Airvine WaveCore™

Getting Started Guide

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Intended Audience

This document is written for and intended for use by technical engineers with some background in Ethernet networking, Wi-Fi design, and 802.11 wireless engineering principles.

For additional information on Airvine and Airvine products, go to https://airvine.com/

Overview

The purpose of this document is to provide guidance for the planning and implementation of an Airvine WaveCore bridge link. Primary markets include multi-dwelling, multi-family, hospitality, large public venues, warehousing and more. Providing a wireless link alternative to the traditional core drilling opens many opportunities that may have been delayed or not feasible due to cost, environmental or disruptive roadblocks.

Before the actual design can start, there are several considerations that can dramatically impact the final design, deployment, and performance. These include:

- What type of wired infrastructure will or can be used?
- What are the devices that will need to be deployed with the WaveCore bridges?
- What is the expected network performance (SLA)?
- What network management topology will be used?
- What problem are you trying to solve with the WaveCore bridge?
- What materials and thickness of each material do you need to overcome?

By addressing these questions early on, planning carefully, and choosing Airvine's patented technology, you can effectively manage various deployment scenarios. This document provides guidance on getting started, setting up and using the Airvine WaveCore bridges, and outlines best practices for planning and deploying an Airvine network.

Finding Airvine Resources

General information and support for Airvine products can be found at:
https://airvine.com/
https://airvine.com/support/

Support includes access to firmware downloads, documentation, warranty, product registration, and technical Q&A.

Contact Airvine support at customersupport@airvine.com
888-341-5197
650-980-9815

For Airvine Partners, once you register and gain access to the Airvine Partner Portal, you'll find a variety of resources, including marketing materials, sales tools, support resources, certification training, and case escalation support.
https://partner.airvine.com/wp-login.php

Pre-Testing WaveCore Nodes

Received Equipment: Please take a moment register your new WaveCore bridges. A QR code insert is included in the packaging and should be scanned to link to the Airvine support page for documentation downloads and the product registration form.

Please do not attempt to use WaveCore product if the box or contents appear damaged. Immediately send a description of the damage to customersupport@airvine.com and replacement product will be sent.

The Box contains the following:

- 2 x WaveCore Nodes
- 2 x Short Mounting Bracket
- QR Code pamphlet

Refer to the WaveCore Product Ordering Guide for a full list of available WaveCore services and product components. Contact our sales team for more information sales@airvine.com

Out of the Box

A user will be able to unbox, set up, and power-on a WaveCore bridge pair without any additional configuration. The WaveCore with the lower MAC address will become the Controller Node (CN), while the WaveCore with the higher MAC address will become the Subordinate Node (SN). Both the CN and SN will initially have a default IP address of 192.168.0.250 with a subnet of 255.255.255.0 and use an IPv6 address for network discovery and communication. It is advisable for the network admin to change the networking configuration on the CN and SN to a customized network setting. The default UN and PW are admin/admin.

> The default IP Address of a WaveCore Node is 192.168.0.250 and subnet of 255.255.255.0 UN=admin PW=admin

Refer to the WaveCore Advanced Configuration portion of this guide for details on how to configure the network settings and update the password.

Management Access of WLAN

WaveCore nodes may also be accessed and managed through a 2.4GHz wireless interface. This interface is used for management only and cannot be used for wireless client access. The default values of the interface are listed below.

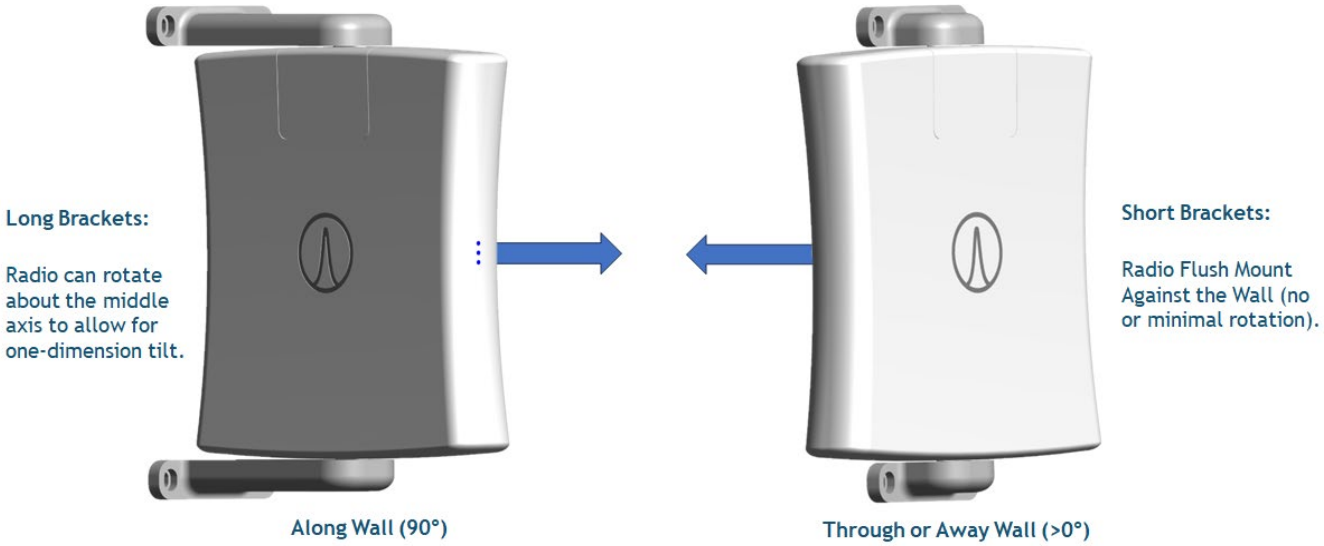
Wi-Fi Management Parameters:

The following are the factory-default parameters to manage the WaveCore using HTTP Web GUI **over a Wi-Fi connection**:

WaveCore Management Wi-Fi SSID: **avc_<device MAC Address>**
WaveCore Management Wi-Fi WPA2 passcode: **airvine!**
WaveCore Management Wi-Fi IP address: 192.168**.3.1**
WaveCore Management default user login and password: **admin/admin**

Mounting

WaveCore nodes may be mounted in the horizontal (wall facing) or vertical (ceiling facing) plane using the standard short mounting brackets that ship with the units or with an optional long mounting kit ACC-220L.



Power

WaveCore nodes do not ship with a power supply. 12VDC, 36Watt power supplies, country specific power cords, and Power over Ethernet (PoE) injectors are available in the WaveCore Product Ordering Guide.

Note that a WaveCore node can be powered simultaneously by a 12VDC power supply and an Ethernet (PoE) injector for power redundancy.

Caution:
If you are using the 12VDC Power Input, maintaining compliance with IEC 62368-1 safety standard requires the use of the Airvine AC/DC 36-Watt Power Adapter, PN: ACC-PS-ACDC-XX00.

Airvine recommends usage of the Airvine ACC-POE-10G-XX00 801.3at PoE Injector: 30-Watt, 53-Volt, 0.75A, AC Input (100-240V). If a different 801.3at PoE power source is used, such power source must be a limited power source that will not exceed 56-Volts, 30-watts, or 0.75A. Passive PoE injectors should never be used.

SFP+

WaveCore nodes come equipped with a Small Form-factor Pluggable Plus (SFP+) port, which can be unlocked with a software license key. The tested SFP+ modules are listed in the WaveCore Ordering Guide.

External System LEDs

The left side of the WaveCore contains 4 System Indicator LEDs.

Power Provides status of power to the system

System Provides important system and alarm status

Radio Indicates if radio is enabled, trying to make a connection, or has made a connection to a far-end WaveCore device

Alignment Indicates how well the radios on the two WaveCore nodes are aligned

Power LED	Behavior
Off	No power source detected
Green On	Power source detected; unit has power

System LED (dual color)	Behavior
Off	System not powered on
Green Blinking	System booting up and being initialized
Green Solid	System operating normally
Red Solid	System Booted Up but Not Functioning Normally (Critical Alarm)

If the **SYSTEM LED** is solid RED, this means the system has booted up successfully, but one or more critical alarms have been activated. To view and clear the alarm(s), log onto VineManager Web GUI and click on the RED-highlighted Alarm Bell located at the top of the window to view the alarms. Clicking the blue-highlighted "**Clear All Alarms**" text will clear the alarms and will result in the **SYSTEM LED** to turn to solid GREEN.

Radio LED	Behavior
Off	Radio disabled
Green Blinking	Radio powered on, trying to make a connection to another WaveCore device
Green On Solid	Radio powered on and connected to another WaveCore device

Align LED – dual color Green	Yellow	Receiver SNR Level (the higher the stronger the signal).	Approximate Over-the-Air Data Rate
Off	Off	No Connection or Align Mode Not Enabled	
Off	Blinking Slow	RSSI is less than -79 dBm	Lower Data Rate
Off	Blinking Fast	RSSI is between -70 dBm and -79 dBm	
Off	On Solid	RSSI is between -60 dBm and -69 dBm	
Blinking Slow	Off	RSSI is between -50 dBm and -59 dBm	
Blinking Fast	Off	RSSI is between -40 dBm and -49 dBm	
On Solid	Off	RSSI is greater than -40 dBm	Highest Data Rate

Ethernet port LEDs

The following table indicates the connection status.

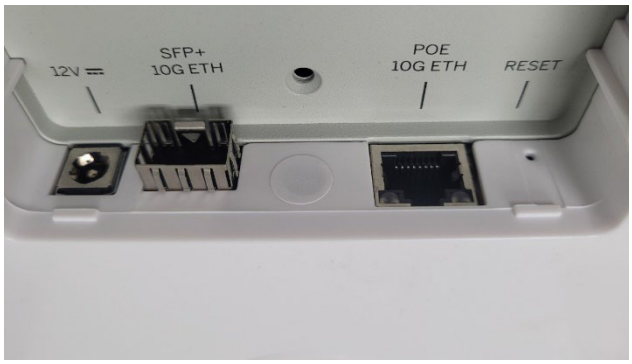
RJ45 Connector State	Green LED	Green/Amber LED*
No Connection	Green	Off
10 Gbps	Green	Amber
5 Gbps	Green	Amber
2.5G	Off	Amber
1G	Off	Green
100M	Off	Off

*The Green/Amber LED will blink when traffic is detected.

Reboot and Factory Reset

A Reboot/Reset pinhole button is located next to the PoE 1/10GbE interface.

- Depress for < 5 sec for a soft reboot
- Depress for > 5 sec for a factory reset



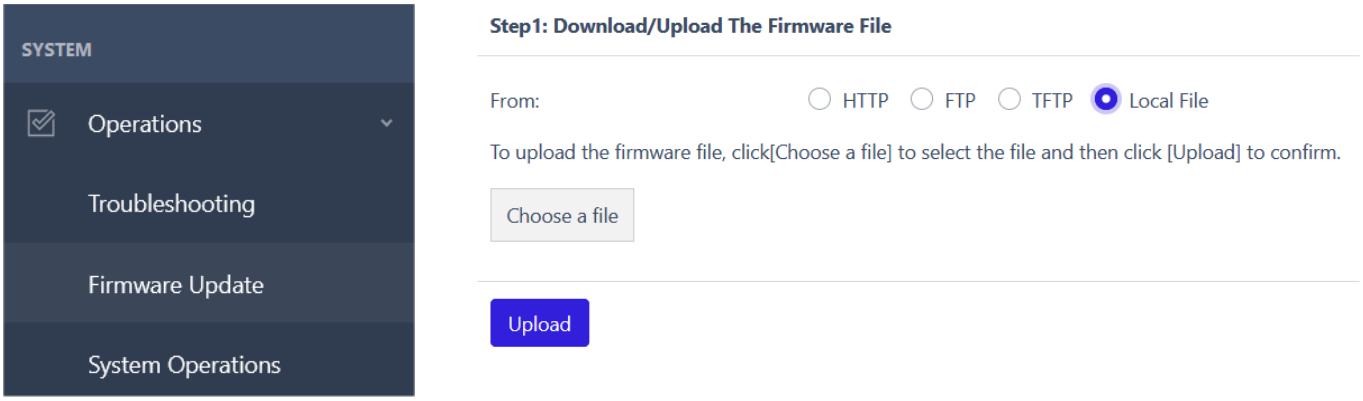
NOTE THAT AT FACTORY DEFAULTS, WHEN CONNECTING THROUGH A WIRED ETHERNET CONNECTION, THE IP ADDRESS OF THE WAVECORE GUI AND SSH IS:
192.168.0.250
HTTP/SSH UN=admin PW= admin

THE IP ADDRESS FOR THE 2.4GHz WAVECORE WIRELESS INTERFACE IS:
192.168.3.1
SSID WPA2 PASSWORD = airvine! with UN=admin PW=admin

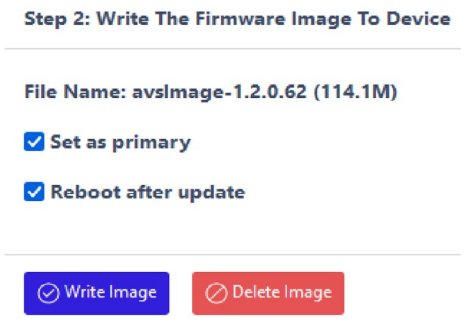
Updating Firmware

WaveCore units may not have the latest code version when shipped from the warehouse, which means important feature updates and fixes that could enhance the user experience may not be included. To update, download the latest version from the Airvine support site https://airvine.com/support/ and refer to the "Airvine Tech Notes WaveCore Firmware Updates" for additional instructions to update the WaveCore firmware.

Note other important links for Contact, Product Registration, Product RMA, and other available downloads.



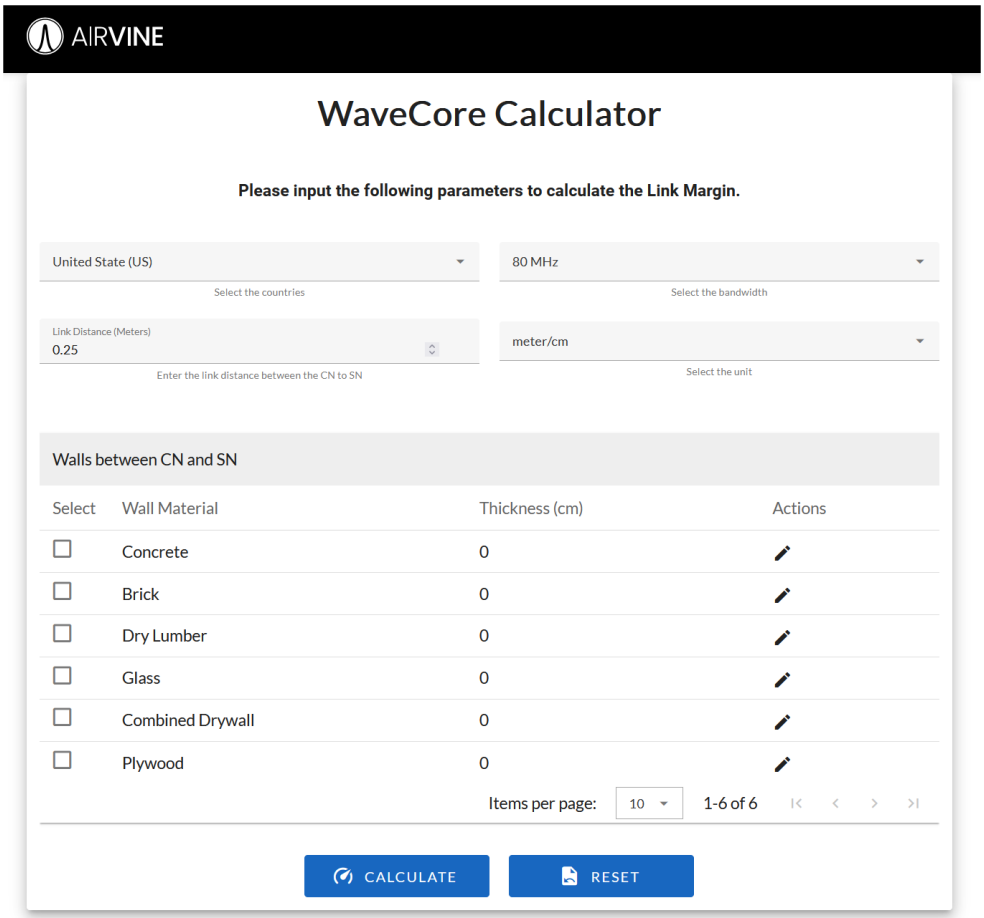
From System > Firmware Update select the firmware file previously downloaded and Upload to the WaveCore. The Local File method may be the easiest. Once the firmware has been loaded, check the Write Image button, and let the system update and reboot.



For detailed information on updating system firmware, refer to Appendix B.

Installation Notes

Users may want to get an idea of the connection characteristics and potential throuput of a WaveCore link before implementation. Airvine has made a WaveCore Calculator available at https://services.airvine.com/calculator/vbcalc, which allows users to input link parameters and receive an estimate of the achievable link margin.



WaveCore Configuration

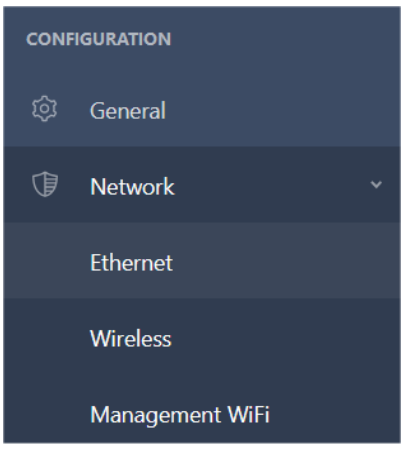
From a factory default state, two WaveCore nodes may be configured as a bridged pair by following the below steps. Unbox the first WaveCore node, power on and configure before powering on the second WaveCore node.

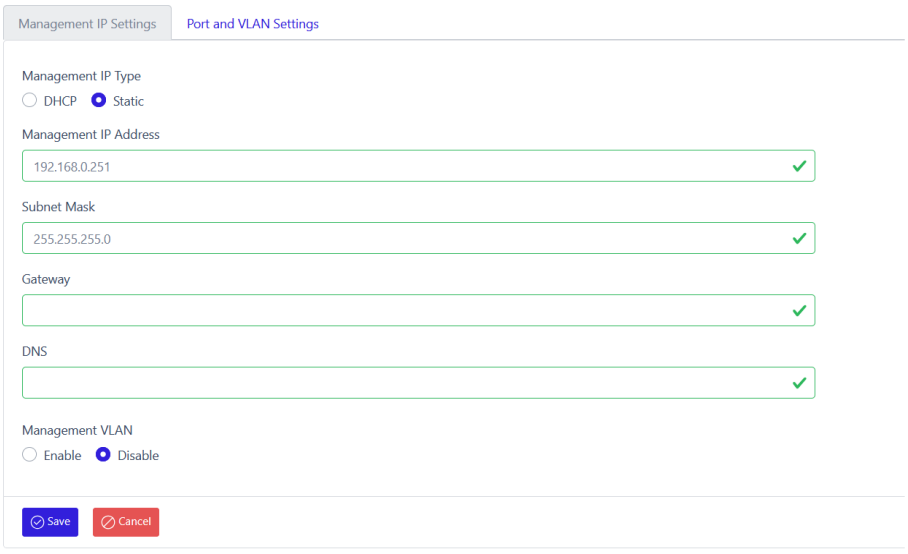
NOTE THAT AT ANY CONFIGURATION CHANGE THAT IS SAVED UNDER THE "NETWORK TAB", WILL ALSO **REQUIRE THAT THE WAVECORE BRIDGE IS REBOOTED BEFOR THE CHANGE WILL TAKE EFFECT.**

USERS SHOULD MAKE ANY NETWORK CONFIGURATION CHANGES, SAVE THESE CHANGES AND THEN REBOOT THE WAVECORE BRIDGE.

Network Configuration

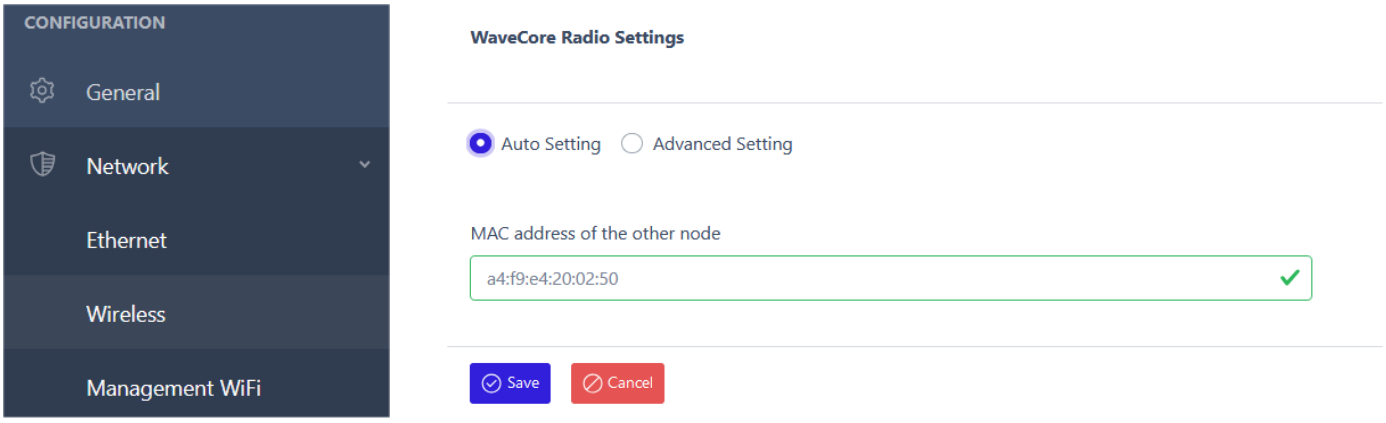
On the left side navigation menu, expand the Configuration > Network dropdown menu and select Ethernet. Enter the desired network settings and save configuration. Note that the user will now need to log into the WaveCore at the new network address.





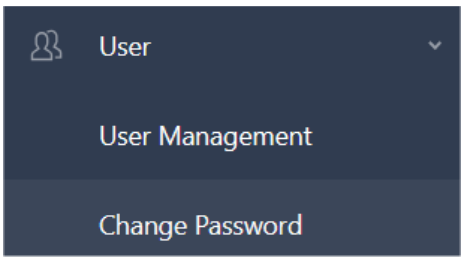
Wireless Bridge Configuration

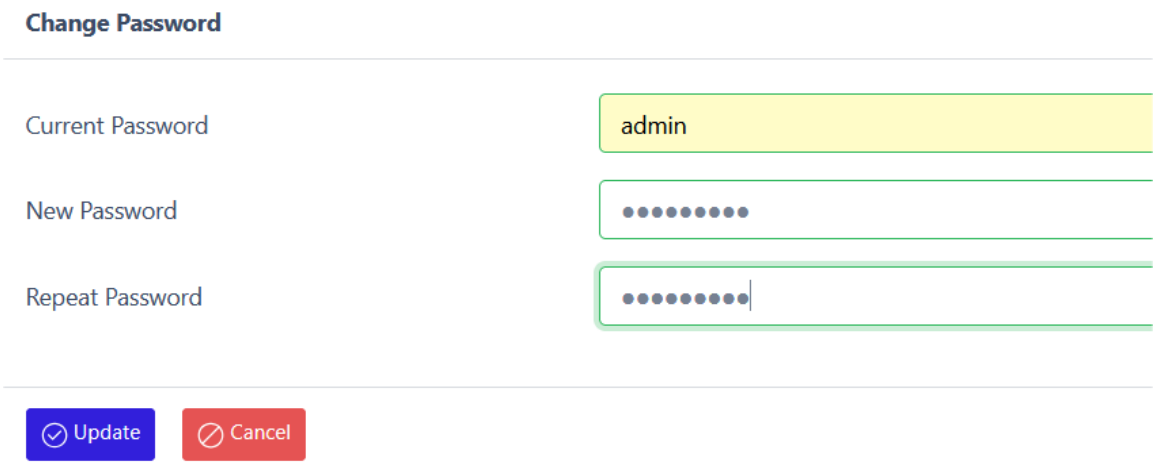
On the left side navigation menu, expand the Configuration > Network dropdown menu and select Wireless. Select Auto Setting and enter the MAC address of the WaveCore node to be bridged in the first field. Save configuration.



Username and Password

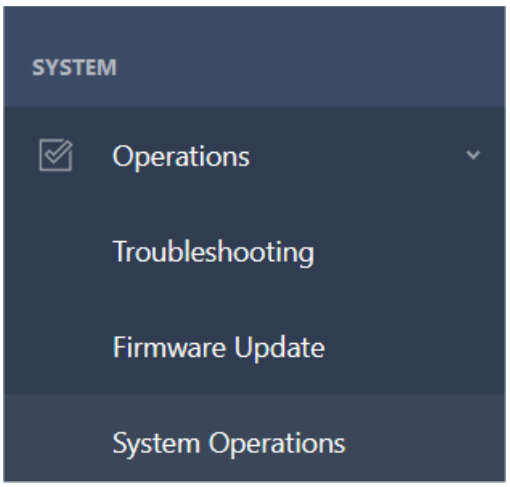
On the left side navigation menu, expand the Configuration > User dropdown menu and select Change Password. The default username is **admin** with a password of **admin**. It is suggested to change the password to a strong password of 8 characters or more.

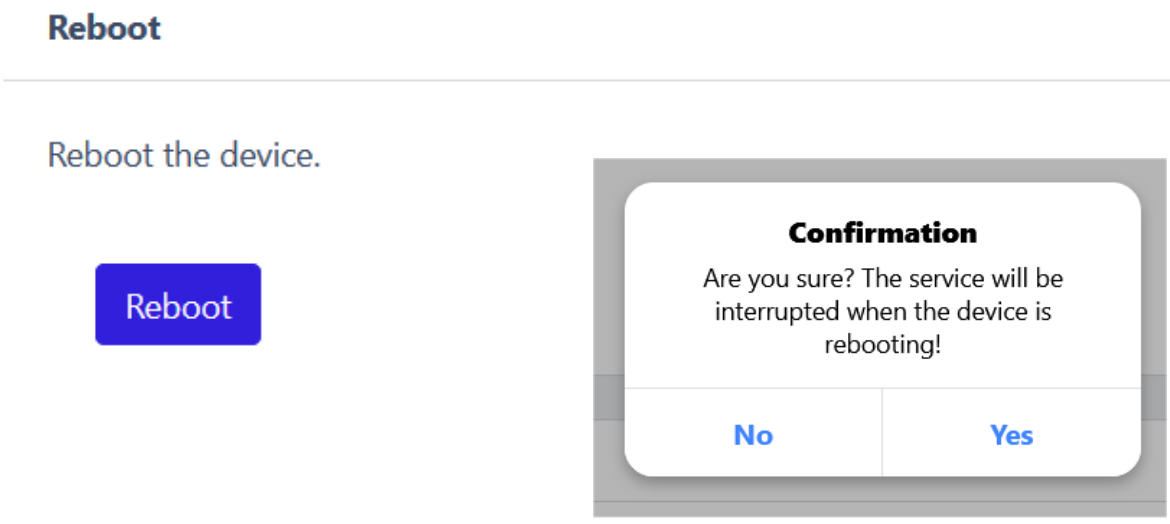




System Reboot

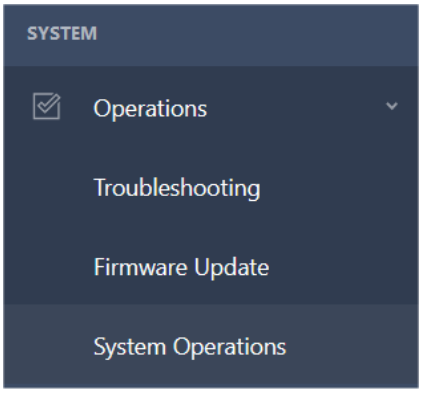
On the left side navigation menu, expand the System > Operations dropdown menu and select System Operations. Navigate to the Reboot button, press and confirm to reboot the system. Once the system is rebooted, the WaveCore node will begin searching for its bridged pair with the other node MAC address that was previously configured.



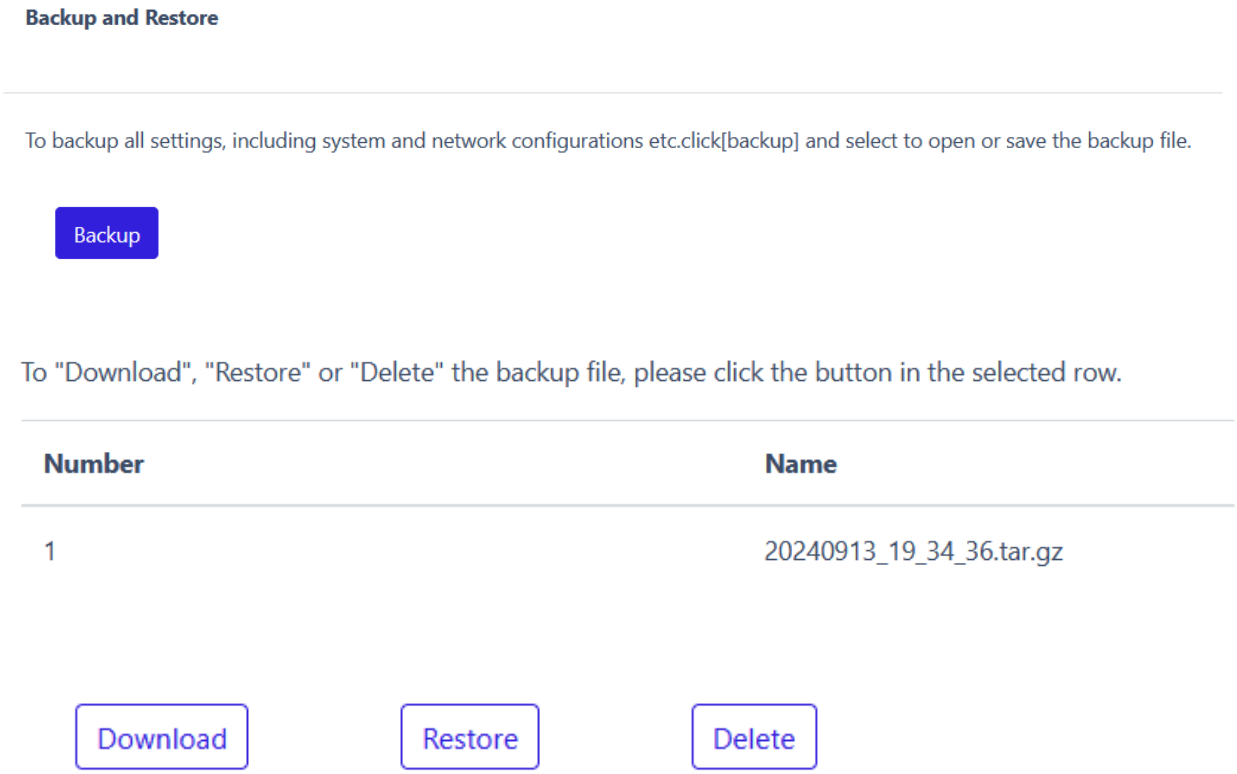


System Backup

It is recommended at this time to back up the system configuration and after any time that configuration changes have been made to the system. On the left side navigation menu expand the System > Operations dropdown menu and select Systems Operations.



Click the Backup button and a file will be created as shown below. Download this file and keep it in a secure location.



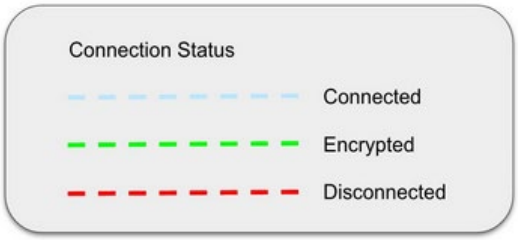
Common Configuration Notes

802.1Q VLANs

While VLANs may be configured on the WaveCore nodes, VLAN traffic will pass across the bridge link without any additional configuration.

Encryption

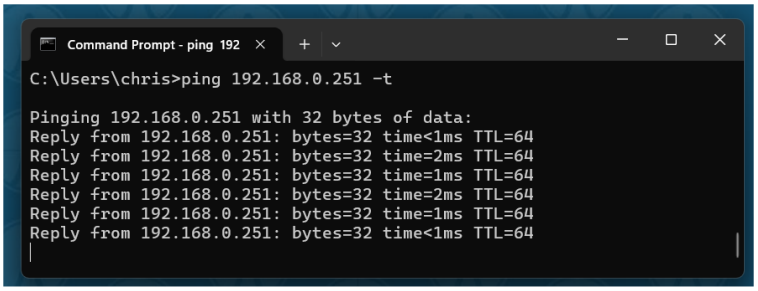
While most network traffic will have end-to-end client server encryption, WaveCore nodes additionally secure all bridged traffic using WPA3-SAE (AES) enhanced encryption.

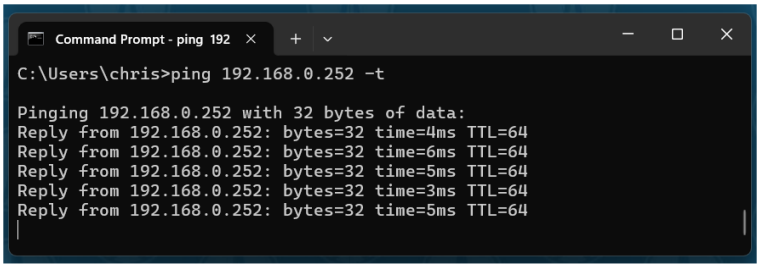


WaveCore Connection and Tuning

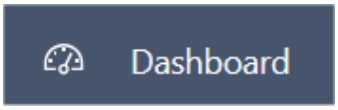
Connecting WaveCore Nodes

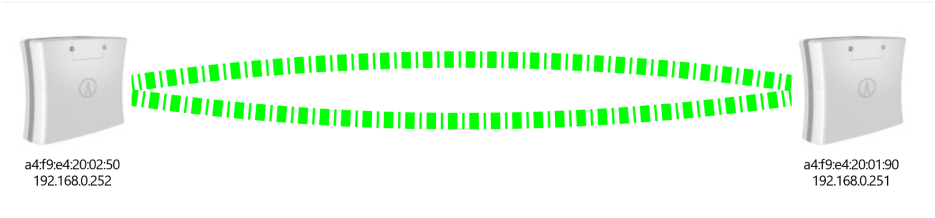
Before installing WaveCore nodes, verify that the pair can link. A continuous ping can be started and used throughout the installation process. Ping each bridge with the IP address that was configured for that device.





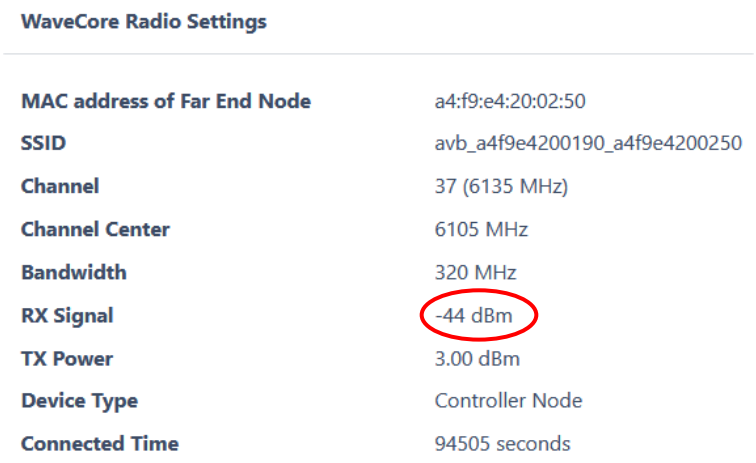
Users may log into either node to view the user interface. On the left side navigation menu click on Dashboard to confirm the WaveCore bridge connection.





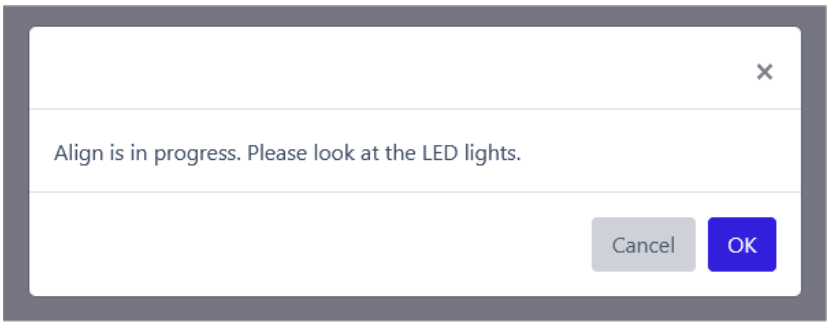
Optimizing WaveCore Connections

WaveCore link connection tools are available from the Monitoring menu. On the left side navigation menu expand the Monitoring > Device dropdown menu and select Wireless. RX Signal dBm levels may be used to fine tune the placement of the WaveCore nodes. By carefully measuring node locations, staging the nodes in place, and then adjusting their positions to optimize dBm levels, the best signal quality can be achieved. dBm levels are updated about every 15 seconds.



Installation Alignment

A WaveCore Installation Alignment tool is located in the Configuration menu to assist with aligning the WaveCore nodes once they are connected. On the left side navigation menu, expand the Configuration > Network dropdown menu and select Wireless. Press the Installation Alignment button and the system will start a 90 sec alignment process with the LEDs updating about every 2 seconds. Note that if the Installation Alignment function is not initiated, the LEDs update at about every 15 seconds.



Optimizing WaveCore Connections

While the Installation Alignment function has been initiated, move the WaveCore node to best optimize the connection between the bridge pair. The table below lists optimized LED behavior at the receiver RSSI levels.

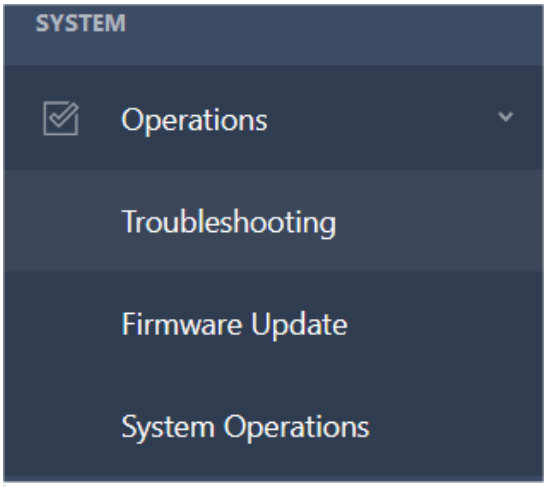
Align LED – dual color Green	Yellow	Receiver SNR Level (the higher the stronger the signal).	Approximate Over-the-Air Data Rate
Off	Off	No Connection or Align Mode Not Enabled	
Off	Blinking Slow	RSSI is less than -79 dBm	Lower Data Rate
Off	Blinking Fast	RSSI is between -70 dBm and -79 dBm	
Off	On Solid	RSSI is between -60 dBm and -69 dBm	
Blinking Slow	Off	RSSI is between -50 dBm and -59 dBm	
Blinking Fast	Off	RSSI is between -40 dBm and -49 dBm	
On Solid	Off	RSSI is greater than -40 dBm	Highest Data Rate

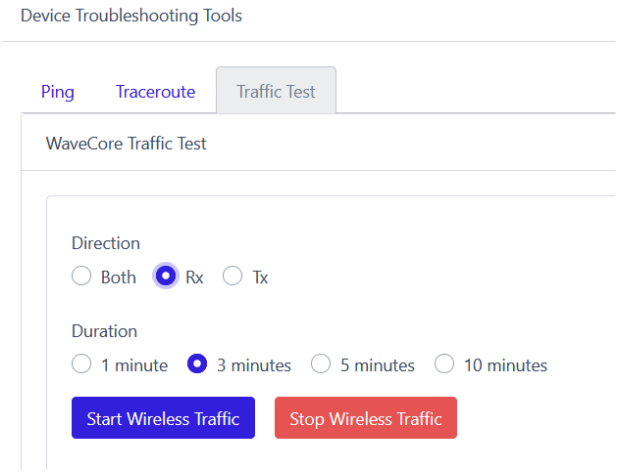
This table provides an approximate indicate of what over-the-air physical (layer 1) data rate to expect which varies based on RSSI and Channel Bandwidth. Higher channel bandwidths result in increased link data rates.

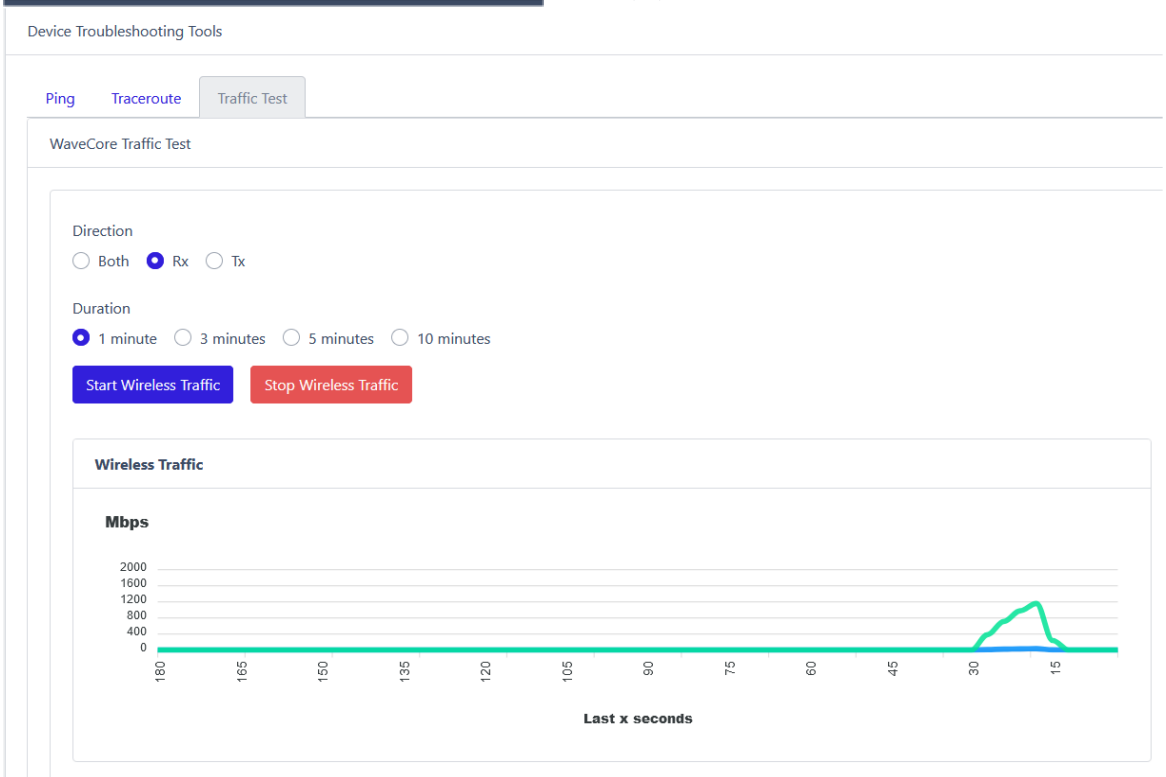
		Mimimum RSSI (in dBm)			Approx Over-the-Air Datarate (in Mbps)		
MCS Level	Modulation & Coding	80 MHz	160 MHz	320 MHz	80 MHz	160 MHz	320 MHz
MCS 0	BPSK 1/2	-88	-84	-82	144	288	577
MCS 1	QPSK 1/2	-86	-82	-79	288	577	1153
MCS 2	QPSK 3/4	-83	-80	-76	432	865	1729
MCS 3	16QAM 1/2	-80	-78	-73	577	1153	2306
MCS 4	16QAM 3/4	-78	-75	-70	865	1729	3459
MCS 5	64QAM 2/3	-76	-72	-67	1153	2306	4612
MCS 6	64QAM 3/4	-74	-68	-63	1297	2594	5188
MCS 7	64QAM 5/6	-71	-65	-61	1441	2882	5765
MCS 8	256QAM 3/4	-68	-65	-58	1729	3459	6918
MCS 9	256QAM 5/6	-66	-63	-56	1922	3843	7686
MCS 10	1024QAM 3/4	-63	-60	-53	2162	4324	8647
MCS 11	1024QAM 5/6	-60	-58	-51	2402	4804	9608
MCS 12	4096QAM 3/4	-56	-53	-49	2594	5188	10377
MCS 13	4096QAM 5/6	-53	-50	-47	2882	5765	11529

Testing WaveCore Throughput

The WaveCore menu offers a way for user to estimate the throughput of the WaveCore link. On the left side navigation menu expand the System > Operations dropdown menu and select Troubleshooting and Traffic Test. Options are available for testing transmit, receive, or both directions of traffic in different time increments. **Note that performing this test will take system resources, reduce network throughput, and should not be performed on a live network.**







WaveCore Towers

For site surveys or installations, it may be necessary to build out tower assemblies to demonstrate a WaveCore bridge link in an environment where the WaveCore nodes will be placed permanently or to just show how the bridge link will function. Various towers have been built by our Airvine engineers and for a list of components and how to purchase, please contact a member of our sales team or contact us at info@airvine.com

Pre-Installation

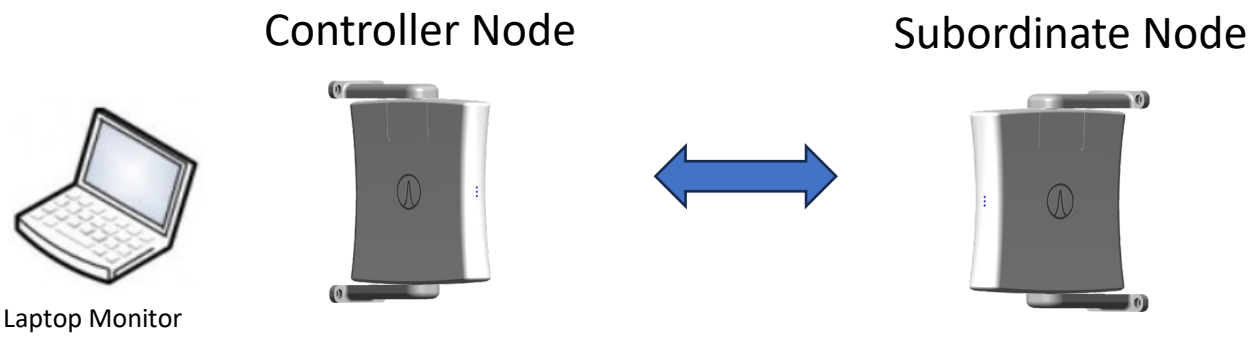
Planning the Installation

Determine location of link and gather materials

- Wall or ceiling/floor installation
- Short or long-mounting brackets options
- Bracket template
- Installation hardware: drills, screwdrivers, wrenches, etc.

Collect the following hardware:

- Laptop or computer running a standard internet browser
- Ethernet cable to connect to one of the WaveCore nodes or network
- Or Wi-Fi wireless connection to connect to the WaveCore's 2.4 GHz wireless interface



Site Survey

- Physical inspection of area to validate any assumptions
- 6 GHz wireless survey to determine if there will be any competing or overlapping channel frequencies
- Determine the distance between radios
- Establish what material the link will going through
- Use Vine Calculator to estimate link budget to later validate the link performance

Powering the unit

- WaveCore nodes can be powered by an AC source or by PoE
- Power may be supplied by both sources for redundancy

Initial Setup

Before deployment, it is recommended to update WaveCore units to the latest firmware version. Once updated, proceed to configure the nodes.

Getting Equipment Ready

Pre-Staging Radios (configure, get link going, all the stuff you have mentioned.
Mounting and Alignment
Validating Performance of Link (VineManager).

Installation

The following examples outline a process that can be used for a Wall or Ceiling/Floor installation.

Wall Installation

Equipment List

- WaveCore Nodes
- Mounting assembly
- Power
- Tape Measure

Location

- Wall thickness can be measured
- Wall material is known
- Wireless signals can be isolated (no leaking)

Prediction

- Go to the Airvine website at https://services.airvine.com/calculator/vbcalc
- Enter in relevant data to calculate the link margin of wall location
- Fill data into the WaveCore Evaluation Worksheet

Process Controller Node

- Decide on location for the Controller Node (CN)
- Mount or secure the CN in place
- Place the Subordinate Node (SN) next to the CN and adjust to the same height, adjusting for any height differences between mounting locations as needed
- Take measurements of the location to best determine/estimate location on opposite wall where SN will be located
- Power on CN
- Start the WaveCore Connection Tool/Ping process

Process Subordinate Node

- Decide on location SN will be placed based on the measurements previously taken
- Mount or secure the SN in place (wouldn't this happen after fine tuning? Mount sounds permanent.)
- Power on SN
- Start the WaveCore Connection Tool/Ping process

Fine Tuning

- Once WaveCore nodes are connected, fine tune the connection
- Use the RX Signal dBm or LED tuning feature to maximize the signal strength
- Once the signal strength has been maximized, lock both CN and SN in place

Ceiling Floor Installation

Equipment List

- WaveCore Nodes
- Mounting assembly
- Power
- Ruler

Location

- Ceiling/ floor thickness can be measured
- Ceiling/ floor material is known
- Wireless signals can be isolated (no leaking)

Prediction

- Go to the Airvine website at https://services.airvine.com/calculator/vbcalc
- Enter relevant data to calculate the link margin of ceiling/floor location

Process Controller Node

- Decide on location for the Controller Node (CN)
- Mount or secure the CN in place in the location where the CN will most likely be permanently installed
- Take measurements of the location to best determine/estimate location on opposite ceiling/floor where SN will be located
- Power on CN
- Start the WaveCore Connection Tool/Ping process

Process Subordinate Node

- Decide on the location SN will be placed based on the measurements previously taken
- Mount or secure the SN in place
- Power on SN
- Start the WaveCore Connection Tool/Ping process

Fine Tuning

- Once WaveCore nodes are connected, fine tune the connection
- Use the RX Signal dBm or LED tuning feature to maximize the signal strength
- Once the signal strength has been maximized, lock both CN and SN in place

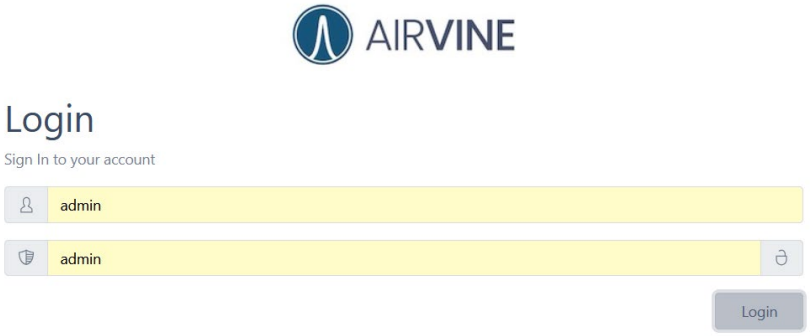
Appendix A

RMA Replacement Configuration

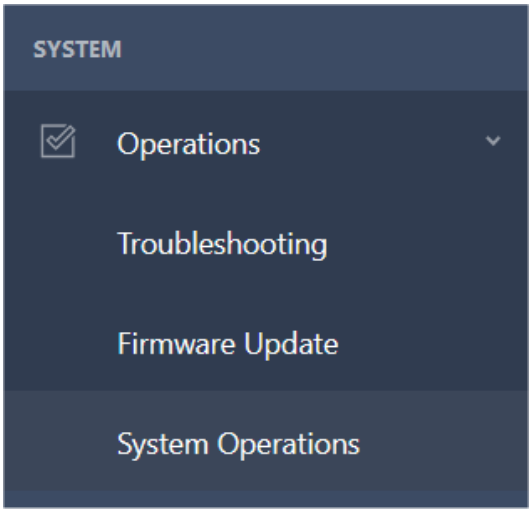
If a paired node is replaced by RMA, the replacement node will need to be reconfigured before normal link is established. Follow the steps below to easily reestablish the WaveCore link.

Configuration of RMA and Paired Nodes

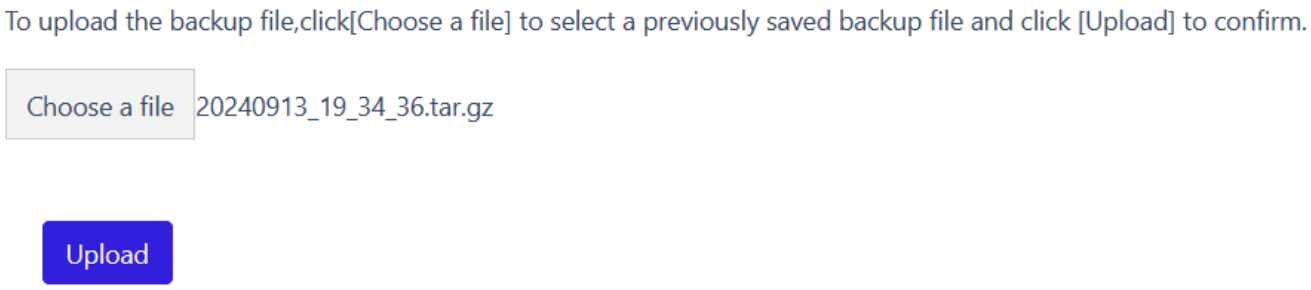
Power on the RMA unit and log into the node at 192.168.0.250. The username and password will be admin / admin.



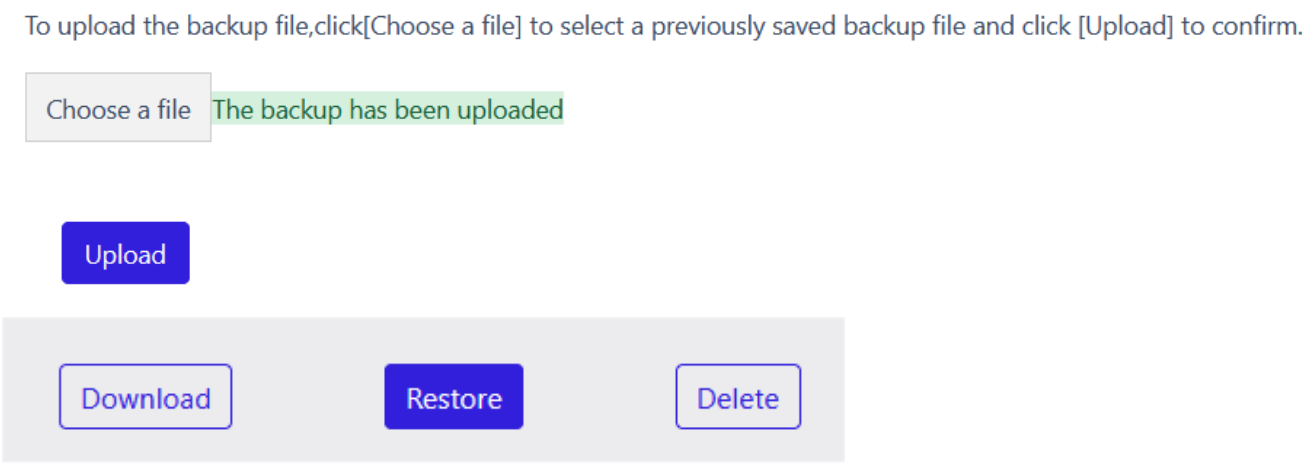
On the left side navigation menu expand the System > Operations dropdown menu and select Systems Operations.

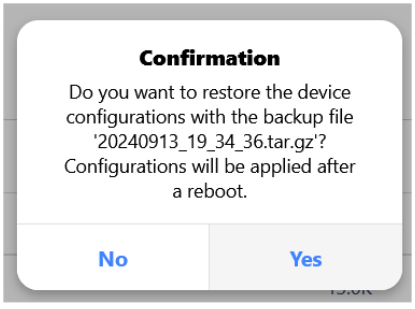


Select “Choose a file” and select the backup configuration file for the WaveCore node that was RMA. If a file was not created, start at the first step at [WaveCore Advanced Configuration].

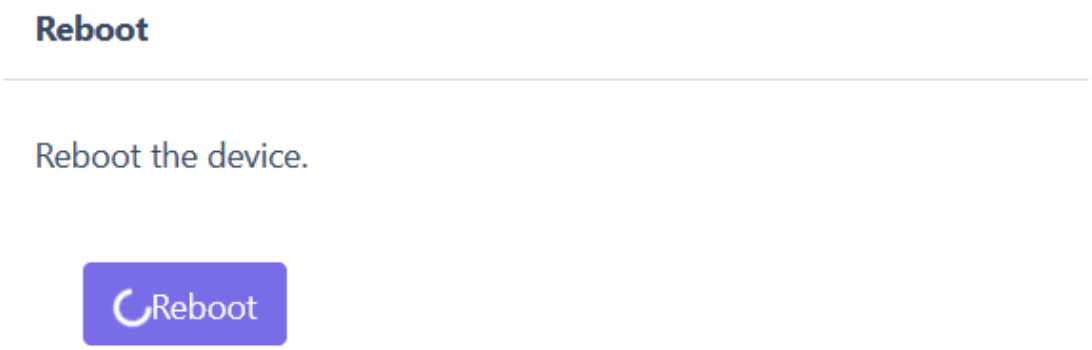


Once the file has been selected, Upload the file and Restore.

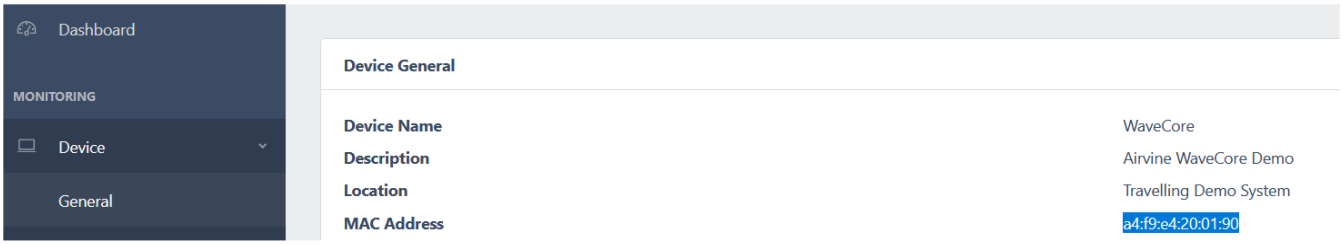




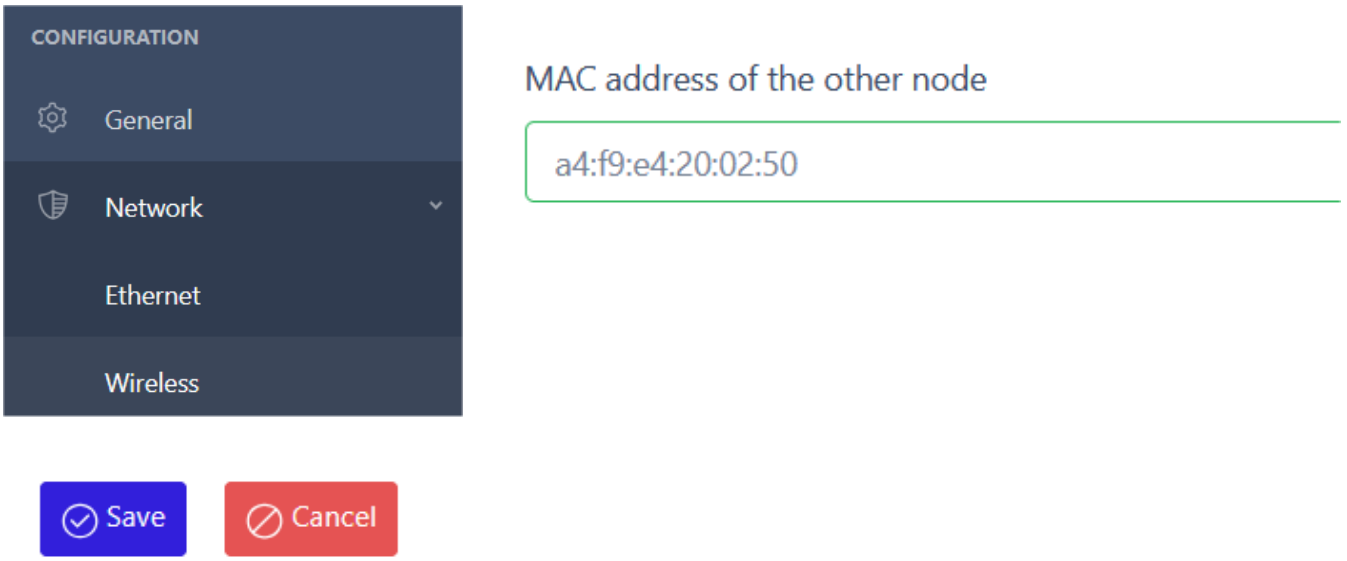
The final step in restoring the configuration will be to reboot the WaveCore node



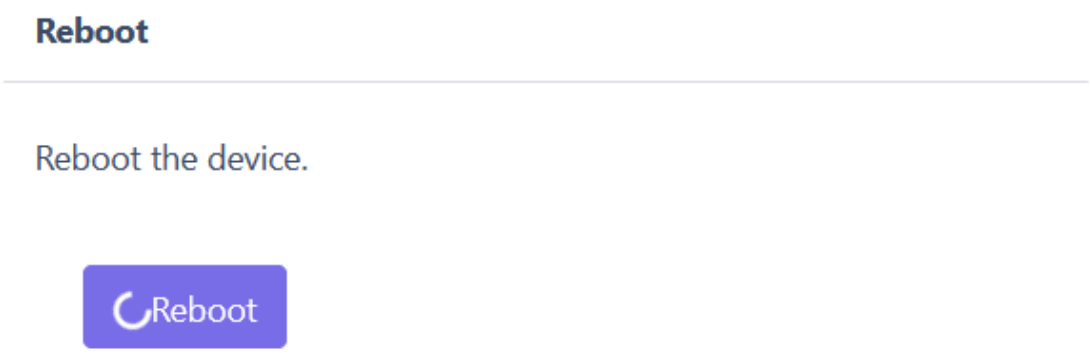
Once the WaveCore node is rebooted, it will be ready to link to the paired node. To pair WaveCore nodes, MAC addresses must be updated. Log into each WaveCore to retrieve the MAC address. On the left side navigation menu expand the Monitoring > Device dropdown menu and select General. Copy and paste the MAC Address of the node into Notepad or similar application.



For both WaveCore nodes, on the left side navigation menu expand the Configuration >Network dropdown menu and select Wireless. Past the MAC address of the paired node into the option field and Save configuration.



The final step in restoring the linked pair will be to reboot both WaveCore nodes and remount the RMA unit.



Appendix B: Firmware Updates

New firmware for the Airvine WaveCore nodes is periodically released, providing new features, bug fixes, and performance enhancements. This technical note will guide users in locating the firmware and release notes, as well as the upgrade process.

Finding Airvine Resources

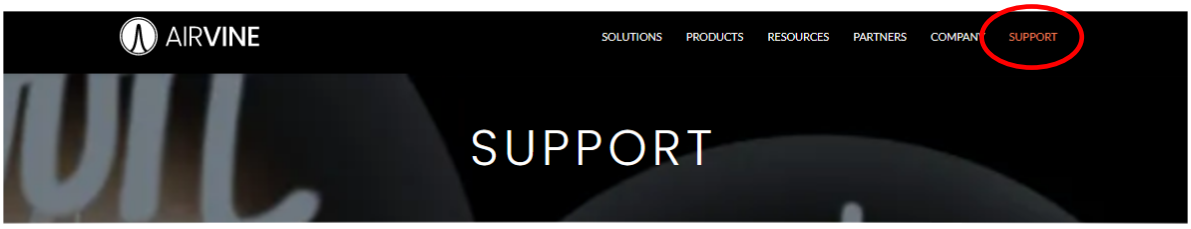
General information and support for Airvine products can be found at

www.airvine.com

https://airvine.com/support/

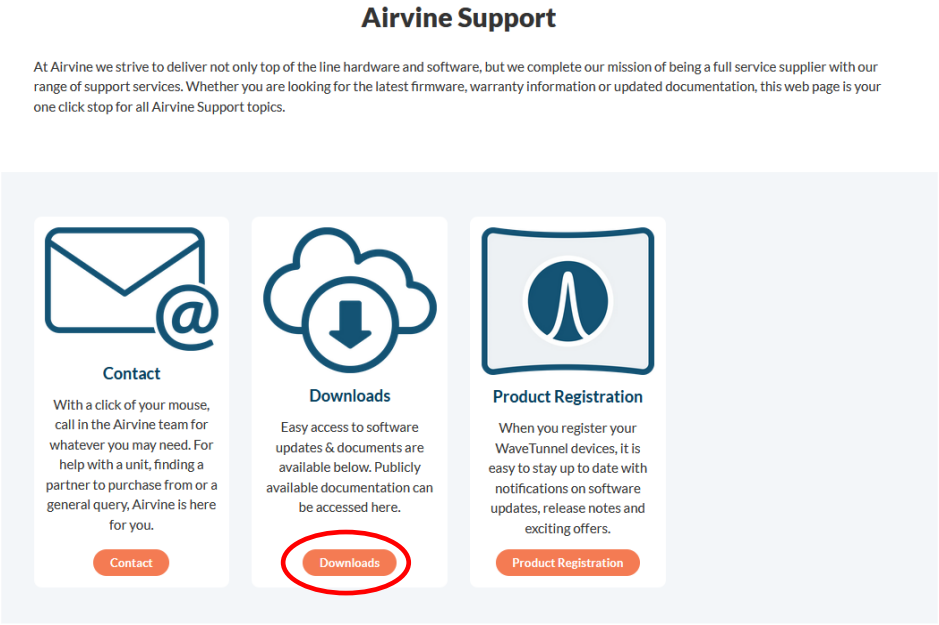
Support includes access to firmware downloads, documentation, warranty, product registration and technical Q&A.

Locate the Support tab on Airvine's website and click on the link that will take you to the Support site.



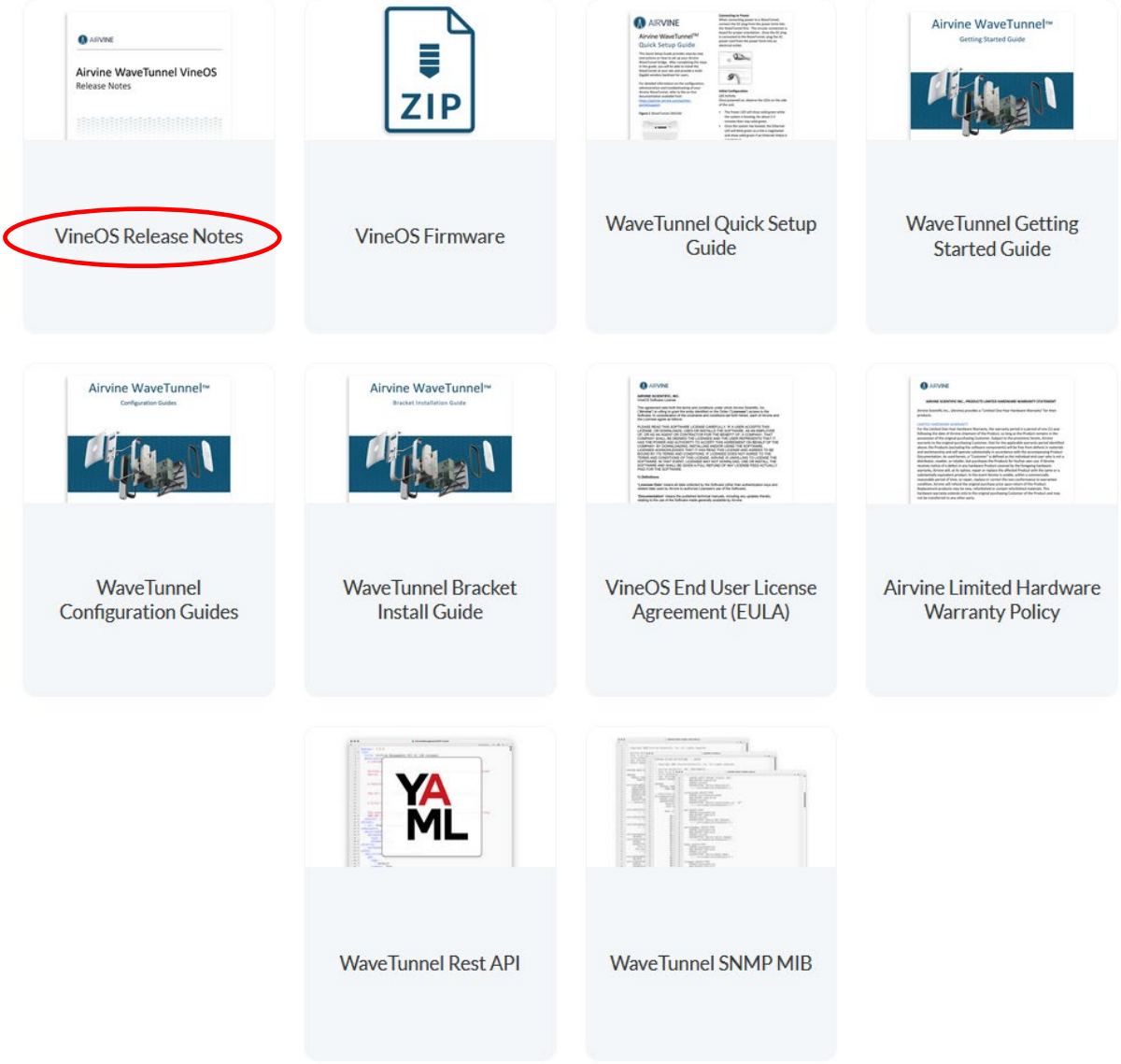
You will be presented with options for contacting our support team, accessing downloads, and registering products. It's important to register purchased products to assist with any support issues, so please take a moment to complete this step if you haven't already.

To gain access to the latest firmware version and release note, click on the Downloads tab.



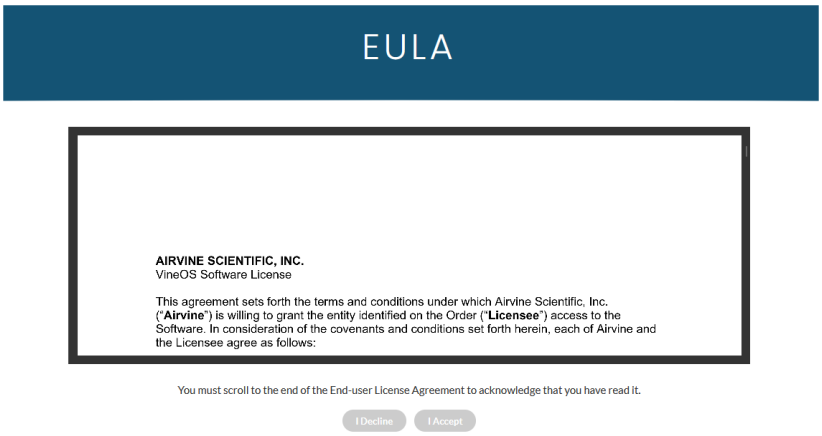
Once in the Downloads section, you will see many helpful resources that will assist you with configuration and advanced programming as needed.

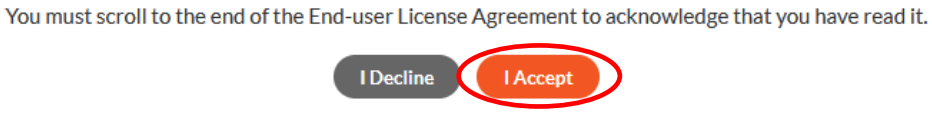
Locate and click on the VineOS Release Notes tab to download and review the latest firmware enhancements and fixes. **Always review VineOS Release Notes before updating the firmware on a WaveCore network as specific instructions are sometimes required.**



Downloading Firmware

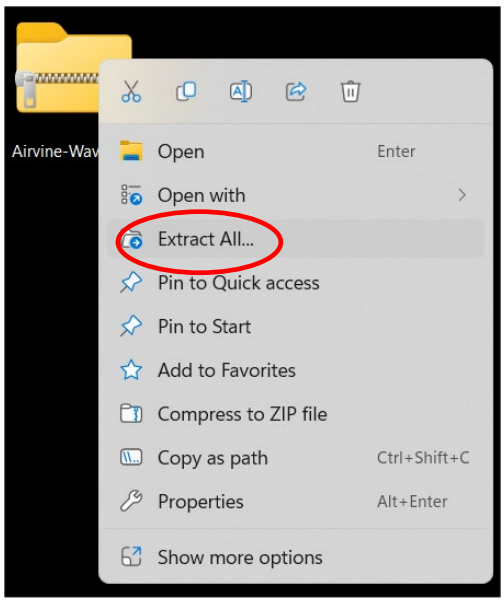
To download the latest WaveCore firmware, click on the VineOS Firmware icon. You will be presented with an End User License Agreement or EULA. Read through this agreement and scroll to the bottom. Once there, click on the "I Accept" and your firmware download will start.

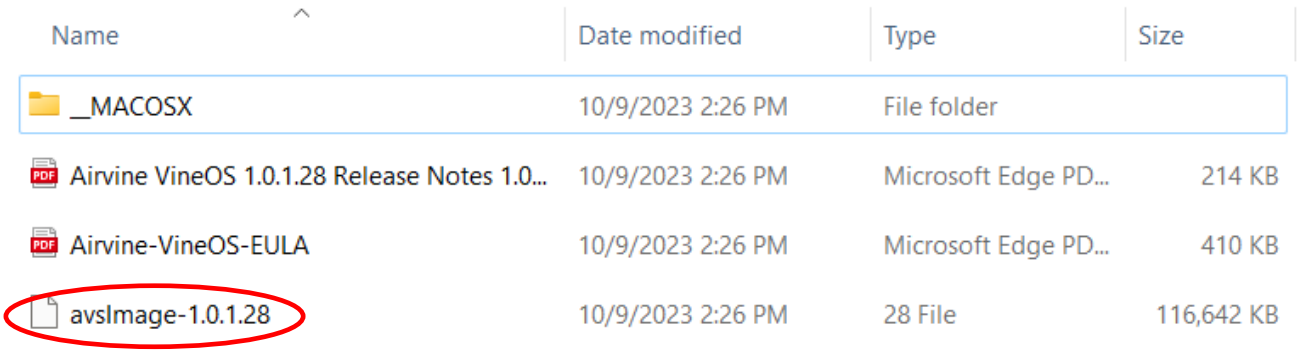




Extracting Firmware

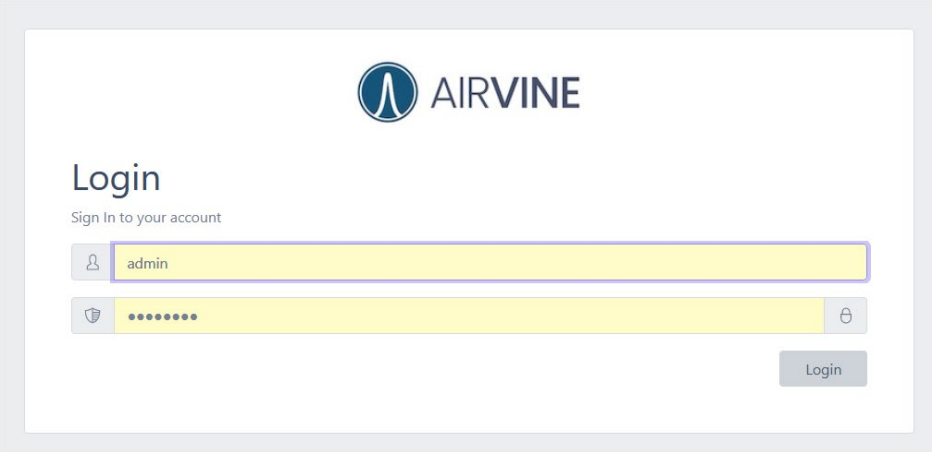
Locate the location in your file system where the firmware has been downloaded to. Firmware will be in a compressed folder. Right click and “Extract All…” The extracted folder will contain a copy of the release notes and EULA as well as the firmware image. The firmware image will be a large fill in the format of “avsImage-x.x.x.x”. Note the location of this firmware.



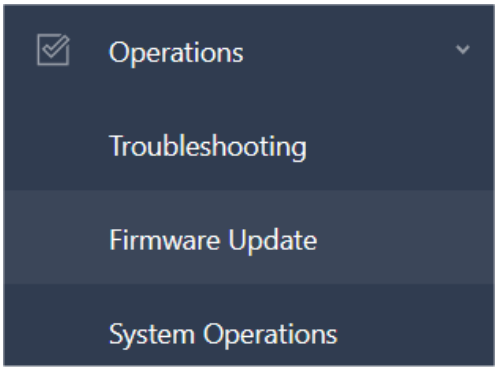


Updating Firmware

Log into the WaveCore node with configured user credentials.



On the left side navigation menu expand the System > Operations dropdown menu and select Firmware Update.

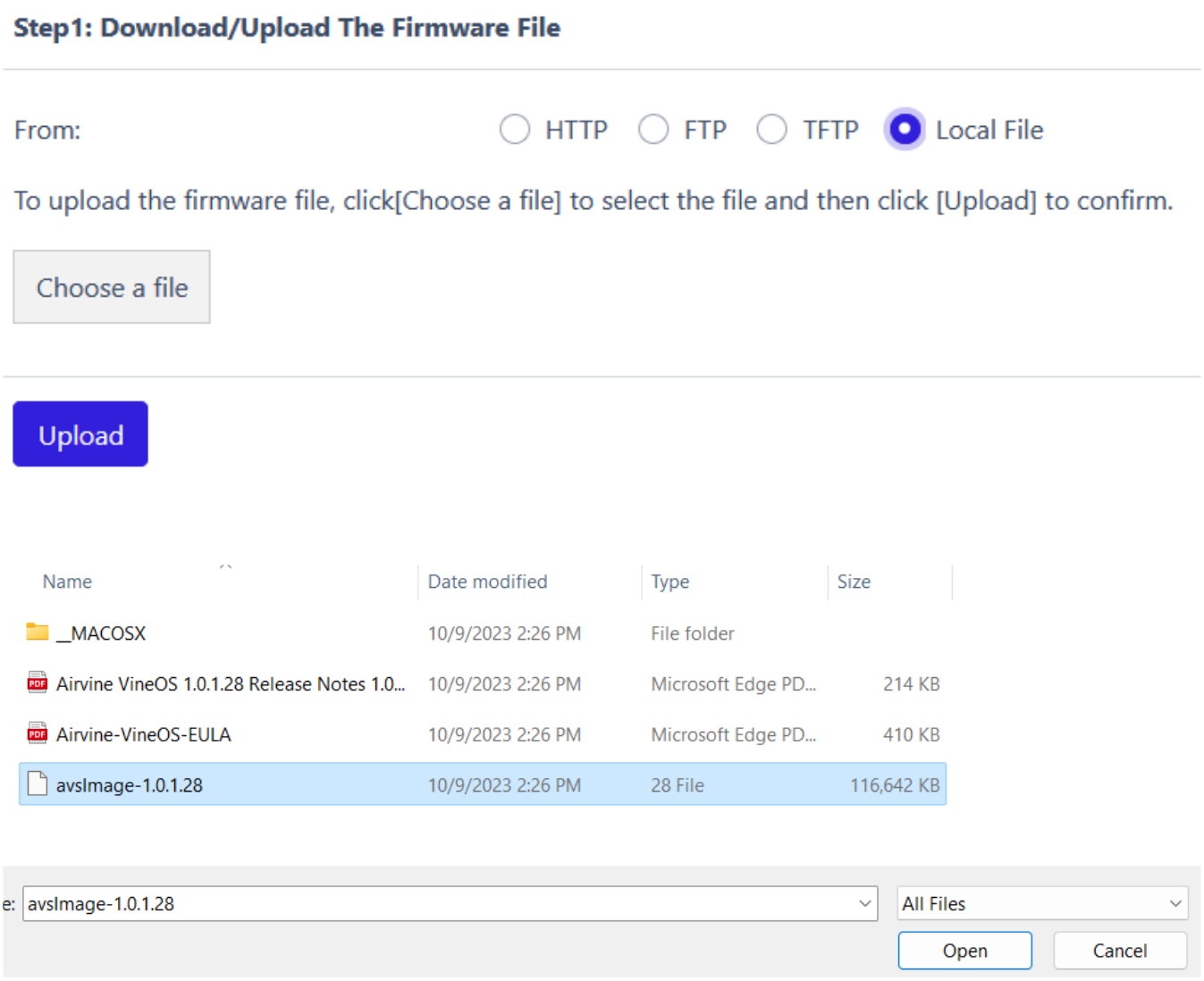


Note the current Active and Inactive firmware versions.

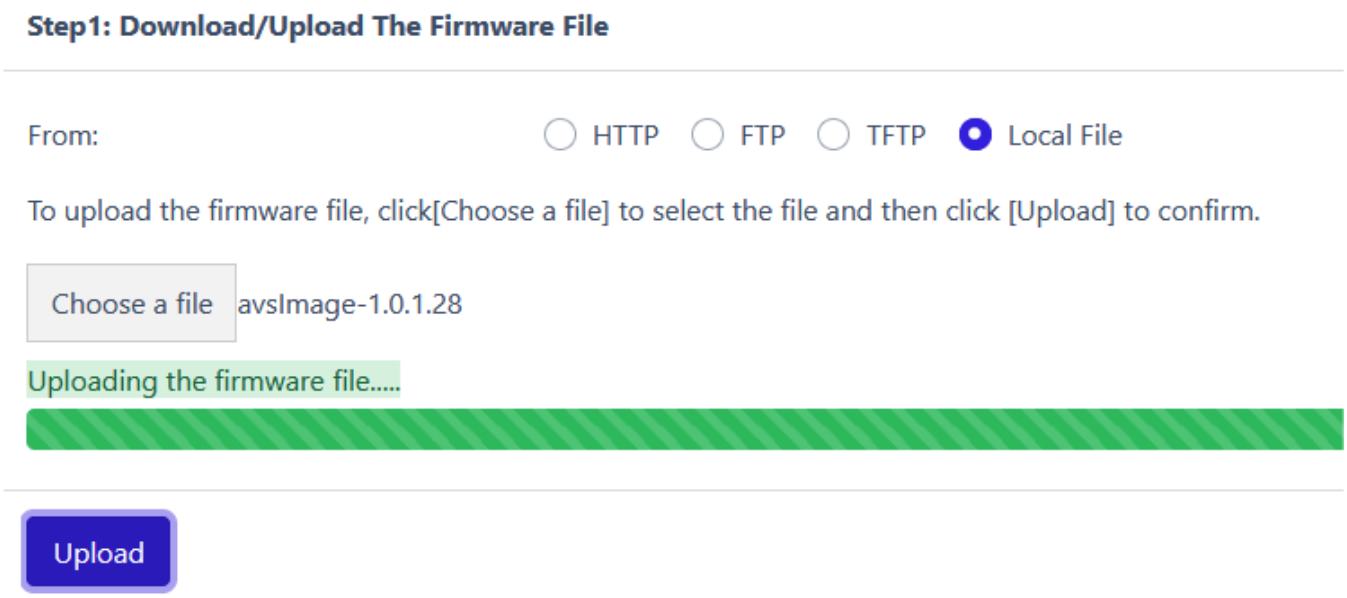
Image Number	Active	Primary	Version
1	Inactive	Backup	0.2.0.116
2	Active	Primary	1.0.0.121

Step 1

Select the protocol for the firmware update. In many cases, the Local File option will be the easiest. Click on “Choose a file” and navigate to the location of the firmware file, select the firmware image, then “Open”.

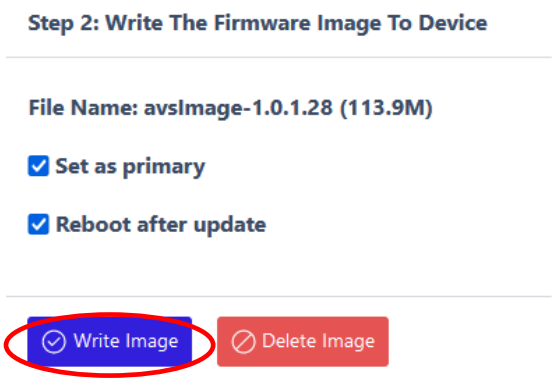


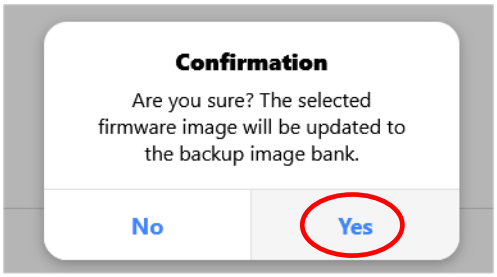
You will now be able to “Upload” the file to the WaveCore



Step 2

Once the firmware has been loaded, Write Image to the WaveTunnel system. Use the “Set as primary” and “Reboot after update” to have the system set the new firmware as the active primary image. Confirm the update and the system will proceed to load the firmware.





Confirmed Firmware Update

Once the system has been updated and the WaveTunnel is rebooted, log into the WaveTunnel and navigate to the Firmware Update page. Verify that the new firmware has been loaded and is set to Active, Primary.

Image Number	Active	Primary
1	Active	Primary
2	Inactive	Backup

Congratulations and enjoy working with the new firmware. If you have any issues or questions, please contact us at customersupport@airvine.com