

Home-Network Implementation

Using the Ubiquiti EdgeRouter X and Ubiquiti AP-AC-LR Access Point

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Project Home <https://github.com/mjp66/Ubiquiti>

Table of Contents

1. Overview	4
2. Disclaimer	5
3. Purpose	5
4. EdgeRouter IP Address Use	5
5. Acquire EdgeRouter Documentation	6
6. Web Resources	6
7. Initial EdgeRouter Hardware Setup	7
8. Initial EdgeRouter Login	8
9. Update EdgeRouter Firmware	9
10. EdgeRouter Wizard	12
11. EdgeRouter Re-Connection	16
12. Network Naming	17
13. EdgeRouter Command Line Interface (CLI)	18
14. EdgeRouter Config Tree	20
15. My Command Line Trouble	21
16. EdgeRouter Backup / Configuration Files	22
17. Remove eth2 from the EdgeRouter's Internal Switch	23
18. Configure EdgeRouter's eth2 IP Addresses	24
19. About DNS settings	25
20. dnsmasq	26
21. System DNS Settings	27
22. Remove ISP Provided DNS Resolvers	28
23. Configure EdgeRouter's eth2 DHCP Server	30
24. Configure EdgeRouter's Time Zone	31
25. DNS Forwarding	32
26. Add VLAN Networks to the EdgeRouter	33
27. Add DHCP Servers to the VLANs	35
28. Set Domain Names for Networks	36
29. Modify EdgeRouter's eth1 DHCP Server	37

30.	Make DHCP Servers “authoritative”	38
31.	EdgeRouter Enable HW NAT Assist.....	40
32.	EdgeRouter ER-X Speed	41
33.	EdgeRouter Enable Traffic Analysis	42
34.	EdgeRouter Traffic Analysis	43
35.	EdgeRouter X/X-SFP bootloader bug	44
36.	EdgeRouter X/X-SFP check bootloader version	44
37.	EdgeMAX EdgeRouter X/X-SFP bootloader update	44
38.	EdgeRouter Power Cycle Warning	45
39.	EdgeRouter UPnP	45
40.	Extended GUI Access / Use May Crash the EdgeRouter	45
41.	EdgeRouter Toolbox	45
42.	Address Groups.....	46
43.	EdgeRouter Layman’s Firewall Explanation.....	49
44.	Firewall State	51
45.	WAN Firewall Rules.....	51
46.	EdgeRouter Detailed Firewall Setup	52
47.	WAN_LOCAL Firewall Rules	53
48.	WAN_IN Firewall Rules	53
49.	HOME_OUT Firewall Rules	54
50.	Firewall Conditions	56
51.	Adding Firewall Rules.....	58
52.	Adding More HOME_OUT Firewall Rules	64
53.	WIRED_IOT_LOCAL, WIFI_IOT_LOCAL Firewall Rules.....	65
54.	WIFI_GUEST_LOCAL Firewall Rules.....	67
55.	Optional DNS Forcing of the WIFI_GUEST_LOCAL Network.....	68
56.	WIRED_SEPARATE Firewall Rules.....	72
57.	EdgeMax Change Interface Names.....	74
58.	SmartQueue Setup.....	75
59.	Ubiquiti AP-AC-LR Access Point Setup	76
60.	Hookup the Ubiquiti AP-AC-LR Access Point	76
61.	Download and Install the Access Point Software	77
62.	Running the UniFi Software	82
63.	Initial Setup of the UniFi Software.....	84
64.	Login to the UniFi Software	87
65.	UniFi Devices.....	89
66.	UniFi Settings	91

67.	Timed Based Firewall Rules	99
68.	Double-NAT.....	99
69.	Another link	99
70.	Adblocking and Blacklisting	100
71.	Intrusion Detection Systems.....	101
72.	Conclusions	101

1. Overview

This guide will attempt to show users how to set up two Ubiquiti pieces of equipment, to provide for a secure and flexible firewall / router and a Wi-Fi Access Point. The two pieces of equipment used in this guide are:

- Ubiquiti EdgeRouter X (about \$50 when this guide was written)
- Ubiquiti AP-AC-LR Wi-Fi Access Point (about \$100 when this guide was written).

This equipment can provide 3 isolated or semi-isolated wired networks, and up to 4 isolated or semi-isolated Wi-Fi SSIDs. The networks provided by this equipment configuration are as follows:

- Wired Home Network For most of the household personal computers
- Wired Separate Network For an isolated and/or separate network and/or personal computer(s)
- Wired IOT Network For wired Internet-Of-Things devices
- Wi-Fi Home Network For household personal computers, tablets and smartphones
- Wi-Fi Guest Network For visiting friends' tablets and smartphones
- Wi-Fi IOT Network For Wi-Fi Internet-Of-Things devices

The Wired Home Network and Wi-Fi Home Network is actually the same Network. Your naming and use may / can be different. See Figure 1 - Overview Diagram.

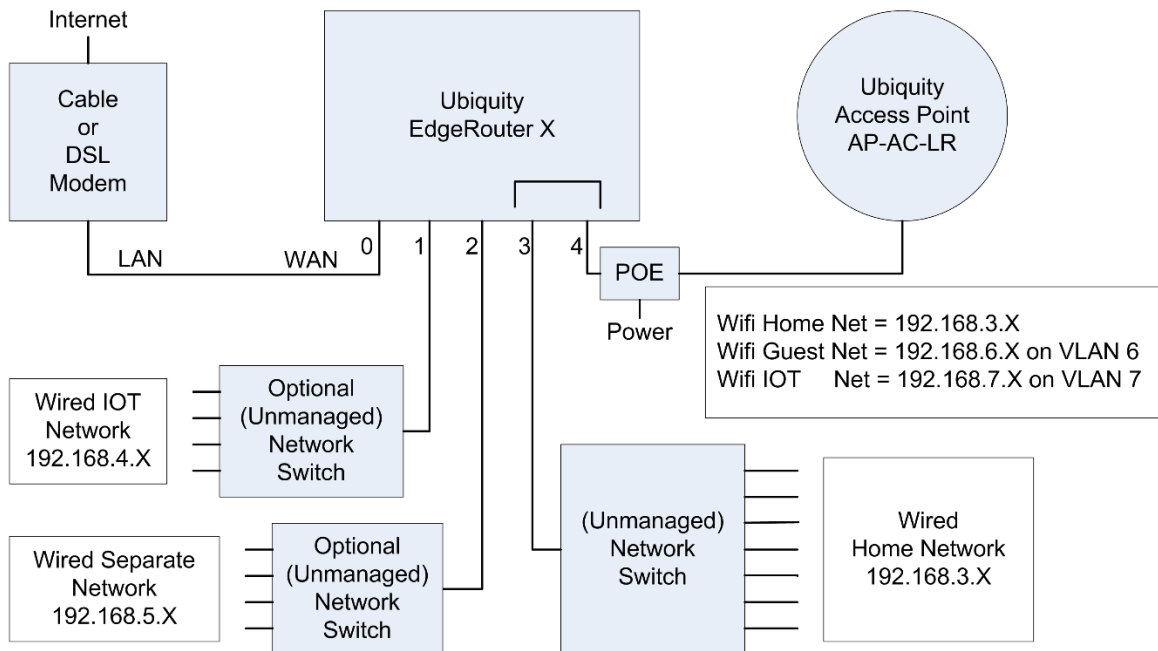


Figure 1 - Overview Diagram

With this setup, the Home Network (both Wired and Wi-Fi) is able to initiate connections / communicate with devices on both the Wired IOT Network and the Wi-Fi IOT Network. Devices on the IOT Networks are NOT able to initiate connections / independently communicate to the Home Network. None of these Networks can communicate with the Wired Separate Network, and the Wired Separate Network cannot communicate with them.

This guide assumes that you will be using both an Ubiquiti EdgeRouter X and some model of Ubiquiti Access Point.

2. Disclaimer

This is a guide, your results may vary. I am not a network engineer. Enough said.

3. Purpose

One purpose of this guide is to provide a stable and usable router / firewall / access point configuration. I also want to provide background on what these configuration settings accomplish, so that the reader can understand why these settings were chosen.

4. EdgeRouter IP Address Use

For the purposes of this guide, I am assuming that you will put your Ubiquiti EdgeRouter in series with your existing firewall / router, after the EdgeRouter has been initially configured. This way, you can leave your existing network alone, while securely setting up and testing your EdgeRouter. You need to ensure that your existing network does not use any of the following network addresses: 192.168.3.X, 192.168.4.X, 192.168.5.X, 192.168.6.X, or 192.168.7.X, as these address ranges will be used within the EdgeRouter. I suggest that you set up or re-configure your existing router to use IP addresses of 192.168.2.X on its LAN ports. Existing router addresses of 192.168.0.X or 192.168.1.X will also work. Your existing equipment may have the “Cable or DSL Modem” portion and “Your Existing Firewall / Router” portion combined into one single unit. See Figure 2 - EdgeRouter Configuration Setup. You will also need a computer to setup the EdgeRouter.

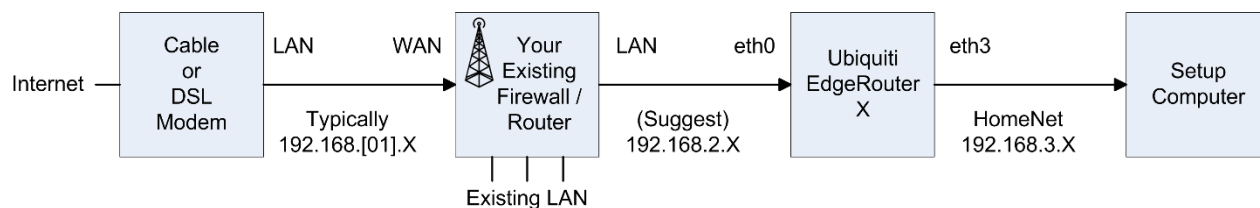


Figure 2 - EdgeRouter Configuration Setup

Most cable / DSL modems seem to be pre-configured for DHCP, and for using addresses of 192.168.0.X or 192.168.1.X on their LAN ports. Therefore, I configured the EdgeRouter Network addresses not to include those ranges. I deliberately left the address range of 192.168.2.X unused within the EdgeRouter, so those addresses could be used by an existing firewall / router's LAN ports.

If the EdgeRouter was using an address that was also used by your Cable / DSL modem, it would mask / hide that equipment's setup web page(s), and you would not be able to access those pages.

The EdgeRouter will NOT work if the address presented via DHCP to its eth0 port maps anywhere within one of the address ranges used internally by the EdgeRouter.

If your Internet Service Provider's (ISP) equipment does not provide an IP address via DHCP, then you will need to adjust your WAN (eth0) settings after running the setup wizard. In particular, if you need to use PPPoE, then you might want to read:

<https://community.ubnt.com/t5/EdgeMAX/Can-t-open-some-webpages/m-p/1950743/highlight/true#M163311>
<https://samuel.kadolph.com/2015/02/mtu-and-tcp-mss-when-using-pppoe-2/>

5. Acquire EdgeRouter Documentation

On the computer you use to setup the EdgeRouter X, download the newest documentation from:

<https://www.ubnt.com/download/edgemax/edgerouter-x/er-x>

There are both a User's Guide and a Quick Start Guide.

Note that Ubiquiti makes several models of EdgeRouter equipment. Each model uses different hardware, has different capabilities, supports a different number of ports, and may be configured (sometimes subtly) differently from each other. For instance, the EdgeRouter Lite typically uses eth1 as its WAN port, while the EdgeRouter X typically uses eth0 as its WAN port. Watch out for these types of differences when doing internet searches. EdgeMAX is the operating system for the EdgeRouter series.

6. Web Resources

EdgeMax <https://help.ubnt.com/hc/en-us/categories/200321064-EdgeMAX>

EdgeMax FAQ https://community.ubnt.com/t5/tkb/allarticlesprintpage/tkb-id/EdgeMAX_FAQ

Community <https://community.ubnt.com/t5/EdgeMAX/bd-p/EdgeMAX>

Unofficial <https://www.reddit.com/r/Ubiquiti/>

Here are some more references:

<https://help.ubnt.com/hc/en-us/articles/115002531728-EdgeRouter-Beginners-Guide-to-EdgeRouter>

<http://www.guruadvisor.net/en/networking/321-edgerouter-x-tiny-but-full-of-resources>

These postings perform similar items as this guide does:

<https://community.ubnt.com/t5/EdgeMAX/EdgeRouter-X-segmentation/td-p/1767545>

<https://help.ubnt.com/hc/en-us/articles/218889067-EdgeMAX-How-to-Protect-a-Guest-Network-on-EdgeRouter>

7. Initial EdgeRouter Hardware Setup

Configure the setup computer's Ethernet jack as having a fixed IP address of 192.168.1.X (where X is 2 to 254), and a netmask of 255.255.255.0. There are many tutorials available on the internet that shows how to configure a computer's Ethernet port to use a fixed IP address. One way to configure a Windows 10 computer is:

Control Panel -> Network & Internet -> Ethernet -> Change Adapter Settings -> Internet Protocol Version 4 -> Properties -> Use the following IP address.

See Figure 3 – Windows 10 Ethernet Address Setup.

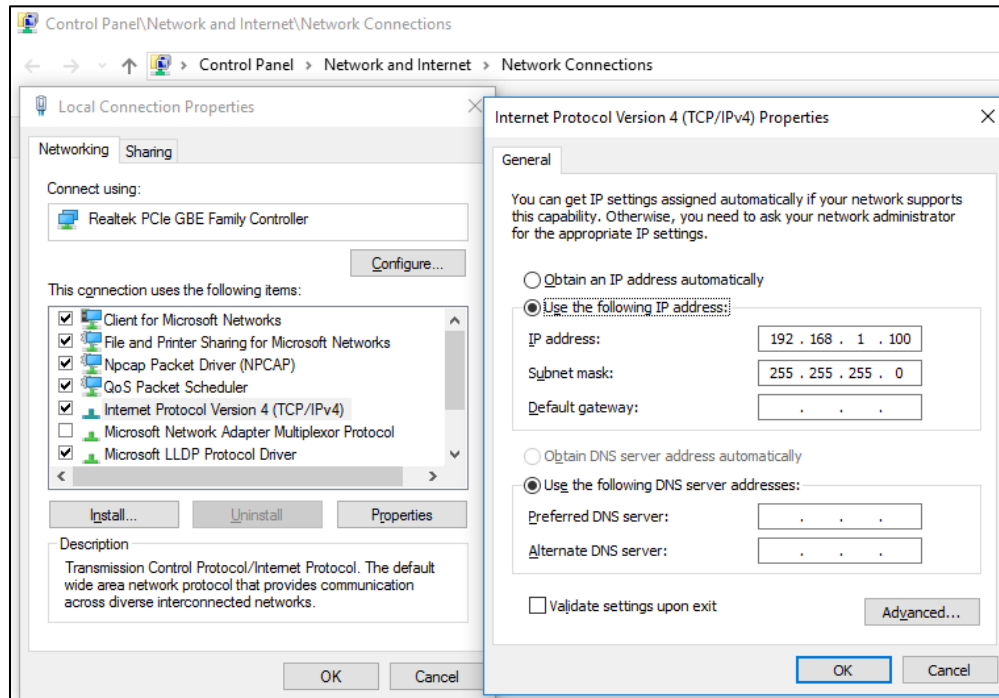


Figure 3 – Windows 10 Ethernet Address Setup

Power up your EdgeRouter X using the supplied power adapter, and then depress and hold the reset button for about 15 seconds. After releasing the reset button, connect a standard Ethernet cable from the EdgeRouter's eth0 port to the setup computer's Ethernet jack. See Figure 4 – Initial EdgeRouter Hardware Setup.

Note that some setup computers may have an additional Ethernet adapter or have an additional Wi-Fi adapter installed. If any additional adapter(s) are installed, and an adapter is using or connecting to an address within the range of 192.168.1.X, then you will need to temporarily disable that additional adapter. The additional adapter only needs to be disabled while you are trying to access the EdgeRouter at its initial hardware setup address of 192.168.1.1.

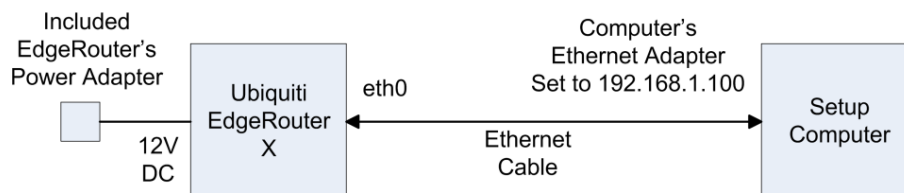


Figure 4 – Initial EdgeRouter Hardware Setup

Reference Quick Start Guide and the User's Guide @Chapter 2:Using EdgeOS.

8. Initial EdgeRouter Login

Wait about three minutes for the EdgeRouter to boot up, then open a web browser of your choice on your setup computer and enter <https://192.168.1.1> into the address field. The browser may issue a security warning. You will need to “Continue to this web site” or equivalent. The exact prompts and responses vary by browser. See Figure 5 – IE Security Certificate Example.

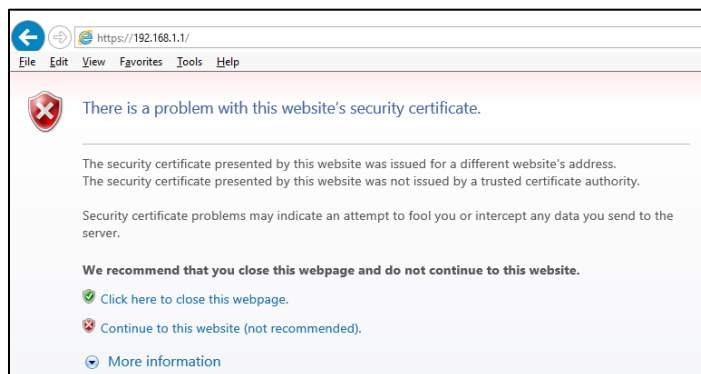


Figure 5 – IE Security Certificate Example

You will likely see a combined login and license agreement dialog. Enter the username and password. The default username is “ubnt” and the default password is “ubnt”. Do what you need to do for the agreement. See Figure 6 – Ubiquiti License Agreement Dialog.

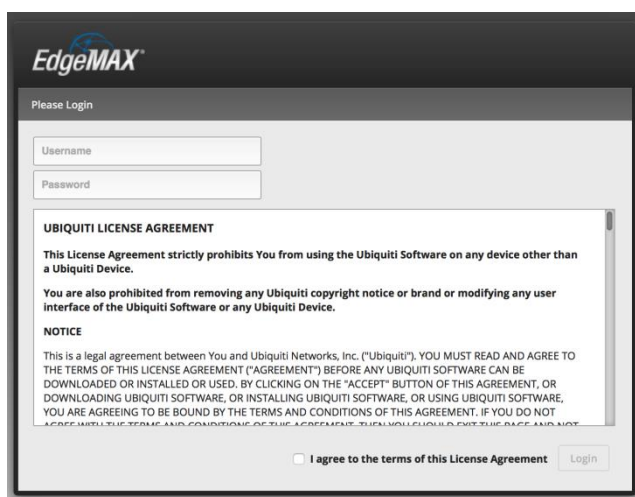


Figure 6 – Ubiquiti License Agreement Dialog

Depending upon the version of firmware that was pre-installed on your EdgeRouter, you may be presented with a dialog box stating that the “Router is in default config. Do you want to start with the Basic Setup wizard?” If presented, answer No. See Figure 7 – Basic Setup Question.

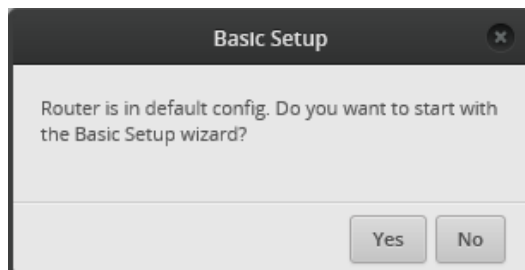


Figure 7 – Basic Setup Question

You will land on the Dashboard screen. See Figure 8 – Initial Dashboard Screen.

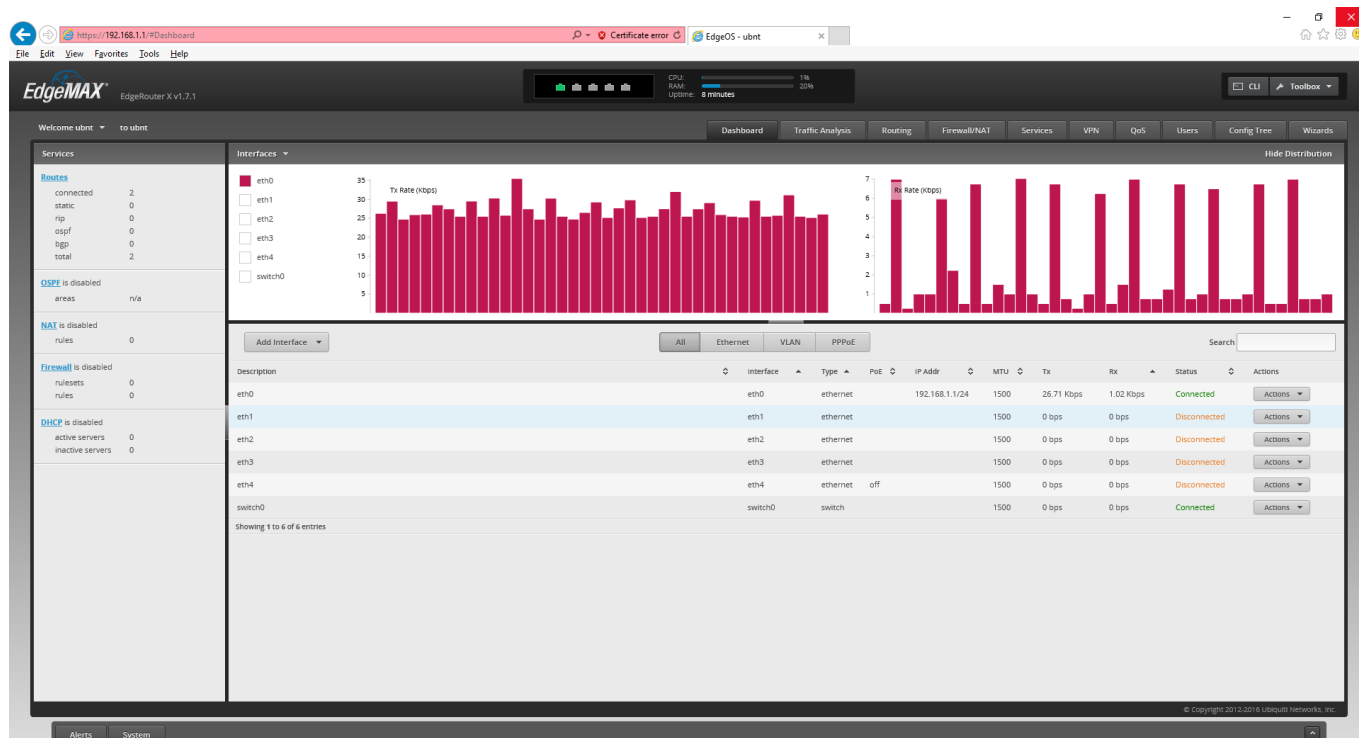


Figure 8 – Initial Dashboard Screen

Reference Quick Start Guide and the User's Guide @Chapter 2:Using EdgeOS.

9. Update EdgeRouter Firmware

On your setup computer, download the NEWEST firmware from:

<https://www.ubnt.com/download/edgemax/edgerouter-x/er-x>

For reference, during the writing of this document, the firmware was at:

"EdgeRouter ER-X/ER-X-SFP/EP-R6: Firmware v1.9.1".

Press the "System" button. See Figure 9 – System Button. This button is located near the lower-left corner of the dashboard screen, as shown in Figure 8 – Initial Dashboard Screen.

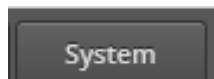


Figure 9 – System Button

Sometimes the System button and/or the Alerts button, which is right next to the System button, don't seem to work for me. I usually just click the other button twice, and then click the button I want.

The System window will then pop-up an overlay that will cover most of your screen. See Figure 10 – System Pop-up Screen.

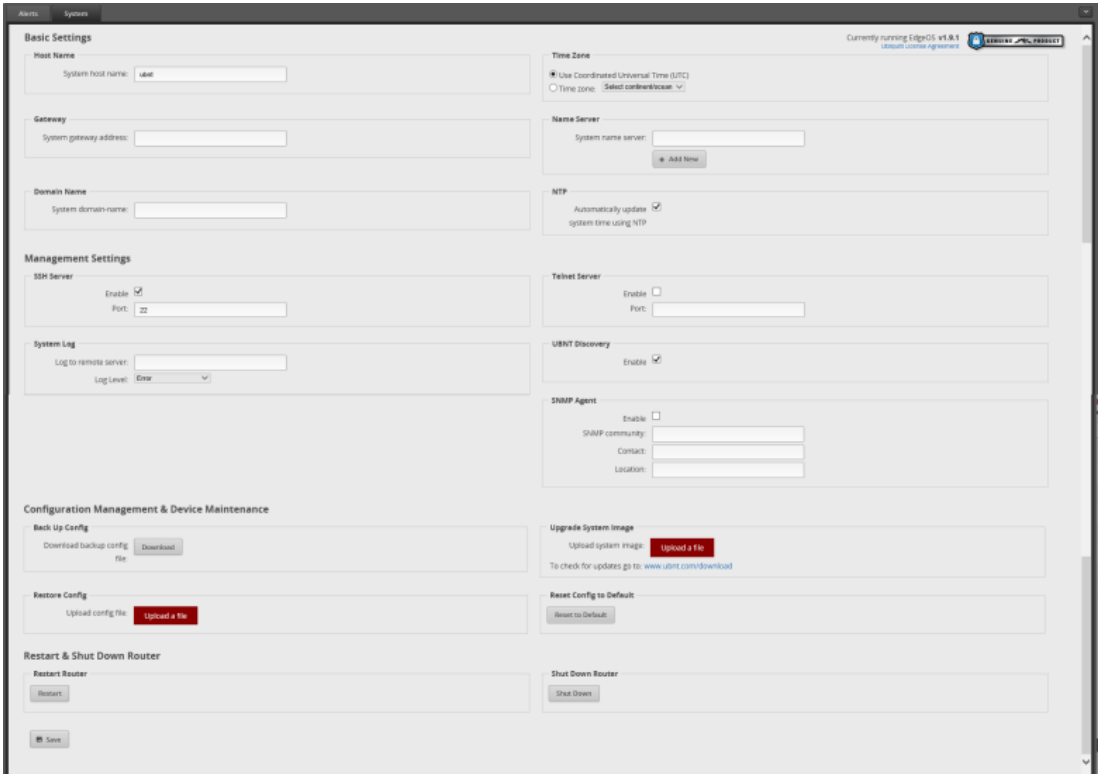


Figure 10 – System Pop-up Screen

Find the “Upgrade System Image” section, and press the “Upload a file” button. See Figure 11 – Upgrade System Image.

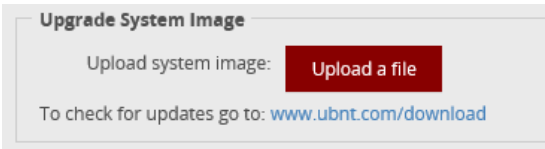


Figure 11 – Upgrade System Image

Choose the firmware file that you downloaded earlier. The EdgeRouter will then install the chosen file. See Figure 12 – Upload a file.

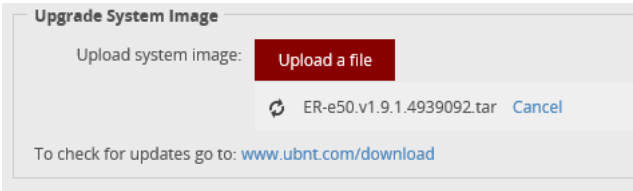


Figure 12 – Upload a file

You will eventually be asked if you want to reboot the EdgeRouter. Press the “Reboot” button. You will then be asked to confirm the reboot, click on the “Yes, I’m sure” button. See Figure 13 – Upgrade Complete Dialog.

The router will inform you that it is rebooting. See Figure 14 – Reboot Process.

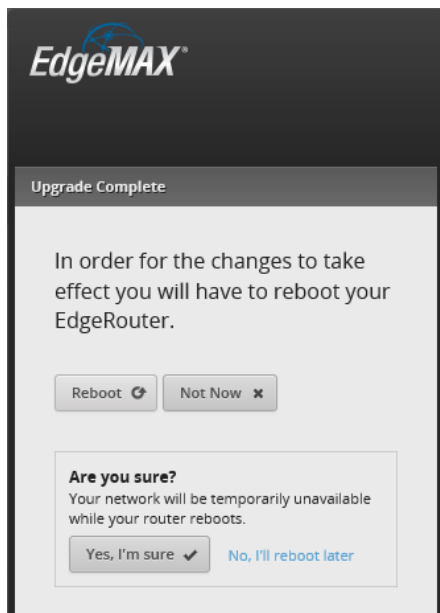


Figure 13 – Upgrade Complete Dialog

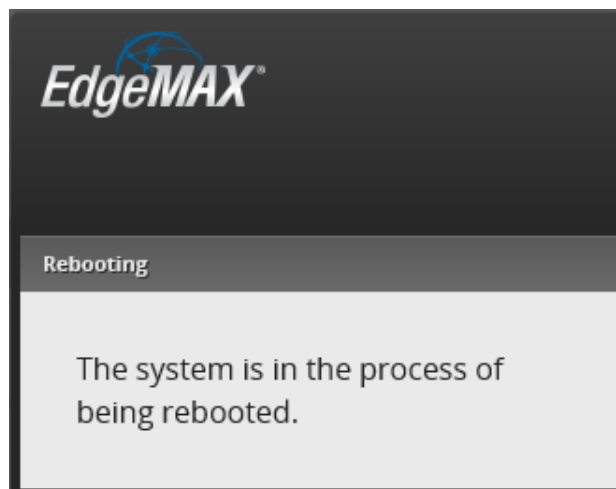


Figure 14 – Reboot Process

While the EdgeRouter is rebooting, the web page will present you with a Lost Connection Dialog. See Figure 15 – Lost Connection Dialog.

Eventually, when the EdgeRouter has fully re-booted, the presented dialog will change to Figure 16 – Timed-Out Dialog. This is a nice touch of web programming from Ubiquiti, so you can easily know when re-booting has completed.

Press the Reload button.

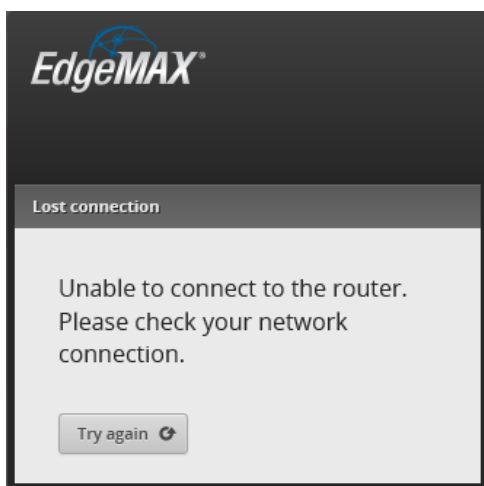


Figure 15 – Lost Connection Dialog

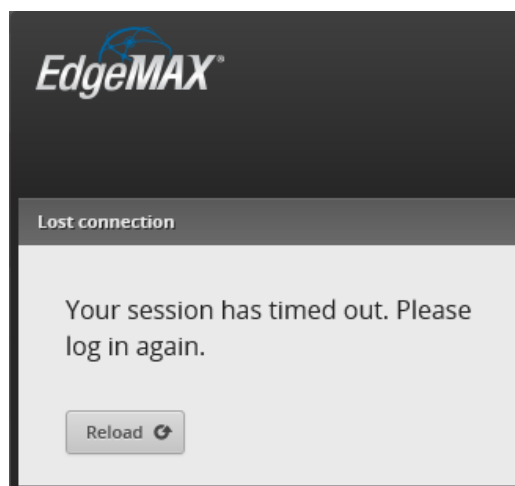


Figure 16 – Timed-Out Dialog

You will be asked to login; please enter the username and password into the dialog. The default username is “ubnt” and the default password is “ubnt”. See Figure 17 – Login Dialog.

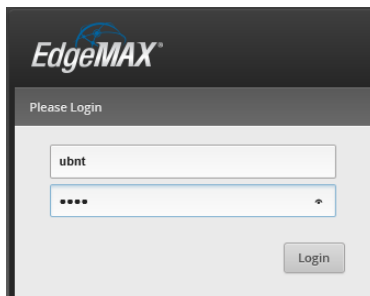


Figure 17 – Login Dialog

You should be presented with a dialog box stating that the “Router is in default config. Do you want to start with the Basic Setup wizard?” Answer “no.” Reference Figure 7 – Basic Setup Question.

You will (again) land at the Dashboard screen. Reference Figure 8 – Initial Dashboard Screen. Check the upper left of the screen and verify that you are presented with the version of code that you just downloaded. See Figure 18 – Example EdgeRouter Version.



Figure 18 – Example EdgeRouter Version

10. EdgeRouter Wizard

Press the “Wizards” button, which is located in the upper-right portion of the Dashboard screen. See Figure 19 – Wizards Button.



Figure 19 – Wizards Button

You will see the following (portion shown) of the Wizard Screen. See Figure 20 – Wizard Screen Portion.

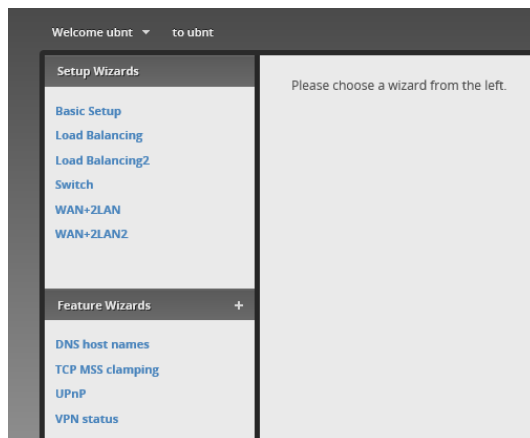


Figure 20 – Wizard Screen Portion

Note that there are various Wizards available, which can turn the EdgeRouter into a network switch, or perform load balancing between two WAN interfaces. Most people will probably be interested in a “standard” setup, as described in this guide, which is “WAN+2LAN2”.

Choose “WAN+2LAN2”. See Figure 21 – Wan+2LAN2 Dialog. You will need to expand / open sections, and make the following selections:

In the “Internet Port” section:

Port:	eth0	
Internet CT:	DHCP	
VLAN:	UN-Checked	(Internet Connection is on VLAN)
Firewall:	CHECKED	(Enable the default firewall)
DHCv6 PD:	UN-Checked	(Enable DHCv6 Prefix Delegation)

In the next (unlabeled) section:

One LAN:	UN-Checked	(Only use one LAN)
----------	------------	--------------------

In the “(Optional) Secondary LAN port (eth1)” section:

Address:	192.168.4.1 / 255.255.255.0	
DHCP:	CHECKED	(Enable the DHCP server)

In the “LAN ports (eth2, eth3, eth4)” section:

Address:	192.168.3.1 / 255.255.255.0	
DHCP:	CHECKED	(Enable the DHCP server)

If your internet provider uses something other than DHCP (i.e. IP address provided from your cable / dsl modem), you will need to select “Static IP” or “PPPoE”, and then configure those settings accordingly.

Unchecking the “Only use one LAN” selection informs the Wizard to un-bundle eth1 from eth2-4, allowing for the provision of a separate Network. I used this eth1 Network for Wired IOT devices.

It is important that “Enable the default firewall” is CHECKED. The entire security of this router depends upon this setting.

Under the “User setup” section, either change the default password to something secure / unique or “Create new admin user” with a secure / unique password. If you “Create new admin user”, you will need to also return to this dialog and delete the default “ubnt” login. You will need to remember your login credentials.

Press “Apply” at the bottom of the screen.

Use this wizard to set up basic Internet connectivity and to customize local network settings

▼ Internet port (eth0 or eth4)

Connect eth0 or eth4 to your Internet connection, for example, the cable modem or DSL modem, and select the connection type.

Port

Internet connection type ☒ DHCP
Automatically obtain network settings from the Internet Service Provider

☐ Static IP

☐ PPPoE

VLAN ☐ Internet connection is on VLAN

Firewall ☒ Enable the default firewall

DHCPv6 PD ☐ Enable DHCPv6 Prefix Delegation

One LAN ☐ Only use one LAN

▼ (Optional) Secondary LAN port (eth1)

Optionally, connect eth1 to your secondary local network.

Address /

DHCP ☒ Enable the DHCP server

▼ LAN ports (eth2, eth3 and eth4)

Connect the LAN ports to your devices or/and a switch that connects to additional devices.

Address x /

DHCP ☒ Enable the DHCP server

▼ User setup

Setup user and password for the new router config.

User ☒ Use default user
Use default user and password for the router. Password could be customized optionally.

User

Password

Confirm Password

☐ Create new admin user

☐ Keep existing users

Figure 21 – Wan+2LAN2 Dialog

After Applying, you will be presented with Figure 22 – Replace Configuration. Please study what it says. Press “Apply Changes.”

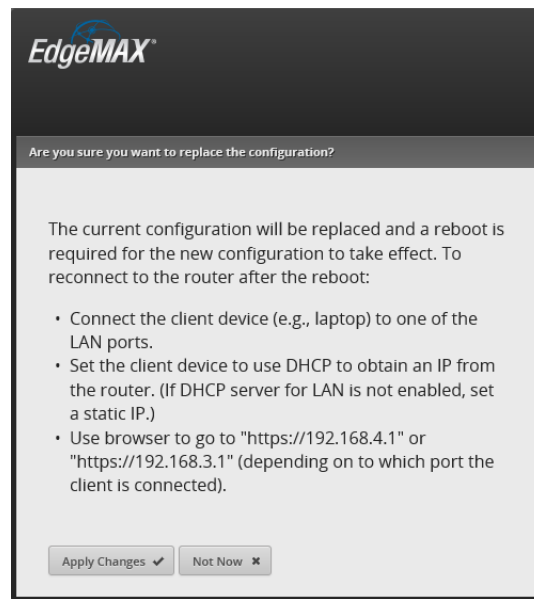


Figure 22 – Replace Configuration

Press Reboot, then confirm the reboot, by pressing the “Yes, I’m sure” button. See Figure 23 – Reboot into New Configuration.

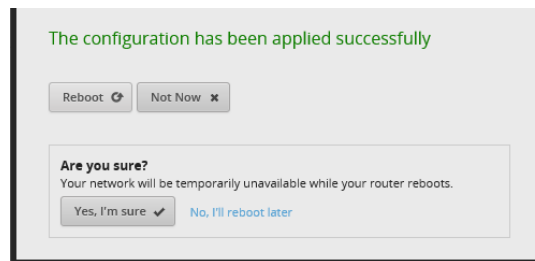


Figure 23 – Reboot into New Configuration

The EdgeRouter will inform you that it is rebooting. Reference Figure 14 – Reboot Process. The EdgeRouter takes several minutes to reboot.

Disconnect your setup computer’s Ethernet jack from the EdgeRouter’s eth0 connection. Re-configure your setup computer’s Ethernet port back to using DHCP. Again, there are many tutorials available on the internet that show how to configure a computer’s Ethernet jack to use DHCP. Reference section 7 - Initial EdgeRouter Hardware Setup, but instead choose “Obtain an IP address automatically.” Also reference Figure 3 – Windows 10 Ethernet Address Setup.

11. EdgeRouter Re-Connection

Ensure that your existing router's LAN ports are not using any of the addresses utilized by the EdgeRouter, i.e. not using 192.168.3.0 through 192.168.7.255. Reference section "4 - EdgeRouter IP Address Use." Connect the EdgeRouter's eth0 port into your existing router's LAN port with a standard Ethernet cable. Connect your setup computer's Ethernet port (now re-configured for DHCP) into the EdgeRouter's eth3 port. See Figure 2 - EdgeRouter Configuration Setup.

Open a web browser on your computer and enter <https://192.168.3.1> into the address field.

Acknowledge the browser's security warning, Reference Figure 5 – IE Security Certificate Example.

Login to your EdgeRouter, as shown in Figure 17 – Login Dialog.

You will be presented with the Dashboard Screen. See Figure 24 – Dashboard Screen.

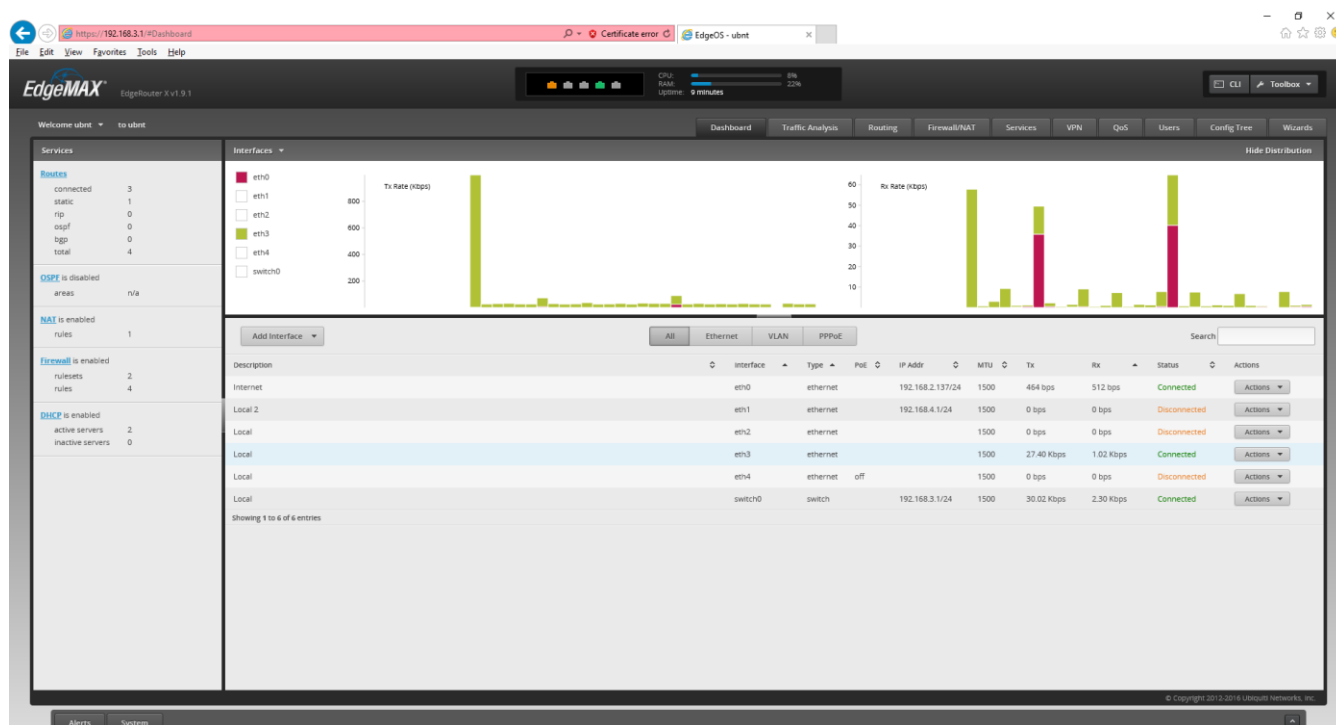


Figure 24 – Dashboard Screen

12. Network Naming

Setting up the EdgeRouter, per this guide, provides for several separate Networks. In this guide, I try to use the word “Network” (capitalized) for these. Each Network has a unique IP address range / subnet. See Table 1 - Table of Networks.

Network Name	IP Address Range	VLAN	Address Group Term
Home Network	192.168.3.X	No	HOME_GROUP
Wired IOT Network	192.168.4.X	No	WIRED_IOT_GROUP
Wired Separate Network	192.168.5.X	No	WIRED_SEPARATE_GROUP
Wi-Fi Guest Network	192.168.6.X	6	WIFI_GUEST_GROUP
Wi-Fi IOT Network	192.168.7.X	7	WIFI_IOT_GROUP

Table 1 - Table of Networks

Some of these Networks are on a Virtual LAN (VLAN). VLANs provide the ability for separate network data to be carried over shared Ethernet cables. Data that is “tagged” as belonging to a specific VLAN cannot interact with either non-VLAN data (trunk data) or with data from any different VLAN.

When VLANs are used, all devices involved with this data need to be VLAN aware. Any network switches carrying VLAN traffic will need to be IEEE 802.1Q capable, e.g. a Level 2 managed switch.

Note that the only VLAN traffic shown in Table 1 - Table of Networks is involved with the Wi-Fi Guest Network and the Wi-Fi IOT Network. The Ubiquiti AP-AC-LR access point is VLAN aware. Eventually the Access Point will be plugged-into the EdgeRouter’s eth4 interface, so VLAN data will be able to be carried between them. This Wi-Fi VLAN data does NOT need to flow to devices on the Wired Home Network. If you only have one Access Point, the network switch attached to the EdgeRouter’s eth3 interface can be (a cheaper) unmanaged switch. If you are going to deploy multiple Access Points, then the switch attached to the EdgeRouter’s eth3 interface MUST be IEEE 802.1Q capable. Reference Figure 1 - Overview Diagram. If they are needed, the network switches attached to the EdgeRouter’s eth1 and/or eth2 interfaces can be (cheaper) unmanaged switches.

Each Network is also customizable to provide functionality and connectivity. The rest of this guide will provide sufficient details on that.

There are many VLAN references on the web. Here is one brief tutorial:

<http://www.microhowto.info/tutorials/802.1q.html>

13. EdgeRouter Command Line Interface (CLI)

In most of Ubiquiti's Edgerouter forum posts, steps to (re-)configure items are given as Command line Interface (CLI) commands. In fact, not very many GUI screenshots are used, and they are typically posted only by novices.

The following steps show how to open and use the built-in CLI interface. Click on the "CLI" button, in the upper-right screen. See Figure 25 – CLI Button.

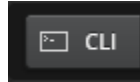


Figure 25 – CLI Button

The initial CLI window will appear as a semi-transparent overlay. See Figure 26 – Initial CLI Window.

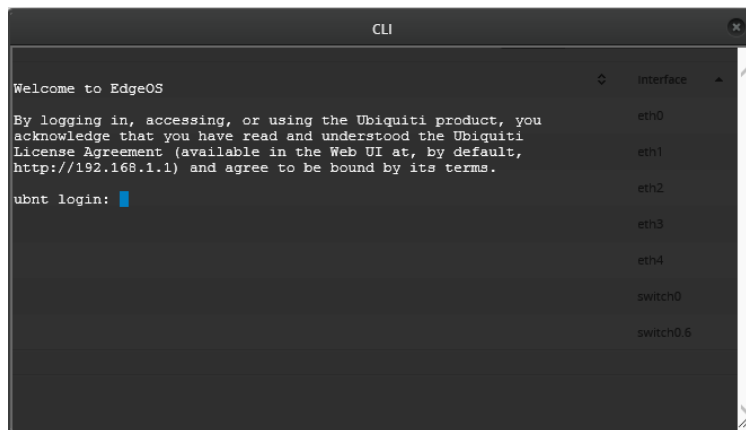


Figure 26 – Initial CLI Window

Login to this window, using your EdgeRouter's user name and password. You will now be presented with a command prompt. See Figure 27 – Logged-In CLI Window.

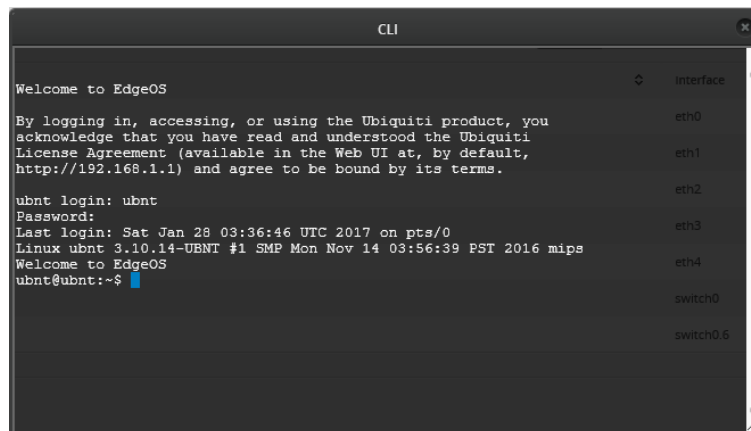


Figure 27 – Logged-In CLI Window

CLI commands are typically divided into configuration commands and non-configuration commands. The CLI interface will accept only configuration commands when in configuration mode. Type the "configuration" command to enter configuration mode. The "exit" command is used to leave configuration mode and return to normal (non-configuration) mode.

If you enter the “configure” command, the CLI window’s prompt will now include “[edit]”. See Figure 28 – Configure CLI Window.

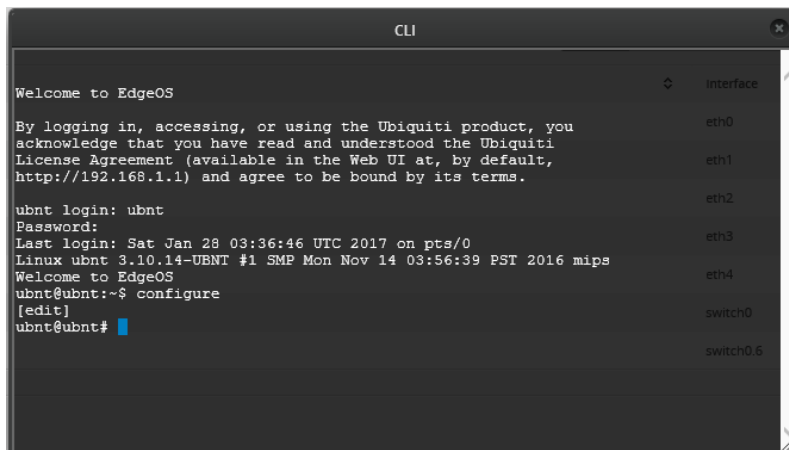


Figure 28 – Configure CLI Window

Many times when doing a commit and/or a save command, the page will need to be refreshed. A refresh dialog box will pop-up on the screen. See Figure 29 – Configuration Change. Press the “Refresh” button.

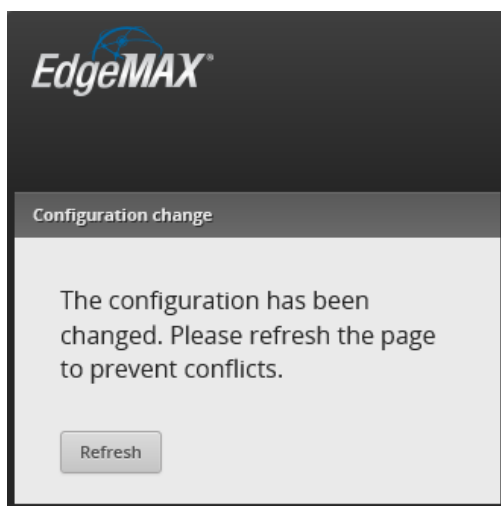


Figure 29 – Configuration Change

You can also use a popular Windows program, called putty.exe, to Secure Shell (SSH) into the EdgeRouter, and then issue CLI commands. Linux users should already be familiar with how to use SSH.

Here are some CLI references:

https://dl.ubnt.com/guides/edgemax/EdgeSwitch_CLI_Command_Reference_UG.pdf
<https://community.ubnt.com/t5/EdgeMAX/EdgeOS-CLI-Primer-part-1/td-p/285388>
https://community.ubnt.com/t5/EdgeMAX-CLI-Basics-Knowledge/tkb-p/CLI_Basics@tkb

14. EdgeRouter Config Tree

There is a neat and alternate way to configure the EdgeRouter. Near the top of the screen is a “Config Tree” button. See Figure 30 – Config Tree Button.

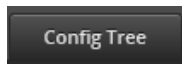


Figure 30 – Config Tree Button

When you press it, the “Configuration” Tree window will appear. See Figure 31 – Config Tree Initial Screen.

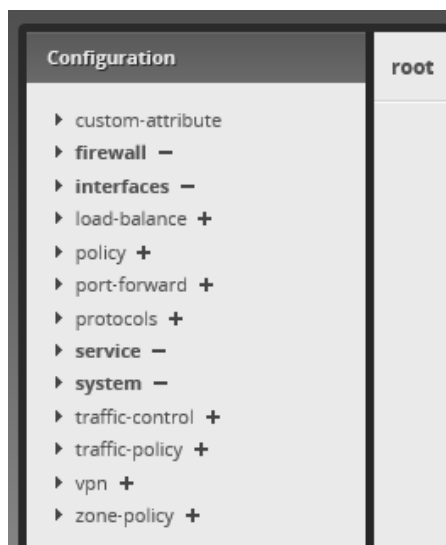


Figure 31 – Config Tree Initial Screen

Using the config tree is an alternate method (for some items) to using the Command Line Interface (CLI).

15. My Command Line Trouble

When I was experimenting with dnsmasq, many internet resources simply gave CLI commands to enable this feature. When I tried some of these commands, my EdgeRouter had problems. I no longer remember what the exact problem was, but I noticed that sometimes when using the Config Tree, multiple commands were issued.

See Figure 32 – Example of Multiple Config Tree Commands.

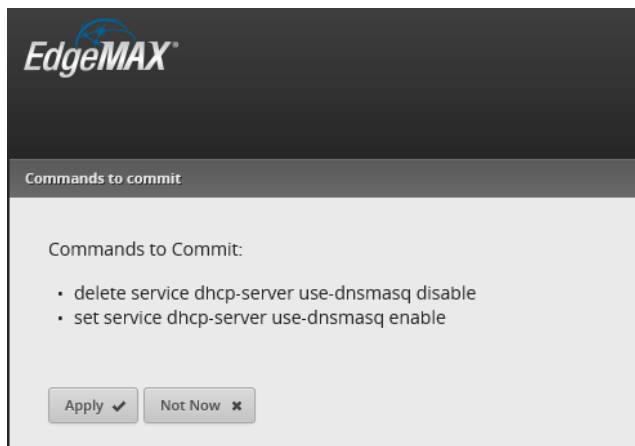


Figure 32 – Example of Multiple Config Tree Commands

16. EdgeRouter Backup / Configuration Files

When EdgeRouters are described in most internet forums, their configuration parameters are usually described (in text) by a standard file format. Eventually, you will need to be fluent in reading these files and translating that data into actions taken in the Command Line Interface (CLI), the Config Tree or the GUI.

You can find this configuration data within the config.boot file that is inside of the backup file generated from the system window. The file that is generated is typically named edgeos_ubnt_<date>.tar.gz, with <date> replaced by numbers representing today's date.

To generate a backup file, first press the System button, as shown in Figure 9 – System Button. You will be presented with the System screen, as shown in Figure 10 – System Pop-up Screen.

Find and press the “Download” button under the Configuration Management & Device Management section. See Figure 33 – Back Up Config Download Button.

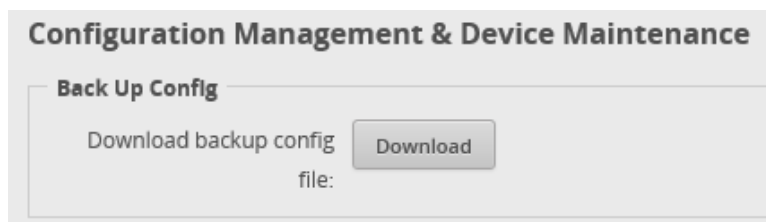


Figure 33 – Back Up Config Download Button

You will be presented with a dialog of where to (open or) save your backup file. This dialog is browser specific. Save your file to a directory of your choice on your setup computer. This file will be needed if you ever need to reload your EdgeRouter. You may want to do this frequently, when setting up this device.

Another way to obtain a relevant portion of this file is to issue one of the following commands into the Command Line Interface (CLI) window. For information about the CLI, reference section “13 - EdgeRouter Command Line Interface (CLI)”.

Two different / similar normal-mode CLI command for acquiring the system configuration are:

```
cat /config/config.boot  
show configuration | no-more
```

I will show as many portions of this config data as possible throughout this guide. One goal of this guide is to teach users enough about this EdgeRouter that they are comfortable reading and understanding the backup files.

17. Remove eth2 from the EdgeRouter's Internal Switch

In this step, we will manually un-bundle the eth2 interface from the EdgeRouter's internal switch chip. This allows us to provide for an additional Network. The switch chip will remain enabled for eth3 and eth4 interfaces. The eth2 interface will be used as the Wired Separate Network. Later, we will setup firewall rules that will keep this Network isolated from the other Networks.

Press the Dashboard Button. See Figure 34 – Dashboard Button.



Figure 34 – Dashboard Button

On the right side of the Dashboard screen, select switch0's "Actions" button. See Figure 35 – switch0's Action Button.



Figure 35 – switch0's Action Button

A sub-menu will appear, Select "Config" from the menu items. See Figure 36 – switch0 Actions Config.

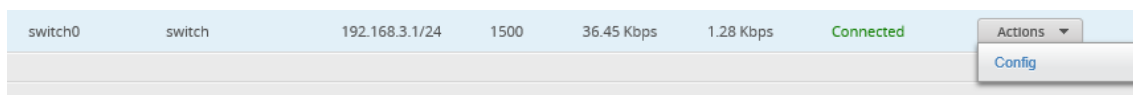


Figure 36 – switch0 Actions Config

You will be presented with the configuration dialog for switch0. See Figure 37 – switch0 Configuration.

Select the VLAN tab. Under the section labeled "Switch Ports", UN-CHECK eth2. See Figure 38 – switch0 Switch Ports.

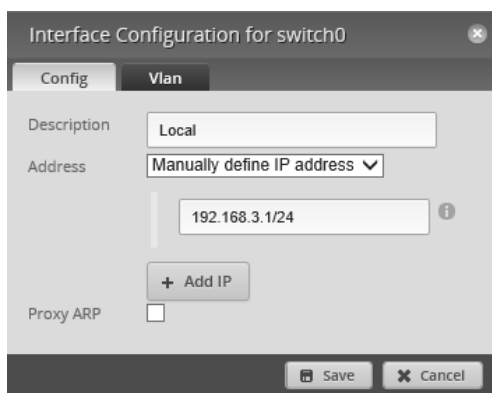


Figure 37 – switch0 Configuration

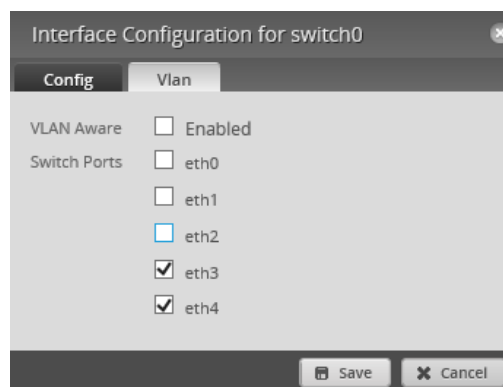


Figure 38 – switch0 Switch Ports

Press "Save". While the EdgeRouter is completing this task, a busy indicator will spin, in the upper right corner of the dialog. See Figure 39 – Busy Indicator. Wait for the Busy Indicator to finish spinning. It will be replaced by a Green checkmark when the task is completed. See Figure 40 – Finished Checkmark.



Figure 39 – Busy Indicator



Figure 40 – Finished Checkmark

18. Configure EdgeRouter's eth2 IP Addresses

Now that the eth2 interface has been un-bundled, we need to allocate a new IP address range to this interface. On the right side of the Dashboard screen select eth2's "Actions" button. See Figure 41 – eth2's Actions Button.

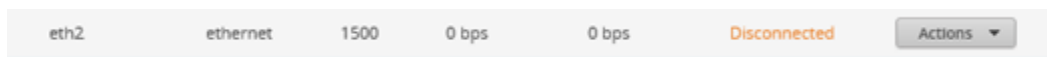


Figure 41 – eth2's Actions Button

A sub-menu will appear, See Figure 42 – Interface Actions.

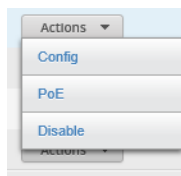


Figure 42 – Interface Actions

Select "Config". You will be presented with Figure 43 – Configuration for eth2 Dialog.

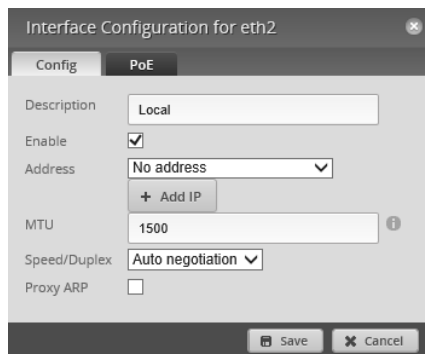


Figure 43 – Configuration for eth2 Dialog

Under the Address selection, choose "Manually define IP address", and enter "192.168.5.1/24" into the address field. See Figure 44 – eth2 Address Dialog.

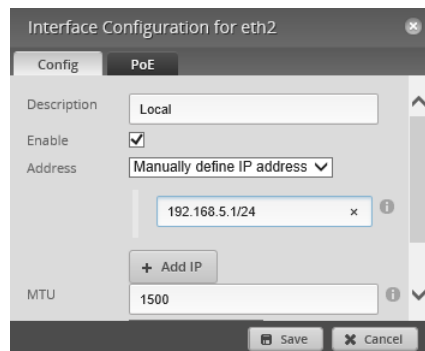


Figure 44 – eth2 Address Dialog

Click the Save button.

19. About DNS settings

I seem to have spent more time investigating DNS settings for the EdgeRouter than in learning firewall rules.

Within this guide, I am now using Quad9 DNS addresses for the Home Network and Level3 DNS addresses for the Separate Network. I am also using / forcing OpenDNS DNS addresses for the IOT and Guest Networks. Change any or all of these addresses to the DNS provider / resolver addresses of your choice.

Steve Gibson has a web page that can help you characterize various DNS providers. Since it runs from your computer, the results are localized to your connection / ISP. Until the EdgeRouter is fully setup, you might want to run this from a computer that is currently wired outside of the EdgeRouter. This is shown as “Existing LAN” in Figure 2 - EdgeRouter Configuration Setup. The page is at:

<https://www.grc.com/dns/benchmark.htm>

Steve Gibson has another web page that tests the “spoofability” (security) of DNS resolvers. It is at:

<https://www.grc.com/dns/dns.htm>

Here are some alternate DNS resolvers, and additional DNS information pages:

https://en.wikipedia.org/wiki/List_of_managed_DNS_providers

<https://dns.norton.com/configureRouter.html>,

<https://dns.norton.com/faq.html>

[https://support.opendns.com/hc/en-us/articles/228006047-Generalized-Router-Configuration-](https://support.opendns.com/hc/en-us/articles/228006047-Generalized-Router-Configuration-Instructions)

[Instructions](https://support.opendns.com/hc/en-us/articles/228006047-Generalized-Router-Configuration-Instructions)

<https://use.opendns.com/#router>

<https://en.wikipedia.org/wiki/OpenDNS>

<https://www.quad9.net/> and <https://www.quad9.net/#/faq>

EdgeRouter DNS References:

<https://community.ubnt.com/t5/EdgeMAX/ERL-3-1-9-0-No-DHCP-leases-since-switching-to-DNSMasq/td-p/1644201>

<https://community.ubnt.com/t5/EdgeMAX/Traffic-Analysis-host-name-resolution/m-p/1774017#M141121>

<https://loganmarchione.com/2016/08/edgerouter-lite-dnsmasq-setup/>

For more information on Quad9, see Security Now Podcast #638 at <https://www.grc.com/securitynow.htm>

20. dnsmasq

There are two different DNS packages available within the EdgeRouter. They are ISC (default) and dnsmasq. Dnsmasq was incomplete as of firmware 1.9.0 and had an additional bug added in firmware 1.9.1, I think it was re-broken and fixed during the hoxfixes of 1.9.7. Enabling dnsmasq is optional.

To enable dnsmasq, enter the Config Tree. Reference section “14 - EdgeRouter Config Tree.” Select and open up the following config tree sub-menu items from the configuration screen:

service
dhcp-server

You should see some DHCP settings, including use-dnsmasq. (Note, your screen will still show “disable”). See Figure 45 – use-dnsmasq.

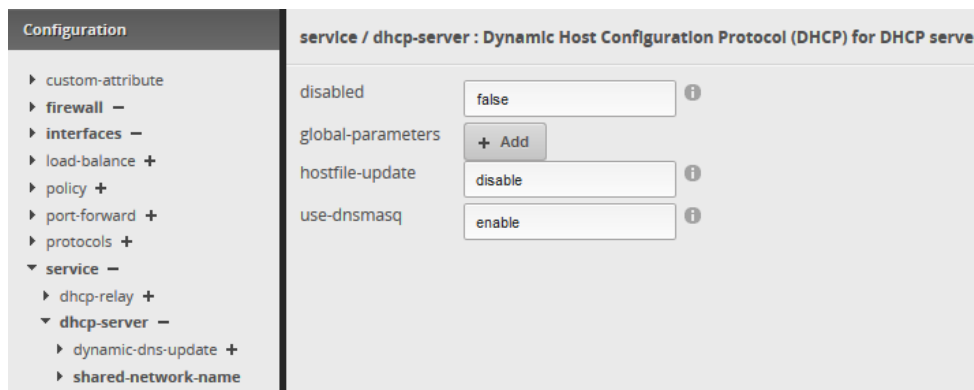


Figure 45 – use-dnsmasq

Type “enable” in the use-dnsmasq box. Then press the “Preview” button. See Figure 46 – commit-dnsmasq.

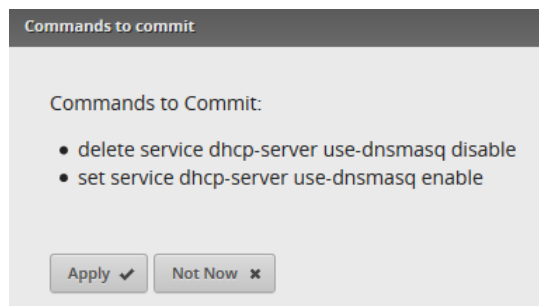


Figure 46 – commit-dnsmasq

Press “Apply.” You should see the message “The configuration has been applied successfully”, in green, near the bottom of the screen.

Reference:

<https://help.ubnt.com/hc/en-us/articles/115002673188-EdgeRouter-Using-dnsmasq-for-DHCP-Server>

<https://help.ubnt.com/hc/en-us/articles/115010913367-EdgeRouter-DNS-Forwarding-Explanation-Setup-Options>

21. System DNS Settings

This step instructs the EdgeRouter to use specific DNS servers to resolve web URLs into IP addresses. These DNS servers are specified under the System window. The Guest and IOT Networks set up via this guide use different DNS servers, as overridden by their specific DHCP servers.

Press the “System” button. Reference Figure 9 – System Button.

On the system window, find the Name Server Box. See Figure 47 – Initial System Name Server.

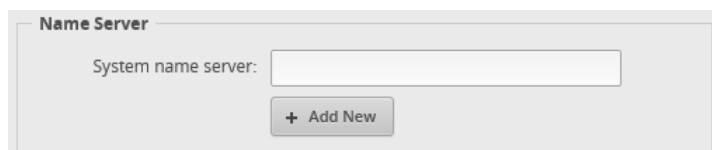
A screenshot of the 'Name Server' configuration box. It has a title bar 'Name Server' in blue. Below it, the text 'System name server:' is followed by an empty text input field. Below the input field is a button with a plus sign and the text '+ Add New'.

Figure 47 – Initial System Name Server

Fill in the System name server field with your primary DNS server address. I recently switched over to using a Quad9 resolver which has an address of:

9.9.9.9

The Quad9 infrastructure only provides a single resolver address. If you were using a more traditional resolver service, then you would press the “+ Add New” button and enter your secondary DNS server address.

See Figure 48 – Example System DNS Entries.

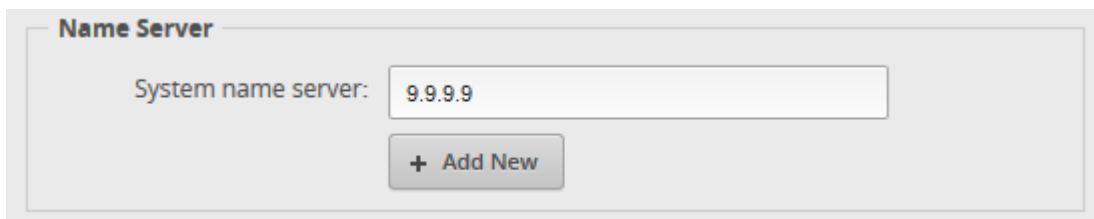
A screenshot of the 'Name Server' configuration box. It has a title bar 'Name Server' in blue. Below it, the text 'System name server:' is followed by a text input field containing the value '9.9.9.9'. Below the input field is a button with a plus sign and the text '+ Add New'.

Figure 48 – Example System DNS Entries

Press the Save button near the bottom of the system page.

A screenshot of a 'Save' button. The button is rectangular with rounded corners, a light gray background, and a darker gray border. It contains a small icon of a floppy disk followed by the text 'Save'.

Figure 49 – System Save Button

22. Remove ISP Provided DNS Resolvers

I don't want to depend upon the DNS servers that are provided by my dsl / cable modem. The specific DNS resolver addresses are specified as part the DHCP data, which is given to the EdgeRouter's eth0 WAN port from the dsl / cable modem. Performing the commands in this section is optional / up to you.

These ISP DNS servers are probably OK, but I don't trust the security of phone-company/cable-company provided modems. Consumer modems are typically full of unpatched security holes, and many have programmed backdoors in them. Commercial modems bulk produced by the lowest bidder and externally controlled by large, uncaring companies have got to be even worse.

The site <http://routersecurity.org/> is a big reason why I moved to this Ubiquiti equipment.

See how many bugs per MONTH are shown at <https://www.routersecurity.org/bugs.php>

In particular, there are DNS changer worms, which attack consumer / commercial routers and change their DNS resolver settings. The way to help circumvent this problem is to instruct the EdgeRouter to ignore the DHCP provided DNS resolver address from your commercial router / ISP.

Since the DNS changer worm could attack an EdgeRouter, remember to change the EdgeRouter's password.

To see the DNS resolvers being used by the EdgeRouter, issue the CLI command:

```
show dns forwarding nameservers.
```

(For information on the CLI, reference section "13 - EdgeRouter Command Line Interface (CLI)")

The following text shows theQuad9 resolver that was entered into the system page, and an ISP-provided resolver, delivered via my existing router, which has an address of 192.168.2.1:

```
-----
Nameservers configured for DNS forwarding
-----
192.168.2.1 available via 'dhcp eth0'
9.9.9.9      available via 'system'
```

To remove the ISP-provided nameservers, drop into the Command Line Interface (CLI) and issue the following commands:

```
configure
set service dns forwarding system
commit
save
exit
```

To see if this worked, re-issue the CLI command "show dns forwarding nameservers". This is what I got:

```
-----
Nameservers configured for DNS forwarding
-----
9.9.9.9 available via 'optionally configured'
-----
Nameservers NOT configured for DNS forwarding
-----
192.168.2.1 available via 'dhcp eth0'
```

Reference <https://community.ubnt.com/t5/EdgeMAX/Change-WAN-DNS-Server/td-p/977885>

QUESTION: Is this the best way to achieve this?

QUESTION: How do you restore using the ISP's resolvers?

23. Configure EdgeRouter's eth2 DHCP Server

Now that eth2 has been un-bundled, and has a unique IP subnet assigned to it, we need to provide a DHCP server on this port. Near the top of the screen select the “Services” button. See Figure 50 – Services Button.



Figure 50 – Services Button

Ensure that the “DHCP Server” tab is selected. See Figure 51 – DHCP Server Screen.

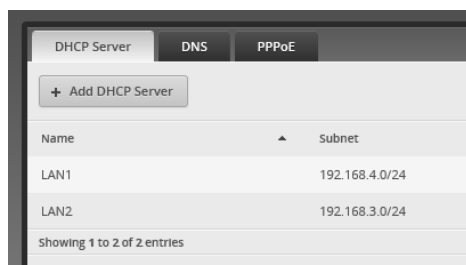


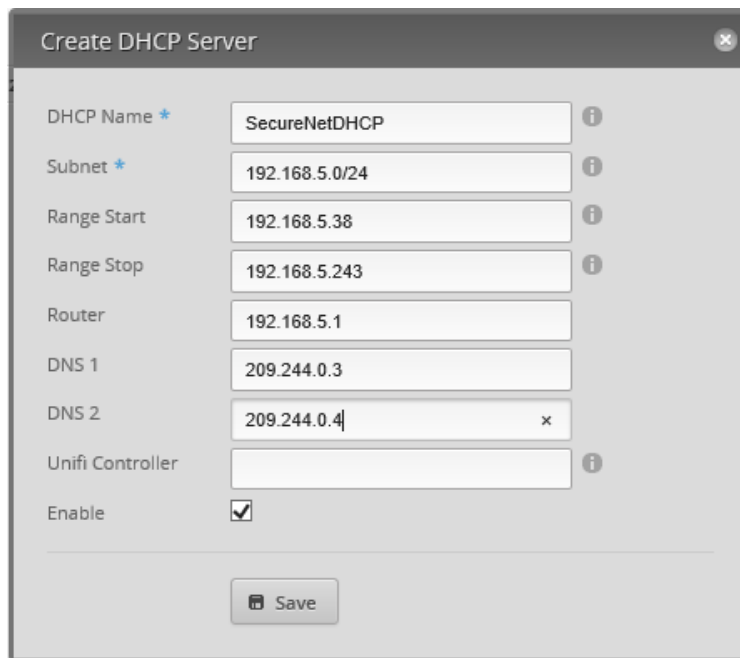
Figure 51 – DHCP Server Screen

Note that I am using Level 3 DNS resolver addresses for DNS1 and DNS2 (below). You can change these to providers of your choice. If you change them here, you will also need to manually modify some firewall / NAT rules, presented later within this guide.

Click on the “+ Add DHCP Server” button. You will be presented with a Create DHCP Server dialog. See Figure 52 – Create eth2 DHCP Server Screen. Fill in the form as follows:

DHCP Name:	SecureNetDHCP
Subnet:	192.168.5.0/24
Range Start:	192.168.5.38
Range Stop:	192.168.5.243
Router:	192.168.5.1
DNS 1:	209.244.0.3
DNS 2:	209.244.0.4
Enable:	CHECKED

Click “Save.”



The image shows a 'Create DHCP Server' window with the following fields and values:

Field	Value
DHCP Name *	SecureNetDHCP
Subnet *	192.168.5.0/24
Range Start	192.168.5.38
Range Stop	192.168.5.243
Router	192.168.5.1
DNS 1	209.244.0.3
DNS 2	209.244.0.4
Unifi Controller	
Enable	<input checked="" type="checkbox"/>

At the bottom is a 'Save' button.

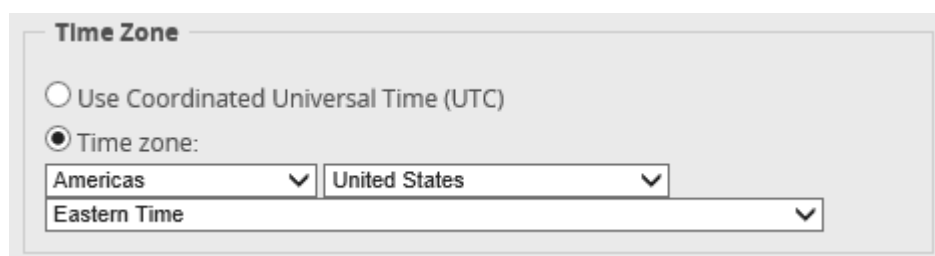
Figure 52 – Create eth2 DHCP Server Screen

I used the same range start and range stop values (38 and 243) that the wan+2lan2 wizard used within the DHCP servers for LAN1 and LAN2.

For some reason, the Ubiquiti GUI programmers seem to have forgotten to include the setting of “authoritative enable” and “domain” from this GUI interface. Setting of those will come later.

24. Configure EdgeRouter’s Time Zone

Near the bottom of the screen select the “System” button. Reference Figure 9 – System Button. Find the section titled “Time Zone” and configure the data in these fields according to the time zone you are in, unless you want your router to remain in UTC. See Figure 53 – Time Zone.



The image shows a 'Time Zone' configuration window with the following options:

- ☐ Use Coordinated Universal Time (UTC)
- ☒ Time zone:
 - Americas (dropdown)
 - United States (dropdown)
 - Eastern Time (dropdown)

Figure 53 – Time Zone

25. DNS Forwarding

Press the “Services” button, near the top right of the window. Reference Figure 50 – Services Button. Ensure that the “DNS” Tab is selected. See Figure 54 – DNS Tab.

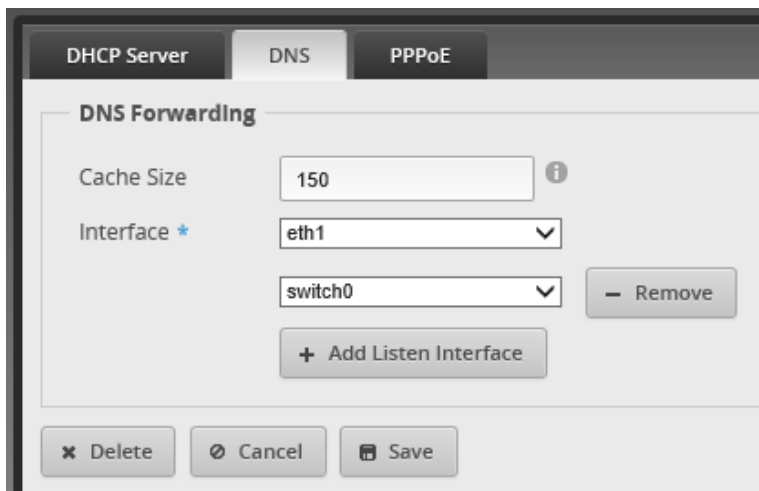


Figure 54 – DNS Tab

I changed my cache size to 400. We want to remove eth1 from this list. Change the first item (which can't be removed to “switch0”. Then press the “- Remove” button to the right of the second item. The result should look like Figure 55 – Remove eth1 from DNS. Press “Save.”

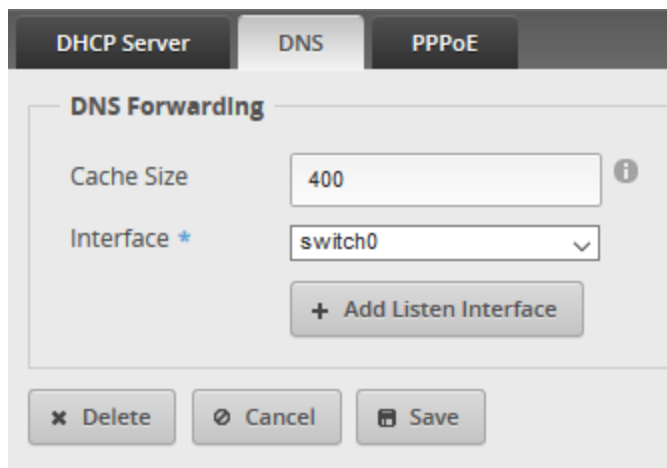


Figure 55 – Remove eth1 from DNS Forwarding

26. Add VLAN Networks to the EdgeRouter

The Ubiquiti AC-AP-LR Wi-Fi access point can manage up to four separate Networks / SSIDs, by using VLANs. VLANs allow separated IP data to flow over one Ethernet cable, without the data being mixed together. This section will create two new Networks using VLANs.

Press the Dashboard button near the top of the Screen. Reference Figure 34 – Dashboard Button. On the upper left side of the Dashboard screen select the Add Interface button. See Figure 56 – Add Interface Button



Figure 56 – Add Interface Button

The Add Interface menu will appear. Select “Add VLAN”. See Figure 57 – Add Interface Menu

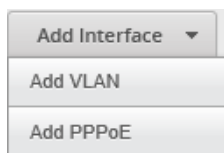


Figure 57 – Add Interface Menu

You will be presented with the “Create New VLAN” dialog. Fill in the information as follows:

VLAN ID:	6
Interface:	switch0
Description:	“Wifi Guest Net”
MTU:	1500
Address:	Manually define IP address
	192.168.6.1/24

The AC-AP-LR access point will eventually be connected to the eth4 interface. The eth3 and eth4 interfaces are internally using the switch0 chip. Therefore, this VLAN needs to be attached to switch0, not to eth3 or to eth4. See Figure 58 – Create New VLAN Example. Press the “Save” button.

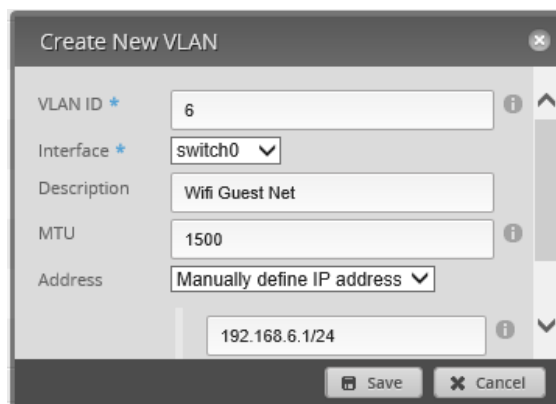
A dialog box titled "Create New VLAN" with a close button (X) in the top right corner. It contains several input fields: "VLAN ID" with the value "6", "Interface" with a dropdown menu showing "switch0", "Description" with the text "Wifi Guest Net", "MTU" with the value "1500", and "Address" with a dropdown menu showing "Manually define IP address". Below the "Address" dropdown is a text input field containing "192.168.6.1/24". At the bottom right are "Save" and "Cancel" buttons.

Figure 58 – Create New VLAN Example

Repeat these steps for adding a VLAN the Wi-Fi IOT Network. Fill in the information as follows:

VLAN ID: 7
Interface: switch0
Description: "Wifi Iot Net"
MTU: 1500
Address: Manually define IP address
192.168.7.1/24

There are the relevant sections from the backup file:

```
vif 6 {  
    address 192.168.6.1/24  
    description "Wifi Guest Net"  
    mtu 1500  
}  
vif 7 {  
    address 192.168.7.1/24  
    description "Wifi Iot Net"  
    mtu 1500  
}
```

Here is a link discussing using VLANs and managed switches to reduce the number of network cables in a home:

<https://community.ubnt.com/t5/EdgeMAX/Need-recommendation-on-tweaking-config-to-support-some-VLAN/td-p/2155404>

When writing this guide, I was not able to figure out how to combine the Wired IOT Network (as 192.168.4.X) and the Wi-Fi IOT Network (as 192.168.7.X) as a single Network / Subnet.

QUESTION: Is there a way to combine the Wired IOT Network and the WiFi IOT Network?

Some ideas for answers are:

<https://github.com/mjp66/Ubiquiti/issues/5>

<https://community.ubnt.com/t5/EdgeMAX/Adding-a-new-subnet-to-an-Edge-Router-X/td-p/2197809>

<https://help.ubnt.com/hc/en-us/articles/115012700967-EdgeRouter-VLAN-Aware-Switch0-with-Inter-VLAN-Firewall-Limiting>

<https://help.ubnt.com/hc/en-us/articles/205197630-EdgeSwitch-VLANs-and-Tagged-Untagged-Ports>

<https://help.ubnt.com/hc/en-us/articles/222183968-Intro-to-Networking-Introduction-to-Virtual-LANs-VLANs-and-Tagging>

I have not tried any of these potential solutions.

27. Add DHCP Servers to the VLANs

Following the directions that are in the section titled “23 - Configure EdgeRouter’s eth2 DHCP Server”, add DHCP servers for the two VLANs that were just created. Note that I am using Open DNS servers for these networks. If you change them here, you will also need to manually modify some firewall / NAT rules, presented later within this guide.

The information for VLAN 6, is as follows:

DHCP Name:	WifiGuestDHCP
Subnet:	192.168.6.0/24
Range Start:	192.168.6.38
Range Stop:	192.168.6.243
Router:	192.168.6.1
DNS 1:	208.67.222.222
DNS 2:	208.67.220.220
Enable:	CHECKED

The information for VLAN 7, is as follows:

DHCP Name:	WifiIotDHCP
Subnet:	192.168.7.0/24
Range Start:	192.168.7.38
Range Stop:	192.168.7.243
Router:	192.168.7.1
DNS 1:	208.67.222.222
DNS 2:	208.67.220.220
Enable:	CHECKED

You should now have five DHCP servers.

28. Set Domain Names for Networks

Near the top of the screen select the “Services” button. Reference Figure 50 – Services Button. Ensure that the “DHCP Server” tab is selected. Reference Figure 51 – DHCP Server Screen

Find the LAN1 line, and follow it to the right side, to the line’s “Actions” button. Click the “Actions” button. You will be presented with a list of actions. Choose “View Details”. See Figure 59 – DHCP Actions.

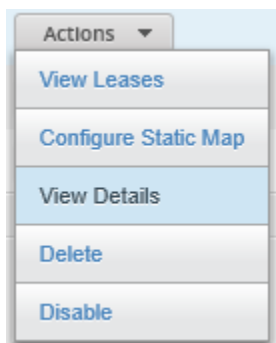


Figure 59 – DHCP Actions

A dialog will open. See Figure 60 – DHCP Server Details Dialog.

A screenshot of a web dialog titled 'DHCP Server - LAN1'. The dialog has three tabs: 'Leases', 'Static MAC/IP Mapping', and 'Details' (which is active). In the 'Details' tab, there is a summary section at the top showing 'Pool Size: 206', 'Leased: 0', 'Available: 206', and 'Static: 0'. To the right of this, it shows 'Subnet: 192.168.4.0/24', 'Range Start: 192.168.4.38', 'Range End: 192.168.4.243', 'Unifi Controller:', 'Router: 192.168.4.1', 'DNS 1: 192.168.4.1', 'DNS 2:', and 'Status: Enabled'. Below this, there are input fields for 'DHCP Name' (set to LAN1), 'Subnet' (set to 192.168.4.0/24), 'Range Start' (192.168.4.38), 'Range Stop' (192.168.4.243), 'Router' (192.168.4.1), and 'Unifi Controller'. To the right of these are fields for 'DNS 1' (192.168.4.1), 'DNS 2' (empty), 'Domain' (WiredotNet), 'Lease Time' (86400 seconds), and an 'Enable' checkbox which is checked. At the bottom left is a 'Save' button, and at the bottom right is a 'Delete' button.

Figure 60 – DHCP Server Details Dialog

Fill-in the “Domain” field with:

WiredlotNet

and then click “Save.” When it is done updating, close the dialog.

Repeat these steps for the following DHCP Servers as show in Table 2 - Table of Domain Names (You have just done the first one of them):

DHCP Servers	Domain
LAN1	WiredlotNet
LAN2	HomeNet
SecureNetDHCP	SeparateNet
WiFiGuestDHCP	WifiGuestNet
WifiIOTDHCP	WifilotNet

Table 2 - Table of Domain Names

29. Modify EdgeRouter's eth1 DHCP Server

Select the "Services" button. Reference Figure 50 – Services Button.

Ensure that the "DHCP Server" tab is selected. Reference Figure 51 – DHCP Server Screen

Select the "Action" button to the right of the "LAN1" line. Reference Figure 59 – DHCP Actions.

Choose "View Details." Reference Figure 60 – DHCP Server Details Dialog.

Modify / enter the following information:

DNS 1: 208.67.222.222

DNS 2: 208.67.220.220

These DNS addresses have the equipment on the Wired lot Network use Open DNS resolvers. If different resolver addresses are used here, then some firewall rules (and probably group addresses) will also need to be modified. Covered later in this guide.

30. Make DHCP Servers “authoritative”

The EdgeRouter does not default any newly created DHCP servers to “authoritative.” This means that devices on the added Networks can take a long time to acquire an IP address. The Networks that were added by the Wizard (LAN1 and LAN2) are made authoritative by default.

Enter the Config Tree. Reference section “14 - EdgeRouter Config Tree.” Select and open up the following config tree sub-menu items from the configuration screen:

service
dhcp-server
shared-network-name

Click on the DHCP server you want to configure; in this case, it is:

SecureNetDHCP

You should see some DHCP settings, including authoritative. (Note, your screen will still show “disable”). See Figure 61 – Authoritative Example.

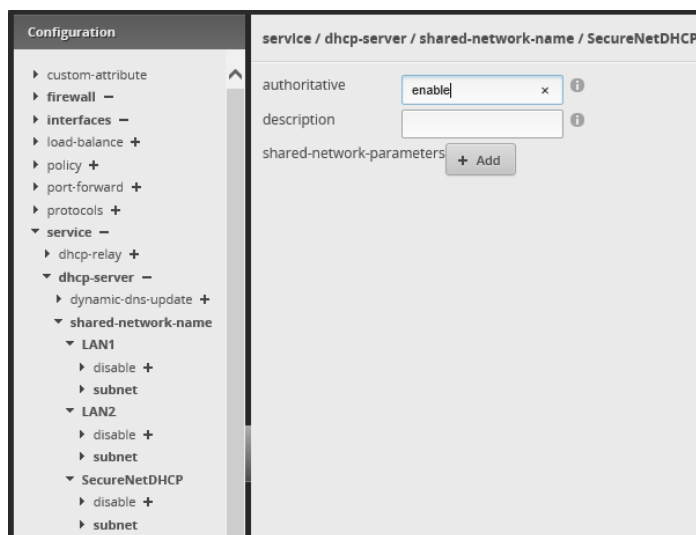


Figure 61 – Authoritative Example

Type “enable” in the authoritative box. Then press the “Preview” button. See Figure 62 – Authoritative Commit.

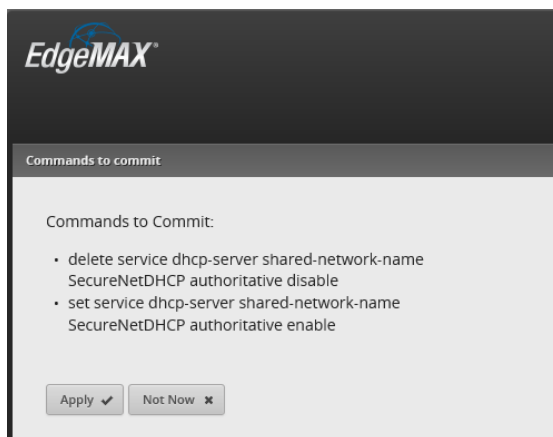


Figure 62 – Authoritative Commit

Press “Apply.” You should see the message “The configuration has been applied successfully”, in green, near the bottom of the screen.

Repeat these steps for the following Authoritative DHCP Servers as shown in Table 3 - Table of Authoritative DHCP Servers. (You have just done the first one of them):

Authoritative DHCP Servers
SecureNetDHCP
WiFiGuestDHCP
WifiotDHCP

Table 3 - Table of Authoritative DHCP Servers

Shown below are excerpts of three of the five DHCP sections from the backup file:

```
dhcp-server {
  disabled false
  hostfile-update disable
  shared-network-name LAN2 {
    authoritative enable
    subnet 192.168.3.0/24 {
      default-router 192.168.3.1
      dns-server 192.168.3.1
      domain-name HomeNet
      lease 86400
      start 192.168.3.38 {
        stop 192.168.3.243
      }
    }
  }
}
shared-network-name SecureNetDHCP {
  authoritative enable
  subnet 192.168.5.0/24 {
    default-router 192.168.5.1
    dns-server 209.244.0.3
    dns-server 209.244.0.4
    domain-name SeparateNet
    lease 86400
    start 192.168.5.38 {
      stop 192.168.5.243
    }
  }
}
shared-network-name WifiGuestDHCP {
  authoritative enable
  subnet 192.168.6.0/24 {
    default-router 192.168.6.1
    dns-server 208.67.222.222
    dns-server 208.67.220.220
    domain-name WifiGuestNet
    lease 86400
    start 192.168.6.38 {
      stop 192.168.6.243
    }
  }
}
}
use-dnsmasq enable
}
```

31. EdgeRouter Enable HW NAT Assist

Enabling “hwnat” turns on some features of a hardware switching chip that is within the EdgeRouter. This chip assists the EdgeRouter’s CPU with routing and NAT functionality, speeding up the operation of the EdgeRouter X. Without this hardware assist, routing of packets is relatively slow. Be warned; if Quality of Service (QoS) functionality is enabled, then this hwnat assist is internally / automatically disabled. You also don’t want to enable bridging, since bridging is implemented via the CPU of the EdgeRouter X and is also relatively slow.

With hwnat enabled, many people report 800 – 900Mbps throughput.

Open up the Configuration Tree. Reference section 14 - EdgeRouter Config Tree.

Select and open up the following config tree sub-menu items from the configuration screen:

- system
- offload

In the hwnat setting area, type:

- enable

then select the “Preview” button at the bottom of the page.

See Figure 63 – System Offload Hwnat Selection (Partial).



Figure 63 – System Offload Hwnat Selection (Partial)

The Edgerouter will preview what command(s) it will issue. See Figure 64 – Preview hwnat Config.

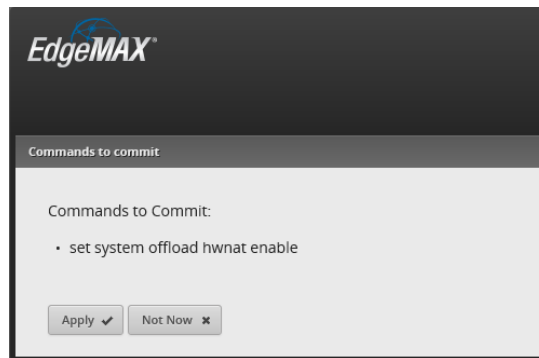


Figure 64 – Preview hwnat Config

Press “Apply.” The system will inform you that, “The configuration has been applied successfully”. See Figure 65 – hwnat Success

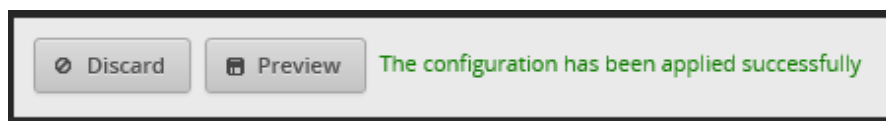


Figure 65 – hwnat Success

The above config-tree hwnat-enable could have been performed with the following CLI commands:

```
configure
set system offload hwnat enable
commit
save
exit
```

Compare the above command(s) with the command that the config-tree automatically issued in Figure 64 – Preview hwnat Config.

Remember that different models of EdgeRouters have different abilities / hardware assisting chips within them. Their commands may be different.

32. EdgeRouter ER-X Speed

The ER-X router seems capable of routing about 1Gbit/second aggregate/total.

The following article is well worth reading:

<http://kazoo.ga/re-visit-the-switch-in-edgerouter-x/>

Performance references:

<https://community.ubnt.com/t5/EdgeMAX/What-is-the-switch0-interface-re-EdgeRouter-X/td-p/1485842>

<https://community.ubnt.com/t5/EdgeMAX/Performance-of-EdgerouterX-vs-Edgerouter-Lite/td-p/1230924>

<https://community.ubnt.com/t5/EdgeMAX/EdgeRouter-X-low-throughput-slow/td-p/1392229>

<https://community.ubnt.com/t5/EdgeMAX/ER-X-vs-ER-Lite-Head-to-Head-Speed-Results-on-Google-Fiber/td-p/1839844>

<https://www.stevejenkins.com/blog/2017/02/edgerouter-x-vs-edgerouter-lite-google-fiber-speed-tests/>

<https://community.ubnt.com/t5/EdgeMAX/Edgerouter-X-Fios-Gigabit-Won-t-go-over-500-Mbps/td-p/1910761>

33. EdgeRouter Enable Traffic Analysis

This step will enable the EdgeRouter to perform Deep Packet Inspection (DPI) / Traffic Analysis.

Press the “Traffic Analysis” button, near the top right of the screen. See Figure 66 – Traffic Analysis Button.

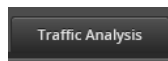


Figure 66 – Traffic Analysis Button

In the upper-right area of the traffic analysis screen, is an “Operational Status” selection. Select “Enabled.” See Figure 67 – Enable Operational Status



Figure 67 – Enable Operational Status

You will be presented with a confirmation dialog. See Figure 68 – Operational Status Confirmation.

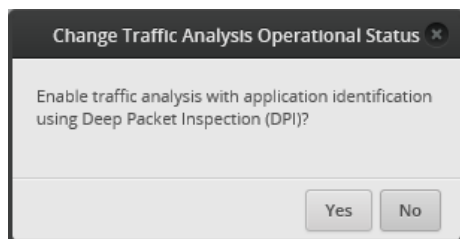


Figure 68 – Operational Status Confirmation

Select “Yes.” The software will (for some reason) present you with an Alert. This is seen in the lower-left of the screen. See Figure 69 – Active Alert.



Figure 69 – Active Alert

Click on the “Alerts” button. You will be presented with the Alert message(s). See Figure 70 – Active Traffic Analysis Message.

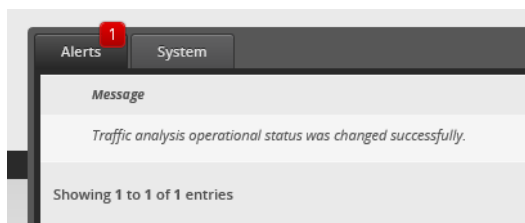


Figure 70 – Active Traffic Analysis Message

To remove this Alert message, press the “Remove” button, located on the right side of the screen. See Figure 71 – Remove Alert Button

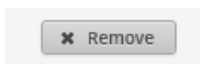


Figure 71 –Remove Alert Button

34. EdgeRouter Traffic Analysis

The Traffic Analysis performed by the EdgeRouter X is pretty neat. The following screen shot was taken when the Edgerouter was at this configuration step in generating this configuration document. The EdgeRouter had been booted for 41 minutes.

The only thing I had done, since I booted the “setup” computer, was to configure the EdgeRouter. I NEVER purposefully go to MSN.com, or to the Financial Times News. I only assume that those web lookups are from Microsoft’s Internet Explorer / Microsoft performing their Windows 10 monetization of their users, sometimes referred to as “spying.” See Figure 72 –Sample Traffic Analysis. This feature seems pretty neat at first. In real use there seems to be a lot of uncharacterized traffic under “Other.”

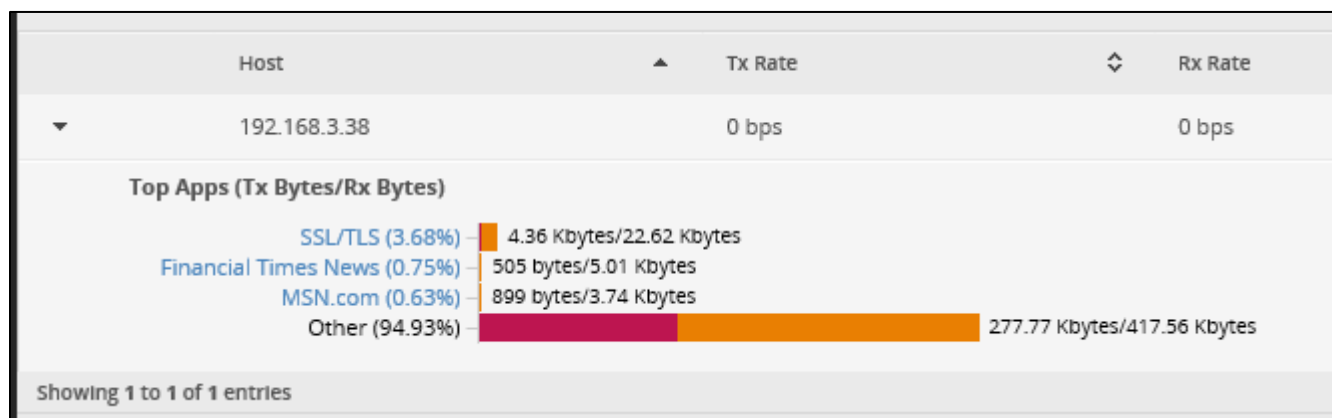


Figure 72 –Sample Traffic Analysis

Note that when HW NAT Assist is enabled, some traffic, which is handled by the internal switch chip, is not shown in traffic analysis. That is because Traffic Analysis is a CPU function, and the traffic that is being handled internally by the switch chip is not visible to the CPU. The configuration used in this guide has setup the switch0 chip to only move traffic between eth3 and eth4, which is the Home Net (Network).

35. EdgeRouter X/X-SFP bootloader bug

There is an initialization issue in the bootloader for the ER-X and ER-X-SFP models that causes all ports to act as a "switch" during a brief period of time when the router is booting up.

When this guide was written, Ubiquiti had still not updated their production line to incorporate the patched bootloader.

Reference <https://community.ubnt.com/t5/EdgeMAX/EdgeRouter-X-acts-as-switch-during-boot/td-p/1393679>

36. EdgeRouter X/X-SFP check bootloader version

Check the version of your bootloader per:

<https://community.ubnt.com/t5/EdgeMAX/EdgeRouter-X-X-SFP-check-bootloader-version/td-p/1617287>

Some postings may be missing the "s" in "firmwares".

37. EdgeMAX EdgeRouter X/X-SFP bootloader update

If your bootloader is not the newest, update your bootloader per:

<http://community.ubnt.com/t5/EdgeMAX-Updates-Blog/EdgeMAX-EdgeRouter-X-X-SFP-bootloader-update/ba-p/1472216>

It is much easier to update the EdgeRouter's bootloader when the EdgeRouter is connected to the internet.

You may need to prepend "sudo" to one for more commands, to get this to work.

<https://community.ubnt.com/t5/EdgeMAX/ERX-bootloader-update/td-p/1892923>

38. EdgeRouter Power Cycle Warning

Generally, you should use the reboot button that is located on the system screen to restart the EdgeRouter; don't simply remove power to the EdgeRouter, if you can help it.

Reference **TBD**

39. EdgeRouter UPnP

Don't enable UPnP. If you need to connect devices like an Xbox behind your EdgeRouter, then manually open / forward the firewall ports by hand. If you really want UPnP, I've got a slightly used D-Link router for sale, which probably has lots of holes already in its firewall. Just ask the Federal Trade Commission.

Reference **TBD**

40. Extended GUI Access / Use May Crash the EdgeRouter

Leaving the EdgeRouter's GUI interface up for extended periods of time (maybe like a day or so) may crash the Edgerouter.

Reference **TBD**

41. EdgeRouter Toolbox

In the upper right side of the main page, is a Toolbox button. When you click on it, you will see some nice utilities. See Figure 73 –Toolbox Items.

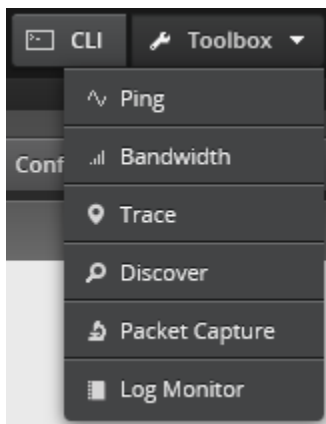


Figure 73 –Toolbox Items

42. Address Groups

The software in the EdgeRouter allows the user to define Address Groups. These groups are used for convenience. We will define several address groups, including one for each Network. Reference Table 1 - Table of Networks.

Select the “Firewall/NAT” Button from the top of the screen. See Figure 74 – Firewall/NAT Button.



Figure 74 – Firewall/NAT Button

From the tabs that are shown, select “Firewall/NAT Groups”. See Figure 75 – Firewall/NAT Groups Tab.



Figure 75 – Firewall/NAT Groups Tab

Find the “+ Add Group” button and click it. See Figure 76 – Add Group Button.

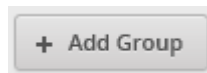


Figure 76 – Add Group Button

You will see the “Create New Firewall/NAT Group” dialog. Fill in this form as follows:

Name: WIRED_IOT_GROUP
Description: Wired Iot Group
Group Type: Address Group.

See Figure 77 – Example New Address Group Dialog. Press “Save.”

A dialog box titled "Create New Firewall/NAT Group" with a close button (X) in the top right corner. It contains three input fields: "Name" with the value "WIRED_IOT_GROUP", "Description" with the value "Wired Iot Group", and "Group Type" with three radio button options: "Address Group" (selected), "Network Group", and "Port Group". A "Save" button is at the bottom right.

Figure 77 – Example New Address Group Dialog

An empty Address group will have been added. Note that the “Number of group members” is 0. See Figure 78 – Added Address Group.

Name	Description	Type	Number of group members	
WIRED_IOT_GROUP	Wired Iot Group	address-group	0	Actions
Showing 1 to 1 of 1 entries				

Figure 78 – Added Address Group

Press the WIRED_IOT_GROUP's Action button and select Config. See Figure 79 – Address Group Actions

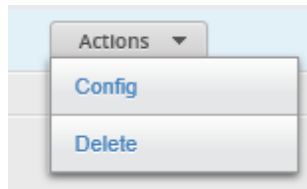


Figure 79 – Address Group Actions

Enter the address specifier of:
192.168.4.0/24

See Figure 80 – Example Edit Address Group. Press “Save.” When it is finished updating, close the dialog.

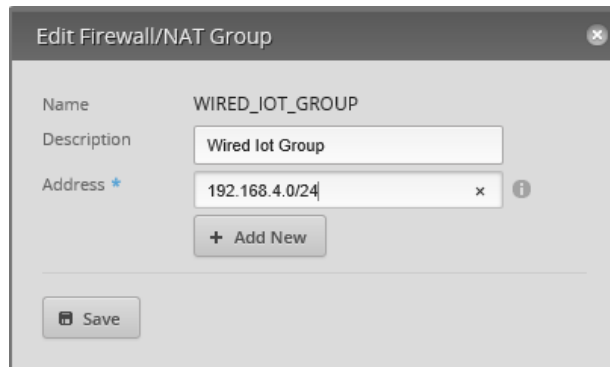


Figure 80 – Example Edit Address Group

Repeat the above steps for the following address groups. If there is more than one address listed in a group, then you will need to use the "+ Add New" button to add additional address(es) to the group. You have just done the WIRED_IOT_GROUP.

```
group {
  address-group HOME_GROUP {
    address 192.168.3.0/24
    description "Home Group"
  }
  address-group MULTIPLE_GROUP {
    address 192.168.3.0/24
    address 192.168.4.0/24
    address 192.168.6.0/24
    address 192.168.7.0/24
    description "Multiple Groups"
  }
  address-group OPENDNS_SERVERS_GROUP {
    address 208.67.222.222
    address 208.67.220.220
    description "OpenDNS Servers"
  }
  address-group WIFI_GUEST_GROUP {
    address 192.168.6.0/24
    description "Wifi Guest Group"
  }
  address-group WIFI_IOT_GROUP {
    address 192.168.7.0/24
    description "Wifi Iot Group"
  }
  address-group WIRED_IOT_GROUP {
    address 192.168.4.0/24
    description "Wired Iot Group"
  }
  address-group WIRED_SEPARATE_GROUP {
    address 192.168.5.0/24
    description "Wired Separate Group"
  }
}
```

The above text section is from the backup file.

43. EdgeRouter Layman's Firewall Explanation

I initially had trouble understanding the EdgeRouter's firewall rules. The firewall rules that I saw on the internet appeared backwards (in direction) to me. I also didn't understand what "local" rules meant or applied to. Then I found the article "Layman's firewall explanation".

Reference: <https://community.ubnt.com/t5/EdgeMAX/Layman-s-firewall-explanation/td-p/1436103>

I highly recommend that you should stop and read that entire posting now.

I have re-produced the main diagram, from that article, as Figure 81 – Layman's Firewall Explanation Diagram. Note that this diagram is for an EdgeRouter Lite, which has its WAN port on eth1. The WAN interface is therefore shown in the middle of this diagram.

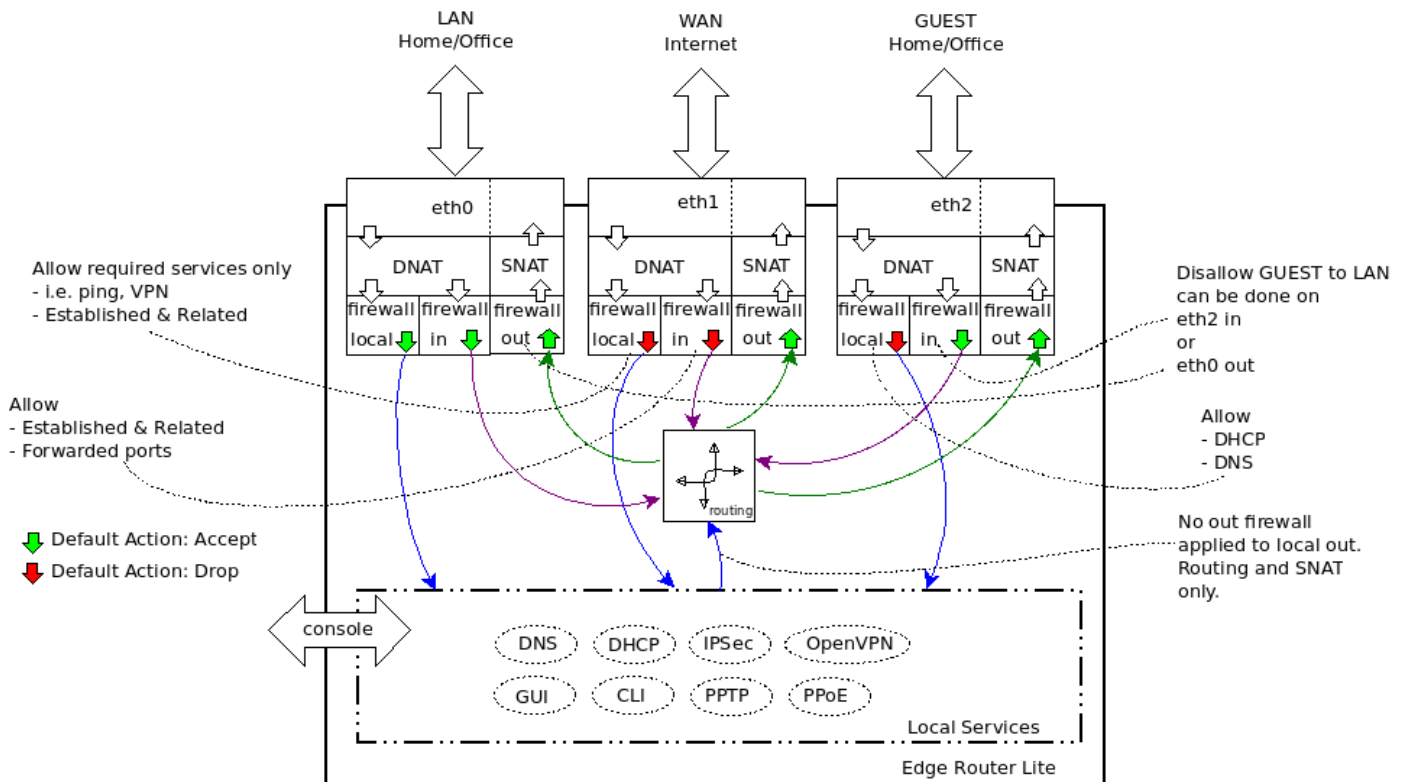


Figure 81 – Layman's Firewall Explanation Diagram

A firewall policy (ruleset) is a set of firewall rules along with a default action. The default action can be "accept," "reject," or "drop." A firewall ruleset is applied to a specific interface as well as applied to a specific "direction." For an EdgeRouter, the directions are "In," "Out," and "Local." The "In" direction is input IP packets from the internet, as well as input into the EdgeRouter from devices on a Network (LAN). The "Out" direction consists of IP packets output from the EdgeRouter destined for the internet, as well as output to your Network devices from the EdgeRouter. "Local" refers to IP data coming into the EdgeRouter destined for (services on the) EdgeRouter itself. Reference Figure 81 – Layman's Firewall Explanation Diagram.

Each firewall rule, within a ruleset, also has an action of "accept," "reject," or "drop." Each IP packet attempting to traverse an interface that has firewall rules will be tested by the individual firewall rules, in the ruleset order, until a firewall rule matches the rule's condition criteria. The individual firewall rules contain conditions that need to all be matched for that firewall rule to perform its action. If no firewall rules match an IP packet, then the ruleset's default action is taken for that packet. Once an IP packet matches an individual firewall rule, no other firewall processing is needed for that IP packet.

Firewall rules within the ruleset are applied (tested) in the specific order that they were arranged. Therefore, it is important to order the firewall rules so that the most frequently used rules are arranged at or near the top of the set of rules, allowing for efficiency within the EdgeRouter.

Firewall policies are applied before SNAT (Source Network Address Translation) and after DNAT (Destination Network Address Translation).

The descriptions above are by no means exact regarding what is happening internally. These descriptions are just meant to convey enough information to help understand these firewall rules, their design, and their operation.

Additional References:

<https://help.ubnt.com/hc/en-us/articles/204976664-EdgeMAX-How-are-packets-processed-by-EdgeRouter>

44. Firewall State

There are many conditions available that can constitute a firewall rule. One of the most important conditions is “State.” States are maintained internally by the underlying firewall code that is within the EdgeRouter, and are:

New – a packet starting a new connection

Invalid – packets that have invalid data in them

Established – packets associated with an existing connection (conversation)

Related – packets related to an existing connection (conversation)

45. WAN Firewall Rules

The most important firewall rules in an EdgeRouter, from a security standpoint, are the default WAN_IN and WAN_LOCAL rulesets. These rulesets were generated by the WLAN+2LAN2 Wizard. The firewall rules with these rulesets provide the “firewall” protection associated with (consumer) Network Address Translation (NAT) routers. The WAN_IN and WAN_LOCAL rulesets are identical, except for naming, and for the interface that they are applied to. This is the WAN_IN ruleset, from the backup file:

```
name WAN_IN {
    default-action drop
    description "WAN to internal"
    rule 10 {
        action accept
        description "Allow established/related"
        state {
            established enable
            related enable
        }
    }
    rule 20 {
        action drop
        description "Drop invalid state"
        state {
            invalid enable
        }
    }
}
```

The name of this ruleset is WAN_IN. The rules in this ruleset are applied (not shown here) to the input side of the eth0 interface, i.e., to IP packets that are entering the EdgeRouter from the internet.

This ruleset has a default action of drop. If a packet destined for this interface doesn’t match any firewall rule, then the packet will be dropped.

The first rule (rule 10) in the ruleset has an action of “accept,” and will allow packets that are “established” and “related” (i.e. associated) to an existing IP conversation to enter eth0. The only way to have an existing connection on eth0 is for the connection to have been started from within the EdgeRouter’s system, i.e., from the EdgeRouter itself, or from a device on one of the EdgeRouter Networks. Note that there are no other / additional qualifiers on this rule(s), so it is applied to every IP packet entering from the internet.

The second rule (rule 20) has an action of “drop.” Any packet matching this rule: “invalid state” will be dropped.

QUESTION: I’ve often wondered why the invalid state rule (number 20) has not been placed before the established/related rule (10). For well-behaved web sites this order should not matter. With badly coded web servers, having the invalid rule first might break some web usage. With the advent of malicious advertisements now being served up on legitimate web sites, it seems like it might make sense to place the invalid rule first, and risk some amount of web usage breakage.

46. EdgeRouter Detailed Firewall Setup

I have adapted Figure 81 – Layman’s Firewall Explanation Diagram to my own diagram. See Figure 82 – Detailed Firewall Setup Diagram.

The FireWall Rules (FWR) that are described in this guide are numbered (as FWR*) in Figure 82 – Detailed Firewall Setup Diagram. Each is associated with a named firewall ruleset that will be described in the following sections. FWRs that are colored red means a ruleset terminates with a default of drop, while FWRs colored green mean a default of accept. The firewall rule sets are:

- FWR1 = WAN_LOCAL.
- FWR2 = WAN_IN.
- FWR3 = WIRED_IOT_LOCAL.
- FWR4 = WIRED_SEPARATE_LOCAL.
- FWR5 = WIRED_SEPARATE_IN.
- FWR6 = WIRED_SEPARATE_OUT.
- FWR7 = HOME_OUT (same single set of rules, but shown in two places).
- FWR8 = WIFI_GUEST_LOCAL.
- FWR9 = WIFI_IOT_LOCAL.

The descriptions below are by no means exact regarding what is happening internally. These descriptions are just meant to convey enough information to help understand these firewall rules, their design and their operation.

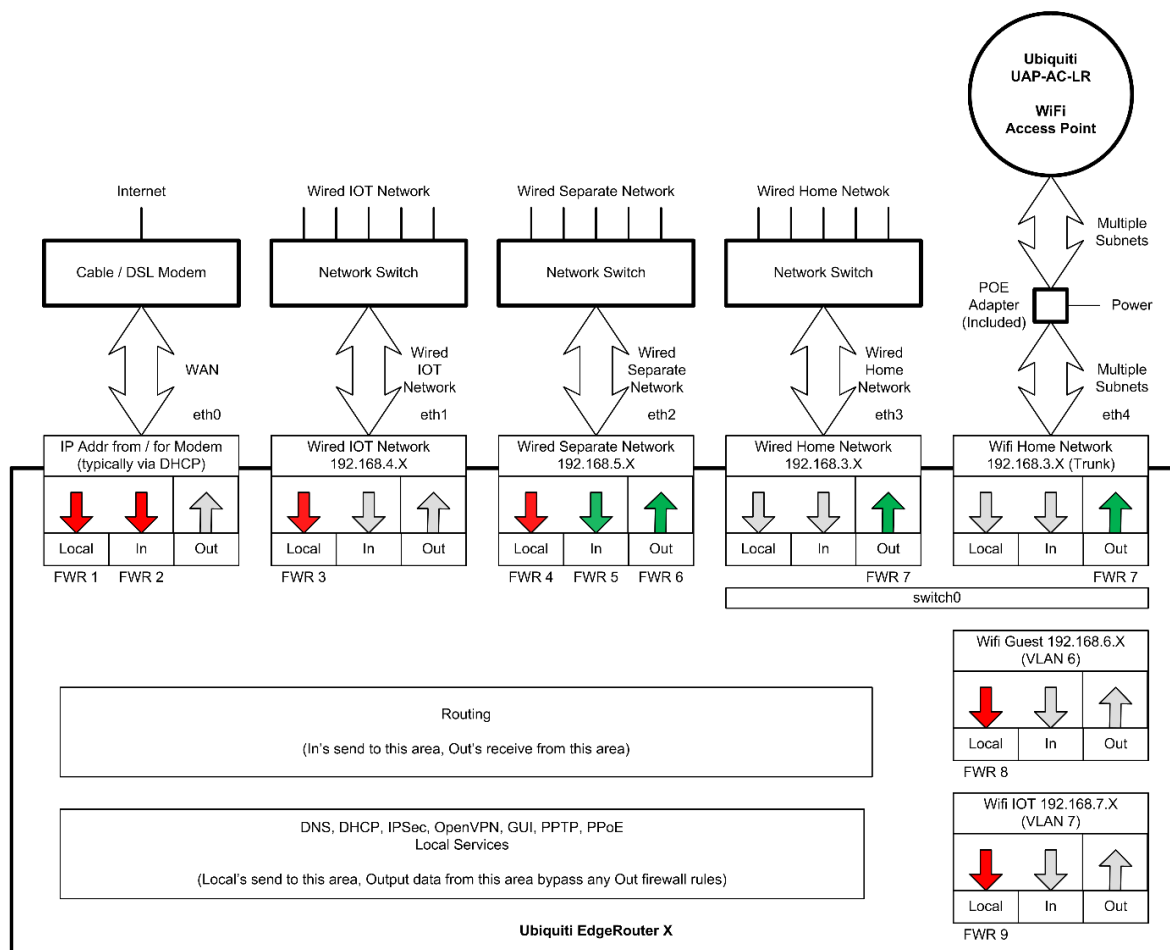


Figure 82 – Detailed Firewall Setup Diagram

47. WAN_LOCAL Firewall Rules

The basic operation of these firewall rules is described above, in the section titled “45 - WAN Firewall Rules”. These rules are FRW1 as shown in Figure 82 – Detailed Firewall Setup Diagram.

Add Optional VPN information, etc...

48. WAN_IN Firewall Rules

The basic operation of these firewall rules is described above, in the section titled “45 - WAN Firewall Rules”. These rules are FRW2 as shown in Figure 82 – Detailed Firewall Setup Diagram.

Add forwarded ports, etc...

49. HOME_OUT Firewall Rules

There are six firewall rules in this ruleset. These firewall rules inspect IP packets that are exiting the EdgeRouter towards devices on the Home Network. Reference “FWR7,” shown as two instances, in the upper-right of Figure 82 – Detailed Firewall Setup Diagram.

These six rules are maintained as three sets of two rules per interface, i.e., these two-rule-sets are applied to three interfaces. Each interface is a separate Network. Except for naming and the Network that they are applied to, the sets of two rules are identical. Only one set of two rules are shown here. The three Networks, which these three sets are applied-to, are: Wired Iot Network, Wifi Iot Network, and Wifi Guest Network.

The following section of backup file will be referenced later, so it was given a reference tag of Equation 1 – A Portion of the HOME_OUT Firewall Ruleset.

This is one set of two rules from the backup file:

```
name HOME_OUT {
  default-action accept
  description "Home Out"
  rule 1 {
    action accept
    description "Allow Wired Iot Replies"
    log disable
    protocol all
    source {
      group {
        address-group WIRED_IOT_GROUP
      }
    }
    state {
      established enable
      invalid disable
      new disable
      related enable
    }
  }
  rule 2 {
    action drop
    description "Drop Rest-Of Wired Iot Traffic"
    log disable
    protocol all
    source {
      group {
        address-group WIRED_IOT_GROUP
      }
    }
  }
}
```

...

Equation 1 – A Portion of the HOME_OUT Firewall Ruleset

The name of this ruleset is HOME_OUT. The rules in this ruleset are applied (not shown here) to the output side of both of the eth3 and eth4 interfaces, i.e., switch0. These interfaces are also known as the Home Network. IP packets that are exiting the EdgeRouter (on eth3/eth4) towards equipment on the Home Network are inspected and potentially dropped by these firewall rules. Remember that eth3 and eth4 are still bound together by the switch hardware within the EdgeRouter. In Figure 82 – Detailed Firewall Setup Diagram, this information is shown as duplicated in two blocks (in the upper-right portion of the diagram), each labeled with FWR7.

This ruleset has a default action of “accept.” If a packet destined for this interface doesn’t match any individual firewall rule, then the packet will be accepted, i.e., passed along to devices attached to the Home Network.

The first rule (rule 1) in this ruleset has an action of “accept,” and will allow IP packets that are “established” and “related” (i.e. associated) to an existing IP conversation, to exit the EdgeRouter to devices that are on the Home Network. Note that this rule has an additional qualifier that the source address must be in the address range of the WIRED_IOT_GROUP, i.e., this rule only applies to traffic that originates from the Wired IOT Network. The only way to have an existing connection between Wired IOT Network and the Home Network is for the conversation to have been started from devices within the Home Network. The name associated with this rule is "Allow Wired Iot Replies."

The second rule (rule 2) in this ruleset has an action of “drop,” and will drop all other IP packets that originate from the Wired IOT Network. Note that this rule also has the additional qualifier that the source address must be within the address range of the WIRED_IOT_GROUP. I.e., this rule only applies to traffic that originates from the Wired IOT Network. The name associated with this rule is "Drop Rest-Of Wired Iot Traffic."

These two rules, treated together, describe the IP connections (conversations) that can occur between equipment on the Wired IOT Network and the Home Network.

If the conversation was started by devices in the Home Network and directed to devices residing on the Wired IOT Network, then replies to those conversations will be allowed back into the Home Network by firewall rule number 1. Internally, the firewall code keeps track of IP connections, which are entering the EdgeRouter (the “In” side) and then allows traffic that is related to that data to exit the EdgeRouter towards the Home Network devices.

If a conversation was instead started by devices within the Wired IOT Network and directed towards the Home Network, firewall rule 1 will have no prior knowledge about this conversation (because it is not “established”/“related”). Therefore, firewall rule number 1 will not match, and firewall rule processing will then proceed to rule number 2. Rule number two drops all traffic from the Wired IOT Network.

There are two more sets of two rules (not shown here) within this ruleset, an identical set applied to the Wifi Guest Network (WIFI_GUEST_GROUP), and an identical set applied to the Wifi IOT Network (WIFI_IOT_GROUP).

Remember that the default action for this ruleset is “accept.” You want the Home Network to be able to operate on its own, when it is not conversing with just these three networks.

Note that every IP packet attempting to exit the EdgeRouter towards devices on the Home Network will need to be inspected by these six firewall rules. Most of the traffic destined for the Home Network will not be from one of the IOT or Guest Networks.

QUESTION: Maybe a single firewall rule can be added, at the top of this ruleset, which allows internet traffic to be accepted. This would increase the efficiency of this ruleset, by not depending upon most of the traffic to reach the default “accept” rule before being accepted.

50. Firewall Conditions

The following figures are from the “Add New Rule” firewall dialog. We will explain how to get to these in the next section. There are several Tabs in this dialog for entering firewall conditions. You might want to study the following figures, and familiarize yourself with what firewall conditions are available. See the following figures:

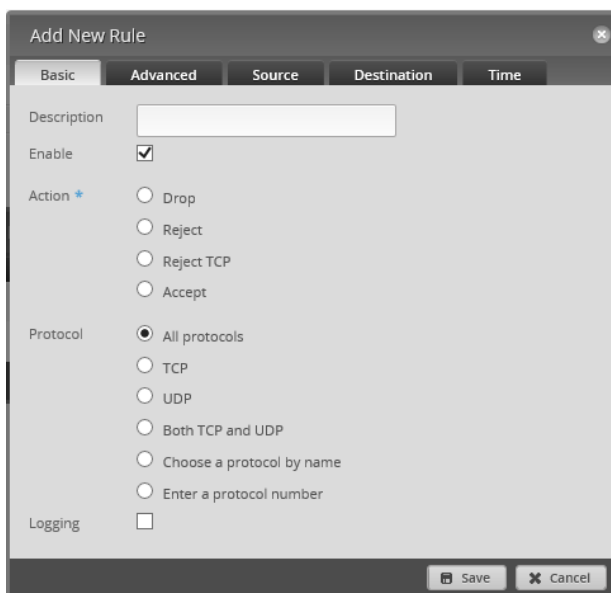
Figure 83 – Firewall Conditions, Basic Tab.

Figure 84 – Firewall Conditions, Advanced Tab.

Figure 85 – Firewall Conditions, Source Tab.

Figure 86 – Firewall Conditions, Destination Tab.

Figure 87 – Firewall Conditions, Time Tab.

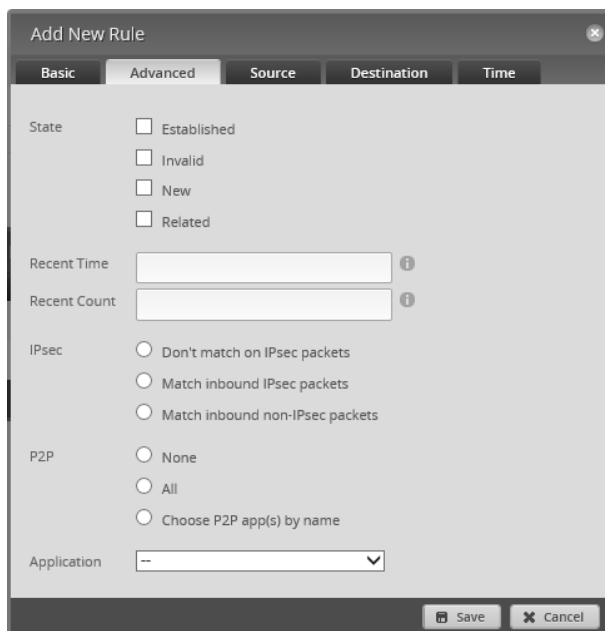


The screenshot shows the 'Add New Rule' dialog box with the 'Basic' tab selected. The dialog has a title bar with a close button. Below the title bar are five tabs: 'Basic', 'Advanced', 'Source', 'Destination', and 'Time'. The 'Basic' tab is active. It contains the following fields and options:

- Description:** A text input field.
- Enable:** A checked checkbox.
- Action:** A dropdown menu with a star icon, showing four options: 'Drop', 'Reject', 'Reject TCP', and 'Accept'.
- Protocol:** A dropdown menu with six options: 'All protocols' (selected), 'TCP', 'UDP', 'Both TCP and UDP', 'Choose a protocol by name', and 'Enter a protocol number'.
- Logging:** An unchecked checkbox.

At the bottom right are 'Save' and 'Cancel' buttons.

Figure 83 – Firewall Conditions, Basic Tab



The screenshot shows the 'Add New Rule' dialog box with the 'Advanced' tab selected. The dialog has a title bar with a close button. Below the title bar are five tabs: 'Basic', 'Advanced', 'Source', 'Destination', and 'Time'. The 'Advanced' tab is active. It contains the following fields and options:

- State:** A dropdown menu with four options: 'Established', 'Invalid', 'New', and 'Related'.
- Recent Time:** A text input field with an information icon.
- Recent Count:** A text input field with an information icon.
- IPsec:** A dropdown menu with three options: 'Don't match on IPsec packets', 'Match inbound IPsec packets', and 'Match inbound non-IPsec packets'.
- P2P:** A dropdown menu with three options: 'None', 'All', and 'Choose P2P app(s) by name'.
- Application:** A dropdown menu with a downward arrow.

At the bottom right are 'Save' and 'Cancel' buttons.

Figure 84 – Firewall Conditions, Advanced Tab

Add New Rule

Basic Advanced **Source** Destination Time

Address (i)

Port (i)

MAC Address (i)

Address Group -- ▾ or Interface Addr -- ▾
or Interface Network -- ▾

Network Group -- ▾

Port Group -- ▾

Save Cancel

Figure 85 – Firewall Conditions, Source Tab

Add New Rule

Basic Advanced Source **Destination** Time

Address (i)

Port (i)

Address Group -- ▾ or Interface Addr -- ▾ or
Interface Network -- ▾

Network Group -- ▾

Port Group -- ▾

Save Cancel

Figure 86 – Firewall Conditions, Destination Tab

Add New Rule

Basic Advanced Source Destination **Time**

Month Days (i)

☐ Match all month days except for these

Week Days (i)

☐ Match all week days except for these

Start Date (i)

Start Time (i)

Stop Date (i)

Stop Time (i)

☐ Interpret dates and times as UTC

Save Cancel

Figure 87 – Firewall Conditions, Time Tab

51. Adding Firewall Rules

Hopefully, you now understand the design of the HOME_OUT firewall rules. Now it is time to actually add these rules. This section will use a pair of HOME_OUT rules as an example of how to add firewall rules using the GUI interface.

While you are using the GUI to add these rules, please frequently reference the backup file segment labeled “Equation 1 – A Portion of the HOME_OUT Firewall Rules”, which is in section “49 - HOME_OUT Firewall Rules.” This should help you better relate between the two forms - that of the backup text description versus that of GUI entry.

Select the “Firewall/NAT” button from the top of the screen. Reference Figure 74 – Firewall/NAT Button.

Ensure that the “Firewall Policies” tab is selected. See Figure 88 – Firewall Policies Tab.

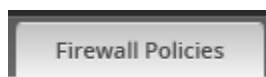


Figure 88 – Firewall Policies Tab

The two WAN rulesets, which were added by the Wizard, should be shown. Press the “+ Add Ruleset” button. See Figure 89 – Add Ruleset.

A screenshot showing a "+ Add Ruleset" button at the top left of a table. The table has two columns: "Name" and "Interfaces". It contains two rows: "WAN_IN" with "eth0/in" and "WAN_LOCAL" with "eth0/local". At the bottom, it says "Showing 1 to 2 of 2 entries".

+ Add Ruleset	
Name	Interfaces
WAN_IN	eth0/in
WAN_LOCAL	eth0/local
Showing 1 to 2 of 2 entries	

Figure 89 – Add Ruleset

You will be presented with a “Create New firewall Ruleset.” See Figure 90 – Blank Create New Firewall Ruleset.

A dialog box titled "Create New Firewall Ruleset" with a close button (X) in the top right corner. It contains the following fields and options:

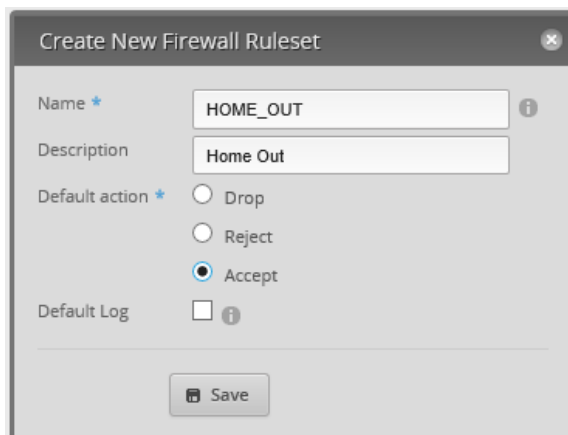
- Name: A text input field with a blue asterisk and an information icon (i).
- Description: A text input field.
- Default action: Three radio button options: "Drop" (selected), "Reject", and "Accept".
- Default Log: A checkbox with an information icon (i).
- Save: A button with a floppy disk icon.

Figure 90 – Blank Create New Firewall Ruleset

Enter the following into the Create New Firewall Ruleset dialog:

Name	HOME_OUT
Description	Home Out
Default action	Accept

See Figure 91 – HOME_OUT Example New Ruleset.

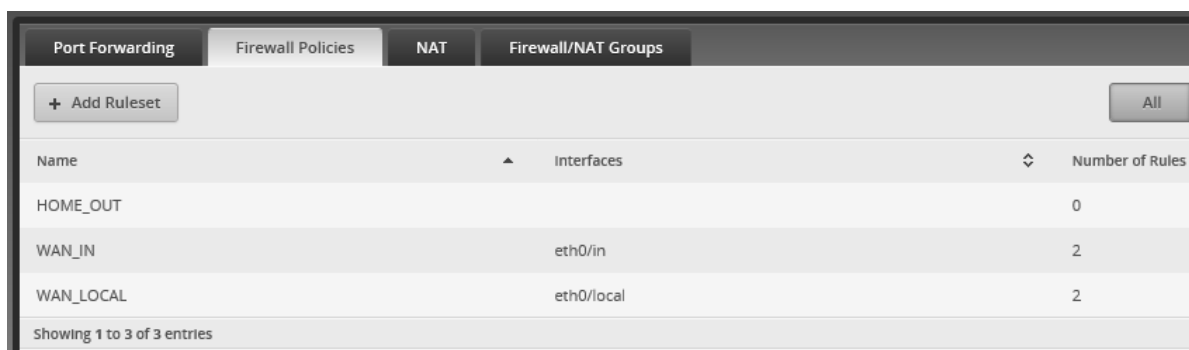


The dialog box titled "Create New Firewall Ruleset" contains the following fields and options:

- Name: HOME_OUT
- Description: Home Out
- Default action: Radio buttons for Drop, Reject, and Accept (Accept is selected).
- Default Log: A checkbox that is currently unchecked.
- A "Save" button at the bottom.

Figure 91 – HOME_OUT Example New Ruleset

Press "Save." A HOME_OUT ruleset will be created. Note that no interfaces have been selected, and the number of rules is 0. See Figure 92 – Empty HOME_OUT Ruleset.



Port Forwarding Firewall Policies NAT Firewall/NAT Groups			
+ Add Ruleset All			
Name	Interfaces		Number of Rules
HOME_OUT			0
WAN_IN	eth0/in		2
WAN_LOCAL	eth0/local		2

Showing 1 to 3 of 3 entries

Figure 92 – Empty HOME_OUT Ruleset.

Find the "Actions" button at the right end of the HOME_OUT line (not shown) and press it. You will be presented with a "Firewall Actions Menu." See Figure 93 – Firewall Actions Menu.



Figure 93 – Firewall Actions Menu

Choose “Edit Ruleset.” A dialog for editing firewall rules appears. The “Rules” Tab should already be selected. See Figure 94 – Edit Ruleset Dialog.

Note that this dialog also contains Tabs of “Configuration,” “Interfaces,” and “Stats.” These match the handy shortcuts that are also in the previously shown Actions menu, reference Figure 93 – Firewall Actions Menu.



Figure 94 – Edit Ruleset Dialog

Choose the “Configuration” Tab. You should see the information that was entered earlier. See Figure 95 – Firewall Rule Configuration Tab.

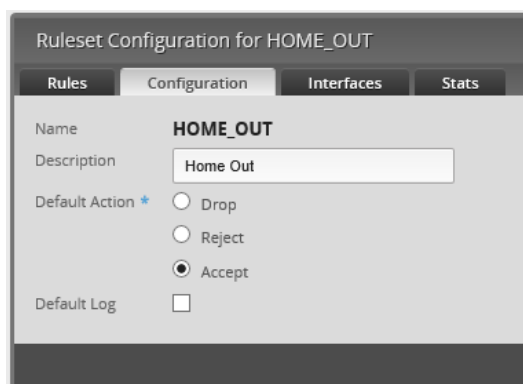


Figure 95 – Firewall Rule Configuration Tab

Choose the “Interfaces” Tab. Select the following information in the dialog:

Interface switch0
Direction out

Then press the “Save Ruleset” button.

A lot of problems occur because a ruleset is created and the interface / direction is never set and/or saved.

Since the Home Network is governed by switch0 (i.e. switch0 contains interfaces of eth3 and eth4), we need to choose “switch0” for the Interface, not the individual eth3 or eth4. If an interface is not part of switch0 (eth0, eth1, or eth2) then we would just select that individual interface. See Figure 96 – Firewall Rule Interface Tab.

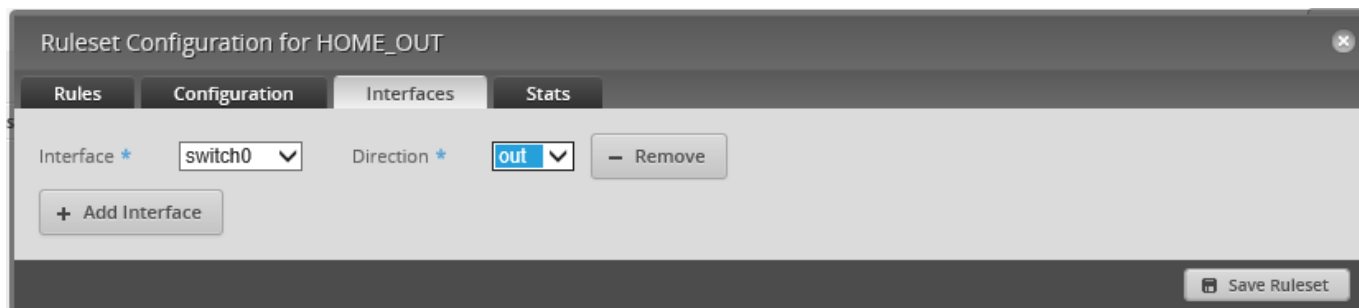


Figure 96 – Firewall Rule Interface Tab

Re-select the “Rules” Tab, and press the “Add New Rule” Button, that is shown in Figure 94 – Edit Ruleset Dialog. An “Add New Rule” dialog will be shown. See Figure 97 – HOME_OUT Firewall, Rule1, Basic. Enter the following into the Basic Tab:

Description	Allow Wired Iot Replies
Enable	CHECKED
Action	Accept
Protocol	All protocols

The screenshot shows the 'Add New Rule' dialog box with the 'Basic' tab selected. The 'Description' field is filled with 'Allow Wired Iot Replies'. The 'Enable' checkbox is checked. Under 'Action', the 'Accept' radio button is selected. Under 'Protocol', the 'All protocols' radio button is selected. The 'Logging' checkbox is unchecked. At the bottom right, there are 'Save' and 'Cancel' buttons.

Figure 97 – HOME_OUT Firewall, Rule1, Basic

Click on the Advanced Tab. See Figure 98 – HOME_OUT Firewall, Rule1, Advanced. Enter the following information into the Advanced Tab:

State, Established	CHECKED
State, Invalid	Un-checked
State, New	Un-checked
State, Related	CHECKED

The screenshot shows the 'Add New Rule' dialog box with the 'Advanced' tab selected. In the 'State' section, 'Established' and 'Related' are checked, while 'Invalid' and 'New' are unchecked. There are input fields for 'Recent Time' and 'Recent Count'. In the 'IPsec' section, 'Don't match on IPsec packets' is selected. In the 'P2P' section, 'None' is selected. The 'Application' dropdown menu shows '--'. At the bottom right, there are 'Save' and 'Cancel' buttons.

Figure 98 – HOME_OUT Firewall, Rule1, Advanced

Click on the Source Tab. See Figure 99 – HOME_OUT Firewall, Rule 1, Source. Select the following information for the Source Tab:

Address Group Wired lot Group.

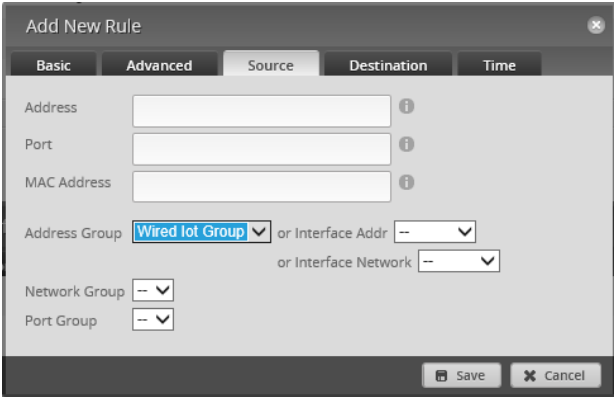


Figure 99 – HOME_OUT Firewall, Rule 1, Source

Press the “Save” button. You now have a new rule in the HOME_OUT ruleset. See Figure 100 – HOME_OUT Firewall, Rule 1.

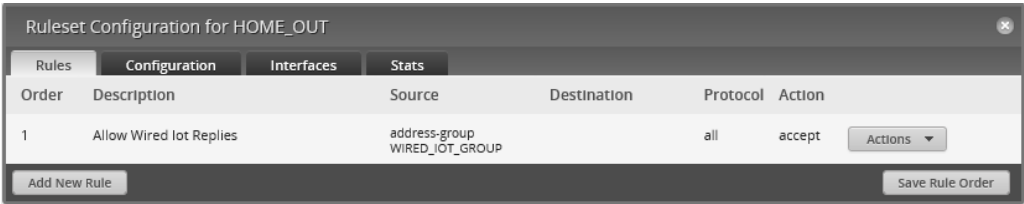


Figure 100 – HOME_OUT Firewall, Rule 1

It is time to add the second firewall rule of this ruleset. Press the “Add New Rule” button, as shown in Figure 100 – HOME_OUT Firewall, Rule 1. You will be presented with the Basic dialog for adding firewall rules. See Figure 101 – HOME_OUT Firewall, Rule 2, Basic. Enter the following information into the Basic Tab:

Description Drop Rest-Of Wired lot Traffic
Enable CHECKED
Action Drop
Protocol All protocols

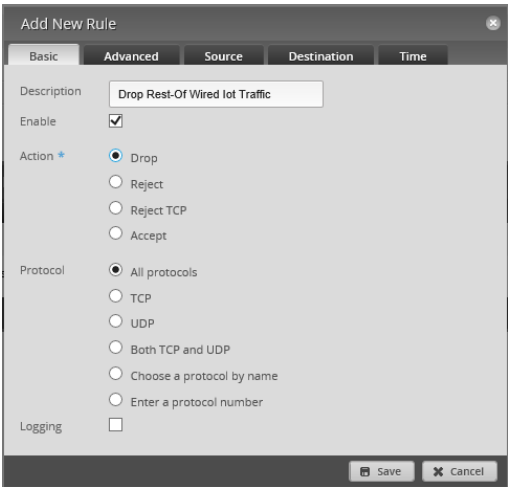


Figure 101 – HOME_OUT Firewall, Rule 2, Basic

Click on the Source Tab. See Figure 102 – HOME_OUT Firewall, Rule 2, Source. Select the following information for the Source Tab:

Address Group Wired Iot Group.

Figure 102 – HOME_OUT Firewall, Rule 2, Source

Press the “Save” button. You now have two rules in the HOME_OUT ruleset, as shown in Figure 103 – HOME_OUT Firewall, Two Rules.

The first rule allow traffic that is “established” and “related” (i.e. associated) to go out FROM the EdgeRouter, towards devices on the Home Network that have a SOURCE address that matches (originated from) the Wired IOT Network. The association would be to traffic that previously went IN (towards the EdgeRouter) destined for the Wired IOT Network. This would typically be a request to a device on the Wired IOT Network from a device on the Home Network.

The second rule drops all traffic from the Wired IOT Network that was not matched by the first rule, i.e., any non-requested traffic that was initiated by the Wired IOT Network.

The default action for the HOME_OUT ruleset is “accept,” allowing traffic that is not SOURCED from the Wired IOT Network to pass OUT to devices on the Home Network. This could be traffic SOURCED from another Network, or traffic coming from the internet, or from the EdgeRouter itself.

Ruleset Configuration for HOME_OUT						
Rules	Configuration	Interfaces	Stats			
Order	Description	Source	Destination	Protocol	Action	
1	Allow Wired Iot Replies	address-group WIRED_IOT_GROUP		all	accept	Actions ▾
2	Drop Rest-Of Wired Iot Traffic	address-group WIRED_IOT_GROUP		all	drop	Actions ▾
Add New Rule		Save Rule Order				

Figure 103 – HOME_OUT Firewall, Two Rules

52. Adding More HOME_OUT Firewall Rules

We now need to add four more rules to the HOME_OUT Ruleset. Using the steps that are shown in the above section “51 - Adding Firewall Rules”, add four more rules per the backup data that is shown below:

```
rule 3 {
    action accept
    description "Allow Wifi Guest Replies"
    destination {
        group {
        }
    }
    log disable
    protocol all
    source {
        group {
            address-group WIFI_GUEST_GROUP
        }
    }
    state {
        established enable
        invalid disable
        new disable
        related enable
    }
}
rule 4 {
    action drop
    description "Drop Rest-Of Wifi Guest Traffic"
    log disable
    protocol all
    source {
        group {
            address-group WIFI_GUEST_GROUP
        }
    }
}
rule 5 {
    action accept
    description "Allow Wifi Iot Replies"
    log disable
    protocol all
    source {
        group {
            address-group WIFI_IOT_GROUP
        }
    }
    state {
        established enable
        invalid disable
        new disable
        related enable
    }
}
rule 6 {
    action drop
    description "Drop Rest-Of Wifi Iot Traffic"
    log disable
    protocol all
    source {
        group {
            address-group WIFI_IOT_GROUP
        }
    }
}
```

53. WIRED_IOT_LOCAL, WIFI_IOT_LOCAL Firewall Rules

These rules are FWR3 and FWR9 as shown in Figure 82 – Detailed Firewall Setup Diagram.

The purpose of these rules is to block the use of EdgeRouter local services from these two IOT Networks, except for the use of DNS and the operation of DHCP.

The DHCP protocol uses port 67 and port 68 of UDP.

The DNS protocol uses port 53 of both TCP and UDP.

The DNS firewall rules for the Wired lot and Wifi lot Networks, presented below, contain an additional destination-address restriction. These DNS firewall rules will only accept DNS requests, which are issued to the Open DNS resolver addresses. DNS requests to other providers will be dropped via the ruleset's default drop rule.

Note that the destination addresses specified here (via the OPENDNS_SERVERS_GROUP) must match the Wired lot and Wifi lot Network's DHCP entered DNS1 and DNS2 addresses. Reference section 27 - Add DHCP Servers to the VLANs and section 29 - Modify EdgeRouter's eth1 DHCP Server. It's not good to tell your lot devices to use one set of DNS provider addresses (via DHCP) and then drop those requests when your firewall rules only accept addresses of a different DHCP provider.

We now need to add two more rulesets, with each ruleset containing two firewall rules. Using the steps that are shown in the above section "51 - Adding Firewall Rules", add the following two rulesets, each containing two firewall rules, per the backup data that is shown below:

When adding the following WIRED_IOT_LOCAL ruleset, remember to also set and SAVE the following:

```
Interface:      eth1
Direction:     local

name WIRED_IOT_LOCAL {
  default-action drop
  description "Wired IOP Local"
  rule 1 {
    action accept
    description "Allow DHCP"
    destination {
      port 67-68
    }
    log disable
    protocol udp
    source {
    }
  }
  rule 2 {
    action accept
    description "Allow Only OpenDNS"
    destination {
      group {
        address-group OPENDNS_SERVERS_GROUP
      }
      port 53
    }
    log disable
    protocol tcp_udp
  }
}
```

When adding the DNS rule, the above "tcp_ucp" description is shown in the GUI as "Both TCP and UDP."

When adding the following WIFI_IOT_LOCAL ruleset, remember to also set and SAVE the following:

Interface: switch0.7

Direction: local

```
name WIFI_IOT_LOCAL {
  default-action drop
  description "Wired Iot Local"
  rule 1 {
    action accept
    description "Allow DHCP"
    destination {
      port 67-68
    }
    log disable
    protocol udp
  }
  rule 2 {
    action accept
    description "Allow Only OpenDNS"
    destination {
      group {
        address-group OPENDNS_SERVERS_GROUP
      }
      port 53
    }
    log disable
    protocol tcp_udp
  }
}
```

When adding the DNS rule, the above "tcp_udp" description is shown in the GUI as "Both TCP and UDP."

54. WIFI_GUEST_LOCAL Firewall Rules

The purpose of these rules is to block the use of EdgeRouter local services from the Wi-Fi Guest Network, except for the use of DNS and the operation of DHCP.

To add the following ruleset and rules, follow what was done in the above section 53 - WIRED_IOT_LOCAL, WIFI_IOT_LOCAL Firewall Rules.

Note that we are not dropping DNS requests based upon which DNS provider address(es) your guests may be using in their devices. Most people's devices are probably configured just to use the providers' (provided via DHCP) DNS resolvers addresses. If a guest hardcoded the DNS resolver addresses within their device AND we only accepted DNS requests going to specific DNS resolvers, then we could have just denied our guests service on our network.

When adding the following WIFI_GUEST_LOCAL ruleset, remember to also set and SAVE the following:

```
Interface:    switch0.6
Direction:    local

name WIFI_GUEST_LOCAL {
  default-action drop
  description "Wifi Guest Local"
  rule 1 {
    action accept
    description "Allow DHCP"
    destination {
      port 67-68
    }
    log disable
    protocol udp
  }
  rule 2 {
    action accept
    description "Allow DNS"
    destination {
      port 53
    }
    log disable
    protocol tcp_udp
  }
}
```

55. Optional DNS Forcing of the WIFI_GUEST_LOCAL Network

Performing the steps within this section is optional.

The destination Network Address Translation (NAT) rules, presented here, will force any devices on the guest Network to only be able to use Open DNS resolvers. This is regardless of if the devices specify their own DNS resolver addresses and ignore the DNS resolver addresses suggested by the EdgeRouter's guest DHCP server.

The two rules presented here work with each other. Rule #1 will exclude NAT from being performed on either of the OpenDNS resolver addresses. These two addresses are in an address group. This allows both the primary and secondary resolver addresses to pass-through the EdgeRouter from the Guest Network. Rule #2 will act upon any port 53 (DNS) request from the Guest network, and translate the associated IP address into the address of the primary OpenDNS resolver.

Press the Firewall/NAT button near the top of the screen. Reference Figure 74 – Firewall/NAT Button.

Ensure that the NAT tab is selected and then press the “+ Add Destination NAT Rule” button. See Figure 104 – NAT Tab.

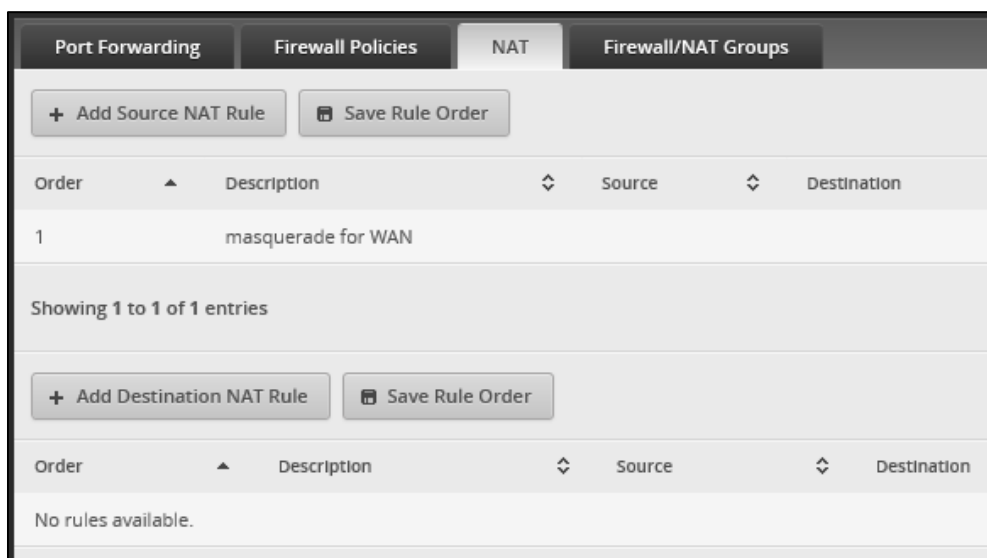


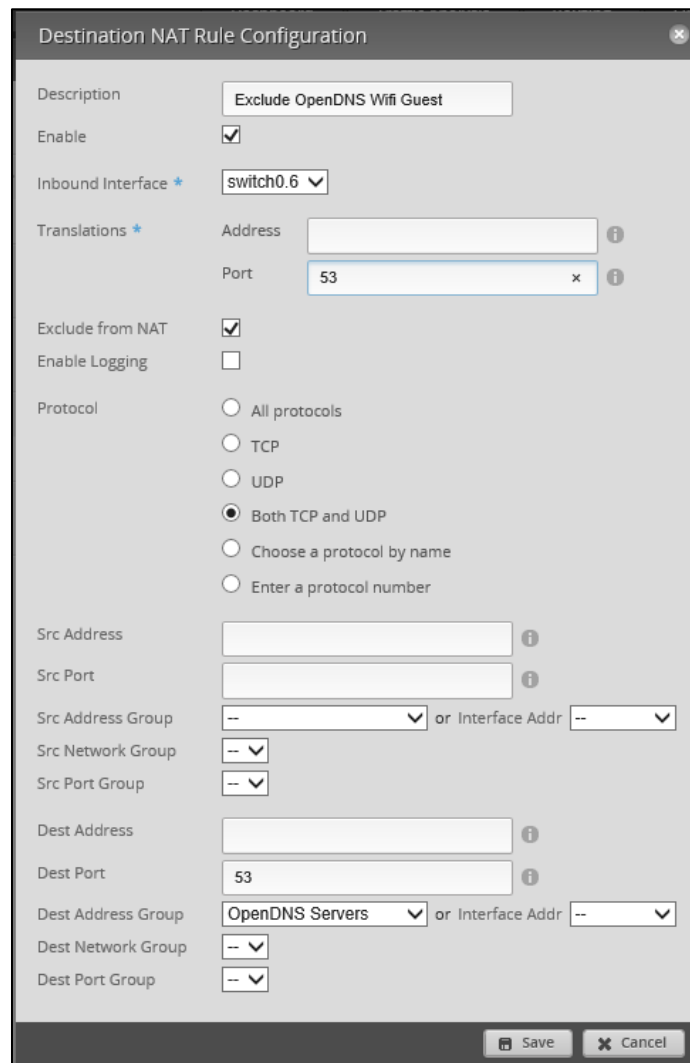
Figure 104 – NAT Tab

You will be presented with a “Destination NAT Rule Configuration” dialog.

Enter the data for NAT rule #1, as follows:

Description	Exclude OpenDNS Wifi Guest
Enable	CHECKED
Inbound Interface	switch0.6
Translations, Port	53
Exclude From NAT	CHECKED
Protocol	Both TCP and UDP
Dest Port	53
Dest Address Group	OpenDNS Servers

and save it. See Figure 105 – NAT Rule Number 1.



The image shows a "Destination NAT Rule Configuration" dialog box. The fields are as follows:

- Description: Exclude OpenDNS Wifi Guest
- Enable: ☒
- Inbound Interface: switch0.6
- Translations: Address (empty), Port: 53
- Exclude from NAT: ☒
- Enable Logging: ☐
- Protocol: ☒ Both TCP and UDP
- Src Address: (empty)
- Src Port: (empty)
- Src Address Group: -- or Interface Addr: --
- Src Network Group: --
- Src Port Group: --
- Dest Address: (empty)
- Dest Port: 53
- Dest Address Group: OpenDNS Servers or Interface Addr: --
- Dest Network Group: --
- Dest Port Group: --

Buttons at the bottom: Save, Cancel

Figure 105 – NAT Rule Number 1

Press the “+ Add Destination NAT Rule” button and enter the data for NAT rule #2, as follows:

Description	Force OpenDNS Wifi Guest
Enable	CHECKED
Inbound Interface	switch0.6
Translations, Address	208.67.220.220
Exclude From NAT	Un-Checked
Protocol	Both TCP and UDP
Dest Port	53

and save it. See Figure 106 – NAT Rule Number 2.

The image shows a 'Destination NAT Rule Configuration' dialog box. The settings are as follows:

- Description: Force OpenDNS WIFI Guest
- Enable: ☒
- Inbound Interface: switch0.6
- Translations: Address: 208.67.220.220, Port: (empty)
- Exclude from NAT: ☐
- Enable Logging: ☐
- Protocol: ☒ Both TCP and UDP
- Src Address: (empty)
- Src Port: (empty)
- Src Address Group: -- or Interface Addr: --
- Src Network Group: --
- Src Port Group: --
- Dest Address: (empty)
- Dest Port: 53
- Dest Address Group: -- or Interface Addr: --
- Dest Network Group: --
- Dest Port Group: --

At the bottom are 'Save' and 'Cancel' buttons.

Figure 106 – NAT Rule Number 2

This is the relevant portion from the backup file. Rule 5010 is an existing Source NAT rule for handling the WAN port (eth0).

```
nat {
  rule 1 {
    description "Exclude OpenDNS Wifi Guest"
    destination {
      group {
        address-group OPENDNS_SERVERS_GROUP
      }
      port 53
    }
    exclude
    inbound-interface switch0.6
    inside-address {
      port 53
    }
    log disable
    protocol tcp_udp
    type destination
  }
  rule 2 {
    description "Force OpenDNS WiFi Guest"
    destination {
      port 53
    }
    inbound-interface switch0.6
    inside-address {
      address 208.67.220.220
    }
    log disable
    protocol tcp_udp
    type destination
  }
  rule 5010 {
    description "masquerade for WAN"
    outbound-interface eth0
    type masquerade
  }
}
```

These rules can be tested, if you are implementing this DNS forcing using actual OpenDNS resolvers. This is because OpenDNS has a test page:

<http://welcome.opendns.com>

that can show if you are using OpenDNS as a resolver.

To perform this test, first temporarily change the DNS resolvers associated with the Guest Network's DHCP server (switch0.6) to something else. I used addresses of 8.8.8.8 and 8.8.4.4 from Google. Reference section 27 - Add DHCP Servers to the VLANs. Then, using a device attached to the Guest Network, visit the OpenDNS test page. If you get their success page, then these two rules translated the Google DNS addresses into OpenDNS addresses. You may have to reboot the EdgeRouter and/or the Guest device to ensure that the changed DNS resolver addresses propagated to the Guest device. Remember to return the Guest Network's DNS resolver addresses (in the DHCP area) back to the OpenDNS addresses.

Reference this OpenDNS page about testing:

<https://support.opendns.com/hc/en-us/articles/227986567-How-to-Test-for-Successful-OpenDNS-Configuration->

56. WIRED_SEPARATE Firewall Rules

The Wired Separate Network is meant to be kept separate from the other Networks, i.e., not allow communications with anyone except with the Internet.

There are two usage scenarios, which I can think of, for the Separate Network.

1. You might want to put your banking computer on this Separate Network.
In this instance, people and devices on the Home Network cannot get to your banking computer.
2. You might want to provide internet access to the friend's kid who lives in your basement.
In this instance, you don't want any people or devices on the Separate Network to be able to access any of your Networks, or be able to access internals of the EdgeRouter.

Reference Figure 82 – Detailed Firewall Setup Diagram, for FWR numbers and Network routing / interactions

Reference Table 1 - Table of Networks, for Network subnet addresses

To block instance number 1, we need to block traffic from exiting OUT of the EdgeRouter and going to devices that are on the Separate Network. This ruleset will be labeled WIRED_SEPARATE_OUT and is denoted as FWR6. This ruleset will need to block addresses from the WIRED_IOT_GROUP and the HOME_GROUP.

Note that two of the Networks: "Wifi IOT Network" and "Wifi Guest Network" are using VLANs and originate from the Access Point. Within the Access Point, these Networks will be configured as Guest Networks, and will therefore be denied access to all of the EdgeRouter's addresses except for the Home Network, which is at 192.168.3.X. So no firewall rules are needed to block these two Networks from accessing the Wired Separate Network.

To add the following ruleset and rules, follow what was done in the above section 53 - WIRED_IOT_LOCAL, WIFI_IOT_LOCAL Firewall Rules.

When adding the following WIRED_SEPARATE_OUT ruleset, remember to also set and SAVE the following:

```
Interface:    eth2
Direction:    out

name WIRED_SEPARATE_OUT {
  default-action accept
  description "Wired Separate Out"
  rule 1 {
    action drop
    description "Drop Home Network"
    log disable
    protocol all
    source {
      group {
        address-group HOME_GROUP
      }
    }
  }
  rule 2 {
    action drop
    description "Drop Wired Iot Network"
    log disable
    protocol all
    source {
      group {
        address-group WIRED_IOT_GROUP
      }
    }
  }
}
```


To block instance number 2, we need to block traffic from entering IN the EdgeRouter and going to devices that are on the other networks. This ruleset will be labeled WIRED_SEPARATE_IN and is denoted as FWR5. Additionally, we need to block traffic from entering the EdgeRouter itself (LOCAL) except for DNS and DHCP requests. This ruleset will be labeled WIRED_SEPARATE_LOCAL and is denoted as FWR4.

When adding the following WIRED_SEPARATE_IN ruleset, remember to also set and SAVE the following:

```
Interface:    eth2
Direction:    in

name WIRED_SEPARATE_IN {
    default-action accept
    description "Wired Separate In"
    rule 1 {
        action drop
        description "Block Multiple Networks"
        destination {
            group {
                address-group MULTIPLE_GROUP
            }
        }
        log disable
        protocol all
    }
}
```

When adding the following WIRED_SEPARATE_LOCAL ruleset, remember to also set and SAVE the following:

```
Interface:    eth2
Direction:    local

name WIRED_SEPARATE_LOCAL {
    default-action drop
    description "Wired Separate Local"
    rule 1 {
        action accept
        description "Allow DHCP"
        destination {
            port 67-68
        }
        log disable
        protocol udp
    }
    rule 2 {
        action accept
        description "Allow DNS"
        destination {
            port 53
        }
        log disable
        protocol tcp_udp
    }
}
```

57. EdgeMax Change Interface Names

Press the Dashboard Button. Reference Figure 34 – Dashboard Button.

Find the line with an Interface of “switch0”. Click on the Action button to the right of this line. Select “Config” from the Actions Menu. You will see a dialog similar to Figure 37 – switch0 Configuration. Change the Description field to “Home Net.”

Repeat these steps for the following Interfaces as shown in Table 4 - Table of Interface Names:
(You have just done the last one)

Interface	Description
eth1	Wired lot Net
eth2	Wired Separate Net
eth3	Home Net
eth4	Home Net
switch0	Home Net

Table 4 - Table of Interface Names

58. SmartQueue Setup

This section is optional and is not implemented in the associated backup file. Turning on SmartQueue (on your WAN port) can help solve the issue of “bufferbloat”. Reference the internet for “bufferbloat” if you are unfamiliar with it.

To enable SmartQueue, press the QoS button, located near the top of the page. See Figure 107 – QoS button.

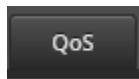


Figure 107 – QoS button

Ensure that the Smart Queue tab is selected, then press the “+ Add Smart Queue” button.

From what I understand, you should enter about 95% of your connection speeds into the form. My connection speeds are 26 down and about 5 up. Adjust the values for your own connection speed(s). There are also posting / indications that you should only implement SmartQueue in the Upload direction.

One place to test connection speeds (and bufferbloat) is:

<http://www.dslreports.com/speedtest>

See Figure 108 – Example SmartQueue Settings

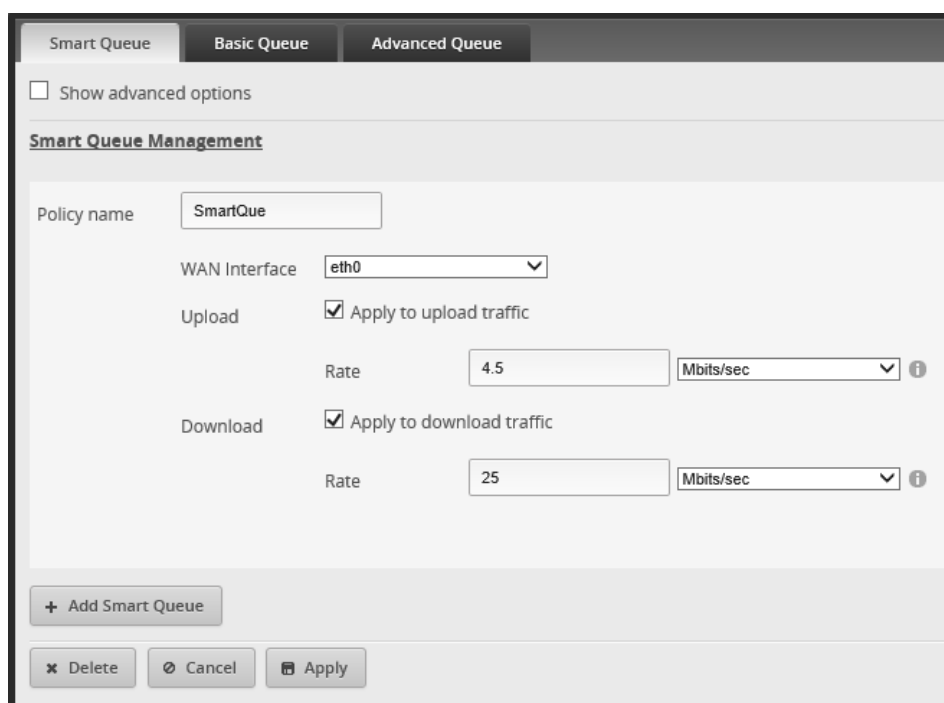


Figure 108 – Example SmartQueue Settings

References:

<https://www.youtube.com/watch?v=3hvmzEv8iNQ>

<http://kazoo.ga/edgerouter-x-smart-queue/>

https://www.reddit.com/r/Ubiquiti/comments/5otj22/edgerouter_x_qos_question/

59. Ubiquiti AP-AC-LR Access Point Setup

This guide will utilize Access Point software installed on a Windows PC. This software ONLY needs to be running WHEN you are adopting or making configuration changes to your Access Point(s). The software does NOT need to be running all the time.

Other Ubiquiti Access points should work; the Ubiquiti AP-AC-LR model is just the one that I purchased.

There are also clients available for Linux, Macs, Android phones and Apple phones.

There are optional guest portal / data-collection features that require this software to be running all the time. These features might be found in a Motel/Hotel WiFi system. Some people choose to therefore run this software on a Raspberry Pi. Ubiquiti has a Cloud Key device that is recommended, if you are going to be running this software all the time.

Reference: <https://www.ubnt.com/unifi/unifi-cloud-key/>

If you are going to re-purpose a consumer router as an access point, instead of using a Ubiquiti Access Point, remember that some of the Network security is achieved via VLANs and Guest options within the Access Point. Firewall rules within the EdgeRouter may need to be adjusted.

60. Hookup the Ubiquiti AP-AC-LR Access Point

Using two standard Ethernet cables:

Wire the EdgeRouter's eth4 port to the LAN port of the included Power Over Ethernet (POE) Adapter.

Wire the POE port of the POE adapter to the Ethernet port on the Ubiquiti AP-AC-LR Access Point.

See Figure 109 – Access Point Wiring.

Plug the POE adapter into your main electrical power.

Note: Connecting the POE port of the POE adapter to any other device will probably burn-up that other device.

There are also internet posts that have the POE adapter powering both the EdgeRouter and the AP-AC-LR Access point. I am not powering my devices that way. Ubiquiti seems to be changing its Access Point voltages / powering options.

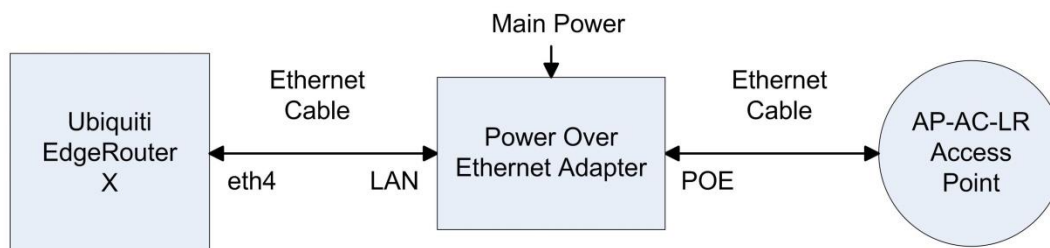


Figure 109 – Access Point Wiring

61. Download and Install the Access Point Software

For Windows users, you will need to be an Administrator, or the installation will install (somewhere else) in the area belonging to the admin's account that was used.

Browse to:

<https://www.ubnt.com/download/unifi/>

Under the SOFTWARE section, download the latest “UniFi Controller for Windows” software (Unifi-installer.exe). When this guide was written, it was version 5.4.11.

Under the DOCUMENTATION section, you might also want to download:

UniFi Controller v5 Users Guide (or later version)

UniFi AC-LR-AP Quick Start Guide.

The following install items may be slightly out of order between your installation and that of this guide. I had to re-start my UniFi Setup.

Run the Unifi-installer.exe. Acknowledge any Windows admin prompts. See Figure 110 – UniFi Setup Welcome Screen.

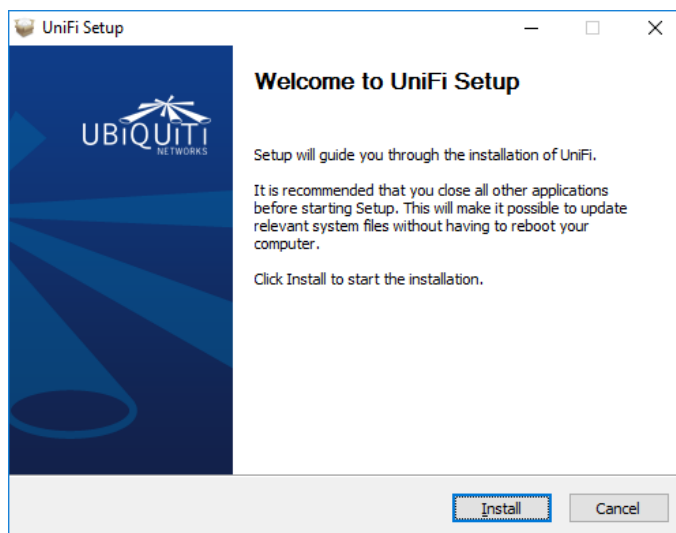


Figure 110 – UniFi Setup Welcome Screen

If Java is not installed on your PC, you will be prompted to install Java. See Figure 111 – UniFi Java Required. Click “OK”.

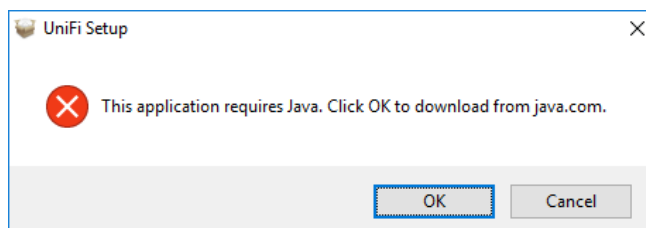


Figure 111 – UniFi Java Required

You will be taken to an Oracle site to download Java. Click on the “Free Java Download” button. See Figure 112 – Unifi Download Oracle Java. Note that Oracle asks “Why download Java?” My only answer is “Because I have to”.

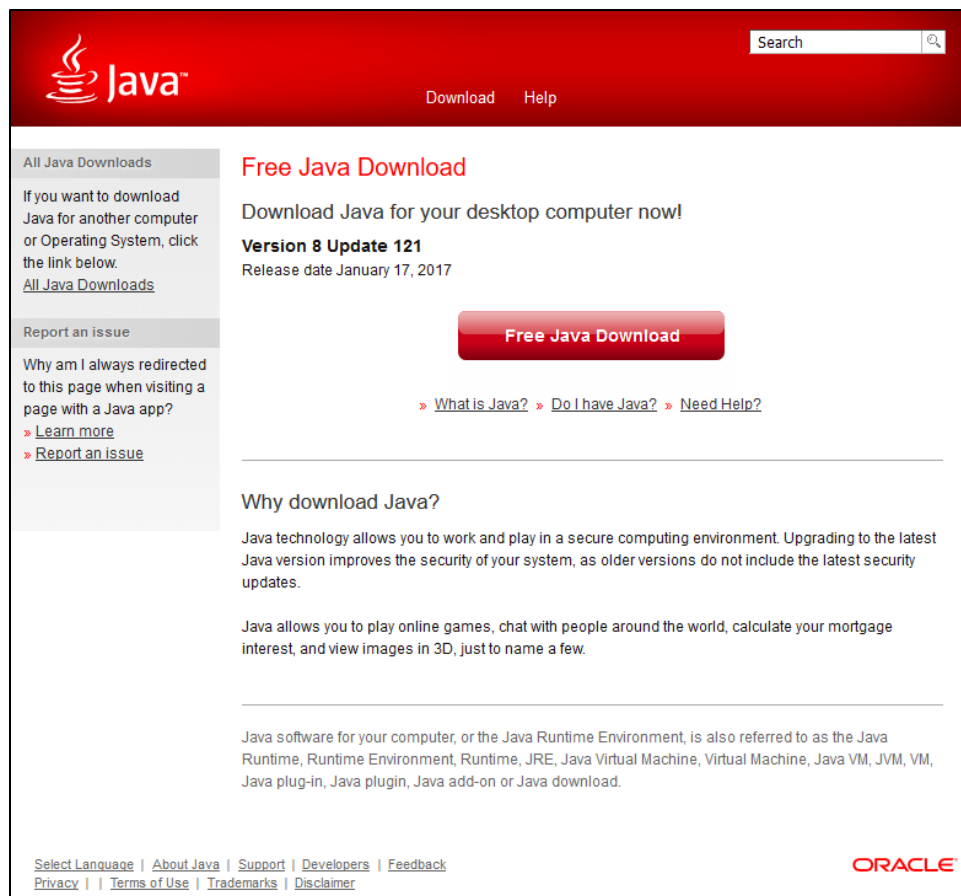


Figure 112 – Unifi Download Oracle Java

While downloading, Oracle will inform you that their security holes are found everywhere, and that you can experience that also. See Figure 113 – Unifi Downloading Oracle Java.

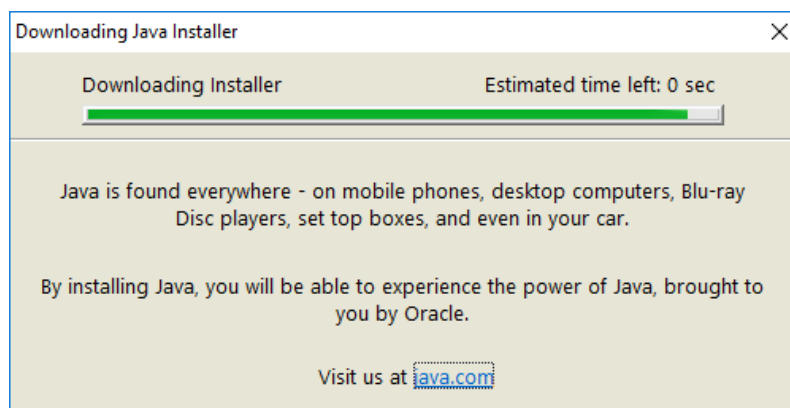


Figure 113 – Unifi Downloading Oracle Java

When done downloading, they will try and monetize you by setting up crapware. Select “Do not update browser settings”, unless you like this type of stuff. See Figure 114 – UniFi Oracle Crapware.

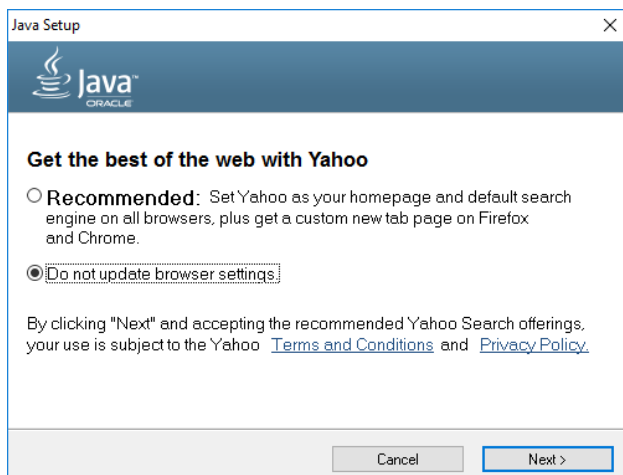


Figure 114 – UniFi Oracle Crapware

Run the downloaded JavaSetup*.exe executable. Java will install. Oracle will again inform you that they are probably responsible for hundreds of billions of accumulated security holes, with billions of them in internet connected devices that will never be patched. See Figure 115 –UniFi Java Installing.

When Java is done installing you will see the dialog of See Figure 116 – UniFi Java Done. Press “Close”. When the next browser window opened (to verify Java is working), I closed that browser verify page.



Figure 115 –UniFi Java Installing



Figure 116 – UniFi Java Done

Press the Windows Start button; Go to the list of programs, select Java, then select “Configure Java”. Press the “Security” tab, and UNCHECK the “Enable Java content in the browser” checkbox. See Figure 117 – UniFi Java Control Panel. Without this you will be live-bait for any drive-by browsing malware.

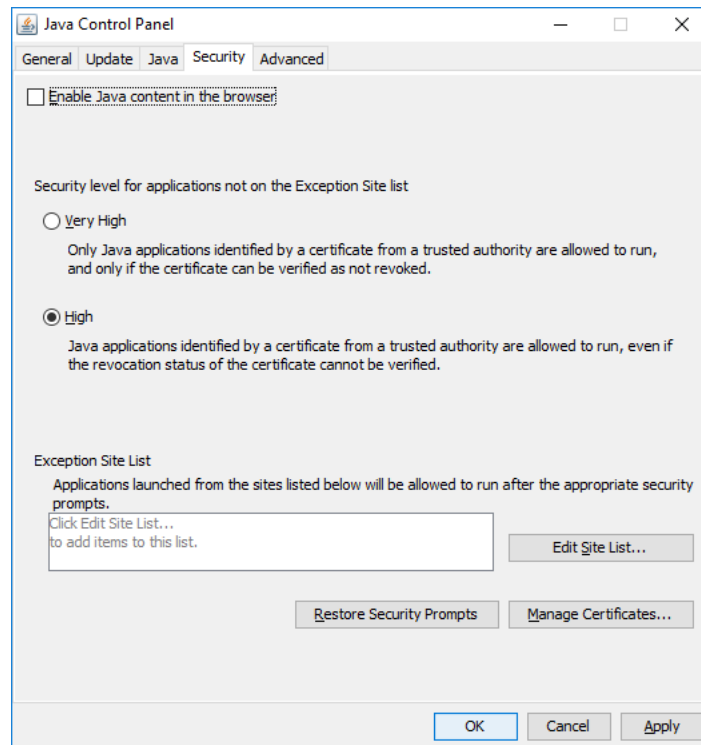


Figure 117 – UniFi Java Control Panel

I had to restart the UniFi installer. See Figure 118 – UniFi Installing.

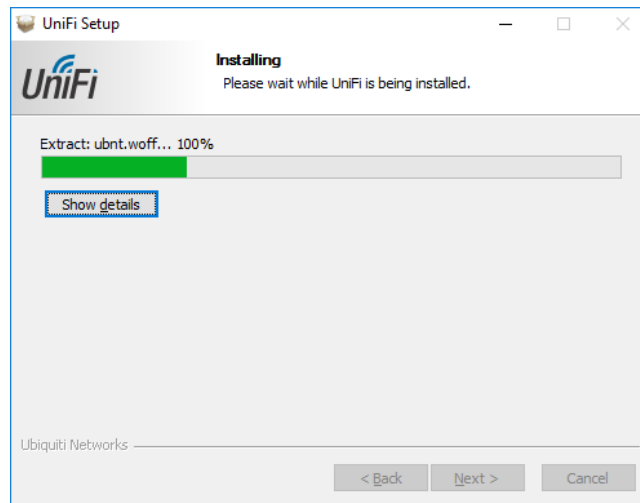


Figure 118 – UniFi Installing

The UniFi software will finish installing. See Figure 119 – UniFi Done Installing

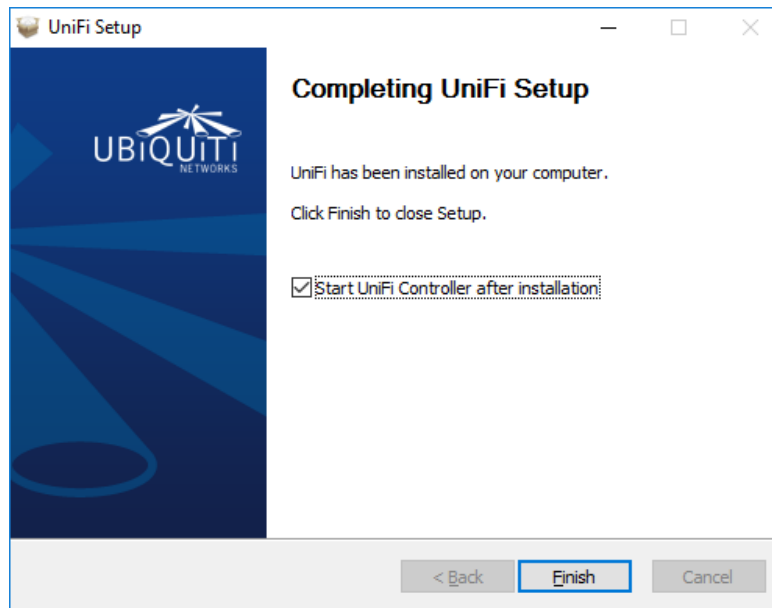


Figure 119 – UniFi Done Installing

62. Running the UniFi Software

Double click the Unifi icon on your desktop. See Figure 120 – UniFi Icon



Figure 120 – UniFi Icon

The UniFi controlling software will start to initialize. See Figure 121 – UniFi Controller Software Initializing.



Figure 121 – UniFi Controller Software Initializing

When it has fully started, it will look like Figure 122 – UniFi Controller Software Running.



Figure 122 – UniFi Controller Software Running

When the UniFi Software started for the first time, a Windows Firewall dialog popped up. See Figure 123 – Windows Initial Firewall - UniFi.

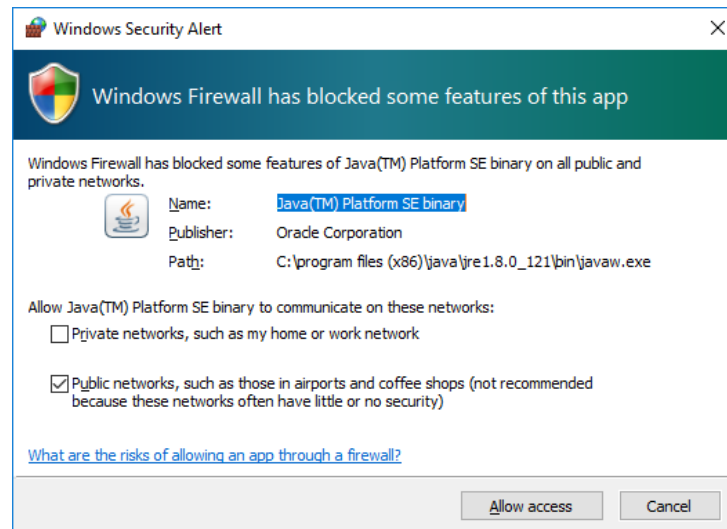


Figure 123 – Windows Initial Firewall - UniFi

The wording and default selections seem backwards to me. I reversed the selections and pressed “Allow access”. See Figure 124 – Windows My Firewall Settings - UniFi.

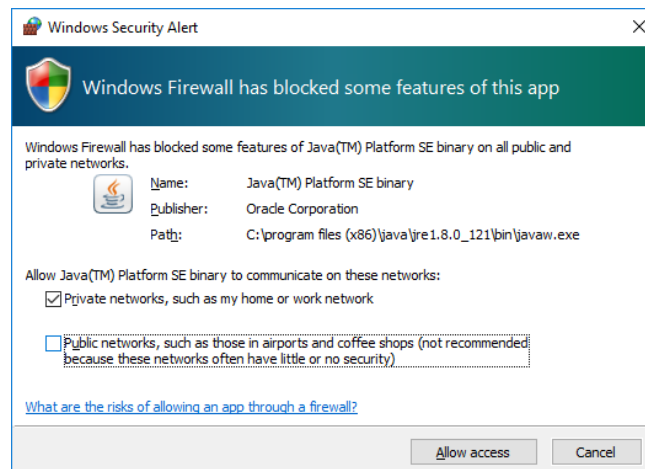


Figure 124 – Windows My Firewall Settings - UniFi

QUESTION: Which settings are correct for keeping Java to only my local / private network?

63. Initial Setup of the UniFi Software

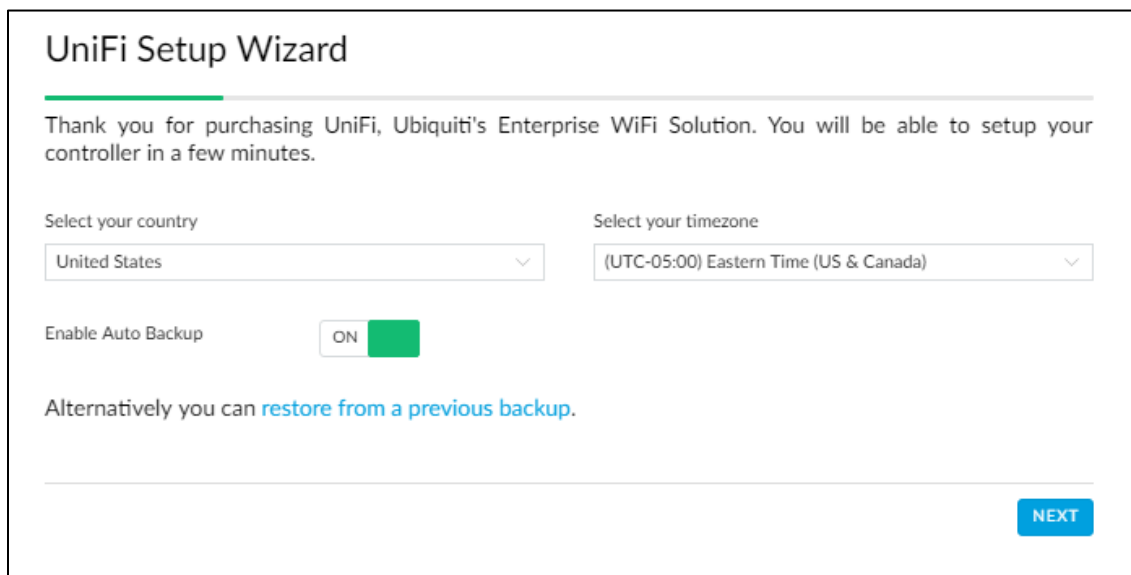
Either press the “Launch a Browser to Manage the Network” button or enter:

<https://localhost:8443/manage>

into your browser.

Most of the following screenshots are portions of the full browser screen.

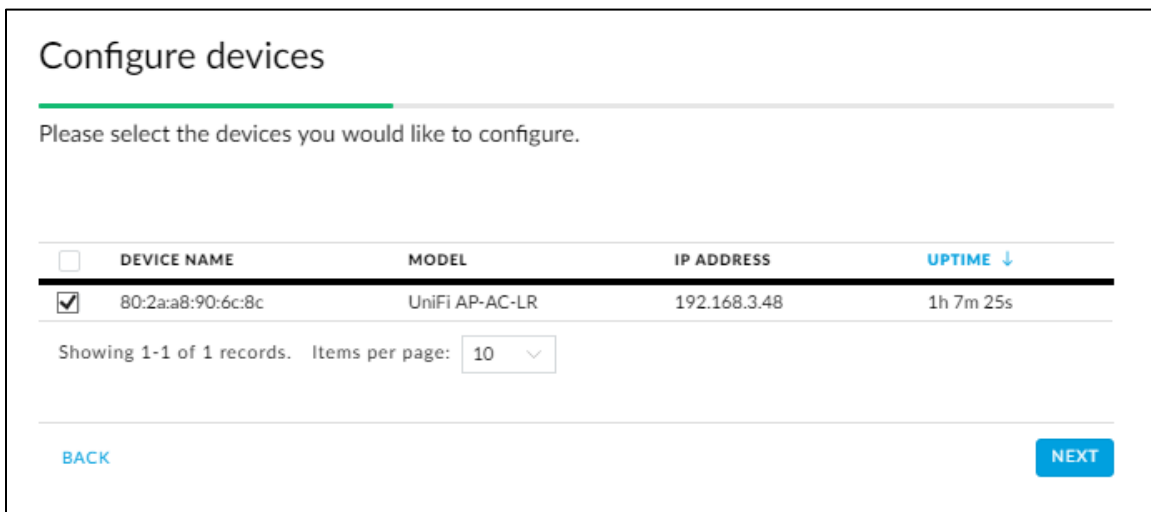
Select your country, time zone, and enable Auto Backup”, then press Next. See Figure 125 – UniFi Setup Wizard.



The screenshot shows the UniFi Setup Wizard interface. At the top, it says "UniFi Setup Wizard" with a progress bar. Below that, a message reads: "Thank you for purchasing UniFi, Ubiquiti's Enterprise WiFi Solution. You will be able to setup your controller in a few minutes." There are two dropdown menus: "Select your country" with "United States" selected, and "Select your timezone" with "(UTC-05:00) Eastern Time (US & Canada)" selected. Below these is a toggle for "Enable Auto Backup" which is currently turned "ON" (indicated by a green switch). A link says "Alternatively you can [restore from a previous backup.](#)". At the bottom right is a blue "NEXT" button.

Figure 125 – UniFi Setup Wizard

Your Ubiquiti Access Point should show up in the list. Check it and then press Next. See Figure 126 – UniFi Configure Devices.



The screenshot shows the "Configure devices" screen. It has a title "Configure devices" and a message "Please select the devices you would like to configure." Below this is a table with the following columns: "DEVICE NAME", "MODEL", "IP ADDRESS", and "UPTIME ↓". There is a checkbox in the first column. The table contains one row with the following data: checkbox checked, "80:2a:a8:90:6c:8c", "UniFi AP-AC-LR", "192.168.3.48", and "1h 7m 25s". Below the table, it says "Showing 1-1 of 1 records. Items per page: 10" with a dropdown menu. At the bottom left is a blue "BACK" link, and at the bottom right is a blue "NEXT" button.

<input type="checkbox"/>	DEVICE NAME	MODEL	IP ADDRESS	UPTIME ↓
<input checked="" type="checkbox"/>	80:2a:a8:90:6c:8c	UniFi AP-AC-LR	192.168.3.48	1h 7m 25s

Figure 126 – UniFi Configure Devices

You will see the initial configure WiFi screen. See Figure 127 – UniFi Initial Configure WiFi.

Configure WiFi

You may skip this step if you are not setting up any UniFi access points.

Secure SSID Security Key

Optionally, you may create an open wireless network for your guests:

☐ Enable Guest Access

BACK SKIP NEXT

Figure 127 – UniFi Initial Configure WiFi

Fill in your main network's SSID and your WiFi password. I used the name "HomeNet" for this guide. This is the WiFi network that most of your computers, tablets, and cell phones will connect to. Leave the Enable Guest Network as UNCHECKED, and then press Next. See Figure 128 – UniFi Configure Wifi SSID.

Configure WiFi

You may skip this step if you are not setting up any UniFi access points.

HomeNet

Optionally, you may create an open wireless network for your guests:

☐ Enable Guest Access

BACK SKIP NEXT

Figure 128 – UniFi Configure Wifi SSID

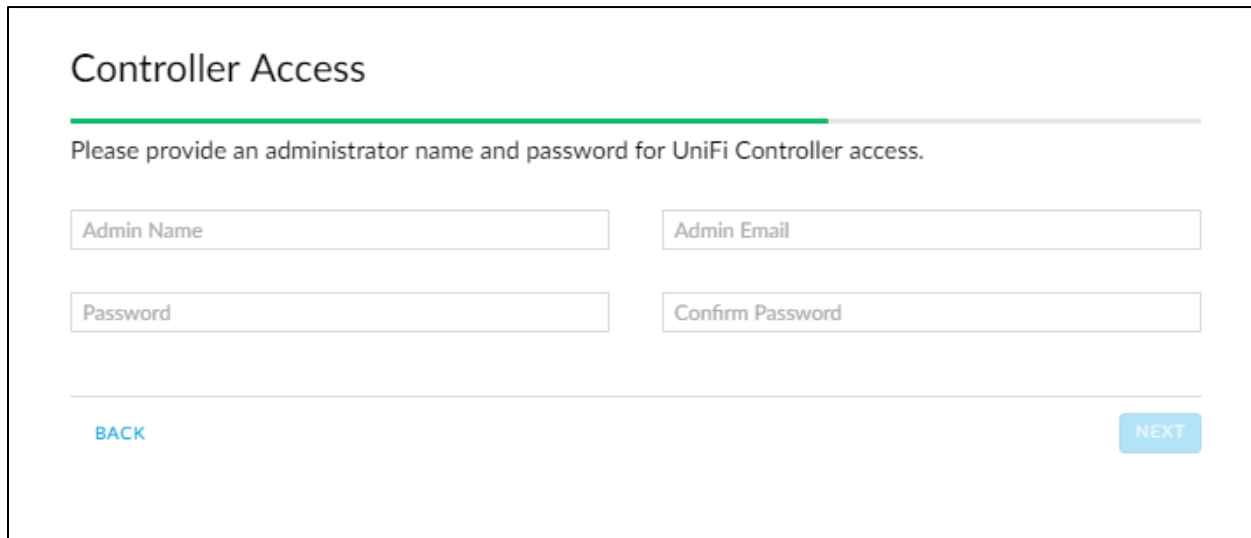
To access this UniFi software later on, fill in the following information:

Admin Name

Admin Email

Password

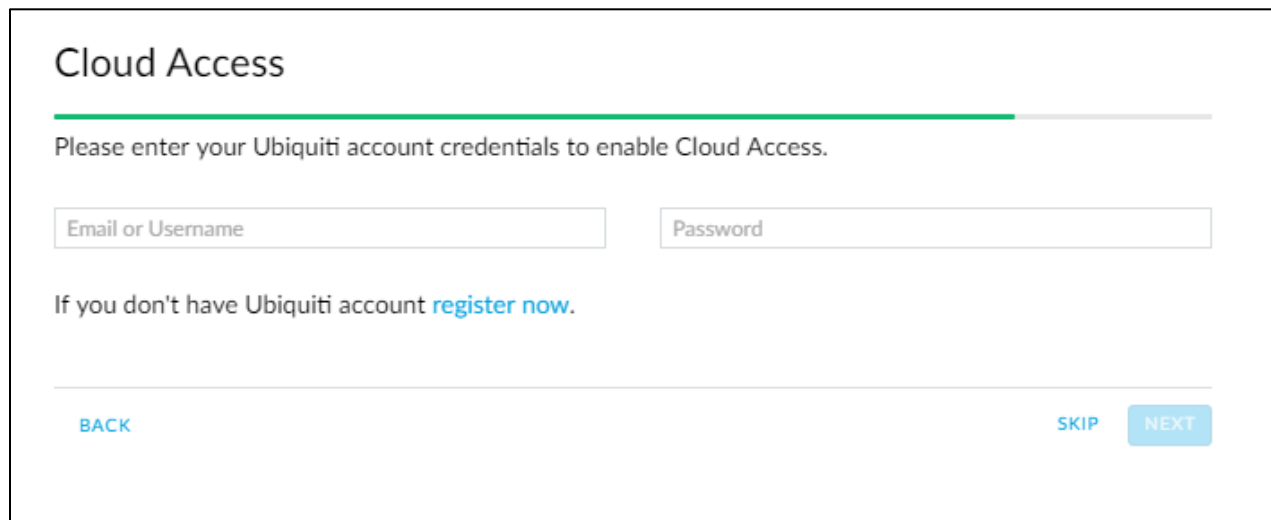
You will want to write these down and/or put them in your password safe. The email address is used for password recovery. When finished, press Next. See Figure 129 – UniFi Controller Access.



The screenshot shows the 'Controller Access' setup screen. At the top, there's a title 'Controller Access' followed by a progress bar that is partially filled with green. Below the title, a message says 'Please provide an administrator name and password for UniFi Controller access.' There are four input fields arranged in two rows: 'Admin Name' and 'Admin Email' in the first row, and 'Password' and 'Confirm Password' in the second row. At the bottom, there are two buttons: 'BACK' on the left and 'NEXT' on the right.

Figure 129 – UniFi Controller Access

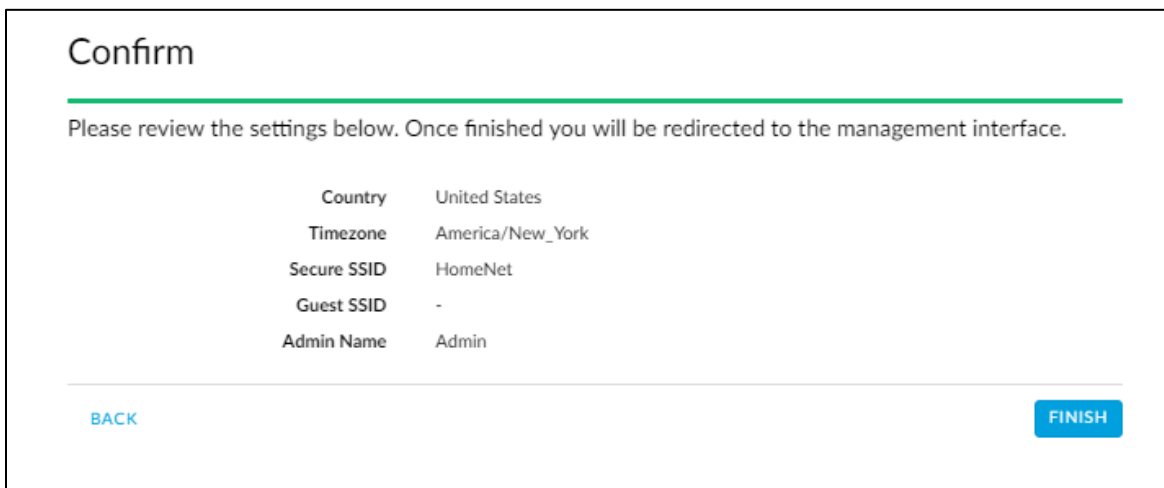
Since I am not using Cloud Access, I pressed Skip. See Figure 130 – UniFi Cloud Access.



The screenshot shows the 'Cloud Access' setup screen. At the top, there's a title 'Cloud Access' followed by a progress bar that is partially filled with green. Below the title, a message says 'Please enter your Ubiquiti account credentials to enable Cloud Access.' There are two input fields: 'Email or Username' and 'Password'. Below the input fields, there's a link that says 'If you don't have Ubiquiti account [register now](#).' At the bottom, there are three buttons: 'BACK' on the left, 'SKIP' in the middle, and 'NEXT' on the right.

Figure 130 – UniFi Cloud Access

You are then asked to confirm the above information. If it is correct, press Finish. See Figure 131 – UniFi Confirm Setup.



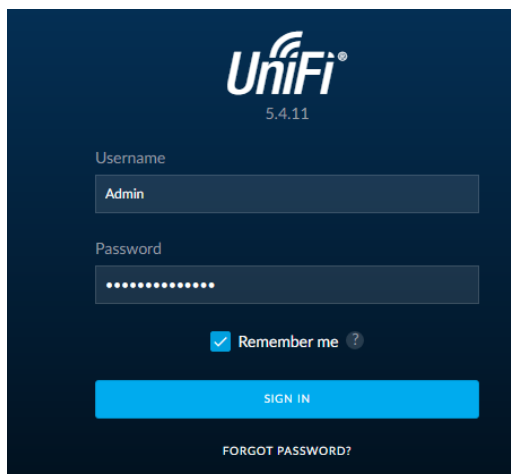
The image shows a 'Confirm' screen from the UniFi setup process. At the top, the word 'Confirm' is displayed in a large, dark font. Below it, a green horizontal line separates the title from the instructions: 'Please review the settings below. Once finished you will be redirected to the management interface.' The settings are listed in a table-like format with labels on the left and values on the right. At the bottom, there are two buttons: 'BACK' on the left and 'FINISH' on the right, both in blue with white text.

Country	United States
Timezone	America/New_York
Secure SSID	HomeNet
Guest SSID	-
Admin Name	Admin

Figure 131 – UniFi Confirm Setup

64. Login to the UniFi Software

You will be asked to login to the UniFi Software. See Figure 132 – UniFi Login. Use your newly created credentials that were entered at Figure 129 – UniFi Controller Access.



The image shows the UniFi login screen. At the top, the UniFi logo is displayed in white on a dark blue background, with the version number '5.4.11' below it. Below the logo, there are two input fields: 'Username' with the value 'Admin' and 'Password' with a masked password represented by dots. Below the password field, there is a checkbox labeled 'Remember me' with a question mark icon to its right. At the bottom, there is a large blue button labeled 'SIGN IN' and a link labeled 'FORGOT PASSWORD?' below it.

Figure 132 – UniFi Login

You will land on the Dashboard page. See Figure 133 – Initial UniFi Dashboard Page

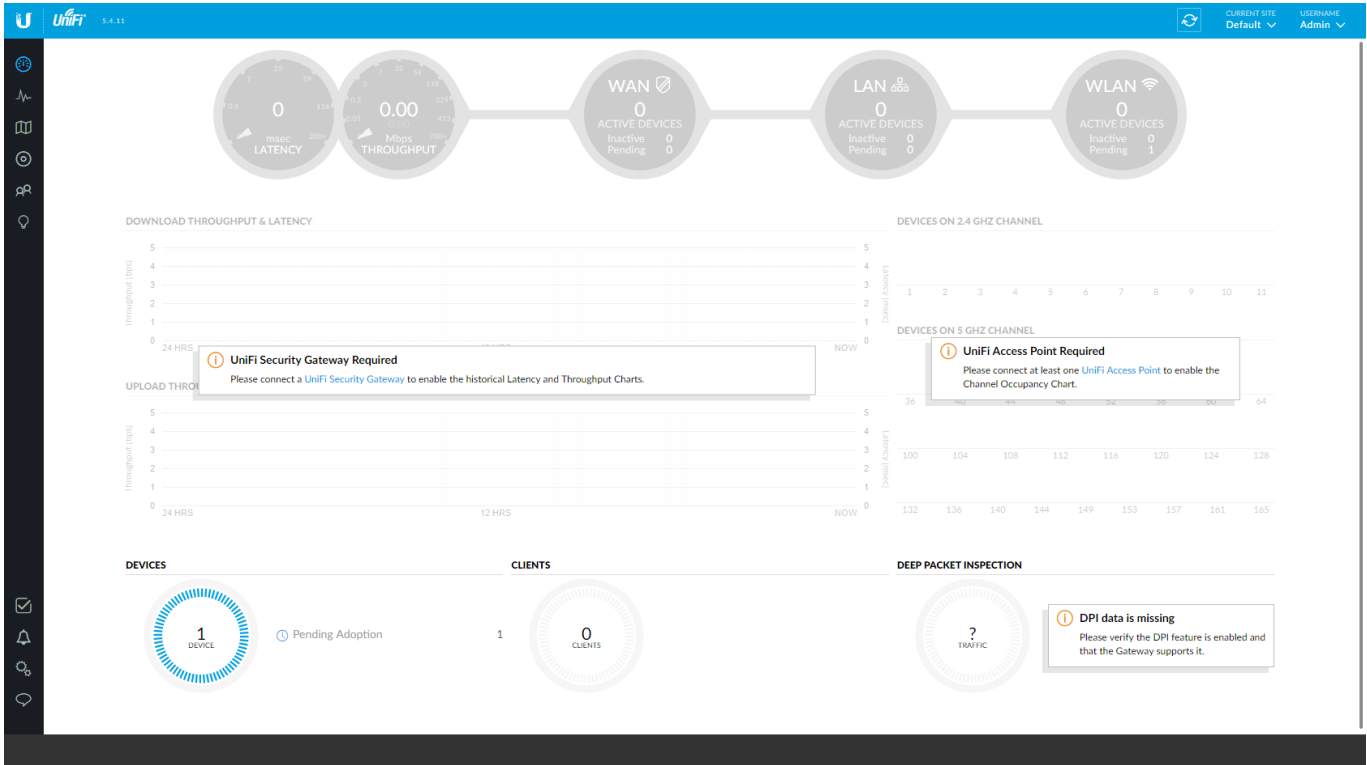


Figure 133 – Initial UniFi Dashboard Page

From the upper left hand side choose Devices. See Figure 134 – UniFi Devices Button.

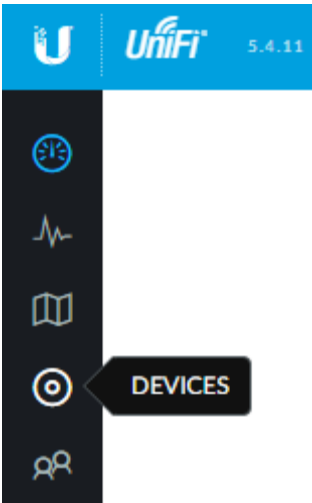


Figure 134 – UniFi Devices Button

65. UniFi Devices

You will see the devices page, and the Access Point should be Pending Adoption. See Figure 135 – Initial UniFi Device Screen. Note that this screenshot / figure was cut into two pieces and folded into one image.

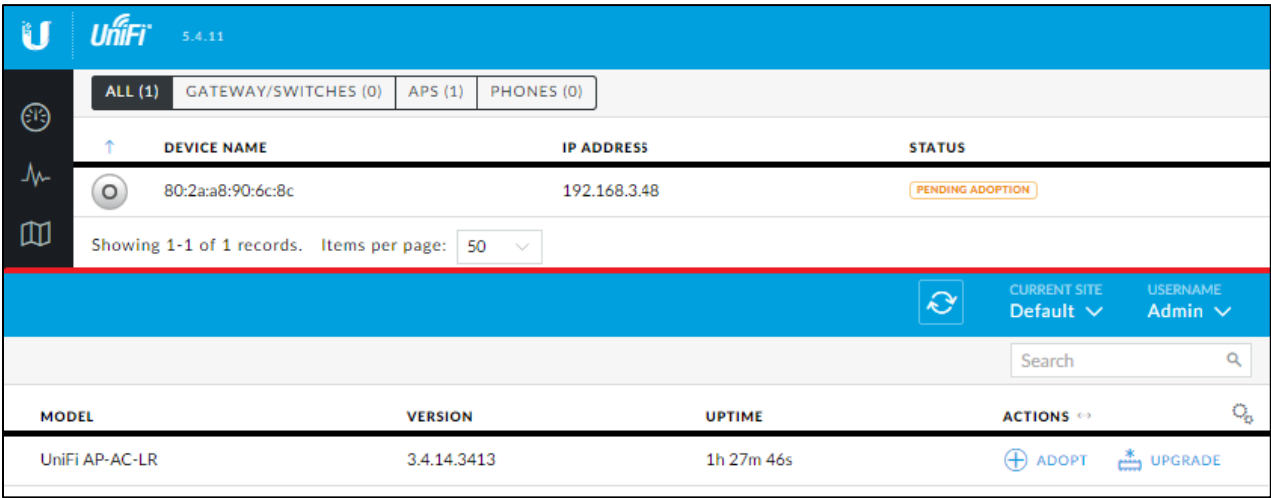


Figure 135 – Initial UniFi Device Screen

Press the Upgrade button on the right side of the device line. Reference Figure 135 – Initial UniFi Device Screen. You will be presented with an upgrade confirmation dialog. Press Confirm. See Figure 136 – UniFi - Upgrade Access Point

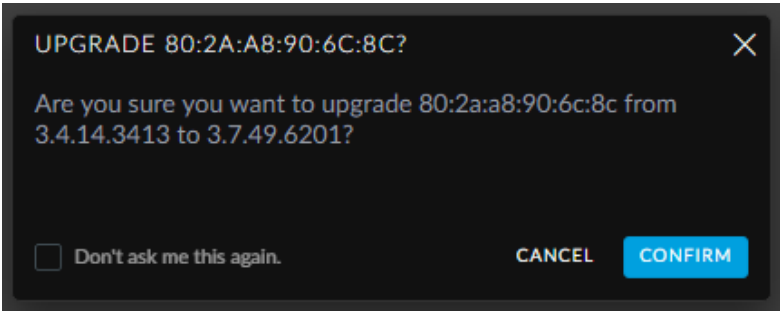


Figure 136 – UniFi - Upgrade Access Point

You should see acknowledgement of the upgrade. See Figure 137 – UniFi – Upgrading.

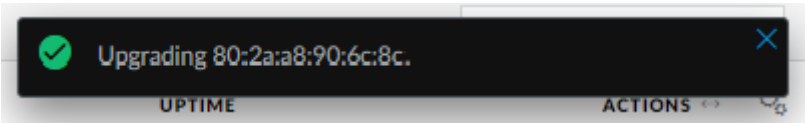


Figure 137 – UniFi – Upgrading Access Point

When the upgrade is finished, press the Adopt button on the right side of the device line. Reference Figure 135 – Initial UniFi Device Screen. You should see acknowledgement of the Adoption. See Figure 138 – UniFi – Adopting.

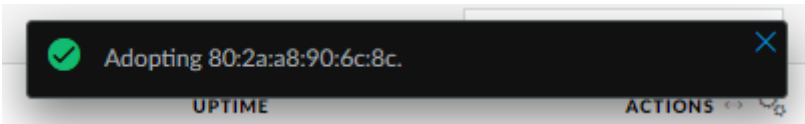


Figure 138 – UniFi – Adopting Access Point

Your device should now say Connected. The buttons on the right now allow you to locate, restart, and upgrade the Access Point. See Figure 139 – UniFi Access Point Connected. Note that this screenshot / figure was cut into two pieces and folded into one image.

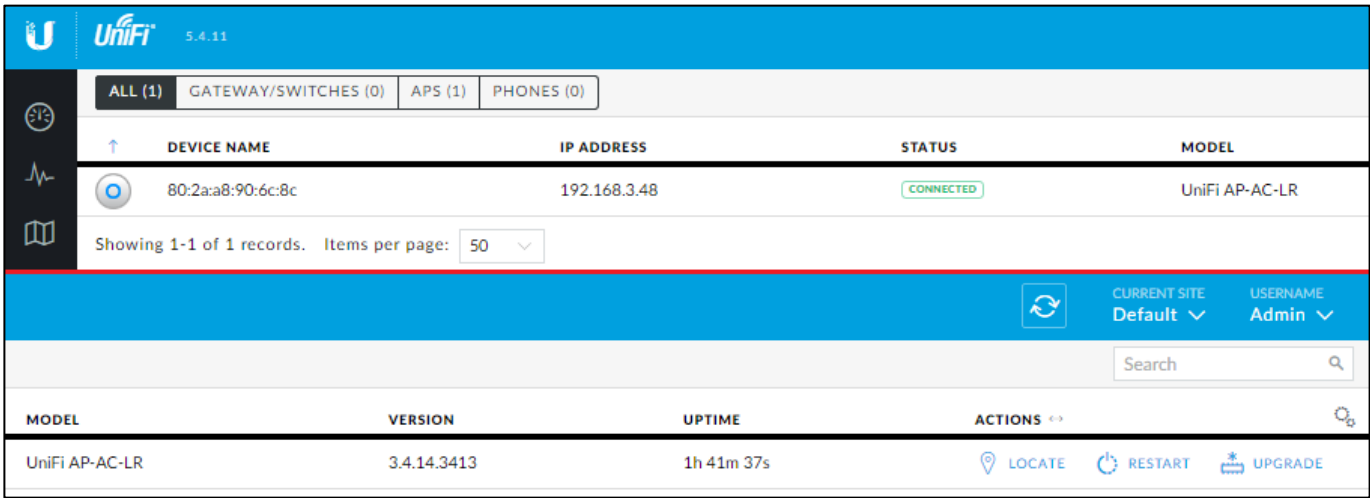


Figure 139 – UniFi Access Point Connected

Find the Settings button, near the lower left side of the screen, and press it. See Figure 140 – Settings Button

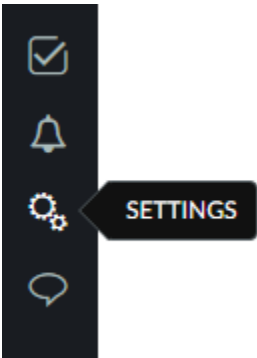


Figure 140 – Settings Button

66. UniFi Settings

You should see the Site Tab of the Settings page. Check Automatically Upgrade firmware, and then press Apply Changes. See Figure 141 – UniFi Site Configuration.

The screenshot displays the UniFi Settings interface, version 5.4.11. The left sidebar shows the 'SETTINGS' menu with the 'Site' tab selected. The main content area is titled 'Site' and contains two sections: 'SITE CONFIGURATION' and 'SERVICES'.

SITE CONFIGURATION

- Site Name: Default
- Country: United States
- Timezone: (UTC-05:00) Eastern Time (US & Canada)

SERVICES

- Advanced Features: ☐ Enable advanced features
- Automatic Upgrades: ☒ Automatically upgrade firmware
- LED: ☒ Enable status LED
- Alerts: ☒ Enable alert emails
- Speed Test (BETA): ☐ Enable periodic speed test every 20 minutes (USG)
- Port Remapping (BETA): ☐ Configure VOIP port as WAN2 on UniFi Security Gateway 3P (USG)
- Uplink Connectivity Monitor: ☒ Enable connectivity monitor and wireless uplink
 - ☐ Enable automatic uplink failover
 - Default gateway (selected) or Custom IP: Uplink IP Address
- SNMP: ☐ Enable SNMPv1 Community String: public
- Remote Logging: ☐ Enable remote syslog server
- Device Authentication: Username: Admin Password: [masked]

At the bottom, there are three buttons: 'APPLY CHANGES' (green), 'RESET', and 'EXPORT SITE' (grey).

Figure 141 – UniFi Site Configuration

Click on the Guest Control tab. Under the Access Control section, add:

192.168.3.0/24

to Pre-Authorization Access, then press Apply Changes. See Figure 142 –Unifi Guest Control.

This will allow devices on the Wifi Guest Network to (respond to) communications from the Home Network. Remember that the EdgeRouter has firewall rules prohibiting Guest network devices from initiating communications with the Home Network. This allows Guest devices to RESPOND to Home Network initiated conversations.

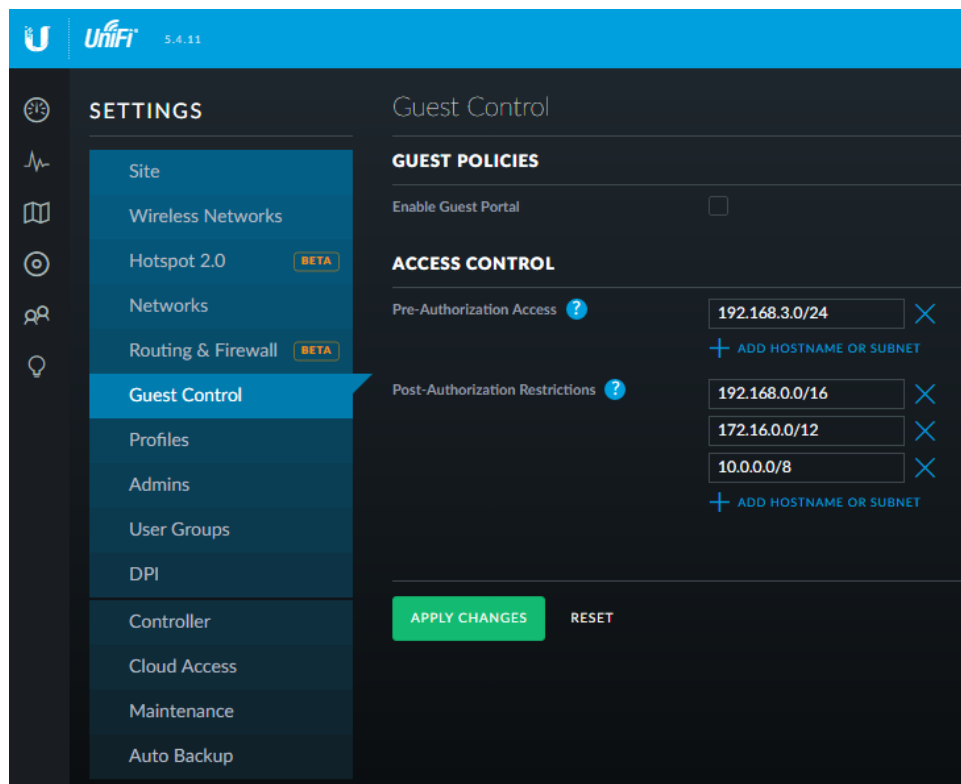


Figure 142 –Unifi Guest Control

Click on the User Groups tab, and then press Create New User Group. See Figure 143 – UniFi Initial User Groups.

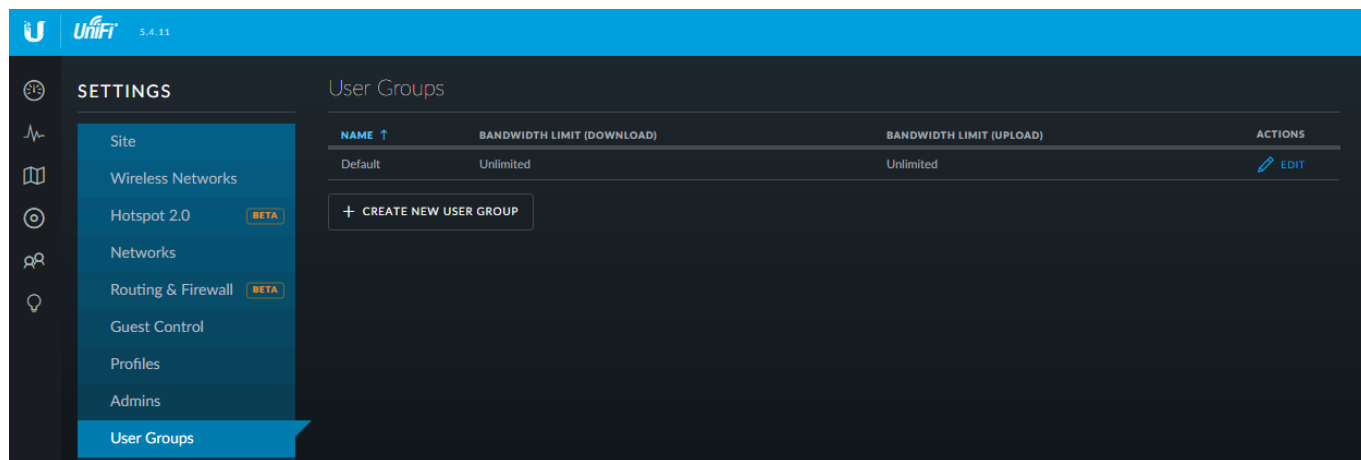


Figure 143 – UniFi Initial User Groups

The following settings allow the Access Point to limit the bandwidth used by users within the guest networks. You may choose to enter different limit values and/or leave either or both of the settings as unchecked. Unchecked is unlimited. The values used here are:

download speed is limited to 10 Mbps

upload speed is limited to 2 Mbps.

I believe that the limits are per user, not per network.

To use the values that are in this guide, complete the form as follows:

Name	GuestGroup	
Bandwidth Limit (Download)	Checked	10000
Bandwidth Limit (Upload)	Checked	2000

then press Save. See Figure 144 – UniFi Guest Group

The screenshot shows the UniFi Settings interface. On the left is a sidebar with navigation icons and labels: Site, Wireless Networks, Hotspot 2.0 (BETA), Networks, Routing & Firewall (BETA), Guest Control, Profiles, Admins, and User Groups (highlighted). The main content area is titled 'User Groups' and contains a 'CREATE NEW USER GROUP' form. The form has three fields: 'Name' with the value 'GuestGroup', 'Bandwidth Limit (Download)' with a checked checkbox and a value of '10000' Kbps, and 'Bandwidth Limit (Upload)' with a checked checkbox and a value of '2000' Kbps. At the bottom of the form are 'SAVE' and 'CANCEL' buttons.

Figure 144 – UniFi Guest Group

You should now see the newly created group. See Figure 145 – UniFi New User Groups.

The screenshot shows the UniFi Settings interface with the 'User Groups' section. A table displays the list of user groups. The table has four columns: NAME, BANDWIDTH LIMIT (DOWNLOAD), BANDWIDTH LIMIT (UPLOAD), and ACTIONS. The 'GuestGroup' row is highlighted. Below the table is a '+ CREATE NEW USER GROUP' button.

NAME ↑	BANDWIDTH LIMIT (DOWNLOAD)	BANDWIDTH LIMIT (UPLOAD)	ACTIONS
Default	Unlimited	Unlimited	EDIT
GuestGroup	10000 Kbps	2000 Kbps	EDIT DELETE

+ CREATE NEW USER GROUP

Figure 145 – UniFi New User Groups

Click on the Wireless Networks tab, you should see the Home Network that was setup earlier. See Figure 146 – UniFi Wireless Network Setup. Click on Create New Wireless Network button

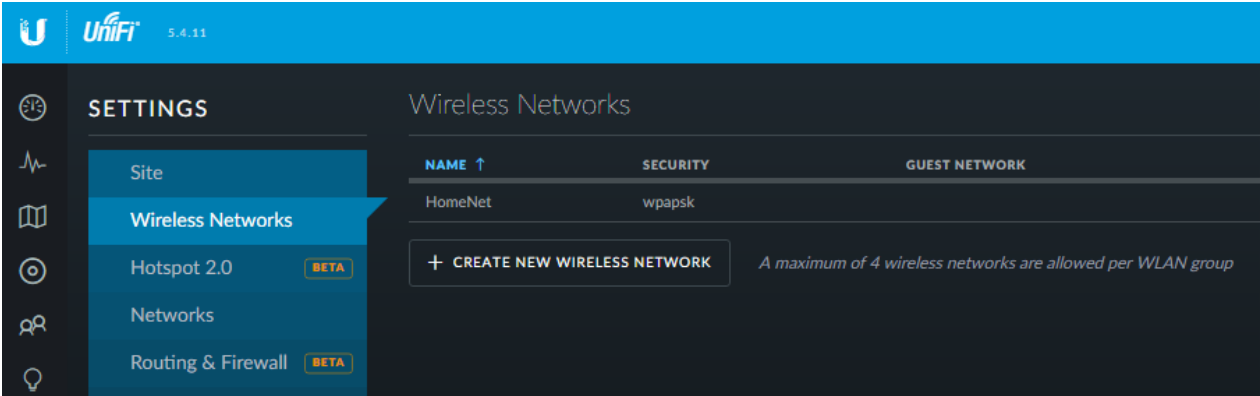


Figure 146 – UniFi Wireless Network Setup

Click on Create New Wireless Network button. You will be presented with the Create New Wireless Network dialog. See Figure 147 – UniFi Create New Wireless Network.

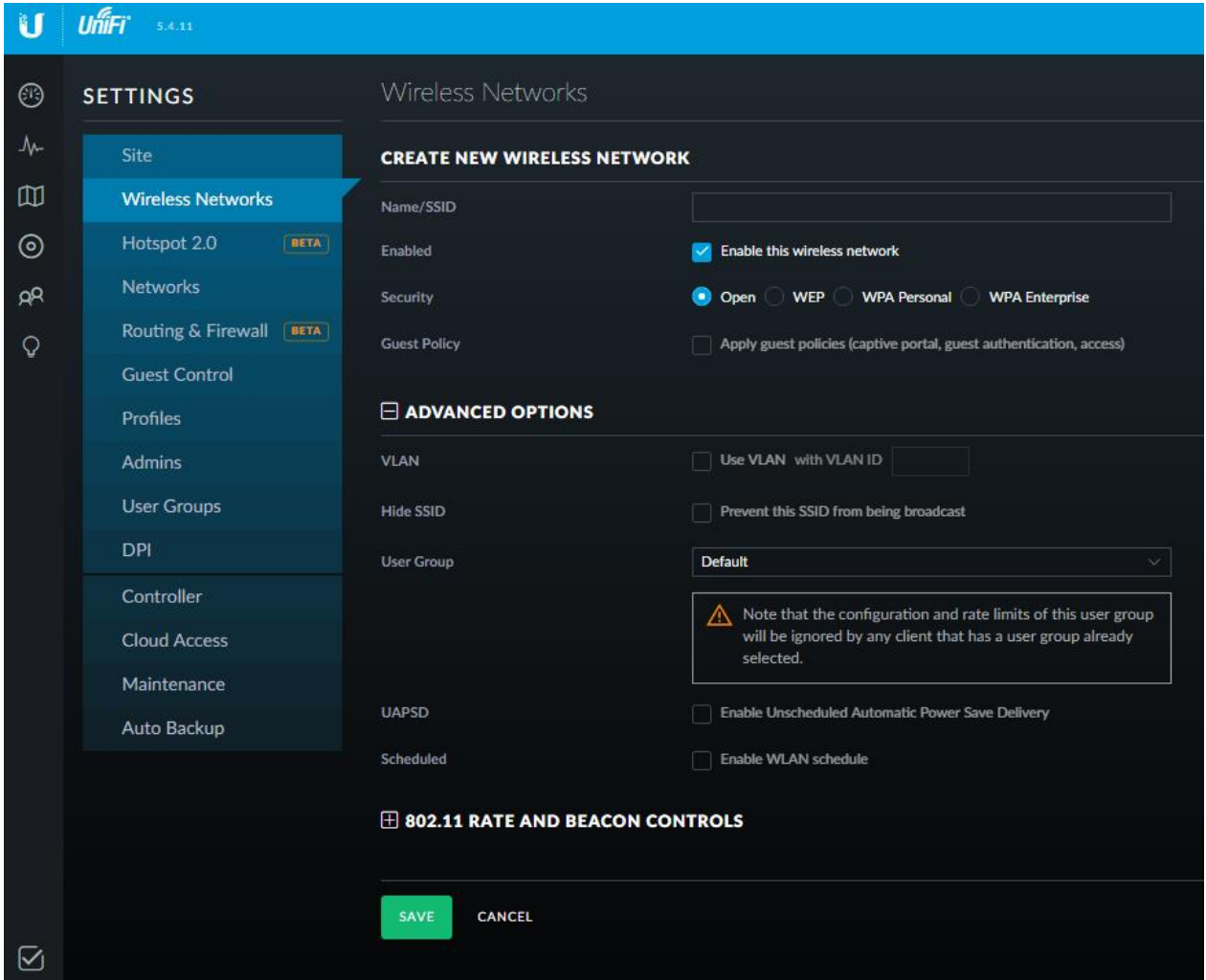


Figure 147 – UniFi Create New Wireless Network

You can change the Name/SSID, Security Key (i.e. password) and WPA Modes as suites you.

Change / Enter the following information:

Name/SSID	GuestWifi		
Security	WPA Personal		
Security Key	<Enter your own password for the guest wifi network >		
Guest Policy	CHECKED	Apply guest policies	
VLAN	CHECKED	VlanId	6
WPA Mode	WPA2 Only	Encryption	AES/CCMP Only
User Group	GuestGroup		

Press Save. See Figure 148 – UniFi Guest Wif.

The screenshot shows the UniFi Settings interface. On the left is a sidebar with navigation options: Site, Wireless Networks (selected), Hotspot 2.0 (BETA), Networks, Routing & Firewall (BETA), Guest Control, Profiles, Admins, User Groups, DPI, Controller, Cloud Access, Maintenance, and Auto Backup. The main content area is titled 'Wireless Networks' and contains the 'EDIT WIRELESS NETWORK - GUESTWIFI' form.

EDIT WIRELESS NETWORK - GUESTWIFI

Name/SSID: GuestWifi

Enabled: ☒ Enable this wireless network

Security: ☐ Open ☐ WEP ☒ WPA Personal ☐ WPA Enterprise

Security Key: [Masked password field]

Guest Policy: ☒ Apply guest policies (captive portal, guest authentication, access)

ADVANCED OPTIONS

VLAN: ☒ Use VLAN with VLAN ID 6

Hide SSID: ☐ Prevent this SSID from being broadcast

WPA Mode: WPA2 Only Encryption: AES/CCMP Only

User Group: GuestGroup

802.11 RATE AND BEACON CONTROLS

UAPSD: ☐ Enable Unscheduled Automatic Power Save Delivery

Scheduled: ☐ Enable WLAN schedule

Buttons: SAVE, CANCEL

Note: Note that the configuration and rate limits of this user group will be ignored by any client that has a user group already selected.

Figure 148 – UniFi Guest Wif

Click on Create New Wireless Network button. You can change the Name/SSID, Security Key (i.e. password) and WPA Modes as suites you.

Change / Enter the following information:

Name/SSID	lotWifi		
Security	WPA Personal		
Security Key	<Enter your own password for the lot wifi network >		
Guest Policy	CHECKED	Apply guest policies	
VLAN	CHECKED	VlanId	7
WPA Mode	WPA2 Only	Encryption	AES/CCMP Only
User Group	GuestGroup		

Press Save. SeeFigure 149 – UniFi lot WiFi.

The screenshot shows the UniFi 5.4.11 settings interface. On the left is a sidebar with navigation options: Site, Wireless Networks (selected), Hotspot 2.0 (BETA), Networks, Routing & Firewall (BETA), Guest Control, Profiles, Admins, User Groups, DPI, Controller, Cloud Access, Maintenance, and Auto Backup. The main content area is titled 'Wireless Networks' and shows the 'EDIT WIRELESS NETWORK - IOTWIFI' configuration page. The configuration fields are as follows:

- Name/SSID:** lotWifi
- Enabled:** ☒ Enable this wireless network
- Security:** ☐ Open ☐ WEP ☒ WPA Personal ☐ WPA Enterprise
- Security Key:** [Masked password field]
- Guest Policy:** ☒ Apply guest policies (captive portal, guest authentication, access)
- ADVANCED OPTIONS:**
 - VLAN:** ☒ Use VLAN with VLAN ID 7
 - Hide SSID:** ☐ Prevent this SSID from being broadcast
 - WPA Mode:** WPA2 Only (dropdown)
 - Encryption:** AES/CCMP Only (dropdown)
 - User Group:** GuestGroup (dropdown)
 - Note:** Note that the configuration and rate limits of this user group will be ignored by any client that has a user group already selected.
 - UAPSD:** ☐ Enable Unscheduled Automatic Power Save Delivery
 - Scheduled:** ☐ Enable WLAN schedule
- 802.11 RATE AND BEACON CONTROLS:** (Section header with expand/collapse icon)

At the bottom of the configuration page are two buttons: **SAVE** (green) and **CANCEL** (grey).

Figure 149 – UniFi lot WiFi

You should now have the following networks. Note that:

GuestWifi	Checked as Guest	Vlan 6
HomeNet	(Unchecked Guest)	(no Vlan)
lotWifi	Checked as Guest	Vlan 7

See Figure 150 – UniFi Three WiFi Networks.

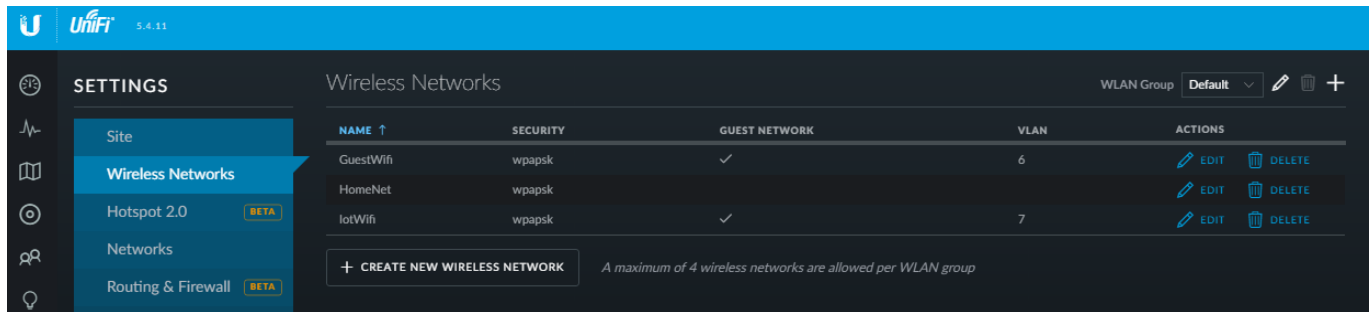


Figure 150 – UniFi Three WiFi Networks

Click on the DPI tab, and set:

Enable Deep Packet Inspection (DPI) On

Press Apply Changes. See Figure 151 – UniFi Deep Packet Inspection

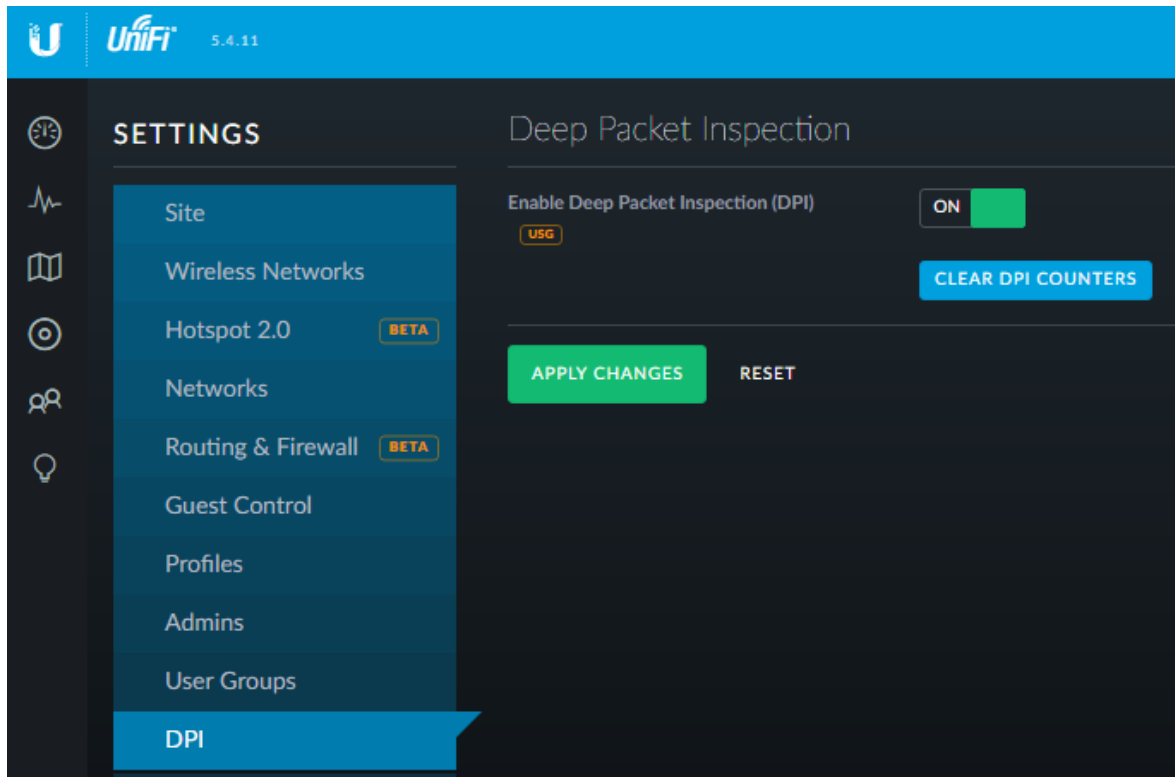


Figure 151 – UniFi Deep Packet Inspection

Return to the Dashboard screen by pressing the Dashboard button. See Figure 152 – UniFi Dashboard Button.

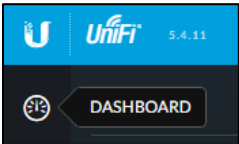


Figure 152 – UniFi Dashboard Button

In the upper right part of the dashboard screen is the Open Properties button. Press the button. See Figure 153 – UniFi Open Properties Button

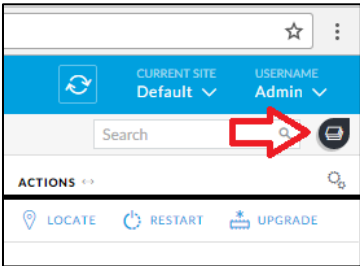


Figure 153 – UniFi Open Properties Button

These are the Properties of the access point. There are some nice settings in here. See Figure 154 – UniFi Access Point Properties.

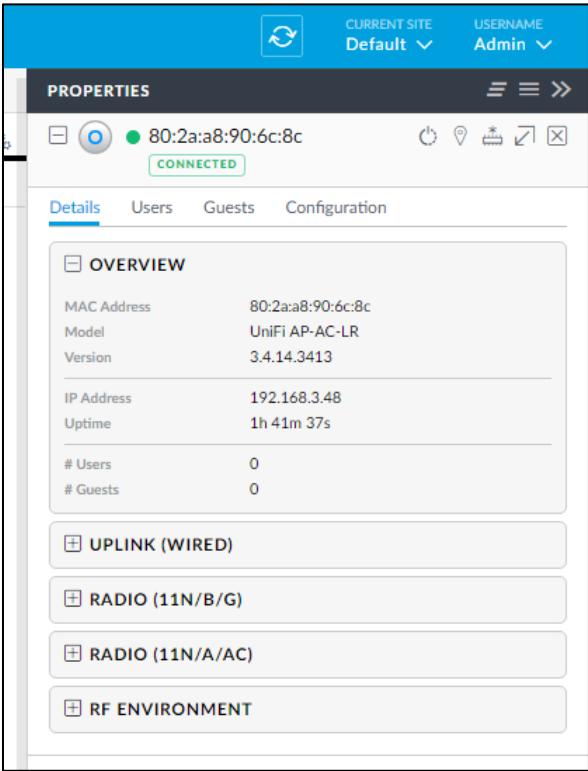


Figure 154 – UniFi Access Point Properties.

You can now exit the UniFi browser and close the UniFi Controller Software by pressing the X in the upper-right corner, as shown in Figure 122 – UniFi Controller Software Running.

This is the end of the Access Point / UniFi setup.

67. Timed Based Firewall Rules

Several people have wanted to restrict their children's Internet usage based upon time. Here are some sample links:

<https://community.ubnt.com/t5/EdgeMAX/Restrict-WAN-Access-to-from-LAN-Clients-by-Specific-IP-By-Time/td-p/2083140>

<https://community.ubnt.com/t5/UniFi-Wireless/User-based-time-control-of-wifi-access/td-p/1490803>

<https://community.ubnt.com/t5/EdgeMAX/Time-control-parental-controll/td-p/1035259>

<https://community.ubnt.com/t5/EdgeMAX/Set-up-time-limits-for-kids-internet-access/td-p/1824135>

<https://community.ubnt.com/t5/EdgeMAX/Parental-controls-time-of-day-routing-content-filtering/td-p/1268520>

68. Double-NAT

When one firewall/router is behind another firewall/router, that combination is called double-NAT. Each router performs Network-Address-Translation (NAT.) Each router will introduce a small time delay as it processes IP packets. If you are running a server behind your (inner) router, then Double NAT can be particularly difficult to configure. Most people in the Ubiquiti forums hate Double-NAT. Once the EdgeRouter 's firewall is configured, the EdgeRouter CAN (but does not have to be) be your main and only router.

69. Another link

This seems like a wealth of information:

<http://wiki.indie-it.com/wiki/Ubiquiti>

70. Adblocking and Blacklisting

I have only installed the following on my test router, but since it seemed to work flawlessly, I will shortly move this to my production router. There are a number of similar posts with different version numbers. I had to use an SSH package (e.g. putty for Windows) to paste the following commands into the EdgeRouter, as the CLI doesn't support copy / paste. Be patient, this takes a while to install.

<https://community.ubnt.com/t5/EdgeMAX/CLI-Integrated-dnsmasq-Adblocking-amp-Blacklisting-v3-7-5-Easy/td-p/1344740>

The following text is cached from the above posting (you should check for updated commands :)

```
Download install_dnsmasq_blklist.v3.7.5.tgz
- curl -o /tmp/install_dnsmasq_blklist.v3.7.5.tgz
https://community.ubnt.com/ubnt/attachments/ubnt/EdgeMAX/78132/71/install_dnsmasq_blklist.v3.7.5.tgz
- cd /tmp
- tar zxvf ./install_dnsmasq_blklist.v3.7.5.tgz
- bash ./install_dnsmasq_blklist.v3.7.5
- select menu option #0 if installing for the first time
- select menu option #1 to completely remove blacklisting if you have a
  previous version, then run install again using option #0
- Uninstall
  * /tmp/install_dnsmasq_blklist.v3.7.5
    - select option #1
```

This is not in the associated backup file.

The menu that was presented is shown in Figure 155 – Adblocking & Blacklisting Menu.

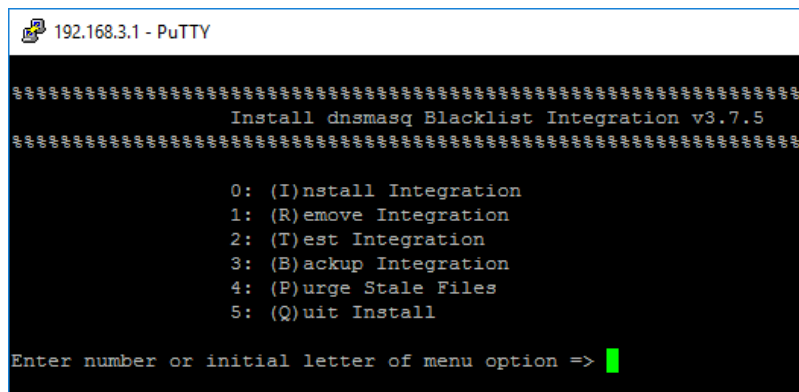
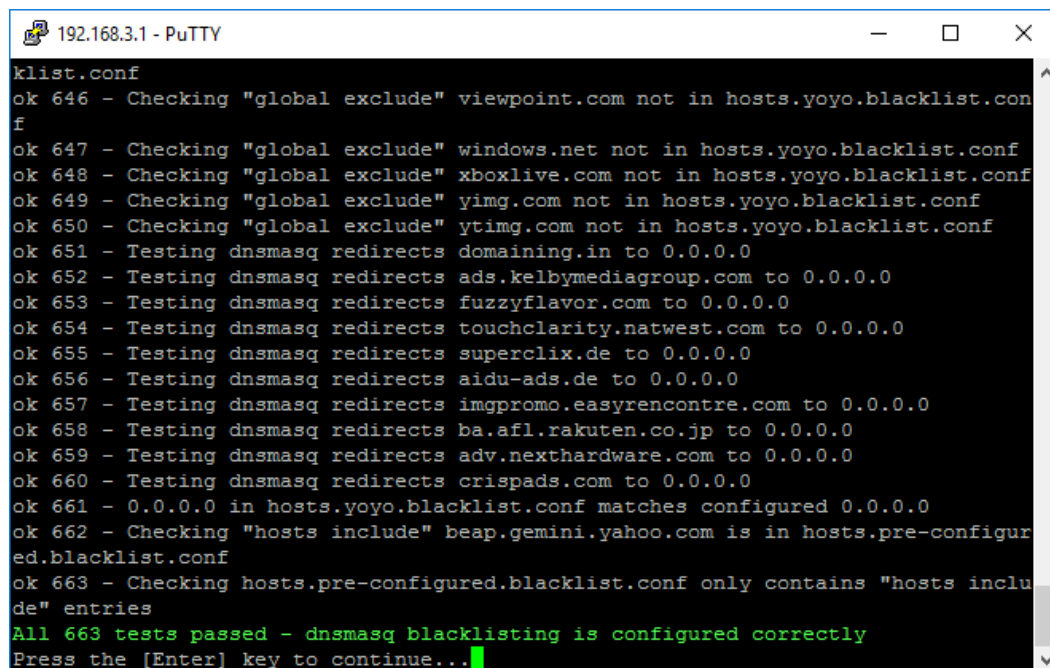


Figure 155 – Adblocking & Blacklisting Menu.

I selected "0", which is Install Integration.

The (final) results are shown in Figure 156 – Adblocking & Blacklisting Results.



```
klist.conf
ok 646 - Checking "global exclude" viewpoint.com not in hosts.yoyo.blacklist.conf
ok 647 - Checking "global exclude" windows.net not in hosts.yoyo.blacklist.conf
ok 648 - Checking "global exclude" xboxlive.com not in hosts.yoyo.blacklist.conf
ok 649 - Checking "global exclude" yimg.com not in hosts.yoyo.blacklist.conf
ok 650 - Checking "global exclude" yting.com not in hosts.yoyo.blacklist.conf
ok 651 - Testing dnsmasq redirects domaining.in to 0.0.0.0
ok 652 - Testing dnsmasq redirects ads.kelbymediagroup.com to 0.0.0.0
ok 653 - Testing dnsmasq redirects fuzzyflavor.com to 0.0.0.0
ok 654 - Testing dnsmasq redirects touchclarity.natwest.com to 0.0.0.0
ok 655 - Testing dnsmasq redirects superclix.de to 0.0.0.0
ok 656 - Testing dnsmasq redirects aidu-ads.de to 0.0.0.0
ok 657 - Testing dnsmasq redirects imgpromo.easyrencontre.com to 0.0.0.0
ok 658 - Testing dnsmasq redirects ba.afl.rakuten.co.jp to 0.0.0.0
ok 659 - Testing dnsmasq redirects adv.nexthardware.com to 0.0.0.0
ok 660 - Testing dnsmasq redirects crispads.com to 0.0.0.0
ok 661 - 0.0.0.0 in hosts.yoyo.blacklist.conf matches configured 0.0.0.0
ok 662 - Checking "hosts include" beap.gemini.yahoo.com is in hosts.pre-configured.blacklist.conf
ok 663 - Checking hosts.pre-configured.blacklist.conf only contains "hosts include" entries
All 663 tests passed - dnsmasq blacklisting is configured correctly
Press the [Enter] key to continue...
```

Figure 156 – Adblocking & Blacklisting Results.

After pressing Enter, I went ahead and ran “2: (T)est Integration” and it produced the same page as shown in Figure 156 – Adblocking & Blacklisting Results.

I looked at the blocking list(s) and found that there are over 64,000 sites that are blocked. I tested this by trying to go to one of the “redirects” sites from my browser. I couldn’t get there.

Thanks to @britannic for this.

71. Intrusion Detection Systems

QUESTION: Which one to pick? How to configure it / connect it to the EdgeRouter?

72. Conclusions

I hope that this guide helped you set up your Ubiquiti equipment, and that you have learned a lot.

Enjoy your new network.

-Mike