comnet
Communication Networks

INSTALLATION AND OPERATION MANUAL

netwave®

MINI INDUSTRIAL OUTDOOR HIGH THROUGHPUT 802.11A/N WIRELESS ETHERNET DEVICE

This manual serves the following ComNet Model Numbers:

NW7/M
NW7E/M
NWK7/M
NWK7E/M

Thank you for purchasing NetWave® from ComNet. This installation guide applies to the following models:

NW7/M: Individual Hardened Single Radio with One GB Ethernet Port, One internal 16dBi 30° beamwidth directional antenna. FCC Certified for use in the NA Region.

NW7E/M: Individual Hardened Single Radio with One GB Ethernet Port, One internal 16dBi 30° beamwidth directional antenna. ETSI certified for use in the EU Region.

NWK7/M: Industrial Multipoint Kit, FCC Version (Includes NWK7/M_AP and NWK7/M_CL)

NWK7E/M: Industrial Multipoint Kit, ETSI Version (Includes NWK7E/M_AP and NWK7E/M_CL)

The NetWave NW7[E]/M industrially hardened high throughput (HT) wireless Ethernet transmission link from ComNet can be configured through the embedded User Interface as a Client or as an Access Point. This point-to-multipoint model allows multiple Ethernet endpoints to be connected to a central Access Point. Up to 15 endpoints can be linked to a central access point. The NW7/M and NW7E/M support up to 240 Mbps throughput using MIMO technology. An easy to read LED array displays unit operational status along with received signal strength ensuring optimal installation and operation. The units can be powered by an 802.3af/at PoE Compliant device or through an optional Midspan Power Injector. The NW7/M is FCC certified and the NW7E/M is ETSI, DFS and TPC certified.

About This Guide

This guide is intended for different users such as engineers, integrators, developers, IT managers, and technicians.

It assumes that users have some PC competence and are familiar with Microsoft Windows operating systems and web browsers such as Windows Internet Explorer and Mozilla Firefox, as well as have knowledge of the following:

» Installation of electronic equipment
» Electrical regulations and guidelines
» Knowledge of Local Area Network technology

Related Documentation

The following documentation is also available:

» NW7[E]/M Datasheet
» NW7[E]/M Quick Start Guide
» NWK7[E]/M Datasheet
» NWK7[E]/M Quick Start Guide

Website

For information on ComNet's entire product line, please visit the ComNet website at **http://www.comnet.net**

Support

For any questions or technical assistance, please contact your sales person (**sales@comnet.net**) or the customer service support center (**techsupport@comnet.net**)

Safety

» Only ComNet service personnel can service the equipment. Please contact ComNet Technical Support.
» The equipment should be installed in locations with controlled access, or other means of security, and controlled by persons of authority.

Contents

Overview

Legal Information

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1.0 Introduction

The NetWave® NW7[E]/M industrially hardened high throughput (HT) wireless Ethernet transmission link from ComNet can be configured through the embedded User Interface as a Client or as an Access Point. This point-to-multipoint model allows multiple Ethernet endpoints to be connected to a central Access Point. Up to 15 endpoints can be linked to a central access point. The NW7/M and NW7E/M support up to 240 Mbps throughput using MIMO technology. An easy to read LED array displays unit operational status along with received signal strength ensuring optimal installation and operation. The units can be powered by an 802.3af/at PoE Compliant device or through an optional Midspan Power Injector. The NW7/M is FCC certified and the NW7E/M is ETSI, DFS and TPC certified.

This user manual is a guide for the NetWave NW7[E]/M wireless Ethernet device as well as the NWK7[E]/M preconfigured kits. ComNet NetWave Wireless offers OpenWRT with the most advanced Qualcomm Atheros 10.1.x wireless drivers. NetWave now includes a new user-friendly LuCI web interface for configuring the device. OpenWRT is an extensible GNU/Linux distribution for embedded devices. It is built from the ground up to be a full-featured, easily modifiable operating system. It is powered by a Linux kernel that's more recent than most other distributions. LuCI is a free, clean, extensible and easily maintainable web user interface for embedded devices. It has high performance, small installation size, fast runtimes, and good maintainability. The units come configured for either point to point or point to multipoint applications.

This manual contains detailed operational and configuration information not covered in the quick start guides.

This guide applies to the following models:

NW7/M - Industrial Multipoint, FCC Version, User Configurable

NW7E/M - Industrial Multipoint, ETSI Version, User Configurable

NWK7/M - Industrial Multipoint Kit, FCC Version (Includes NWK7/M_AP and NWK7/M_CL)

NWK7E/M - Industrial Multipoint Kit, ETSI Version (Includes NWK7E/M_AP and NWK7E/M_CL)

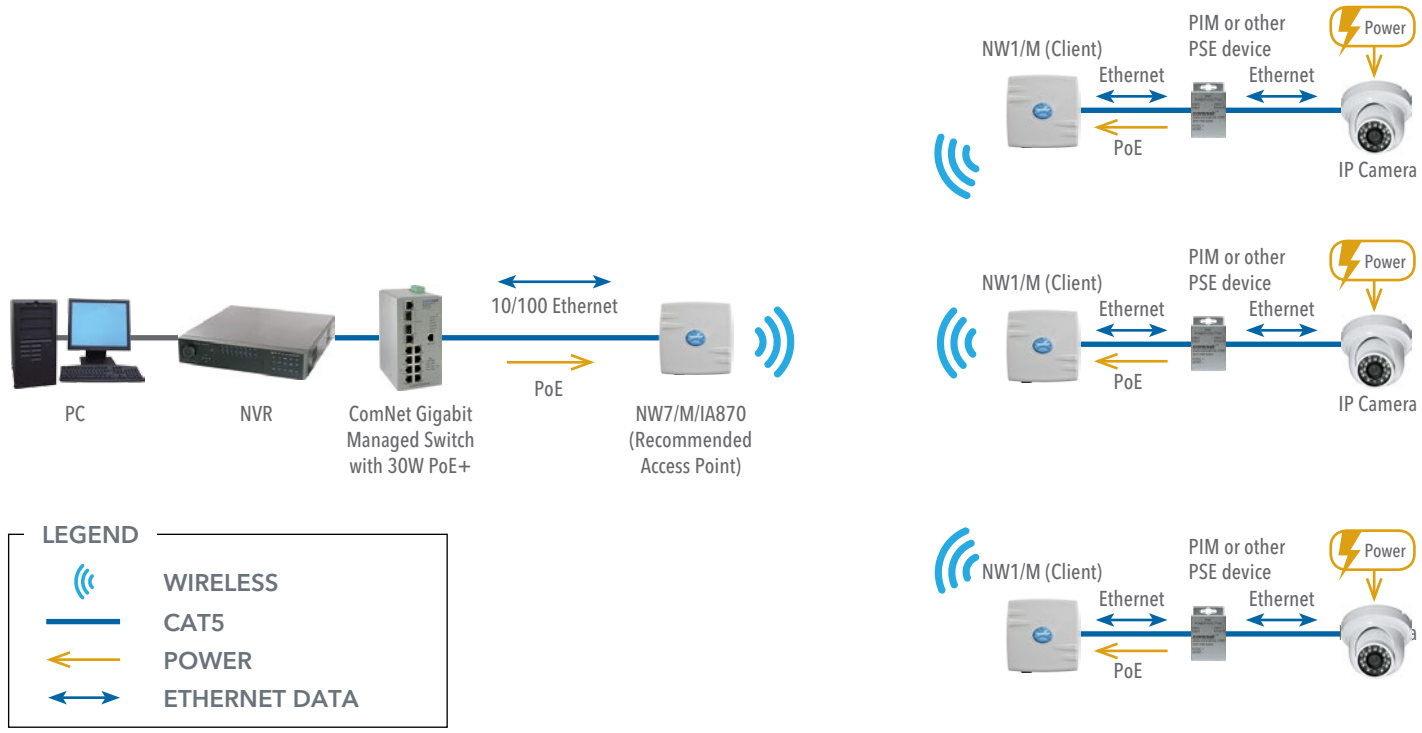
1.1 System Requirements

Operating System:
Microsoft Windows XP, Windows Vista, Windows 7, Windows 8, Linux, or Mac OS X.

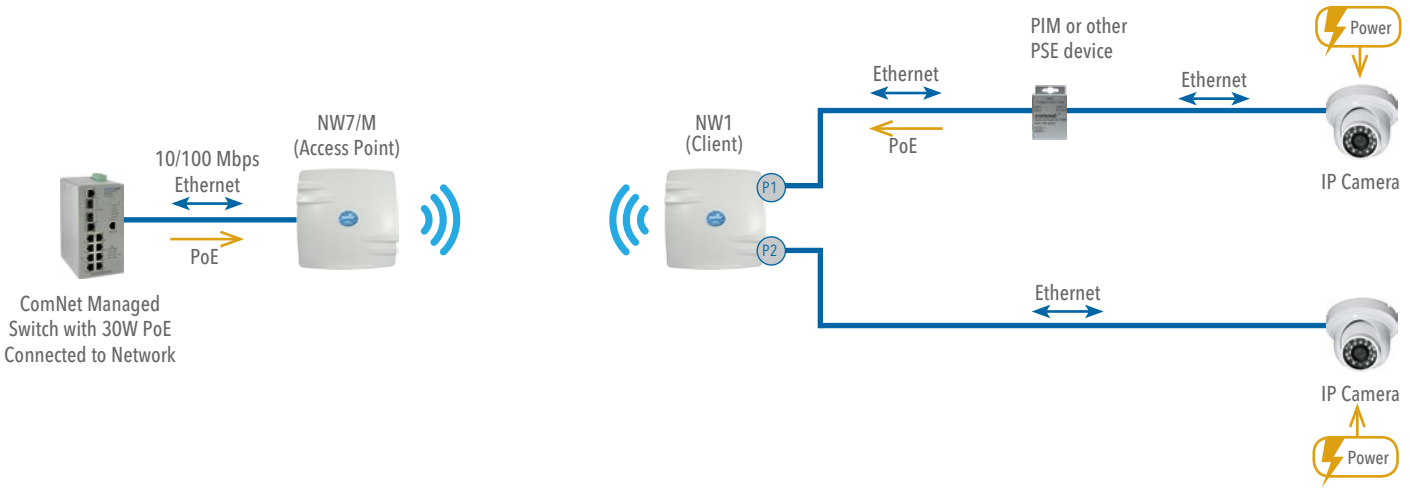
Web Browser:
Mozilla Firefox, Google Chrome, Apple Safari, or Microsoft Internet Explorer 8 or above.

2.0 Point to Multi-Point

These individual units allow the user to configure for either multipoint access point or client operation. There is a MAC address lock feature that can be enabled through the user interface but is not enabled by default. The NW7[E]/M includes a 16dBi 30° internal antenna and there is an optional 8dBi 70° internal antenna. See the ComNet website for the latest information regarding antenna support. Preconfigured NWK kits do not support point-to-multipoint topologies.



3.0 Point-to-Point Topology Utilizing Dual Ports



4.0 Cabling Requirements

Shielded CAT 5 or better should be used for all out of plant Ethernet connection and should be properly grounded through the PoE AC ground. Industrial grade shielded Ethernet cable is recommended to help prevent ESD damage commonly experienced with outdoor installations. Visit www.comnet.net/comnet-products/cables

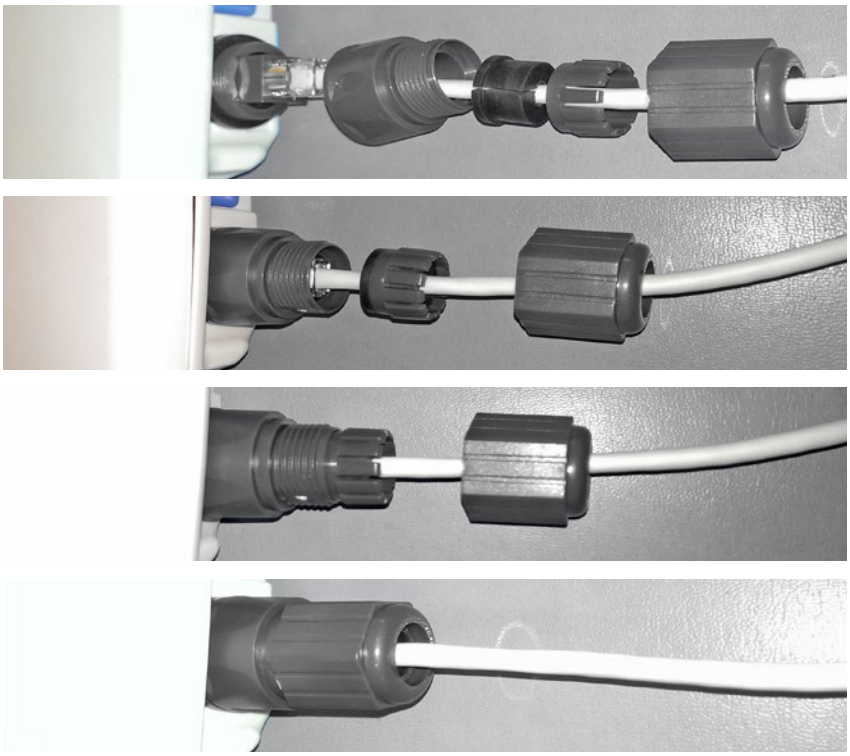
5.0 Hardware Installation

5.1 Outdoor Ethernet Gland Installation

There will be at least one cable gland included with each outdoor enclosure. Below is an image of the individual parts of the gland with an Ethernet cable routed through.

Note: The split rubber washer allows a pre-terminated Ethernet cable to be used.

Once the cable has been routed through the weather connection, and the RJ45 connection has been made, screw in the gland into the housing making sure it is tight enough for a water tight seal. Push the split rubber gasket into place and loosely screw the cap that goes over the rubber washer.



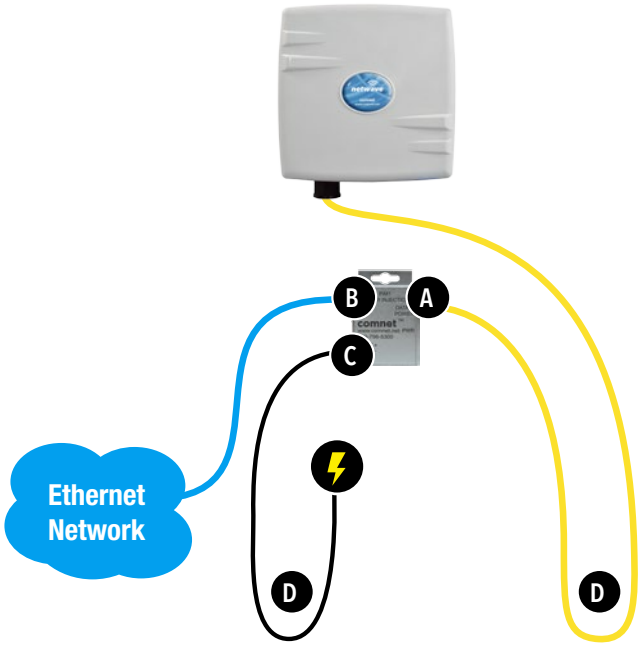
Once the gland is tight in the housing, tighten the outer nut/cap making sure the rubber seal squeezes and seals the Ethernet cable to the gland as shown below.

Connect one end of an RJ-45 Ethernet cable to the LAN OUT port of the Power Injection Module (PIM) and the other end to LAN of the access point – as sown below.

Note: Maximum length of the RJ-45 CAT5 cable is 90 meters.

Connect the RJ-45 Ethernet cable attached to the PIM to a network device, such as a switch or to the configuration PC. Then plug the power adaptor to an AC power outlet and power plug into the socket of the PIM – as shown in the diagram below.

Note: DC Passive PoE input for the NW7[E]/M and NWK7[E]/M is 48 VDC.



A. Connect one end of an RJ-45 Ethernet cable to the OUT port of the Power Injection Module (PIM) and the other end to LAN of the access point.

   Maximum length of the RJ-45 CAT5 cable is 100 meters.*

B. Connect the RJ-45 Ethernet cable attached to the PIM to a network device, such as to a switch or to the PC you will use to configure the access point.

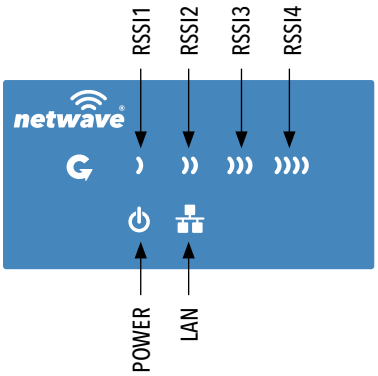
C. Connect the power adaptor to the main electrical supply and the power plug into the socket of the PIM.

   PoE power input: Passive PoE (range 42 to 56 VDC).
   The unit can also be powered by a suitable IEEE 802.3af/at PSE device such as a PoE switch or injector.

D. A Drip Loop is recommended as additional precaution against moisture entering the Access Point housing.

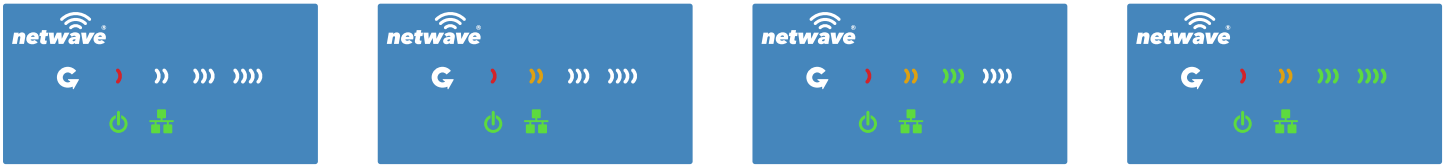
** Up to 200mW radio. For higher power radio upgrade to higher rating power adapter.*

5.2 NW7/M and NW7E/M Indicating LED Details



LED	VISUAL CUE	INDICATION
POWER	SOLID GREEN	Power is supplied to the unit
	OFF	No power is supplied to the unit or the unit is in reset.
LAN	SOLID GREEN	LAN Connected
	OFF	No Connectivity
RSSI1	SOLID RED	Weak Connection
RSSI2	SOLID ORANGE	Moderate Connection
RSSI3	SOLID GREEN	Solid Connection
RSSI4	SOLID GREEN	Excellent Connection (Advisable to check Status Page to confirm RSSI is > -55)

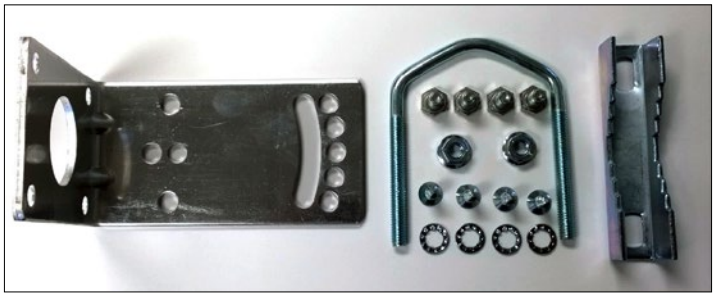
SIGNAL STRENGTH:



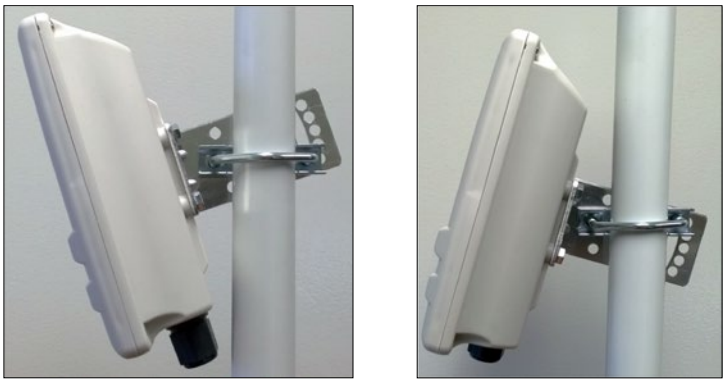
WEAK SIGNAL EXCELLENT SIGNAL

5.3 Outdoor Standard Mounting Hardware

This mounting hardware will support pole diameters up to 2 in (5.8 cm). Below are the parts contained in the standard mounting hardware.



Here is the mounting hardware assembled shown in a +30° and -30°vertical position



6.0 Key Default Configurations

IP Address of Web Server	192.168.10.100 (NWKX_AP) 192.168.10.101 for all others
LAN Mode for Web Server	Static Addressing
Web Server User ID	admin
Web Server Password	admin
SSID	NetWave-1
WPA Pre-shared Key	12345678
Channel-Frequency (AP)	Auto
Channel Spectrum Width	20/40M
Long Range Parameters	Enabled and defaulted to 1000m

Note: A Reset to defaults (performed on the ADMIN page or via the RESET button) will erase all user configurations.

7.0 Quick Configuration

1. Connect an Ethernet cable from the port labelled as IN on the power Injection Module to either a laptop or a PC LAN port.
2. Connect the second Ethernet cable from the OUT port on the Power Injection Module to the NetWave LAN port.
3. Apply 48 VDC to the Power Injection Module with the provided power supply. You should notice the green LED illuminate in the Power Injection Module and the power LED on the NetWave unit.
4. Set the IP address of the laptop being used to configure NetWave to static and the subnet to 192.168.10.x/24 subnet.
5. Point the browser to 192.168.10.101. This is the default address.
   For preconfigured kits (NWKX_AP and NWKX_CL) point the Browser to 192.168.10.100 for the Access Point or 192.168.10.101 for the Client.
6. A login prompt will pop up. Enter:
   Username admin
   Password admin
7. Select the NETWORK » WIFI tab and set the desired network settings.
   Select Apply & Save

Note: This will be the network address for the NetWave web server. It is not necessary to set to the same subnet as the operating network but it is recommended.

8. Select the NETWORK -> WIFI tab and set:
   • Wireless mode – Set to AP or Client
   • Country code – Only required if setting up the NW7E/M (ETSI) model
   Note: It is the user's responsibility to ensure that the correct country is chosen. ComNet accepts no liability for incorrect equipment set up.
   • Output RF power – if received signal strength is greater than -40 dBm, it is recommended to reduce RF TX power
   • Set SSID – if changing from the default setting
   • Channel Spectrum Width – May want to reduce to 20M from the default 20/40M if the 5GHz spectrum is crowded
   • Wireless Security – if changing from default settings
   • Select Apply Settings
   • Select Save

Note: NW7/M and NW7E/M Multipoint nodes will need to have the Wireless Mode set to either AP or Client (default is Client). And the IP addresses will need to be all set to different addresses (default address is 192.168.10.101). Once this is done, all the clients will connect to the multipoint AP with all other setting kept at default.

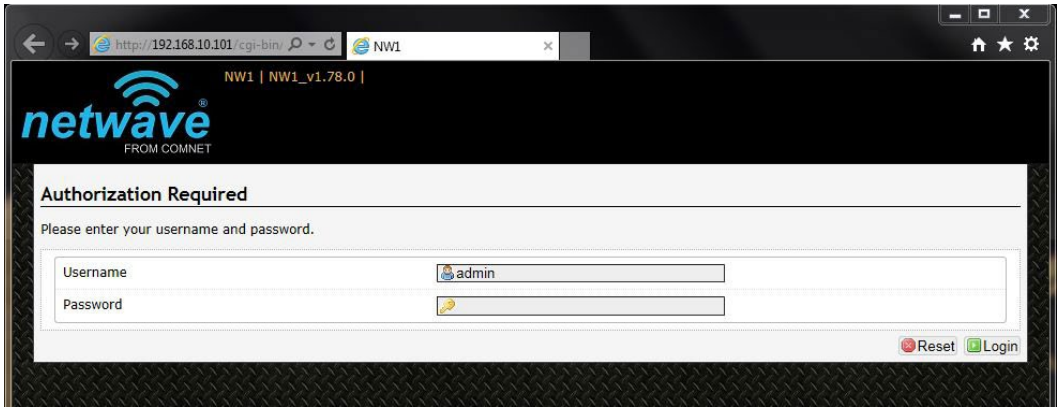
8.0 Detailed Configuration

8.1 Getting Started

To access the NetWave configuration interface, perform the following steps:

1. Connect an Ethernet cable from the Data In port on the Midspan Injector or switch the radio is connected to.
2. If you are using a Midspan Power Injector, Connect the power cable to an outlet and turn on power.
3. Assign the Ethernet adapter on your computer with a static IP address on the 192.168.1.x network, e.g. 192.168.10.10 and with a subnet mask 255.255.255.0.
4. Launch a web browser and enter the default IP address of the device, 192.168.10.101, into the address bar.

The first page that you see is the login page. The words on the top left denote the hardware part number and the firmware build version e.g. NW7 NW7_v1.78.0



The login page is presented upon requesting the Netwave Radio's IP address.

The default authorization details are:

Username: admin

Password: admin

8.2 Operating Modes

The Netwave Radio can operate in the following modes:

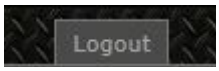
1. Access Point WDS
2. Client WDS

Once configured as Access Point and Client units can link together to form either Point-to-Point or Point-to-Multipoint topologies.

8.3 Buttons and Alerts

The buttons are described here.

Reset	Undo the changes.
Save	Saves the changes but does not take effect till settings are applied
Save & Apply	Saves and applies the changes. Please use this button instead of the 'Save' button so that the changes would be applied immediately. It is recommended to click this button before moving to a different page.



Logout	Logs out of the device's web page.

Note: At the top right corner of the NetWave configuration web page, there may be either of the following texts displayed:

Changes: 0: Means that all changes on the configuration web page have been applied to the Wireless Device.

Unsaved Changes: Shows the number of changes that have not yet been Save & Apply.

8.3.1 Reset Button

 The reset button is a physical button attached to the underside of the radio.

Please refer to Section "Reset Button."

8.3.2 Indicating LEDs

The light emitting diodes (LEDs) on the board are described in Section "Indicator LEDs".

8.3.3 Buzzer

The new NetWave buzzer provides the following audible information:

- Power up: Beep once.
- End of Firmware Loading: Beep twice.
- Alignment: Beep according to signal thresholds defined. The alignment buzzer is described in Section "Link Status (for Station Mode)".

9.0 Status Tab

After login, when you click on the Status top-level tab, you can see the second-level tabs of Overview, Routes, System Log, Kernel Log, and Real-time Graphs. This is shown in Figure 2.

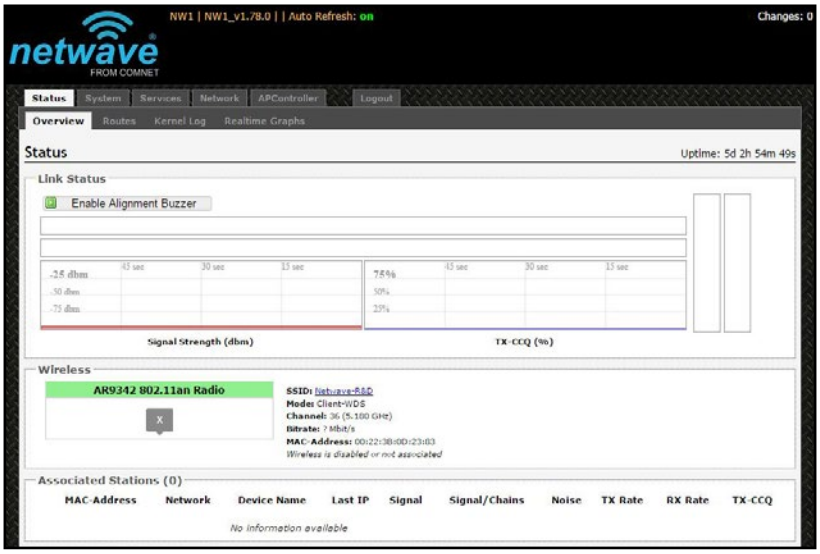


Figure 2: The Status Tab.

9.1 Overview

The Status » Overview page is divided into the sections Link Status, Wireless, Associated Stations, System, Memory, Network, and DHCP Leases.

Uptime: Displays the duration of time since the NetWave device was turned on or rebooted.

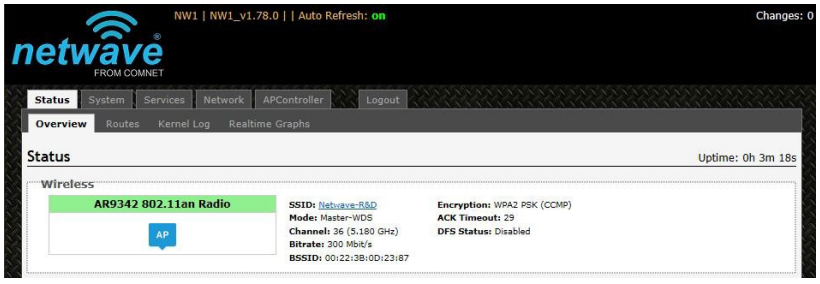


Figure 3: The Status » Overview page.

9.2 Wireless

The wireless chipset model is shown in the little box on the left e.g. AR9342 802.11an Radio.

Figure 4: Wireless chipset model.

The characters AP in the small callout box means that the radio is operating in the Access Point (AP) mode. If the characters are CPE, it means that the radio is operating as a Client. The character X is shown if the radio is disabled.

9.3 Wireless (for AP Mode)

The Wireless section in the Status » Overview page shows a summary of the wireless parameters. The following describes the parameters when the device is in the AP mode.

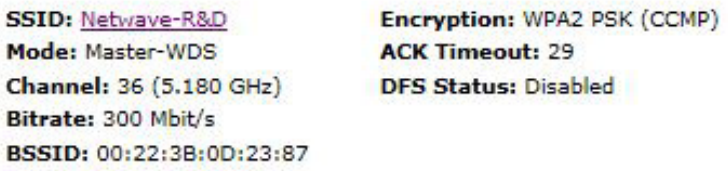


Figure 5: A summary in the Wireless section for a device operating as an 802.11 access point.

SSID	Displays the name of the wireless network that this access point (AP) is offering, the Service Set Identifier (SSID).
Mode	This is 'Master' if the device is in AP WDS mode.
Channel	Shows the channel number and frequency that this AP is using.
Bitrate	This is the maximum bitrate supported by the radio in the current configuration.
BSSID	This is the MAC address of the AP's radio.
Encryption	Displays the wireless encryption used.
ACK Timeout	Shows the maximum acknowledgment time in microseconds.
DFS Status	If DFS is enabled, the AP automatically switches channel if radar is detected on the current channel.

9.4 Wireless (for Client Mode)

The following describes the parameters for a device operating in Station mode.

Figure 6: A summary in the Wireless section for a device operating as an 802.11 station.

SSID	Displays the name of the wireless network that this station should be associated with.
Mode	Client
Channel	Shows the channel number and frequency that this station is using. Normally, it would automatically select the same channel as the AP.
Bitrate	This is the maximum bitrate supported by the radio in the current configuration.
MAC-Address	States the MAC address of the device's radio.
BSSID	This is the MAC address of the AP's radio.
Encryption	Displays the wireless encryption used.
ACK Timeout	Shows the maximum acknowledgment time in microseconds.
DFS Status	If DFS is enabled, the AP automatically switches channel if radar is detected on the current channel.
TX-CCQ	Displays the transmission quality in %. A higher percentage means a better wireless connection quality.
RX Rate	Shows the receive bit rate of this station.
TX Rate	Shows the transmit bit rate of this station.

9.5 Associated Stations (for AP Mode)

This section shows the connected devices, if the Radio is in the AP mode.

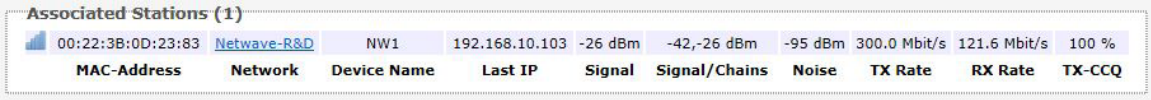


Figure 7: List of Associated Stations.

If there are no associated Clients, the text "No information available" is displayed. The parameters shown are as follows:

MAC-Address	Displays the MAC address of the station's radio.
Network	States the name of the wireless network.
Device Name	Shows the name of the station.
Last IP	States the most recent IP address of the station as seen by the Radio.
Signal	Displays the received signal strength from the Client e.g. -26 dBm.
Signal/Chains	Shows the received signal strengths from the station on each antenna e.g. -42, -26 dBm. The value of -95 dBm is taken to mean "no antenna" if the radio has only 2 antennas.
Noise	Displays the received noise power at the AP.
TX Rate	Shows the transmit bit rate from the AP towards this Client.
RX Rate	Shows the receive bit rate at the AP from this Client.
TX-CCQ	Indicates the wireless connection quality.

9.6 System

This section shows the Netwave Product name, Firmware Version, Kernel Version, and Local Time.

Figure 8: System parameters.

9.7 Memory

Here, the Total Available and Free memory are shown.

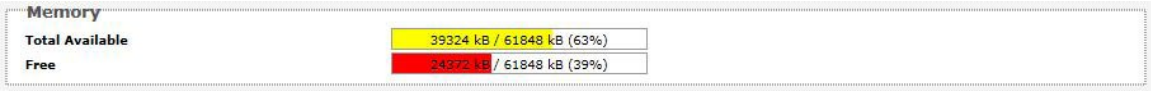


Figure 9: Total Available and Free Memory.

9.8 Network

This section displays the status of the LAN and WAN networks.

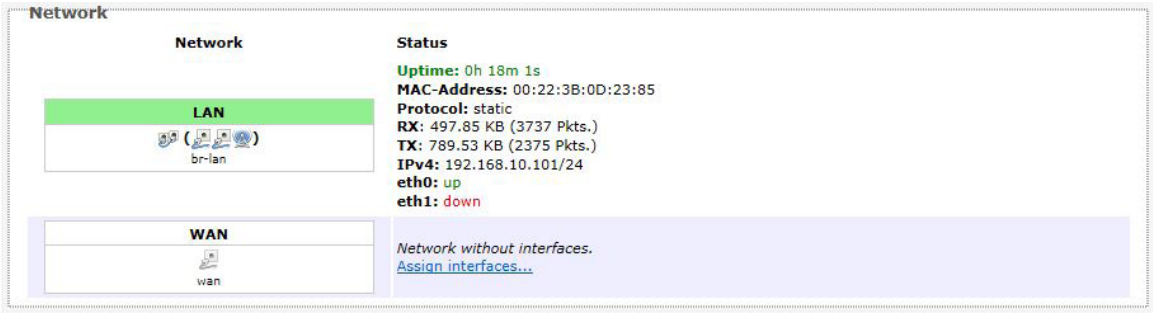


Figure 10: Network summary.

Status	Shows summaries of the interfaces for the LAN and WAN zones. This may include uptime, MAC address, protocol, bytes and packets received by the device, bytes and packets transmitted by the device, and its IPv4 address.

9.9 DHCP Leases

This section shows a table of MAC and IP addresses of connected devices with static DHCP leases. They are specified in the Network » Interfaces » LAN » Static Leases section of the device's configuration web page.

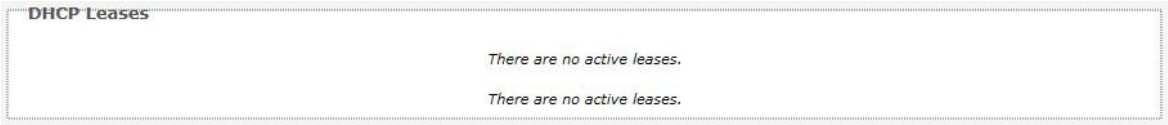


Figure 11: Currently active static DHCP leases.

9.10 Link Status (for Client Mode)

This section only applies if the device operates as an 802.11 station.

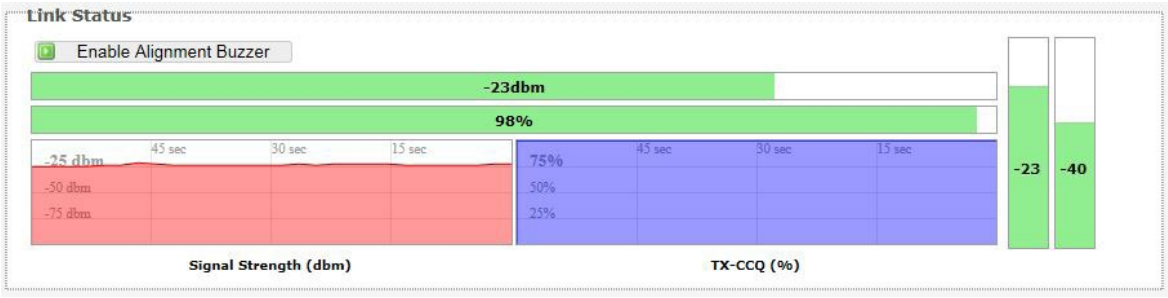


Figure 12: The Link Status section.

In the Link Status section on the Status » Overview web page, the value in the top left box denotes the current received signal strength e.g. -23 dBm. The box directly below it shows the current TX-CCQ (transmission client connection quality) e.g. 98%. The bottom left box shows a real-time

graph of the received signal strength over the last 60 seconds.

The box directly to its right shows a real-time graph of the TX-CCQ over the past 60 seconds. On the right of this section, there are 2 vertical bars. Each bar shows the current received signal strength of each antenna e.g. -23 dBm, -40 dBm.

Enable Alignment Buzzer	When enabled, the board would continually emit beeping sounds to indicate the received signal strength. Every 3 seconds, the board would emit a number of beeps (1 to 4) in quick succession. The number of beeps is the same as the number of lighted Signal strength indicator LEDs. See Section " LED Configuration." Just like for the LEDs, more beeps indicate a higher received signal strength. This is useful for a person aligning directional antennas at a height, in an outdoor scenario, if the LEDs are not visible. Another person on the ground could adjust the threshold values for the LEDs. There is some delay before the received signal strength gets reported by the alignment buzzer. To turn off the beeping sounds, click the button “Disable Alignment Buzzer”.

9.11 Routes

When you click on the Status » Routes tab, you would see the page that shows the routing rules that are currently active on the device.

Figure 13: The Status » Routes page.

ARP	This address resolution protocol (ARP) table shows the IP address and corresponding MAC address of each device on the network.
Active IPv4-Routes	This table shows the IPv4 gateway and network ID (Target) for each subnet.

9.12 Kernel Log

This page shows the kernel debugging messages. This kernel log can also be obtained by typing "dmesg" in a serial console such as Tera Term if a suitable serial connector is used.

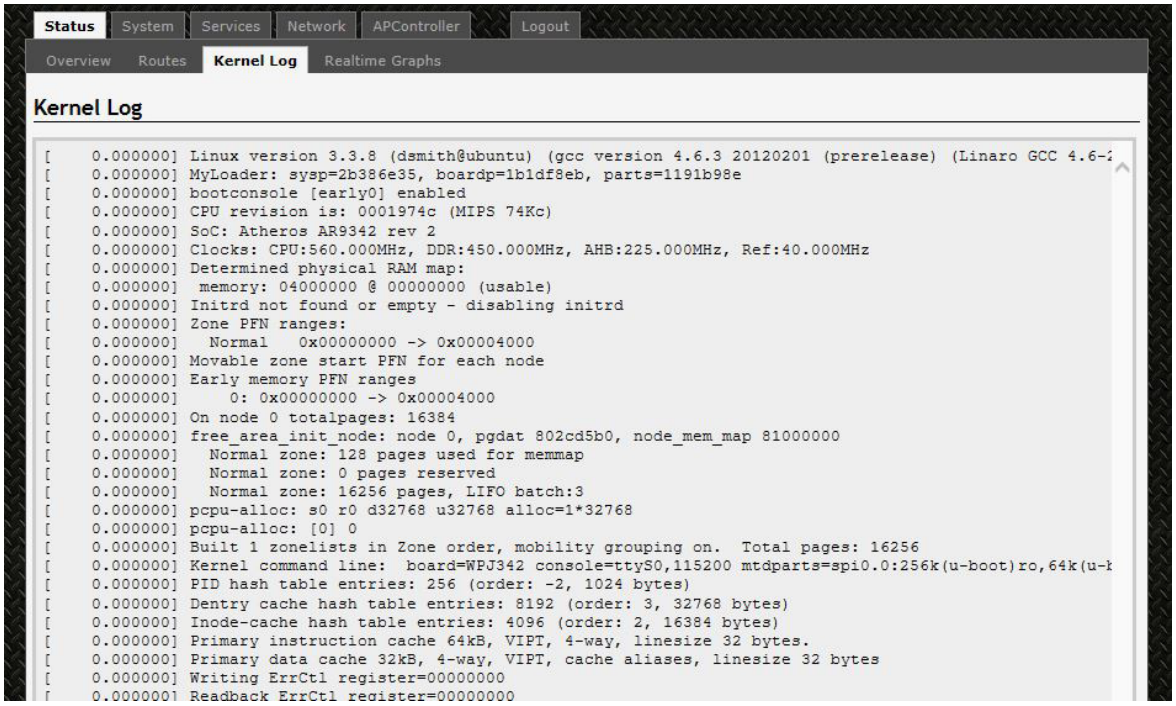


Figure 14: The Status » Kernel Log page.

9.13 Real-time Graphs

Under the tab for Real-time Graphs, there are four tabs titled Load, Traffic, Wireless, and Connection.

9.13.1 Load

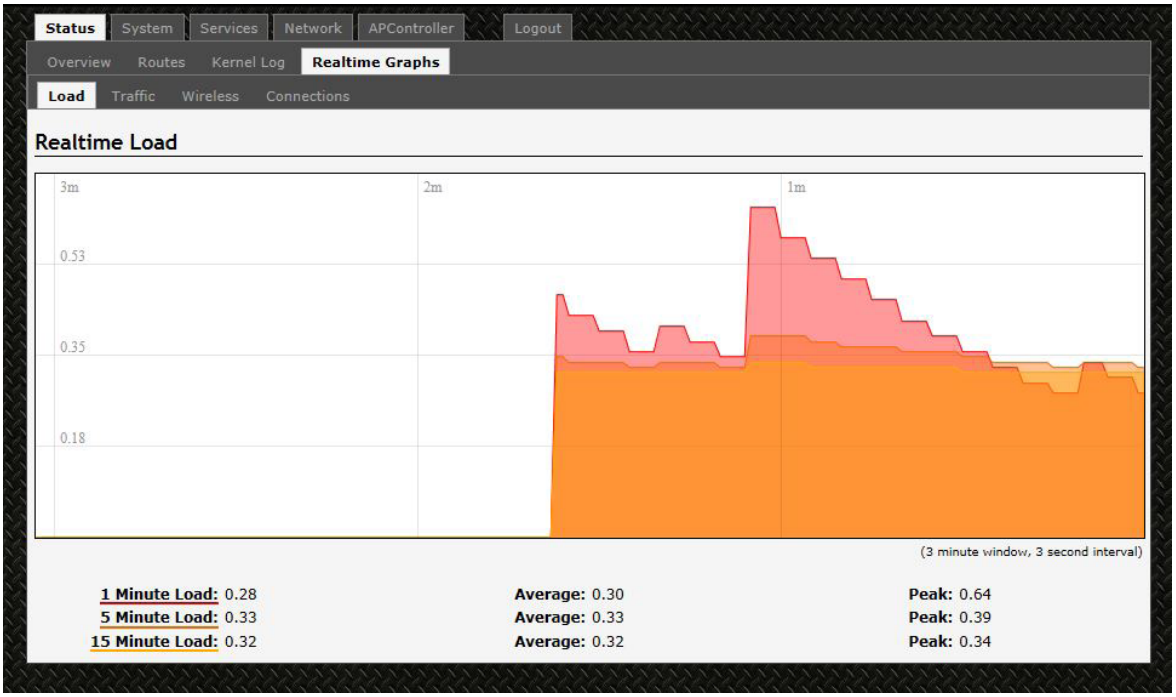


Figure 15: The graph for Real-time Load.

9.13.2 Traffic

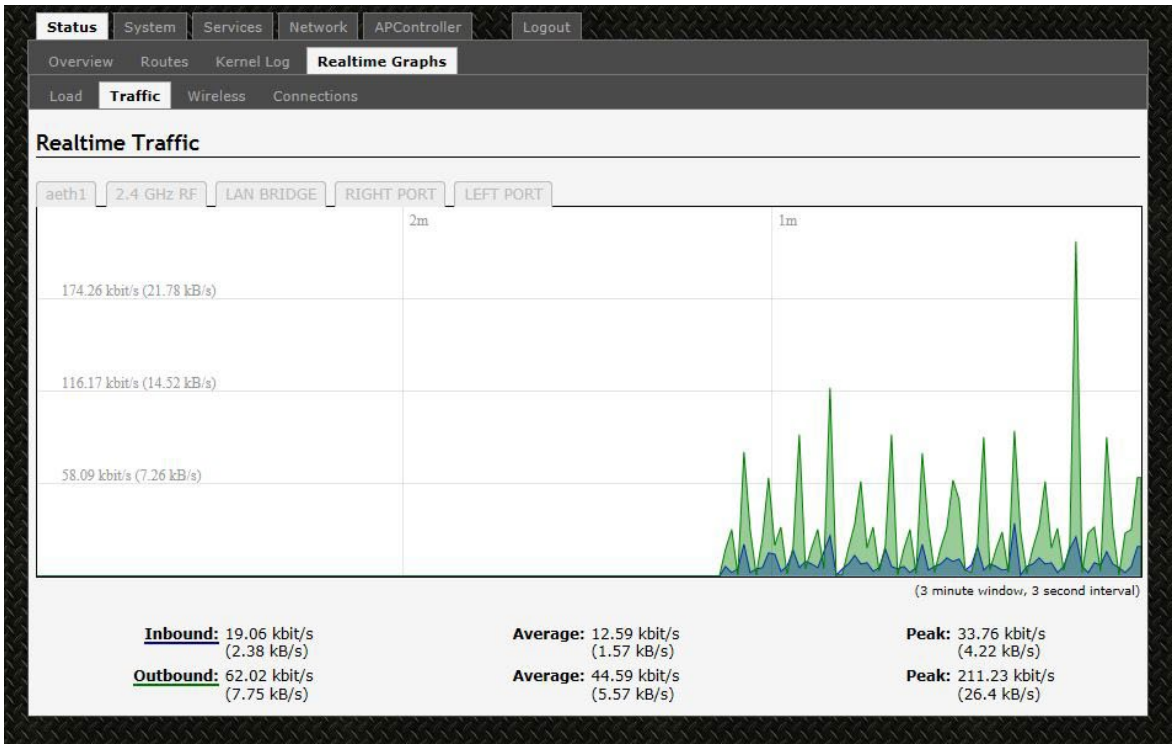


Figure 16: The graph for Real-time Traffic.

9.13.3 Wireless

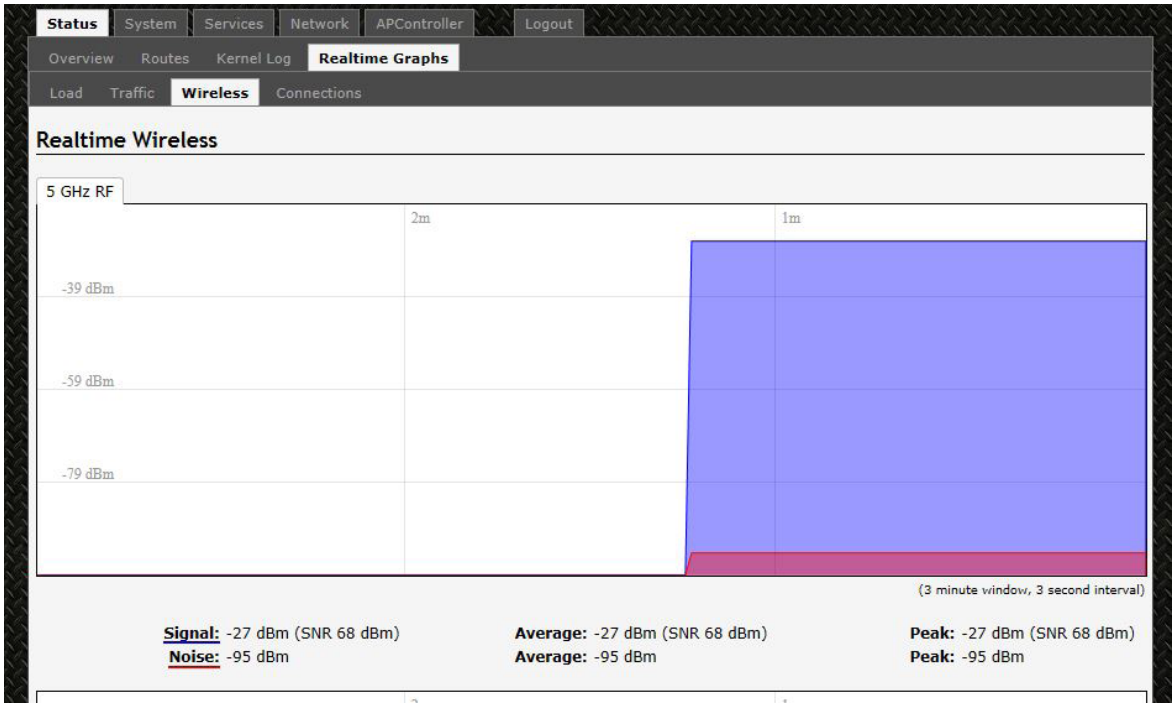


Figure 17: The graph for Real-time Wireless.

9.13.4 Connection

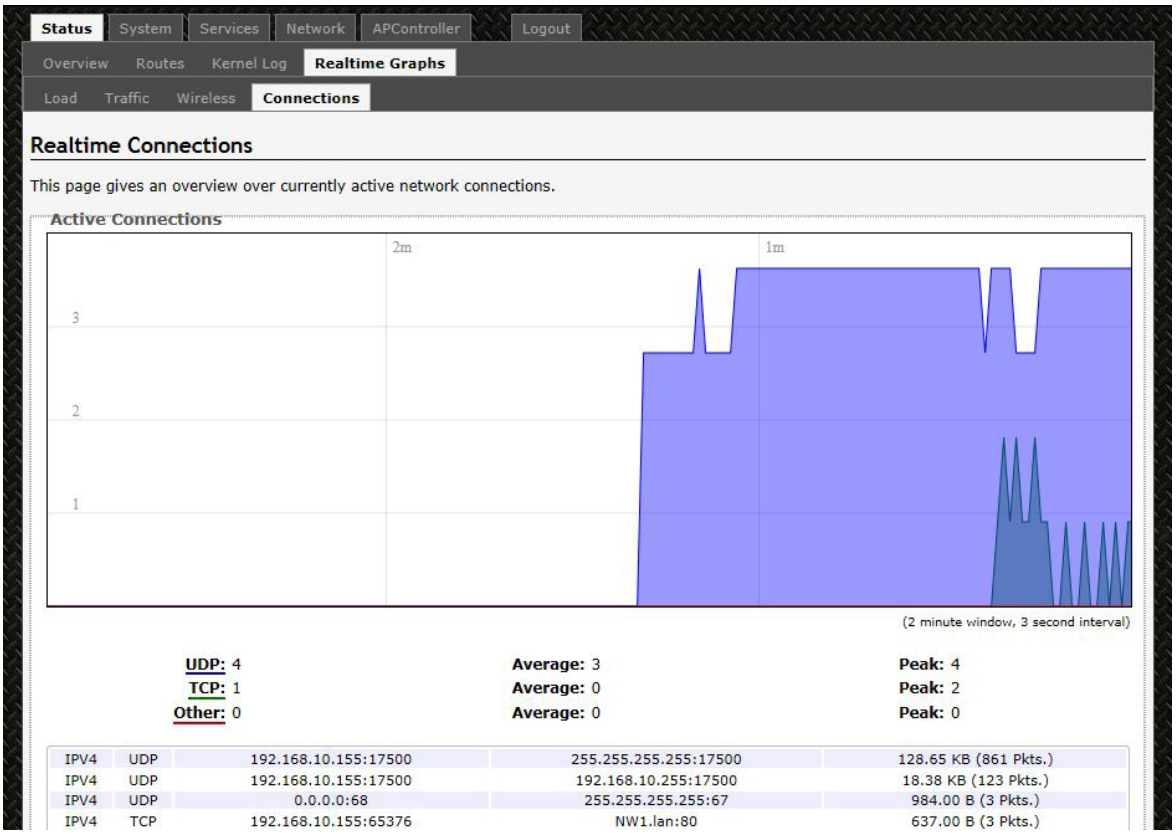


Figure 18: The graph for Real-time Connections.

10.0 System Tab

Within the System >>System page, you can configure the device parameters such as the hostname, time zone and set Time Synchronization.

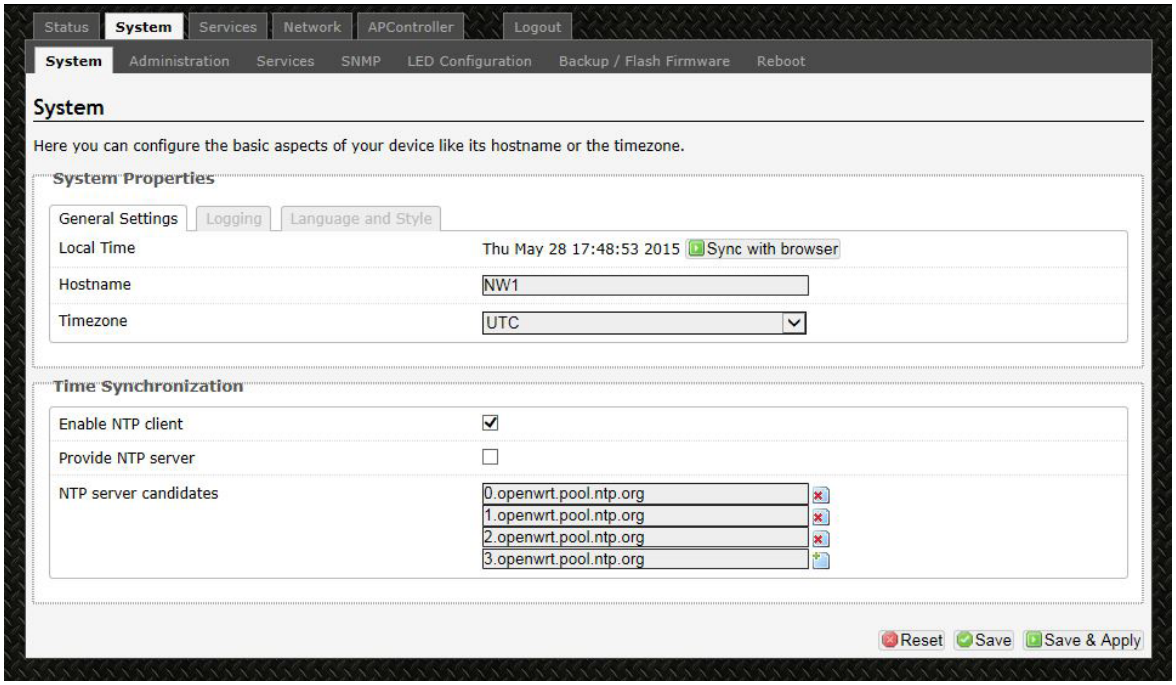


Figure 19: The System top-level tab.

10.1 System Properties

Within the section on System Properties, there are tabs corresponding to General Settings, Logging, and Language and Style.

General Settings

Local Time	Displays the local time according to the time zone.
Hostname	Configures the name of the device.
Time Zone	Sets the time zone.

10.2 Time Synchronization

Enable NTP client	Obtains the date and time from specified Network Time Protocol (NTP) servers.
NTP server candidates	These are the sources of the time information. At least three are recommended for accurate time synchronization.

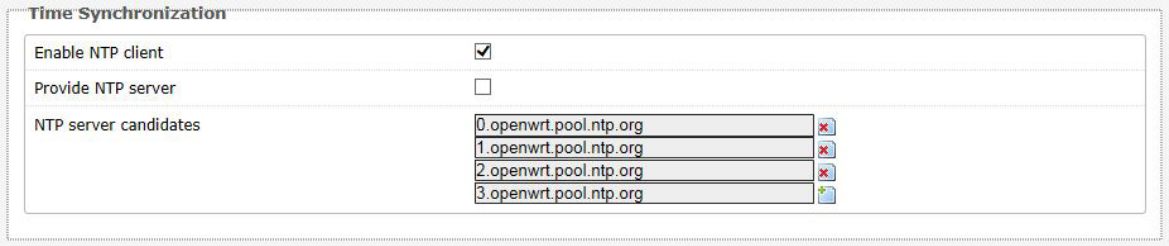


Figure 20: Time Synchronization settings.

Logging

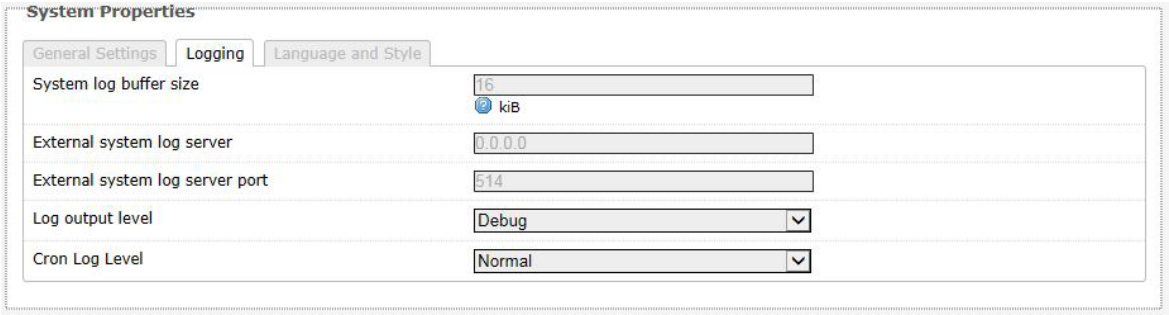


Figure 21: Changing the system properties for Logging.

Logging	Specifies parameters used for the system log, such as System log buffer size, External system log server, External system log server port, Log output level, and Cron Log Level.

Language and Style

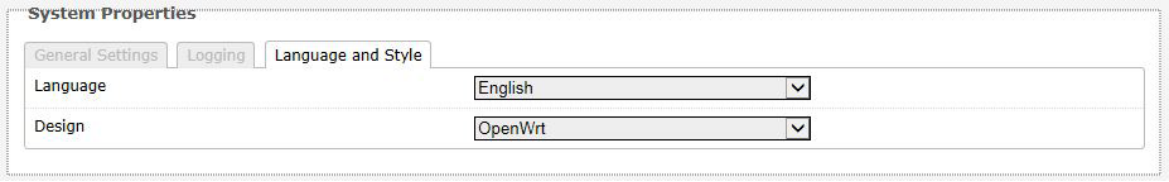


Figure 22: Modifying the Language and Style.

10.3 Administration

Within the System » Administration page, you can configure the Device Password, SSH, Telnet, Web, and FTP settings.

10.3.1 Device Password

Figure 23: Setting the router password.

Password	Allows you to set the device password, the default being admin
Confirmation	Requires you to re-enter the password.

10.3.2 SSH

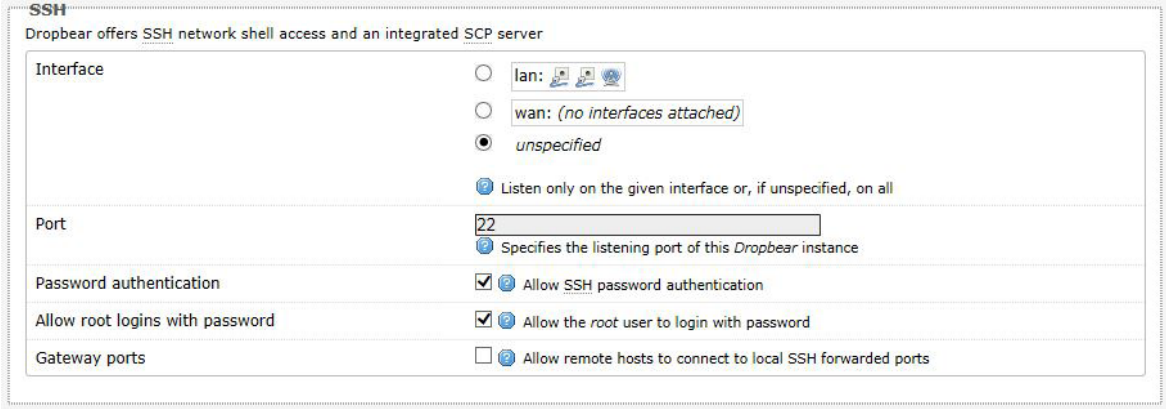


Figure 24: SSH settings in the System » Administration page.

SSH	Allows you to access the device's Linux shell and file system using the Secure Shell protocol. For example, the programs PuTTY and WinSCP can be used.
Interface	Lets the device listen on a given interface or all interfaces.
Port	Specifies the listening port, the default being 22.
Password authentication	Allows SSH password authentication.
Allow root logins with password	This is enabled by default.
Gateway ports	Allow remote hosts to connect to local SSH forwarded ports.

10.3.3 Telnet

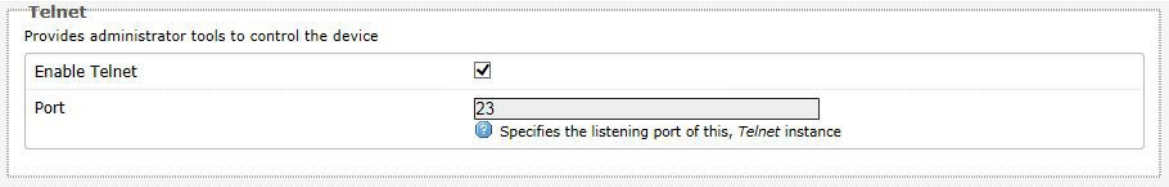


Figure 25: Telnet settings in the System » Administration page.

Telnet	Provides administrator tools for controlling the device or network debugging, over an unencrypted connection.
Port	Specifies the listening port, the default being 23.

To start using Telnet, enter the command “telnet 192.168.10.101” or “telnet 192.168.10.101 23” into a Command Prompt if using Windows, or into a Terminal if using Linux or Mac OS X.

10.3.4 Web

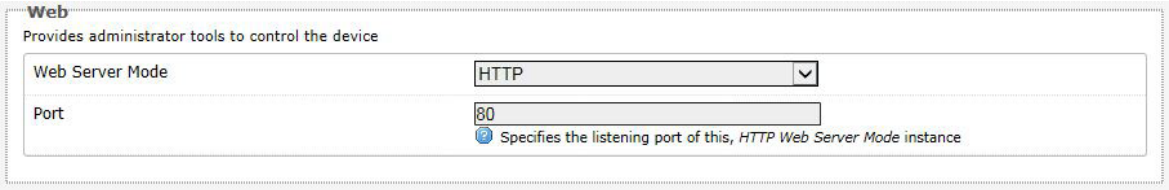


Figure 26: The device's web server mode and port.

Web Server Mode	This can be set to Hypertext Transfer Protocol (HTTP) or Hypertext Transfer Protocol Secure (HTTPS). For HTTPS, if you see the warning, “The certificate is not trusted because it is self-signed. The certificate is only valid for OpenWRT,” click “Add Exception”, “Confirm Security Exception” and proceed.
Port	Specifies the listening port, the default being 80 for HTTP and 443 for HTTPS.

10.4 Services

In the System» Services page, you can configure the Ping Watchdog and the Auto Reboot.

10.4.1 Ping Watchdog

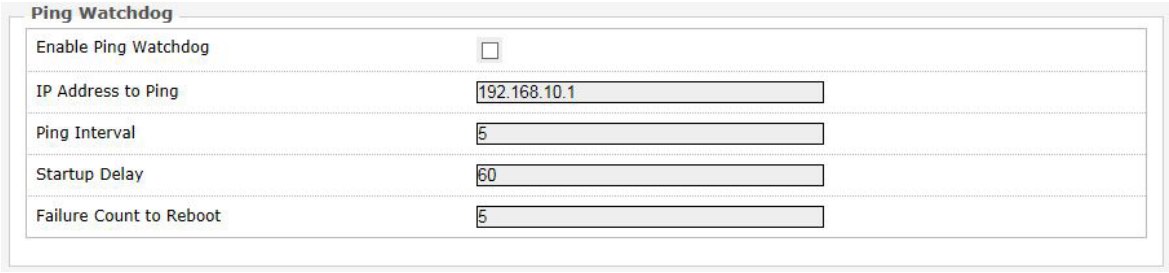


Figure 27: Ping Watchdog settings in the System » Services page.

Ping Watchdog	Configures the device to ping to a remote IP address and reboot if the connection is lost. It is disabled by default.
IP Address to Ping	Sets the remote IP address to ping e.g. 192.168.10.10 or 8.8.8.8.
Ping Interval	Specifies the time between successive pings, the default being 5 seconds.
Startup Delay	Sets the time delay after the device finishes rebooting, before running the Ping Watchdog, the default being 60 seconds.
Failure Count to Reboot	Specifies the number of failed pings before the device reboots automatically.

10.4.2 Auto Reboot

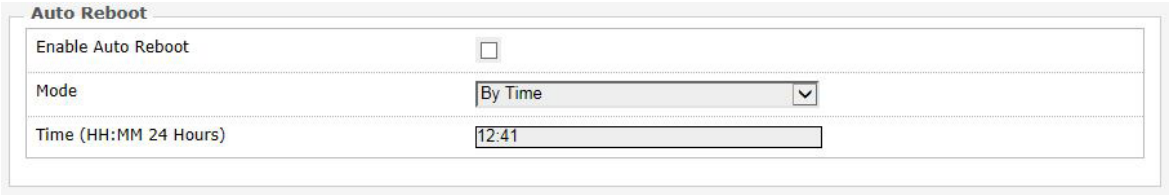


Figure 28: Auto Reboot settings in the System » Services page.

Auto Reboot	Allows the device to reboot itself automatically, disabled by default.
Mode	Chooses the Auto Reboot mode by Time or by Number of Hours.
Time	Sets the time of day to reboot if the Mode is by Time.
Number of Hours	Sets the delay as an integer number of hours after each reboot, if the Mode is by Number of Hours.

10.5 SNMP

The Simple Network Management Protocol (SNMP) is an Internet-standard protocol for managing devices on IP networks. It consists of a set of standards for network management, including an application layer protocol, a database schema, and a set of data objects. SNMP exposes management data in the form of variables on the managed systems, which describe the system configuration. These variables can then be queried (and sometimes set) by managing applications.

In the System » SNMP Page, you can configure SNMP V2c and SNMP V3.

10.5.1 SNMP Information

In the SNMP Information section, the text fields for the SNMP Enterprise ID, Contact, and Location information are shown.

10.5.2 SNMP Configuration

General Settings

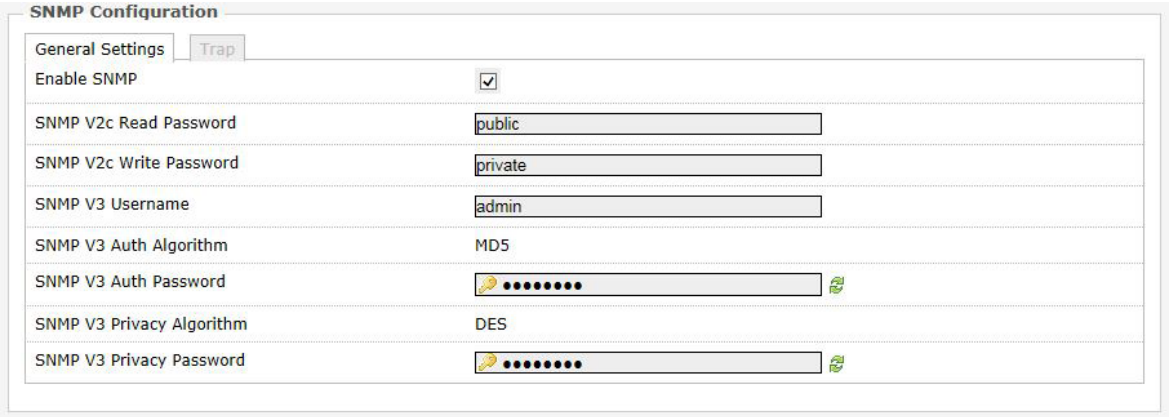


Figure 29: General settings for SNMP.

Enable SNMP	Enables SNMP.
SNMP V2c Read Password	Sets the community string for read-only access (to the variables on the SNMP agent) by the network management station (NMS). The NMS is the software which runs on the SNMP manager. (default: public)
SNMP V2c Write Password	Sets the community string for read-write access by the SNMP manager. (default: private) A community string identifies a group of SNMP agents. It is sent in clear text. It should be changed from the default string “public” or “private”. The variables on the SNMP agent can be classified into read-only or read-write variables.
SNMP V3 Username	Sets the username for authentication. (default: admin)
SNMP V3 Auth Algorithm	Shows the authentication algorithm used e.g. MD5.
SNMP V3 Auth Password	Configures the password for user authentication. (default: password)
SNMP V3 Privacy Algorithm	Shows the data encryption algorithm used e.g. DES.
SNMP V3 Privacy Password	Sets the password for data encryption. (default: password)

Trap

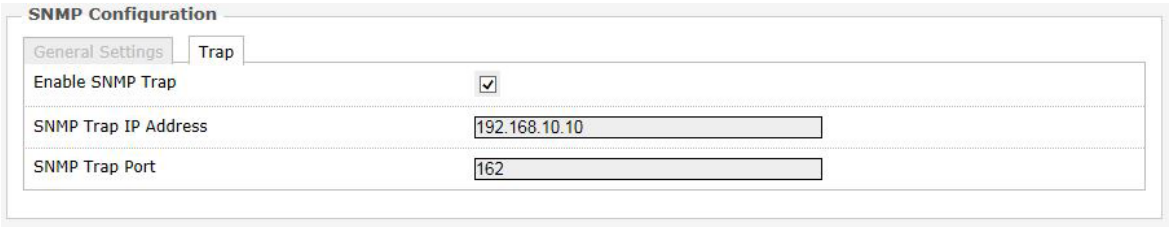


Figure 30: SNMP trap configuration.

Enable SNMP Trap	Allows the SNMP agent to notify the SNMP manager of events.
SNMP Trap IP Address	Sets the IP address of the SNMP manager which receives the trap messages.
SNMP Trap Port	Sets the port number.

10.6 Reset Button

The reset button is a physical hardware button on the AP hardware board. Depending on how long the button is pressed, you can reboot the board or reset it to factory default. First make sure that the power is on and wait a minute for the board to finish starting up. The following table shows the duration of the button press and the corresponding action.

Button Press Duration	Effect
0 - 3 seconds	Reboot
4 - 30 seconds	Reset to factory default

10.7 Indicating LEDs

10.7.1 LED Configuration for Signal

Strength Indicator LEDs #1 to #4

The System » LED Configuration page customizes how the LEDs indicate the received signal strength.

Signal strength indicator interface	Chooses the Wireless interface, which is the wireless network name.
Signal strength indicator LEDs	Sets the received signal strength thresholds (in dBm) above which RSSI LEDs #1 to #4 would light up.

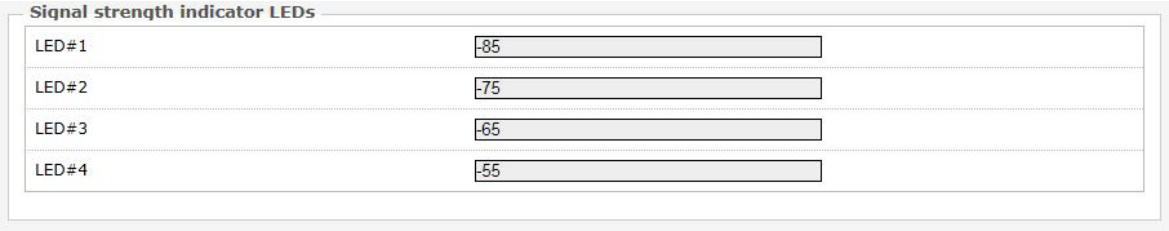
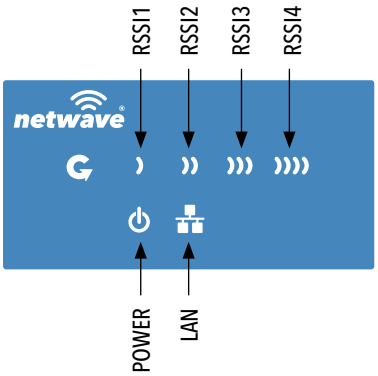


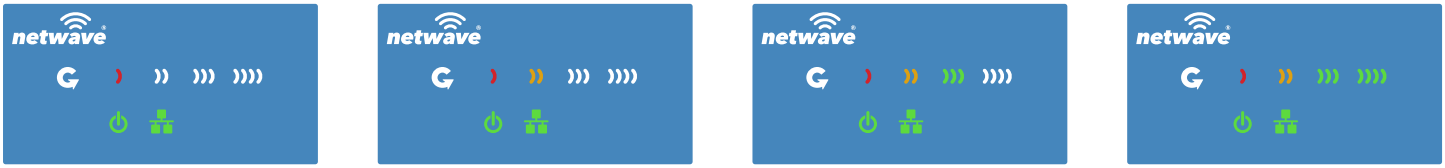
Figure 31: Signal strength indicator LEDs and their default threshold values in dBm.

10.7.2 Summary of the LED Indicators



LED	VISUAL CUE	INDICATION
POWER	SOLID GREEN	Power is supplied to the unit
	OFF	No power is supplied to the unit
LAN	SOLID GREEN	LAN Connected
	OFF	No Connectivity
RSSI1	SOLID RED	Weak Connection
RSSI2	SOLID ORANGE	Moderate Connection
RSSI3	SOLID GREEN	Solid Connection
RSSI4	SOLID GREEN	Excellent Connection (Advisable to check Status Page to confirm RSSI is > -55)

SIGNAL STRENGTH:



WEAK SIGNAL

EXCELLENT SIGNAL

10.8 Backup/Flash Firmware

The System » Backup/Flash Firmware page lets you perform backup and restore, or flash a new firmware.

10.8.1 Backup/Restore

Download backup	Generate archive: Downloads a tar archive of the current configuration files. ***Note: The backup archive file should be stored in a safe place because it contains the wireless password in clear text.***
Reset to defaults	Perform reset: Resets the firmware to its initial state.
Restore backup	Upload archive: Lets you upload a previously generated backup archive to restore configuration files.

10.8.2 Flash new firmware

You can upload a new firmware to replace the currently running firmware.

Keep settings	Retains the current configuration.
Firmware	Shows the current version of the firmware and allows you to upload a new firmware.

10.9 Reboot

Perform reboot	Reboots the operating system of your device. This is similar to the power-off and power-on cycle. The system configuration remains the same. Any changes that are not applied are lost.

11.0 Network Tab

You can view and configure the interfaces of the local area network (LAN) zone as well as the wide area network (WAN) zone. Network address translation (NAT) occurs between these two network zones. The router that performs the NAT is called a gateway. A gateway is a network point that acts as an entrance to another network.

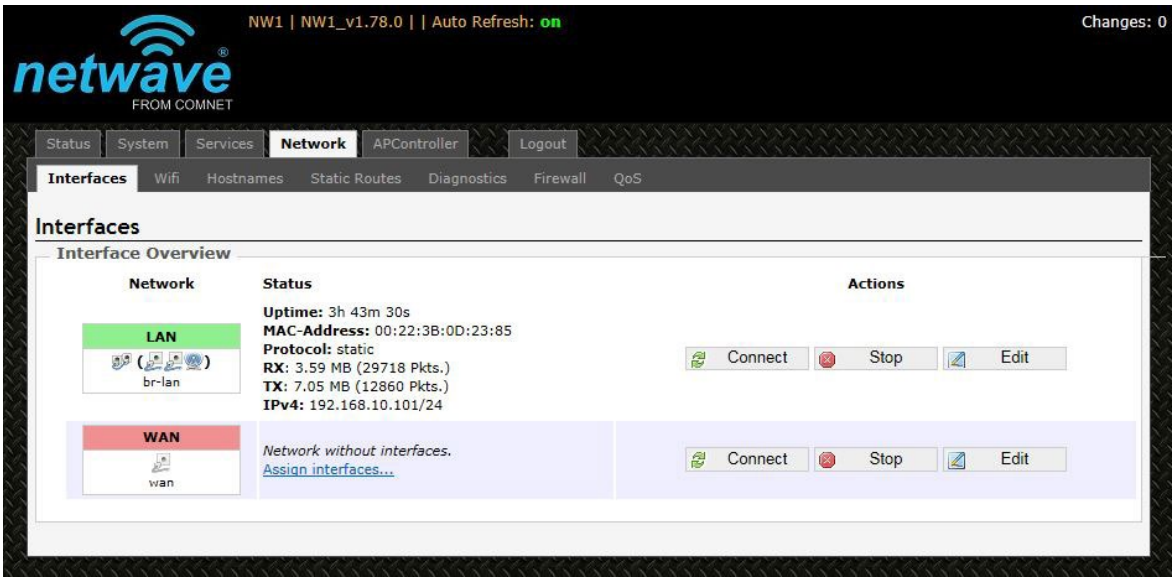


Figure 32: The Network top-level tab.

Figure 33: The Interface Overview on the Network » Interfaces page.

The Network column shows that the WAN zone has the physical port “eth1” as its interface.

In Figure 33, the LAN zone (icon with two Ethernet ports) has the bridged interface “br-lan” which consists of one physical port (icon with one Ethernet port) and two wireless networks (each icon looking like a short standing fan) on the device. Hovering the mouse over each icon would give the name of the interface it represents.

11.1 Interfaces – WAN

The Network » Interfaces » WAN page configures the interface for the WAN zone.

11.1.1 Common Configuration

General Setup

Status	Shows a summary of the interface for the WAN zone. This includes uptime, MAC address, bytes and packets received by the device, bytes and packets transmitted by the device, and its IPv4 address.

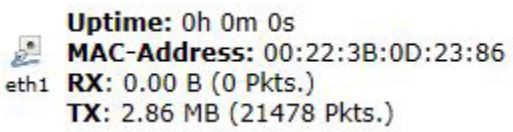


Figure 34: Status of the "eth1" interface of the WAN zone.

Protocol	Chooses between DHCP client (default), where the device obtains it IP address automatically, or Static address, where you can specify the device IP address. Other protocols are PPTP, PPPoE, and L2TP.

Protocol – Static address

IPv4 address	Sets the IP address of the device as seen from the WAN zone.
IPv4 netmask	Sets the subnet mask e.g. 255.255.255.0. The IP address and netmask together determine the subnet or network ID e.g. 192.168.10.0/24. Two devices must be in the same subnet in order to establish a (Layer 2) link between them.
IPv4 gateway	Specifies the IP address of the remote router that allows the device's shell to gain internet access.
IPv4 broadcast	Specifies the IPv4 broadcast address, optional.
Use custom DNS servers	Configures the IP address of the DNS servers e.g. 165.21.100.88 for the SingNet DNS server in Singapore or 8.8.8.8 for the Google DNS server in the USA. The computers in the same subnet as this device can then set this device's IP address as their preferred DNS server to obtain the same DNS service.

Protocol – DHCP client

The Dynamic Host Configuration Protocol (DHCP) is a standardized networking protocol used by servers on an IP network to allocate IP addresses automatically to client devices.

Hostname to send when requesting DHCP	Specifies the name of this device as seen by the remote DHCP server.

Protocol – PPTP

The Point-to-Point Tunneling Protocol (PPTP) is a method for implementing virtual private networks. PPTP uses a control channel over Transmission Control Protocol (TCP) and a Generic Routing Encapsulation (GRE) tunnel operating to encapsulate Point-to-Point Protocol (PPP) packets.

VPN Server	Specifies the IP address of the remote PPTP server for the virtual private network (VPN).
PAP/CHAP username	Sets the username for the Password Authentication Protocol (PAP) or the Challenge-Handshake Authentication Protocol (CHAP).
PAP/CHAP password	Sets the password for the PAP or CHAP.
Configure PPTP IP settings	Upon clicking the “Configure...” button, the PPTP Common Configuration page would be displayed. The protocol DHCP client or Static address can be selected. The corresponding options are explained within this section "Common Configuration"

Protocol – PPPoE

The Point-to-Point Protocol over Ethernet (PPPoE) is a network protocol for encapsulating PPP frames inside Ethernet frames. Most DSL providers use PPPoE, which provides authentication, encryption, and compression.

The options PAP/CHAP username and PAP/CHAP password have been explained earlier.

Access Concentrator	Identifies the PPPoE server. Leave empty to autodetect.
Service Name	Specifies the PPPoE service name. The server will accept clients which send an initialization message with the service name that matches the server's configuration. Leave empty to autodetect.

Protocol – L2TP

The Layer 2 Tunneling Protocol (L2TP) is a tunneling protocol used to support virtual private networks (VPNs) or as part of the delivery of services by ISPs. It does not provide any encryption or confidentiality by itself. Rather, it relies on an encryption protocol that it passes within the tunnel to provide privacy. The options PAP/CHAP username and PAP/CHAP password have been explained earlier.

L2TP Server	Specifies the IP address of the remote L2TP server.
Configure L2TP IP settings	Upon clicking the “Configure...” button, the L2TP Common Configuration page would be displayed. The protocol DHCP client or Static address can be selected. The corresponding options are explained within this section "Common Configuration"

Advanced Settings

The following are options in the Advanced Settings section tab. Some of these options are shown, depending on the protocol being used.

Override MAC address	Allows you to specify a different MAC address other than the router's original MAC address. This is useful if the ISP uses the MAC address of a router to identify a customer. Suppose that the router needs to be replaced. The new router can take on the MAC address of the previous router in order to continue having internet access.
Override MTU	Sets the maximum transmission unit (MTU), the default being 1500 bytes. Unless, your ISP requires, it is not recommended to change this setting.
Use gateway metric	Allows you to specify a gateway metric. This acts as a cost for choosing the gateway when a connected device has to select between multiple available gateways. The gateway with the smallest metric is chosen.
Use broadcast flag	When sending DHCP requests, a client can indicate if it wants an answer in unicast or broadcast, by setting the broadcast flag. This is required for certain ISPs. Unchecked by default.
Use default gateway	Configures a default route. Checked by default.
Use DNS servers advertised by peer	Uses the DNS settings advertised by the DHCP server. Checked by default.
Client ID to send when requesting DHCP	Sets the identifier that may be required by the ISP or network administrator. If not stated, the MAC address of the client will be sent.
Vendor Class to send when requesting DHCP	Identifies the vendor of a DHCP client for the enhancement of vendor-specific DHCP functionality. The following three options are specific to the PPTP and PPPoE protocols: Physical Settings Interface – Chooses which physical interface to use for the WAN zone. This can be the Ethernet Adapter “eth0” or “eth1” that corresponds to each of the two ports on the device for example. It could also be set as the Wireless Network. If there is a physical interface selected for the WAN zone, this can be referred to as the “NAT mode”, because network address translation occurs between the WAN zone and the LAN zone. If No Interface is selected for the WAN zone, all interfaces would be within the LAN zone. This may also be referred to as the “Bridge Mode”.

11.2 Interfaces – LAN

11.2.1 Common Configuration

General Setup

Status	Shows a summary of the current LAN port status, which includes uptime, MAC address, received bytes and packets, transmitted bytes and packets, and IPv4 address.
Protocol	Chooses between Static address, where you can specify the device IP address, or DHCP client, where the device obtains it IP address automatically. Static address is necessary if other devices obtain internet connection through this device. Static address is also recommended if you wish to configure the device via the LuCI web interface. ***Note: After modifying the Protocol option, please click the "Switch protocol" button. If using the Static address protocol, please fill in the IPv4 address, IPv4 netmask, IPv4 gateway, and a custom DNS server. Finally, please click the "Save & Apply" button.***

Protocol – Static address

IPv4 address	Sets the IP address of the device e.g. 192.168.10.1, where you can access the Radios configuration web page.
IPv4 netmask	Sets the subnet mask e.g. 255.255.255.0. The IP address and netmask together determine the subnet or network ID e.g. 192.168.10.0/24. Two devices must be in the same subnet in order to establish a (Layer 2) link between them.
IPv4 gateway	Specifies the IP address of the network Gateway.
IPv4 broadcast	Specifies the IPv4 broadcast address, optional.
Use custom DNS servers	Configures the IP address of the DNS servers e.g. 8.8.8.8 for the Google DNS server in the USA. The computers in the same subnet as this device can then set this device's IP address as their preferred DNS server to obtain the same DNS service.

Protocol – DHCP client

The Dynamic Host Configuration Protocol (DHCP) is a standardized networking protocol used by servers on an IP network to allocate IP addresses automatically to client devices.

Hostname to send when requesting DHCP	Specifies the name of this device as seen by the remote DHCP server.

Advanced Settings

The following are options in the Advanced Settings section tab. Some of these options are shown, depending on the protocol being used.

Override MAC address	Allows you to specify a different MAC address other than the Radio's original MAC address. This is useful if the ISP uses the MAC address of a router to identify a customer. Suppose that the router needs to be replaced. The new router can take on the MAC address of the previous router in order to continue having internet access.
Override MTU	Sets the maximum transmission unit (MTU), the default being 1500 bytes. Unless, your ISP requires, it is not recommended to change this setting.
Use gateway metric	Allows you to specify a gateway metric. This acts as a cost for choosing the gateway when a connected device has to select between multiple available gateways. The gateway with the smallest metric is chosen.
Use broadcast flag	When sending DHCP requests, a client can indicate if it wants an answer in unicast or broadcast, by setting the broadcast flag. This is required for certain ISPs. Unchecked by default.
Use default gateway	Configures a default route. Checked by default.
Use DNS servers advertised by peer	Uses the DNS settings advertised by the DHCP server. Checked by default.
Client ID to send when requesting DHCP	Sets the identifier that may be required by the ISP or network administrator. If not stated, the MAC address of the client will be sent.
Vendor Class to send when requesting DHCP	Identifies the vendor of a DHCP client for the enhancement of vendor-specific DHCP functionality.

Physical Settings

Enable STP	Enables the Spanning Tree Protocol on this bridge. It is unchecked by default.

11.2.2 DHCP Server

This section allows you to configure the device as a DHCP server.

General Setup

Ignore interface	Disables DHCP for this interface. You should uncheck this to enable DHCP. ***Note: All the following options in this DHCP Server section depend on DHCP being enabled.***
Start	Specifies the lowest leased address as offset from the network address, the default being 100.
Limit	Sets the maximum number of leased addresses, the default being 150.
Lease Time	States the expiry time of leased addresses, the default being 12h.

Advanced Settings

Dynamic DHCP	Dynamically allocates DHCP addresses for clients. If disabled, only clients having static leases will be served. Checked by default.
Force	Forces DHCP on this network even if another server is detected, unchecked by default.
IPv4-Netmask	Overrides the netmask sent to clients. Normally it is calculated from the subnet that is served.
DHCP-Options	Defines additional DHCP options, for example "6,192.168.10.1,192.168.10.2" which advertises different DNS servers to clients. Normally, connected devices would take this board's IP address as the default gateway. To set an alternative default gateway, add the DHCP option "3,192.168.10.3" for example.

11.2.3 Static Leases

In this section, you can specify that a particular DHCP client obtain an IP address that you define. The MAC address of the client is required. Click the Add button to add a static DHCP lease, then click Save & Apply to apply the changes.

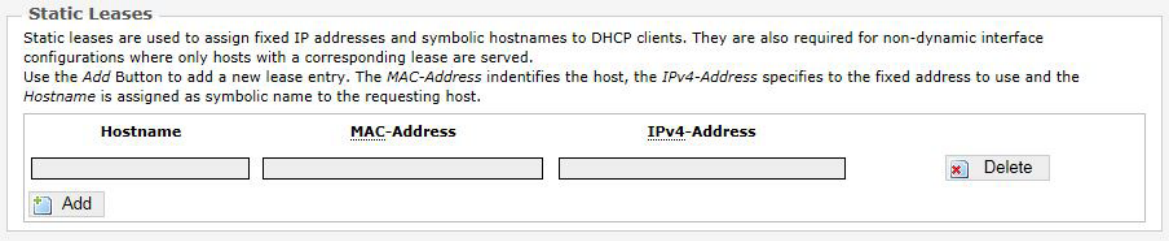


Figure 35: Adding a static DHCP lease.

11.3 WiFi – Overview

Clicking on the Network » WiFi tab would bring you to the Wireless Overview page. This page shows the radios present on the device. .

The wireless local area networks (WLANs) are displayed under each radio.

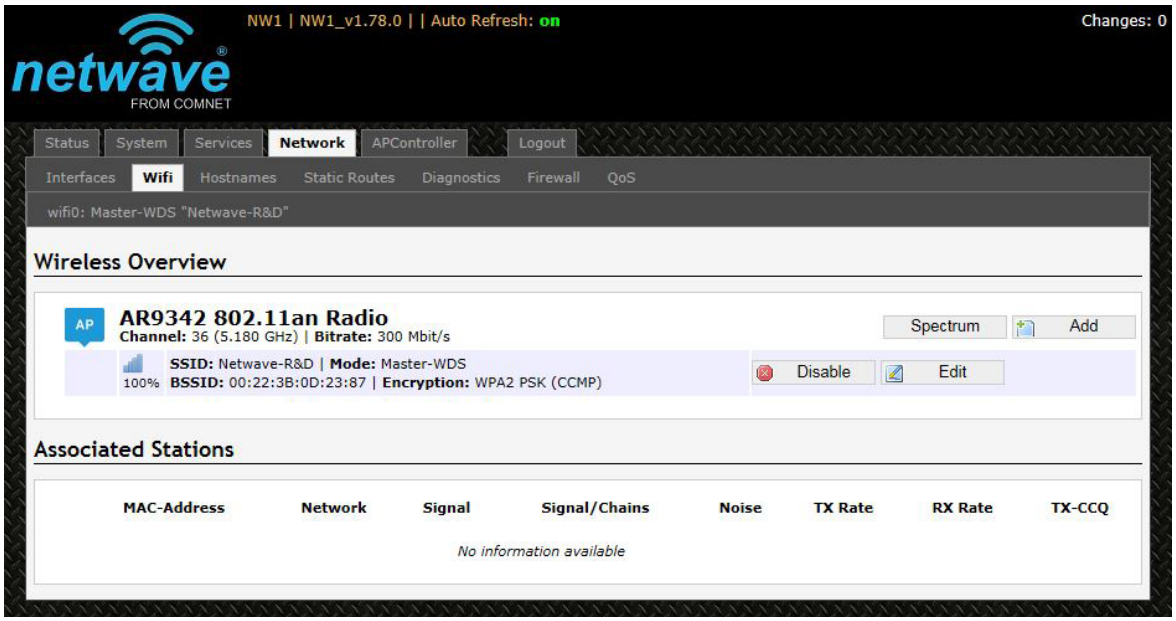


Figure 36: The Wireless Overview page showing one radio.

Spectrum	Shows the Channel Scan Report and allows you to run the Interference Analyzer.
Add	Allows you to add virtual access points (VAPs) to the radio. By default, there is only one VAP on the radio. Each VAP corresponds to one network.
Enable	Enables the radio.
Disable	Disables the radio.
Edit	Brings you to the configuration page of the network. Clicking this button is equivalent to clicking the corresponding tab above.

11.3.1 Radio in AP Mode

Associated Stations will show a list of devices connected to the AP.

Figure 37: The Associated Stations are also shown on the Wireless Overview page.

The MAC address, network name, received signal strength, noise power, transmit rate, receive rate, and transmission quality for each station are displayed.

11.3.2 Spectrum: Interference Analyzer

For a radio in AP mode, clicking the Spectrum button would bring up the Channel Scan Report.

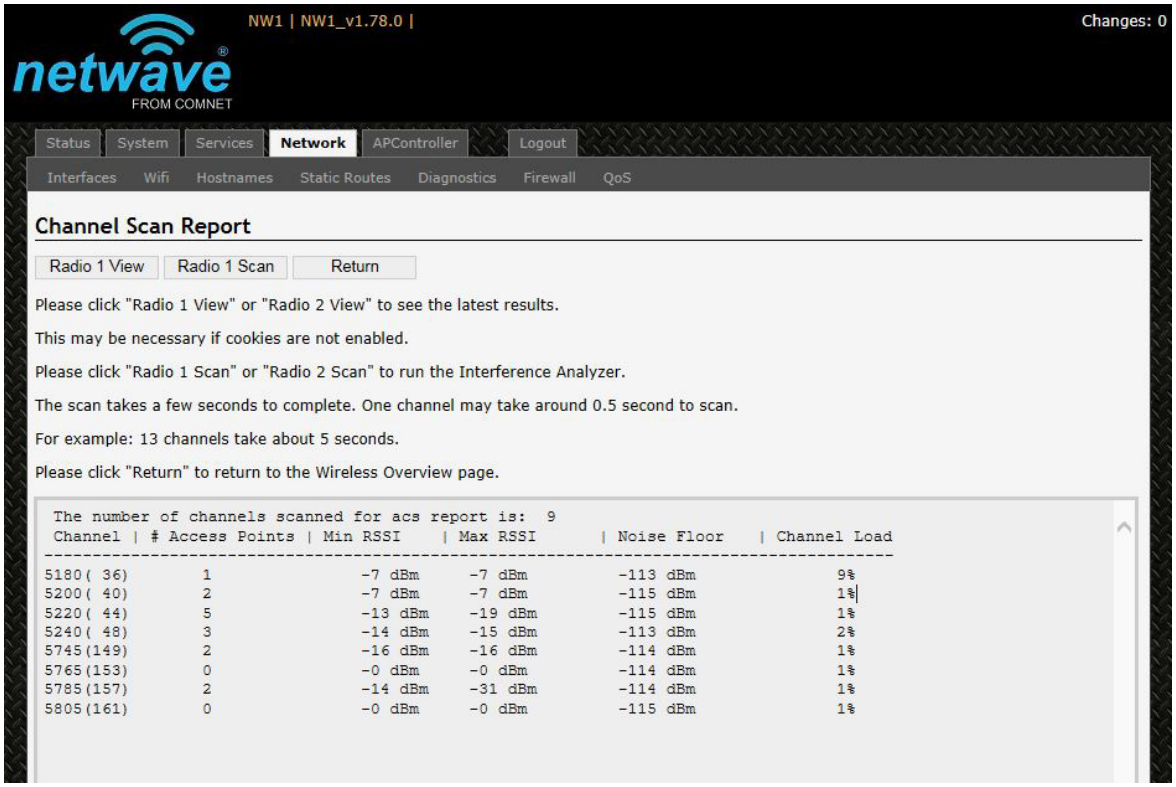


Figure 38: The Channel Scan Report.

The button 'Radio 1 View' shows the number of neighboring access points for each channel, the Min RSSI, Max RSSI, Noise Floor, and Channel Load.

Min RSSI	Shows the minimum received signal strength indicator due to the neighboring access points.
Max RSSI	Shows the maximum received signal strength indicator due to the neighboring access points.
Noise Floor	Shows the level of the noise on the channel.
Channel Load	Shows how much the channel is utilized. A lower channel load denotes a channel with less interference. You can click 'Radio 1 Scan' to do the full channel scan again and get the latest results. The buttons for Radio 2 would be shown if Radio 2 is enabled on the device.
Return	Brings you back to the Wireless Overview page.

11.3.3 Radio in Client Mode

A radio can operate as a client. This can be set in the Interface Configuration » General Setup » Mode option, after clicking on the Edit button.

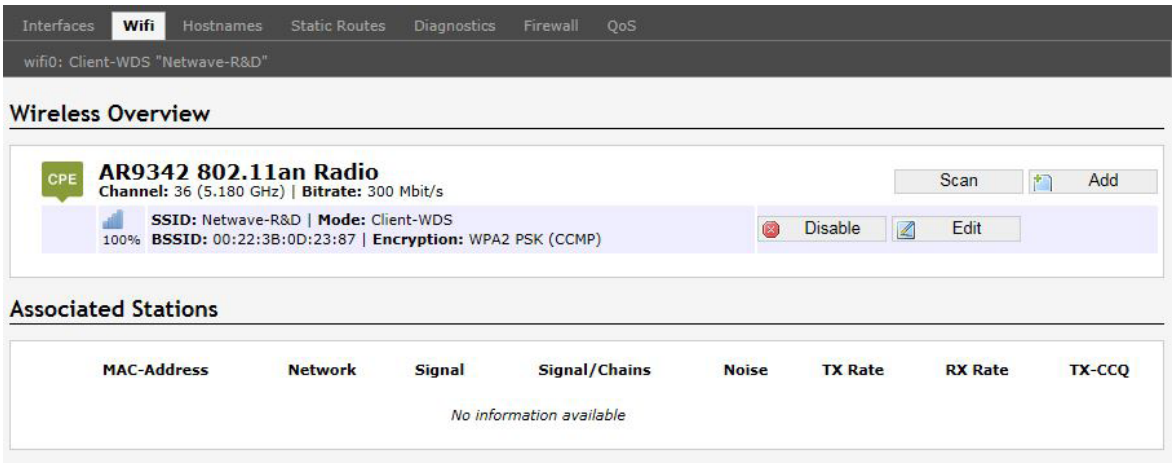


Figure 39: The Wireless Overview page showing a radio as a Client (station).

The following buttons are for a radio operating as a client.

Scan	Scans for available wireless networks. This button is available if the device is operating as a client. You can then select the network to connect to.
Join Network	Associates this device with the selected wireless network.

11.4 WiFi – Wireless Network

As mentioned earlier, clicking on the Edit button for a network would bring you to the configuration page. This page contains the sections Device Configuration and Interface Configuration.

The Device Configuration section covers the physical settings of the radio hardware such as channel, transmit power, or antenna selection. These are shared among all defined wireless networks of the radio. Per network settings like encryption or operation mode are grouped in the Interface Configuration.

11.4.1 Device Configuration

The Device Configuration section consists of the section tabs for General Setup and Advanced Settings.

General Setup

Status	Shows a summary of the wireless network.

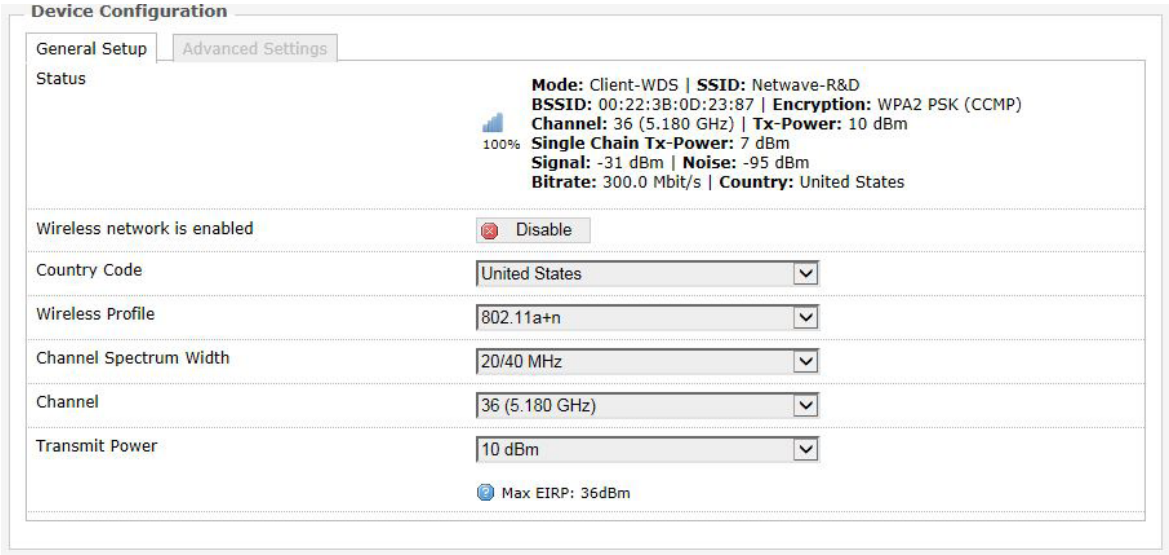


Figure 40: The WiFi Device Configuration section.

Enable	Enables the wireless network.
Disable	Disables the wireless network.
Country Code	Selects the country. Each country has its own transmit power and frequency regulations. To ensure regulatory compliance, you must select the country where the device is operating in. The transmit power levels for each channel are tuned accordingly.
Wireless Profile	The default choice of 802.11a+n is a combination of 802.11a and 802.11n, and operates in the 5 GHz frequency band.
Channel Spectrum Width	Selects whether 20 MHz or 20/40 MHz bands are used. A 40 MHz band has twice the throughput of a 20 MHz band. A smaller bandwidth may allow more devices to be connected. The 20/40 MHz option allows both 20 and 40 MHz bands to be used.
Channel	Chooses the frequency channel. The default setting of Auto is may be used. For an AP, it would select the channel with the least interference from other APs. For a client, it would automatically select the same channel as its AP. The frequency channel may also be manually selected. An AP and its station must have the same channel in order to communicate.
Transmit Power (dBm)	Limits the maximum transmit power of the card at that particular frequency, e.g. 4 dBm, 5 dBm, …, 22 dBm or "Max". This is the power supplied to the antennas of the radio. The minimum transmit power values for the radios are: • For 2-Chain: 4 dBm The "Max" power depends on both the country and the frequency channel used.

Understanding the Maximum Transmit Power Calculation

The maximum transmit power calculation is illustrated with the following examples.

Example

» Country Code: CZ, Channel = 100

» Antenna Gain is 5dBi

» Transmit Power is 15dBm

In the Czech Republic, Channel = 100 would mean the maximum power is 30dBm for EIRP. Transmit Power is 15dBm, when adding Antenna Gain of 5dBi, it would be 20dBi, which would NOT EXCEED the EIRP. Thus the “Max” transmit power of the card is 15dBm, as Antenna Gain has no effect.

Advanced Settings

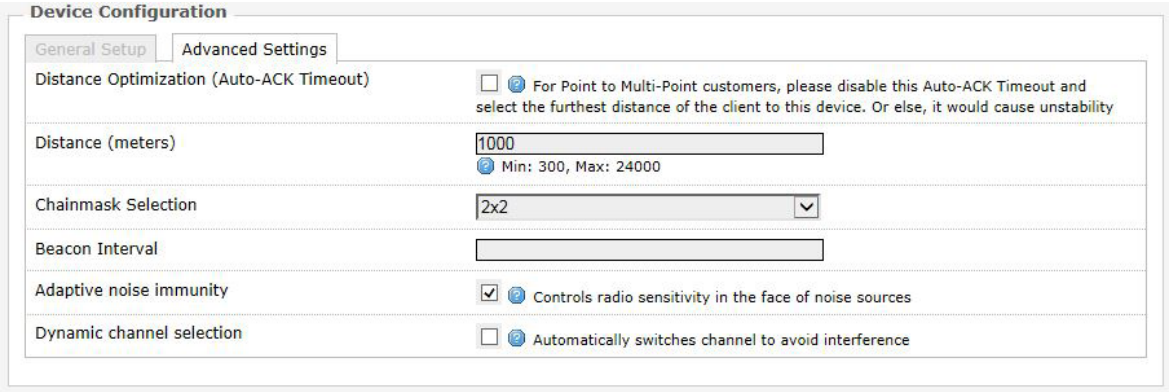


Figure 41: Advanced Settings for the Wifi Device Configuration.

Distance Optimization (Auto-ACK Timeout)	Determines the distance of the connected station from the AP and automatically adjusts the ACK timeout. This is disabled by default. If the stations are positioned over a wide area at different distances from the AP, it is recommended to disable this option to prevent the ACK timeout from fluctuating widely.
Distance (meters)	Specifies the distance between the AP and the station, if the previous option is unchecked. Min: 300, Max: 12000 (80MHz), 24000 (40MHz), 48000 (20MHz). This value may be set to slightly more than the physical distance between the AP and the farthest station.
Chainmask Selection	Sets the antenna port selection on the radio. For example, 2x2 means that 2 antennas are being used. Note: The following options are for the device operating as an access point (AP).
Beacon Interval	Specifies the interval between beacon transmissions by the AP, in ms. A beacon is a frame broadcast by the AP to synchronize the wireless network. For the multiple VAP case, the beacons are transmitted evenly within this interval. Thus, if four VAPs are created and the beacon interval is 200 ms, a beacon will be transmitted from the radio portion every 50 ms, from each VAP in a round-robin fashion. The default value of the interval is 100 ms.
Adaptive noise immunity	Controls radio sensitivity in the face of noise sources. Adaptive noise immunity allows the AP to reject spurs and non-WLAN noise. An advantage is that the AP would have to spend less time decoding the signal, resulting in lower packet loss rate.
Dynamic channel selection	Automatically switches channel to avoid interference. Dynamic channel selection is a feature to detect and avoid continuous wave (CW) interference. CW interference or spurs cause the noise floor to be high. This stops transmissions as well as causes receives to fail frequently. The noise floor is monitored by the calibration logic. When the noise floor is above a threshold, the AP performs an automatic channel selection. It would disconnect from the clients (it would already have due to the interference) and move to a new channel. The clients are then expected to re-associate with the AP on their own.

11.4.2 Interface Configuration

The Interface Configuration section contains the section tabs for General Setup, Wireless Security, MAC-Filter, and Advanced Settings.

General Setup

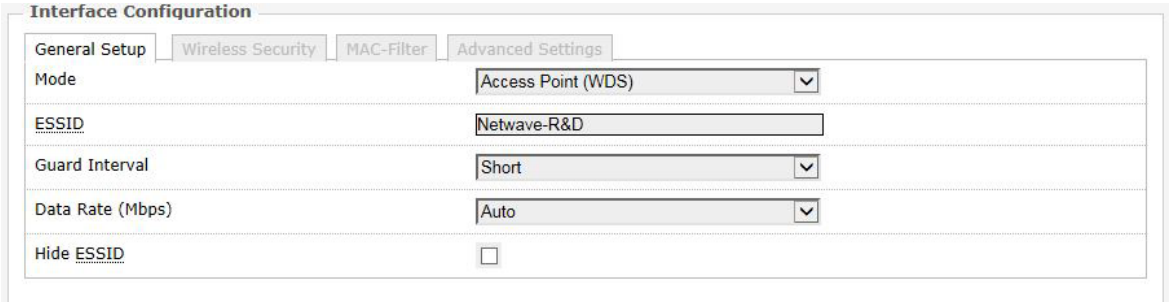


Figure 42: The Wifi Interface Configuration section.

Mode	Selects whether the device is operating as an Access Point WDS or Client WDS.
ESSID	Specifies the name or extended service set identifier (ESSID) of the wireless network as it is provided in the beacon message. The network name can be up to 32 characters in length and can contain spaces. When running in AP mode, it is the name of the network as advertised in the beacon message. In Client mode, it is the network name that the client associates with.
BSSID	Sets the MAC address of the AP. This option is available for a device operating as a client. This is useful because there can be multiple APs with the same ESSID. Setting the MAC address would prevent the client from roaming to other APs.
Guard Interval	Chooses between Short and Long guard intervals. Guard intervals are used to ensure that distinct transmissions do not interfere with one another. Data rate is improved in downlink and uplink if both AP and client use the Short Guard Interval.
Data Rate (Mbps)	Selects the data rate or the modulation and coding scheme (MCS). The default setting of Auto is recommended. The MCS and data rates are adjusted automatically depending on the wireless channel conditions.
Hide ESSID	Hides the network name (ESSID) from being broadcast publicly. (This option is for a device operating as an AP.) Note: If the goal is securing your network, use WPA or preferably WPA2 encryption. Hiding the ESSID does not provide complete security.

WDS

A Wireless Distribution System (WDS) is a system enabling the wireless interconnection of access points in an IEEE 802.11 network. It allows a wireless network to be expanded using multiple access points without the traditional requirement for a wired backbone to link them. The notable advantage of WDS over other solutions is it preserves the MAC addresses of client frames across links between access points.

WDS may also be considered a repeater mode because it appears to bridge and accept wireless clients at the same time (unlike traditional bridging).

However, with this method, throughput is halved for all clients connected wirelessly.

Wireless Security

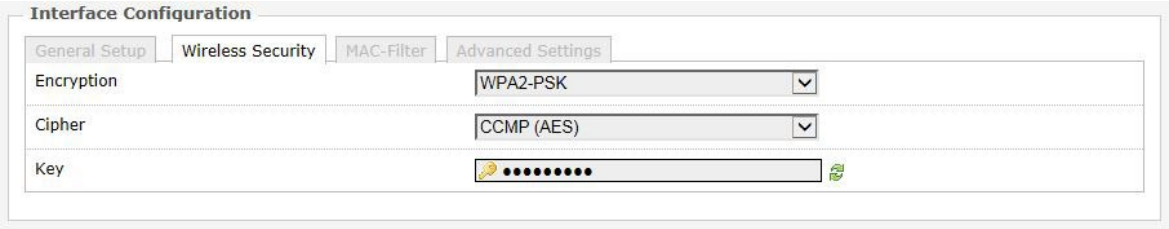


Figure 43: Setting the Wireless Security for the Wifi Interface.

Encryption	Chooses between No Encryption (open) and the following encryptions: WPA-PSK, WPA2-PSK, WPAPSK/ WPA2-PSK Mixed Mode, WPA-EAP, and WPA2-EAP.

WPA or WPA2 with PSK

Wifi protected access (WPA) is a stronger encryption than WEP.

Furthermore, WPA2 was developed to strengthen the security of WPA and is stronger than WPA and WEP.

For WPA-PSK, WPA2-PSK, WPA-PSK/WPA2-PSK Mixed Mode encryptions, we have the following options.

Cipher	Can be set to Auto, CCMP (AES), or TKIP and CCMP (AES). The Temporal Key Integrity Protocol (TKIP) was developed as a temporary replacement for WEP. The Counter Mode Cipher Block Chaining Message Authentication Code Protocol (CCMP) is based on the Advanced Encryption Standard (AES) and is the most secure protocol.
Key	The pre-shared key (PSK) is the password for the wireless network. This may consist of 8 to 63 ASCII characters.

WPA or WPA2 with EAP

The Extensible Authentication Protocol (EAP) is encapsulated by the IEEE 802.1X authentication method. IEEE 802.1X is equivalent to EAP over LAN or WLAN. Enterprise networks commonly use this authentication method.

WPA or WPA2 with EAP (AP Mode)

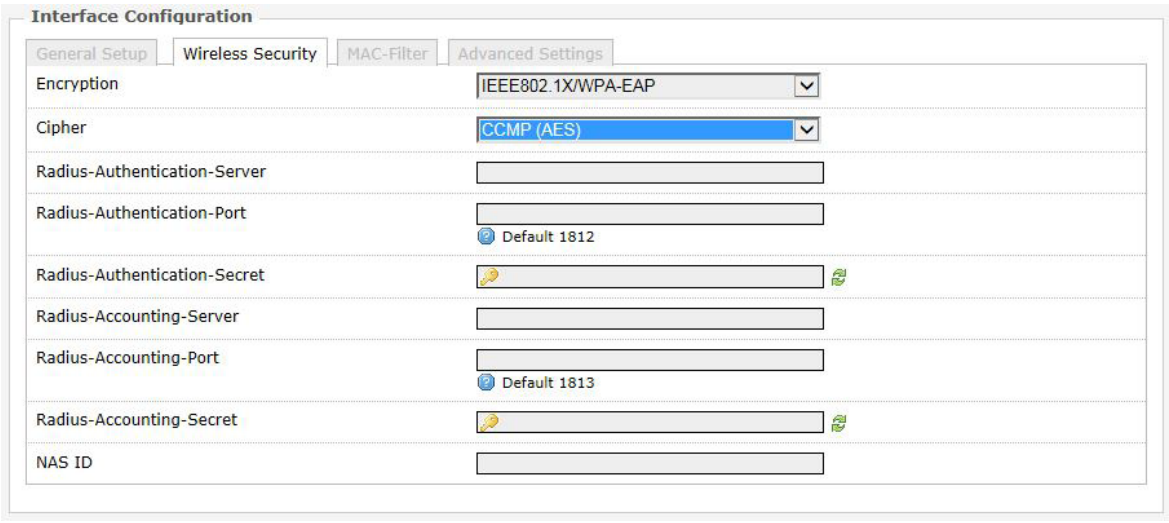


Figure 44: Encryption options for WPA-EAP or WPA2-EAP in AP mode.

Cipher	Can be set to Auto, CCMP (AES), or TKIP and CCMP (AES).
Radius-Authentication-Server	Specifies the IP address of the RADIUS authentication server. Note: Remote Authentication Dial In User Service (RADIUS) is a networking protocol that provides centralized Authentication, Authorization, and Accounting (AAA) management for users that connect and use a network service.
Radius-Authentication-Port	Sets the port number for the RADIUS authentication server. Normally, the port number is 1812.
Radius-Authentication-Secret	Configures the password for the authentication transaction.
Radius-Accounting-Server	Specifies the IP address of the RADIUS accounting server.
Radius-Accounting-Port	Sets the port number for the RADIUS accounting server. Normally, the port number is 1813.
Radius-Accounting-Secret	Configures the password for the accounting transaction.
NAS ID	Specifies the identity of the network access server (NAS).

WPA or WPA2 with EAP (Client Mode)

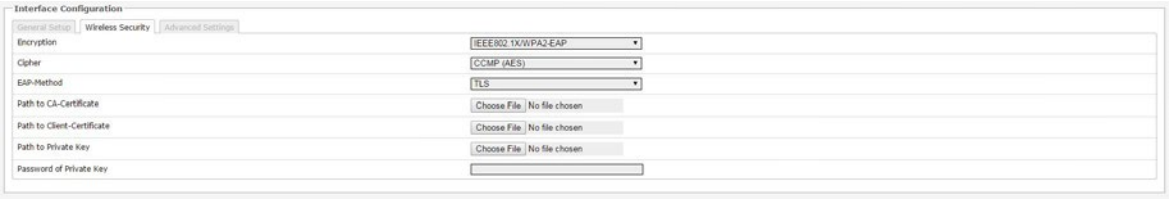


Figure 45: Encryption options for WPA-EAP or WPA2-EAP in Client mode.

Cipher	Only Cipher option is CCMP (AES)
EAP-Method	The authentication protocol can be set to Transport Layer Security (TLS), Tunneled TLS (TTLS), or Protected EAP (PEAP).
Path to CA-Certificate	Selects the file for the CA certificate. Note: The certificate authority (CA) is a trusted third party that issues digital certificates. In a public key infrastructure scheme, a digital certificate certifies the ownership of a public key by the named subject of the certificate.
Path to Client-Certificate	Selects the file for the client certificate.

Options for TLS as the EAP method

Path to Private Key	Selects the file for the private key.
Password of Private Key	Configures the password for the private key.

Options for TTLS or PEAP as the EAP method

Authentication	Selects the authentication method used by the AP, e.g. PAP, CHAP, MSCHAP, or MSCHAPV2.
Identity	Sets the identity used by the supplicant for EAP authentication.
Password	Sets the password used by the supplicant for EAP authentication.

MAC-Filter

This section tab is only available for a device operating as an AP.

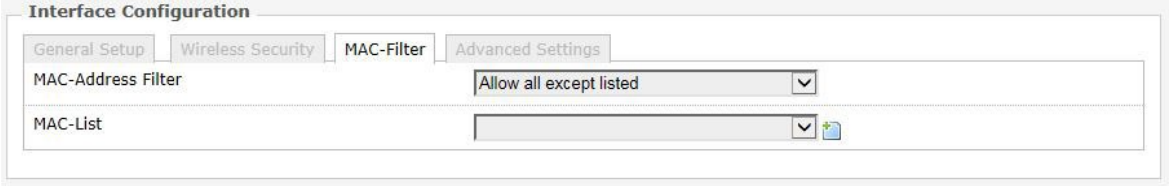


Figure 46: Configuring the MAC-Filter for a Wifi AP.

MAC-Address Filter	Lets you allow only devices with the listed MAC address to associate with this AP, or lets you block devices with the listed MAC address.
MAC-List	Adds the MAC address of the remote device to either block or allow.

Advanced Settings

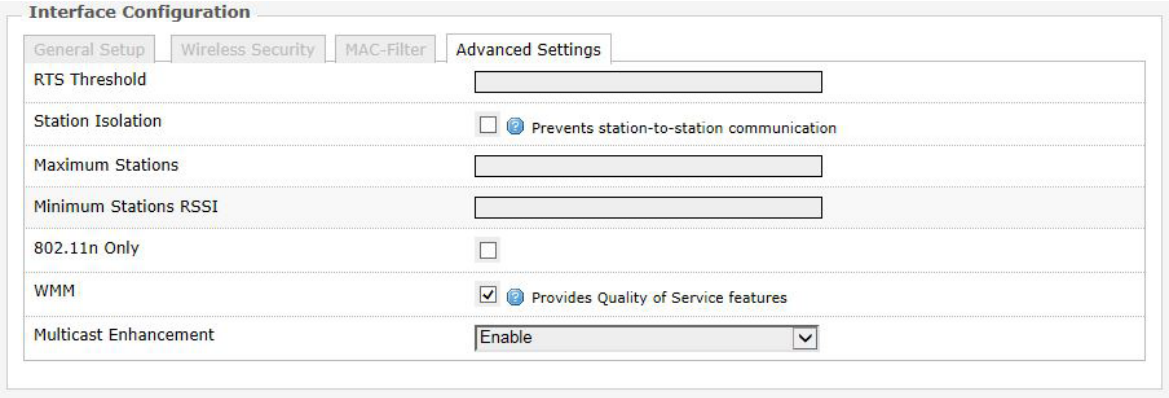


Figure 47: Advanced Settings for the Wifi Interface.

RTS Threshold	Sets the threshold for the packet size above which the request to send (RTS) mechanism is used. The default is 2346 octets. There is a trade-off to consider when setting this parameter. On the one hand, using a small value causes RTS packets to be sent more often, consuming more of the available bandwidth, and therefore reducing the throughput of the network packet. On the other hand, when more RTS packets are sent, the system recovers faster from interference or collisions. This is useful in a heavily loaded network, or a wireless network with high electromagnetic interference. Note: The following options for Station Isolation, Maximum Stations, Minimum Stations RSSI, and 802.11n only are available only for a device operating as an AP.
Station Isolation	Prevents station-to-station communication, unchecked by default. When Station Isolation is disabled, wireless clients can communicate with one another normally by sending traffic through the AP. When Station Isolation is enabled, the AP blocks communication between wireless clients on the same AP.
Maximum Stations	Specifies the maximum number of associated stations, the default being 127.
Minimum Stations RSSI	Sets the minimum received signal strength indicator for a station to be associated. The default value of 0 means that the AP would allow a station to associate independent of its RSSI.
802.11n Only	Forces the device to use only the IEEE802.11n standard, unchecked by default.
HT 20/40 Coexistence	Allows the network to use both 20 MHz and 40 MHz bands. Required on AP side primarily to support co-existence. The client can also send intolerant bit status to AP to signal use of 20 MHz channel. The client will follow the AP's channel bonding and channel switching HT 20/40 mechanism. Disabling this setting forces the use of 40 MHz bandwidth/channel bonding, and results in high data rate.
WMM	Provides Quality of Service (QoS) features, checked by default. Wireless multimedia enables the classification of the network traffic into 4 main types, voice, video, best effort, and background, in decreasing order of priority. Higher priority traffic has a higher transmission opportunity and would have to wait less time to transmit. As a result, an existing video stream would not be interrupted by additional background processes.

11.5 Hostnames

In the Network » Hostnames page, you can specify custom hostnames (URLs) with their respective IP addresses. This is an additional local DNS.

Note: The computers in the same subnet need to set the IP address of this device as their preferred DNS server in order to interpret these custom hostnames.

11.6 Static Routes

The Network » Static Routes page shows the static IPv4 routes.

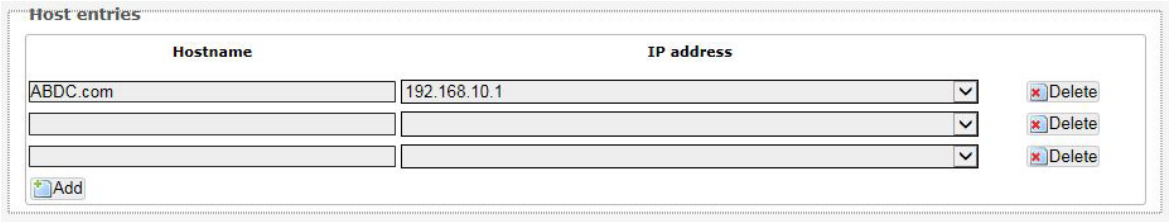


Figure 48: Static IPv4 Routes.

Each row shows the interface and gateway over which a certain host or network can be reached.

11.7 Firewall

The Network » Firewall page contains the subpages for General Settings, Port Forwards, and Traffic Rules.

11.7.1 General Settings

The firewall creates zones over the network interfaces to control network traffic flow.

The Network » Firewall » General Settings page contains the zone settings.

Zone Settings

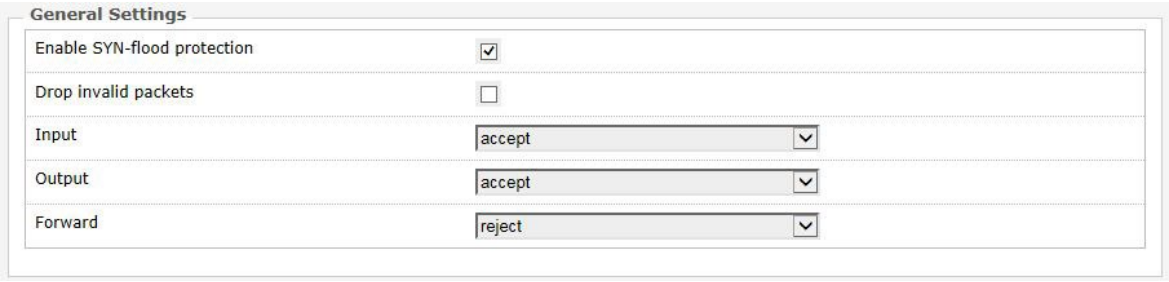


Figure 49: General Settings for the Firewall Zones.

Enable SYN-flood protection	Checked by default.
Drop invalid packets	Unchecked by default.
Input	To accept by default.
Output	To accept by default.
Forward	To reject by default.

Zones

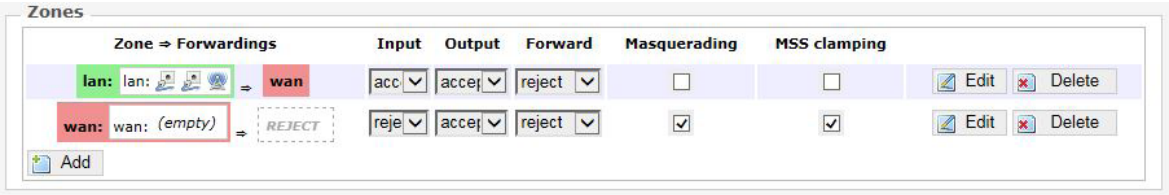


Figure 50: The Zones section showing the default settings for the firewall zones.

11.7.2 Port Forwards

Port forwarding allows remote computers on the Internet to connect to a specific computer or service within the private LAN.

The Network » Firewall » Port Forwards page lets you define the protocol and port number to access an internal IP address.

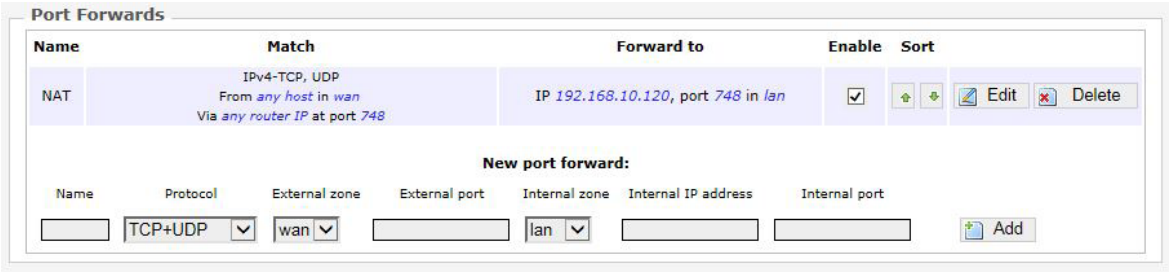


Figure 51: Adding a port forwarding rule.

11.7.3 Traffic Rules

The Network » Firewall » Traffic Rules page configures the traffic rules and source NAT.

Traffic Rules

Traffic rules define policies for packets travelling between different zones, for example to reject traffic between certain hosts or to open WAN ports on the router.

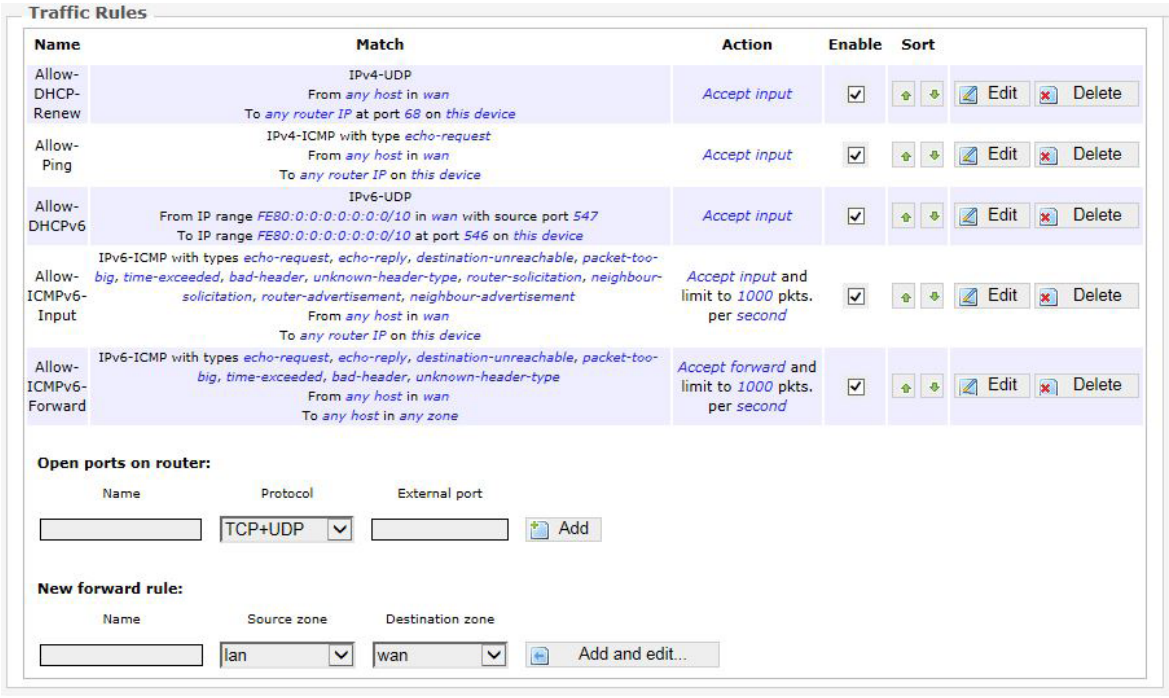


Figure 52: Firewall Traffic Rules with the default settings.

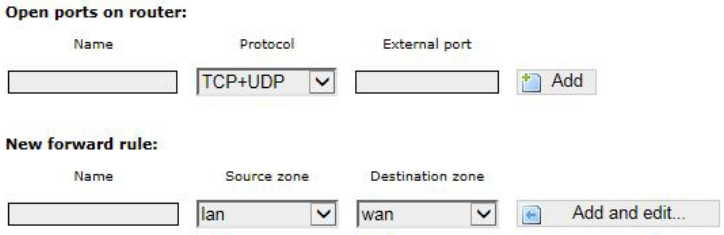


Figure 53: You can choose to open ports on the router or add new forwarding rules.

Source NAT

Source NAT is a specific form of masquerading which allows fine grained control over the source IP used for outgoing traffic, for example to map multiple WAN addresses to internal subnets.

Figure 54: Source NAT.

11.8 Diagnostics

11.8.1 Network Utilities

Figure 55: Network Utilities consist of Ping, Traceroute, and Nslookup.

```
PING 192.168.10.155 (192.168.10.155): 56 data bytes
64 bytes from 192.168.10.155: seq=0 ttl=128 time=0.797 ms
64 bytes from 192.168.10.155: seq=1 ttl=128 time=0.829 ms
64 bytes from 192.168.10.155: seq=2 ttl=128 time=0.689 ms
64 bytes from 192.168.10.155: seq=3 ttl=128 time=0.833 ms
64 bytes from 192.168.10.155: seq=4 ttl=128 time=0.934 ms

--- 192.168.10.155 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max = 0.689/0.816/0.934 ms
```

Figure 56: Result of Ping.

```
traceroute to 192.168.10.103 (192.168.10.103), 30 hops max, 38 byte packets
 1  192.168.10.103  3.683 ms
```

Figure 57: Result of Traceroute.

```
Server:    127.0.0.1
Address 1: 127.0.0.1 localhost

Name:      192.168.10.103
Address 1: 192.168.10.103
```

Figure 58: Result of Nslookup.

11.9 Quality of Service

The Network » QoS page configures the quality of service (QoS). With QoS you can prioritize network traffic that passes through the WAN port. You can limit the download and upload speeds. Network QoS is disabled by default.

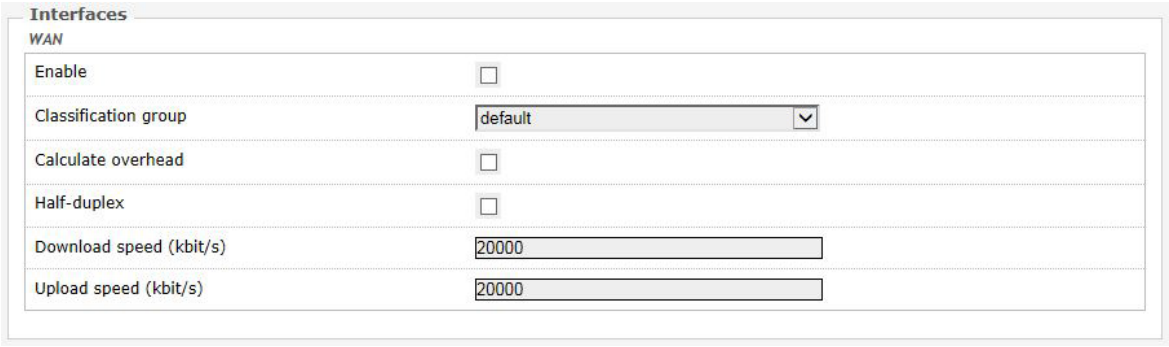


Figure 59: Network QoS settings.

12.0 AP Controller Tab

APs running the Netwave OpenWRT firmware can be managed by an Access Point Controller (APc). The APc sends and receives information from Comnet OpenWRT APs using the SNMPv3 protocol.

12.1 Getting Started with Managing APs using the APc

For each AP, please perform the following steps in the AP's web page:

1. Set the APc IP address.
2. Set the AP's IP address, default gateway, and custom DNS server.
   - » The web page may not jump automatically to the new IP address if the subnet changed, so please re-enter the new IP address in the browser.
   - » Click on the network tab to check that the L2TP is communicating packets with the APc.
3. Set the hostname of the AP to better identify it.

The following describes the “APController” top-level tab.

When using the APc for the first time, you only need to set the IP address of the APc. This has to be done in the AP's configuration web page itself. All other settings should remain as the default values for now.

Please always click “Save & Apply”. Do not click “Save”. This is to apply the settings immediately.

12.2 L2TPv3 Settings

The following are the settings for the Layer 2 Tunneling Protocol Version 3 (L2TPv3).

Remote Server	Configures the IP address of the APc e.g. 192.168.3.178.
Chap-username	Sets the username for the Challenge-Handshake Authentication Protocol (CHAP).
Chap-secret	Sets the password for the Challenge-Handshake Authentication Protocol (CHAP).

12.3 IPSec

By default, the Internet Protocol Security (IPsec) is disabled for the Netwave Radio boards to decrease the usage of the CPU resources. It can also be enabled.

The L2TPv3 itself already provides data channel protection against malicious data insertion.

Pre-shared key	Sets the password for the IPsec.

12.4 APc SNMP Settings

The “SNMPv3 AP to APC” section contains the APc SNMP settings.

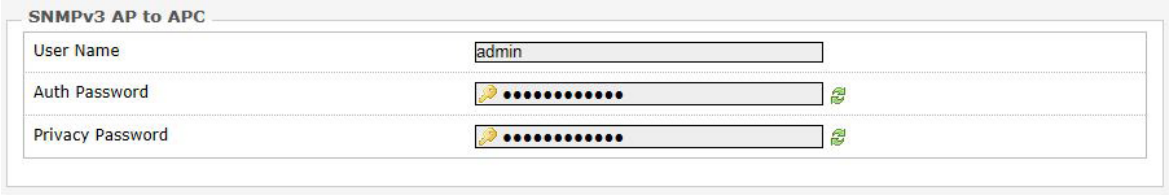


Figure 60: APc SNMP Settings.

Currently, the following default values must be used.

User Name: “admin”

Auth Password: “apc0ntr0ll3r”

Privacy Password: “apc0ntr0ll3r”

12.5 AP SNMP Settings

For communication from the APc to the AP, the settings in the following section of the LuCI web page is used:

System » SNMP » SNMP Configuration » General Settings

The description of the SNMP options are mentioned in Section "SNMP Configuration."

13.0 Troubleshooting

13.1 Troubleshooting steps

13.1.1 PC cannot connect to the NetWave device

The configuration web page for the NetWave device would not be able to show up if the NetWave device and your computer are not connected. If the PC and the NetWave device are joined to the network by LAN cables, they would not be able to connect if any of the network cable connections are loose. A possible indicator is that there is no light at the LAN port of the PC. In Windows, if you click the network icon and click to “View network connections”, the LAN port shows “Disconnected”. Please ensure that all the connections are tight. Sometimes, disconnecting and reconnecting the LAN cable solves connection problems if DHCP is used, because the DHCP server and DNS server are reset.

(Also, dis-associating and re-associating to the wireless network has a similar benefit as unplugging and re-inserting the LAN cable.)

The NetWave device, the computer, and the gateway must have IP addresses on the same network. For example, if you use a subnet mask of 255.255.255.0 and the gateway IP address is 192.168.3.1, all the IP addresses must be unique and be of the form 192.168.3.X. Check whether the NetWave device and your computer are connected on the same network by running the ping command to ping the IP address of the NetWave device.

Alternatively, type the following in the NetWave device's Linux terminal:

• ping 192.168.3.77 (if your computer's IP address is 192.168.3.77 for example.)

They should be able to give the ping responses.

An IP address conflict would cause unstable pings.

Switch to another address and ping the conflicting address to check.

If using a Windows computer, you should run the command arp -d * if the network configuration has changed. This is to delete the address resolution protocol (ARP) table in Windows as it may not update fast enough.

If the ping still cannot get responses, try disabling the firewall on your Windows computer. The Windows Firewall on your computer may prevent it from sending back a ping response. Disabling the firewall may be a security risk, so you should take the precaution of disconnecting the Internet first.

13.1.2 PC Ethernet and Wifi adapters

If your PC has both Ethernet and Wifi adapters, they must not have the same subnet. Otherwise, packets from the PC may not be directed to the correct network.

13.2 Resetting to factory default

To reset the router to the factory default settings, while the power is on, hold down the reset button for 8 seconds and then release

14.0 Glossary

Term	Definition
Access Point (AP)	A device that provides network access to associated stations (connected wireless devices). A wireless router can function as an AP.
ACK	Acknowledgment. This is a response to a transmission to indicate that the data packet was received correctly.
ARP	Address Resolution Protocol. This is a broadcast protocol for mapping IP addresses to MAC addresses.
CHAP	Challenge-Handshake Authentication Protocol. This is a protocol for authenticating users to an ISP.
CPE	Customer-Premises Equipment. This is also known as a station.
dB	Decibels. This is a measure of intensity.
dBm	Decibel-milliwatts. This is a measure of power relative to 1 mW. This is commonly used to measure wireless signal power. A higher power leads to better signal quality.
DDNS	Dynamic DNS. This is a system for updating domain names in real time. It allows a domain name to be assigned to a device with a dynamic IP address.
DHCP	Dynamic Host Configuration Protocol. This is a protocol for allocating IP addresses dynamically so that addresses can be reused when hosts (e.g. computers) no longer need them.
DNS	Domain Name System. This is a distributed and hierarchical naming system for computers, services, or any resource connected to the Internet or a private network.
EIRP	Equivalent Isotropically Radiated Power. Each country sets the legally permitted maximum for the EIRP limits on each channel.
ESSID	Extended Service Set Identifier. This is the name of the wireless network. It is case-sensitive and up to 32 alphanumeric characters in length. The ESSID differentiates one wireless network from another. All access points and devices trying to connect to a specific wireless network should use the same ESSID (and password) to enable effective roaming.
FTP	File Transfer Protocol. This is a protocol for transferring files between network nodes.
HTTP	Hypertext Transfer Protocol. This is a protocol used by web browsers and web servers to transfer files.
IP	Internet Protocol. This is the primary communications protocol used for relaying network packets (also known as datagrams) across an internetwork using the Internet Protocol Suite. IP is responsible for routing packets across network boundaries. It is the principle protocol that establishes the Internet.
ISP	Internet Service Provider.
L2TP	Layer 2 Tunneling Protocol. This is a tunneling protocol used to support virtual private networks (VPNs) or as part of the delivery of services by ISPs. It does not provide any encryption or confidentiality by itself. Rather, it relies on an encryption protocol that it passes within the tunnel to provide privacy.
LAN	Local Area Network.

Term	Definition
Layer 2 Data	link layer of the Open Systems Interconnection (OSI) model. This corresponds to the Link layer of the Internet protocol suite.
MAC Address	Media Access Control Address. This is a globally unique identifier attached to a network adapter. It also identifies the hardware manufacturer.
Mbps	Megabits per second. Also Mbit/s. This is a measure of the data rate.
MiniPCIe	Mini Peripheral Component Interconnect Express. A miniPCIe radio is a radio card that can be inserted into a router's circuit board.
MTU	Maximum transmission unit. This is the size, in bytes, of the largest packet that can be passed on. The MTU for Ethernet is a 1500-byte packet.
NAT	Network Address Translation. This is the process of rewriting IP addresses as a packet passes through a controller or firewall. NAT enables multiple computers (or hosts) on a LAN to access the Internet using the single public IP address of the LAN's gateway controller.
NMS	Network Management Station. This is a software which runs on the SNMP manager. It is sometimes simply referred to as an SNMP manager.
NTP	Network Time Protocol. This is a protocol for synchronizing a controller to a single clock on the network, known as the clock master.
PAP	Password Authentication Protocol. This is a protocol for authenticating users to a remote access server or ISP.
PPPoE	Point-to-Point Protocol over Ethernet. This is a protocol for connecting a network of hosts to an ISP without the ISP having to manage the allocation of IP addresses.
PPTP	Point-to-Point Tunneling Protocol. This is a protocol for the creation of VPNs for the secure transfer of data from remote clients to private servers over the Internet.
QoS	Quality of Service. This is the prioritization of network traffic. Voice traffic gets the highest priority, followed by video, best effort, and background traffic, in this order.
RADIUS	Remote Authentication Dial In User Service. This is a networking protocol that provides Authentication, Authorization, and Accounting (AAA) management for remote users. The RADIUS provides centralized management of usernames and passwords.
SNMP	Simple Network Management Protocol. This is an Internet-standard protocol for managing devices on IP networks. It consists of a set of standards for network management, including an application layer protocol, a database schema, and a set of data objects. SNMP exposes management data in the form of variables on the managed systems, which describe the system configuration. These variables can then be queried (and sometimes set) by managing applications.
SSID	Service Set Identifier. This is also known as the ESSID or the wireless network name.
Station	A device that connects wirelessly to an access point.
Subnet	A portion of a network that shares a common address component. On TCP/IP networks, subnets are defined as all devices whose IP addresses have the same prefix. For example, all devices with IP addresses that start with 192.168.10 belong to the same subnet.
TCP	Transmission Control Protocol. This is a protocol for transmitting data over the Internet with guaranteed reliability and in-order delivery.

Term	Definition
UDP	User Datagram Protocol. This is a protocol for transmitting data over the Internet quickly but with no guarantee of reliability or in-order delivery.
VAP	Virtual Access Point. A VAP simulates a physical access point. A VAP is configured on a per-radio basis. By default, only one VAP is enabled. Up to 16 VAPs can be created for each radio, each with its own SSID.
VPN	Virtual Private Network. This is a network that enables IP traffic to travel securely over a public TCP/IP network by encrypting all traffic from one network to another. The VPN uses tunneling to encrypt all information at the IP level.
WAN	Wide Area Network. This is a network that covers a broad area. The world's most popular WAN is the Internet.
Web Browser	A software that allows the user to surf the Internet.
WDS	Wireless Distribution System. This is a system enabling the wireless interconnection of access points in an IEEE 802.11 network. It allows a wireless network to be expanded using multiple access points without the traditional requirement for a wired backbone to link them.
WLAN	Wireless Local Area Network.

15.0 Agency Compliance

FCC

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a Industrial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operations of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Industry Canada

This Class A digital apparatus complies with Canadian ICES-003. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication. This device complies with Industry Canada license-exempt RSS standard(s).

Operation is subject to the following two conditions:

- This device may not cause interference, and
- This device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil numérique de la classe A est confrome à la norme NMB-003 Canada. Pour réduire le risque d'interférence aux autres utilisateurs, le type d'antenne et son gain doivent être choisies de façon que la puissance isotrope rayonnée équivalente (PIRE) ne dépasse pas ce qui est nécessaire

pour une communication réussie. Cet appareil est conforme à la norme RSS Industrie Canada exempts de licence norme(s). Son fonctionnement est soumis aux deux conditions suivantes:

17 Compliance

- Cet appareil ne peut pas provoquer d'interférences et
- Cet appareil doit accepter toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositif.

RF Exposure Warning

The antennas used for this transmitter must be installed to provide a separation distance of at least 2.52m from all persons and must not be located or operating in conjunction with any other antenna or transmitter.

Les antennes utilisées pour ce transmetteur doivent être installé en considérant une distance de séparation de toute personnes d'au moins 2.52m et ne doivent pas être localisé ou utilisé en conflit avec tout autre antenne ou transmetteur.

CE Marking

CE marking on this product represents the product is in compliance with all directives that are applicable to it.

This equipment may be operated in the following countries:

Great Britain and Northern Ireland, Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Romania, Switzerland, Sweden

Installer Compliance Responsibility

Devices must be professionally installed and it is the professional installer's responsibility to make sure the device is operated within local country regulatory requirements.

RoHS/WEEE Compliance Statement

European Directive 2002/96/EC requires that the equipment bearing this symbol on the product and/or its packaging must not be disposed of with unsorted municipal waste. The symbol indicates that this product should be disposed of separately from regular household waste streams. It is your responsibility to dispose of this and other electric and electronic equipment via designated collection facilities appointed by the government or local authorities. Correct disposal and recycling will help prevent potential negative consequences to the environment and human health. For more detailed information about the disposal of your old equipment, please contact your local authorities, waste disposal service, or the shop where you purchased the product.

16.0 GPL (General Public License) Statement

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