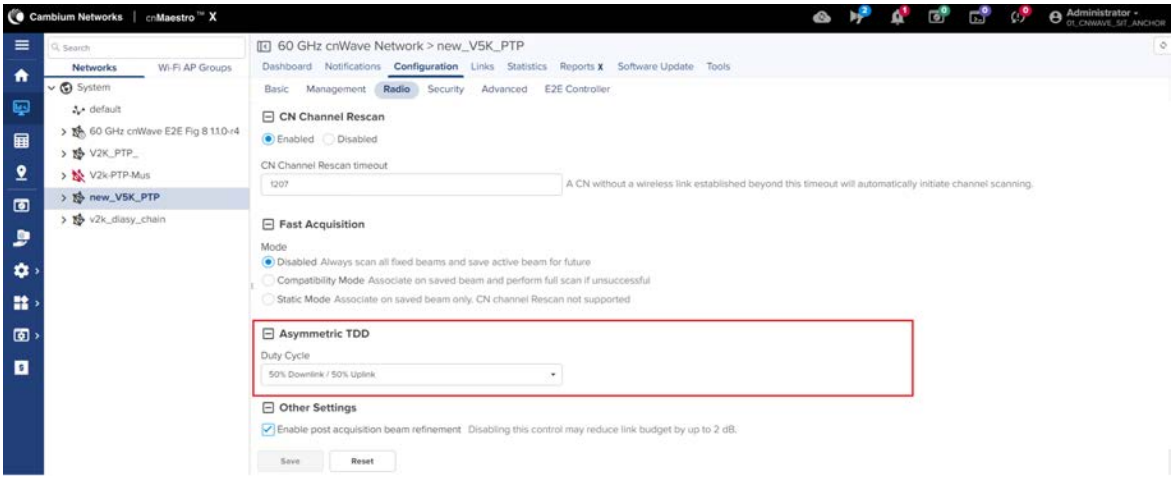
1. Log in to the cnMaestro UI and select the **Monitor and Manage** icon on the left navigation pane.

   The **Dashboard** page appears.

2. Select a network name under the **Networks** group and navigate to the **Configuration** > **Radio** page.

   The **Radio** page appears, as shown in Figure 178.

   Figure 178: *Asymmetric TDD - cnMaestro UI*



3. In the **Asymmetric TDD** section, select the required TDD ratio from the **Duty Cycle** drop-down list.

   By default, `50% Downlink / 50% Uplink` is selected. When you modify the value of the **Duty Cycle** parameter, the **Confirm** message box prompts you to confirm the modification. You must click **Continue** to save the changes.

4. Click **Save** to apply the changes.

Security

The **Security** page allows you to set the following configurations:

- Wireless security
- Security banner

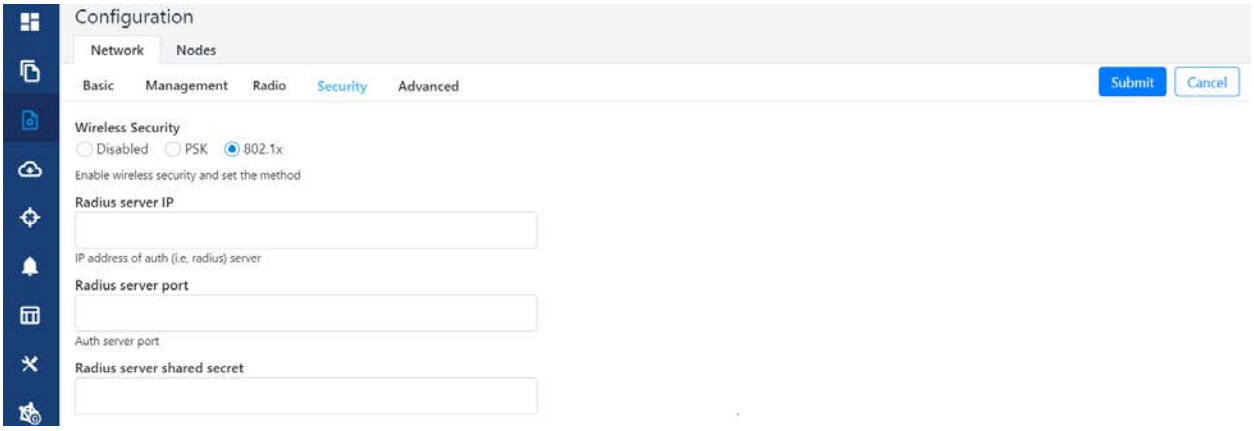
Wireless security

On the **Configuration** > **Network** > **Security** page, the **Wireless Security** section contains the following options:

- **Disabled** - There is no wireless security.
- **PSK** - WPA2 pre-shared key can be configured. A default key is used if this configuration is not present. AES-128 encryption is used for data encryption.

- **802.1X** - Nodes are authenticated using Radius server and EAP-TLS. Encryption is based on the negotiated scheme in EAP TLS. When **802.1X** is selected, the following parameters are applicable:
    - **RADIUS Server IP** - IPv4/IPv6 address of the Radius authentication server.
    - **RADIUS Server port** - Port number of the Radius authentication server.
    - **RADIUS server shared secret** - The shared secret of a Radius server.

Figure 179: *The Wireless Security section*



Security banner

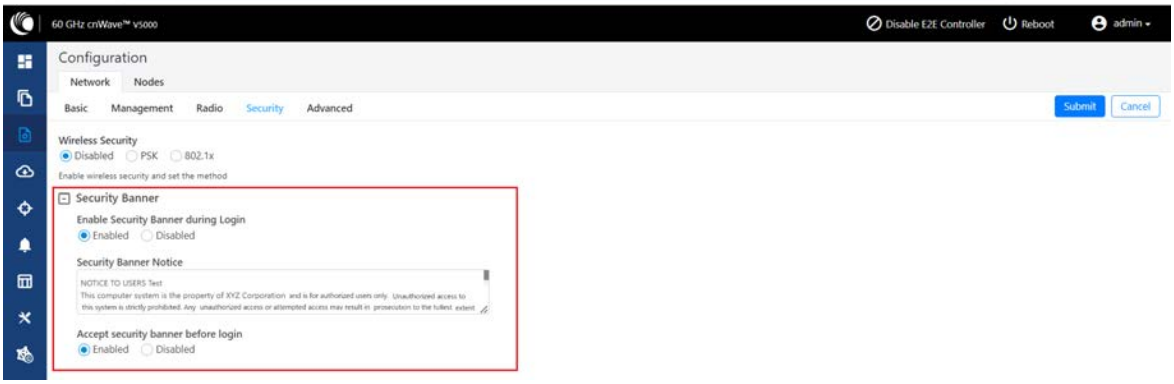
You can enable or disable a security banner using the **Configuration** > **Network** > **Security** page.

When you enable a security banner, the login page of a device UI displays the security notice. You can view and accept (optional based on the configuration) the terms and conditions of a company before logging into the device UI.

For 60 GHz cnWave devices, the configuration of a security banner involves the following process:

1. Enable or disable the security banner option using the **Configuration** > **Network** > **Security** page of the device UI (as shown in Figure 180).

    Figure 180: *Configuring the security banner*

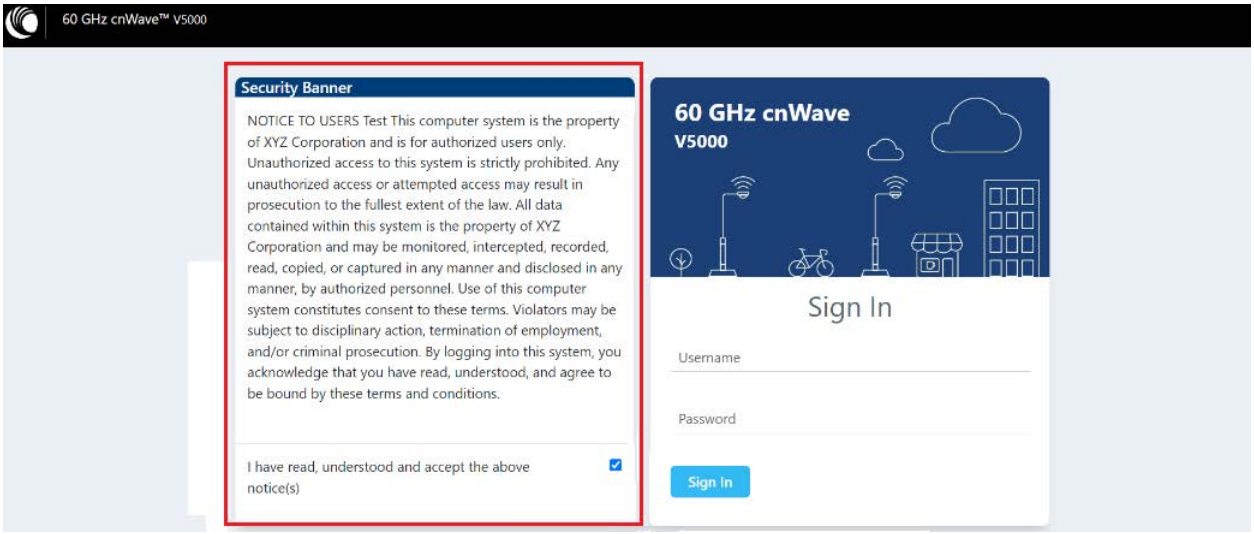
2. If the **Enable Security Banner during Login** parameter is enabled, provide the security text for intended users in the **Security Banner Notice** text box. This text box supports up to 1000 characters.

3. Determine whether the users must accept the security banner before logging into the device UI using the **Accept security banner before login** parameter.

4. Click **Submit** to save the changes.

When you enable and configure the security banner settings (as shown in Figure 180), the login page of a device UI displays the security banner as shown in Figure 181. The users must accept the security notice and then log into the device UI, as shown in Figure 181.

Figure 181: *Example of a Security Banner on the login page*



If you have disabled the **Accept security banner before login** option for users, then the users are not forced to accept the security notice before logging in to the device UI.

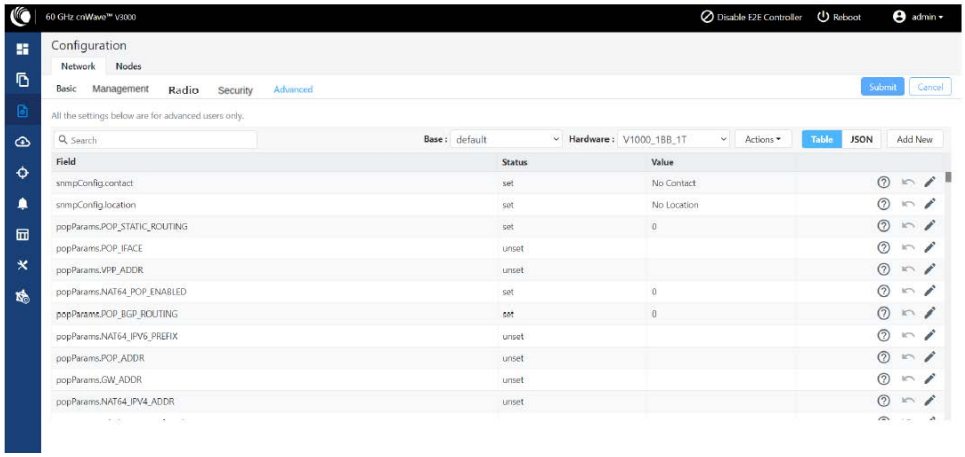
Advanced

The **Advanced** page settings are for advanced users only. This page displays the merged configuration of all layers for a particular node.

Caution

The users are not recommended to modify or change settings on the **Advanced** page.

Figure 182: *The Advanced page*



The **Network** > **Advanced** page supports the configuration of the following features:

- DN Channel rescan
- Gratuitous ARP support
- Dynamic Walking PBF
- Auto Channel and Golay Optimizers

DN Channel Rescan

The DN Rescan feature optimizes the deployment and management of temporary network structures in settings such as concerts, recreational vehicle (RV) parks, and others. The feature also enables a seamless reconnection of DNs that have moved within new network environments.

How this feature works?

The DN Rescan feature comes into action when a DN loses a DN-DN link, consequently leading to a Point of Presence (PoP) being unreachable.

In a normal operation, the DN remains on the same channel and does not perform a rescan. This is due to the lost link that might be in the downstream direction where rescan does not apply or the affected sector might be serving other active links. However, the DN Rescan feature changes this behaviour under specific circumstances.

How to configure the feature?

To enable the DN Rescan feature, configure the `envParams.CAMBIUM_ENABLE_DN_CHANNEL_RESCAN` parameter using the **Configuration** > **Advanced** page of the device UI. By default, the value of this parameter is `false` (disabled). To enable the DN Rescan feature, set the value of this parameter to `true`.

If you set the value of this parameter to `true` and the DN is unable to detect a PoP for a certain duration (which is configurable using the `envParams.CAMBIUM_DN_CHANNEL_RESCAN_TIMEOUT` parameter), the DN resets the channel, Golay, and polarity on all its sectors by proceeding to scan all channels. This scan process facilitates the DN to form new links with an upstream PoP or DN without any manual intervention, achieving a true zero-touch experience.

Note

To set the timeout duration (in minutes) for different environments, configure the `envParams.CAMBIUM_DN_CHANNEL_RESCAN_TIMEOUT` parameter using the **Configuration** > **Advanced** page of the device UI. The default value of this parameter is 20 minutes, and the minimum allowed value is 10 minutes.

Use cases

The DN Rescan feature supports the movement of DNs in temporary deployments with zero touch (main use case). In addition, the feature supports the modification of the channel on the near end DN first.

The correct method is to change the far end DN channel first and then the near end. However, this feature can serve as a fail-safe in case if the near end DN channel is modified first. Note that both the ends must match, otherwise the controller does not ignite the link.

Frequently asked questions (FAQs)

The following table lists the FAQs specific to the **DN Rescan** feature.

FAQ	Answer
How the feature detects the DN-DN link loss?	The DN Rescan feature does not detect the link loss, directly. It helps in monitoring the visibility of the POP, periodically.
What happens if the DN fails to detect a PoP even after the channel, Golay, and polarity reset and rescan process?	The DN continues to scan until it reaches the timeout period (configured using the `CAMBIUM_POP_UNREACHABLE_REBOOT_TIMEOUT_INTERVAL` parameter), after which it reboots. Note: The `CAMBIUM_POP_UNREACHABLE_REBOOT_TIMEOUT_INTERVAL` parameter is available on the **Configuration** > **Advanced** page of the device UI.
Are there any impacts or disruptions to other active links in the same sector when the feature initiates a rescan process?	Yes. All the active links within the same sector goes down.
What are the prerequisites or requirements for the feature to work properly?	The DN Rescan feature does not require any specific prerequisites.
Can this feature be enabled or disabled on each DN or is it a global setting?	The DN Rescan feature can be enabled either at the node level or the network level. There are no restrictions.
Are there any caveats (cautions) when using the feature?	Yes. You must consider the following: 1. The DN will lose all its links and recovery will be slower, necessitating careful usage of this feature. 2. If the channel is modified via the local GUI (for instance, to run Antenna Alignment), it is recommended to disable the feature first. Otherwise, the timeout might kick in and erase the set channel. 3. Scanning of CB1 and CB2 channels at a time is not supported.

Gratuitous ARP support

You must enable the Gratuitous Address Resolution Protocol (ARP) support for the 60 GHz cnWave products.

Disabling the downstream broadcast at the Point of Presence (PoP) in L2 mode results in upstream nodes losing access to cnWave nodes through their IPv4 addresses. This is due to the deletion of ARP entries in the upstream routers or devices beyond the POP on their expiration.

To maintain connectivity, the support initiates Gratuitous ARP updates for the configured IPv4 management IP.

To enable (activate) the Gratuitous ARP support for DN/CN, you can set the following parameters using the **Configuration** > **Network** > **Advanced** page of the device UI or cnMaestro UI:

- `envParams.CAMBIUM_GRATUITOUS_ARP_ENABLE`: This parameter supports the following Boolean values:
  - `false`: To disable the Gratuitous ARP support. By default, the value of this parameter is `false`.
  - `true`: To enable (activate) the Gratuitous ARP support.
- `envParams.CAMBIUM_GRATUITOUS_ARP_TIME`: Specifies the time interval (in seconds) between the two Gratuitous ARP packets that are sent by the node to the upstream network. The default value of this parameter is 150 seconds.

  The integer value of this parameter ranges between 20 and 6000 seconds. This parameter is applicable only when the `envParams.CAMBIUM_GRATUITOUS_ARP_ENABLE` parameter is set to `true` (enabled).

Note

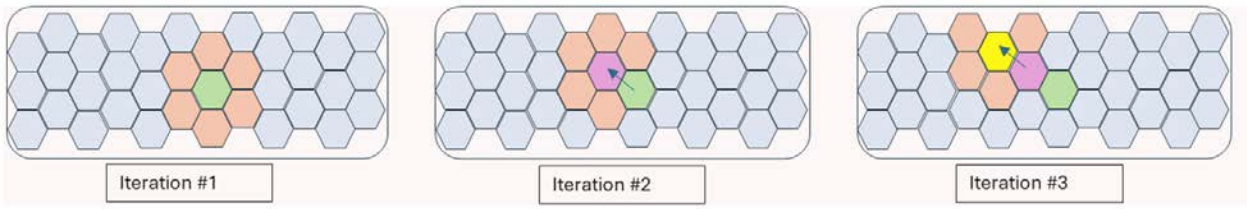
The Gratuitous ARP support is not applicable when DN/CN is configured with the default IPv4 address (169.254.1.1).

Dynamic Walking PBF

The Dynamic Walking PBF feature is an enhancement over the walking PBF feature (which was introduced in Release 1.4) to facilitate more frequent updates compared to the previously supported Scheduled Beam Adjust feature. This feature is intended for deployments where very slow mobility is expected or where the optimal Line of Sight may vary at a slow rate.

The figure below illustrates how the feature functions. It depicts a typical scan range of the beamforming RF tile, with each cell representing the beam coverage for a specific beam selection.

Figure 183: *Illustration of Dynamic Walking PBF principle*



When enabled, the Dynamic Walking PBF feature iteratively refines the beams at a user-defined rate. During each iteration, the radio's current beam and its six surrounding beams are evaluated for the best link quality, and the optimal beam is selected. This allows the beam to dynamically traverse across the entire scan range, albeit at a slow rate.

This section covers the following topics:

- Benefits
- Enabling Dynamic Walking PBF
- Key points

Benefits

The key benefits of enabling Dynamic Walking PBF are:

- Connectivity of very slow-moving targets, such as connecting cranes at a container terminal or floating platforms on seabed where the radio height changes with the tide.
- Improved performance: Iteratively searching for the best beam ensures that the link remains on the best possible beam to achieve the best signal-to-noise ratio. When interference affects a particular direction,

selecting an adjacent beam may create a null in the true line-of-sight direction experiencing interference, at the cost of 1 to 2 dB of desensitization.

- Recovery from severe weather conditions: When a link drops due to snow, ice, or rain and subsequently recovers, the beams may reconnect on a suboptimal beam since the radio will link up at the first opportunity. Dynamic Walking PBF enables the beams to iteratively refine themselves as weather conditions improve, ensuring the connection remains on the best beam.

Enabling Dynamic Walking PBF

You can enable the Dynamic Walking PBF feature through the **Advanced** page in the device UI or the cnMaestro UI.

Device UI

Using the device UI, complete the following steps:

1. From the dashboard page, navigate to the **Configuration** > **Network** > **Advanced** page.
2. In the search box, type `configPbfInterval`.
   You can view the following radio and link parameters: `radioParamsBase.fwParams.configPbfInterval` and `linkParamsBase.fwParams.configPbfInterval`.
3. Set the value of these two parameters (radio and link) to the required interval (in seconds) by using the edit icon in the corresponding row, respectively.
   The default value of these parameters is 0 (disabled) and the minimum interval is 2 seconds (most dynamic value). The maximum value is 120 seconds.
   Figure 184: *The Advanced page - Device UI*

4. Click **Submit** to save the changes.

cnMaestro UI

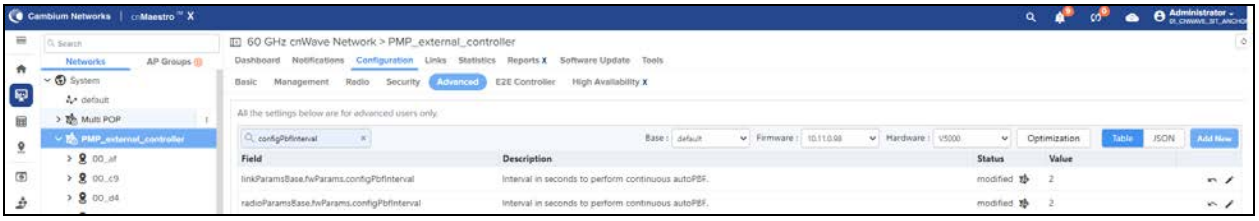
Using the **Monitor and Manage** > **Networks** > **Configuration** > **Advanced** page in the cnMaestro UI, you can search for `configPbfInterval` and set the value of radio and link parameters to the required interval (in seconds).

The default value of these parameters is 0 (disabled) and the minimum interval is 2 seconds (most dynamic value). The maximum value is 120 seconds.

Note

cnMaestro 5.2.0 and later versions support the UI controls for configuring the Dynamic Walking PBF feature.

Figure 185: *The Advanced page - cnMaestro UI*



Key points

Note the following key points specific to the Dynamic Walking PBF feature:

- Dynamic Walking PBF is applicable only to a `50% Downlink / 50% Uplink` duty cycle. This is because any scan or beamforming function causes the TDD configuration to fall back to the default 50:50 duty cycle. In a scheme where Walking PBF operates at relatively short intervals, the frequent switching between TDD0 and other TDD configurations would deem Asymmetrical TDD operation meaningless.
- When configured for Dynamic Walking PBF, the slot allocation for carrying data traffic is reduced to 50% for 400ms in this Interval Period to accommodate these scans.
- Even when configured for Dynamic Walking PBF, priority is still given to ignition requests from the controller. When the controller issues an ignition request to ignite a link, the Dynamic Scan is blocked for 25 seconds. The scan will resume (re-establish) once the 25-second timeout expires. In a distributed (mesh) network, a scan block out on a DN sector propagates to all wirelessly connected DN sectors and their clients.
- Enable Dynamic Walking PBF only at the network level and only after all nodes have been upgraded to Release 1.5 or later, which supports this feature. For a standalone PTP link connected to the rest of the network through a relay, the feature can be enabled as a node-level advanced configuration.
- When there is only one link in a sector (for example, PTP), Dynamic Walking PBF will run at intervals of `configPbfInterval` seconds. When multiple links are present in the sector, the scans are synchronized with the control superframe, and each link performs its scan at intervals of `configPbfInterval * 16` seconds.

Auto Channel and Golay Optimizers

The Auto Channel and Golay Optimizer features provide installers with a good starting point for channel planning in an established network.

Channel and Golay planning are crucial aspects of CnWave 60 GHz network design. In a network that has grown organically, it may be necessary to optimize channels and Golay settings at various stages of growth to update the channel and Golay allocation, ensuring the best resiliency against self-interference.

This section covers the following topics:

Channel Optimizer

With the Auto Channel Optimizer, the controller estimates the interference profile for the entire network by utilizing site coordinates and the antenna beam profiles for each hardware variant. Based on this information, channels and Golays

are allocated. Channel changes are coordinated across the network by the E2E Controller without requiring input from the installer.

Note

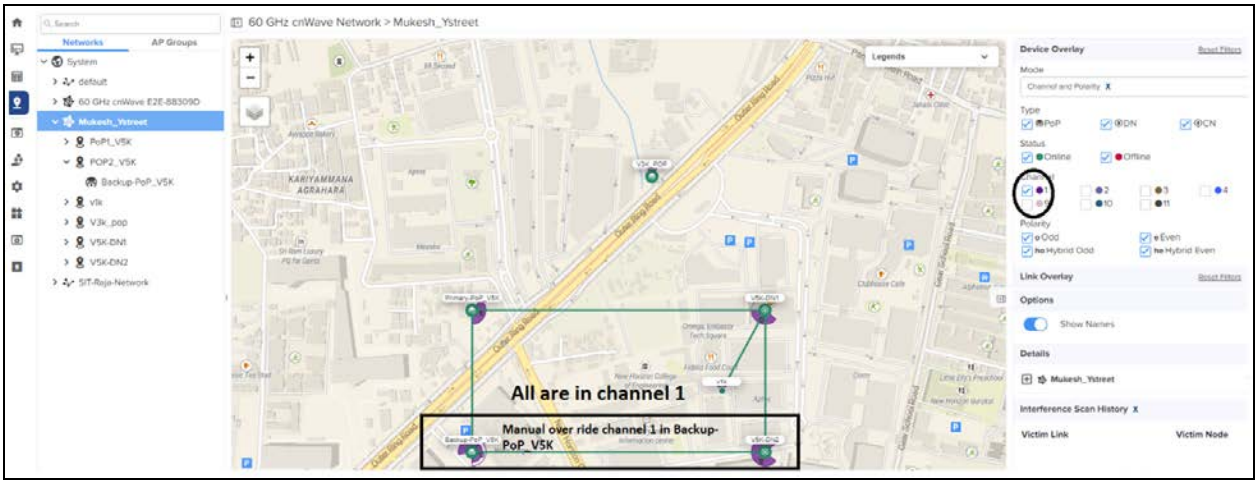
In Fast Acquisition static mode, if the backup link is used for backhaul, running channel optimization may cause the CN to lose connectivity because the backup link's channel remains fixed and does not adjust during the optimization process. To avoid this issue, channel optimization should not be performed in static mode when the backup link is in use.

Clearing user overrides for channel assignments

User overrides refer to manual configurations made by a network administrator or installer, such as assigning specific nodes to use a particular channel.

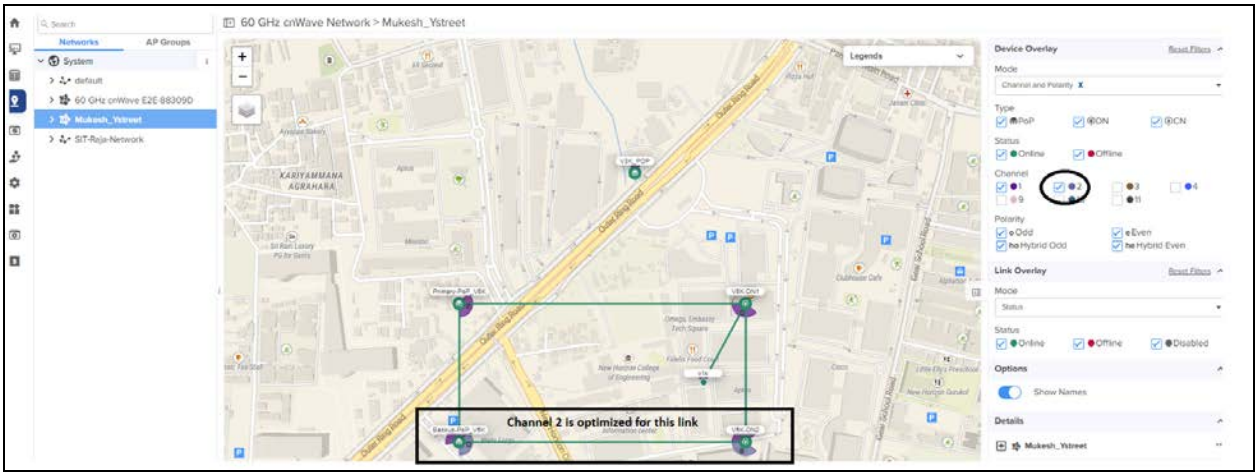
There is an option (or flag) that can be set to clear these overrides. When the flag is enabled, manual settings are erased, and the system automatically adjusts channels based on its interference analysis. However, there may be scenarios where the user prefers to retain overrides, such as when a long-range link (a connection over a long distance) relies on a specific channel for example, channel 4). In such cases, the installer would leave the flag disabled to preserve the manual override settings. For example, the figure below shows that all are in channel 1 and manual channel override is configured in Backup-Pop_V5K.

Figure 186: *Manual channel override settings before clearing user assigned channels*



When the channel overrides are cleared (using device UI or cnMaestro UI), the devices get automatically from the controller. Channel 2 is optimized between Backup-PoP_V5K and V5K-DN2 by the controller (as shown in Figure 187).

Figure 187: *Optimized channel after clearing user-assigned channels*



Golay Optimizer

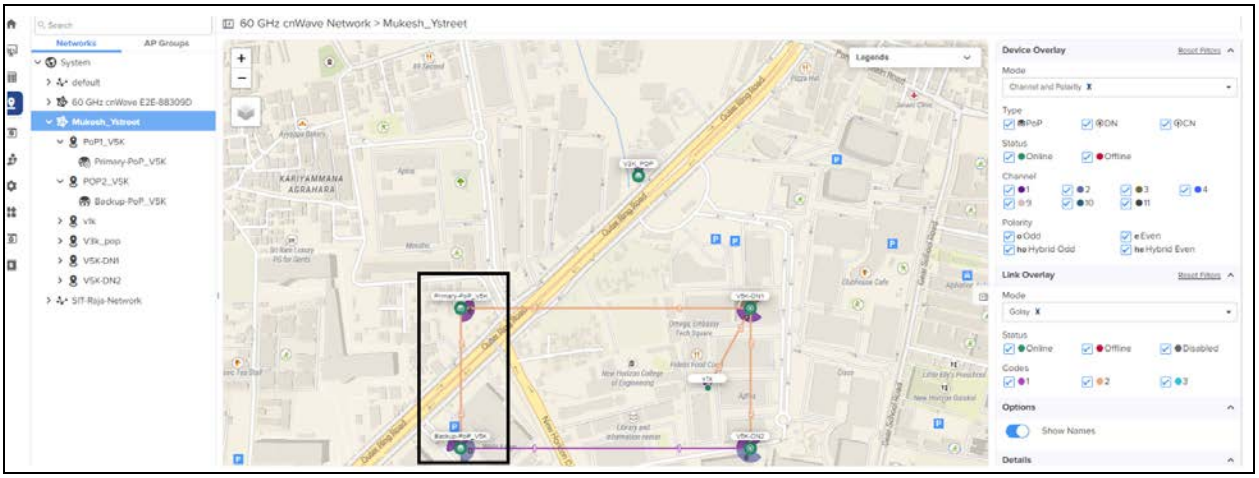
Golay codes are used in CnWave 60 GHz for PHY training and synchronization. Different Golay codes are necessary to prevent false correlations in the presence of interference. They help protect links from early-stage weak interference and situations where channel discrimination is not possible because the interfering link belongs to the same link group. Since Golay is a link-based parameter and not a link group-based parameter like channel, different heuristics are applied during the optimization process.

Clearing user overrides for Golay assignments

Similar to channel assignments, there is also a flag for Golay codes that allows you to clear any user-set overrides. When enabled, the optimizer ignores manual Golay assignments and recalculates them based on the interference profile.

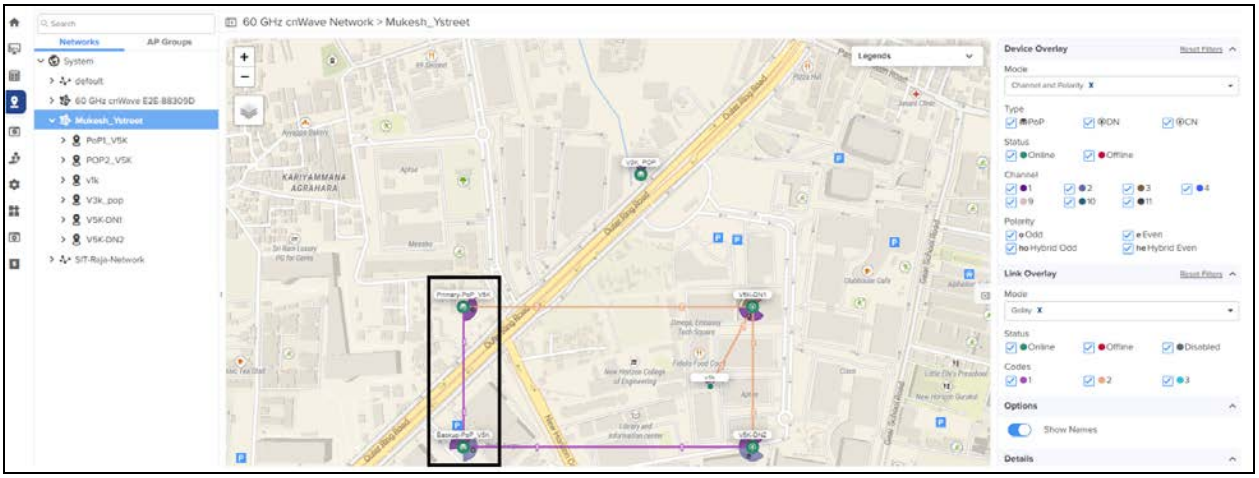
For example, the figure below shows the link between Primary-Pop_V5K and Backup-PoP_V5K has Golay 2 . In this case, Backup-PoP_V5K is configured with Golay 2 override.

Figure 188: *Golay assignment before clearing user overrides*



When the Golay overrides are cleared (using device UI or cnMaestro UI), the devices get Golay code automatically from the controller. The figure below shows the optimized Golay. In this case, the devices have received the Golay code as 1 from the controller, automatically.

Figure 189: *Optimized Golay assignment after clearing user overrides*



Key points

Note the following key points specific to Auto Channel and Golay Optimizer:

- When optimizing the network for channels and Golay codes, channel optimization should be performed first, followed by Golay optimization.
- It is important to note that channel changes do not cause a minion restart. The links will attempt the channel change without dropping the link; however, if the RF channel conditions differ significantly, the links may drop and then re-establish.
- The Channel Optimizer requires all links to be online for the network to compute and apply channel changes. If any links are offline, channel changes for the group containing the offline link will be skipped. This prevents the offline DN from being stranded after a channel change.
- Only channels from the enabled channel list and those permitted by the regulatory region will be used. Check the enabled channel list (using the Advanced UI page) to ensure that the required channels are available.
- The interference profile is calculated based on the node's coordinates and antenna beam pattern. For DNs and CNs with a GPS, the coordinates are automatically available. However, for V1000s, which do not have a built-in GPS, the coordinates must be manually entered to reflect the node's position with reasonable accuracy, ensuring that the synthesized interference profile is representative.
- The Channel Optimizer assumes that all links in the network use CB1 channels only. CB2 channels are not included in the channel or Golay optimization.

Executing Auto Channel and Golay Optimizers

You can enable the Auto Channel and Golay Optimizer features through the **Advanced** page in the device UI or the cnMaestro UI.

Note

cnMaestro 5.2.0 and later versions support the UI controls for executing Auto Channel and Golay Optimizer features.

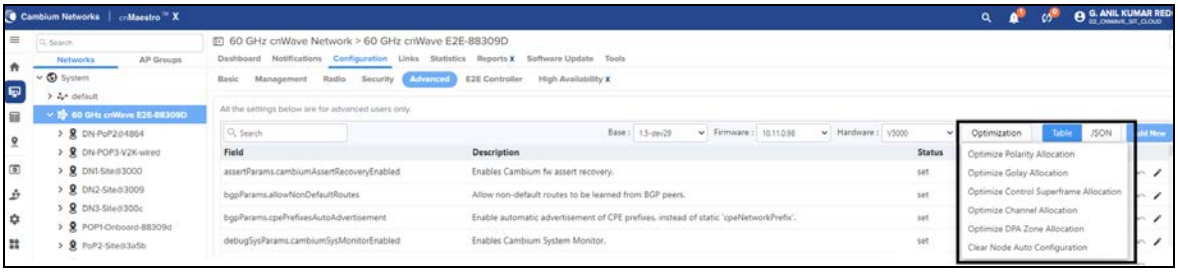
cnMaestro UI

Using the cnMaestro UI, perform the following tasks:

1. From the dashboard page, navigate to the **Monitor and Manage** > **Networks** > **Configuration** > **Advanced** page.
2. Click **Optimization** on the Advanced page.

   The drop-down list displays Optimize Golay Allocation, Optimize Channel Allocation, and other options.

   Figure 190: *Auto channel and Golay optimizers - cnMaestro UI*

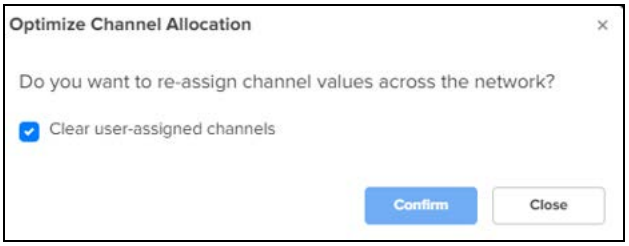


3. To execute the Channel Optimizer feature, complete the following steps:
   a. Select **Optimize Channel Allocation** from the **Optimization** drop-down list.

      The Optimize Channel Allocation configuration box appears.

   b. Select the **Clear user-assigned Channels** checkbox and click **Confirm**.

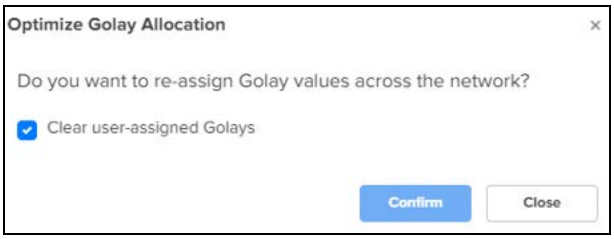
      Figure 191: *The Optimize Channel Allocation configuration box*



4. To execute the Golay Optimizer feature, complete the following steps:
   a. Select **Optimize Golay Allocation** from the **Optimization** drop-down list.

   b. Select the **Clear user-assigned Golays** checkbox and click **Confirm**.

      Figure 192: *The Optimize Golay Allocation configuration box*



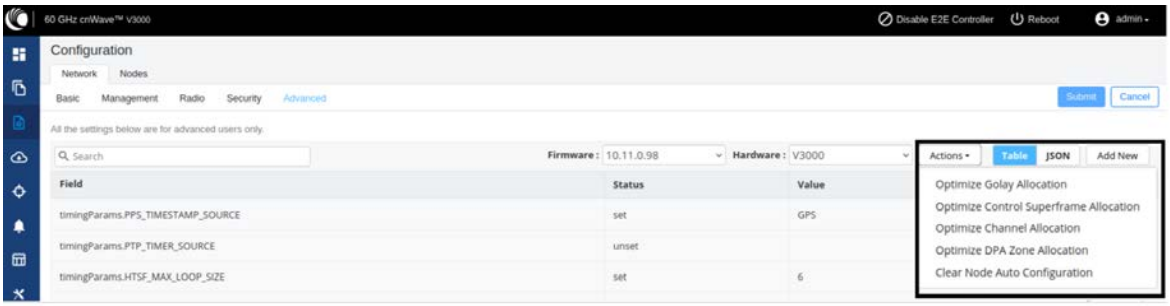
Device UI

Using the device UI, perform the following tasks:

1. From the dashboard page, navigate to the **Configuration** > **Network** > **Advanced** page.
2. Click **Action** on the Advanced page.

   The drop-down list displays Optimize Golay Allocation, Optimize Channel Allocation, and other options.

   Figure 193: *Auto channel and Golay optimizers - Device UI*



3. To execute the Golay Optimizer feature, select Optimize Golay Allocation from the **Action** drop-down list. Then, Select the **Clear user-assigned Golays** checkbox and click **Confirm**.
4. To execute the Channel Optimizer feature, select Optimize Channel Allocation from the **Action** drop-down list. Then, Select the **Clear user-assigned Channels** checkbox and click **Confirm**.

Node configuration

Node configuration is used to configure the nodes via E2E Controller. E2E Controller can modify the node settings. Select the node(Radio) on the left pane to modify the settings.

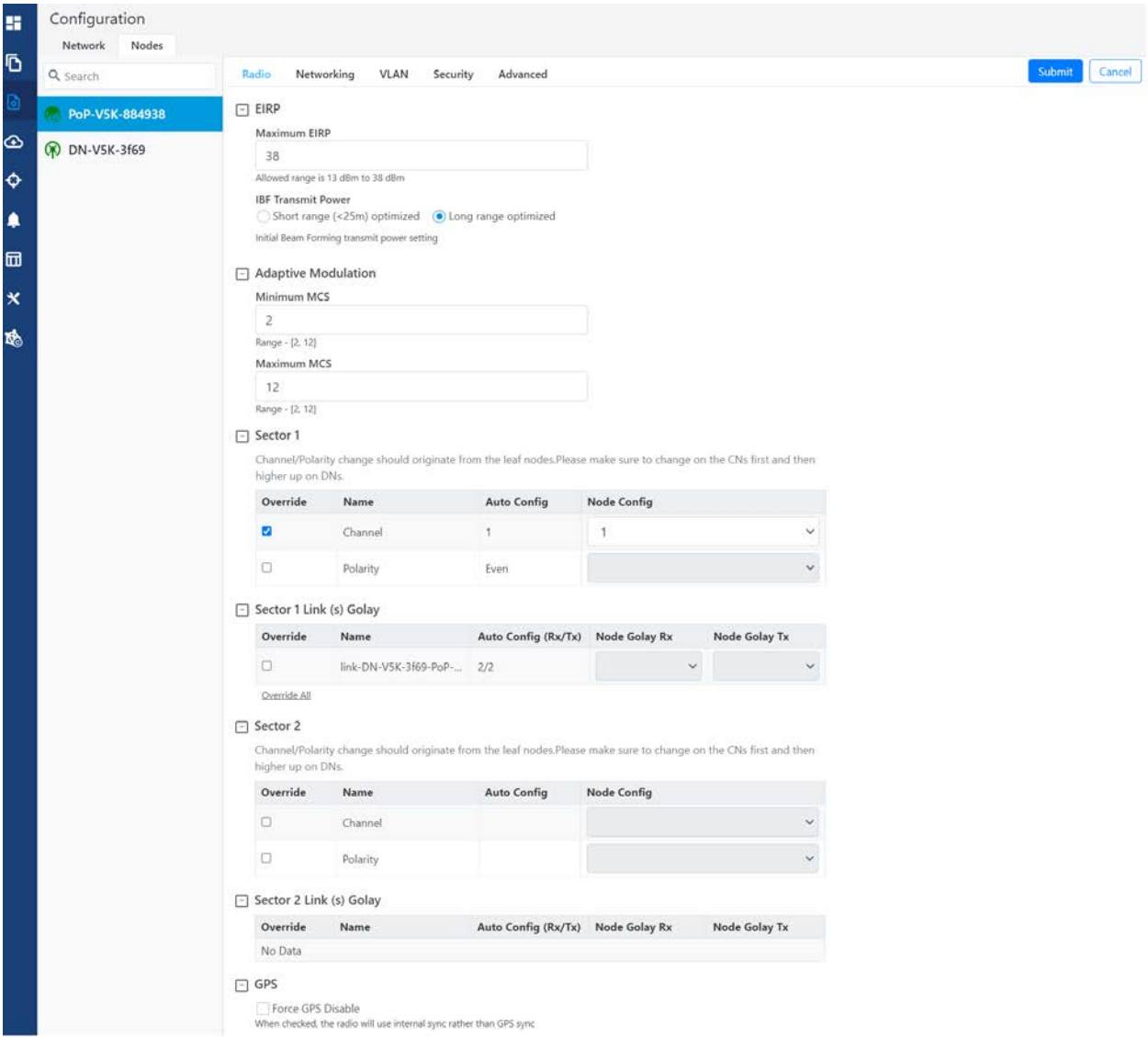
The **Node** configuration contains the following tabs:

- Radio
- Networking
- VLAN
- Security
- Advanced

Radio

To configure the Radio page, navigate to **Nodes** > **Radio** page from the **Configuration** page. The **Radio** page settings apply to individual nodes selected in the left side panel. Select the required options for Transmit Power, Adaptive Modulation, Sector 1, Sector 2 from the drop-down. Enable **Force GPS Disable** to establish the link between indoor nodes.

Figure 194: *The Radio page*



The **Radio** page contains the following elements:

Table 48: Elements in the Radio page

Elements	Description
EIRP	Transmit power of the radio • **Maximum EIRP** - The maximum EIRP transmitted by the radio. Range differs based on the platform and country selected (in the Network page). • **IBF Transmit power** - Transmit power using during initial beam forming. When all the links are in short-range, high transmit power can cause interference. Selecting short-range optimized will prevent this. Post beam forming, automatic power control will make sure the radio transmits at optimal power.
Adaptive	Select minimum and maximum coding scheme ranging from 2 to 12.

Elements	Description
Modulation	
Sector 1	• Select the frequency channel and polarity. • **Channel and Polarity** - When a link is created in topology, the controller automatically sets the sector's channel and polarity. To manually override, click the check box and select the channel in the node configuration. Note that changing channel/polarity breaks the link. It is important to change for leaf nodes first and then higher up on DNs.
Sector 1 Link(s) Golay	Golay codes help in avoiding inter-sector interference. In rare scenarios, individual links might require separate Golay codes. In most scenarios, all the links belonging to a sector are configured same Golay code. The controller automatically sets the Golay code. To manually override, select the check box and set the Golay from the drop-down. **Override All** button helps in setting the same Golay code for all the links. **Note** Golay codes and frequency on both ends of the link should match.
Sector 2	Select the frequency channel and polarity.
Sector 2 Link(s) Golay	Golay code.
GPS	If enabled, the radio uses internal sync rather than GPS sync. In some scenarios like lab setups, it may be necessary to disable GPS.

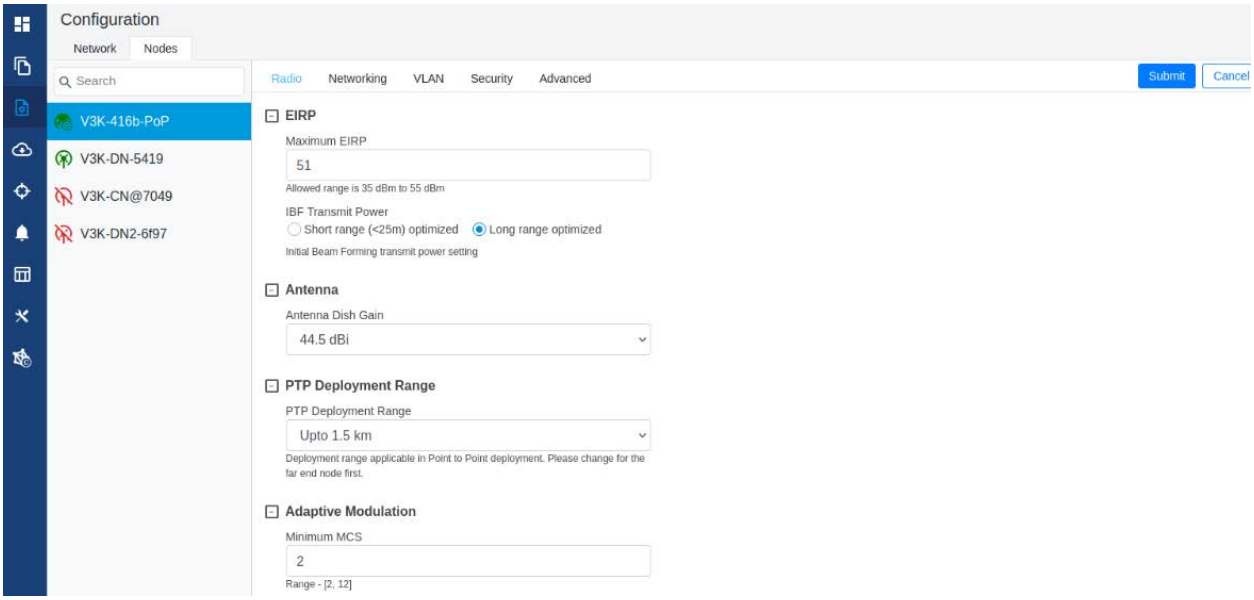
Caution

60 GHz cnWave V1000 and V3000 devices has only **Sector 1**.

V3000 Small dish support

The software allows the selection of smaller 40.5 dBi antenna dish. To select V3000 small dish, navigate to **Configuration** > **Nodes** > **Radio**. The **Antenna** section is available in the Radio page.

Figure 195: *The Antenna section*



Caution

Small dish is supported only for 60 GHz cnWave V3000.

Networking

Using the **Nodes** > **Networking** page, you can set the following configurations:

- Configuring static IPv4 management and other network settings
- Configuring DHCPv4 client on PoP nodes
- Enabling the DHCP Option 82 feature
- Configuring Monitor IPV4 Gateway
- Setting the Out of Band (OOB) interface
- Configuring PTP External failover

Configuring static IPv4 management and other network settings

To configure static IPv4 management, PoP interface, and other network settings, perform the following steps:

1. From the home page of device UI, navigate to **Nodes** > **Networking**.

   The **Networking** page appears.

2. In the **IPv4 Management** section, enter the local IPv4 address.

Figure 196: *The IPv4 Management section in the Networking page*

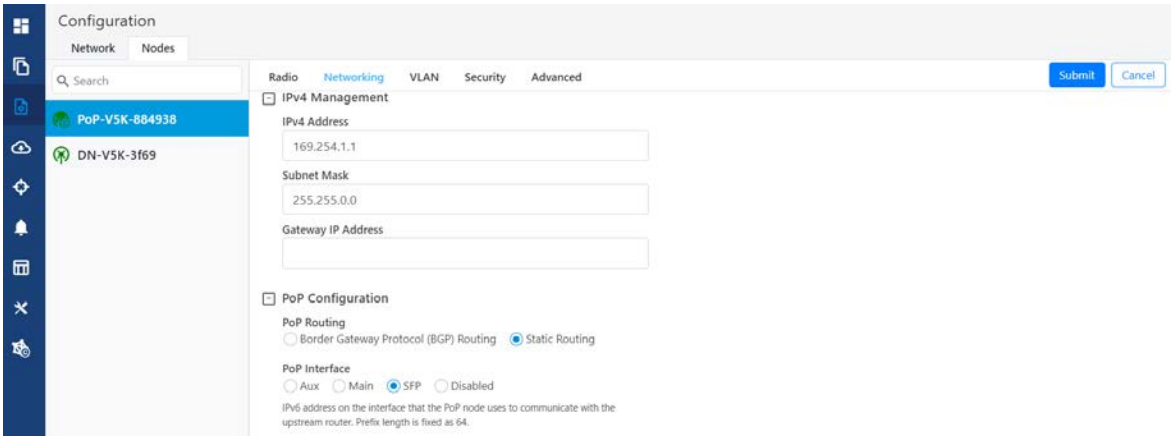


Table 49: Elements in the IPv4 Management section

Elements	Description
IPv4 Address	Static IPv4 address of the individual node. Node's GUI /CLI can be opened using this IP address when directly connected over Ethernet. For Over the air access, L2 Bridge should be enabled. Its predominantly used on PoP nodes with the onboard controller.
Subnet Mask	Subnet mask for the IPv4 address.
Gateway IP Address	IPv4 Gateway address.

3. In the **PoP Configuration** section, select the options for **PoP Routing**, **PoP Interface**, and click **Generate** to generate **PoP Interface IP Address**.

Figure 197: *The PoP Configuration section in the Networking page*

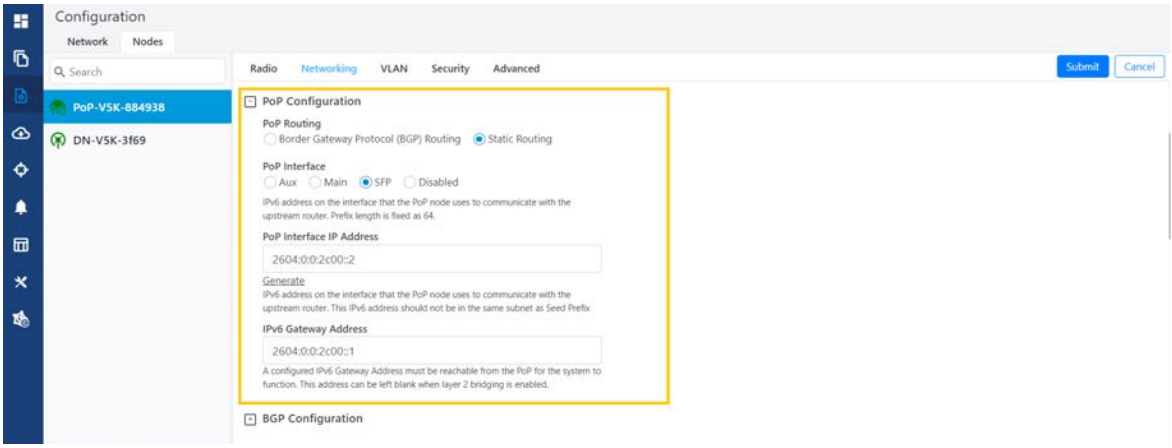


Table 50: Elements in the PoP Configuration section

Elements	Description
PoP	PoP nodes connect to the upstream IPv6 router in one of two ways:

Elements	Description
Routing	• **Border Gateway Protocol (BGP) Routing** – PoP acts as a BGP peer • **Static routing** – IP gateway address should be specified on the PoP and static route should be added on the upstream router. When the system is targeted for L2 traffic (Layer 2 bridge enabled) and an onboard controller is used, this configuration is of not much significance, recommended to set to static routing.
PoP Interface	The wired interface on which PoP communicates to an upstream router or switch when the L2 bridge is enabled.
PoP Interface IP Address	IPv6 address on the interface that the PoP node uses to communicate with the upstream router.
IPv6 Gateway Address	Gateway address. It can be left empty when the L2 bridge is enabled and no IPV6 services like NTP /Radius are used.

4. Under **E2E Controller Configuration**, enter E2E IPV6 Address (Address of E2E Controller). When using the onboard controller on the same node, it can be left empty and GUI automatically fills the POP IPv6 address.

Note

If PoP DN is V5000/V3000 then, IPv6 both address is same.

Table 51: Elements in the E2E Controller Configuration section

Elements	Description
E2E IPv6 Address	Address of E2E Controller. When using the onboard controller on the same node, it can be left empty and GUI automatically fills the POP IPv6 address.
E2E Network Prefix	Seed Prefix in the CIDR format followed by a comma and the prefix length. Should be specified when BGP is used. Otherwise, optional.
IPv6 CPE Interface	IPv6 SLAAC provides IP prefix to downstream CPE devices. Keep it disabled when L2 Bridge is active.

5. Select the required BGP configuration.

Figure 198: *The BGP Configuration section*

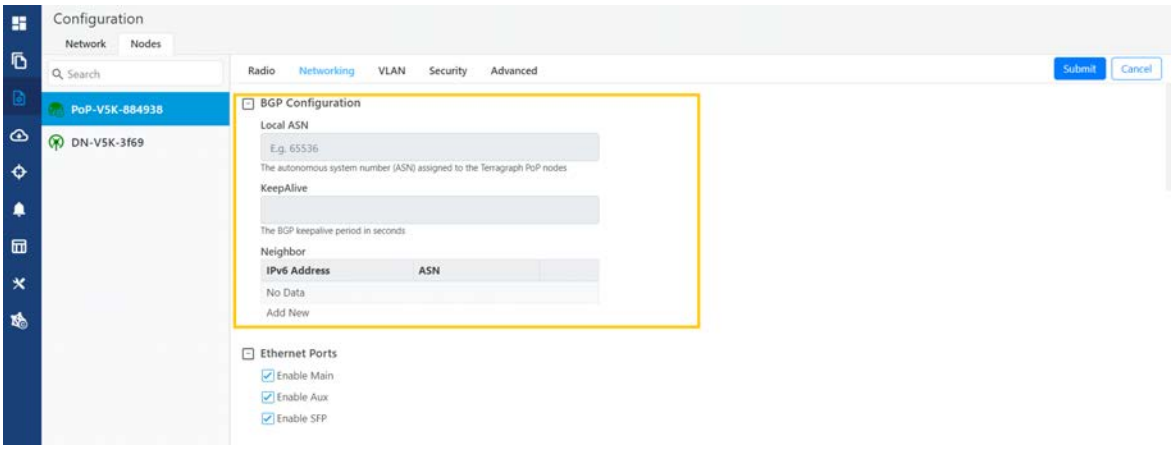
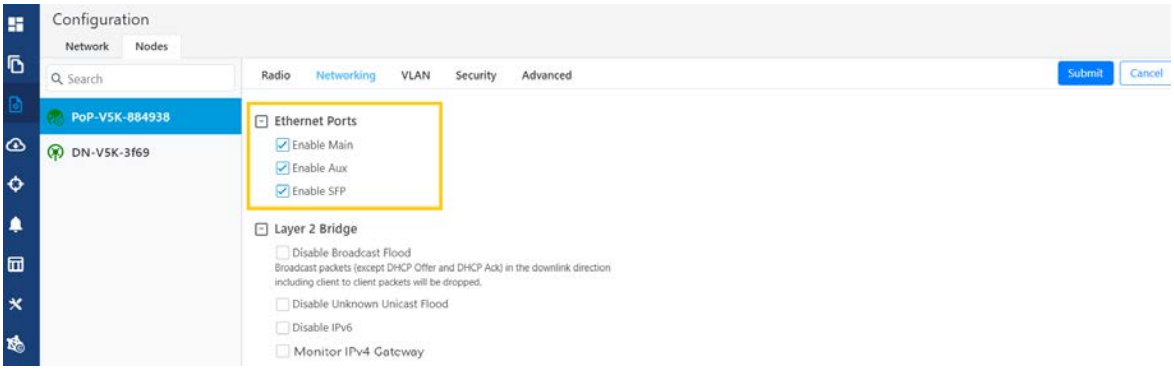


Table 52: Elements in the BGP Configuration section

Elements	Description
Local ASN	Local ASN
KeepAlive	The BGP keepalive period in seconds.
Neighbour ASN	Upstream router's ASN
Neighbour IPv6	Upstream router's IPv6 address
Specific Network prefixes	Specifically allocated network prefixes to be advertised via BGP

6. Enable the required Ethernet ports. Individual Ethernet ports can be turned off with this configuration.

Figure 199: *The Ethernet Ports section*



7. Select the required options for **Layer 2 Bridge**, **IPv6 Layer 3 CPE**, **Aux PoE** (enable to power on Aux port), and **Multi-PoP / Relay Port**. By default, this option is disabled and PoP floods any unknown unicast ingress packets on all the L2 GRE tunnels. When the option is enabled, PoP drops such packets.

Figure 200: *The Layer 2 Bridge section in the Networking page*

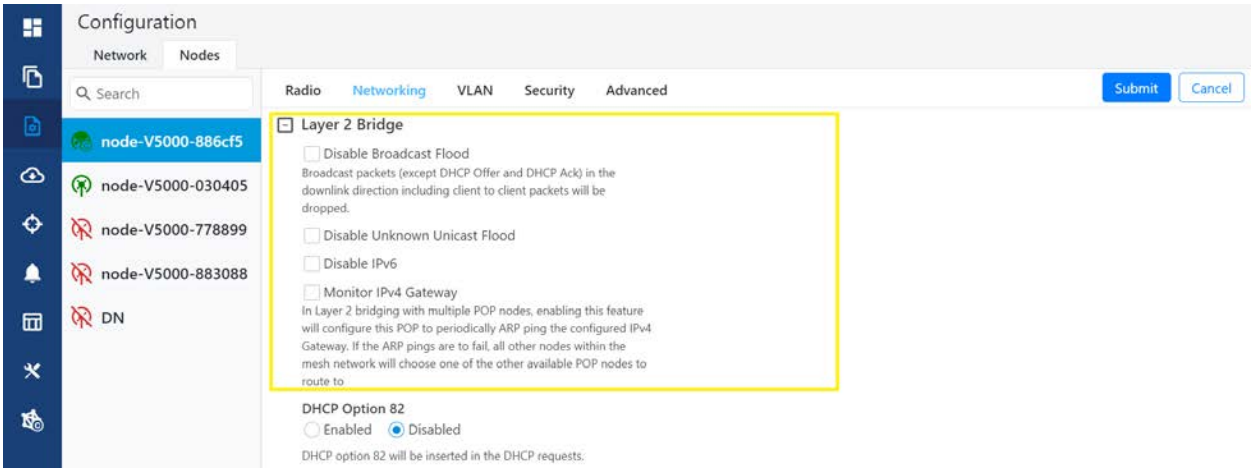


Table 53: Elements in the Layer 2 Bridge section

Elements	Description
Layer 2 Bridge	It has three options: • Disable Broadcast Flood • Disable Unknown Unicast Flood • Disable IPv6 • Monitor IPv4 Gateway For information on **Monitor IPv4 Gateway**, refer to Configuring Monitor IPv4 Gateway,
Aux PoE	Enable PoE out (25 W) on V5000/V3000 aux port. 802.3af and 802.3at compliant devices could be powered up, passive PoE devices cannot be powered up. Note that the aux port cannot power another V5000/V3000.
Multi-PoP / Relay Port	Indicates the wired interfaces (or Ethernet) on which OpenR is running. This element must be used: • When DNs are connected back-to-back. • When multiple PoPs are in the network. This allows PoP nodes to forward traffic to other PoP nodes via a wired connection when the routing path of the other PoP node is closer to the traffic destination The following options are supported: • Aux • Main • SFP • Disabled

Configuring DHCPv4 client on PoP nodes

When you configure DHCPv4 on the PoP nodes, the DHCP client simplifies and automates the process of network configuration for devices. A manual configuration of the network settings is not required. The DHCP client automates the process by interacting with DHCP servers on the network. The DHCP client uses the information received from the DHCP server to configure its network interface, including obtaining an IP address, subnet mask, default gateway, DNS server addresses, and other relevant settings.

Note

The DHCP configuration is available only for the PoP nodes. It is not available for CN and DN nodes.

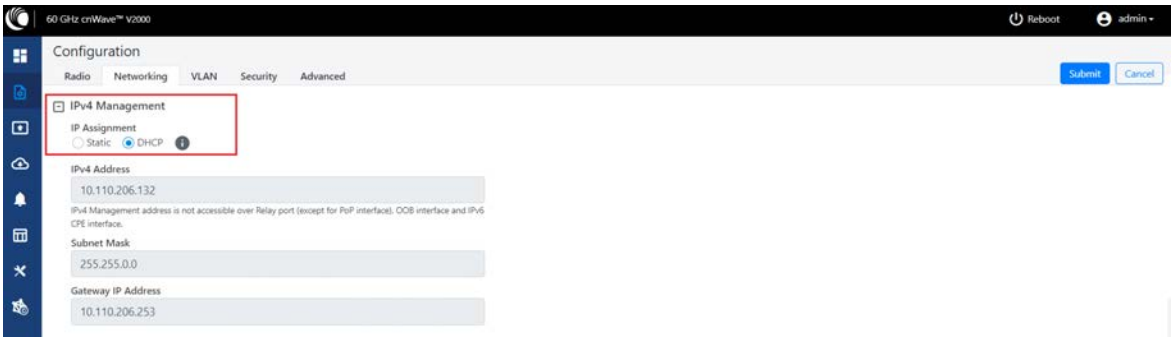
To set the DHCP configuration, perform the following steps:

1. From the home page of device UI, navigate to **Nodes** > **Networking**.

   The **Networking** page appears.

2. In the **IPv4 Management** section, select **DHCP** from the IP Assignment parameter options, as shown in Figure 201.

   Figure 201: *DHCPv4 Configuration - device UI*



Note

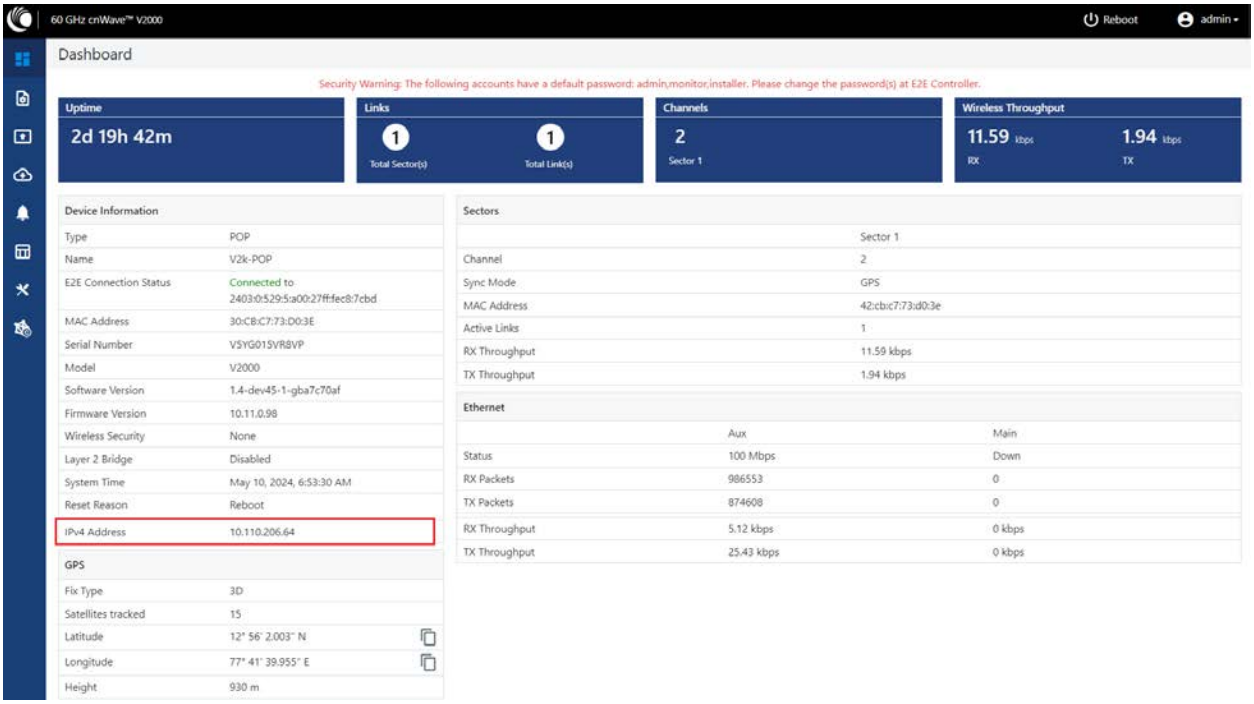
You can also use the cnMaestro UI (Configuration > Network page) to set the DHCP configuration.

3. Click **Submit** to apply the changes.

   When you set the DHCP configuration, the IPv4 address, Subnet mask, and Gateway IP address are automatically obtained from the DHCP server.

The dashboard page in both the device UI (running the Onboard Controller) and cnMaestro display the IPv4 address. Figure 202 shows the dashboard page of a device UI.

Figure 202: *The dashboard page displaying the IPv4 address*



Enabling the DHCP Option 82 feature

When the **DHCP Option 82** feature is enabled, 60 GHz cnWave intercepts DHCPv4 REQUEST and DISCOVER packets and inserts option 82 fields.

Note

This feature is supported in the L2 bridge mode.

In addition, you can also configure **Circuit ID** and **Remote ID** fields. Use the following wildcards to configure **Circuit ID** and **Remote ID** fields:

- $nodeMac$ - MAC address of the node in ASCII format without colons. This is a default option.
- $nodeName$ - Topology name of the node.
- $siteName$ - Name of the site.
- $networkName$ - Network name as shown in cnMaestro.

Multiple wildcards can be combined with a : delimiter. The total length of the option (after replacing wildcards with corresponding values) is truncated to 120 characters. You can also configure a custom string, which must not start with a $ character. For example, a customer's phone number.

Note

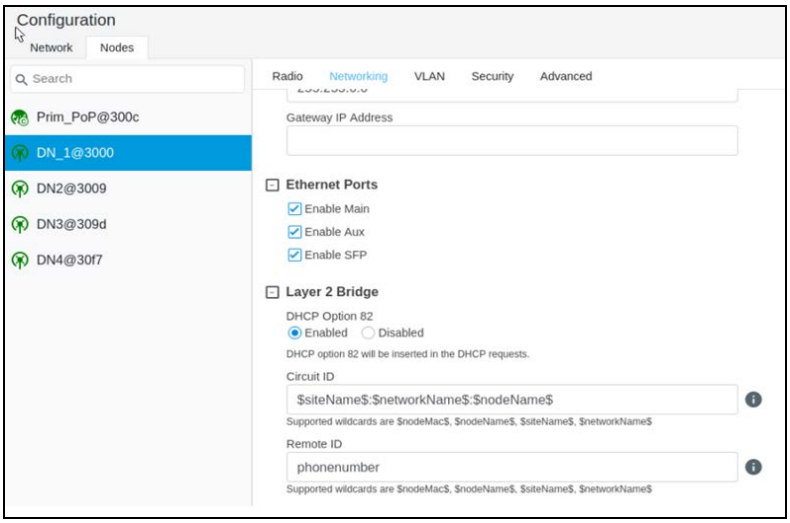
You cannot use the customized string and predefined wildcards together as a single sub option (Circuit ID / Remote ID).

To enable the **DHCP Option 82** feature, perform the following steps:

1. Navigate to **Nodes** > **Networking** from the home page.

   The **Networking** page appears. The **DHCP Option 82** feature is available in the Layer 2 Bridge section, as shown in Figure 203.

   Figure 203: *The DHCP Option 82 feature*



   The enabled status of **DHCP Option 82** implies that the feature is activated.

2. Type appropriate values in **Circuit ID** and **Remote ID** text boxes.

3. To save the configuration, click **Submit**.

Configuring Monitor IPV4 Gateway

The **Monitor IPV4 Gateway** parameter is applicable when static routing and Layer 2 bridge are enabled in the device UI.

When you enable this parameter using the device UI, the IPv4 gateway is monitored. In Layer 2 bridging with multiple PoP nodes, this parameter (when enabled) configures the PoP to periodically ARP ping the configured IPv4 gateway. If the ARP ping fails for consecutive 12 seconds, all the other nodes (within the mesh network) choose one of the other available PoP nodes to route.

The **Monitor IPV4 Gateway** configuration results in failover of Layer 2 tunnels to next best PoP when the PoP cannot reach the IPv4 gateway. This configuration is applicable when static routing is used and IPv4 gateway is configured.

Before configuring the **Monitor IPv4 Gateway** parameter, perform the following configurations using the device UI:

- Enable the **Layer 2 Bridge** parameter using the **Configuration** > **Network** > **Basic** page. This action enables Layer 2 network bridging (through automatically created tunnels) across all nodes connected to a PoP. This action also facilitates the bridging of IPv4 traffic across the wireless networks.

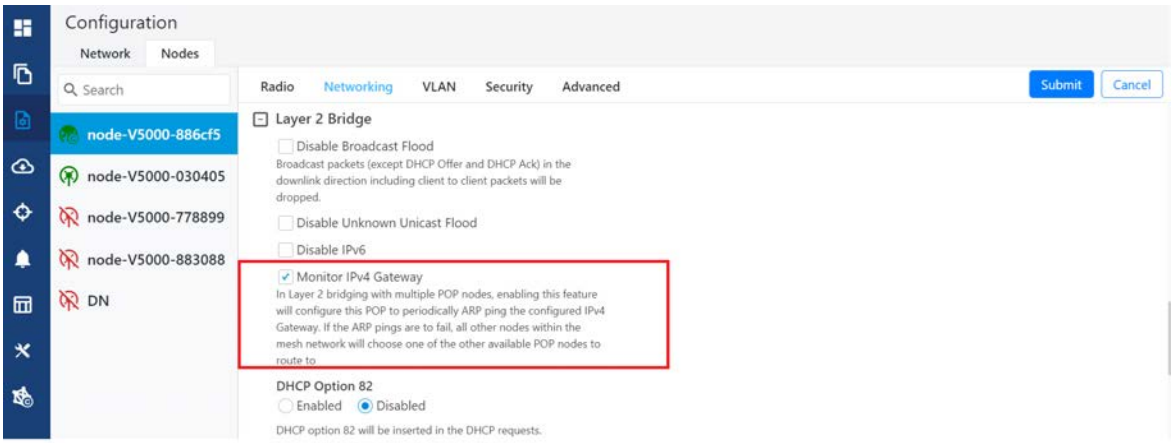
- Set the value of **PoP Configuration** parameter to Static Routing for the required PoP using the **Configuration** > **Nodes** > **Networking** page. This action results in failover of Layer 2 tunnels to next best PoP when the PoP cannot reach the IPv4 gateway. This configuration is applicable when static routing is used and IPv4 gateway is configured.

To enable and configure the **Monitor IPV4 Gateway** parameter, perform the following steps:

1. From the home page, navigate to **Configuration** > **Nodes**> **Networking**.

   The **Networking** page appears. The **Monitor IPV4 Gateway** check box is available in the **Layer 2 Bridge** section, as shown in Figure 204.

   Figure 204: *The Monitor IPV4 Gateway parameter*

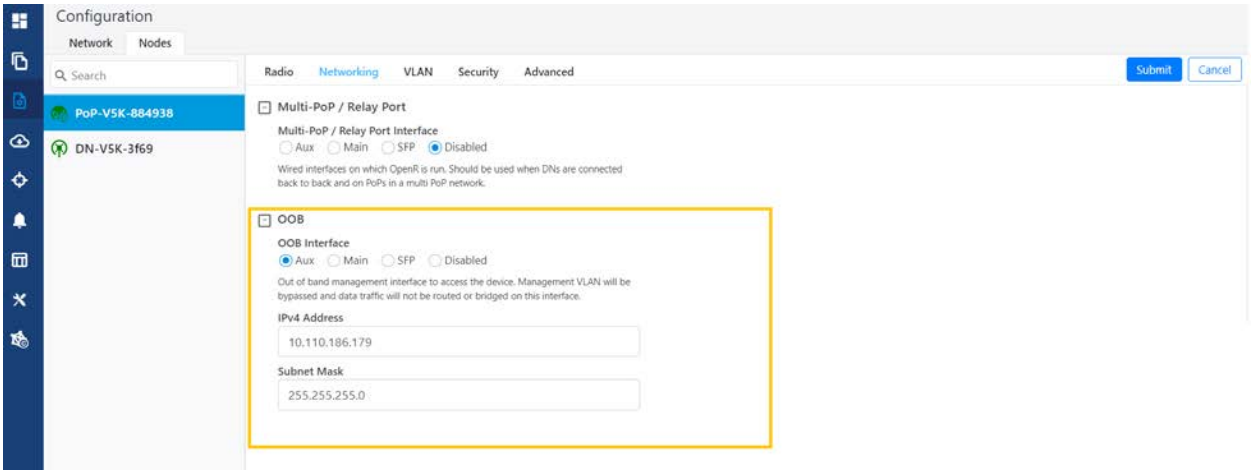


2. Select the **Monitor IPV4 Gateway** check box to enable the parameter.
3. Click **Submit** to save the changes.

Setting the Out of Band (OOB) interface

Out of band (OOB) management interface to access the device. Management VLAN is bypassed, and data traffic will not be routed or bridged on this interface. The OOB management interface is supported at PoP. A separate IPv4 address should be configured by bypassing the Management VLAN. Navigate to **Configuration** > **Nodes** > **Networking** > **OOB** and select the required option. Enter the IPv4 address and Subnet Mask to access the device.

Figure 205: *The OCB section in the Networking page*



Configuring PTP External failover

The **PTP External Failover** feature supports the failover of a 60 GHz cnWave RF link using external devices such as PTP450 and ePMP.

Note

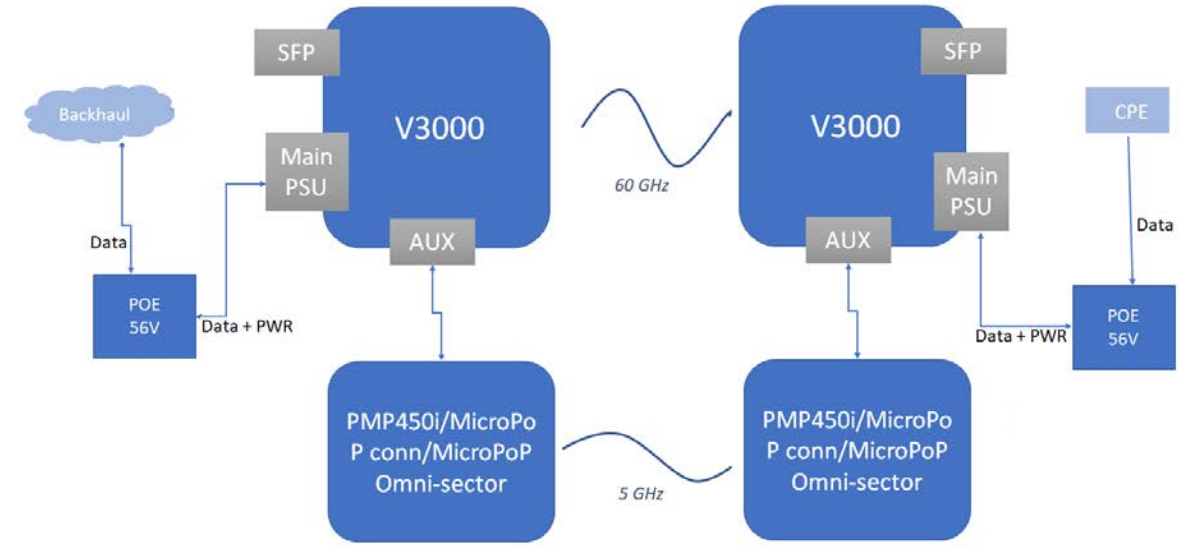
System Release 1.2.2 and later subsequent release versions support the external failover link feature for Point-to-Point (PTP) links. The external failover interface must not be same as PoP, Relay, or Out of Band (OOB) interface.

This feature does not support V1000 (which contains only one port).

Figure 206 shows how a 60 GHz cnWave PTP link is backed up with a PTP450 link. You can consider the 60 GHz link (as shown in Figure 206) as the primary link and 5 GHz link as the secondary link.

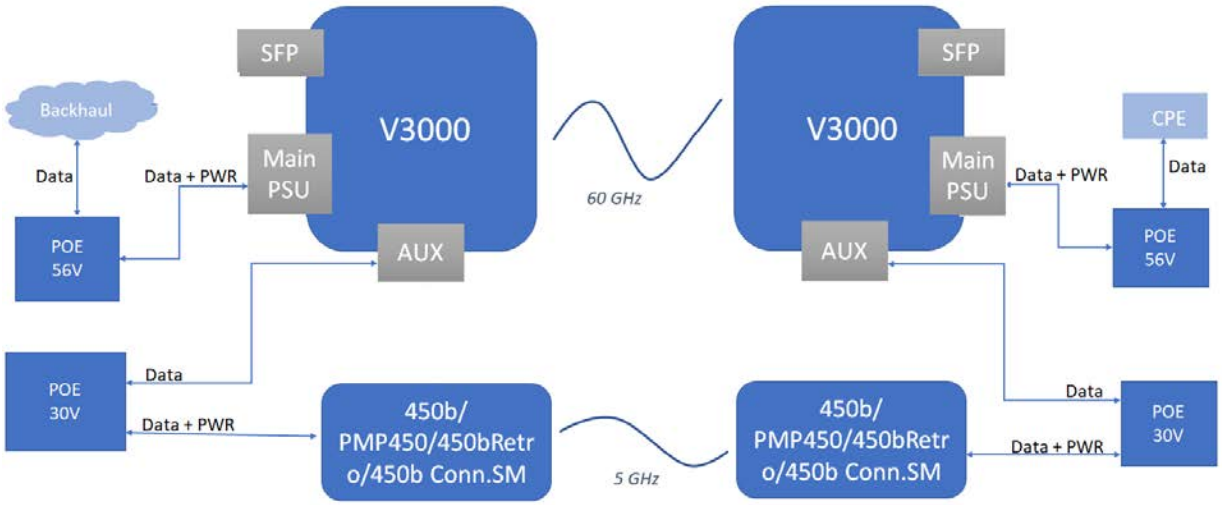
Figure 206: *Backing up the 60 GHz cnWave PTP link*

Scenario 1:



Note: Enable AUX PoE Power on V3000.

Scenario 2:



Note: Disable AUX PoE Power on V3000.

Whenever a 60 GHz link is up or active, traffic flows through the 60 GHz cnWave link. When the 60 GHz link is down, traffic fails over (shifts) to the 5 GHz link (PTP450). When the 60 GHz link is back (up), the traffic shifts instantly over to the 60 GHz cnWave link.

You can configure the external failover link feature using the device UI or the cnMaestro UI.

Using the device UI:

To enable and configure the external failover link feature using the device UI, perform the following steps:

1. From the home page of the device UI, navigate to the **Configuration** > **Nodes** > **Networking** page.

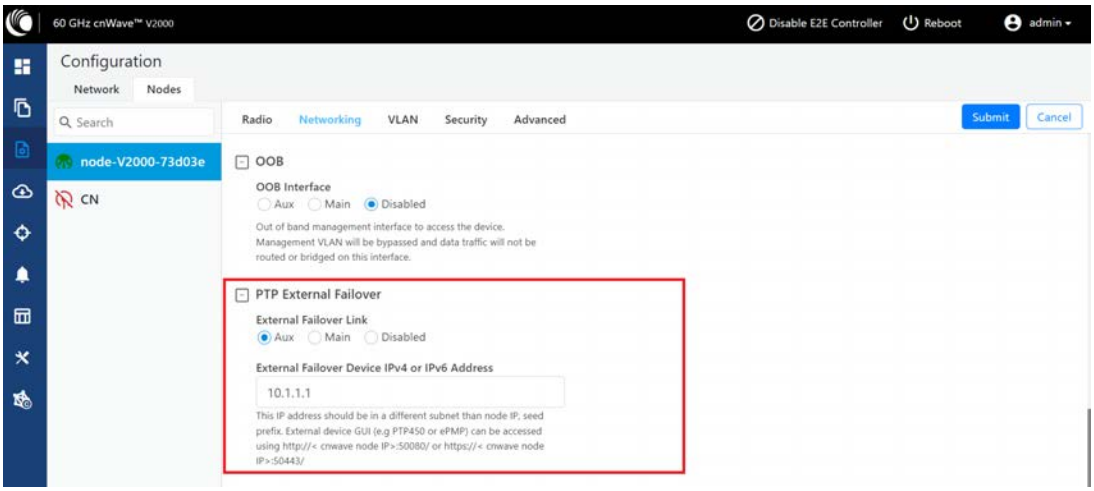
   The **Networking** page appears.

2. In the **PTP External Failover** section (as shown in Figure 207), set the following configurations:

   a. To set the Ethernet interface for a node connected to external failover link, select either **Aux** or **Main** (Ethernet ports) from the **External Failover Link** parameter.

   By default, the **Disabled** option is selected.

   Figure 207: *The PTP External Failover section in the device UI*



   b. Enter either IPv4 or IPv6 address of the external failover device In the **External Failover Device IPv4 or IPv6 Address** text box.

   Note

   Ensure that IPv6 is enabled in the external failover device.

3. Click **Submit** to save the changes.

Using the cnMaestro UI

To configure the external failover link feature, add and manage the following configurations in the **Advanced** page of cnMaestro UI:

- **Ethernet interface for each node**: Configure the Ethernet interface in PoP and CN, which are connected to the failover link. You must select the Ethernet port to which the external device is connected. Open/R protocol runs on this interface.

- **External failover interface address (IP address)**: An optional configuration that is required only if you want to access the AP or SM UI from upstream. You must configure the IP address of external devices (for example, PTP450 or ePMP). This IP address must be in a different subnet other than node IP address or seed prefix.

  The IP address can be either IPv4 or IPv6. However, ensure that external failover devices have IPv6 enabled.

- **Remote external failover node address**: Configure the remote external failover node address. You can access the external failover device UI using `http://<cnwave node IP>:50080/` or `https://<cnwave node IP>:50443/`.

To configure the external failover link feature using the cnMaestro UI, perform the following steps:

1. From the dashboard page of the cnMaestro UI, navigate to the **Monitor and Manage** > **Networks** > **Configuration** > **Node** > **Advanced** page.

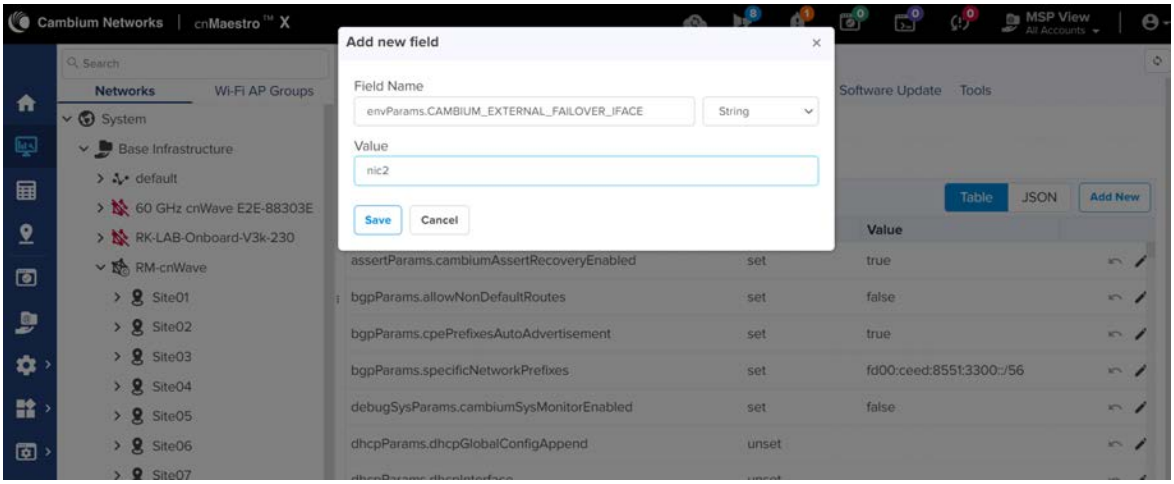
   The **Advanced** page appears.

2. To add and manage the Ethernet interface for each node (PoP and CN), Click **Add New** located at the right side of the page.

   The **Add new field** page appears.

3. In the **Field Name** text box, provide `envParams.CAMBIUM_EXTERNAL_FAILOVER_IFACE` (in String format) for each node, as shown in Figure 208.

   Figure 208: *The Add new field page in the cnMaestro UI*



4. In the **Value** field, enter an appropriate value.

5. Click **Save**.

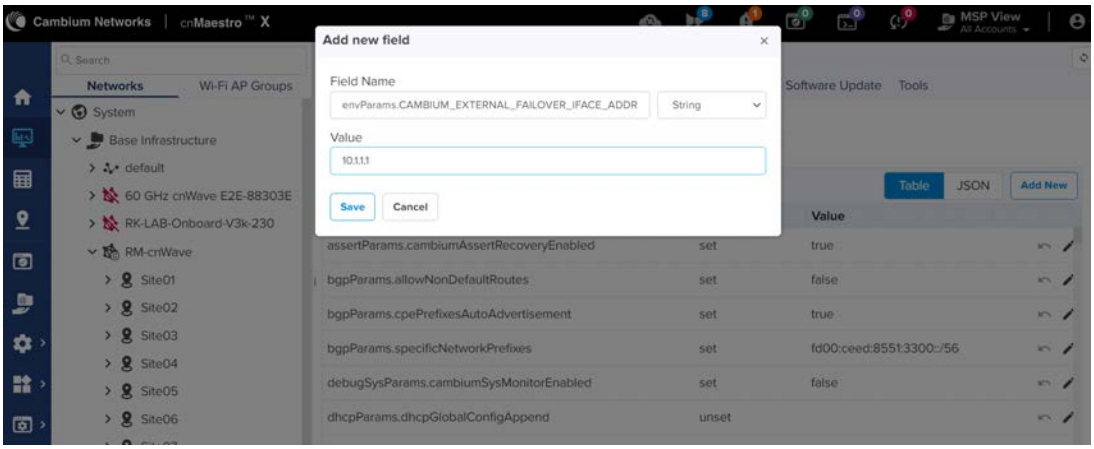
   The **Advanced** page is updated the new entry that you added.

6. Click **Submit** located on the right side of the **Advanced** page.

   Similarly, you must add and manage the following configurations, separately, using the **Add New** button on the **Advanced** page:

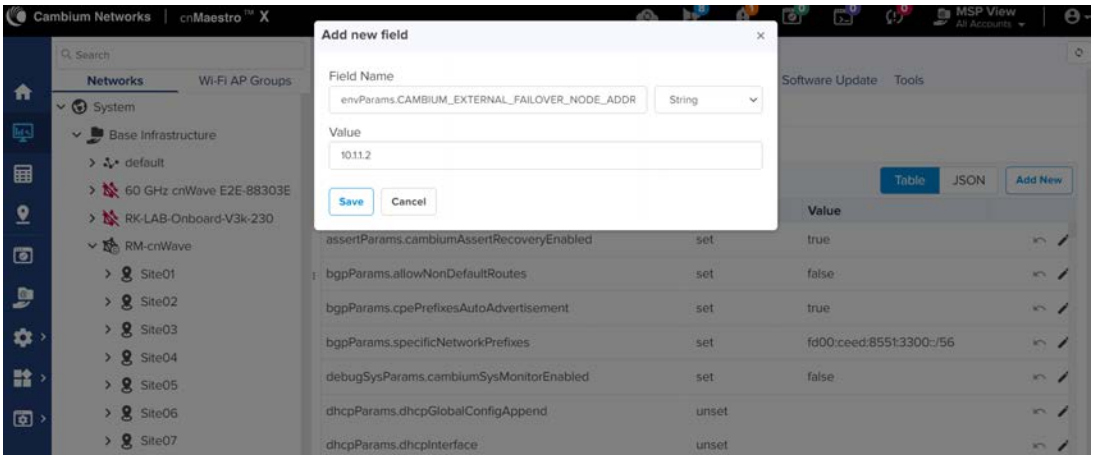
   - For external failover interface address (IP address), provide `envParams.CAMBIUM_EXTERNAL_FAILOVER_IFACE_ADDR` (in String format) in the **Field Name** text box, as shown in Figure 209.

Figure 209: *Configuring the external failover interface address*



- For remote external failover node address, provide `envParams.CAMBIUM_EXTERNAL_FAILOVER_NODE_ADDR` (in String format) in the **Field Name** text box, as shown in Figure 210.

Figure 210: *Configuring the remote external failover node address*



Then, you must ensure to provide an appropriate value in the **Value** text box for each configuration. Finally, you must save and submit each configuration.

Note

Following limitations are observed in this release specific to the external failover feature:

- There is no representation of an external failover link on the **Map** page.
- There are no statistics available on the external failover link.
- No other UI or cnMaestro used for configuring the external failover interface and address. This feature can be configured only through the **Configuration** > **Nodes** > **Advanced** page.

VLAN

Data VLAN

The following 802.1Q features are supported per port:

- Adding single VLAN tags to untagged packets
- Adding QinQ/double-tag to untagged packets
- Adding QinQ outer tag to single tagged packets
- Transparently bridge single/double-tagged packets (default behavior)
- Remarking VLAN ID
- Remarking 802.1p priority
- Option to allow only the selected range of VLAN IDs
- Option to drop untagged packets
- Option to drop single tagged packets
- Option to select the ethertype of the outer tag

These options are per Ethernet port.

Note

VLAN configuration is applicable only when Layer 2 bridge is enabled.

Port Type

Figure 211: *The port types*

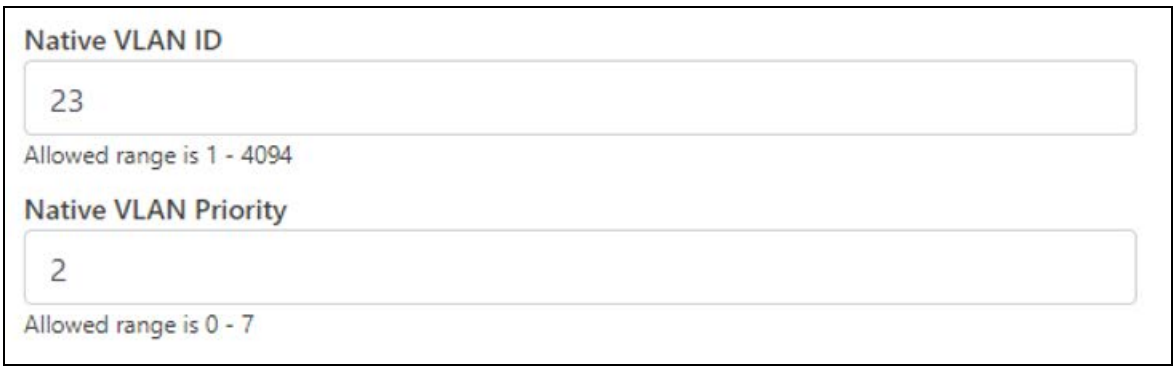
Transparent

By default, the Ethernet port is in transparent mode. Packets will be transparently bridged without any 802.1Q processing.

Q

Q mode allows adding a single C-VLAN tag to untagged packets.

Figure 212: *Native VLAN ID and priority*

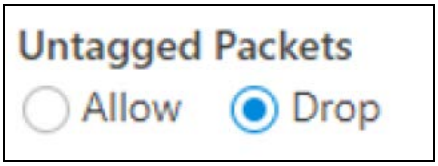


Native VLAN ID and priority fields define the C-VLAN tag properties.

Figure 213: *Allowed VLANs*

Allow only the listed range of VLAN IDs.

Figure 214: *Untagged types*

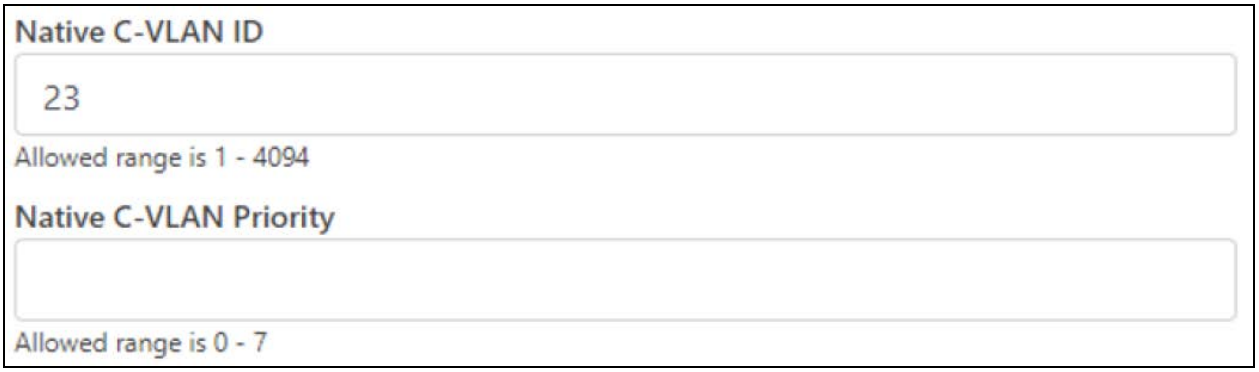


This option allows the dropping of untagged packets. Native VLAN properties are not necessary to fill when untagged packets are dropped.

QinQ

QinQ mode allows adding a double tag to untagged packets and outer S-VLAN to single-tagged packets.

Figure 215: *Native C-VLAN ID and priority*

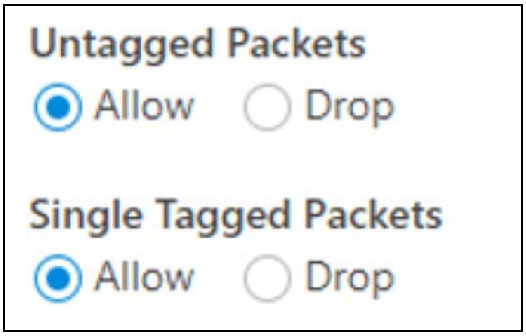


These are the C-VLAN tag properties of added tag.

Figure 216: *Native S-VLAN ID and priority*

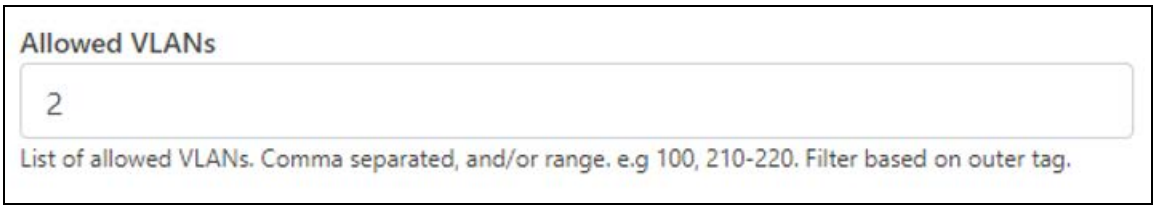
These are the S-VLAN tag properties of the added outer tag.

Figure 217: *Untagged and Single tagged packets*



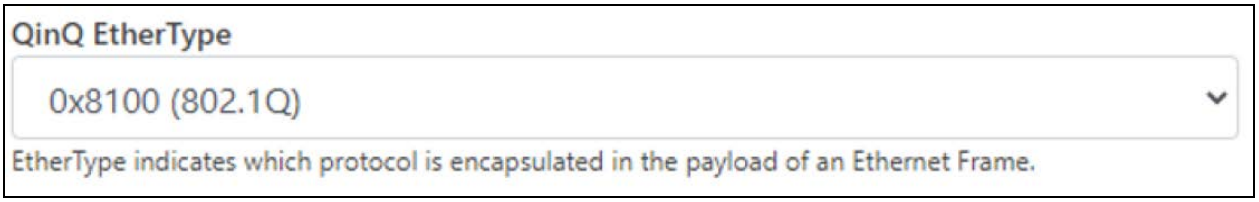
In QinQ mode, the above options allow dropping untagged/single-tagged ingress packets. Native C-VLAN fields are not necessary only when dropping single-tagged packets. Native S-VLAN fields are not necessary when dropping untagged and single tagged packets.

Figure 218: *Allowed VLANs*



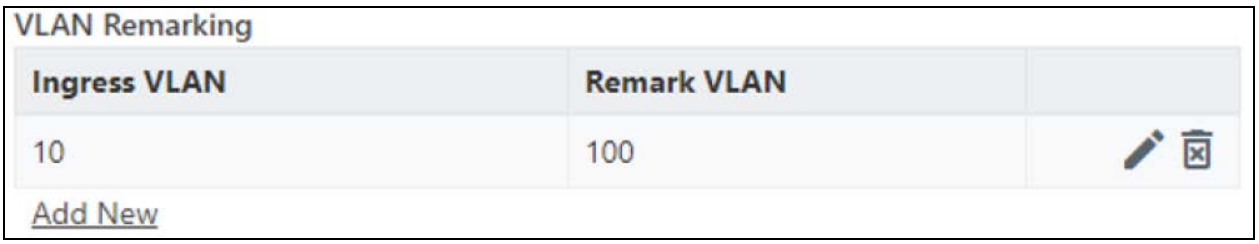
Allow only the listed range of VLAN IDs. VLAN ID of the outer tag is used for this check.

Figure 219: *QinQ EtherType*



QinQ EtherType is used while adding an outer tag. There are no other checks for EtherType.

Figure 220: *VLAN ID Remarking*



VLAN ID of the ingress packet is remarked. In the above example, if a packet with VLAN ID 10 enters an Ethernet port, it is remarked to 100. In the egress path, the reverse remarking occurs. VLAN ID 100 is remarked to 10 and egresses the ethernet port.

The VLAN ID of the outer tag is used for remaking. For a double-tagged packet, S-VLAN ID gets remarked and for a single-tagged packet, C-VLAN 1D.

802.1p overriding

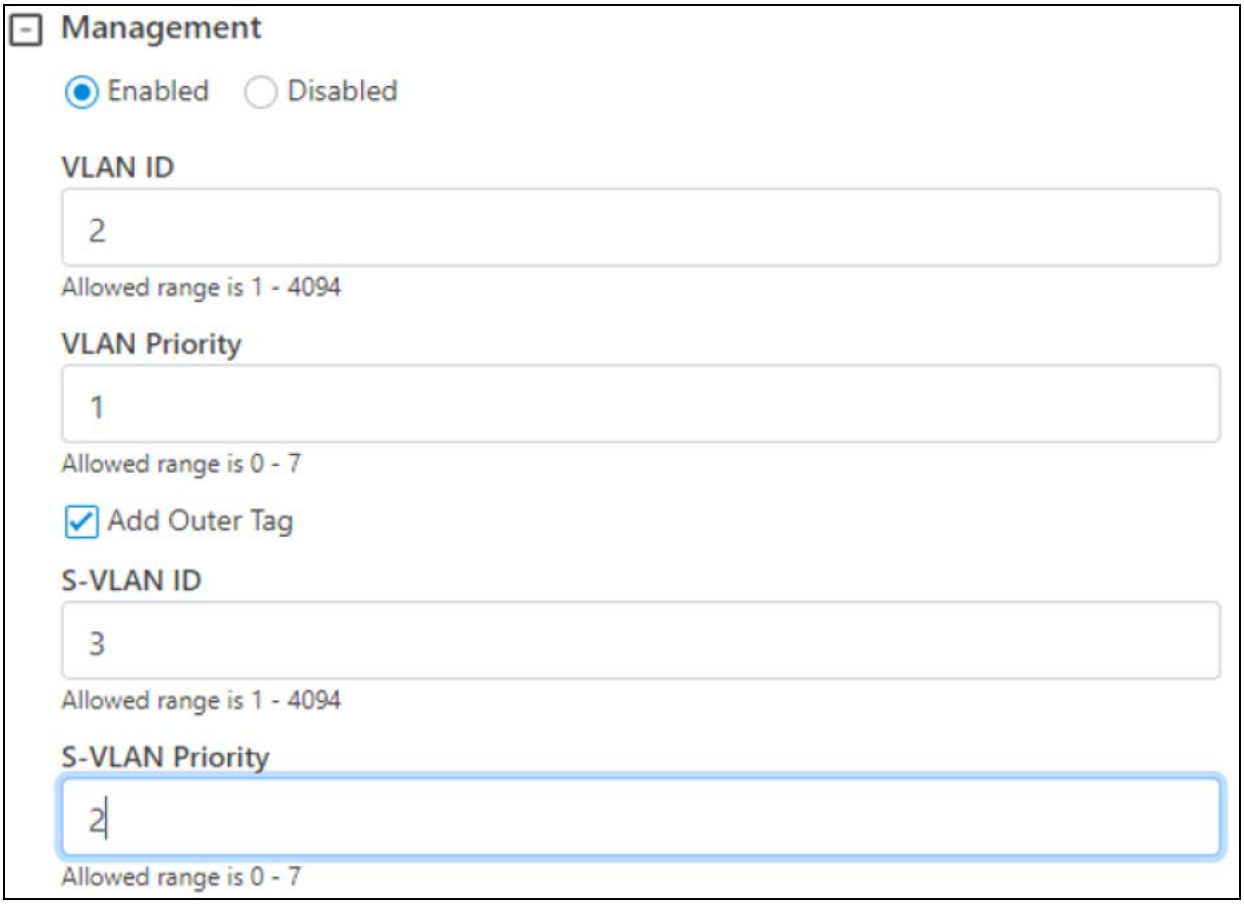
The Priority field in the (outer) VLAN tag of ingress packet can be overwritten using this option.

Figure 221: *VLAN Priority Override*

Management VLAN

A Single tag or double tag can be added to Management traffic.

Figure 222: *The Management section*

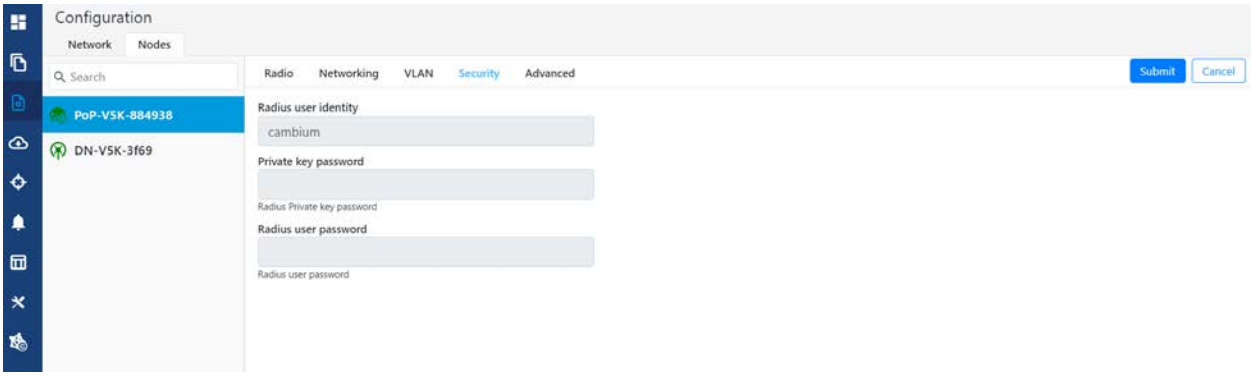


Security

In the **Security** tab, enter **Private key password** and **Radius user password**.

- Private key password
- Radius user password

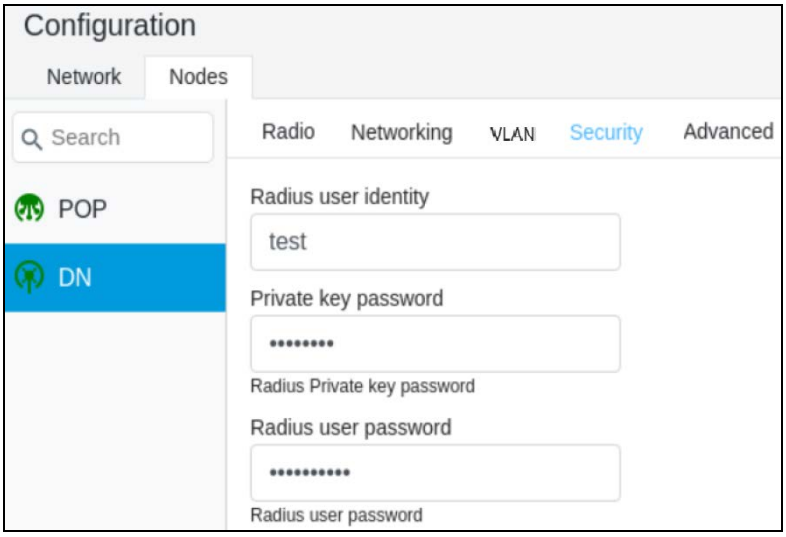
Figure 223: *The Security page*



Controller UI configuration

This Controller GUI configuration to be made on each DN.

Figure 224: *Elements specific to Controller configuration*



Node UI configuration

You can configure the **Security** page for a single node. The **Security** page is available on the single node UI.

Figure 225: *Elements specific to node configuration*

Note

Both the configurations are important for a successful authentication.

RADIUS Server configuration

Any RADIUS server can be used for authentication. Perform the following steps to configure the RADIUS Server:

1. Ensure that RADIUS packets from IPv6 subnet (IP subnet) is accepted in RADIUS configuration.
2. Configure EAP-TLS for RADIUS Server and setup server certificate, key.

Note

Server certificate is signed by CA uploaded in node configuration.

3. Set the CA certificate which signed the client certificate installed on each node.

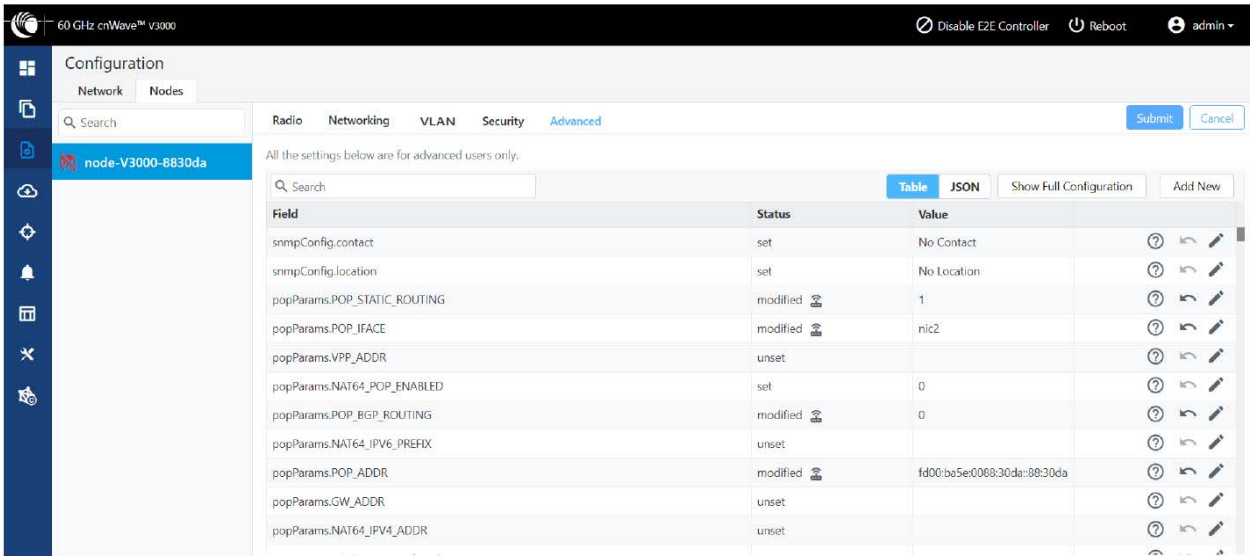
Advanced

These settings are for advanced users only.

Caution

Users are not recommended to do these settings.

Figure 226: *The Advanced page - Node configuration*



Configuration options under **Network > Advanced** and **Node > Advanced** are for advanced users who understand the cnWave configuration model well. It is not recommended to use these options. Shows the merged configuration from the Base layer to the Network override layer.

cnWave is based on Facebook's Terragraph architecture. It follows a layered configuration model, with a node's "full" configuration computed as the union of all layers in the following order:

- **Base configuration** - The default configuration, which is tied to a specific software version and is included as part of the image. The controller finds the closest match for a node's software version string and falls back to the latest if no match was found.
- **Firmware-specific base configuration** - The default configuration is tied to a specific firmware version, which is also included as part of the image. Values are applied on top of the initial base configuration layer.
- **Hardware-specific base configuration** - The default configuration is tied to a specific hardware type, which is also included as part of the image. Each hardware type supplies configuration that changes with software versions. Values are applied on top of the firmware-based configuration layer.
- **Automated node overrides** - Contains any configuration parameters for specific nodes that were automatically set by the E2E controller.

- **Network overrides** - Contains any configuration parameters that should be uniformly overridden across the entire network. This takes precedence over the base configuration and automatic overrides.
- **Node overrides** - Contains any configuration parameters that should be overridden only on specific nodes (e.g. PoP nodes). This takes precedence over the network overrides.

The E2E controller manages and stores separate configuration layers. The cnWave nodes have no knowledge of these layers, except the base configuration on the image. The nodes copy the latest base version (via natural sort order) if the configuration file on disk is missing or corrupt.

Click **Submit** to apply the changes.

Operation

Software upgrade

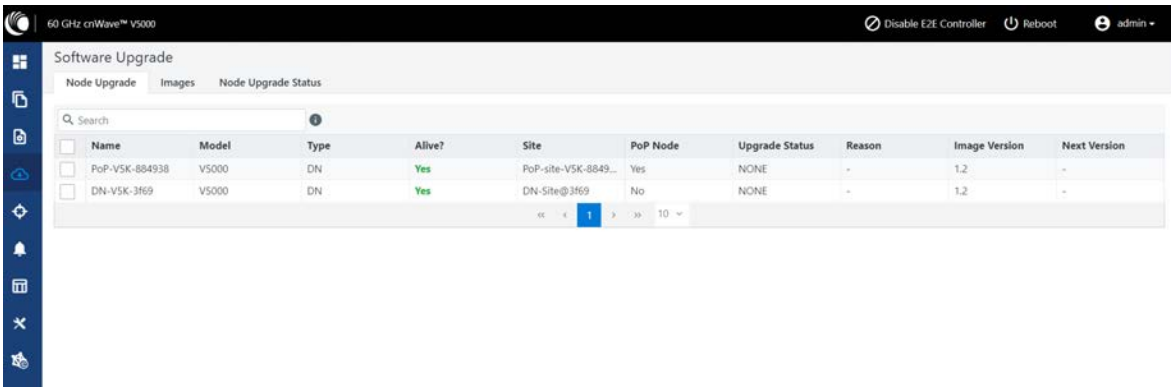
The **Software Upgrade** page is used to upgrade the installed software. This page contains the following three tabs:

- **Node Upgrade** - to upgrade the node
- **Images** - to upgrade the software images
- **Node Upgrade Status** - displays the upgrade status

To upgrade a node, perform the following steps:

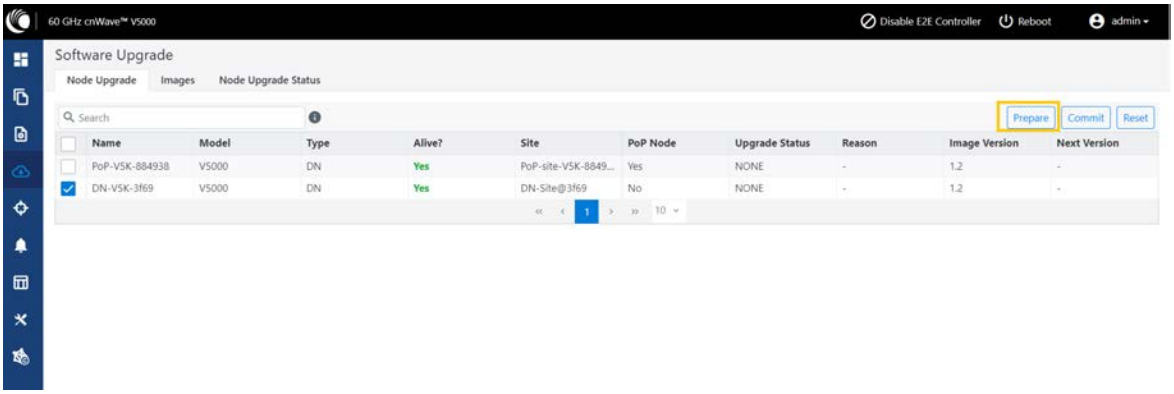
1. From the main dashboard page, click **Software upgrade** on the left navigation pane.

   The **Software Upgrade** page appears, as shown below:



   By default, the **Node Upgrade** tab is selected.

2. In the **Node Upgrade** page, select the required device for which you want to upgrade the node and click **Prepare** (as shown below).



   The **Prepare Nodes** dialog box appears.

3. In the **Prepare Nodes** dialog box, select the required image file for the node and click **Save**.

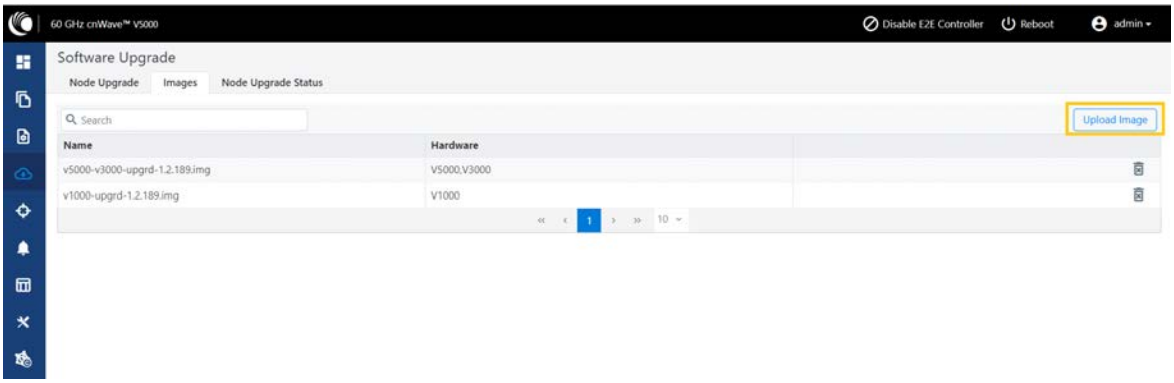
   You can also set additional options, if required, such as Upgrade Timeout, Download options, and Download Timeout.

4. Click **Commit** to upgrade the node.

5. To upgrade the software image, click on the **Images** tab in the **Software Upgrade** page.

   The **Images** page appears, as shown below:

   Figure 227: *The Images page*



6. In the Images page, click **Upload Image**.

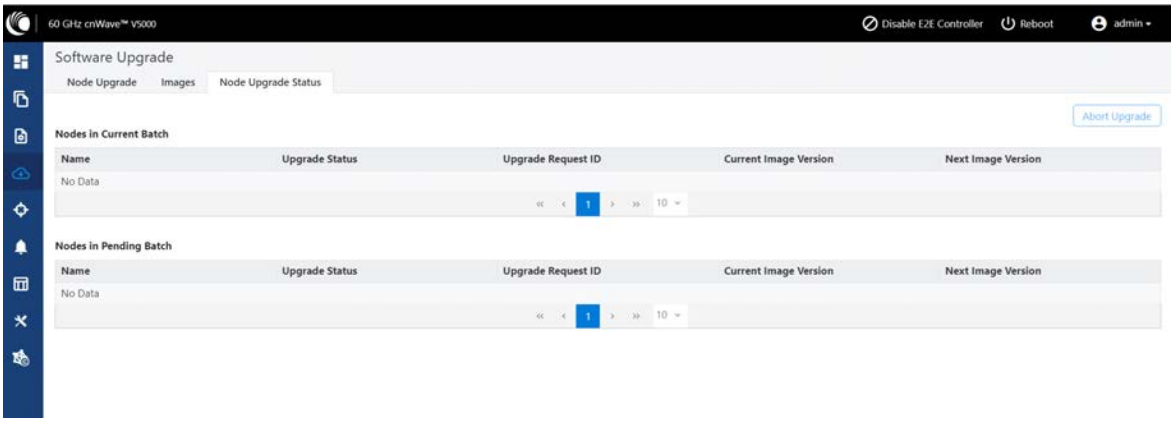
   You must browse and select the required image file from your machine. Example: Software image or package (cnWave60-<release>.tar.gz). The selected image file gets uploaded.

   You can also delete an existing image file in the **Images** page.

7. To view the node upgrade status, click on the **Node Upgrade Status** tab in the **Software Upgrade** page.

   The **Node Upgrade Status** page appears, as shown below:

   Figure 228: *The Node Upgrade Status page*



   You can view the upgrade status for the required device nodes.

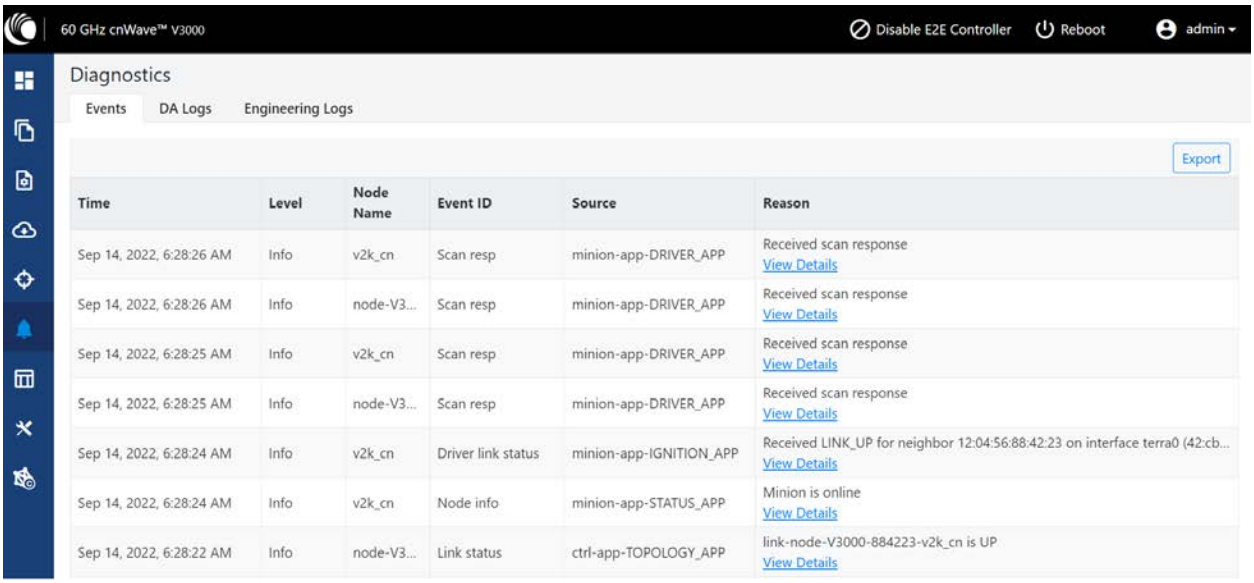
Diagnostics

The **Diagnostics** page contains the following tabs:

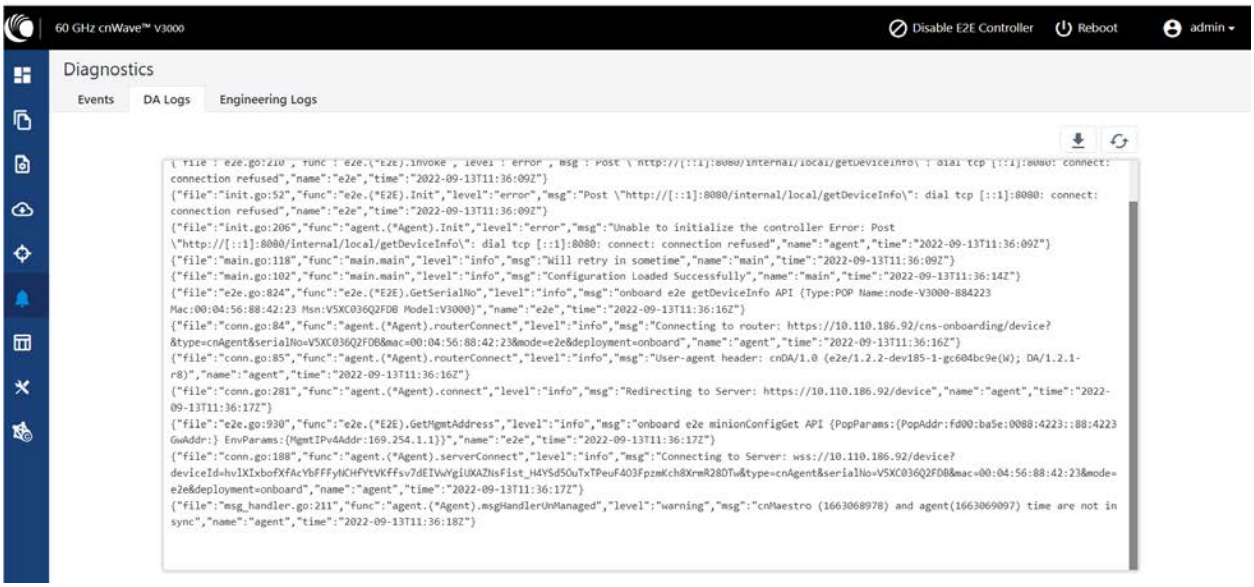
- Events
- DA Logs
- Engineering logs

Events

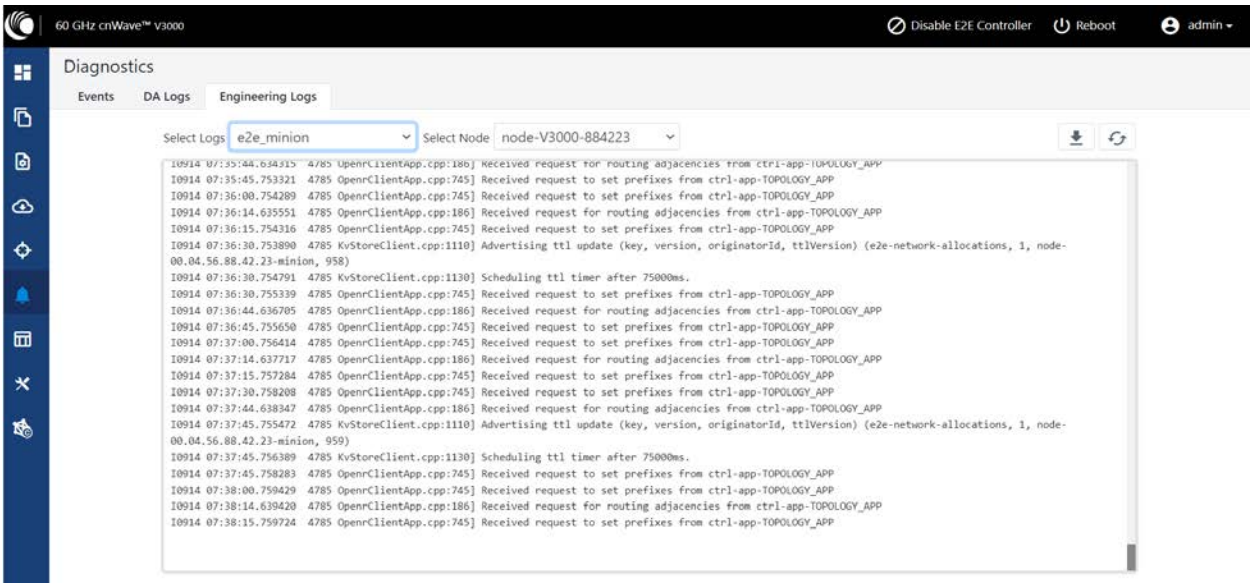
The **Events** page displays the running and completed task list. These events can be exported. To export the event list, click **Export**.



DA Logs



Engineering logs



Statistics

The **Statistics** menu contains the following options:

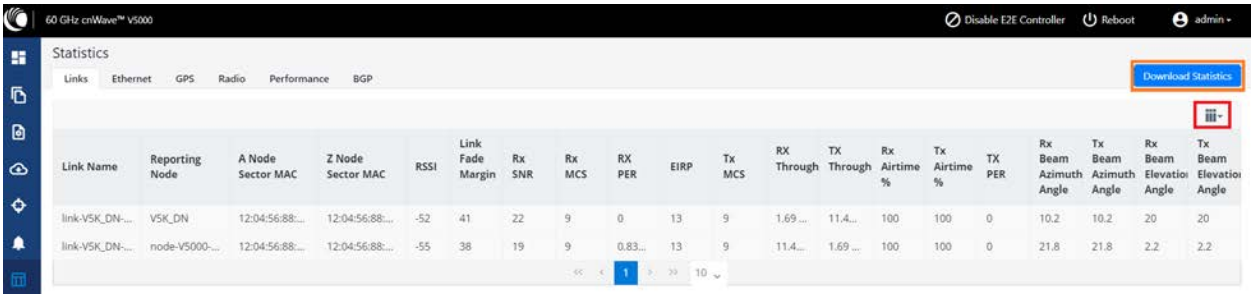
- Links
- Ethernet
- GPS
- Radio
- Performance
- Prefix Zone Statistics
- Border Gateway Protocol (BGP)

Links

The **Links** page contains Uplink and Downlink statistical data. It displays TX and RX data of the reporting nodes from A to Z and Z to A. The page also displays statistics (for example, Rx/Tx Throughput and Rx/Tx Airtime %) that provide the necessary insights to manage and optimize cnWave networks effectively.

Based on the filters that you select using the icon (as shown in Figure 229), the **Links** page displays the relevant elements and statistics.

Figure 229: *The Links page*



The **Links** page displays the following elements:

Table 54: Elements in the Links page

Element	Description
Link Name	Link name
Reporting Node	Name of the reporting node for which the statistics are available.
A Node Sector MAC	MAC address of the initiator node.
Z Node Sector MAC	MAC address of the responder node.
RSSI	The Receiver Signal Strength Indicator (RSSI) value
Link Fade Margin	The statistic value (in dB) available for each RF link The **Link Fade Margin** statistic values help operators to quickly assess any additional system gain or low marginal RF links (if any), which must be addressed. The **Link Fade Margin** statistic value calculation is based on: • Checking the RSSI received from a remote transmitter, • Assessing the availability of TX power (from the remote transmitter), and • Considering the RSSI value that is calculated based on how far away it is from an established receiver sensitively floor of -72 dBm.
Rx SNR	Signal to Noise Ratio
Rx MCS	Modulation Code Scheme of Receiver
RX PER	Receiver packer error rate
TX Power Index	Transmitter power index
EIRP	The Effective Isotropic Radiated Power (EIRP) value.
TX MCS	Modulation Code Scheme of Transmitter
TX PER	Transmitter packer error rate
RX Errors	Receiver errors

Element	Description
RX Frames	Receiver frames
TX Errors	Transmitter errors
TX Frames	Transmitter frames
Rx Throughput	The receive throughput as received by the reporting node.
Tx Throughput	The throughput transmitted by the reporting node. Monitoring this metric can clarify the data transmission rate, providing a clearer view of the network's outbound data performance.
Rx Airtime %	The percentage of airtime allocated by the scheduler to each link in the Rx direction from the perspective of reporting node. This metric is relevant for a DN as it indicates how airtime is shared across multiple links.
Tx Airtime %	The percentage of airtime allocated by the scheduler to each link in the Tx direction from the perspective of reporting node. Similar to **Rx Airtime %**, this metric provides insights into how airtime is distributed among links when transmitting data. This metric is only relevant for a DN.
Following replace **Rx Scan Beams** and **Tx Scan Beam** elements:	
Rx Beam Azimuth Angle	The angle of the selected fixed beam (in degrees) in the azimuth direction for each link. The selected beam is independent of transmit and receive directions. For more information on Tx/Rx azimuth beam angle statistics, refer to the Link diagnostics - Beam angle statistics section.
Tx Beam Azimuth Angle	
Rx Beam Elevation Angle	The angle of the selected fixed beam (in degrees) in the elevation direction for each link. The selected beam is independent of transmit and receive directions. For more information on Tx/Rx azimuth beam angle statistics, refer to the Link diagnostics - Beam angle statistics section.
Tx Beam Elevation Angle	

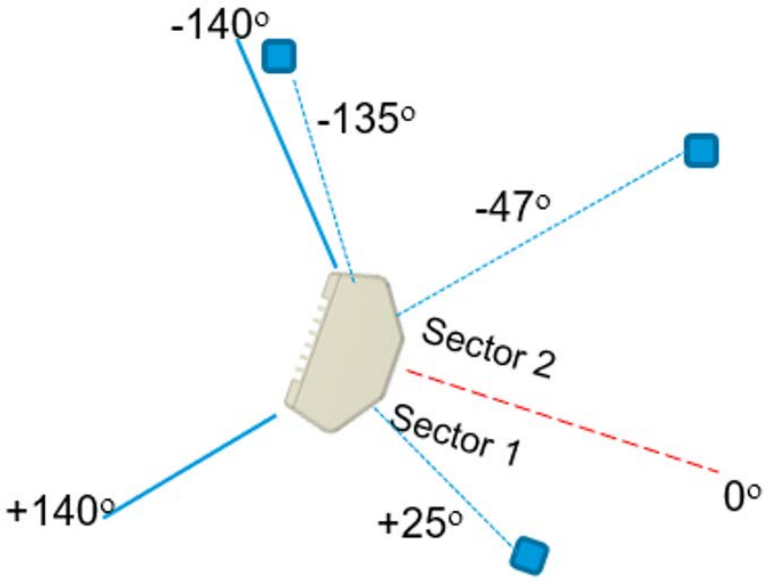
To download the statistics in `.xls` format, click **Download Statistics**.

Link diagnostics - Beam angle statistics

To understand Tx/Rx azimuth and elevation beam angle statistics, let's consider the following examples:

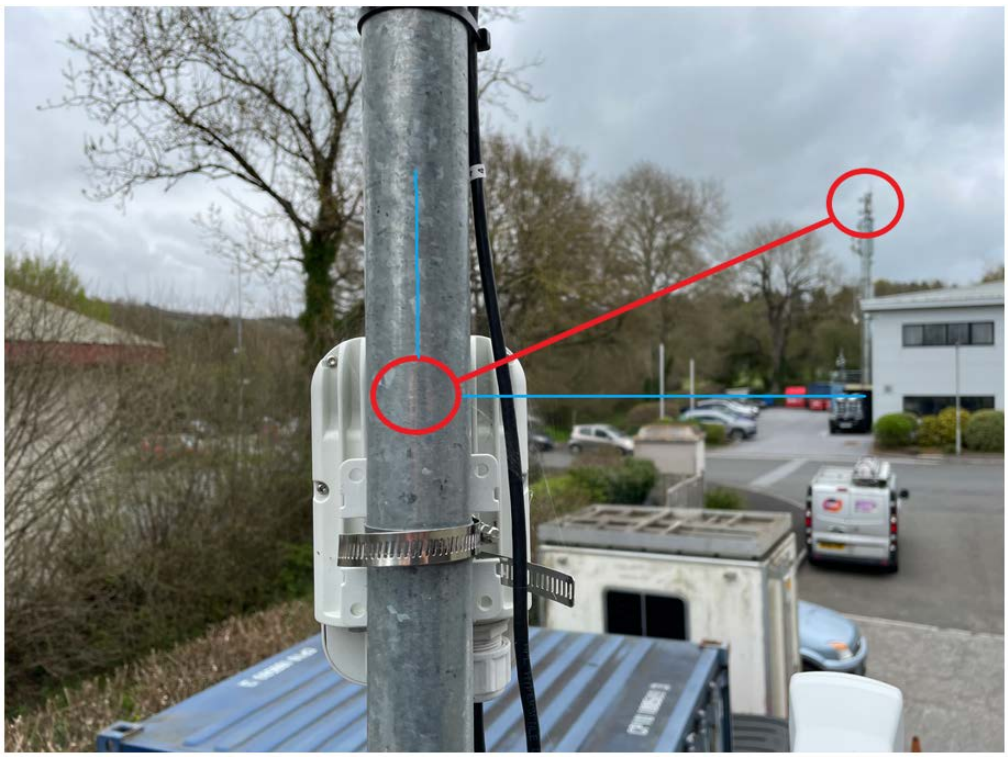
- In Figure 230, the reported beam angle is relative to the reporting nodes boresight and not a bearing from North. Therefore, an **elevation angle** of +5 degrees is from the unit's perspective, choosing a fixed beam pointing of 5 degrees above the horizontal axis (towards the sky). An **azimuth angle** of +5 degrees is from the centre line or boresight of the unit with 5 degrees counting clockwise. An azimuth angle of -5 degrees is from the centre line or boresight of the unit with 5 degrees counting anti-clockwise.

Figure 230: *An example of V5000 azimuth angles relative to boresight*



- In Figure 231, a V1000 has been pole mounted with 0 degrees elevation tilt and is pointing approximately 20-30 degrees to the left of the target node (which is located on the tower, as shown in Figure 231). The location of the remote node is at the top of the cell tower therefore it has a higher elevation.

Figure 231: *An example of V1000 installation*



From V1000 CN's perspective, the reported beam angles are as follows:

- Tx Beam Azimuth Angle: +25.2 degrees
- Rx Beam Azimuth Angle: +25.2 degrees
- Tx Beam Elevation Angle: +14.3 degrees
- Rx Beam Elevation Angle: +14.3 degrees

Table 55 lists the fixed beam scan ranges for 60 GHz cnWave products.

Table 55: Fixed beam scan ranges

Product	Azimuth scan range	Elevation scan range
V1000	-45 degrees to +45 degrees	- 20 degrees to +20 degrees
V2000	-12 degrees to +12 degrees	-6 degrees to +4 degrees
V3000	-2.3 degrees to +2.3 degrees	-2 degrees to +1 degrees
V5000 (both sectors combined)	-140 degrees to +140 degrees	- 20 degrees to +20 degrees

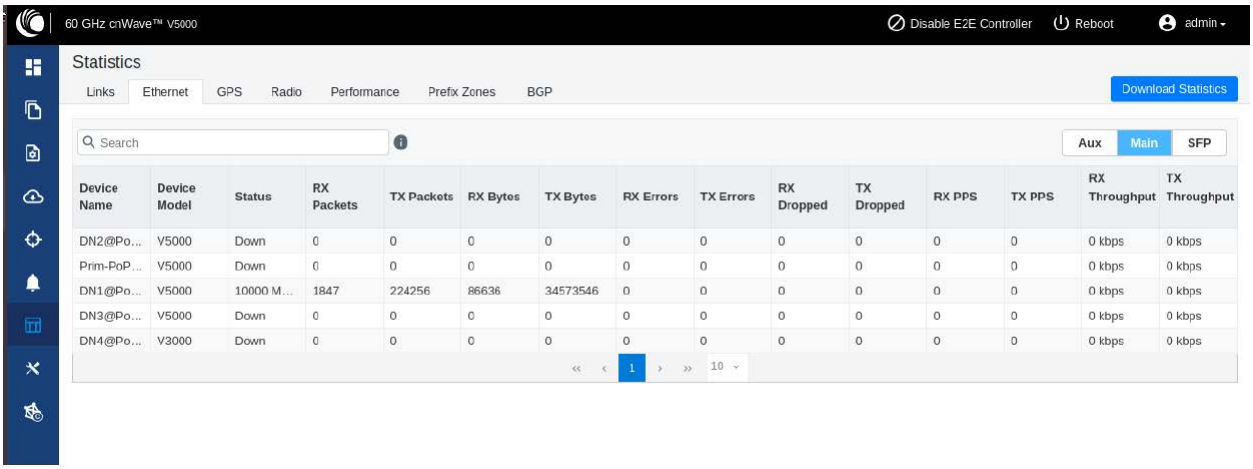
The Tx/Rx x/Rx beam azimuth and elevation angle statistic help in:

- identifying links, which are operating near the boundary of the scan range, for example, within 5 degrees of +/- 140 degrees on a V5000. This implies that the link can be aligned off the edge of the sector and possibly requires the realignment.
- analysing whether interference affects the beam selection -
    - when the physical node alignment matches LINKPlanner but the beam angles are significantly out from what is predicted, and/or
    - when there is considerable variability in the beam angles used from linkup to linkup.
- determining whether signal obstruction, signal multipath, or interference causes an issue when there is a significant difference between the Tx and Rx beam angle for the same link at the same node.
- On a CN with only one wireless link to align, aiming at an azimuth beam angle close to 0 degrees is optimal.

Ethernet

The **Ethernet** page displays Transmitting and receiving data of the nodes.

Figure 232: *The Ethernet page*



The following elements are displayed on the **Ethernet** page:

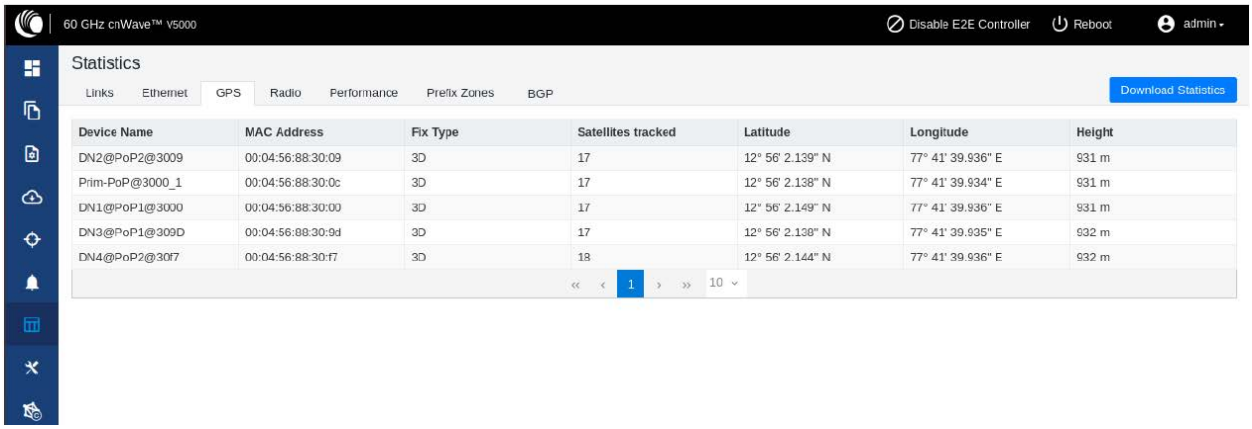
Table 56: Elements in the Ethernet page

Elements	Description
Device Name	Name of the device
Device Model	Model of the device.
Status	Status of Ethernet link
RX Packets	Receiver packets
TX Packets	Transmitter packets
RX Bytes	Receiver bytes
TX Bytes	Transmitter bytes
RX Errors	Receiver errors
TX Errors	Transmitter errors
RX Dropped	Receiver dropped
TX Dropped	Transmitter dropped
RX PPS	Receiver Packets Per Second
TX PPS	Transmitter Packets Per Second
RX Throughput	Receiver throughput
TX Throughput	Transmitter throughput

GPS

The **GPS** page displays geographical data of the nodes.

Figure 233: *The GPS page*



The following elements are displayed on the **GPS** page:

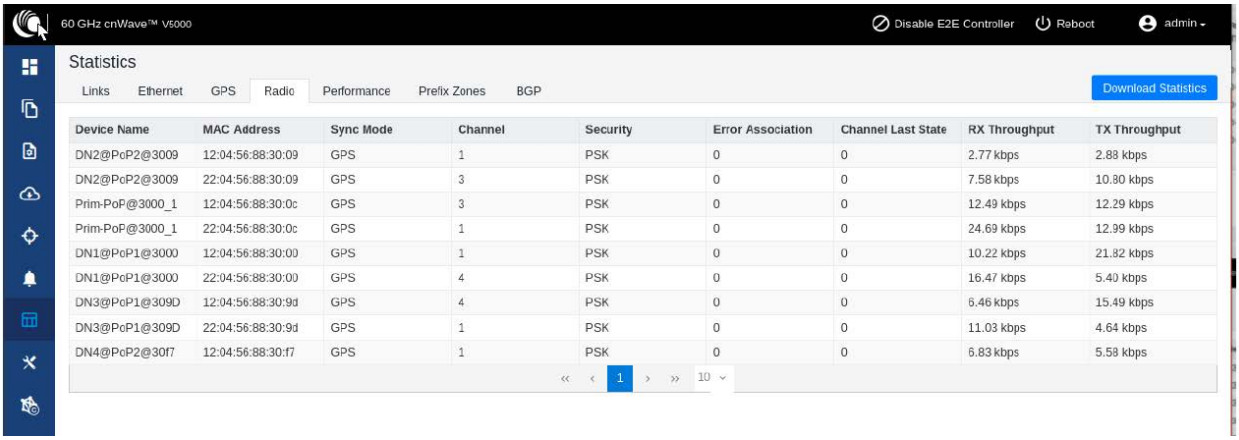
Table 57: Elements in the GPS page

Elements	Description
Device Name	Name of the device
MAC Address	MAC address of the device
Fix Type	GPS fix type. The fix status indicates the type of signal or technique being used by the GPS receiver to determine its location. The fix status is important for the GPS consumer, as it indicates the quality of the signal, or the accuracy and reliability of the location being reported.
Satellites tracked	The number of satellites tracked
Latitude	Latitude of the device
Longitude	Longitude of the device
Height	Height of the device

Radio

The **Radio** page displays the radio data of the nodes.

Figure 234: *The Radio page*



The **Radio** page has the following elements:

Table 58: Elements in the Radio page

Elements	Description
Device Name	Name of the device
MAC Address	MAC address of the device

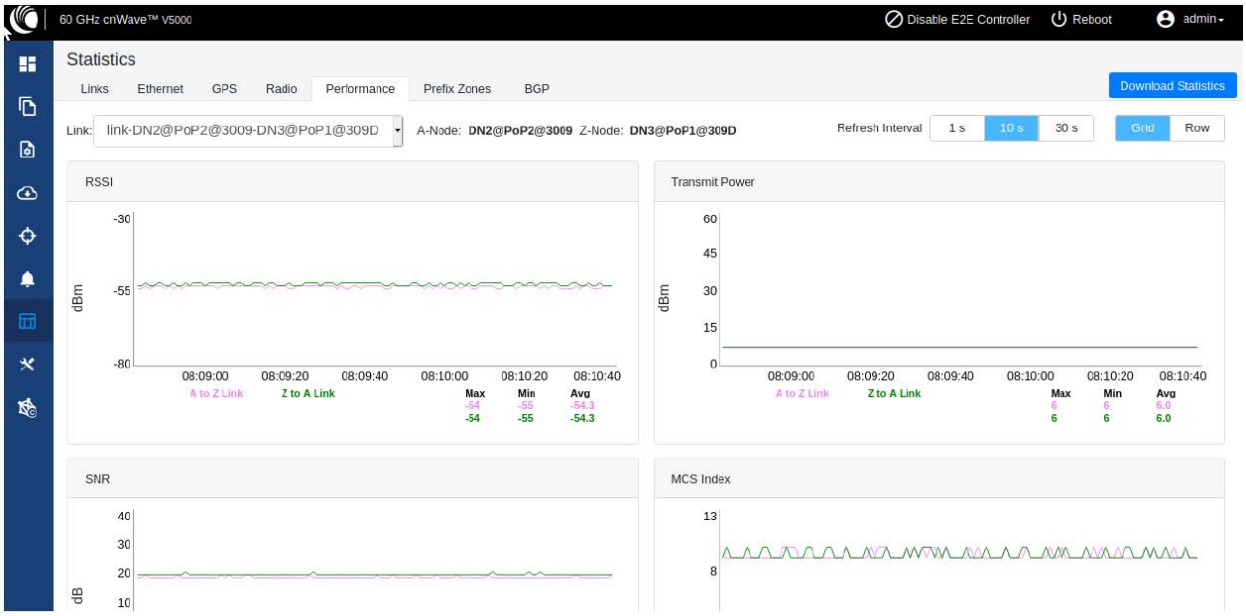
Sync Mode	• **GPS sync**:
	  • *Entry condition*: Valid samples from GPS have been received for a few consecutive seconds (typically 2 seconds).
	  • *Exit condition*: Valid samples from GPS have not been received for a few consecutive seconds (typically 10 seconds).
	• **RF sync**: Not in “GPS sync”, but is reachable to a DN with “GPS sync” over wireless links (1-2 hops away).
	  • *Entry condition*: Conditions for “GPS sync” have not been met, but a link exists to at least one other DN from which to derive timing.
	  • *Exit condition*: Conditions for “GPS sync” have not been met and no links to other DNs exist from which to derive timing.
	• **No sync**: Neither in GPS sync nor RF sync. This is the default state.
	  • *Entry condition*: Conditions for “GPS sync” or “RF sync” are not met.
	  • *Exit condition*: Condition for “GPS sync” or “RF sync” are met.

Channel	Operating channel
Security	Security type
Error Association	Error Association
Channel Last State	Channel Last State
RX Throughput	Receiver throughput
TX Throughput	Transmitter throughput

Performance

The **Performance** page displays the performance graph.

Figure 235: *The Performance page*



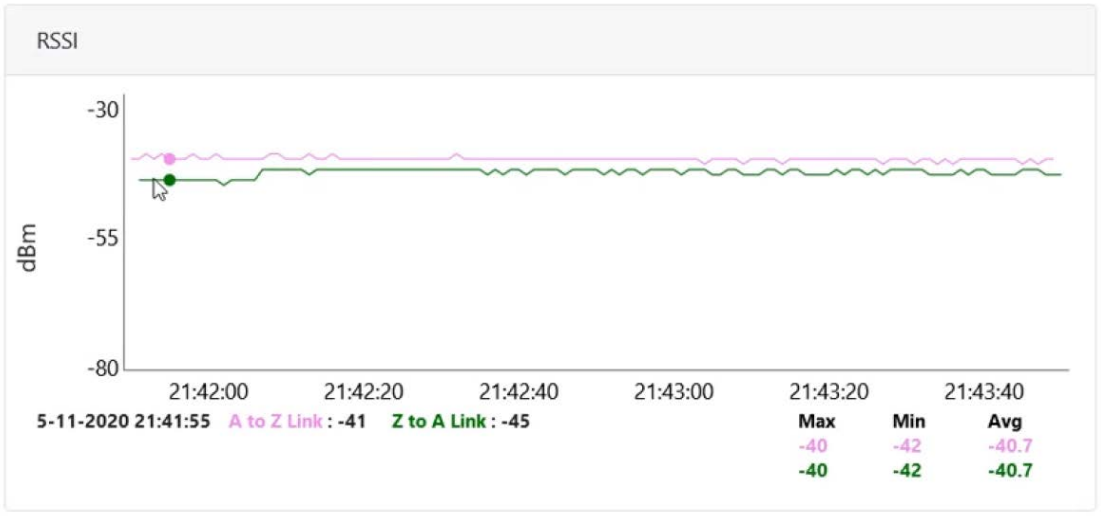
The **Performance** page contains the following graphs:

Table 59: Elements in the Performance page

Elements	Description
RSSI	Receiver Signal Strength Indicator. It is a measurement of the power present in a received radio signal
Transmit Power	Transmitting power
SNR	Signal to Noise Ratio
MCS Index	Modulation and Coding Scheme (MCS) Index Values can be used to determine the likely data rate of your wireless connection. The MCS value essentially summarizes the number of spatial streams, the modulation type and the coding rate that is possible when connecting your wireless access point.
Packet Error Ratio	Packet error ratio. It is the ratio, in percent, of the number of Test Packets not successfully received by the node to the number of Test Packets sent to the node by the test set.
Received Frames	The number of frames received at the node.
Transferred Frames	The number of frames transferred from the node.

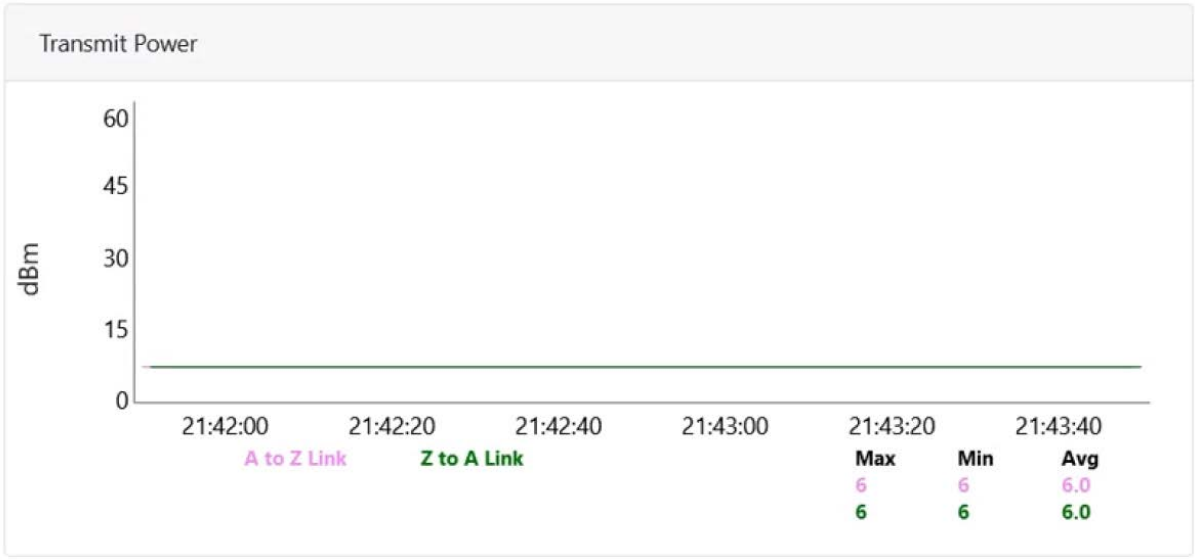
RSSI graph

Figure 236: *RSSI graph*



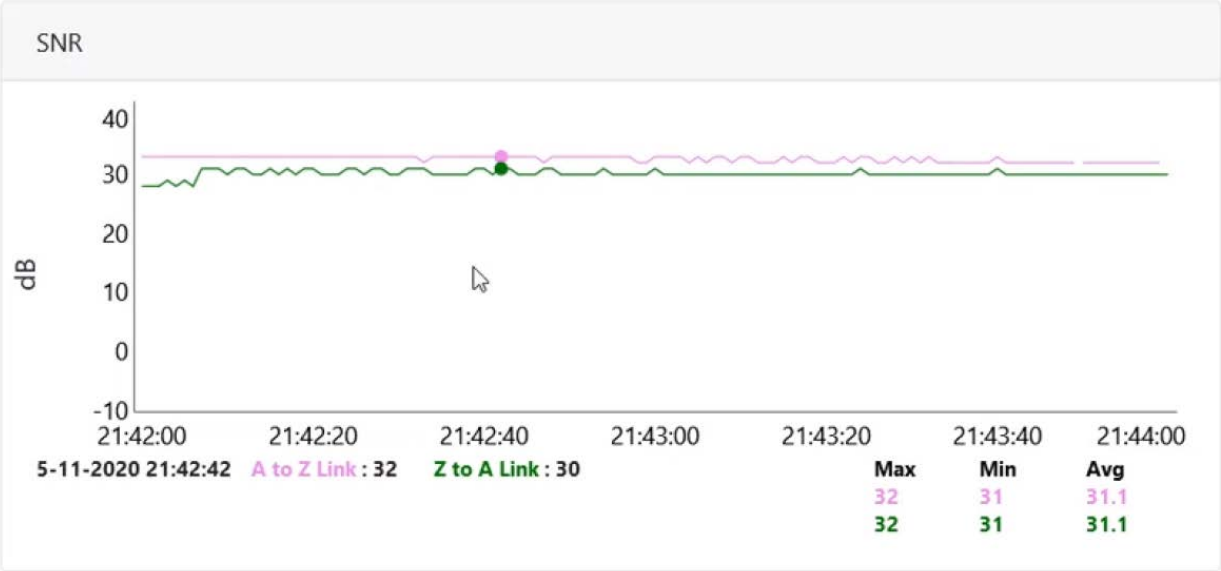
Transmit Power graph

Figure 237: *Transmit Power graph*



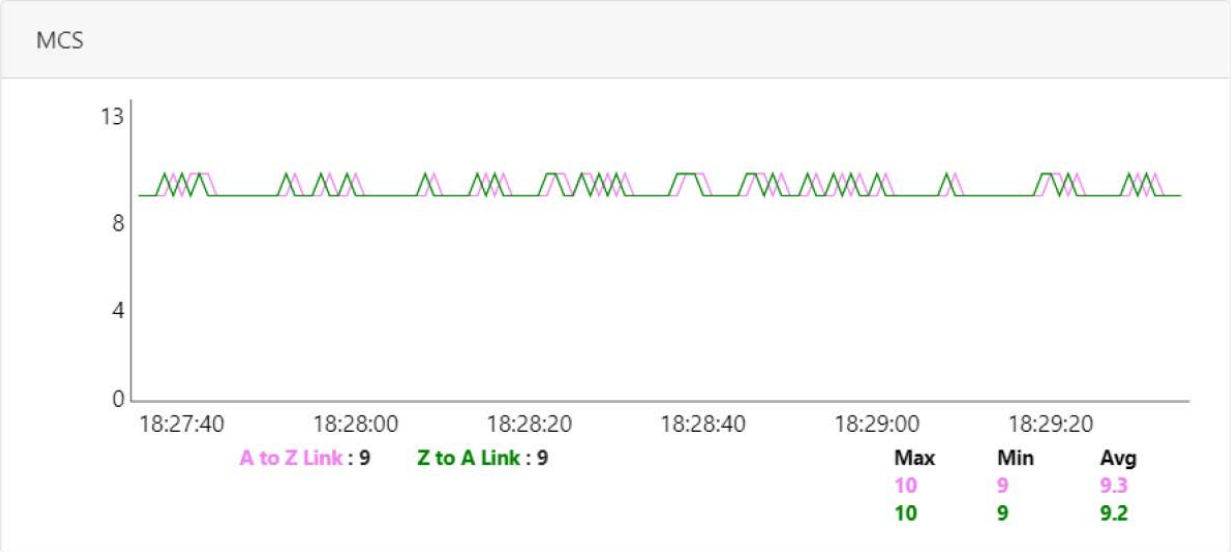
SNR graph

Figure 238: *SNR graph*



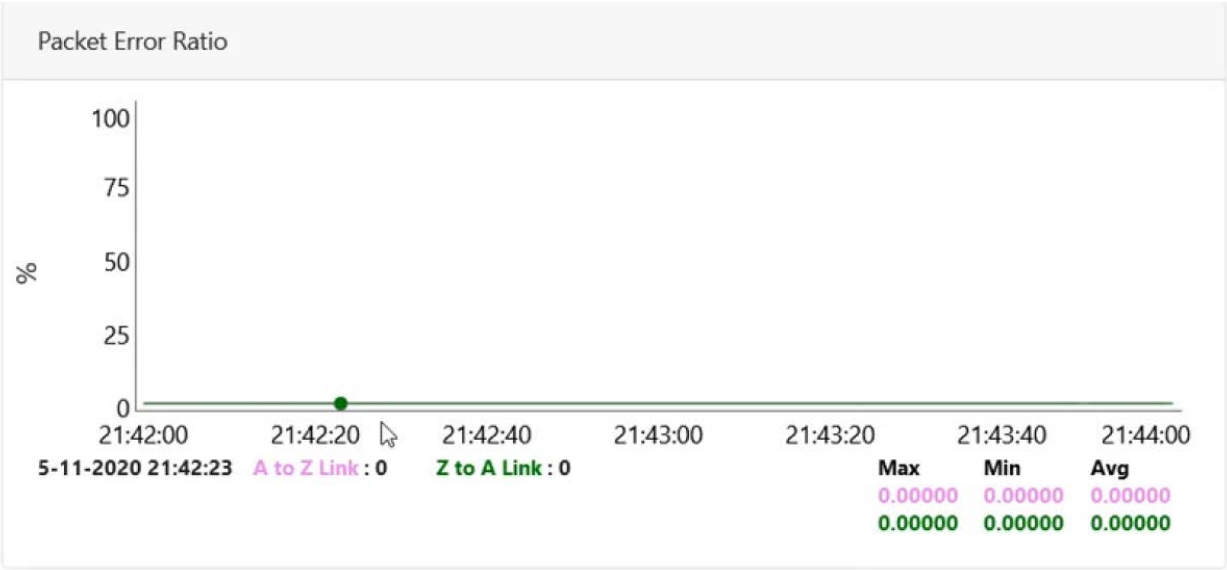
MCS Index graph

Figure 239: *MCS Index graph*



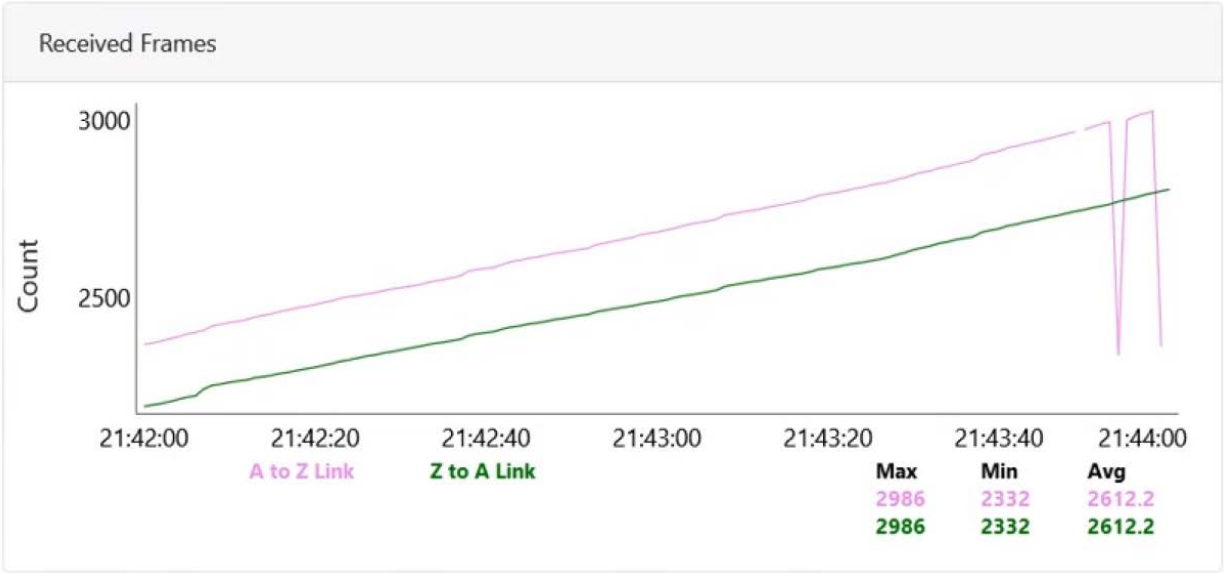
Packet Error Ratio graph

Figure 240: *Packet Error Ratio graph*



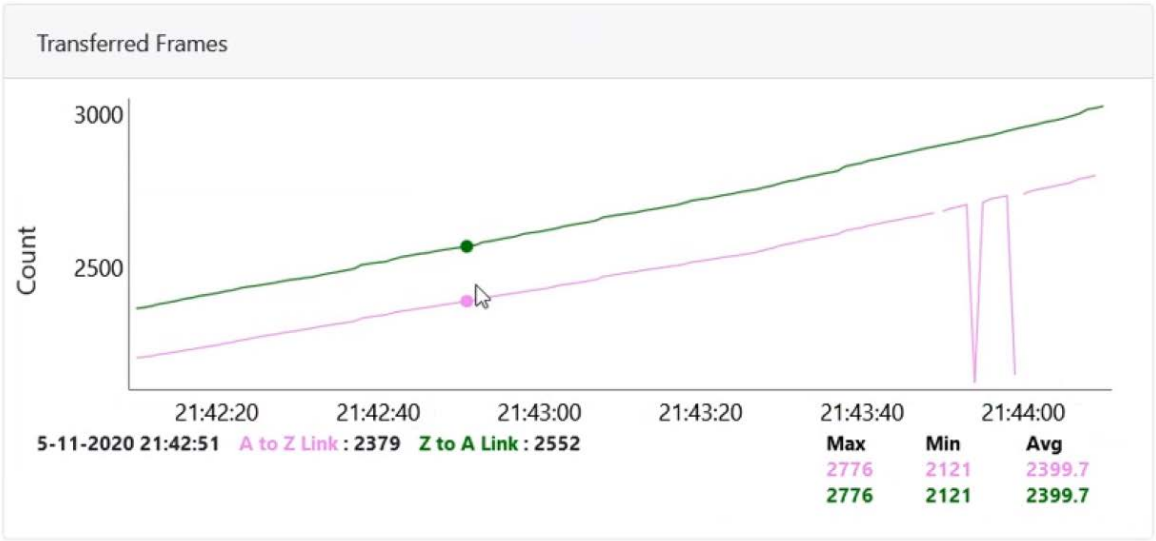
Received Frames graph

Figure 241: *Received Frames graph*



Transferred Frames graph

Figure 242: *Transferred Frames graph*



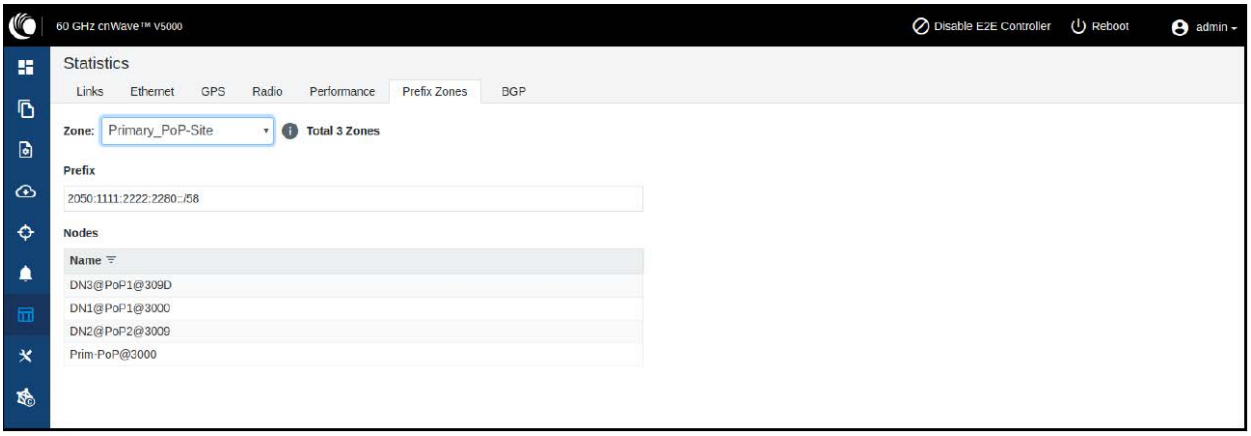
Prefix zone Statistics

In the multi-PoP deployments, the mesh is divided into prefix zones. Prefix zone statistics are available on the **Statistics > Prefix Zone** page.

Note

You can view the prefix zone statistics only when Deterministic prefix (DPA) is enabled. With CPA enabled, the **Prefix Zone** tab is not visible on the **Statistics** page.

Figure 243: *The Prefix Zones page*

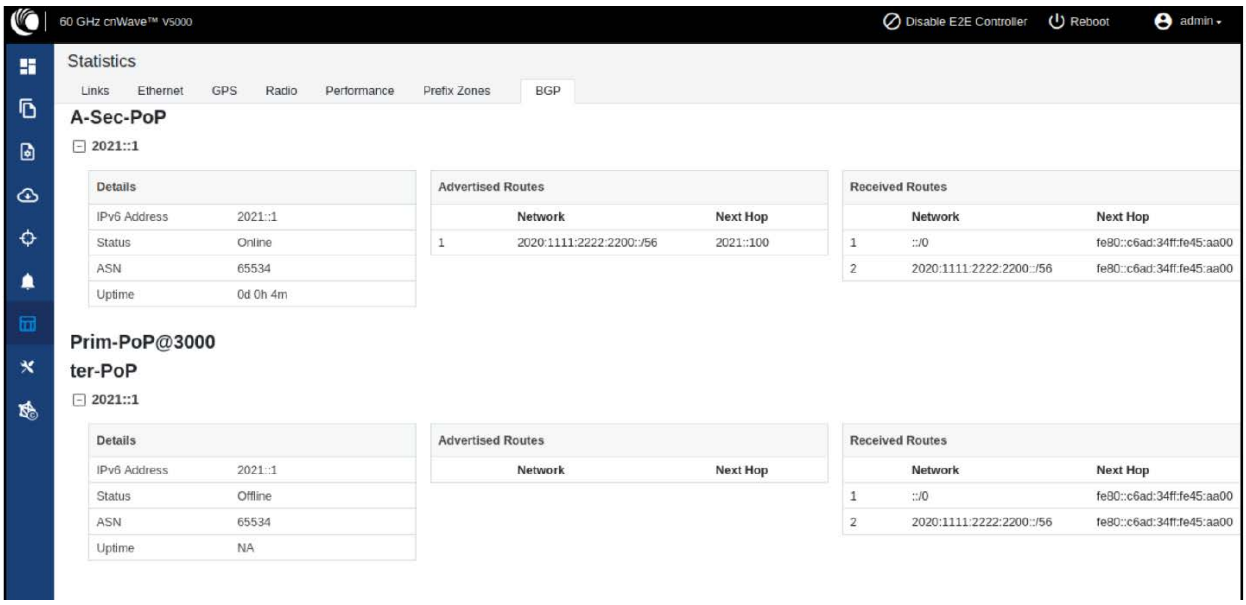


Border Gateway Protocol (BGP)

The BGP is the protocol used throughout the Internet to exchange routing information between networks. It is the language spoken by routers on the Internet to determine how packets can be sent from one router to another to reach their final destination. BGP has worked extremely well and continues to be protocol that makes the Internet work.

The **BGP** page displays routing information. This page also contains the details of routes advertised by PoPs to their peers and the routes received by the peers.

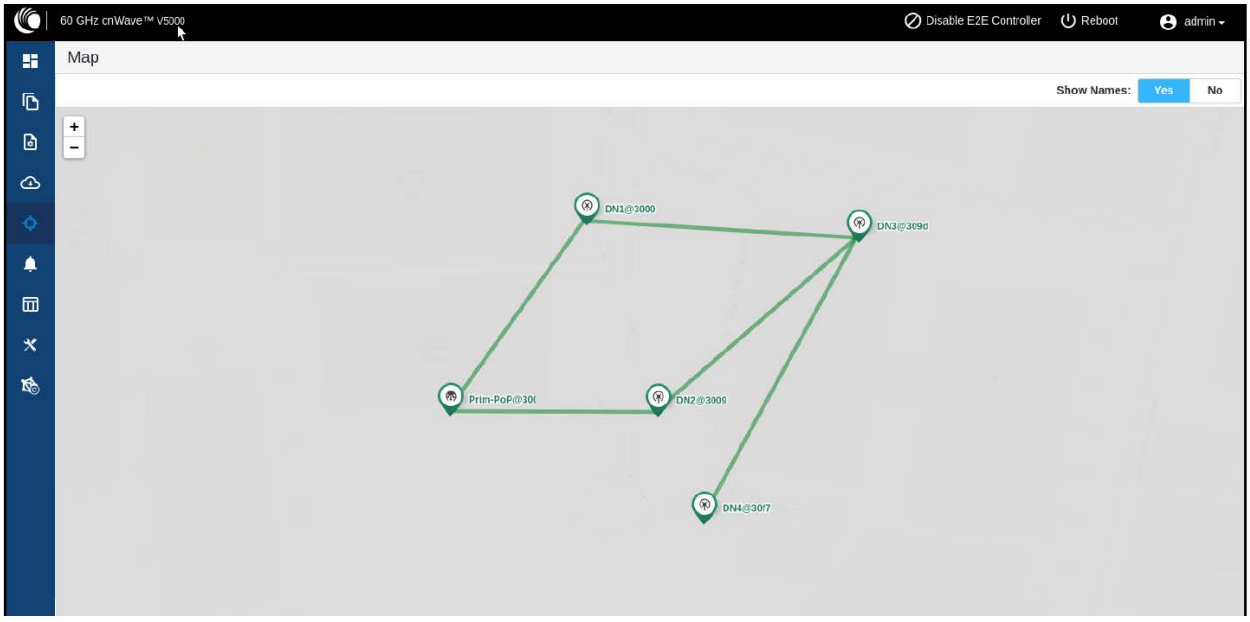
Figure 244: *The BGP page*



Maps

The **Maps** page displays the topology and location/sites of the deployed nodes in the cnWave network. Click the **Maps** icon on the left panel to display the nodes.

Figure 245: *The Map page*



Interference Scan

Interference Scan (also known as Interference Management (IM) Scan) is an end-to-end, Controller-coordinated scan that aims at performing real-time measurements of interference affecting a specific interfered link (referred to as the victim link). The Controller filters the network topology to identify potential interfering links (known as aggressor links).

The Controller then issues batches of scan requests to the filtered aggressor nodes or sectors. These requests are transmitted using the antenna beams and transmit power intended for their data links. Meanwhile, the victim receiver listens for these scan requests (transmissions). The extent to which the victim receiver detects these scan requests determines the level of interference exerted by the aggressor links on the victim receiver.

This section covers the following topics:

Output of Interference Scan

Using the cnMaestro UI, you can run the Interference Scan tool. The scan results show the victim link and its corresponding receiver MAC address (which serves as a unique identifier for the network devices).

It also provides a list of aggressor links along with their corresponding Signal-to-Noise Ratio (SNR) values relative to the victim receiver. SNR indicates the measurement of a signal strength compared to background noise, with higher values indicating better signal quality.

Impact on link performance

The interference from aggressor links impacts the maximum data rate that the victim link can achieve, determined by the Modulation and Coding Scheme (MCS). For instance, achieving MCS9 requires an SNR of at least 10 dB. However, if interference from an aggressor link reduces the SNR to 6 dB, the victim link will be limited to MCS4 or lower, resulting in slower data rates.

If the SNR is less than 0 dB, the interference is minimal and the aggressor links are unlikely to impact the victim link's performance.

Running the Interference Scan tool in cnMaestro

You can run the Interference Scan tool using the **Map** page in cnMaestro UI only.

Note

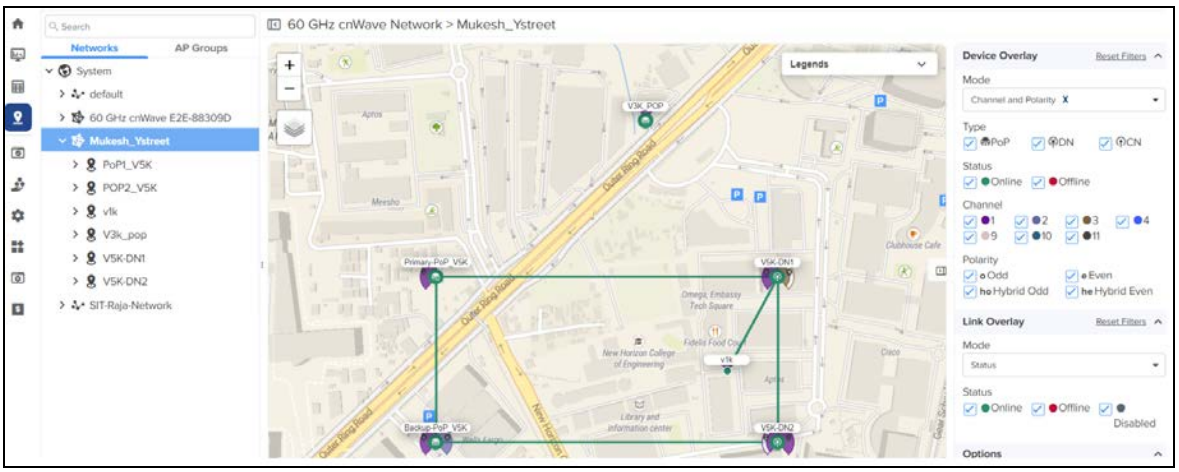
cnMaestro 5.2.0 and later versions support the UI controls for running the Interference Scan X feature (tool).

To run the Interference Scan tool, complete the following steps:

1. Log in to the cnMaestro UI and navigate to the **Map** > **Networks** page.
2. Select a cnWave network and click on the link for which you want to run the interference Scan tool.

   The **Details** section on the right side of the **Map** page displays the selected link information. For example, there is a Backup-POP_V5K linked to V5K-DN2 in the figure below.

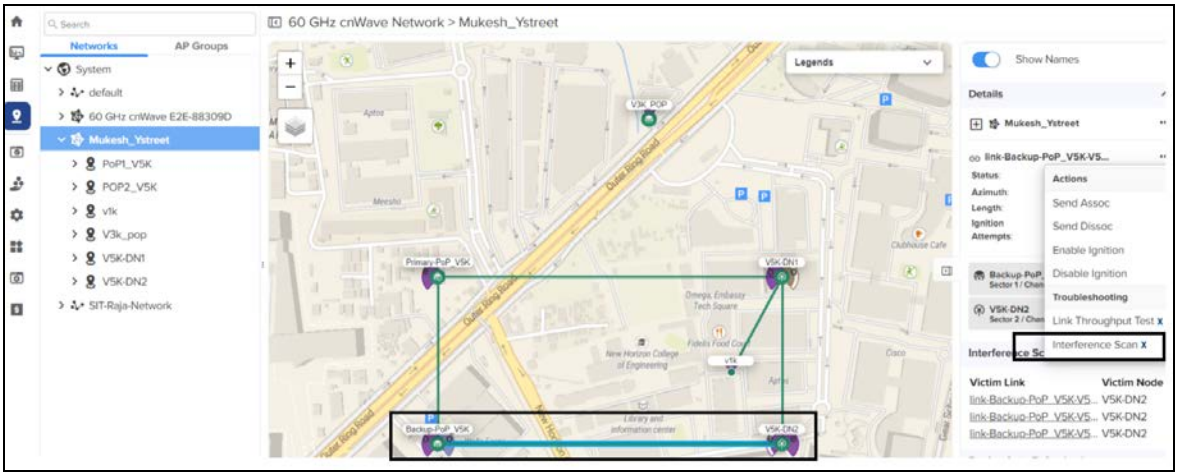
Figure 246: *Selecting a link to run the Interference Scan tool*



3. Click the ... icon next to the link name and select **Interference Scan X** from the drop-down list.

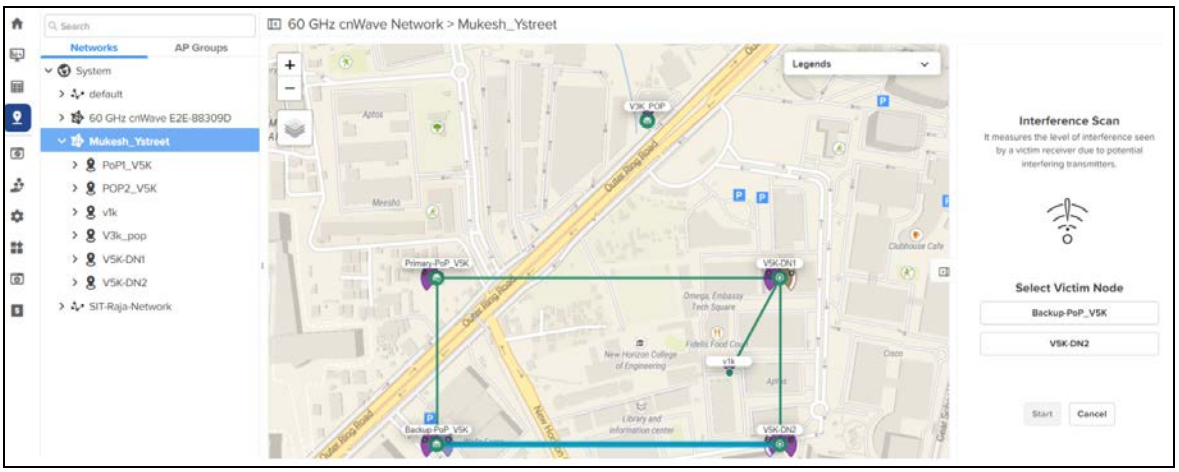
   For example, Interference Scan is used for the link highlighted between Backup-POP_V5K linked to V5K-DN2 in the figure below.

Figure 247: *Selecting the Interference Scan X tool*



When **Interference Scan X** is selected, the **Interference Scan** section appears with the victim node names on the right side of the Map page.

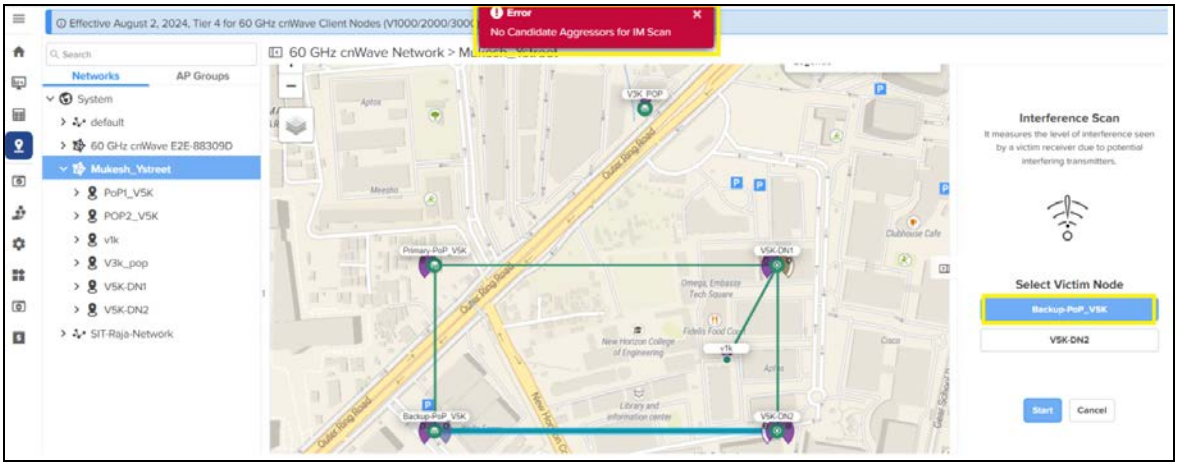
Figure 248: *The **Interference Scan** section on the Map page*



4. Select the required victim node and click **Start**.

   The Interference Scan tool detects neighbouring interfering links with wireless settings that may affect your network. The Interference Scan tool can be executed on any of the victim nodes. In the figure below, Interference Scan is executed on the first victim node *Backup-POP_V5K*. If no aggressor is found, an error message appears stating that ***no candidate aggressors found for IM scan***.

   Figure 249: *When no aggressors are found*

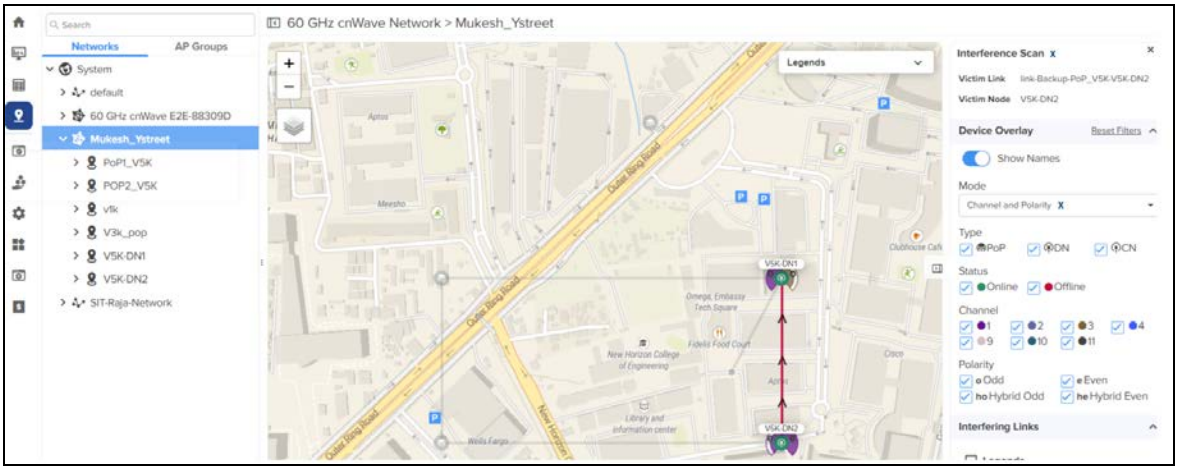


When you run the Interference Scan test on the second victim node (for example, V5K-DN2), the aggressor (if any) details are displayed as shown in the figure below. In this case, Backup-POP_V5K to V5K-DN2 uses channel 1 and V5K-DN2 to V5K-DN1 uses channel 1. The SNR values need to be analysed.

Note

The cnMaestro UI displays both a map view and a list view of the victim-aggressor relationship. The map is color-coded to show the severity of interference. The lower the SNR from aggressor links, the greater the interference on the victim link.

Figure 250: *When aggressors are found*



5. View the scan result for the selected victim node and take appropriate actions.

Tools

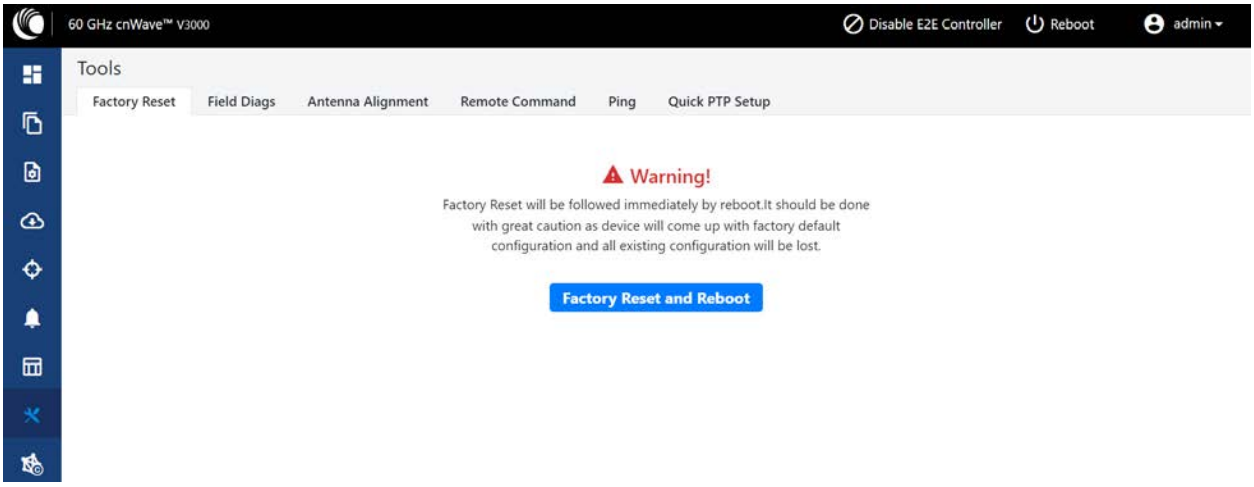
The **Tools** page contains the following tabs:

- Factory Reset
- Field Diags
- Antenna Alignment
- Remote Command
- Ping
- Quick PTP Setup
- iPerf

Factory reset

The **Factory Reset** page is used to set the default settings.

Figure 251: *The Factory Reset page*



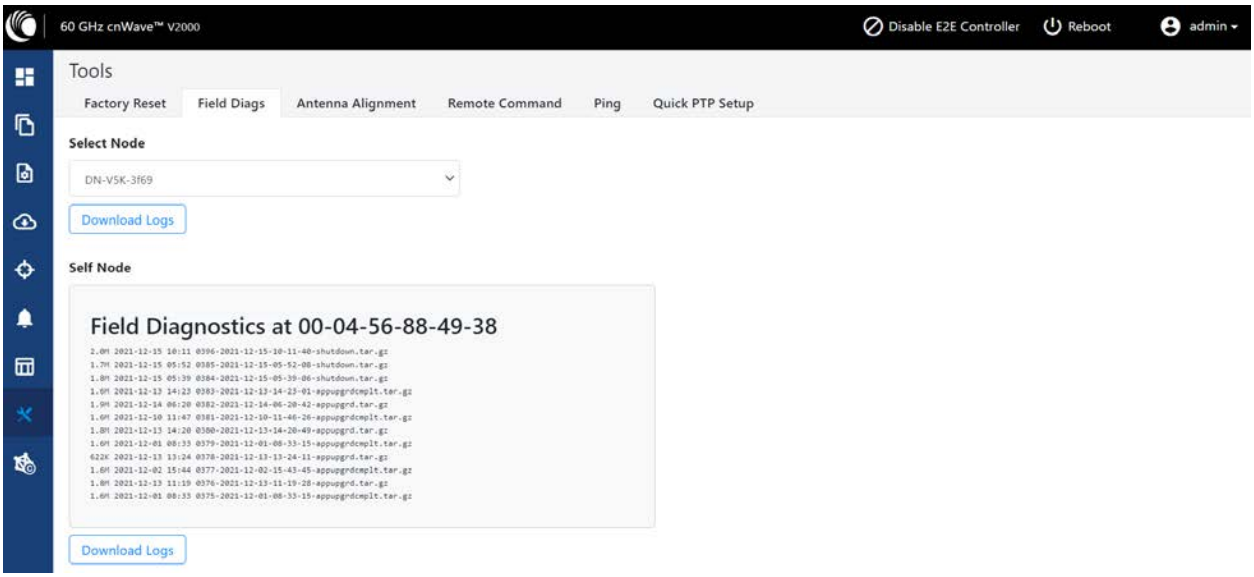
Warning

Factory reset is followed immediately by a system reboot. You must carefully configure the factory reset settings as the device comes up with the default settings. All the existingconfigurations are lost when the system comes up.

Field diags

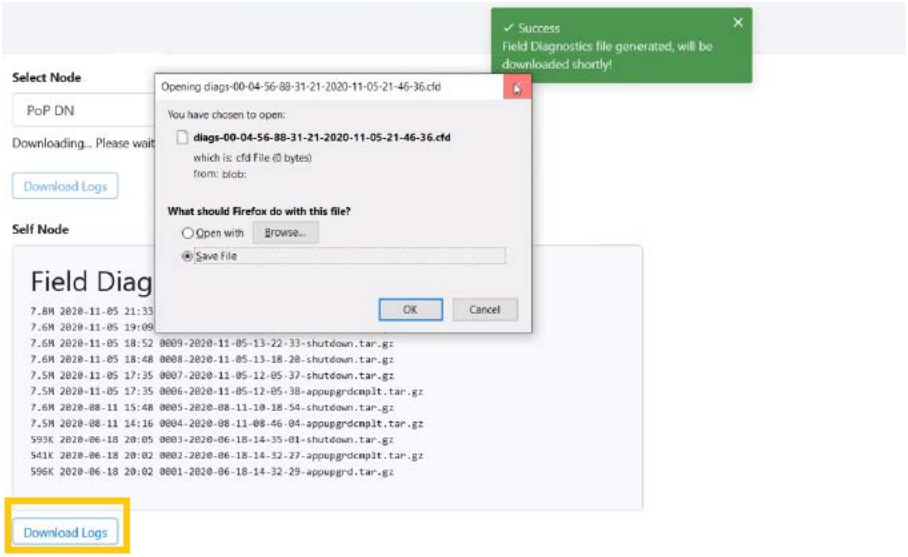
The **Field Diags** tab is used to view and download the error logs. To download the DN logs, select the DN node from the **Select Node** drop-down and click **Download Logs** (as shown in Figure 252)**.**

Figure 252: *The Field Diags page*



To download the logs for a self-node, click **Download Logs** at the bottom of the page. Save the log file.

Figure 253: *Saving log files*



Antenna alignment

The Antenna Alignment tool assists in optimizing the alignment of V3000 to V3000, V5000, V2000, or V1000. This feature helps you to install and align the devices to achieve optimal performance.

Warning

The antenna alignment tool is not a substitute for optical alignment. The optical alignment is the key for getting the signal within the +/-2 degree azimuth and +/1 degree Elevation window. At this window level, the tool can be used to get away from the edge, corner or spurious beams to ensure optimal alignment.

Prerequisite tasks:

- Complete a Link Plan with Link Planner from Cambium Networks. This prerequisite task provides the information on the RSSI expected for the PTP link. This must be used as a target while using the antenna alignment feature.
- Enter the PTP topology in cnMaestro or the UI of a device (with the Onboard Controller on it). Then, perform the following steps:
    - Create two Sites and nodes.
    - Set up the wireless link between the two nodes.
- Ensure that the nodes are already mounted at the sites.
- An installer must have access to the UI of the device.

Note

When the antenna alignment test is executed between the following devices, ensure that GPS is disabled at the CN side:

- V3000 PoP and V1000 CN
- V3000 PoP and V2000 CN

- V3000 PoP and V3000 CN

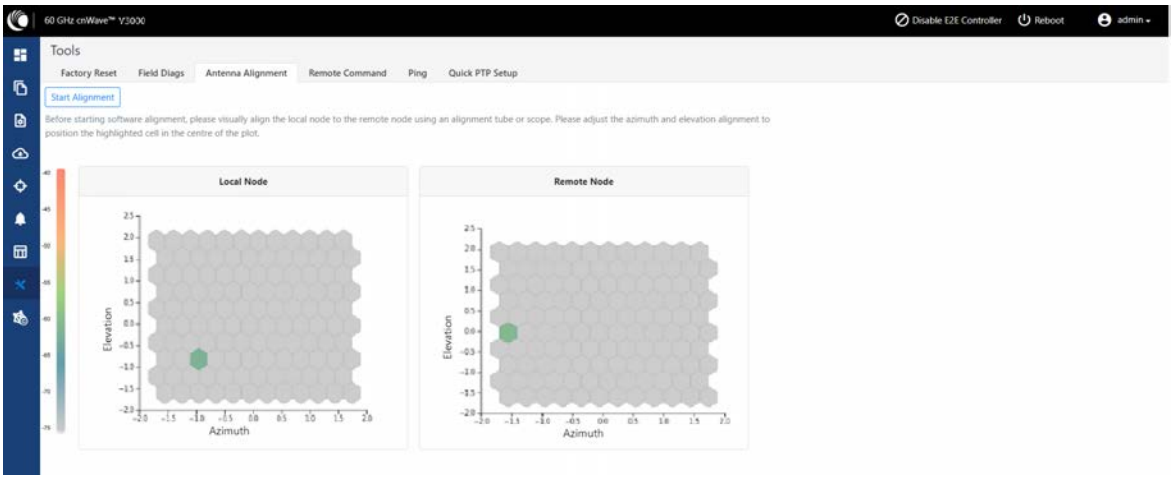
Using the Antenna Alignment tool

To use the Antenna Alignment tool, perform the following steps:

1. From the home page of the device UI, navigate to **Tools** > **Antenna Alignment.**

   The Antenna Alignment page appears, as shown in Figure 254.

   Figure 254: *The Antenna Alignment page*



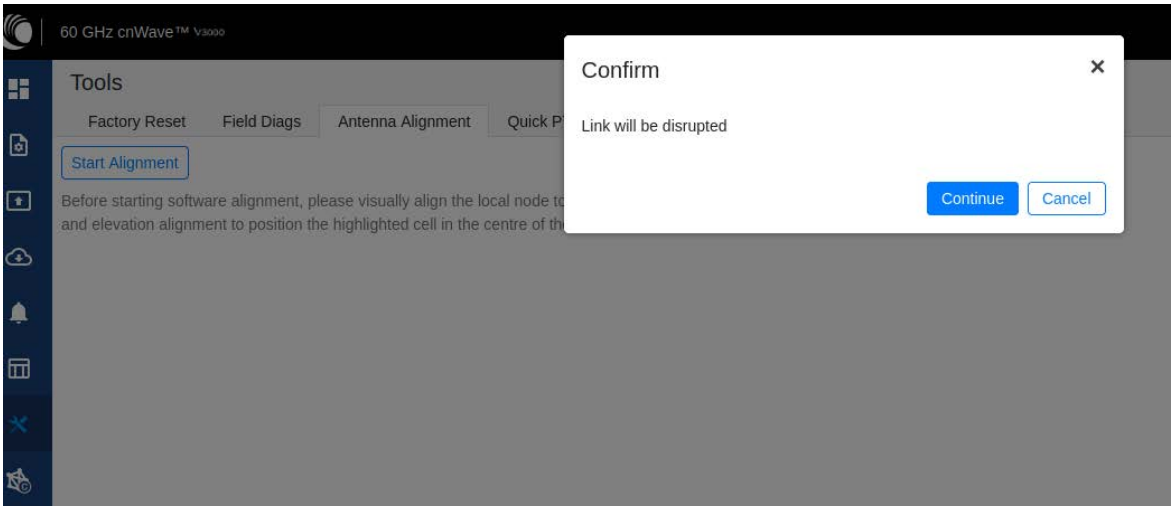
Note

If the alignment is initiated from a CN, ensure that the operating channel is set on the radio (before alignment). If the channel is not set, you must set the required channel in the **Configuration** page of the V3000 single node UI.

2. Click the **Start Alignment** button located at the top left side of the Antenna Alignment page.

   The **Confirm** message box appears (as shown in Figure 255), indicating that the link will be disrupted. For running the antenna alignment tool, the auto ignition needs to be disabled. If a link has been established already, it is disassociated at this level.

Figure 255: *The Confirm message box in the Antenna Alignment page*



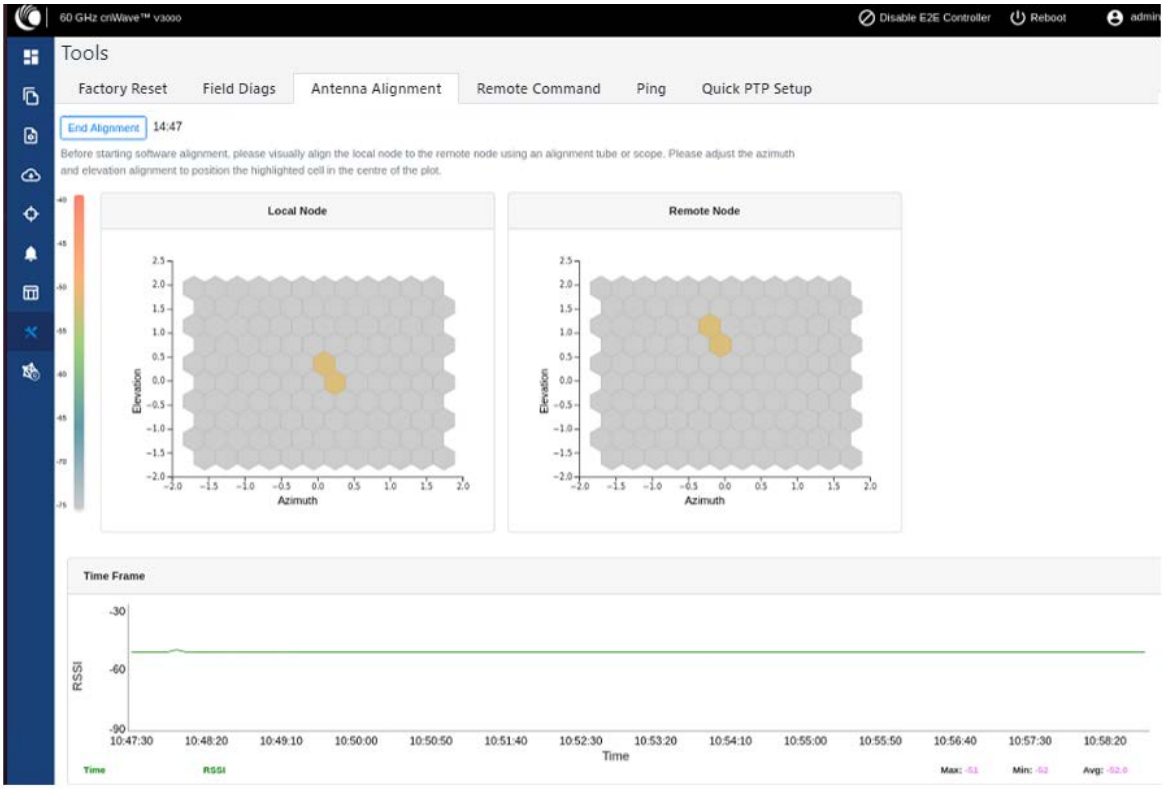
3. In the **Confirm** message box, click **Continue** to start the antenna alignment process.

   The antenna alignment process begins.

> **Note**
>
> If the alignment is initiated from a device (which is not running with Onboard Controller), perform the following actions:
>
> a. Disable the ignition of the link at the Controller.
>
> b. Send Dis-assoc for the link from the Controller.
>
> c. When the alignment starts, select the required node from the **Remote Node Model** drop-down list.

The **Time Frame** section populates the RSSI time series as shown in Figure 256.

Figure 256: *The RSSI time series*



The following details explain about the RSSI time series that populates in the Antenna Alignment page:

- The **Local Node** section (located at the left side of the Antenna Alignment page) displays the direction of arrival angle with respect to the local (PoP) device.
- The **Remote Node** section (located at the right side of the Antenna Alignment page) displays the direction of arrival angle with respect to the remote device.
- In **Local Node** and **Remote Node** sections, a cell marks the direction of arrival. The color of the cell represents the RSSI based on the heatmap scale given on the left side.
- The **Time Frame** section (located at the bottom of the Antenna Alignment page) displays the RSSI time series, along with the peak RSSI time and the latest data point (on the right end of the plot).

The RSSI time series and the heatmap plots get updated every six seconds. This is due to the processing time taken for a complete sweep of all the combinations of beams and channels.

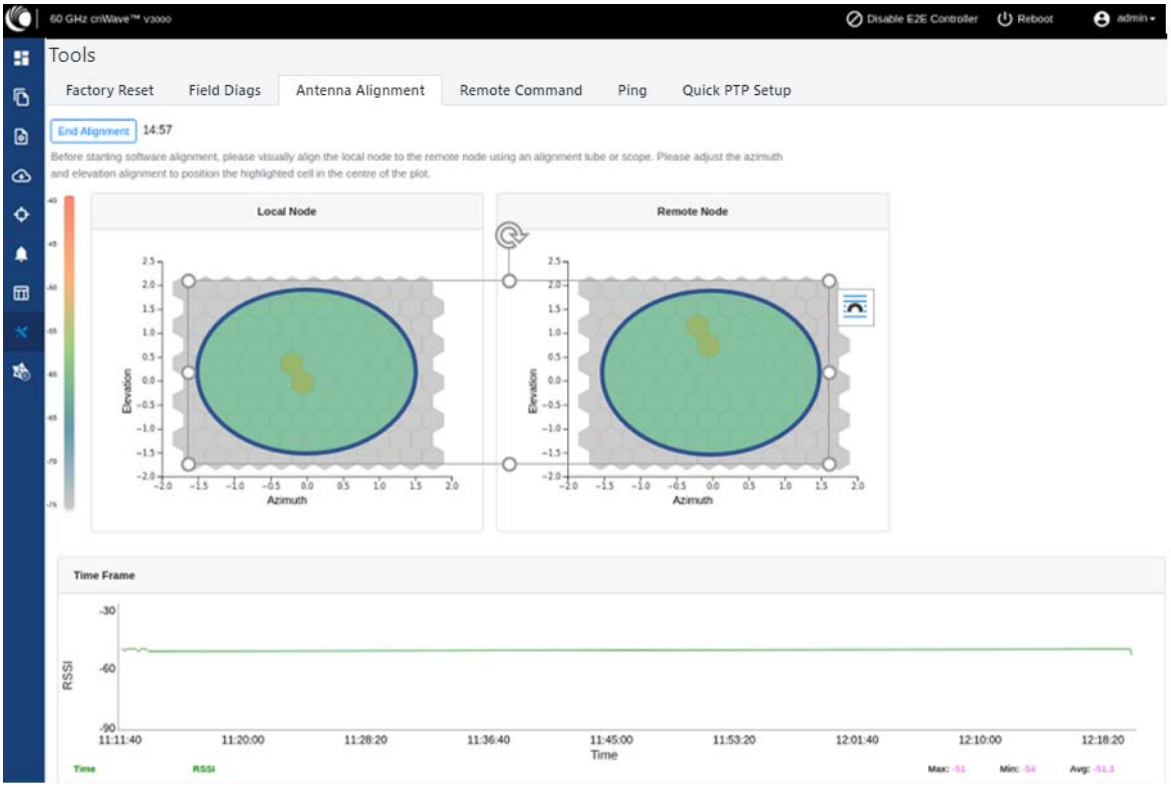
During the alignment phase, the transmit power used is the maximum configured power and the transmit power control is disabled.

Note

If the installer has enabled the short-range installation in the radio configuration, the transmit power control is set to the minimum configured power.

4. Adjust the optimal RSSI that must be reached when the beams are close to the central region, as shown in Figure 257.

Figure 257: *The optional RSSI alignment*



The RSSI time series must be close to the Link planner's predicted RSSI (the receive level when aligning, as shown in Figure 258), with an error of +/-5dB. Consider the following points when adjusting the optional RSSI:

- If the time series reporting RSSI is more than 10dB from that of the Link Planner's expected RSSI, then the device has been aligned incorrectly and is being picked up by the sidelobes or spurious beams.
- If a cell is highlighted and the time series reporting RSSI is more than 10dB off the expected RSSI, then it is necessary to sweep beyond the current position of both azimuth and elevation, in turn to ride past the sidelobes.

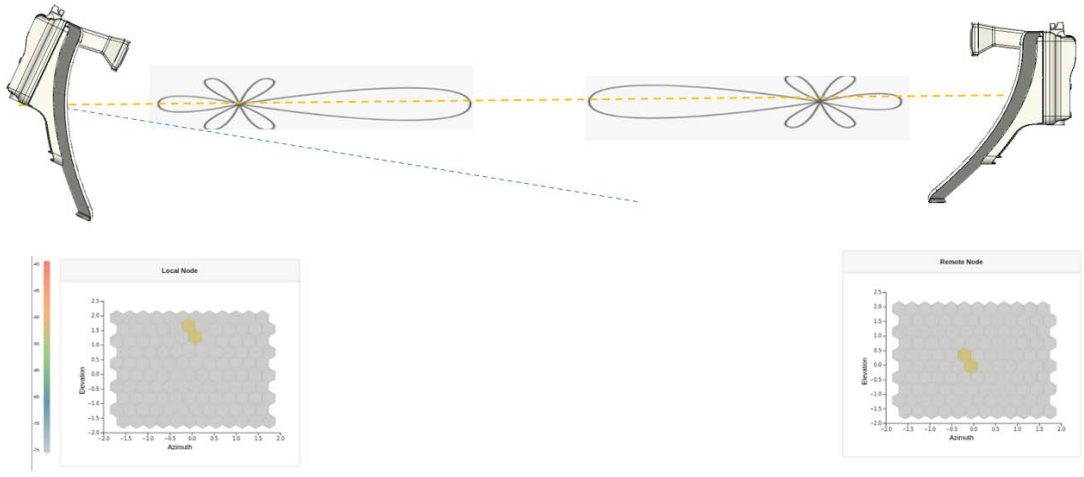
Figure 258: *An example of the receive level when aligning - Link planner*

Radio Commissioning Notes for CN	
Model	V3000
Maximum EIRP	60 dBm
Minimum MCS	MCS 2
Maximum MCS	MCS12 (16QAM 0.75 Sngl)
Channel	64.80 GHz (Channel 4)
Polarity	Auto
Predicted Receive Power	-46 dBm ± 5 dB while aligning
Operational EIRP	46 dBm
Operational Receive Power	-60 dBm ± 5 dB
Predicted Link Loss	116.25 dB ± 5.00 dB

5. Make use of the direction of arrival information (if there is any elevation or azimuth mismatch) to physically align the radio antennas.

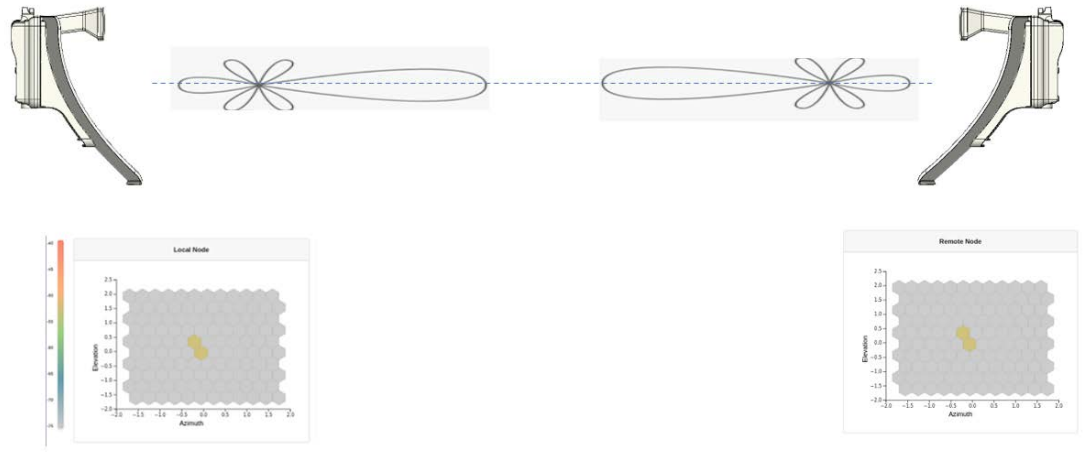
- When there is an elevation mismatch (as shown in Figure 259):

  Figure 259: *Example of the elevation mismatch*

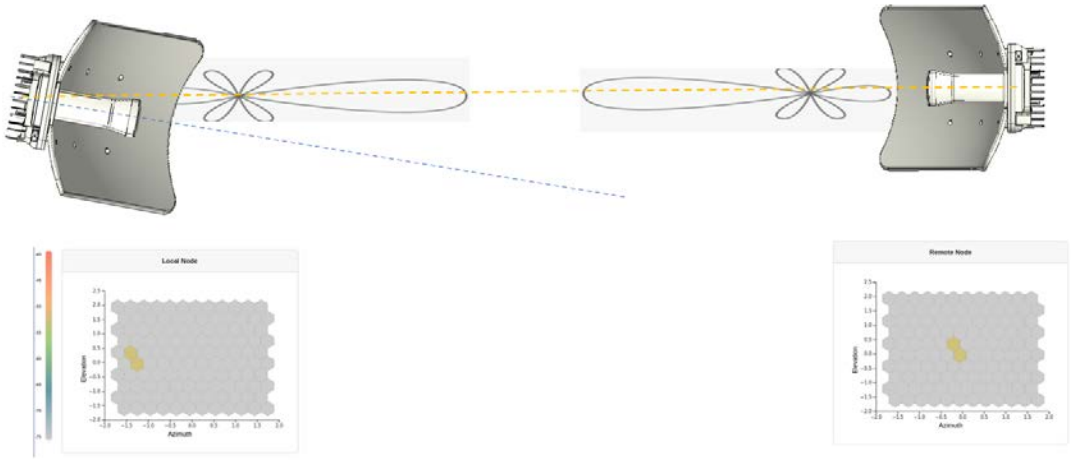
  In Figure 259, the angles are exaggerated to show the point. In this example, consider that the radio has been misaligned by a down-tilt of 2 degrees behind the unit (from an installer's view side). This means that the angle of the beam selected might be in the +2 degrees direction in the elevation due to beamforming. The aim is to get the optimal boresight beam. Therefore, the radio must be up tilted in the elevation direction by 2 degrees. The selected beam is now closer to the boresight beam, as shown in Figure 260.

  Figure 260: *On correcting the elevation mismatch*

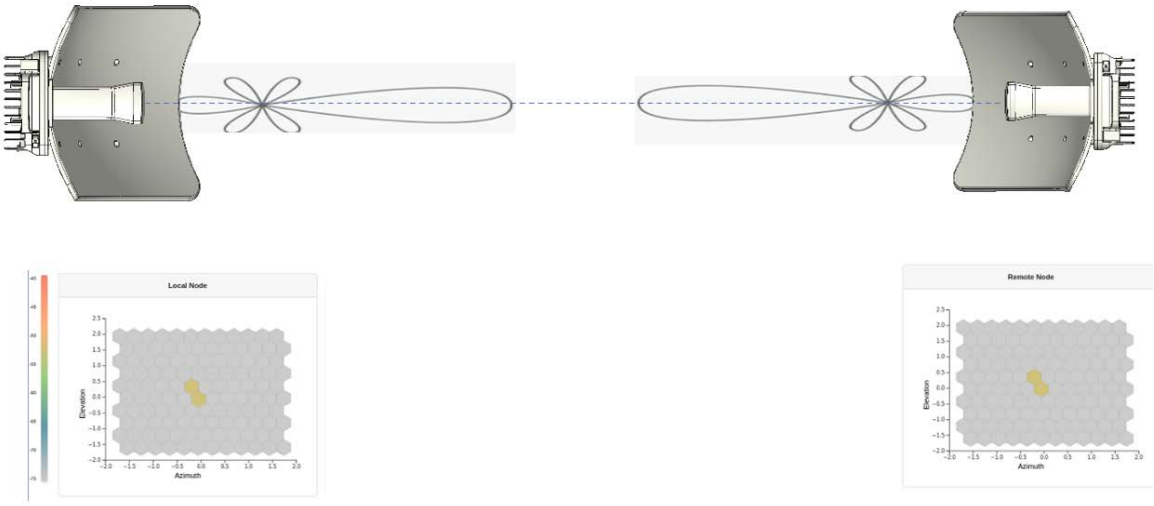
- When there is an azimuth mismatch (as shown in Figure 261):

  Figure 261: *Example of the azimuth mismatch*



In Figure 261, the angles are exaggerated to show the point. In this example, consider that the radio has been misaligned in azimuth by 2 degrees to the right behind the unit (from an installer's view side). This means that the angle of the beam selected might be in the -2 degrees direction due to beamforming. The aim is to get the optimal boresight beam. Therefore, the radio must be tilted in the azimuthal direction to the left by 2 degrees. The selected beam is now closer to the boresight beam, as shown in Figure 262.

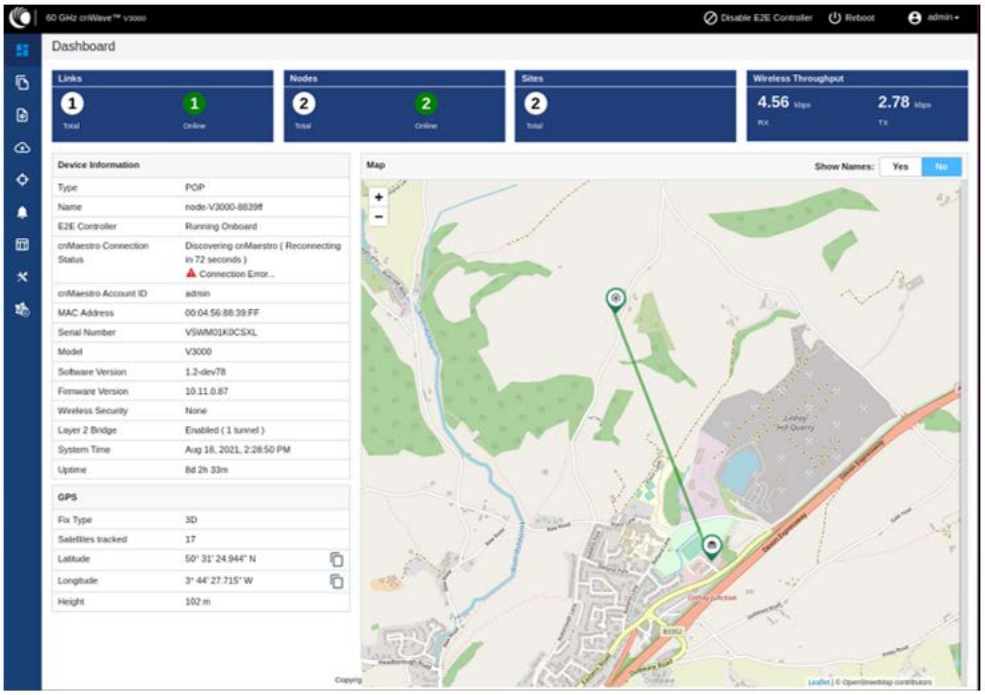
Figure 262: *On correcting the azimuth mismatch*



6. When you achieve the desired alignment and RSSI, click the **End Alignment** button located at the top left side of the Antenna Alignment page.

   If you do not click the **End Alignment** button, the alignment cycle ends automatically after 15 minutes. When the alignment cycle ends, the ignition state (disabled earlier) is enabled to auto ignition and the link is established. Figure 263 shows how the Antenna Alignment dashboard page looks on completing the antenna alignment task.

Figure 263: *The updated Antenna Alignment dashboard page*



Remote Command

The **Remote Command** tool page supports the following commands:

- Show SFP power details
- Show ipv4 neighbors
- Show ipv6 neighbors
- Show Wired Interface State Changes

Show SFP power details

The **Show SFP Power Details** command is available on the **Tools** page. When you execute this remote command from the Onboard Controller UI or the node CLI, the command provides the SFP power details (as an output) for the required SFP ports and interfaces.

Note

Currently, the **Show SFP Power Details** remote command is not available in cnMaestro.

To execute the **Show SFP Power Details** remote command, perform the following steps:

1. From the home page of the device UI, navigate to **Tools** > **Remote Command**.

   The **Remote Command** page appears.

2. Select the required node from the **Select Node** drop-down list.

3. Select **Show SFP Power Details** from the **Select Command** drop-down list.

4. Click **Execute**.

The **Output** section displays the SFP power details for the selected node, as shown in Figure 264.

Figure 264: *The UI supported output - SFP Power details*

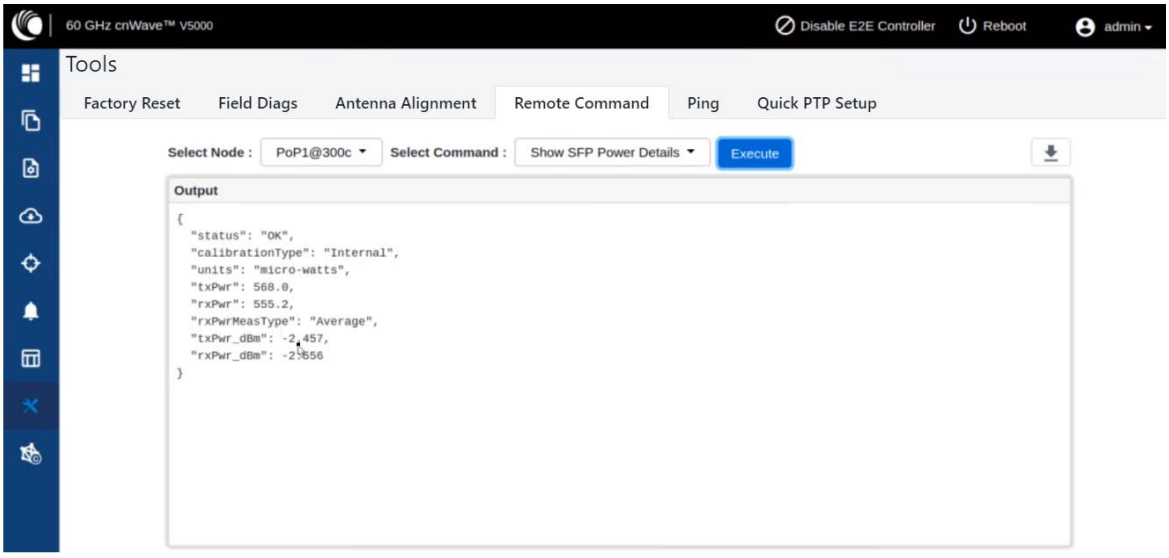


Table 60 lists and describes each parameter in the output.

Table 60: Output details

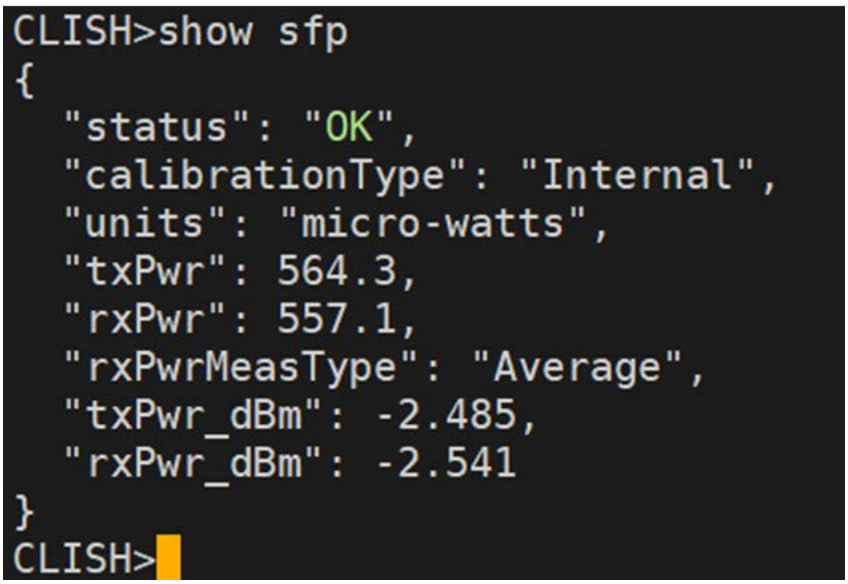
Output Parameter	Description
Status	Determines whether the output is valid. If the **Status** field contains OK, it implies that the rest of the output is valid. If the **Status** field does not contain OK, it implies that only the **Status** field is valid. In such cases, the **Status** field provides the reason for not being able to read the laser powers.
CalibrationType	Indicates the measurement type that is calibrated over the criteria, such as the following (for example): • Specified transceiver temperature, • Transceiver supply voltage, • TX output power, and • RX received optical power. The value of this parameter is Internal.
Units	Indicates the unit of measurement. The value of this parameter is micro-watts (mW).
txPwr	Indicates the TX output power in mW.
rxPwr	Indicates the RX received optical power in mW.

Output Parameter	Description
rxPwrMeasType	Indicates whether the received power measurement represents an average input optical power. The value of this parameter is Average.
txPwr_dBm	Indicates the TX output power in dBm.
rxPwr_dBm	Indicates the RX received optical power in dBm.

5. To download the output, click the download icon located at the top left side of the **Remote Command** page.

You can also execute the **Show SFP Power Details** command by using the device CLI. Log on to the device and open the CLI. At the command prompt, provide the `Show SFP` value and hit **Enter** on your keyboard. The command displays the output, as shown in Figure 265.

Figure 265: *The CLI supported output - SFP Power details*



Show ipv4 neighbors

The **Show ipv4 neighbors** remote command reveals the Address Resolution Protocol (ARP) table for IPv4 addresses in the network. The ARP table, also known as the neighbour table for IPv4, links IP addresses to MAC addresses for devices within the same local network.

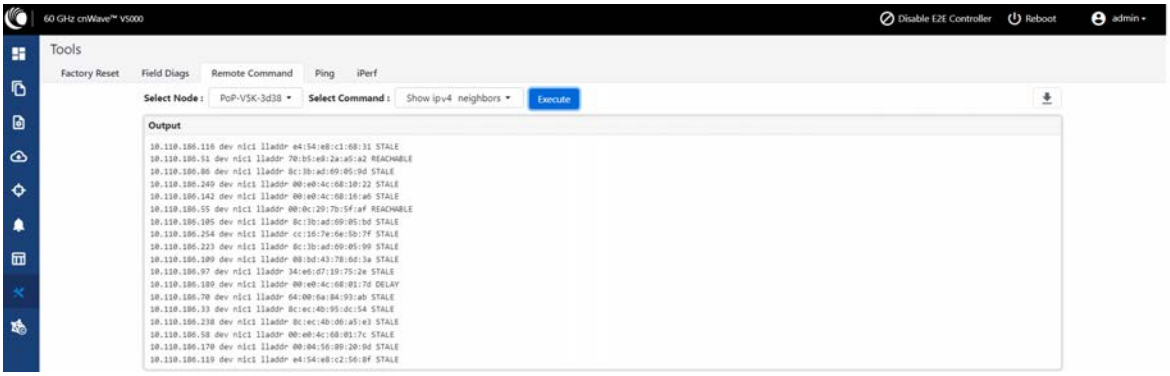
When you execute the **Show ipv4 neighbors** command using the **Tools** > **Remote Command** page, you can view information of the active IPv4 neighbours in the output. In addition, the output information can also aid in identifying potential network anomalies or connectivity issues.

To execute the **Show ipv4 neighbors** command, perform the following steps:

1. On the **Tools** > **Remote Command** Page, select the required node from the **Select Node** drop-down list.
2. Select **Show ipv4 neighbors** from the **Select Command** drop-down list.
3. Click **Execute**.

   The **Output** section displays the IPv4 neighbor details for the selected PoP or CN, as shown in Figure 266.

Figure 266: *The Show ipv4 neighbors command output*



You can use the icon to download the output (in `.txt` format).

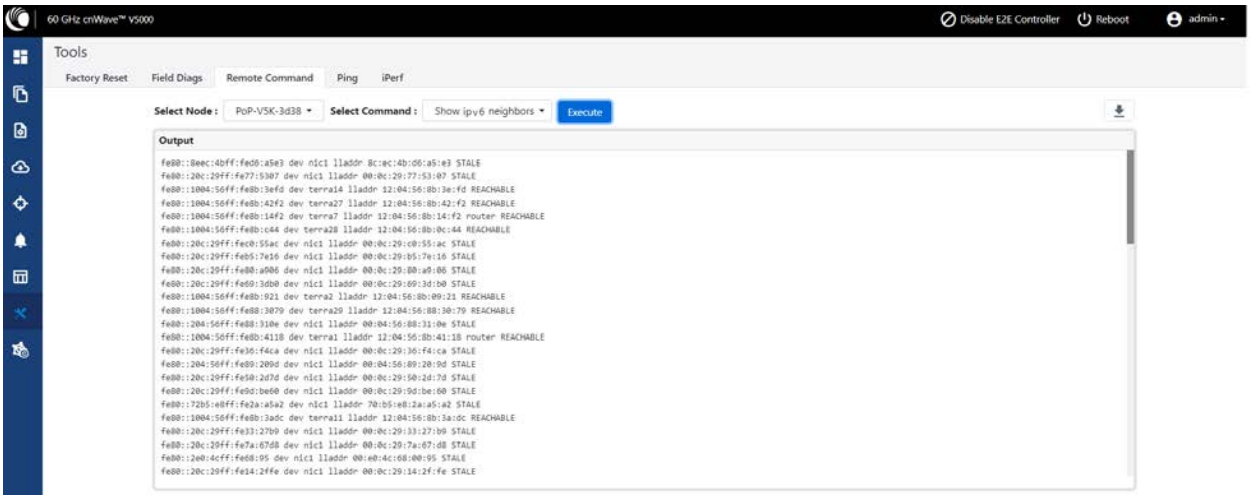
Show ipv6 neighbors

The **Show ipv6 neighbors** remote command displays the neighbour table for IPv6 addresses, analogous to the IPv4 ARP table but for IPv6 addresses. As the adoption of IPv6 continues to rise, the visibility into these connections becomes more critical.

When you run the **Show ipv6 neighbors** command from the **Tools** > **Remote Command** page, the command unveils the relationship between IPv6 addresses and MAC addresses within a local network. In addition, the command enables effective monitoring and troubleshooting of IPv6 network issues.

On selecting the required node from the **Select Node** drop-down list and **Show ipv6 neighbors** from the **Select Command** drop-down list, click **Execute**. The **Output** section displays the IPv6 neighbor details for the selected node, as shown in Figure 267.

Figure 267: *The Show ipv6 neighbors command output*



To download the output (in `.txt` format), use the icon.

Show Wired Interface State Changes

The **Show Wired Interface State Changes** remote command displays up or down events on wired interfaces. This command is useful for debugging and troubleshooting network events.

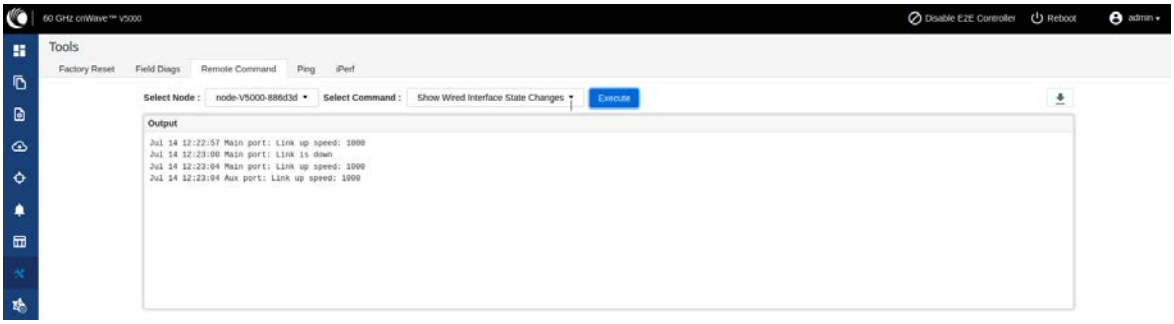
This remote command enables network administrators to identify and analyze Ethernet port state changes, and provides insights into network events such as connection issues or device status changes.

To execute the **Show Wired Interface State Changes** command, perform the following steps:

1. On the **Tools** > **Remote Command** Page, select the required node from the **Select Node** drop-down list.
2. Select **Show Wired Interface State Changes** from the **Select Command** drop-down list.
3. Click **Execute**.

   The **Output** section displays the up or down events for the selected criteria, as shown in Figure 268.

   Figure 268: *The Show Wired Interface State Changes output*



   To download the output, use the  icon.

Ping

The **Ping** tool provides information that is used to identify the reachability between the required node and another node or destination (for IPv4 and IPv6). The ping tool is useful in troubleshooting radio links.

To use the ping tool, perform the following steps:

1. From the home page of the device UI, navigate to **Tools** > **Ping**.

   The **Ping** page appears.

2. Set the parameters with the required values, as described in Table 61.

   Table 61: List of parameters in the Ping page

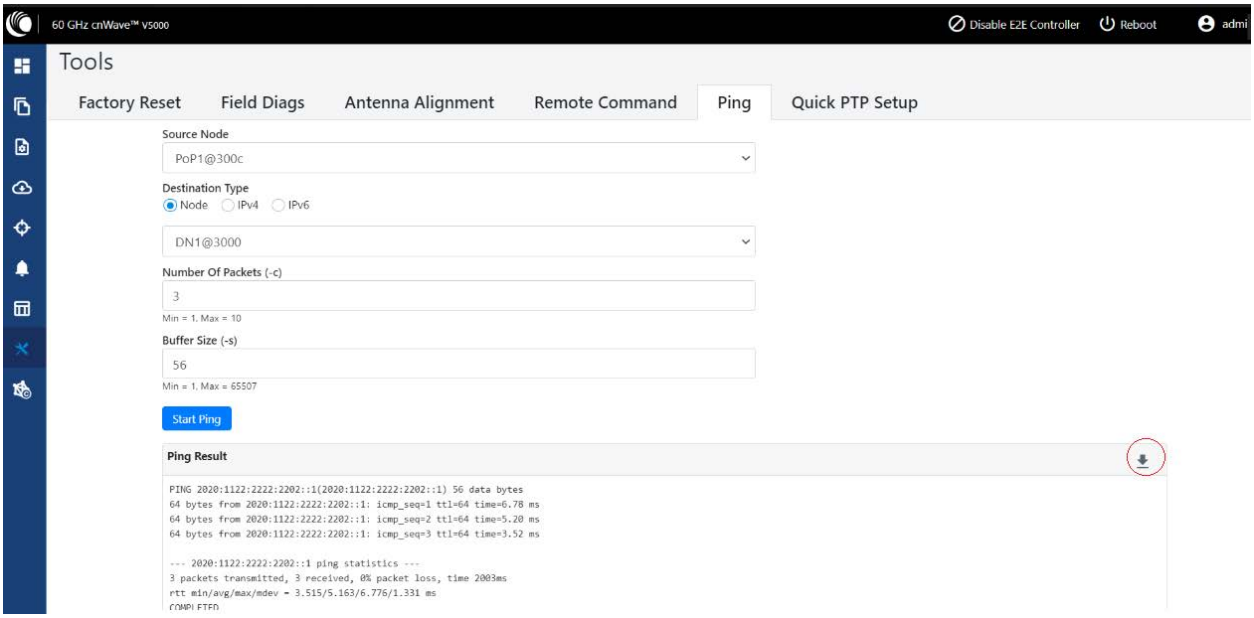
Parameter	Description
Source Node	The source node for which you want to find the reachability with another node or destination. Select the required source node from the drop-down list.
Destination Type	The required node or destination address (IPv4 or IPv6) that for which the reachability has to be identified. Following options are supported: • Node • IPv4

Parameter	Description
	• IPv6 Select the required option (mandatory).
Number of Packets (-c)	Number of times that a packet is transmitted to find the reachability. Default value: 3 This parameter supports values between 1 (minimum) and 10 (maximum). Type an appropriate value in the text box.
Buffer Size (-s)	Size (in bytes) of the packet. Default value: 56 This parameter supports values between 1 (minimum) and 65507 (maximum). Type an appropriate value in the text box.

3. Click **Start Ping**.

   The **Ping Result** section displays the information for the selected criteria, as shown in Figure 269.

Figure 269: *The Ping page*



You can use the icon to download the ping result.

Quick PTP setup

Quick PTP Setup is a simple user-friendly tool used for quickly creating a PTP link between the PoP and the CN. This option eliminates the long process of creating a PTP link with Onboard Controller in the **Topology** UI page.

Note

The Quick PTP Setup option is supported only on V1000, V2000, and V3000 products.

With the **Quick PTP Setup** option, you can skip the long process of creating a PTP link that involves the following actions:

1. Enabling Onboard Controller on the required node that can also act as a PoP node.
2. Adding a site for the CN node.
3. Adding a node for the CN node.
4. Creating a link between the PoP and the CN nodes.

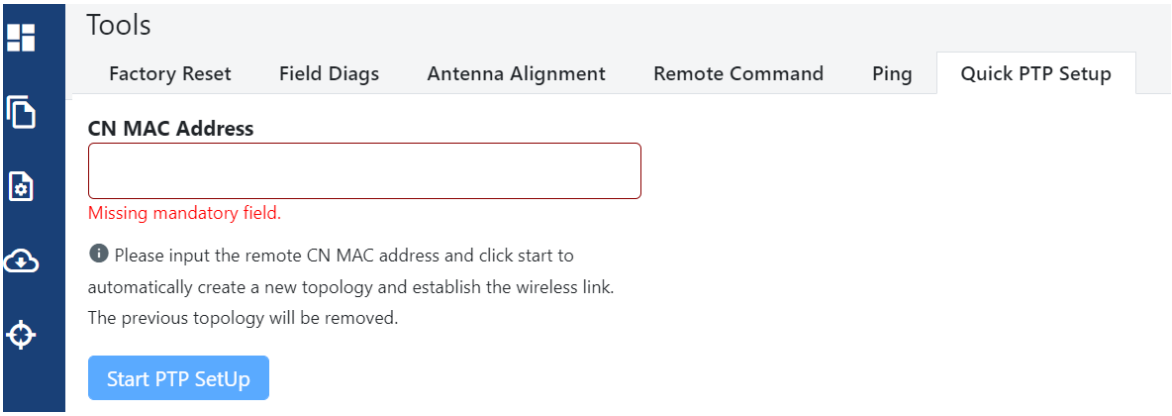
The **Quick PTP Setup** option enables you to create the PTP link using the simple process on the **Tools** page of the device UI.

To create the PTP link quickly for the required nodes, perform the following steps:

1. Navigate to **Tools** > **Quick PTP Setup** from the home page of device UI.

   The **Quick PTP Setup** page appears, as shown in Figure 270.

   Figure 270: *The Quick PTP Setup tab on the Tools page*



2. In the **CN MAC Address** text box, enter the MAC address of the required CN node (which is connected).

   Note

   You can also access the MAC address of the connected CN in the **Device Information** section of the main **Dashboard** page (of the device UI).

3. Click **Start PTP Setup**.

   This action creates the PTP link between the PoP and the CN nodes, quickly.

   When you configure **Quick PTP Setup**, the unit turns to a DN running E2E Controller with Layer 2, and default IPv4 address of 169.256.1.1. When the client onboards, E2E Controller pushes the configuration to a CN with the IPv4 address of 169.254.1.2.

   You can view the connected PoP and CN details on the **Topology** page of the device UI.

iPerf

The **iPerf** tool is a user-friendly tool for conducting network performance tests using the device UI. The tool makes network performance testing more accessible and manageable. It helps you with tools required for effective measuring

and understanding the network's performance.

The iPerf tool is built around the widely recognized iPerf testing tool (open source) and provides a graphical UI for conducting the network performance tests with ease.

The following are the features of the iPerf tool:

- **Server Node and Client Node selection**: The iPerf tool allows you to easily select the server and client nodes for your network performance tests. The node selection sets up the endpoints required for the test. In addition, the test traffic is unidirectional, flowing from the client to the server.
- **Time and Parallel Streams selection**: You can specify the time in seconds to customize the duration of the tests. You can also select the number of parallel streams to run during the test, providing more granular control over the testing parameters.
- **TCP, IPv6 Layer 3 Traffic Profile**: Network performance tests are conducted using a TCP, IPv6 Layer 3 traffic profile. The iPerf tool internally handles the selection and implementation of the traffic profile, and simplifies the test process.
- **Network performance profiling**: The iPerf tool allows you to profile the performance of your network on a link-by-link basis. This tool is instrumental in identifying performance blockers and optimizing network performance.
- **Coexisting with customer data**: The iPerf tool tests traffic that competes with customer data, rather than blocks or stops. There is no prioritization given to either data, ensuring that the test results reflect real-world network conditions.
- **Complete iPerf output display**: On conducting the network performance test, you can view the entire iPerf output in a dedicated panel on the **Tools** > **iPerf** page. This tool offers an easy and a convenient way to interpret the results (within the interface).

Note

The throughput, measured by the iPerf tool, must only be used as a guideline. Using traffic testing software onboard the radio carries additional processing overheads, which are not present in the normal operation.

To use the **iPerf** tool, perform the following steps:

1. From the homepage of the device UI, navigate to **Tools** > **iPerf**.

   The **iPerf** page appears.

2. Set the values for the parameters, as described in Table 62.

   Table 62: Parameters required for running the iPerf tool

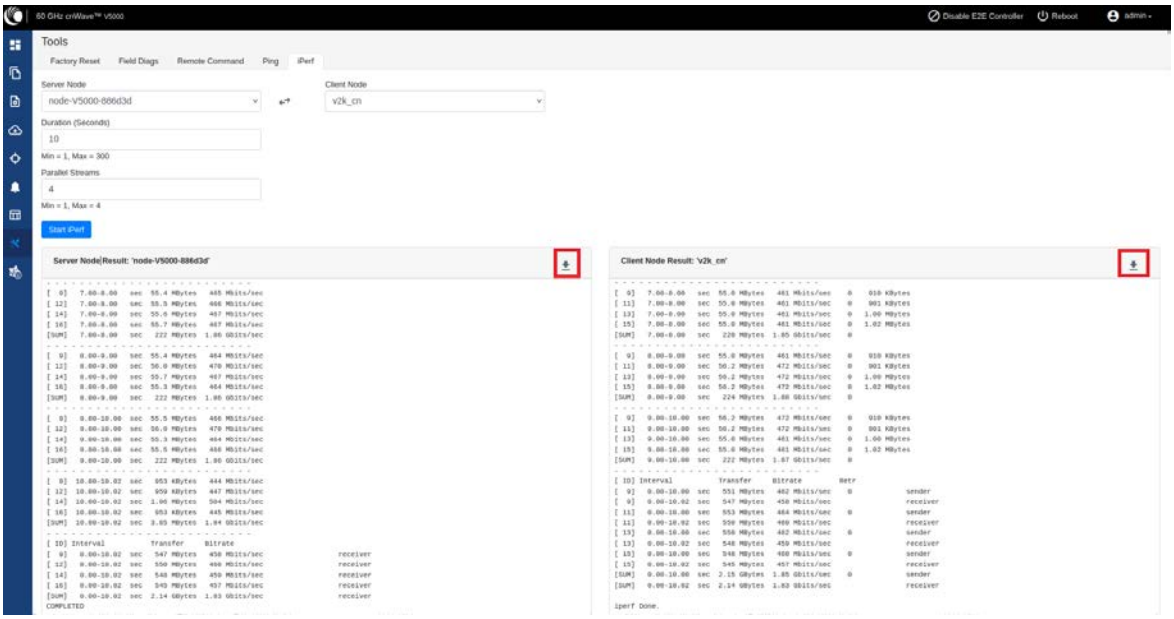
Parameter	Description
Server Node	The server node for which you want to conduct the network performance test. Select the required server node from the drop-down list. **Note**: You can use the ⇄ icon to reverse the server and client node names.
Client Node	The client node for which you want to conduct the network performance test. Select the required client node from the drop-down list.

Parameter	Description
	Note: You can use the ⇄ icon to reverse the server and client node names.
Duration (Seconds)	Period (in seconds) that you want to set for the test. Type an appropriate value (in seconds) in the text box. Default value: 10 seconds **Note**: This parameter supports values from 1 to 300 (in seconds).
Parallel Streams	Number of parallel streams that you want to run during the test. Default value: 4 Type the required value in the text box. **Note**: This parameter supports values from 1 to 4.

3. Click **Start iPerf**.

   The **Server Node Results** section and the **Client Node Results** section display the results for the selected criteria, as shown in Figure 271.

   Figure 271: *The iPerf tool page*



   To download the server and client node results (in .txt format), use the ⬇ icon on the **iPerf** page.

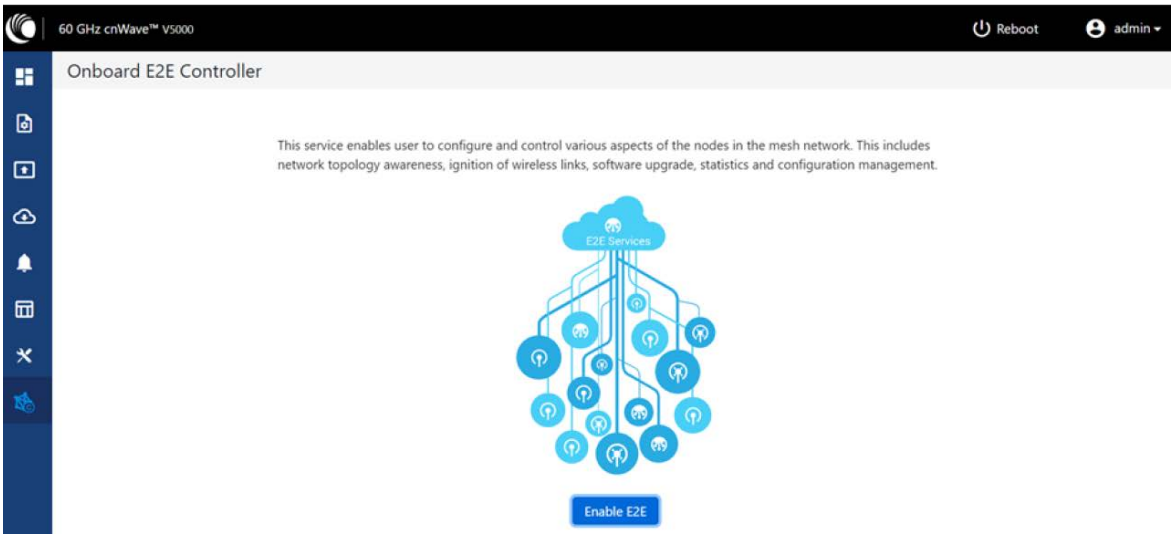
cnMaestro support for Onboard Controller

The Onboard E2E controller can be managed by cnMaestro 2.5.0 (On-Premises) for network management.

1. After the Onboard E2E controller is enabled from UI, enter the cnMaestro URL. If **Cambium ID based authentication** option is enabled in cnMaestro, then enter the Cambium ID and onboarding key.

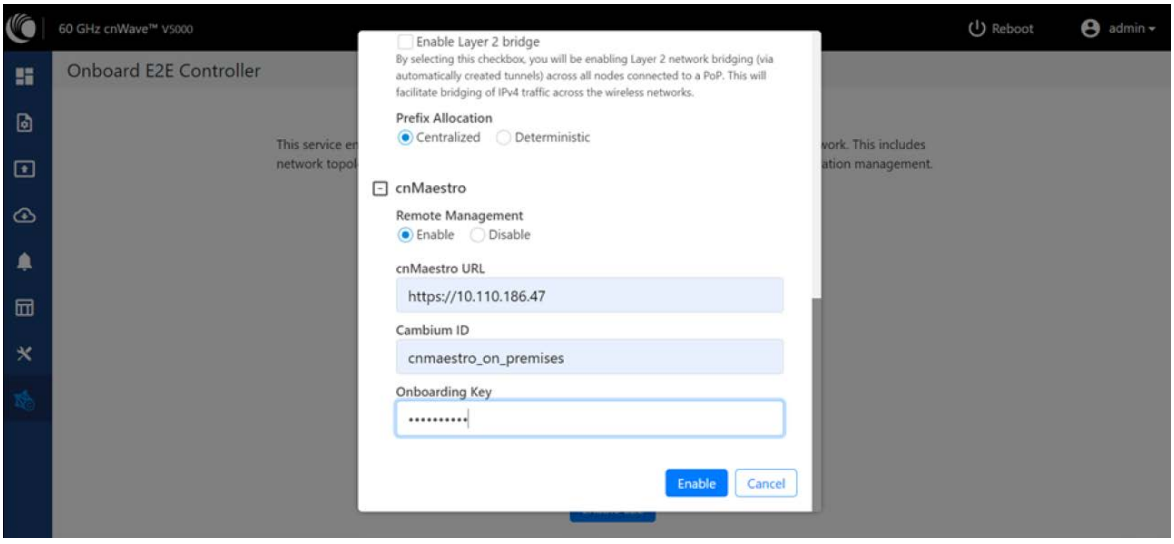
2. Click **Enable E2E** on **Onboard E2E Controller** in UI.

   Figure 272: *The Onboard E2E Controller page*



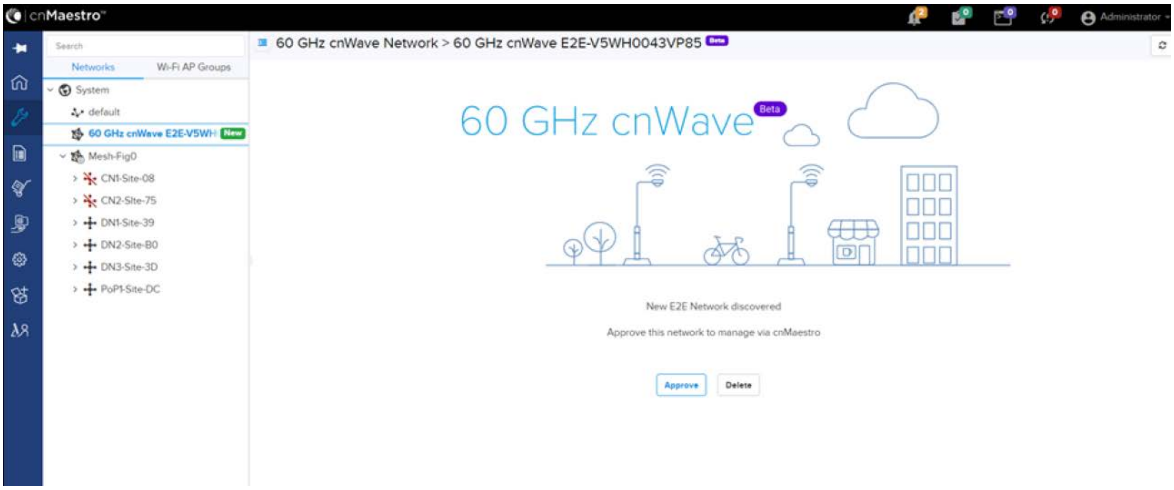
3. Enter the cnMaestro management configuration information.
   - Remote Management - Select the required remote management option
   - cnMaestro URL - cnMaestro address
   - Cambium ID - Cambium ID of the device
   - Onboarding key - Password to onboard the device

     Figure 273: *The cnMaestro section*



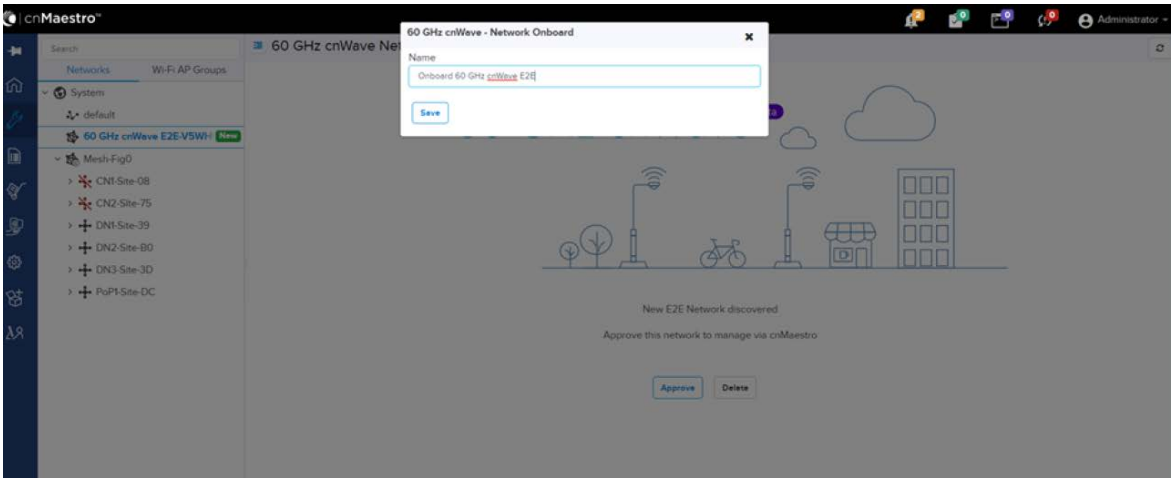
4. Click **Enable**.
5. A new E2E Network appears in cnMaestro. Click **Approve** to manage it.

Figure 274: *Information on the new E2E network*



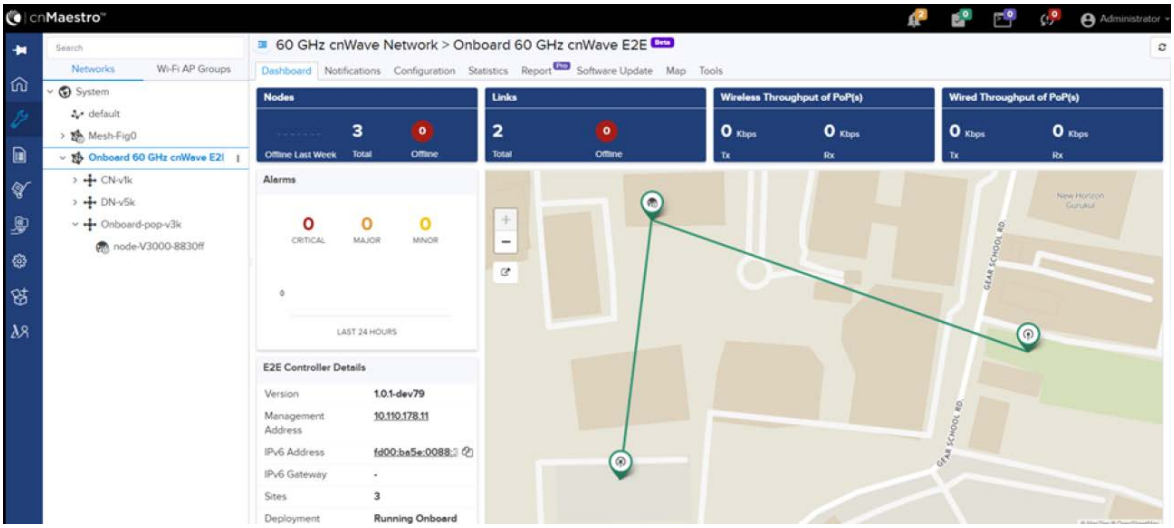
6. The **Network Onboard** window appears and provides an option to edit the network name.
7. Click **Save**.

Figure 275: *The 60 GHZ cnWave - Network Onboard*



After the successful onboarding of the E2E Network, it can be managed through cnMaestro.

Figure 276: *The Onboard 60 GHZ cnWave E2E dashboard page*



Backup CN link

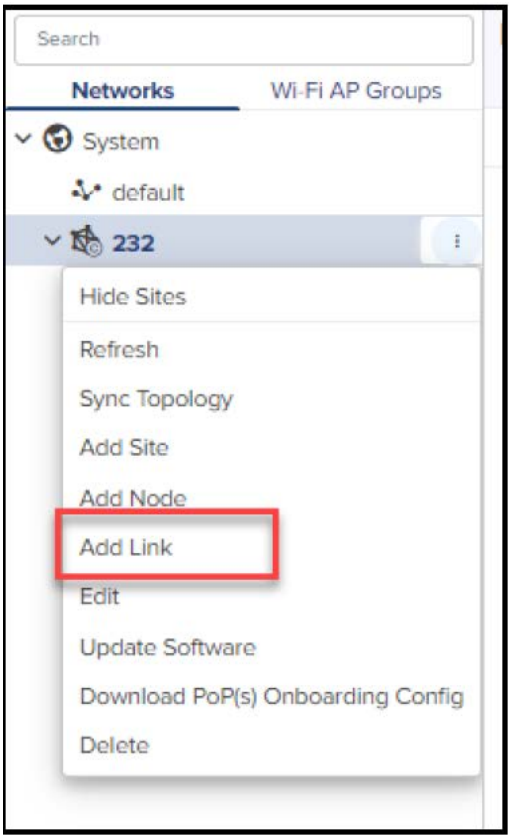
If a link between Pop or DN and CN gets disconnected, then a backup CN link (if enabled using the cnMaestro UI) provides connectivity from PoP or DN to a particular CN. CNs can form only one link but additional backup links can be provided for use when the primary link is unavailable (for at least 300 seconds).

To add and enable the backup CN link, perform the following actions:

1. From the landing page of the device UI, navigate to Networks > required link name and select the ⋮ icon.

   A drop-down list appears with multiple options, as shown in Figure 277.

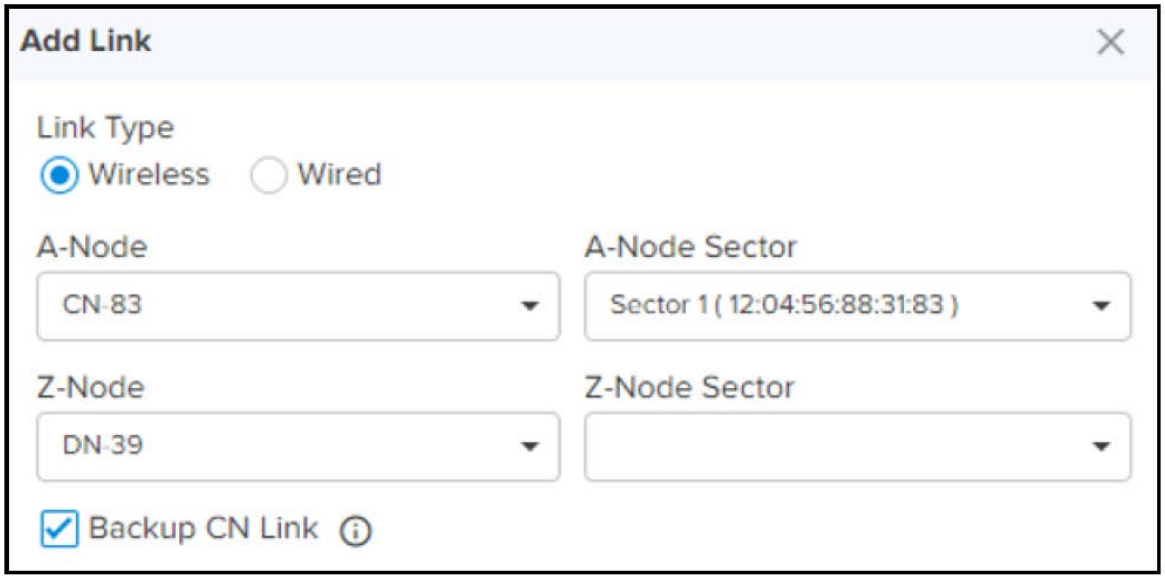
Figure 277: *The drop-down list with the Add Link option*



2. From the drop-down list, select **Add Link** as shown in Figure 277.

   The **Add Link** page appears with the **Backup CN Link** checkbox, as shown in Figure 278.

   Figure 278: *The Backup CN Link checkbox*

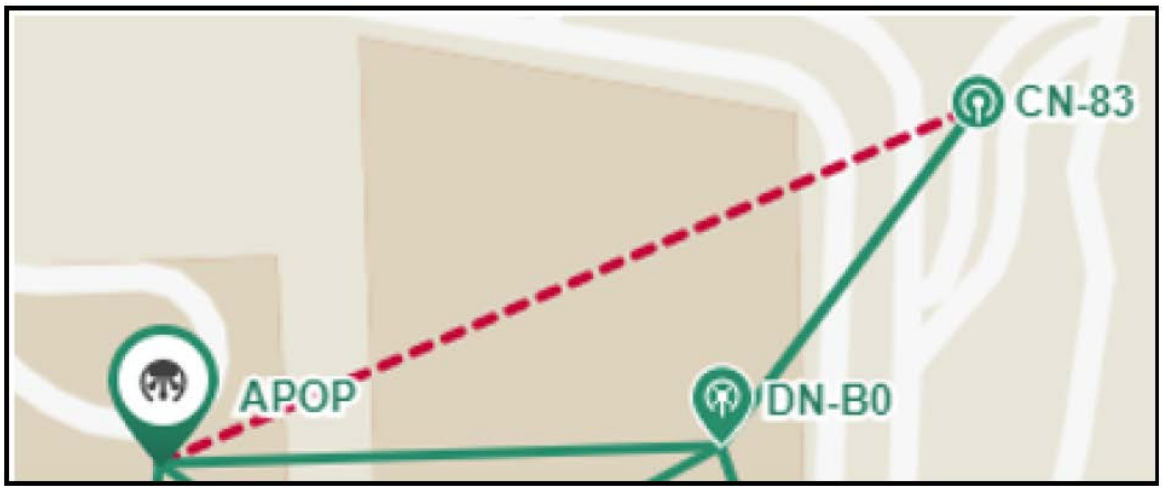


You must configure the required node-specific parameters, such as A-Node, A-Node Sector, and Z-Node, before enabling the backup CN link.

3. Select the **Backup CN Link** checkbox.

   On the **Maps** page, backup CN links are shown in a dash line format (as shown in Figure 279).

   Figure 279: *Representation of the backup CN links on the Maps page*



Auto Manage IPv6 Routes (External E2E Controller)

E2E Controller communicates with all nodes over IPv6. PoP nodes use IPv6 address of the statically configured interface to communicate with E2E Controller. CNs and DNs use the IPv6 address derived from Seed Prefix.

Note

The **Auto Manage Routes** feature requires cnMaestro 3.0.4.

The **Auto Manage Routes** feature adds and manages the IPv6 routes at E2E Controller. These IPv6 routes are required for routing the IPv6 packets to CNs and DNs.

The feature is applicable only when PoP and E2E Controller are in the same subnet.

Single PoP network

When the feature is disabled, you must add the IPv6 route by performing the following steps:

1. From the landing page of the device UI, navigate to **Tools** > **Settings** > **IPv6 Routes** > **Add new.**

   The Add Route page appears, as shown in the Figure 280.

Figure 280: *The Add Route page in the cnMaestro UI*

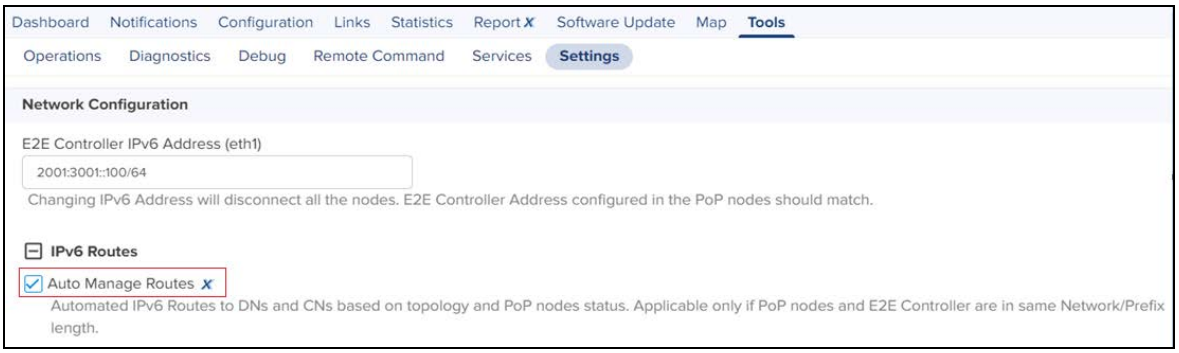
2. Type the seed prefix value in the **Destination** text box.
3. Type the required PoP's interface IP address in the **Gateway** text box.
4. Click **Add**.

   The IPv6 route is added.

   When the feature is enabled, all the above steps (described from step 1 to step 5 in this section) are not required and IPV6 routes are added automatically.
5. Select the **Auto Manage Routes** check box in the IPv6 Routes page.

   Figure 281 shows the location of the **Auto Manage Routes** check box in the IPv6 Routes page.

   Figure 281: *The Auto Manage Routes check box*



Multi-PoP network

In a multi-PoP network, the **Auto Manage Routes** feature allows you to avoid a BGP v6 router under the following conditions:

- When the Layer 2 bridge is enabled (which implies that the BGP v6 router is not required for managing data traffic).
- When PoPs and E2E Controller are in the same subnet or L2 broadcast domain.

In a multi-PoP network, Deterministic Prefix Allocation (DPA) is used. The mesh gets divided into zones. Each PoP is the best gateway to reach nodes in its zone. When a PoP is down, a different alive PoP must be used as a gateway to reach zones. When the **Auto Manage Routes** feature is enabled, it performs the following functions in a multi-PoP network:

- Understands the network topology of 60 GHz cnWave,
- Keeps a track of aliveness of PoPs, and
- Dynamically builds and manages the routing table.

Figure 282 is an example of an IPv6 route table that is built automatically by the feature for a four PoP network.

Figure 282: *Example of IPv6 route entries in the IPv6 Routes page*

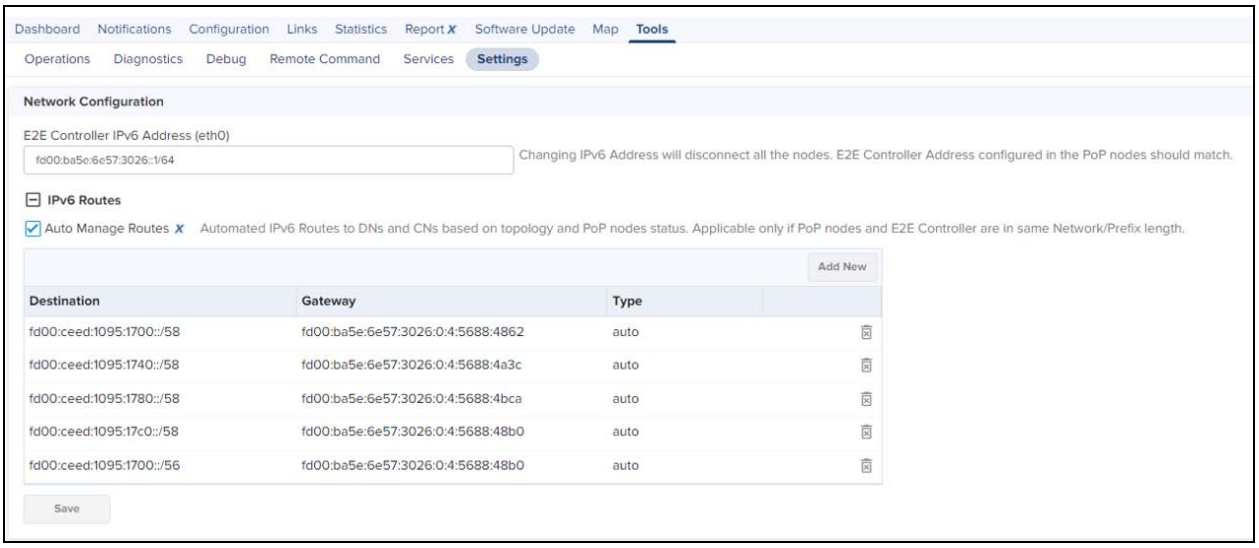
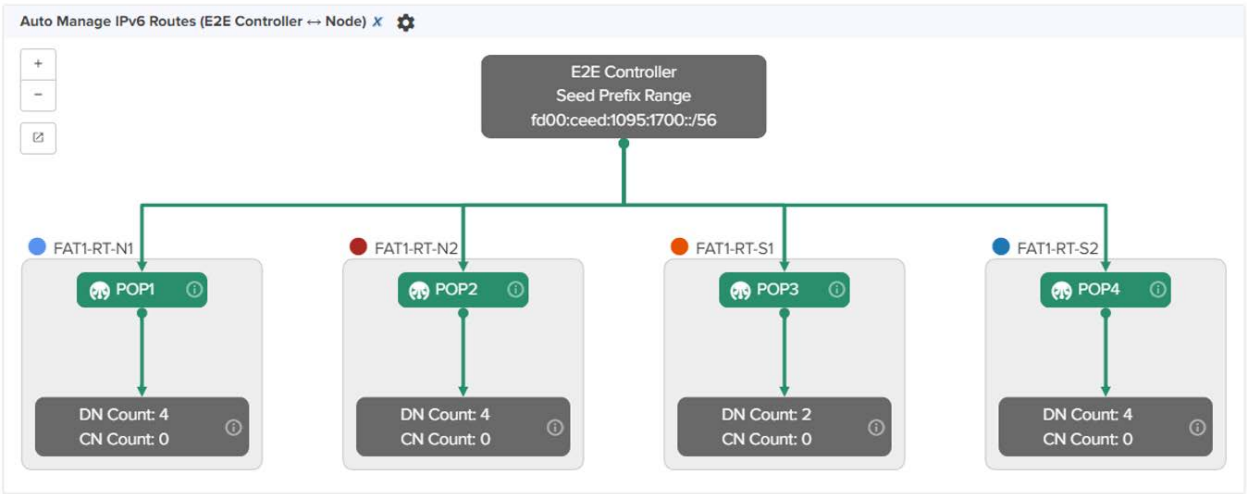


Figure 283 shows how the cnMaestro dashboard diagrammatically displays the routes taken by E2E Controller and the traffic controlled by cnWave nodes.

Figure 283: *Diagrammatic representation of IPv6 routes and traffic control*



Unconnected PoPs

In a multi-PoP network, PoPs must be able to exchange openR packets either on wired or wireless path. Otherwise, DNs might not receive the IPv6 address allocation and might not onboard to E2E Controller. This is observed when Controller sends the Prefix Allocation message to one of the PoPs and expects the message to reach other PoPs through openR.

In some cases, PoPs might be isolated temporarily, especially while building the network. Figure 284 is an example that shows two unconnected zones.

Figure 284: *Unconnected zones due to isolated PoPs*

To facilitate such a scenario, a new configuration parameter **flags.enable_pop_prefix_broadcast** has been introduced in this release. This parameter supports the following Boolean values:

- true - When the value of this parameter is set to true, E2E Controller sends the prefix allocation message to all PoPs individually.
- false -When the value of this parameter is set to false, E2E Controller sends the prefix allocation message to one of the PoPs.

  The default value of this parameter is false (default setting).

Note

You must set this parameter's flag to false when there is a wired or wireless path between PoPs.

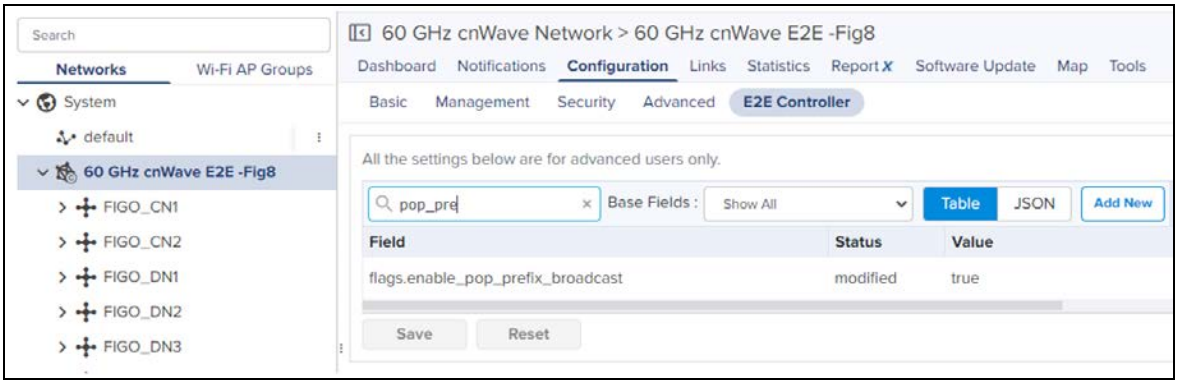
You can modify the **flags.enable_pop_prefix_broadcast** parameter in the UI of 60 GHz cnWave.

To configure the parameter, perform the following steps:

1. From the landing page of the device UI, navigate to **Configuration** > **E2E Controller.**

   The E2E Controller page appears. The **flags.enable_pop_prefix_broadcast** parameter is available on the E2E Controller page, as shown in Figure 285.

Figure 285: *The flags.enable_pop_prefix_broadcast parameter*



2. Modify the value of the parameter.
3. Click **Save** to save the configuration changes.

High Availability (HA) support for Onboard E2E Controller

You can configure the high availability (HA) support for Onboard E2E Controller.

Using cnMaestro, you can enable and configure HA support in a Multi-PoP Onboard E2E Controller that is running 60 GHz cnWave devices in a mesh network. This HA support configuration allows you to configure a primary (active mode) and a backup or secondary (passive mode) E2E Controller from cnMaestro.

If the active primary E2E Controller, with HA enabled and functioning, goes down, then the backup E2E Controller is active and manages the 60 GHz cnWave devices. All the devices report to the backup E2E Controller until the primary E2E Controller comes back.

This topic covers the following sections:

- Theory of operation
- Configuring HA support using cnMaestro
- Caveats of HA configuration

Theory of operation

E2E Controllers use the high-availability protocol (primary-backup) and support the HA configuration. In such a primary-backup setup, two controllers (peers) run on separate PoP nodes and are designated as either *primary* or *backup*. If the primary controller catastrophically fails (for example, power outage, network failure, hardware failure), the backup controller assumes control of the cnWave 60 GHz network.

The HA configuration supports the following operational mechanisms for Onboard E2E Controller:

1. **Role designation**: At setup, one controller is statically designated as primary, and the other as backup. This designation determines their initial operational roles during network management.
2. **Initial state**: The primary controller starts in an active state, overseeing network configuration and collecting network statistics. The backup controller remains in a passive state, prepared to assume control if needed.
3. **Health monitoring**: Both primary and backup controllers monitor each other's status through regular heartbeat messages, sent every five seconds. These messages are crucial for detecting any disruptions or failures in the primary (active) controller.

4. **Data synchronization**: Both primary and backup controllers periodically synchronize topology and configuration data. This synchronization is key to enabling a fast and seamless transition from passive to active state, ensuring the backup controller can immediately manage the network with up-to-date settings and configurations.

5. **Failover process**: If the primary (active) controller fails, detected by a loss of heartbeat messages for 20 seconds, the backup controller automatically transitions from passive to active. This change ensures continuous network management without manual intervention.

6. **Recovery and Reversion**: After the failed primary controller is repaired and comes back online, it starts in a passive state. It remains in this passive state until it has successfully exchanged heartbeat messages for 150 seconds, ensuring stability. Following this period, a role reversal occurs where the primary controller transitions back to active and the backup controller reverts to passive.

Configuring HA support using cnMaestro

Note

The HA support is applicable only to cnMaestro X accounts. Consider the following key points:

- The Onboard E2E Controller must be managed using cnMaestro.
- The Onboard network must have at least two PoP nodes to enable HA.
- The two PoP nodes are selected to host Primary. The backup controllers should be able to communicate over wire/ethernet.
- For HA, all the DN/CN nodes in network are expected to have a route to report to both the HA peers.
- The HA feature is supported in a network when devices are running software version 1.4 or later version.

To enable HA support for E2E Controller, complete the following steps:

1. From the Home page of cnMaestro, navigate to **Monitor and Manage** > **E2E Network** > **Configuration** > **High Availability X**.

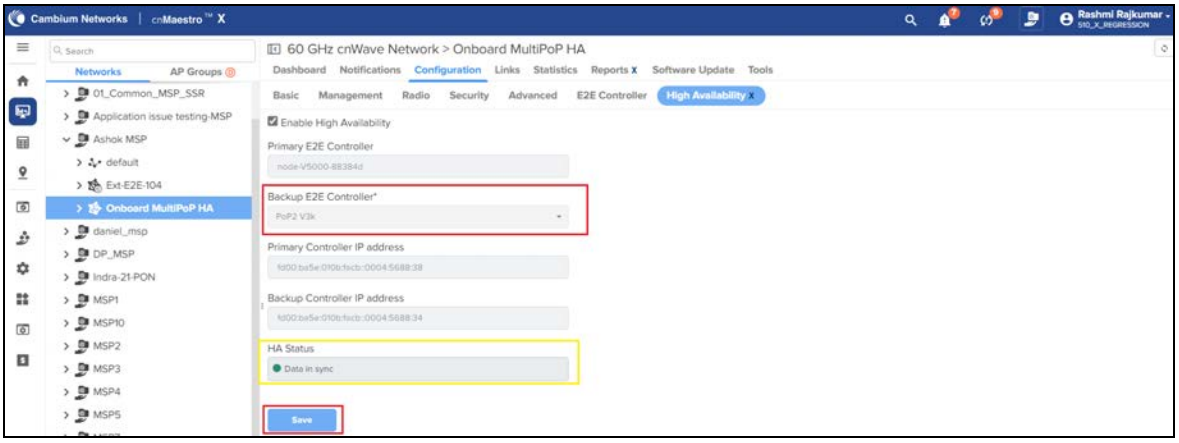
   The **Enable High Availability** checkbox appears.

   Figure 286: *The **Enable High Availability** check box - cnMaestro UI*

2. To enable HA support for E2E Controller, select the **Enable High Availability** checkbox.

   The **High Availability X** page displays options to configure the backup Controller.

Figure 287: *The HA support configuration options*



By default, the current Onboard Controller is selected as the primary controller.

3. From the **Backup E2E Controller** drop-down list, select the required node that is connected to the complete network.

   You can check the IP addresses (read only) of primary and backup controllers.

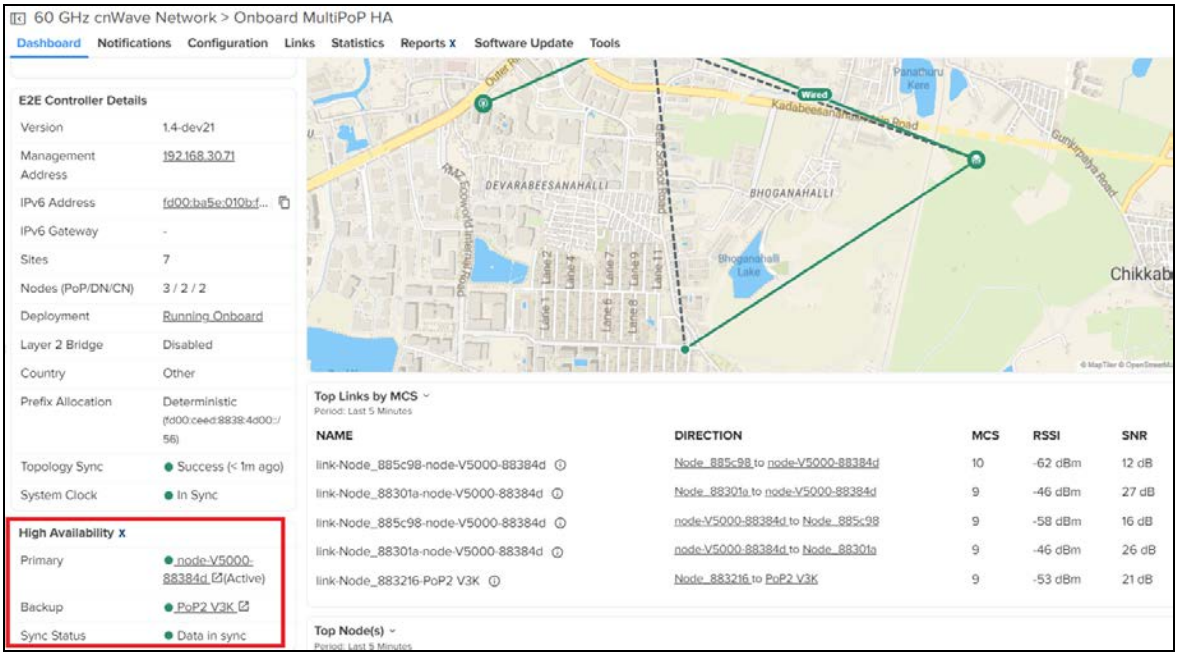
4. Click **Save** to apply the changes.

5. When you configure the HA support, ensure to check the **HA Status** parameter.

   The **HA Status** parameter must display the green button, indicating that the HA support is functioning and data is in sync. If **HA Status** displays the red button, then it indicates that the HA support is not functioning.

   You can also view the HA status in the **High Availability X** section on the **Dashboard** page.

   Figure 288: *Viewing the HA status on the Dashboard page - cnMaestro UI*



The **Primary** field displays the primary node name. The **Backup** field displays the backup node name. Green bullets in **Primary** and **Backup** fields show the online or offline status of nodes. The keyword **Active** toggles between **Primary** and **Backup** fields, indicating that the respective node is currently functioning as the active controller, managing the network, and is connected to cnMaestro.

Caveats of HA configuration

Consider the following caveats of the HA configuration for 60 GHz cnWave devices:

Configuration	Caveats
Configuration backup and restoration	• The configuration backups are supported when the HA is enabled. • The backup collected from a non-HA network can only be restored in a non-HA network. • The backup collected from an HA enabled network is restored only in a HA enabled network. • When HA is enabled, the restoration is allowed only when the primary node is active, managing the network and connected to cnMaestro.
Software update flow	• When HA is enabled, it is recommended to update the nodes when primary is functioning as the active controller. • It is recommended to run the HA pairs on the same version to avoid HA functionality issues. • Avoid downgrading the device version to less than 1.4 when HA is enabled in the network. • Avoid updating the device software from a device UI when HA is enabled. You must update the software from cnMaestro.
Device UI	• It is recommended to make changes to the network only from cnMaestro. • Making changes through device UIs may have issues in HA functionality.
cnMaestro X to Essentials downgrade	• The HA functionality will be disabled leaving the current active controller that is connected to cnMaestro as the only controller in the network. • The HA functionality can be enabled back when the subscription is enabled.
Connecting an HA enabled E2E Controller network to an Essential cnMaestro account	• The HA functionality will be disabled leaving the current active controller (which is connected to cnMaestro) as the only controller in the network. • The HA functionality can be enabled back when the network is connected to the cnMaestro X account.

For more information on configuring the HA support using cnMaestro, refer to the cnMaestro 5.1.0 User Guide.

Regulatory Information

This chapter provides regulatory notifications.

Caution

Intentional or unintentional changes or modifications to the equipment must not be made unless under the express consent of the party responsible for compliance. Any such modifications could void the user's authority to operate the equipment and will void the manufacturer's warranty.

Attention

Les changements ou modifications intentionnels ou non intentionnels à l'équipement ne doivent pas être effectués sauf avec le consentement exprès de la partie responsable de la conformité. De telles modifications pourraient annuler l'autorisation de l'utilisateur à faire fonctionner l'équipement et annulera la garantie du fabricant.

The following topics are described in this chapter:

- Compliance with safety standards lists the safety specifications against which the 60 GHz cnWave family of ODUs has been tested and certified. It also describes how to keep RF exposure within safe limits.
- Compliance with radio regulations describes how the 60 GHz cnWave family of ODUs complies with the radio regulations that are in force in various countries.

Compliance with safety standards

This section lists the safety specifications against which the 60 GHz cnWave™ platform family is tested and certified. It also describes how to keep RF exposure within safe limits.

Electrical safety compliance

The 60 GHz cnWave platform family hardware is tested for compliance to the electrical safety specifications listed in following Safety compliance specifications table.

Table 63: Safety compliance specifications

Region	Specification
USA	UL 62368-1, UL 60950-22
Canada	CSA C22.2 No.62368-1, CSA C22.2 No. 60950-22
Europe	EN 62368-1, EN 60950-22
International	CB certified IEC 62368-1 Edition 2 IEC 60950 -22

Electromagnetic Compatibility (EMC) compliance

The EMC specification type approvals that are granted for 60 GHz cnWave platform family are listed in following table.

Table 64: EMC compliance

Region	Specification
USA	FCC Part 15 Class B
Canada	RSS Gen
Europe/International	EN 301 489-1 V2.2.3, EN 301 489-17 V3.2.4

Human exposure to radio frequency energy

Relevant standards (USA and EC) applicable when working with RF equipment are:

- ANSI IEEE C95.1-2005, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
- Council recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC) and respective national regulations
- *Directive 2013/35/EU - electromagnetic fields* of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields) (20th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) and repealing Directive 2004/40/EC.
- US FCC limits for the general population. See the FCC web site at http://www.fcc.gov, and the policies, guidelines, and requirements in Part 1 of Title 47 of the Code of Federal Regulations, as well as the guidelines and suggestions for evaluating compliance in FCC OET Bulletin 65
- Health Canada limits for the general population. See the Health Canada web site at https://www.canada.ca/en.html.
- EN 62232: 2017 Determination of RF field strength, power density and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure (IEC 62232:2017)
- EN 50385:2017 Product standard to demonstrate the compliance of base station equipment with radiofrequency electromagnetic field exposure limits (110 MHz - 100 GHz), when placed on the market
- ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines for the general public. See the ICNIRP web site at https://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf and Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields.

Power density exposure limit

Install the radios for the 60 GHz cnWave platform family of wireless solutions to provide and maintain the minimum separation distances from all persons.

The applicable FCC power density exposure limit for RF energy in the 57 - 66 GHz frequency bands is 10 W/m^2. For more information, see Human exposure to radio frequency energy.

Calculation of power density

The following calculation is based on the ANSI IEEE C95.1-1991 method, as that provides a worst-case analysis.

Peak power density in the far field of a radio frequency point source is calculated as follows:

$$S = \frac{\mathrm{P.G}}{4\pi \mathrm{d}2}$$

Where:

S: power density in W/m^2

p: maximum average transmit power capability of the radio, in W

G: total Tx gain as a factor, converted from dB

d: distance from point source, in m

Rearranging terms to solve for distance yields:

$$d = \sqrt{P.G/4\pi S}$$

Calculated distances and power compliance margins

The following table displays recommended calculated separation distances, for the 60 GHz cnWave™ for Europe the USA and Canada. These are conservative distances that include compliance margins.

Note

Les tableaux suivants indiquent les distances de séparation recommandées calculées pour le cnWave ™ 60 GHz pour l'Europe, les États-Unis et le Canada. Ce sont des distances prudentes qui incluent des marges de conformité.

At these and greater separation distances, the power density from the RF field is below generally accepted limits for the general population.

Note

À ces distances de séparation et à des distances supérieures, la densité de puissance du champ RF est inférieure aux limites généralement acceptées pour la population générale.

60 GHz cnWave™ Platform Family ODU adheres to all applicable EIRP limits for transmit power when operating in MIMO mode. Separation distances and compliance margins include compensation for the antenna configuration of each product.

Note

L'ODU de la famille de plates-formes cnWave ™ 60 GHz respecte toutes les limites EIRP applicables pour la puissance de transmission lors d'un fonctionnement en mode MIMO. Les distances de séparation et les marges de conformité incluent la compensation de la configuration d'antenne de chaque produit.

Table 65: Calculated distances and power compliance margins

Product	Countries	EIRP (dBm)	EIRP (W)	Maximum power density (W/m^2)	Compliance distance (m)
V1000	USA, Canada, EU	38	6.3	10	0.22
V2000	USA, Canada, EU	49	79.4	10	0.9
V3000	USA, Canada	60.5	1122	10	3.0
V3000	EU	55	316.2	10	1.6
V5000	USA, Canada, EU	38	6.3	10	0.22

Note

The regulations require that the power used for the calculations is the maximum power in the transmit burst subject to allowance for source-based time-averaging.

The calculations above are based upon platform maximum EIRP and worst case 100% duty cycle.

Remarque

Les réglementations exigent que la puissance utilisée pour les calculs soit la puissance maximale de la rafale d'émission sous réserve de la moyenne temporelle basée sur la source.

Les calculs ci-dessus sont basés sur la PIRE maximale de la plate-forme et le pire des cas, un cycle de service de 100%.

Compliance with radio regulations

This section describes how the 60 GHz cnWave platform family complies with the radio regulations that are in force in various countries.

Caution

Where necessary, the end user is responsible for obtaining any national licenses required to operate this product and these must be obtained before using the product in any particular country. Contact the appropriate national administrations for details of the conditions of use for the bands in question and any exceptions that might apply.

Attention

Le cas échéant, l'utilisateur final est responsable de l'obtention des licences nationales nécessaires pour faire fonctionner ce produit. Celles-ci doivent être obtenus avant d'utiliser le produit dans un pays particulier. Contactez les administrations nationales concernées pour les détails des conditions d'utilisation des bandes en question, et toutes les exceptions qui pourraient s'appliquer.

Caution

Changes or modifications not expressly approved by Cambium Networks could void the user's authority to operate the system.

Attention

Les changements ou modifications non expressément approuvés par les réseaux de Cambium pourraient annuler l'autorité de l'utilisateur à faire fonctionner le système.

Type approvals

The system is tested against various local technical regulations and found to comply. The Radio specifications section lists the radio specification type approvals that is granted for the 60GHz cnWave products.

Some of the frequency bands in which the system operates are “license exempt” and the system is allowed to be used provided it does not cause interference. In these bands, the licensing authority does not guarantee protection against interference from other products and installations.

Region	Regulatory approvals	FCC ID	IC ID
USA	Part 15C	QWP-60V1000 QWP-60V2000 QWP-60V3000 QWP-60V5000	-
Canada	ISED RSS-210	-	109AO-60V1000 109AO-60V2000 109AO-60V3000 109AO-60V5000

Federal Communications Commission (FCC) compliance

The 60 GHz cnWave V1000, V2000, V3000 and V5000 comply with the regulations that are in force in the USA.

Caution

If this equipment does cause interference to radio or television reception.

FCC Notification

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

Innovation, Science and Economic Development Canada (ISEDC) compliance

The 60 GHz cnWave V1000, V2000, V3000 and V5000 comply with the regulations that are in force in Canada.

Caution

If this equipment does cause interference to radio or television reception.

Attention

Si cet équipement cause des interférences à la réception radio ou télévision.

60 GHz cnWave example product labels

Figure 289: *60 GHz cnWave™ V5000 Distribution Node*

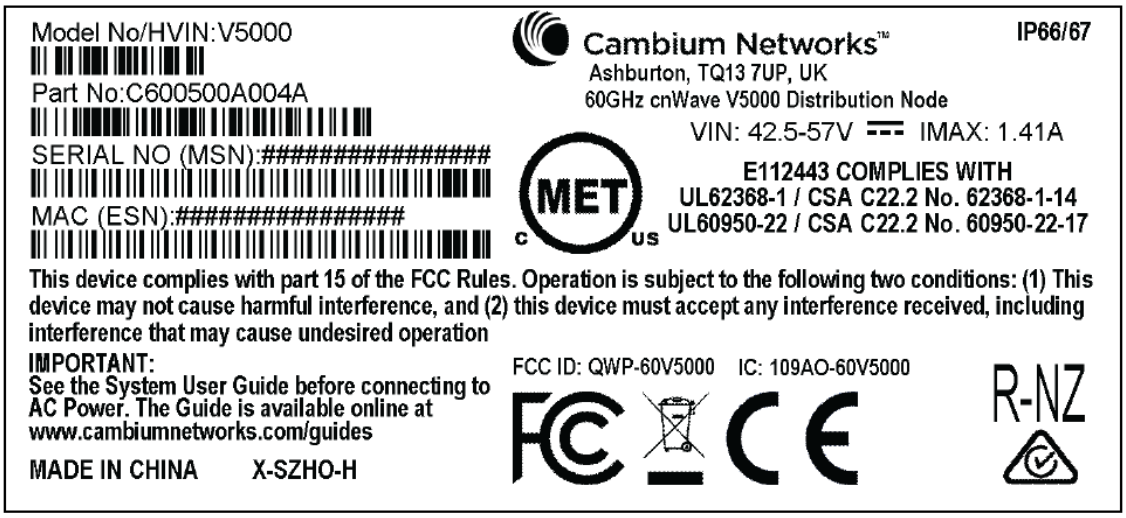


Figure 290: *60 GHz cnWave™ V3000 Client Node Radio only*

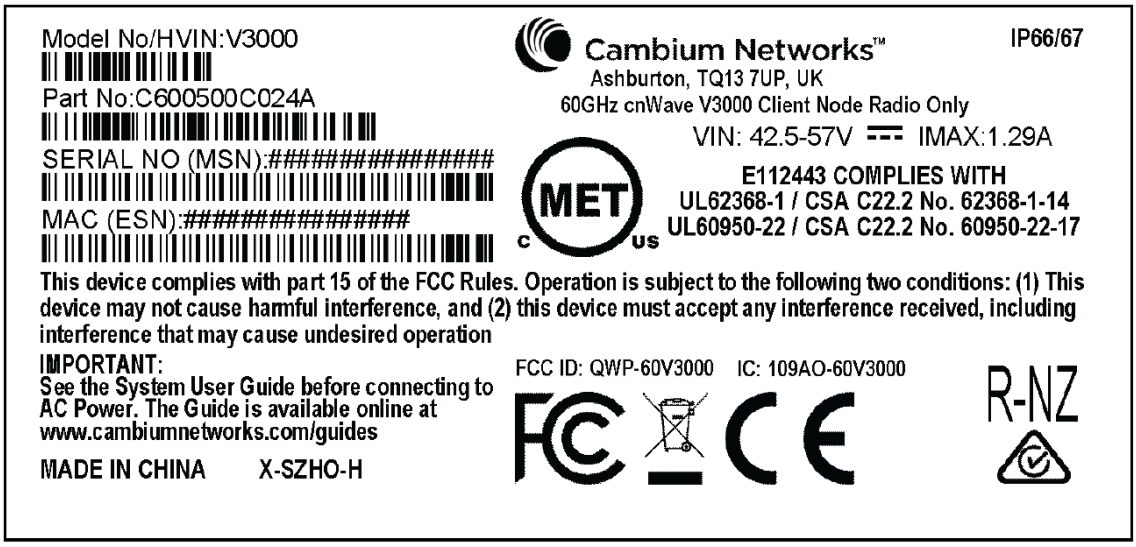


Figure 291: *60 GHz cnWave™ V2000 Client Node with no power cord*

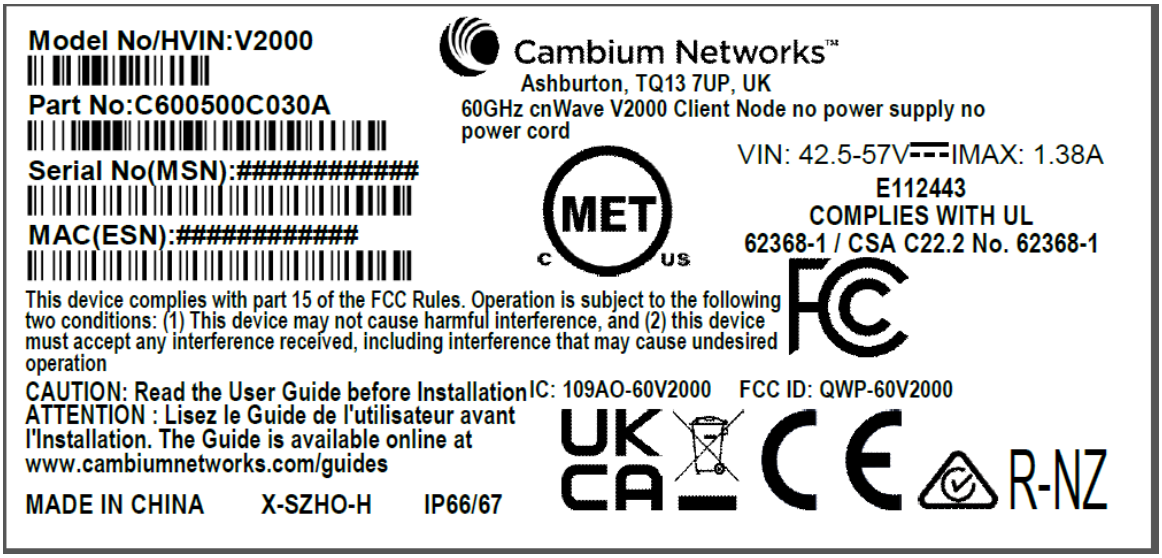


Figure 292: *60 GHz cnWave™ V1000 Client Node with no cord*

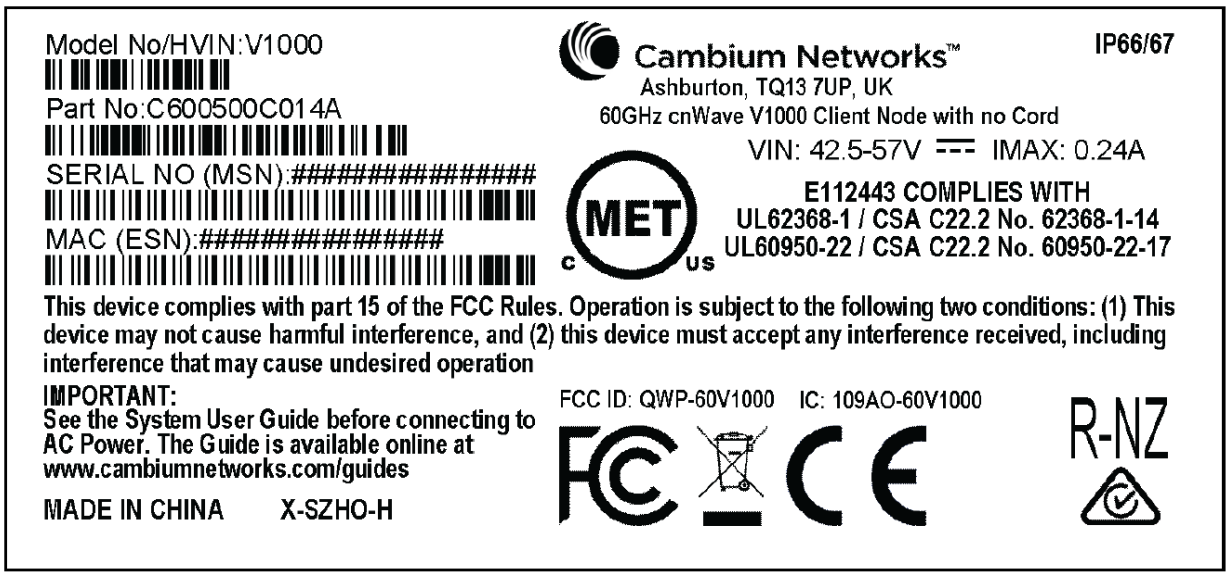


Figure 293: *60 GHz cnWave™ V1000 with US cord*

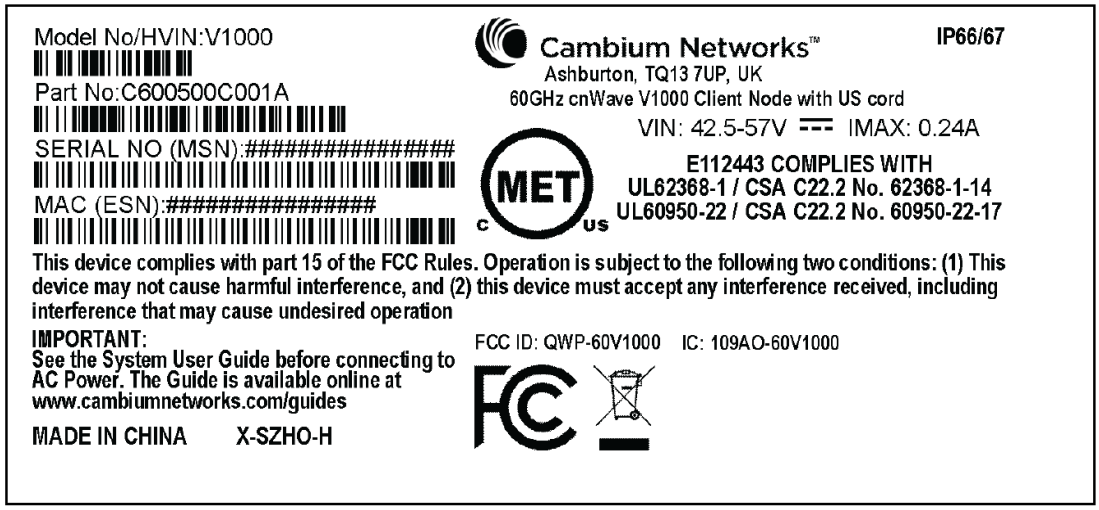


Table 66: Details of accessories, radio nodes, and part numbers

Accessories	Radio nodes	Cambium Part Number
60 GHz cnWave™ V5000 Distribution Node	V5000	C600500A004B
60 GHz cnWave™ V3000 Client Node radio only	V3000	C600500C024B
60GHz cnWave V2000 Client Node no power supply, no power cord	V2000	C600500C030B
60 GHz cnWave™ V1000 Client Node with no cord	V1000	C600500C014B
60 GHz cnWave™ V1000 with US cord	V1000	C600500C001B

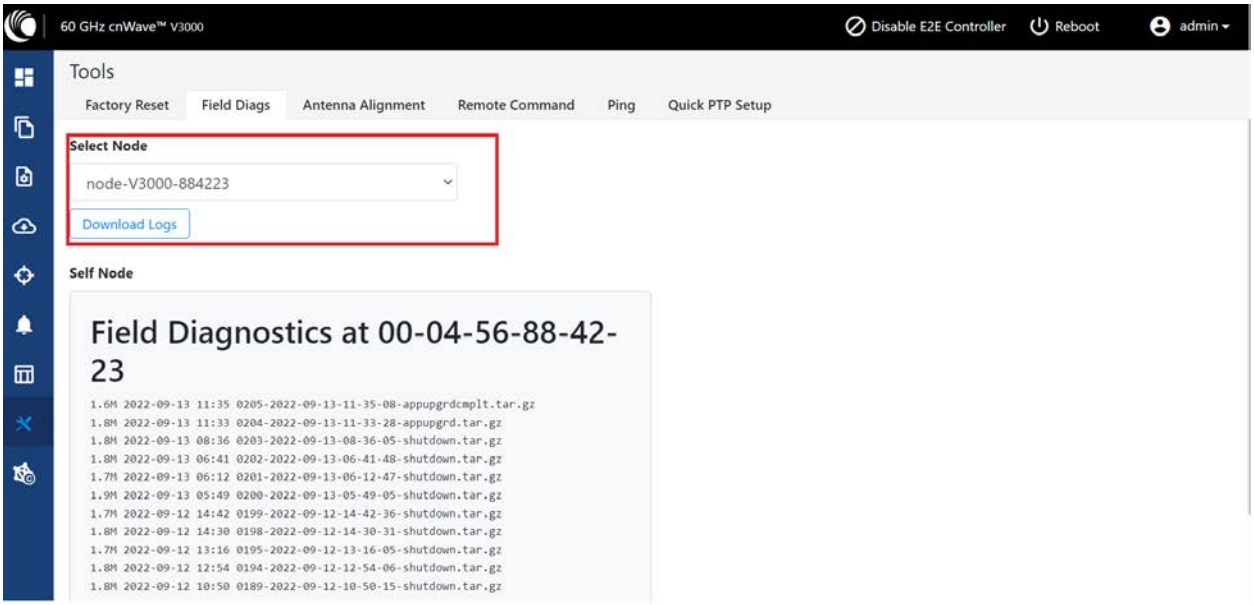
Troubleshooting

This section describes the troubleshooting steps and addresses frequently asked questions related to 60 GHz cnWave product deployment.

Field diagnostics logs

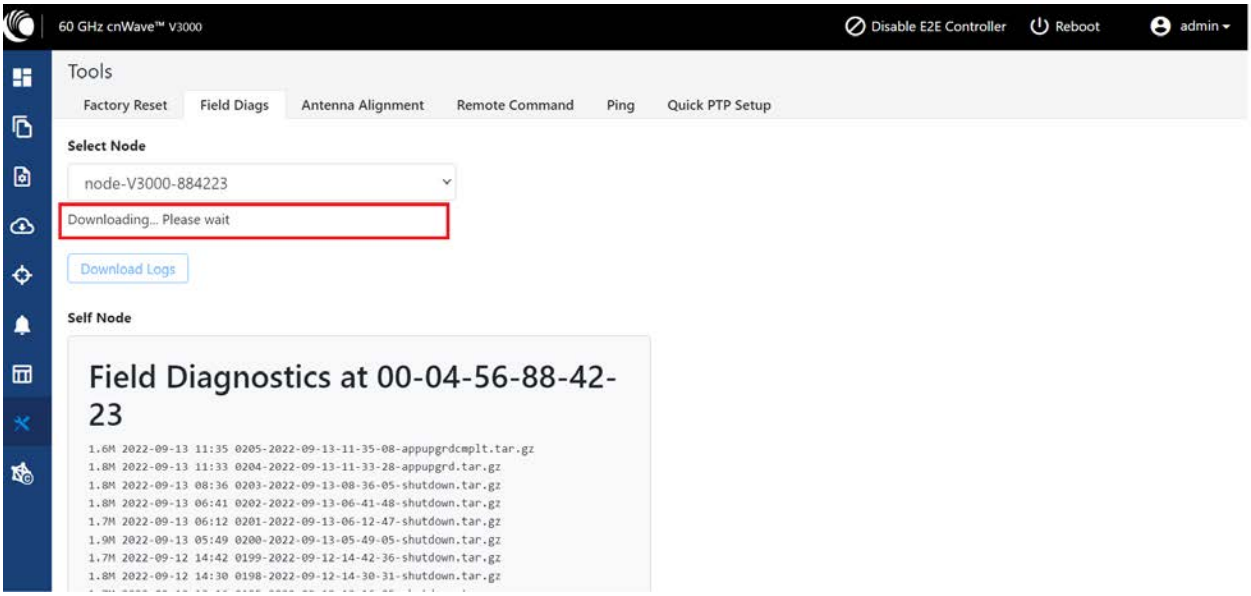
Download the logs to view more information about the error. To download the error logs select the node from the drop-down and click **Download Logs**.

Figure 294: *The Logs tab in the Tools page*



On clicking **Download Logs**, the status for download is displayed.

Figure 295: *Downloading the logs*

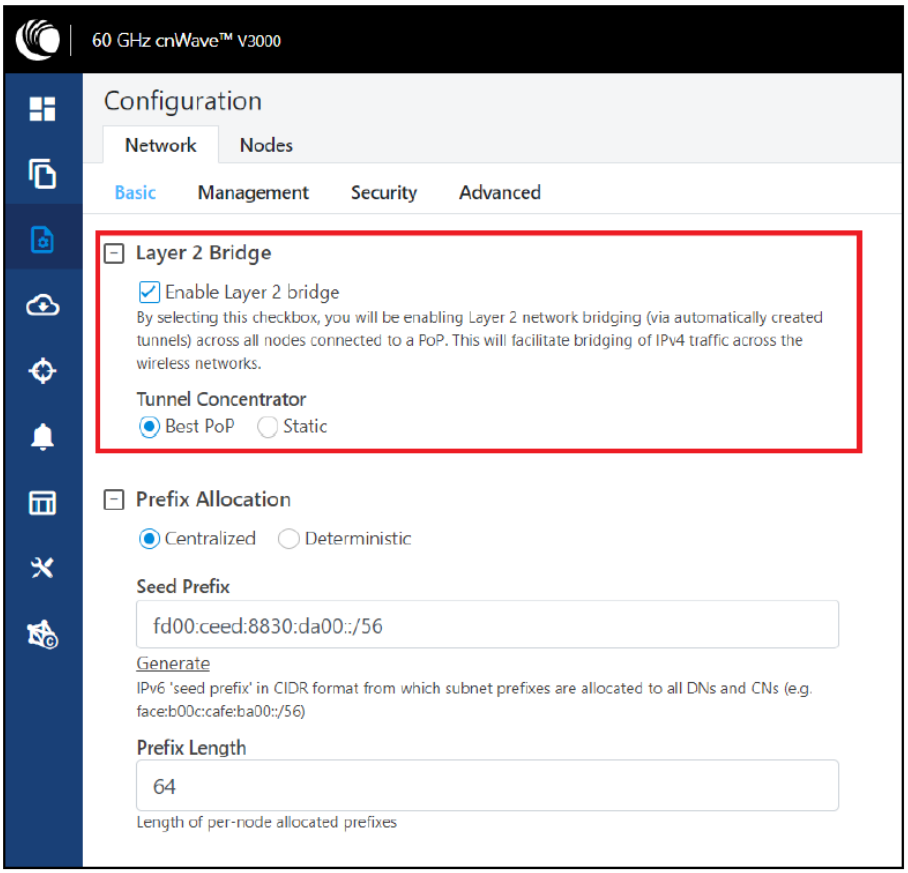


To download the logs for a self node, click **Download Logs** at the bottom and save the log file.

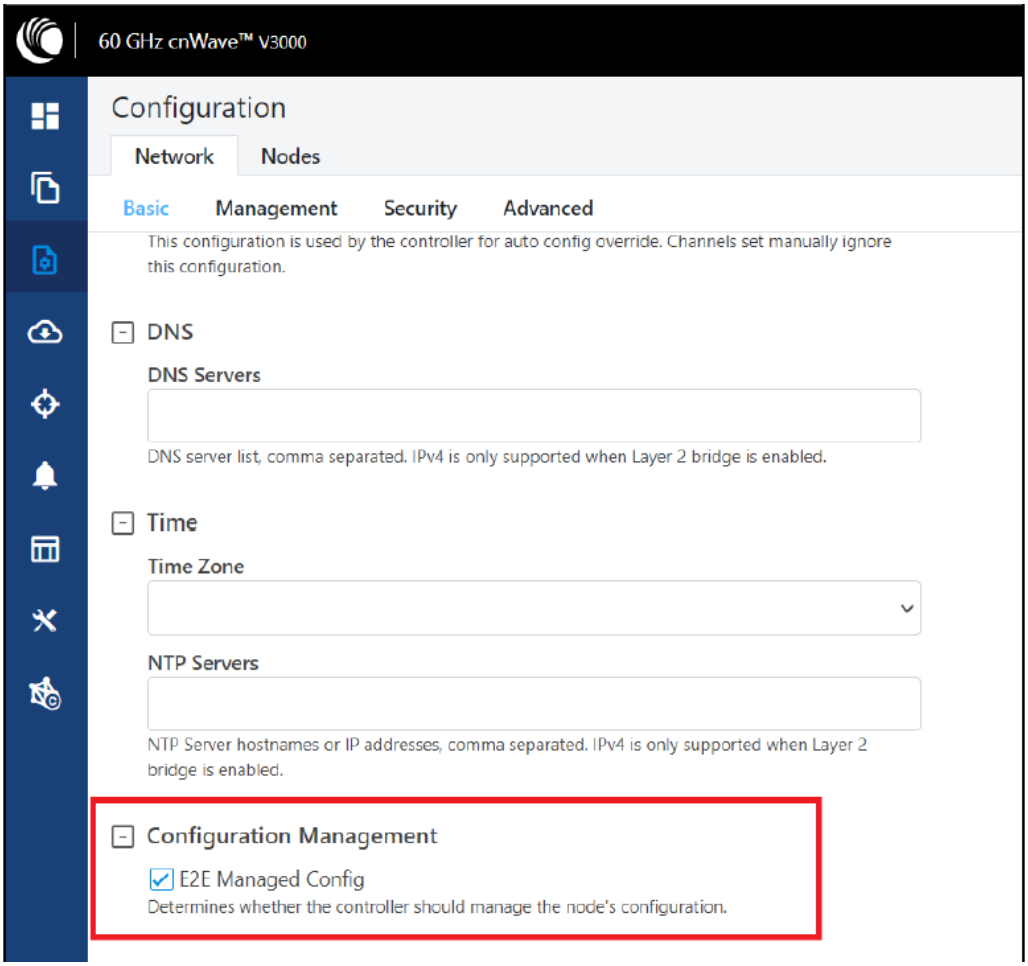
Setup issues in IPv4 tunneling

In IPv4 tunneling, if setup issues occur then perform the following steps:

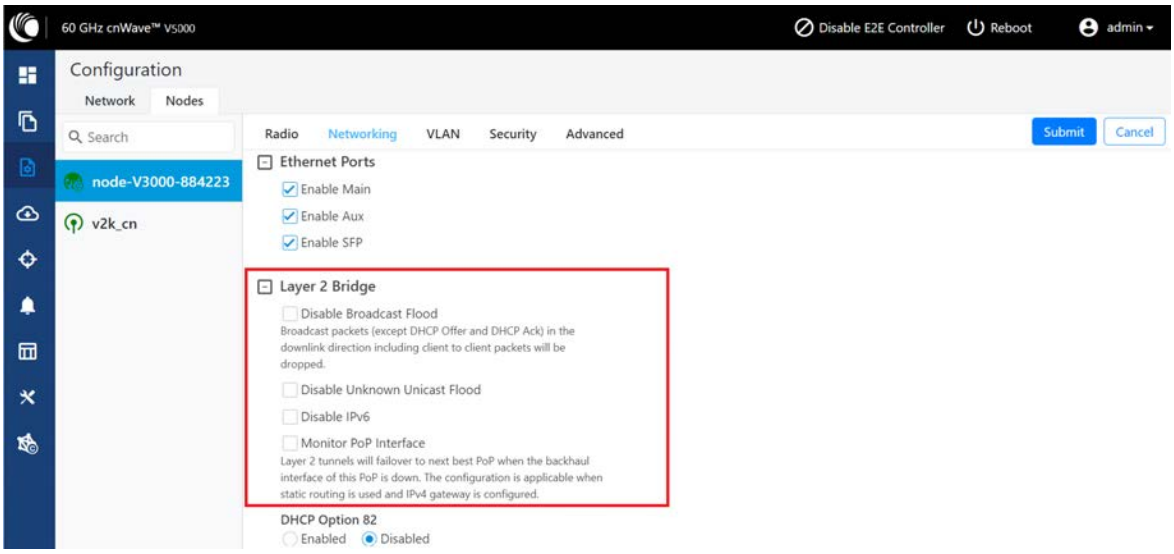
1. Click **Configuration** on the left pane, navigate to **Network** > **Basic** > **Layer 2 Bridge** and verify **Enable Layer 2 bridge** is selected.



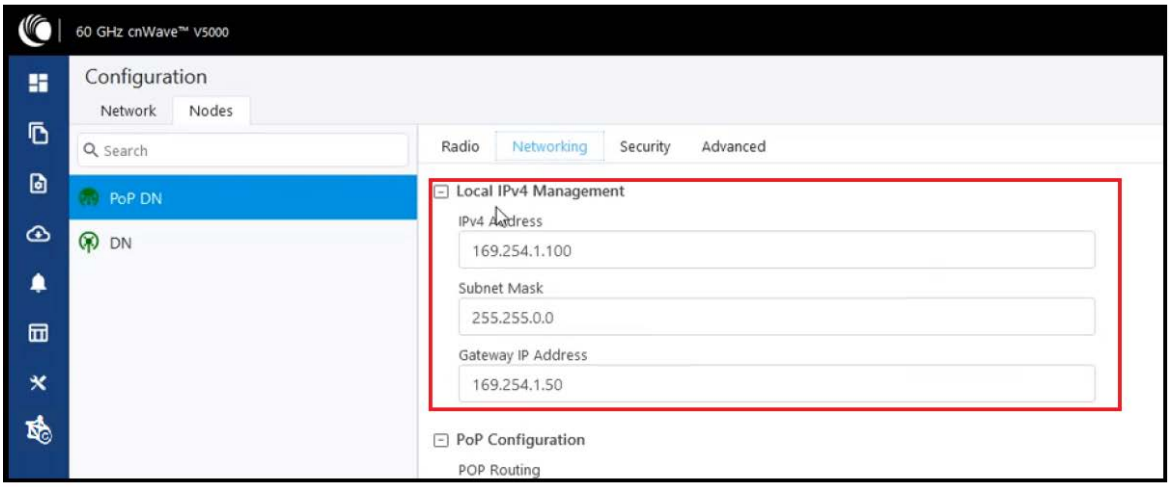
2. On the same page under **Configuration Management**, verify **E2E Managed Config** is selected.

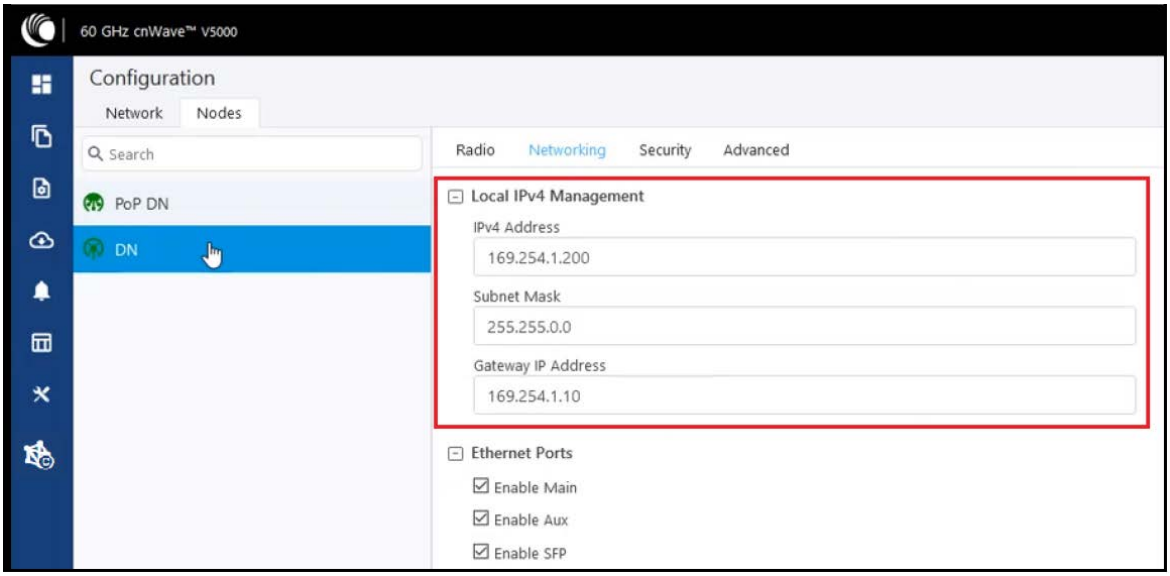


3. Click **Configuration** > **Nodes** > **PoP DN** > **Networking** > **Layer 2 Bridge** and verify **Disable Broadcast Flood** and **Disable IPv6** are disabled.



4. Ensure that PoP DN and DNs are in the same subnet and verify gateway is correct.



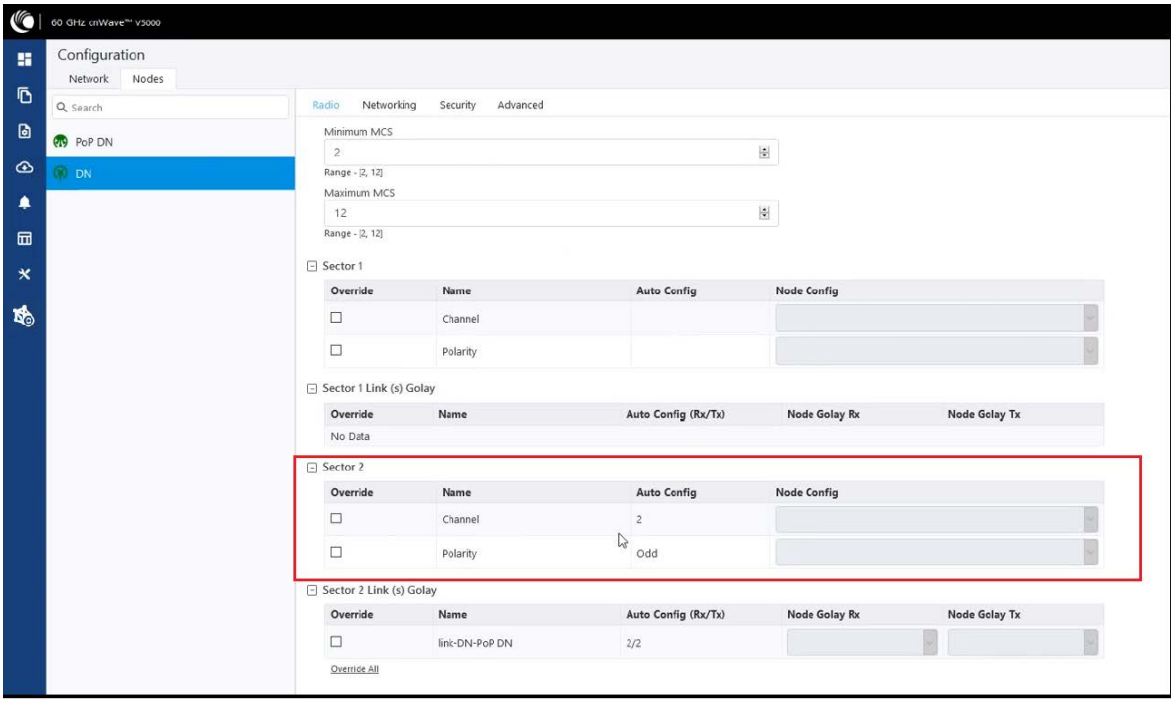


Link is not established

If a link is not established between the nodes, then verify the below options:

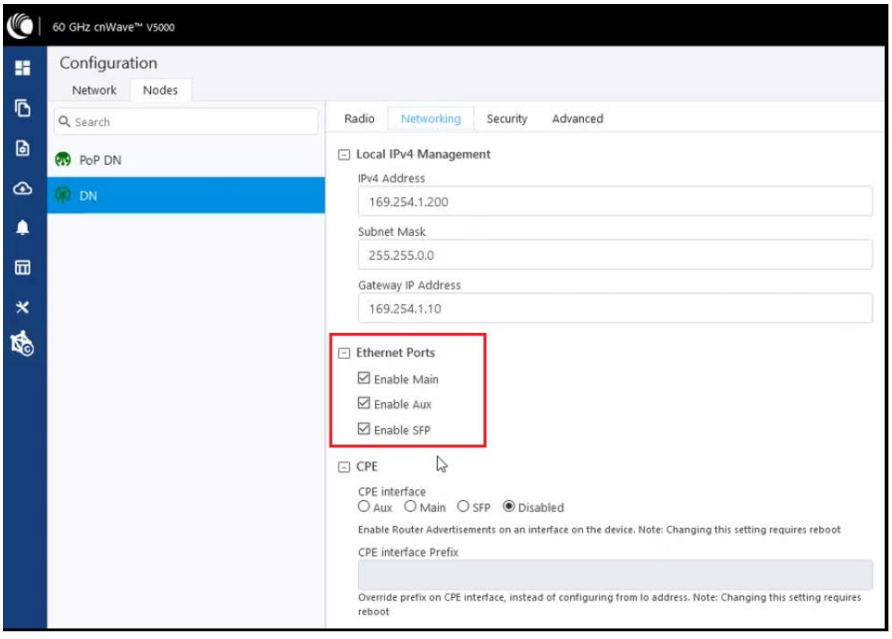
1. Click **Configuration** on the left navigation pane of the home UI page.
2. Navigate to **Nodes** > **Radio**. Verify Sector 2 PoP DN and DN's polarities, frequency, and Golay codes.

   Figure 296: *The Sector 2 section in the Radio page*



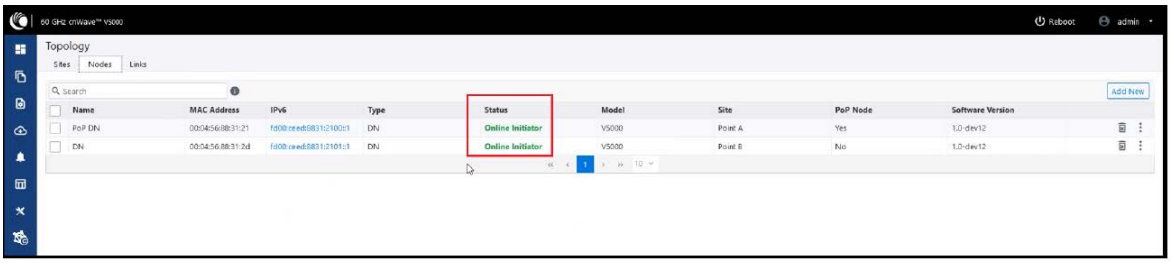
3. Select **DN** > **Networking** > **Ethernet Ports** and ensure that specific Ethernet ports are enabled.

   Figure 297: *The Ethernet Ports section in the Networking page*



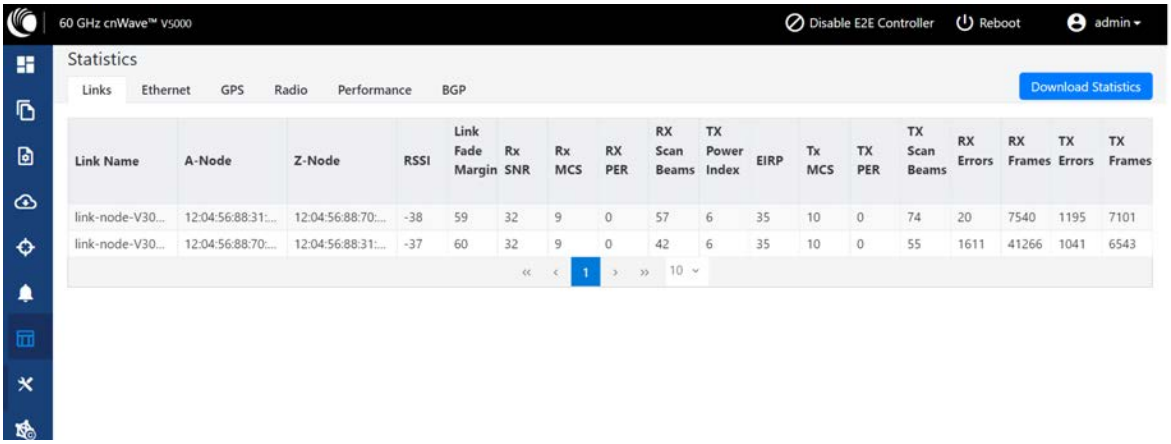
4. From the left navigation pane, navigate to **Topology** > **Nodes** and verify the Status is **Online Initiator**.

   Figure 298: *Status of nodes in the Topology page*



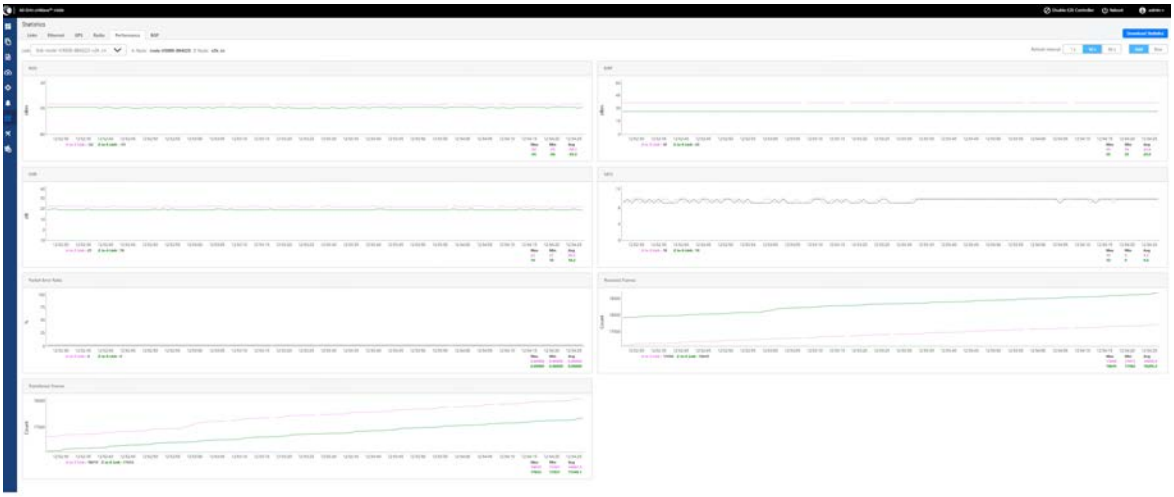
5. From the left navigation pane, go to **Statistics** > **Links** and verify **RSSI**, **MCS**, and **TX Power Index**.

   Figure 299: *Link details in the Statistics page*



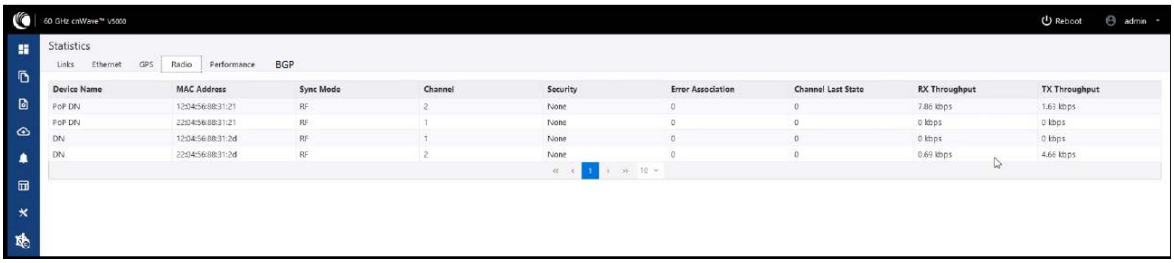
6. Go to **Performance** and verify the graphs.

   Figure 300: *Graphs in the Performance page*



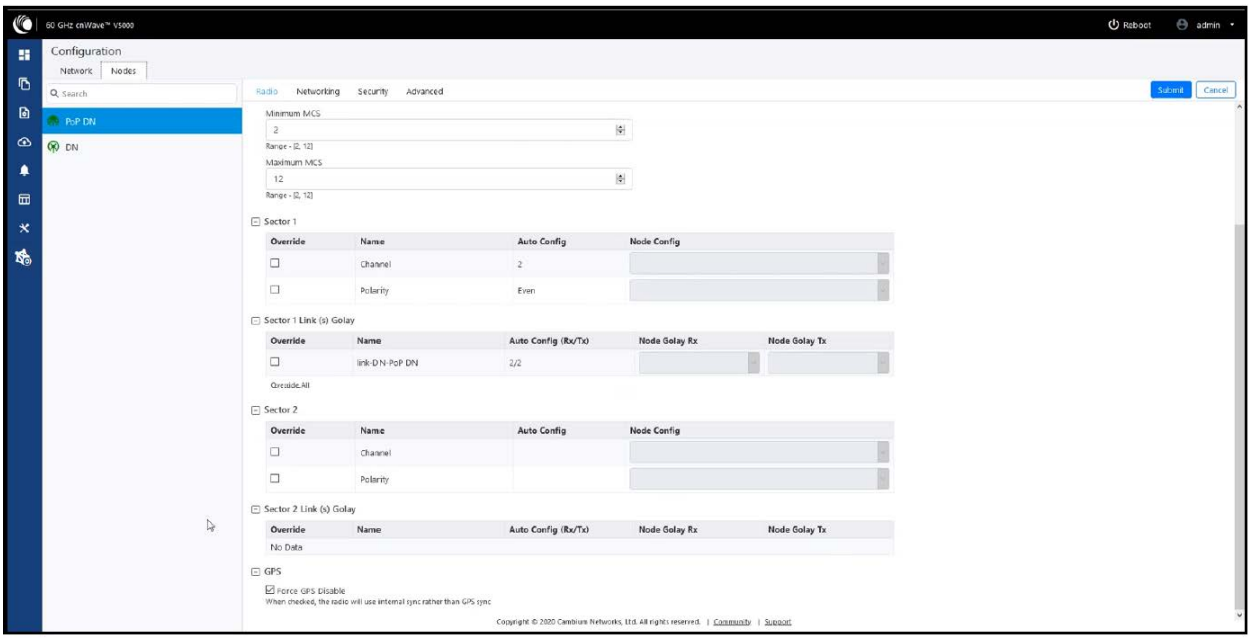
7. Go to **Radio** and monitor the throughput capacity.

Figure 301: *Monitoring the throughput in the Radio page*



8. If internal GPS is used, then verify **Configuration** > **Nodes** > **Radio** > **GPS** > **Force GPS Disable** is enabled.

Figure 302: *Verifying the Force GPS Disable check box*



PoP not online from E2E or cnMaestro UI

This usually means that the PoP node is not able to talk to the E2E controller. Ensure that the PoP node has the E2E IPv6 configured properly. Also ensure that there is a route between the E2E controller and the PoP node, if they are not in the same VLAN. Try to ping the E2E from the PoP node (by logging in to SSH).

Link is not coming up

1. Ensure that the two ends of the radios can see each other (clear line of sight in between). If the link is using V3000, ensure that they are properly aligned.
2. Ensure that the MAC address of the radios is configured correctly in the E2E Controller.
3. Ensure that GPS sync is not enabled if indoor and ensure that GPS sync is enabled if outdoor.
4. Ensure that both ends of the link have the same software version.

5. Ensure to configure country code on the E2E GUI.
6. Ensure that the two ends of the link use opposite polarity and Golay codes that matches each other.
7. Ensure that the remote ends can reach the E2E Controller – IPv6 configuration (if beamforming is successful but the remote end cannot reach back to the E2E Controller, the E2E Controller/cnMaestro GUI displays link status as up, but the remote radio is offline).
8. If you already have experience in setting up a link and you are trying to set up a daisy chain, ensure that there is no any interference caused by the existing link. Example: Make sure that the two neighboring links use different Golay code.

Link does not come up after some configuration change

There is a possibility that the remote unit could be in a state that it uses different channel/Golay code/polarity from the near-end unit. Try to factory default the remote radio if possible.

On the E2E Controller/cnMaestro, it shows that the link is up, but the remote radio is NOT online - This means that link is established but the remote end radio cannot reply to the E2E Controller. Check the E2E configuration to make sure that the IPv6 default gateway is configured correctly to allow a route between the E2E controller and the remote radio.

Link is not having expected throughput performance

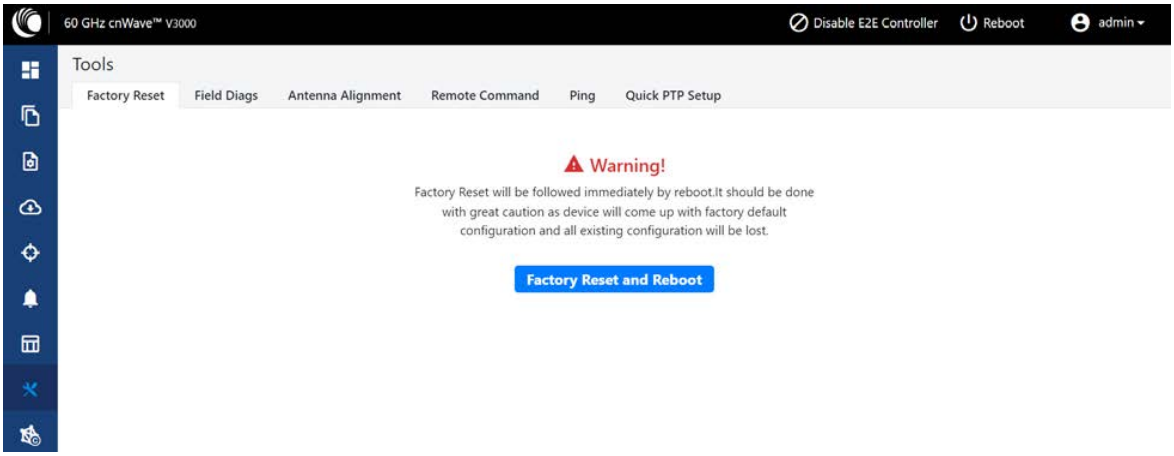
- Check the radio GUI to ensure that the link is running as the expected MCS mode when user data is passing through.
- Check to ensure that the Ethernet ports of the radios and the testing devices are negotiated to expected data rate (10Gbps).
- Ensure that your testing devices are capable of handling the throughput – run data throughput test by bypassing the radio link.
- Do not use radio internal iperf tool to test throughput.

Factory reset

Recovery mode is used to reset the configuration to the factory settings. To reset the configuration, perform the following steps:

1. From the main home page, navigate to **Tools** > **Factory Reset**.

   The **Factory Reset** page appears, as shown in the following figure:

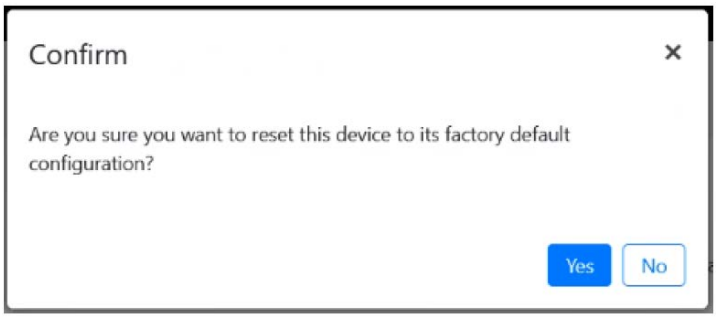


Warning

Factory reset is followed immediately by a system reboot. You must carefully configure the factory reset settings as the device comes up with the default settings. All the existingconfigurations are lost when the system comes up.

2. Click **Factory Reset and Reboot**.

   The **Confirm** message box appears, as shown in the following figure:



3. Click **Yes** to confirm the factory reset of the system.

   The system reboots immediately following the factory reset.

4. When the reboot is complete, access the device using **169.254.1.1** (IP address).

Note

After factory reset, all configurations are set to default mode.

Cambium Networks

Cambium Networks delivers wireless communications that work for businesses, communities, and cities worldwide. Millions of our radios are deployed to connect people, places and things with a unified wireless fabric that spans multiple standards and frequencies of fixed wireless and Wi-Fi, all managed centrally via the cloud. Our multi-gigabit wireless fabric offers a compelling value proposition over traditional fiber and alternative wireless solutions. We work with our Cambium certified ConnectedPartners to deliver purpose built networks for service provider, enterprise, industrial, and government connectivity solutions in urban, suburban, and rural environments, with wireless that just works.

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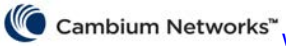
Address	Cambium Networks Limited, Unit B2, Linhay Business Park, Eastern Road, Ashburton, Devon, TQ13 7UP United Kingdom



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