OFF-SEASON FMS

Last Updated: 06-13-2018

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Disclaimer

Disclaimer

WARNING

Robot can be dangerous. By using the Field Management System (FMS) Software, you understand that in addition to the safety mechanisms built into the software, you, the operator, play a critical part in making sure that the environment around you is safe before enabling robots. You should only enable robots (use the "Match Start" button) when the robots are in a contained area and segregated from humans, who may be injured due to the robot's motion. If you disagree, or are not willing to use the software under these conditions, you should not proceed.

Off-Season Additional Disclaimer

The Off-Season version of the Field Management System (formerly “FMS Lite”) is similar in operation to that of the one used at official district and regional competitions but specially adapted to better suit the needs of teams and volunteers who operate events throughout the off-season. As such, some of the buttons, features or options that appear in the regular competition season are not available in FMS Off-Season. In most cases, unavailable features are called out (as possible) in the FMS User’s Guide and describe what may be different about the installation.

This document is a supplement to the official FMS User’s Guide available on the *FIRST* website (and located on this same site). This document will outline the unique network configuration for off season events, while the FMS User’s Guide details the software operation.

Configuration

About Off-Season FMS and Requirements

Overview

The Field Management System (FMS) is the electronics core of a *FIRST* Robotics Competition (FRC) playing field and encompasses both hardware and software components. The software package is used to control all the field electronics (LED Displays, Station Control Cabinets, E-stops, enable/disable of the Robots, network security, etc.) and is used to manage the event by creating match schedules, scoring the matches in real-time, and posting information to the Audience screen. The FMS Off-Season version is designed to work without the full set of FRC field electronics, but retain much of the functionality that remains useful to events without *FIRST* hardware.

Additional information about the software can be found in the other articles of this documentation.

Hardware Requirements

To run the Off-Season version the following minimum hardware items are required:

- Laptop or desktop computer with Ethernet Port
- WiFi Access Point (Linksys WRT610N or equivalent)
- Ethernet Switch (Unmanaged, 8 port, qty 3 recommended)

Other items, such as speakers or a projector, are recommended to supplement the user experience, but not required for basic functionality.

Software Requirements

In order to install Off-Season FMS, the target machine must meet these minimum requirements:

- Operating System: Windows 10
- Processor Speed: 64 bit OS
- CPU: 2.0 GHz
- Memory: 2 GB RAM
- Hard drive: 1 GB free hard disk space
- Hardware: Ethernet and USB Port
- Resolution: 1280x1024 or higher for best visibility

Audience Display Requirements

If you wish to run the Audience Display in addition to the Off-Season FMS, on the same computer, the target machine will need a modern video card and the machine must allow for it to be used as an extended display. The resolution should be either 1920 x 1080 or 1280 x 720 for the 16:9 Audience Display. For game sounds the target machine will need a sound card and, if desired, ability to output to a speaker system. The Audience Display can also be run on a separate machine, as long as they are on the same Ethernet network.

Important Off-Season Notes

Do not install FMS Off-Season on top of a previous installation of the software. Due to annual changes in areas such as the database, it is safest to completely uninstall and remove any previous installations of FMS from your computer before installing a new version. For assistance in properly removing a previous version, please see this article.

IMPORTANT: It is highly recommended that you do not install FMS Off-Season on machines that are school or business "owned" or controlled, as they often include restrictive user accounts, additional firewall and security programs, etc, which are not tested by *FIRST* and may interfere with FMS's ability to function properly.

Installation

Retrieve Installer

FMS OFF-SEASON SHOULD NOT BE INSTALLED ON TOP OF A PREVIOUS FMS OFF-SEASON VERSION, YOU MUST COMPLETELY REMOVE THE OLD VERSION AND DELETE THE SQL INSTANCE BEFORE CONTINUING. For help on doing this, please go to this article.

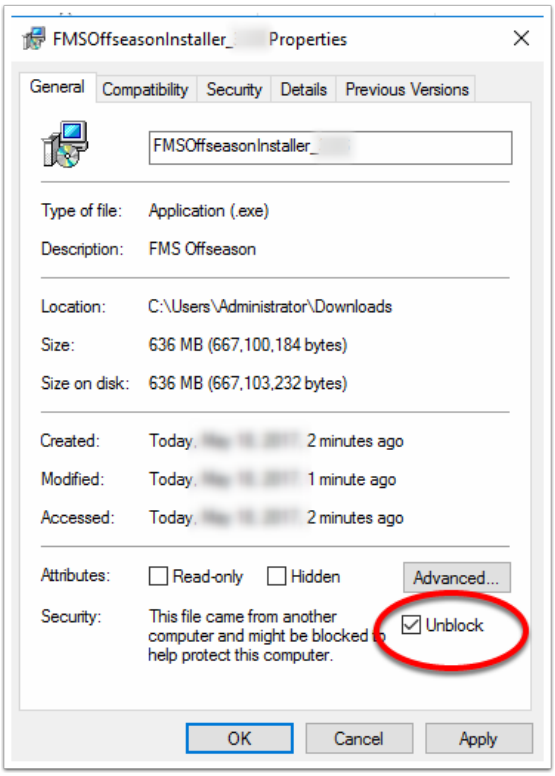
In order to install FMS Off-Season, download the EXE file from the *FIRST* website. The file contains the necessary pre-requisites and is usually around 600 MB in size.

Access the Installer download from this site (look for the most recent available)

FMS (2017+) require a 64 bit OS. *FIRST* recommends Windows 10.

Installation Process

Depending on your machine settings, Windows may prevent the file from running since it was downloaded from the Internet. To do this, right click on the Installer file and select "Properties." On the Properties menu, select "Unblock" and "OK." Then, attempt to run the installer by double-clicking.



By default, FMS will utilize port 80 (localhost) for its Web Portal. If you need FMS Off-Season to operate on a different port, please see the section about using an alternate port. For most users, the normal installation instructions should be sufficient.

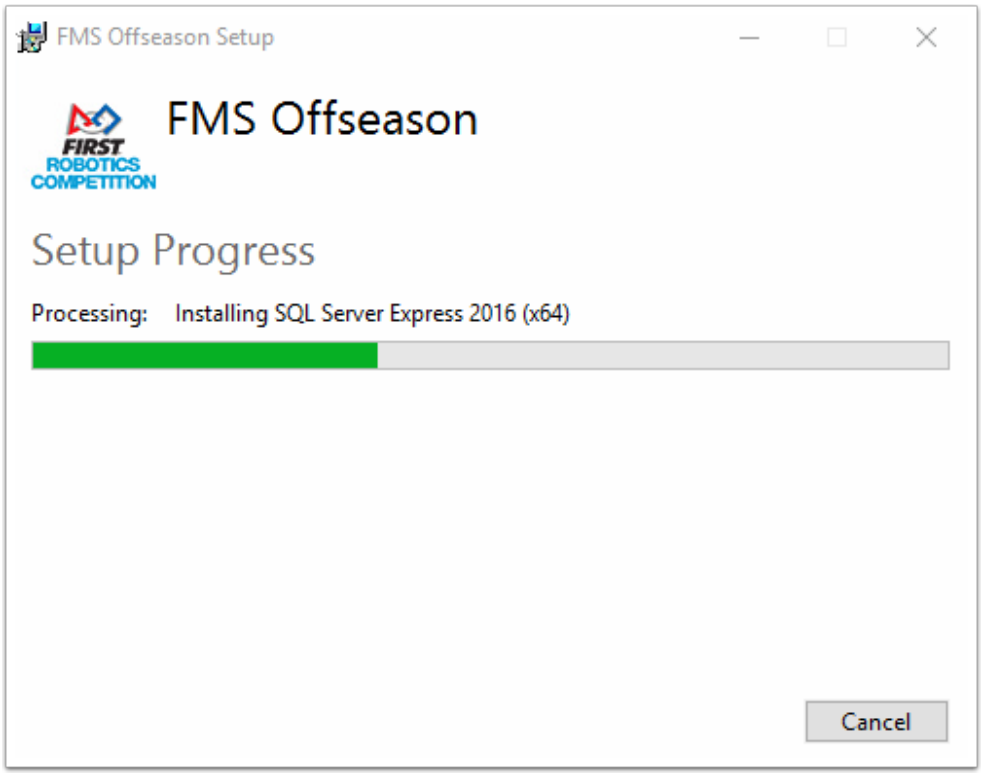
- Double-click the FMSOffSeasonInstaller_x.xx.exe to open the installation wizard.

Read the license terms. If you agree to the terms, click the box and select the Install option. You can specify the install path using the Options button. By default, the program will install in:

C:\Program Files\FIRST\FMSExeOffseason (64 bit OS)

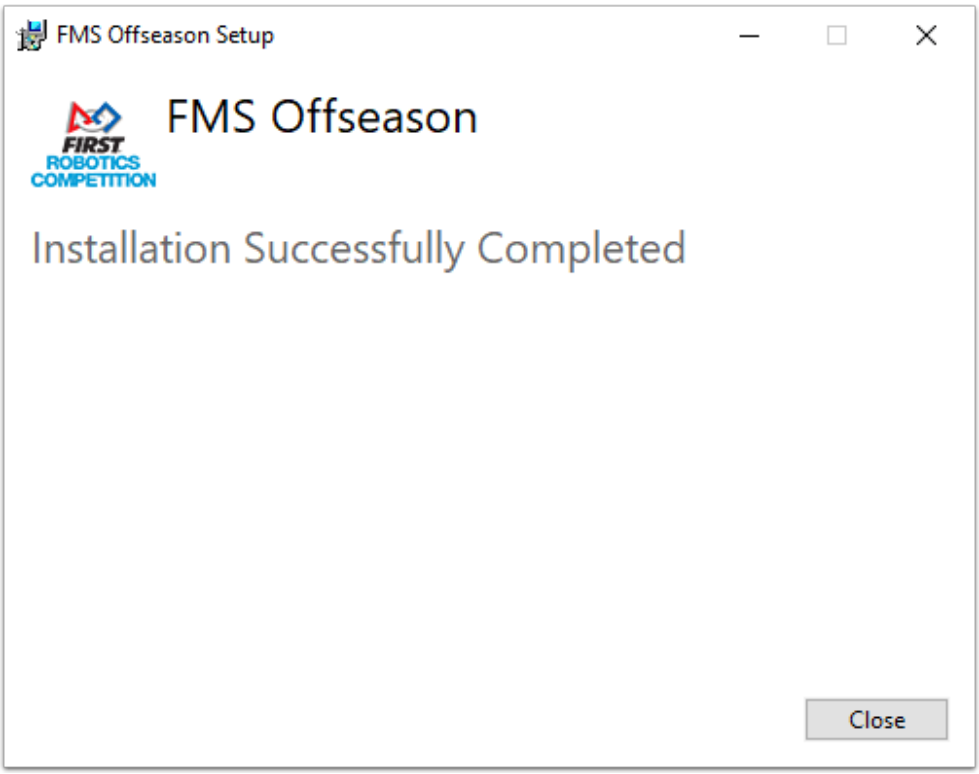
The install button may bring up the User Account Control box depending on your version of Windows. If so, select Yes to grant FMS Off-Season access to install.

The FMS Off-Season installer will run and Windows will provide feedback on the progress.



When the installation finishes, you can close the installer.

Off-Season FMS



Desktop Icons

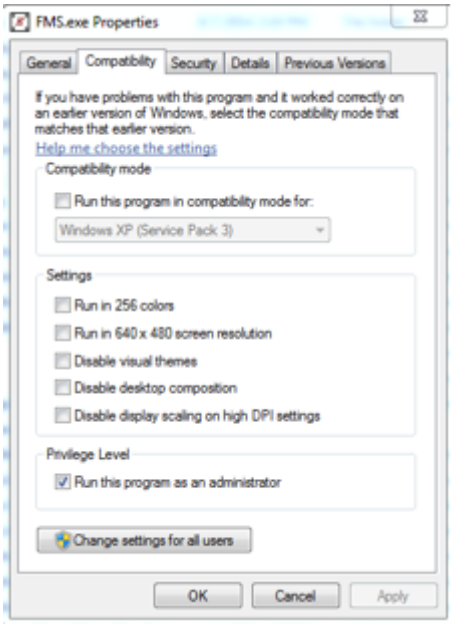
The installer will place an icon on the desktop. The FMS icon (red arrow) will open the Event Manager (which includes the wizard that walks through the event, the control to turn robots on and off, etc).

The Audience Display, which will display scores and team information (as well as playing game sounds), will additionally add an icon if you elect to install it. For more information, see this article.

Uninstalling

To uninstall the software, use the Programs and Features option on the control panel and select “FMS Off-Season”, repair and uninstall options will be presented. SQL Server Express must be uninstalled separately if desired. Uninstalling and reinstalling FMS Off-Season will recreate the database. Be sure to create a backup of the database before uninstalling if you would like to retain the contents of the database.

Run as Admin



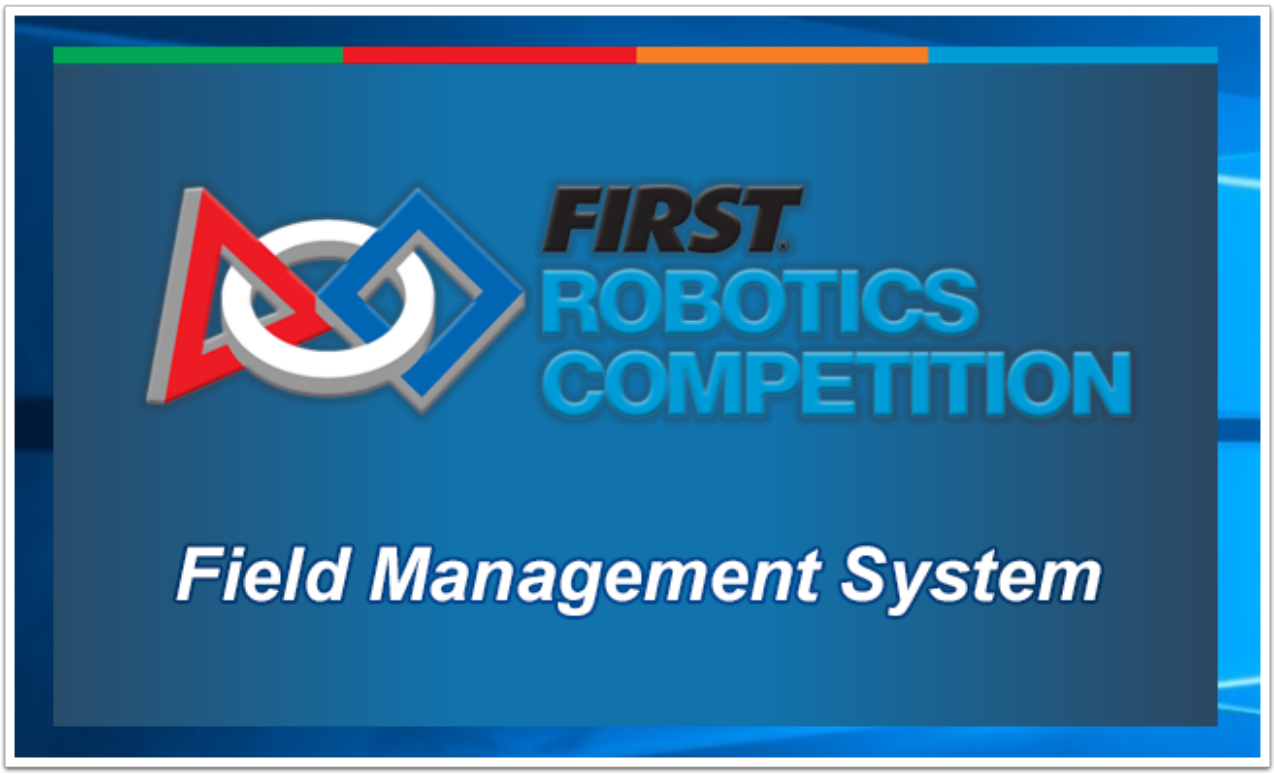
Right click on the FMS icon (red arrow) on the desktop and select Properties. Under the Compatibility tab, click the box next to “Run as an administrator” and select OK.

Launching FMS

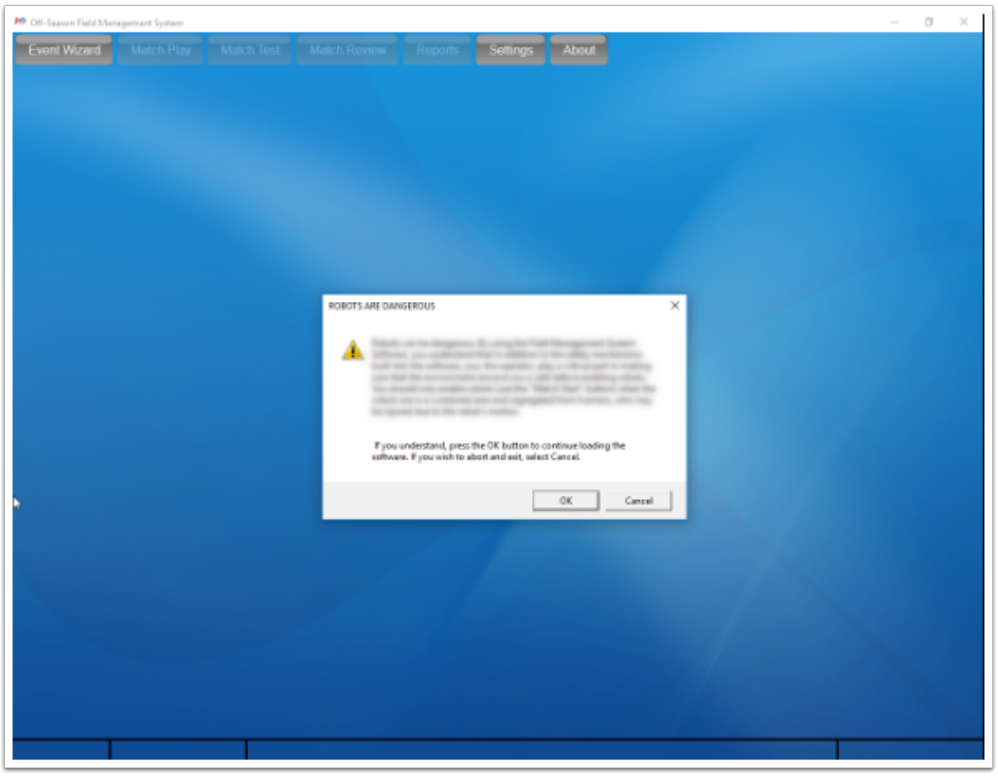
Once FMS Off-Season is installed, you should see a shortcut on your desktop to “FMS”. FMS requires administrative privileges on the machine in order to run properly. Make sure you have configured administrative privileges as described previously for the FMS shortcut.

Off-Season FMS

Launch FMS Off-Season by double-clicking on the FMS shortcut. If you are prompted by “User Account Control,” select Yes to give FMS access to run on your machine.



Once FMS is loaded you will see the following screen must agree to the warning to get started. Beyond that, refer to the User’s Manual for additional operating instructions.

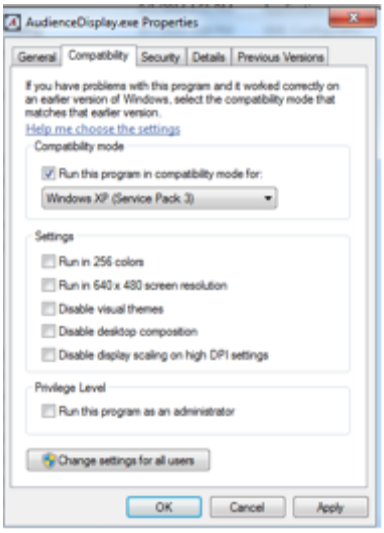


Launching Audience

Double click the “Audience Display” shortcut on your desktop to launch the Audience Display. The audience display will appear with the “Background” and game logo visible. **Only open the Audience Display after configuring an event through FMS Event Wizard.**

See the Audience Display information in the FMS User’s Guide documentation for additional details about using the Audience Display. **Note:** The Audience Display must be running in order to hear game sounds.

Audience Compatibility Mode



The Audience Display should run properly with no advanced configuration. You only need to follow these instructions if you encountered trouble running the program out of the box.

If you have trouble running the Audience Display in its default configuration, you may need to use compatibility mode. Open the location where you installed FMS, which is usually something similar to:

C:\Program Files (x86)\FIRST\AudienceDisplayExeOffseason (64 bit OS)

Right click on AudienceDisplay.exe and select Properties. Under Compatibility, select “Run this program in compatibility mode” and pick “Windows XP (Service Pack 3)” from the dropdown box.

Select OK. When you re-launch the Audience Display using the shortcut on your desktop, it should run properly.

It’s also possible to run the audience display remotely. If you wish to do so, please see the appropriate configuration instructions in the User’s Guide. **It is recommended to run no more than two (2) instances of the Audience Display at any given time.**

Advanced Installation

By default, FMS will use port 80 (localhost) for its Web Portal. However, this can be changed if you need FMS to use another port. **Notice: The documentation references port 80 in examples. If you install on another port, you would need to change the references in the documentation to match.**

Using a command line, navigate to the folder which contains the FMS Off-Season Installer. The only user-configurable installation option for FMS is WebSitePort. Invoke the installer with the WebSitePort argument specifying the port you would like to use. For example, to invoke the installer with the default port (80) you would use the following command (you may need to change the name of the .exe file in this example):

FMSOffSeasonInstaller.exe WebSitePort=80

Proceed with the installation as described previously.

Shutting Down

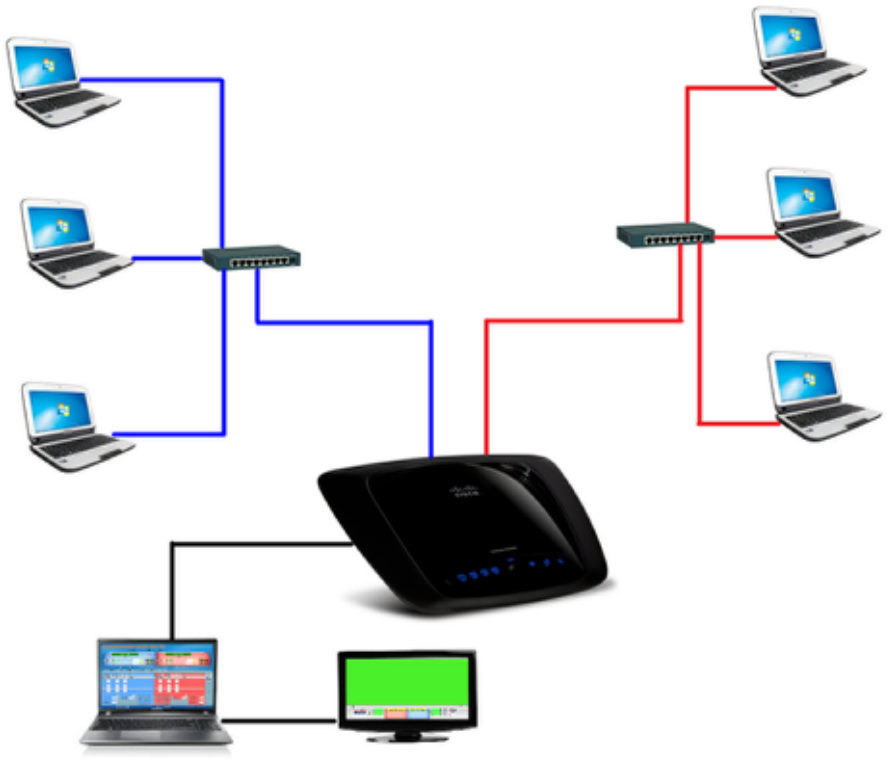
To shut down the "FMS" application, simply click the "X" in the upper right. Only do this if a match is not running.

To shut down the "Audience Display" application, simply click "Alt+F4" when the application is in the foreground. Alternately, right click on the icon in the taskbar and selecting "Close Window."

Network Hardware Configuration

Preparing the network for Off-Season events

Layout



Because FMS Off-Season is used at off-season events, the typical FRC field, electronics and hardware are not normally available. As such, the host team or organization will need to provide some basic network hardware in order to run the event. If you event has the full official electronics, you should not use FMS Off-Season, you must use the official FMS build in order to talk to network hardware.

At a very basic level, the Field Management System consists of a router, switches and a laptop/desktop with the FMS software. In the above diagram, the six driver station computers can be seen connected to switches on either side of the field (shown with red and blue lines). The switches are

then connected to the router, which usually resides on the scoring table. In most scenarios, the red drivers should be on the right of the scorekeeper, as that is the way the software is configured to appear visually. In the above diagram, an external monitor (such as a projector or TV) is connected to the FMS machine and used to show the Audience Display. See below for more details about the wiring.

Wiring

In order to operate an event effectively, you will need some basic cabling between the field hardware. Use the basic field diagram from the previous section as a reference. The three driver station machines on each end of the field are connected to a switch, which is typically placed under the middle driver station, using CAT6 Ethernet cables. Depending on your venue, the cables may need to be 15-20 feet. Each switch, one for the red alliance and one for the blue alliance, will need a CAT6 Ethernet cable to run along the side of the field to the scoring table. These cables should be at least 50-75 feet in order to reach the full distance. The router will also need a CAT6 Ethernet cable to the machine that is running FMS Off-Season.

While CAT6 cables are recommended, CAT5e also work.

Router and Computer Configuration

The router and FMS Computer must also be configured. See the next article for instructions.

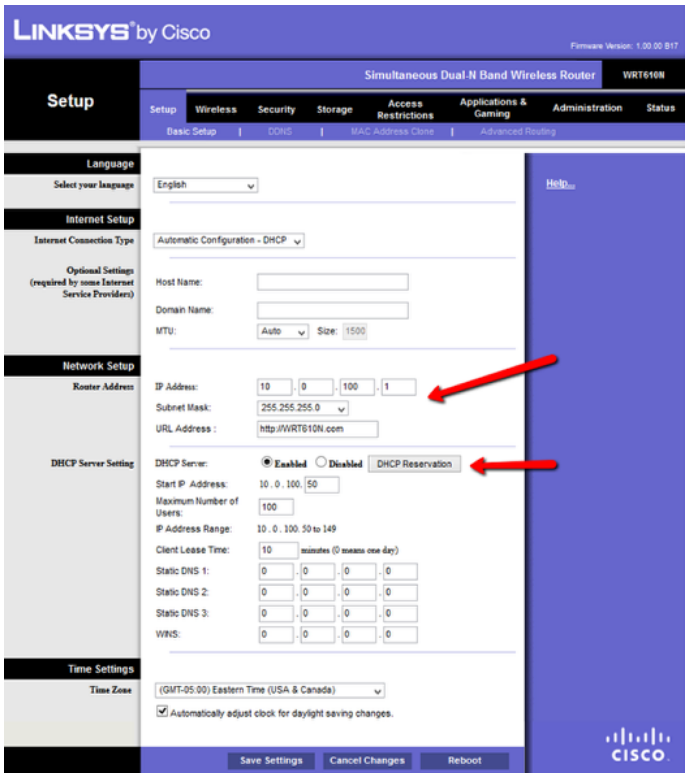
Router Configuration

Router Notes

Your router will need to be configured in order to correctly communicate with robots that come to the field. Many different kinds of routers can be used, but a Linksys WRT610N or equivalent is recommended. The instructions in this documentation apply to many kinds of routers (WRT shown), but may be slightly different depending on the hardware you use.

- Open the router's web configuration, which is usually at an IP such as 192.168.1.1. You will also need to log in to the router administrative pages.

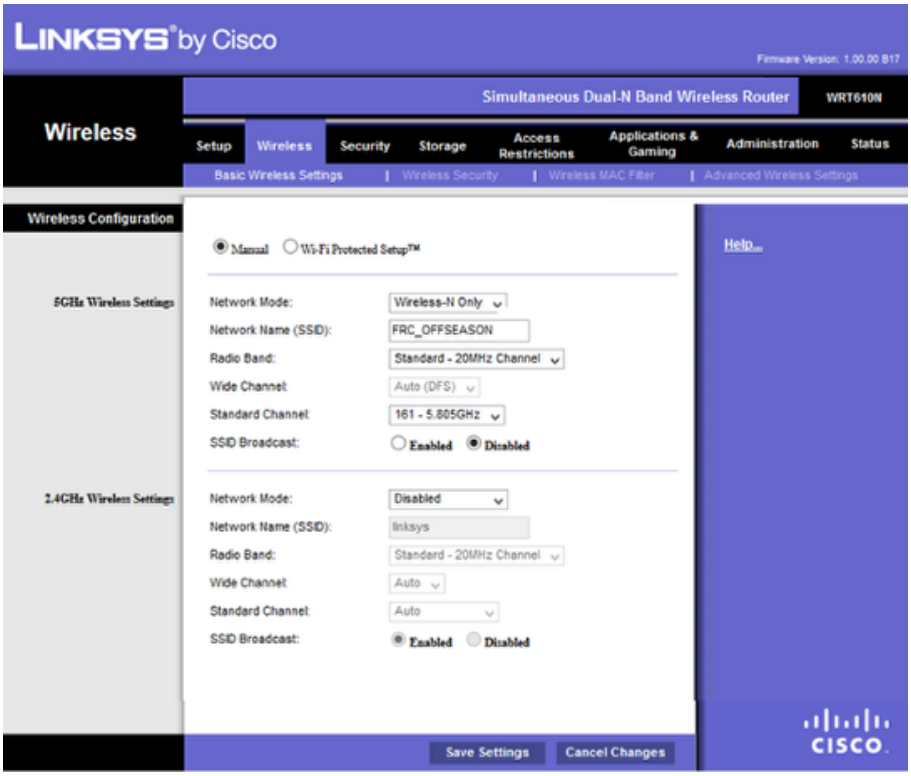
IP Address



As shown in the diagram, set the **IP address to 10.0.100.1** and the **Subnet Mask to 255.255.255.0**. Make sure you **Enable** the DHCP server with a Start IP Address of 50, Maximum Number of Users of 100, and Client Lease Time of 10 minutes. Save the settings, and the router will apply them.

After about a minute, unplug the Ethernet from your computer and re-attach it to acquire a new IP address. In your browser, navigate and **login to the router again** (which is now at 10.0.100.1).

Wireless Configuration

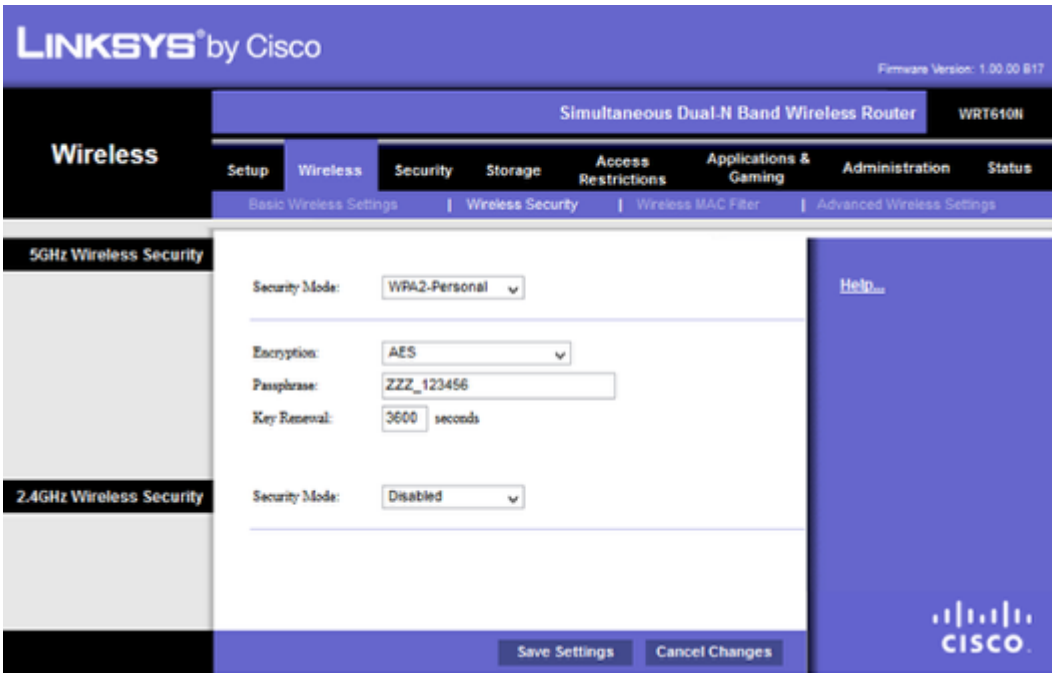


- Navigate to the Basic Wireless Settings for the router.

In Manual configuration, for 5GHz settings, select Network Mode of Wireless-N Only, Network Name of [*your event ssid*], Radio Band of Standard - 20MHz Channel, Standard Channel of [*your event channel*], and SSID Broadcast as Disabled.

For 2.4GHZ select setting for Network Mode of Disabled. Save the settings.

Security



- Navigate to the Wireless Security for the router.

For 5GHz select settings for Security Mode of WPA2-Personal, Encryption of AES, Passphrase of [*your event passphrase*], and Key Renewal of 3600.

For 2.4 GHz select settings for Security Mode of Disabled.

Save all your settings.

Note

You can adjust the settings as you see fit, but be sure to keep the teams and FTA at your event in the loop to assist with troubleshooting any problems you may run into. Example images and steps may not fit exactly with your router, but similar options should be available.

Configure Robot Radios

Get those bots ready for play!

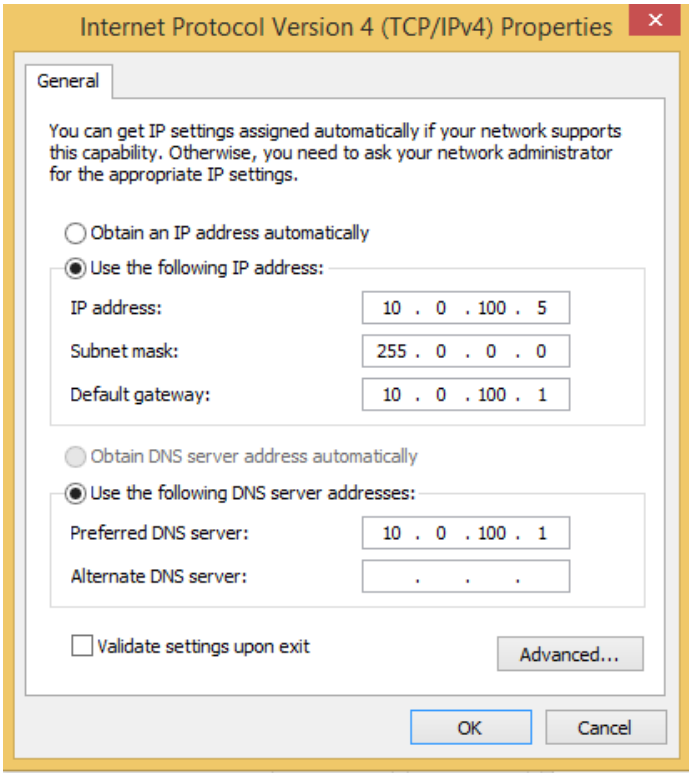
Instructions

Teams should use the FRC bridge configuration utility to program their robot radios for Off-Season use. Please see this article for instructions.

FMS Computer Configuration

Only complete these steps after completing the previous setup requirements.

Network Adapter

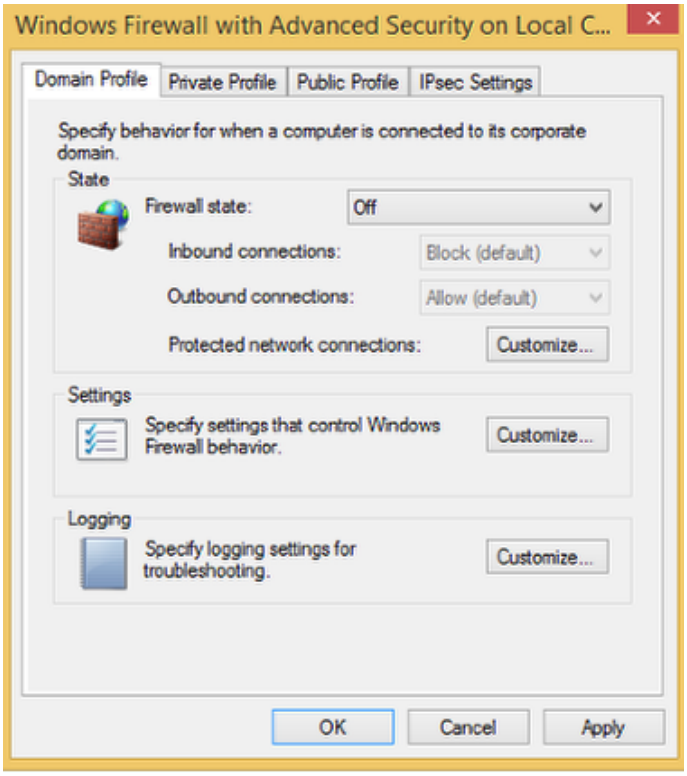


Configure the network connections for the Ethernet port of the FMS computer.

Set the IP address to 10.0.100.5, Subnet mask to 255.0.0.0, Default gateway to 10.0.100.1, and Preferred DNS server to 10.0.100.1.

Disable the wireless adapter (bluetooth, WiFi, and any others) if installed.

Firewall



Disable all firewall settings on the FMS computer. Select Windows Firewall from the Control Panel; Advanced Settings; Windows Firewall Properties.

For Domain Profile, Private Profile, and Public Profile select Firewall state of Off.

Driver Stations and Robots

Robots and driver stations should be configured to use DHCP to obtain IP addresses.

Setting Up Your Event

This article is a supplement to the full documentation. See the full software documentation for detailed instructions about particular elements.

Basic Steps

- In the event wizard create a new Off-Season event. Select the playoff and event settings you desire.
- In the event wizard select the teams participating in the event. Additional teams may be added if necessary at a later time. Even though team WPA keys are not used click Generate Security Keys before leaving this step (Match Play will require keys to exist in the database)
- Continue with schedule creation and generation as at a regular event, using the FMS User's Guide for assistance as needed.

Since off season events are not using the full set of FMS electronics, the Field Monitor (Website) and Status (FMS) screens will always show Red for the DS-ETH state indicator (X) and 0.000 for the BWU value as they are not available.

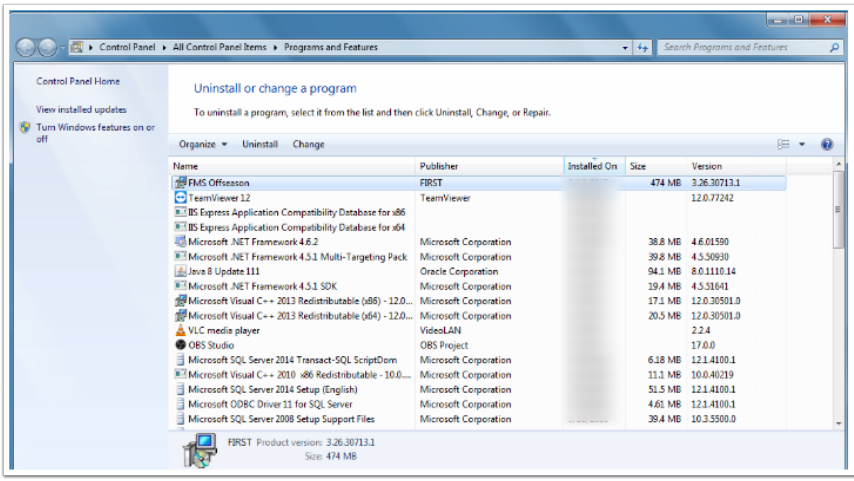
Upgrading from a previous edition of FMS Off-Season

In order to install an edition of Off-Season FMS on a machine that had a previous installation of FMS (any previous year to your target install), some changes must be made prior to running the installer.

If the target machine did/does not contain a previous version of FMS, Off-Season this article is not relevant.

Heads Up! Running this process will delete all the match/scoring data from this machine, so only do this if you're sure you won't need that data!

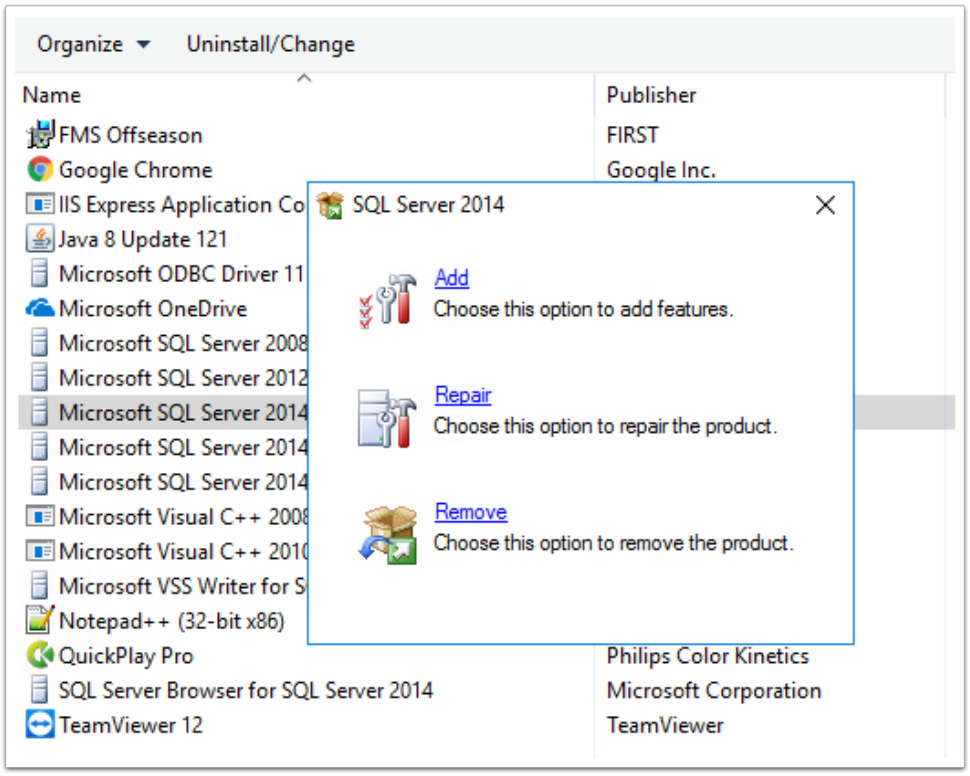
Uninstall the previous FMS Edition



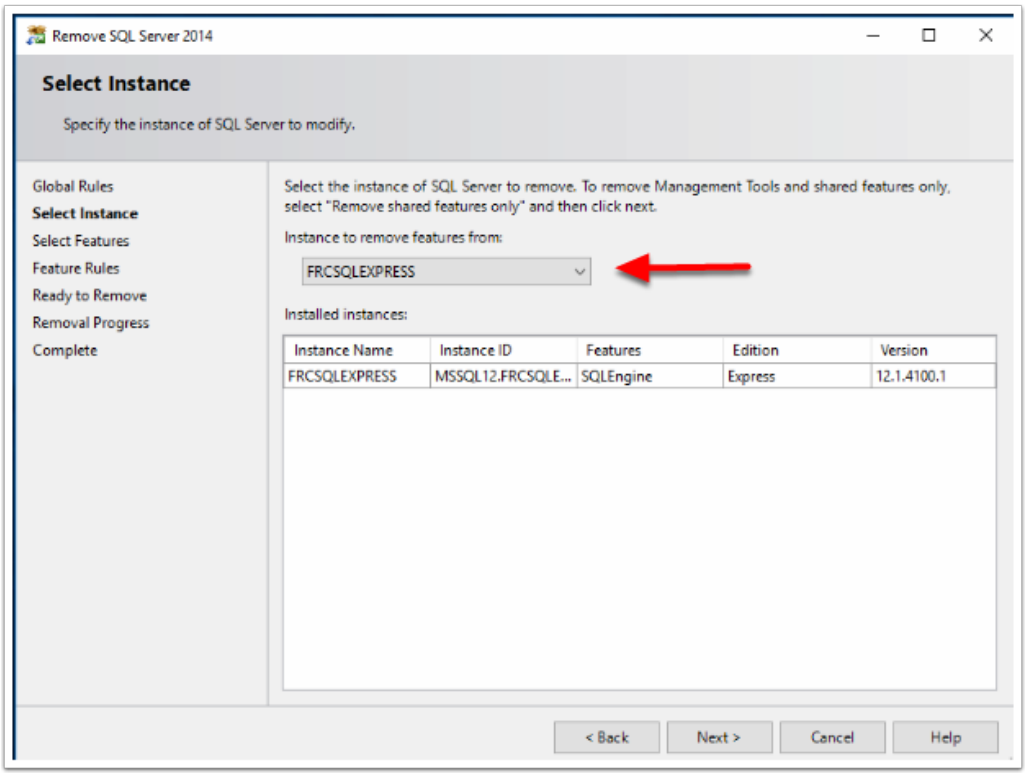
On your machine's Control Panel, look for the previous edition of "FMS Off-Season" and select Uninstall. Upon successful uninstall, the screen at right will be shown.

Remove SQL Server 2014 (or 2016)

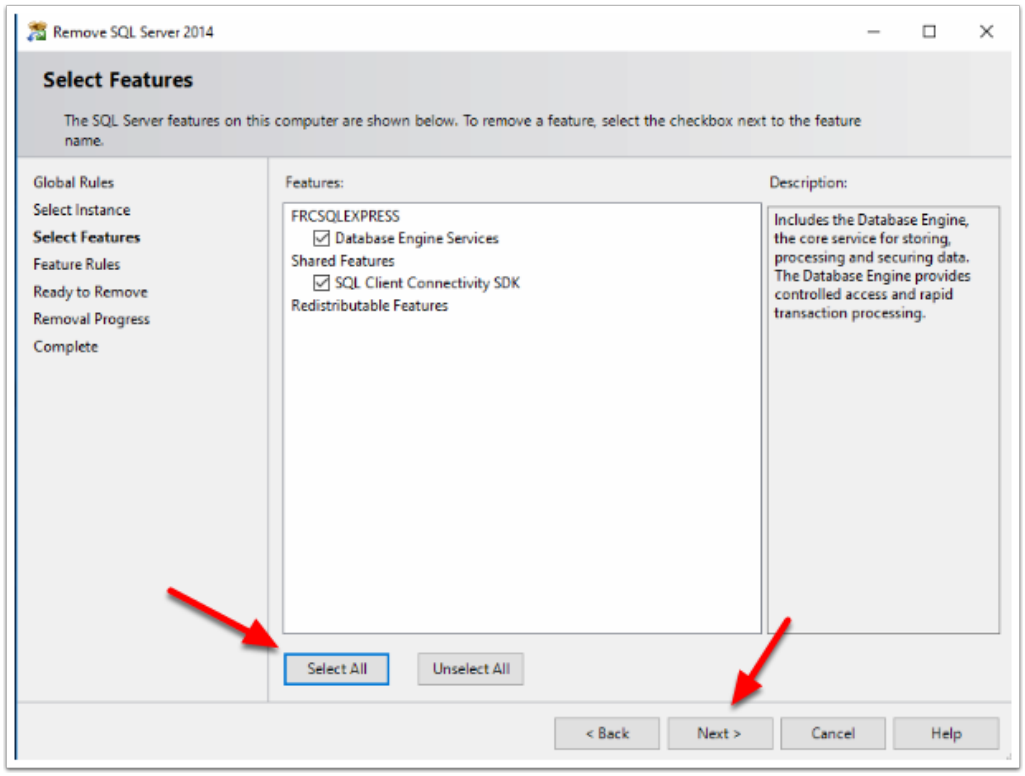
On your computer's Control Panel, navigate to Uninstall/Manage Programs, and find "Microsoft SQL Server 2014" in the list. Select "Uninstall/Change" and then "Remove" from the menu that appears. Depending on your machine, you may instead have Microsoft SQL Server 2016, but the same uninstall process should be followed.



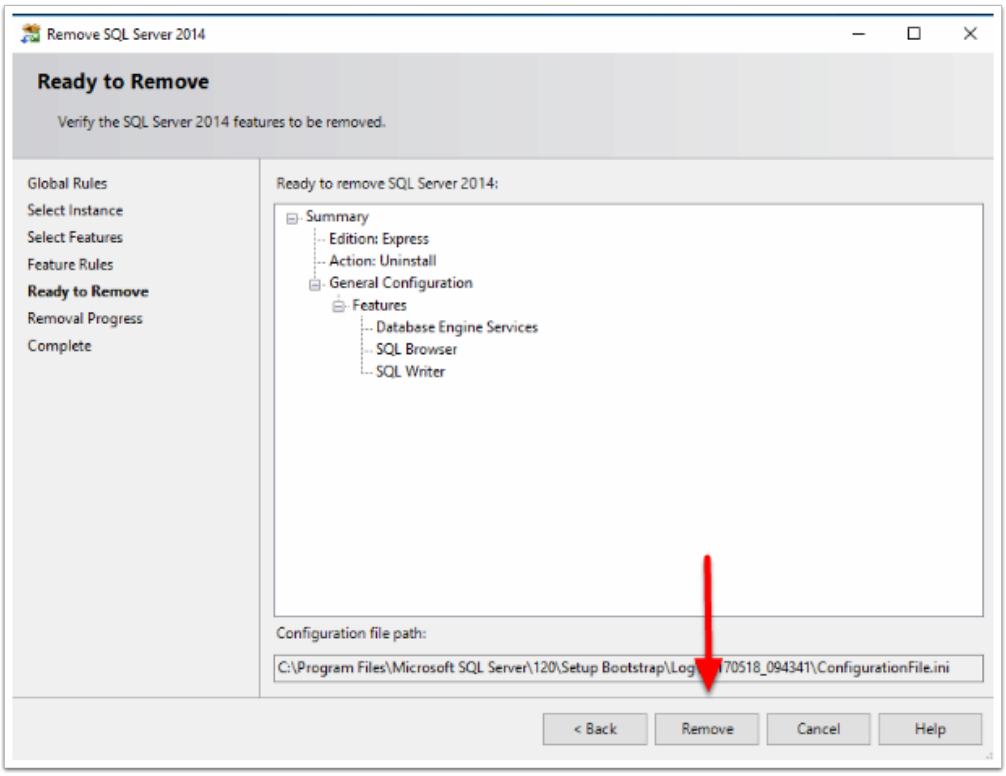
An instance selection panel will appear. Make sure "FRCSQLEXPRESS" is selected, then select "Next."



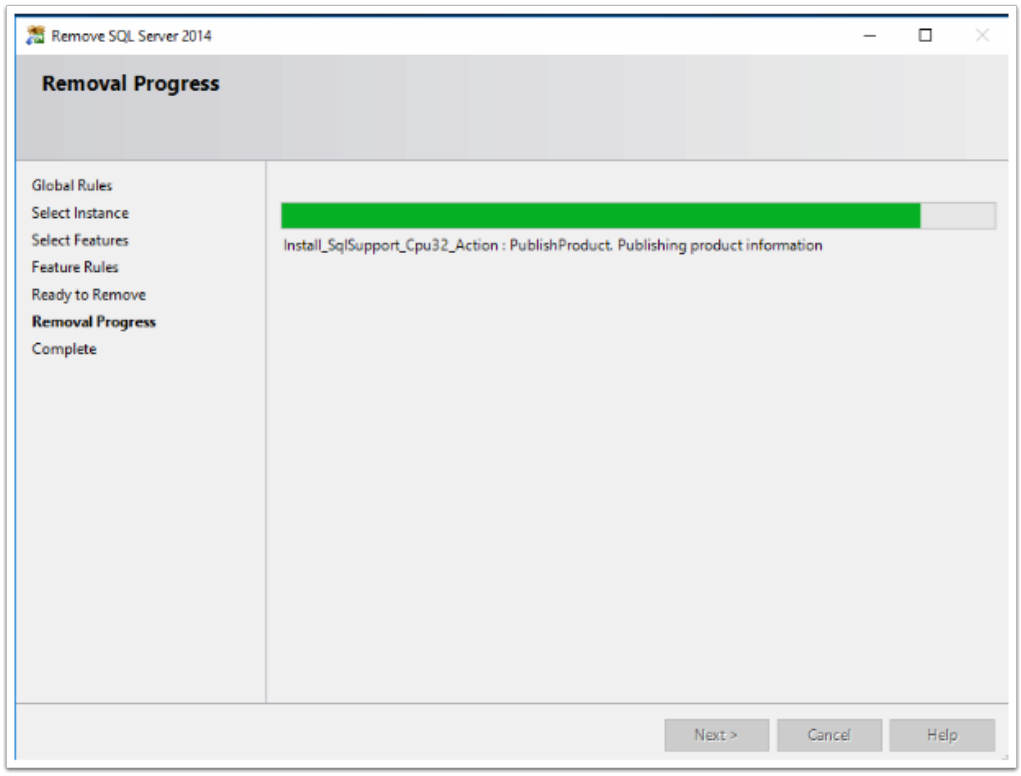
The Features menu will appear. Click the "Select All" button, then "Next."



The confirmation screen will appear. Select "Remove" to begin the process.

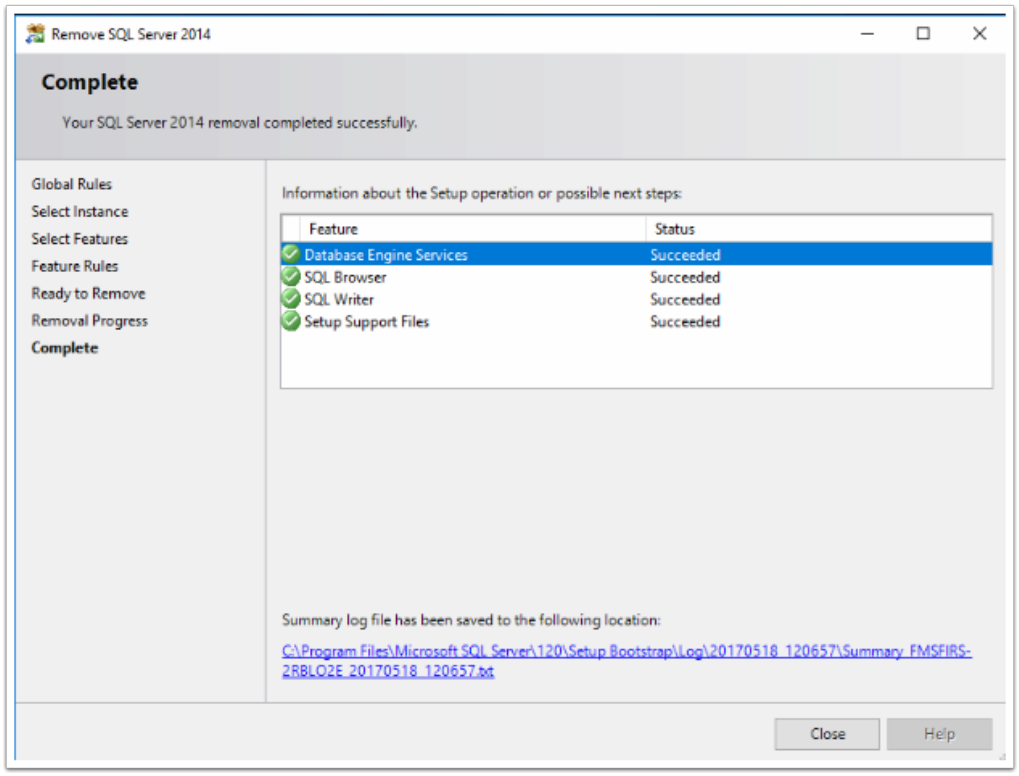


Windows will configure the changes to remove the old FMS database installation.



When the changes are complete, you can click "Close."

Off-Season FMS



The FMS Off-Season installer will add the new version of the database to your machine as part of it's standard installation process. There is no need to manually adjust other SQL settings prior to running the installer.

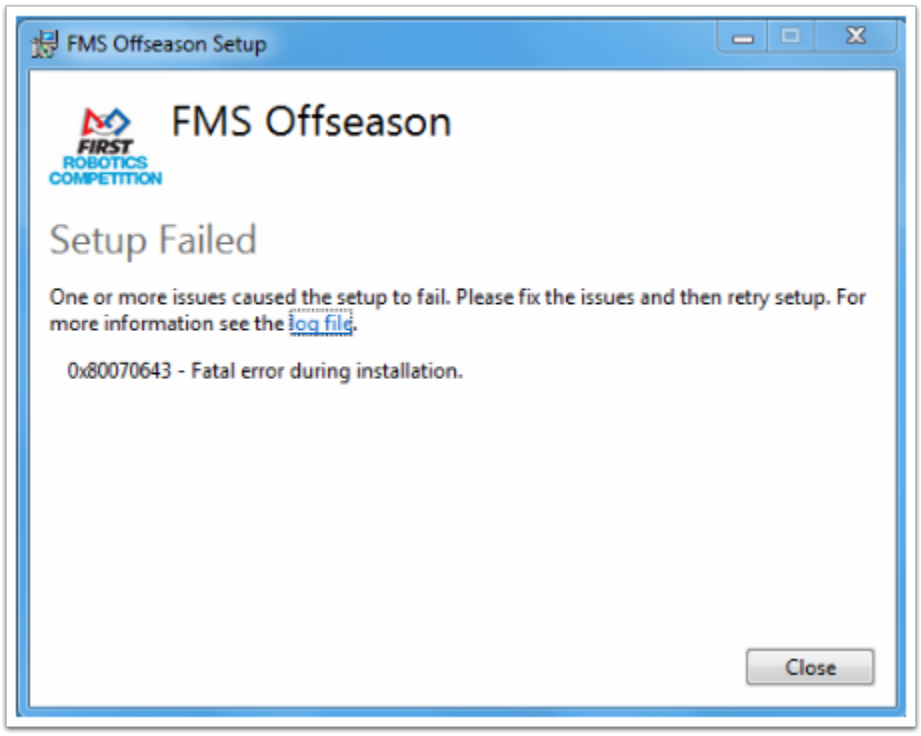
Reboot

Reboot the computer before continuing.

Installing FMS Off-Season

For information on installing the new version of FMS, please go to this article.

Failed Installations



If your machine is not compatible, or the installer encounters other problems, you can review the log file for assistance. *FIRST* HQ is not able to provide individual troubleshooting assistance.

Syncing Data with FIRST

Availability

FIRST allows Off-Season events (who meet requirements) to synchronize their data and results with *FIRST* HQ, similar to the way that *FIRST* posts results of official events during the competition season. Off-Season events that meet requirement criteria will be able to have their events included- meaning results will be posted to FIRST's Event Results website (https://frc-events.firstinspires.org/) and API (https://frc-api.firstinspires.org/v2.0/). *FIRST* has many partners that use *FIRST*'s data to power their apps, such as The Blue Alliance or FRC Tracker.

This is not available for versions of FMS installed on personal computers, our "FMS Off-Season" software. This is available only on official *FIRST* fields that were used at 2018 Continental United States competitions.

Requirements

To apply and participate, the Off-Season event must requirements that include:

- End before November 10th
- Use an official *FIRST* field, with FMS and Electronics
- Have a 2018 certified *FIRST* Technical Advisor (FTA) present throughout the event
- Have a required minimum number of teams in attendance (read details on the application carefully, please)
  - *Note that this process requires all teams participating at the event to have participated in the 2018 FRC Season. For "unofficial" teams (like a "pre-rookie" team or a "second robot" team), FIRST has reserved Team numbers 9985-9999, and they may be used to accommodate these teams. Off-Season events may not "take" a team's number who isn't attending the event*
    - *For example: If team 123 is not attending your event, but team 122 is, and brings a second robot, you cannot use team 123 for the second robot. This would miss-represent team 123's record as they are not actually participating. Instead, team 122's second robot could be any number in the reserved range of 9985-9999.*
- Steady **wired (ethernet)** internet must be available throughout the event, at the scoring table. This internet connection should have unrestricted/unfiltered access to ports 80 and 443 (data sync is not WiFi compatible, only hardline internet)
- *FIRST* Staff are not available for Support of Off-Season events, the FTA is the troubleshooting resource

- *FIRST* does not build custom software for specific Off-Season events, all scoring and software is written to match the most recent published version of the official Game Manual. Individual scoring values or thresholds are not adjustable.

Additional terms will be displayed on the application, and should be read in detail.

FIRST has additional information and policies regarding the rental and use of official fields for Off-Season events. They can be found in the Resource Library on the *FIRST* website.

Application

To apply for your Off-Season event to be included, please complete the following form at least 7 days before your event start date:

https://goo.gl/forms/jOQH362N6CEnKh8e2

Field Access Point

Overview

The Wireless Acess Point used for 2017 FRC competitions was a Linksys 1900ACS running customized OpenWRT firmware. In an attempt to provide a tested AP that can be used with FMS Offseason, we are releasing a modified version of the firmware used during the season that teams or individuals could load on their own devices.

This page provides an overview of the images. For download and installation information, please see Loading OpenWRT.

While we have not yet had any issues with a device that could not be recovered using the Recovery Procedure in the 80+ devices we have flashed this season, please note that loading new firmware on a device or modifying device settings always carries some level of risk. Additionally, loading non-manufacturer provided firmware onto the device may invalidate your warranty.

The OpenWRT build used during the FRC season contained a specific set of drivers (including a specific patch developed to address an issue that was seen when used with the OM5P-AC) and modules that was tested to work with the OpenMesh OM5P-AN and OM5P-AC radios. This build also contained a set of default settings such as usernames and passwords, network configurations, and firewall configuration, that matched the desired configuration for the 2017 FRC season.

For offseason use, we are releasing 2 modified versions of our image that have been customized for specific use cases.

Offseason Simple

The Offseason Simple image has been modified to be used either standalone, or with FMS Offseason.

This image contains the same software used in the 2017 season image, but with the following modifications:

Off-Season FMS

- Username and Password have been reset to the default of root/root
- Network configuration has been modified to a simplified, non-VLAN configuration
- Network configuration "flipped" (management network moved to single port) to better accomodate offseason or multi-computer use cases using the built-in switch.
- Wireless network has been simplified to a single SSID on each frequency (compared to 1 SSID per robot which is reconfigured each match)
- Firewall has been modified to allow access to the AP webpage/ssh from the single network and to allow the Non-FMS DS->Robot Control traffic through.

If you are looking for an image to use the Linksys 1900ACS with FRC robots and aren't sure which one you need, you very likely want Offseason Simple.

Offseason VLAN

The Offseason VLAN image contains the same software used in the 2017 season image, but with the following modifications:

- Username and Password have been reset to the default of root/root

Loading OpenWRT

This article describes how to load the customized FRC build of OpenWRT onto a Linksys 1900ACS wireless access point. This customized build contains versions of various components that have been tested to be (mostly) stable in the FRC use case. It also contains a default network setup (network and wireless configuration, firewall, DHCP, etc.) appropriate for many FRC use cases.

Aquiring the firmware

Go to one of the following locations to download a ZIP of the FRC firmware build.

Offseason Simple

Offseason VLAN

The filename of the image files will always be constructed using the following pattern:

frc-DESCRIPTOR-YEAR.MAJOR.MINOR-mvebu-armada-385-linksys-shelby-squashfs-IMAGETYPE

DESCRIPTOR is a description of the specific type of FRC image. "offseason_simple" is typically going to be the image you are looking for, this image removes all of the VLAN configuration from the network configuration and reverses the ports from the standard FRC image to allow the 4 ports on the AP to be used as a switch in offseason configurations. "offseason_vlan" is identical to the standard FRC image but with the username/password set to root/root and can only be effectively used with network hardware that is sending appropriately tagged packets over a VLAN trunk line plugged into the AP's yellow port.

YEAR is the year of the firmware build

MAJOR is the major release number

MINOR is the minor release number. This is used for internal builds and should always be 0 on release builds

IMAGETYPE is the type of OpenWRT image. "factory.img" is the image that is used to switch to OpenWRT from the factory Linksys firmware. "sysupgrade.tar" is the image used to update an existing OpenWRT installation.

From Stock Firmware

The following section describes how to load the FRC OpenWRT image onto the device from the stock Linksys firmware.

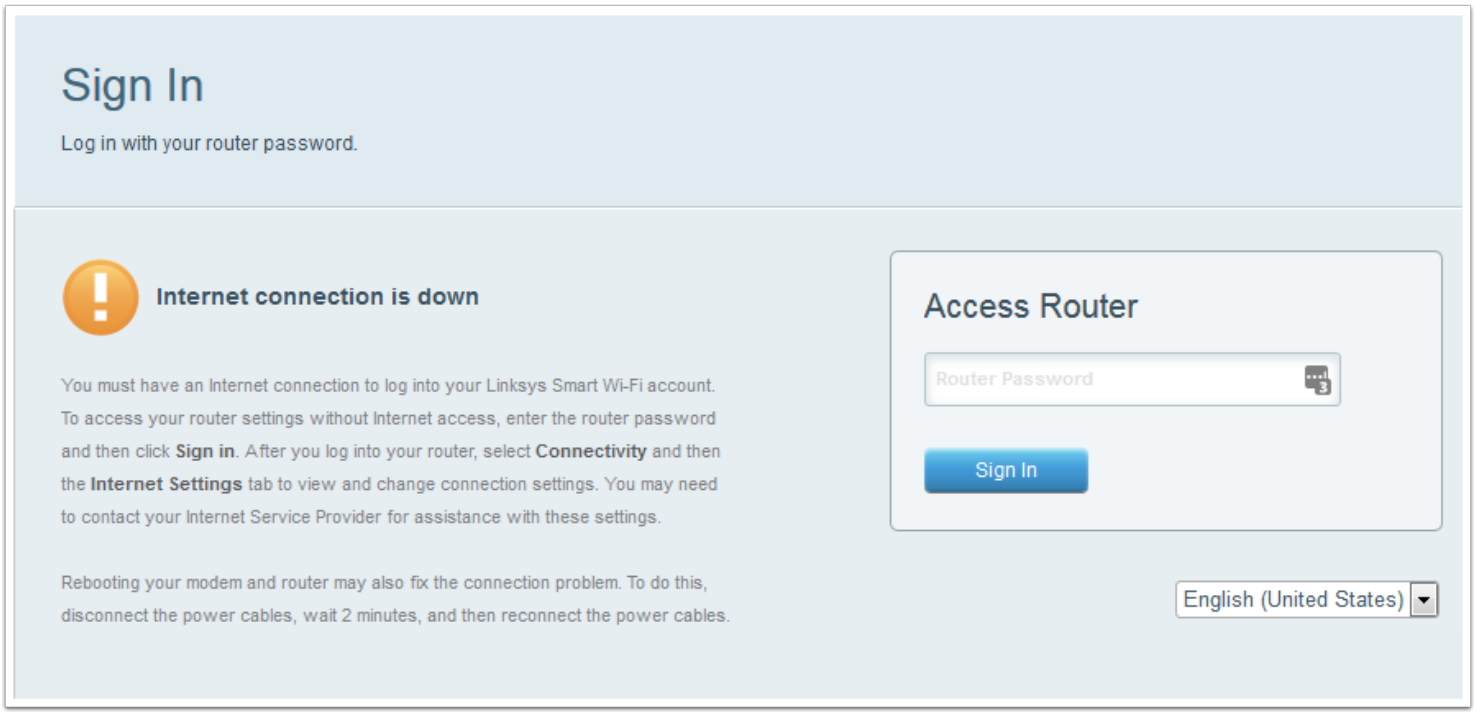
Connecting to the AP

The most reliable way to connect to the AP is to set your computer to a static IP on the 192.168.1.* subnet. The AP is reachable at 192.168.1.1 so it is recommended to set your computer to 192.168.1.2 with a netmask of 255.255.255.0. Plug your PC into one of the 4 ports labeled "Ethernet" on the back of the AP.

Open a webbrowser and enter 192.168.1.1 into the address bar. The browser will automatically re-direct you to the Linksys setup page.

Check the top box to indicate that you accept the License, then click the **Manual Configuration** link the bottom left of the page.

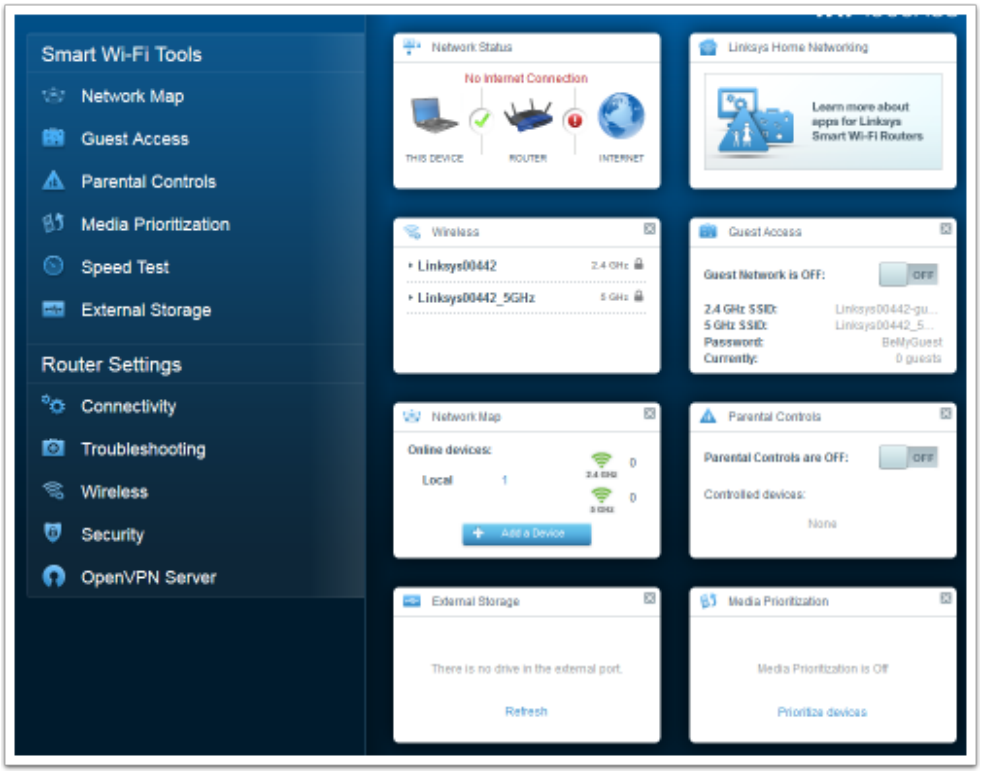
Login



1. Wait for the internet connection attempt to time out, then click Login (screen not pictured).
2. Enter the default password "admin" and click **Sign In**.

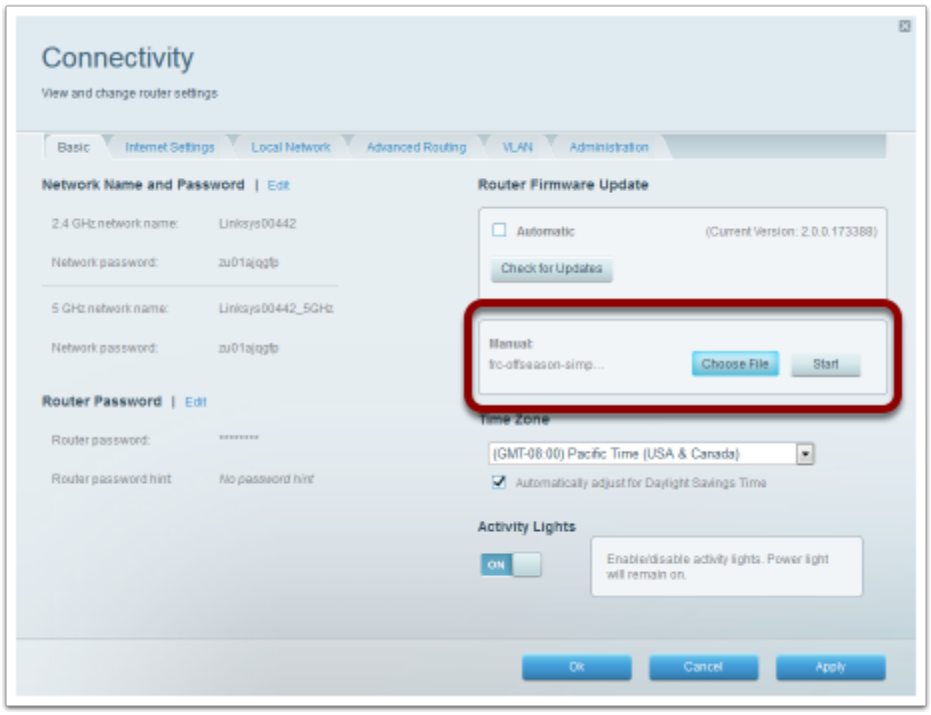
Off-Season FMS

Access flash page



Click on "Connectivity" in the navigation bar on the left side to access the firmware flash page.

Flash Firmware



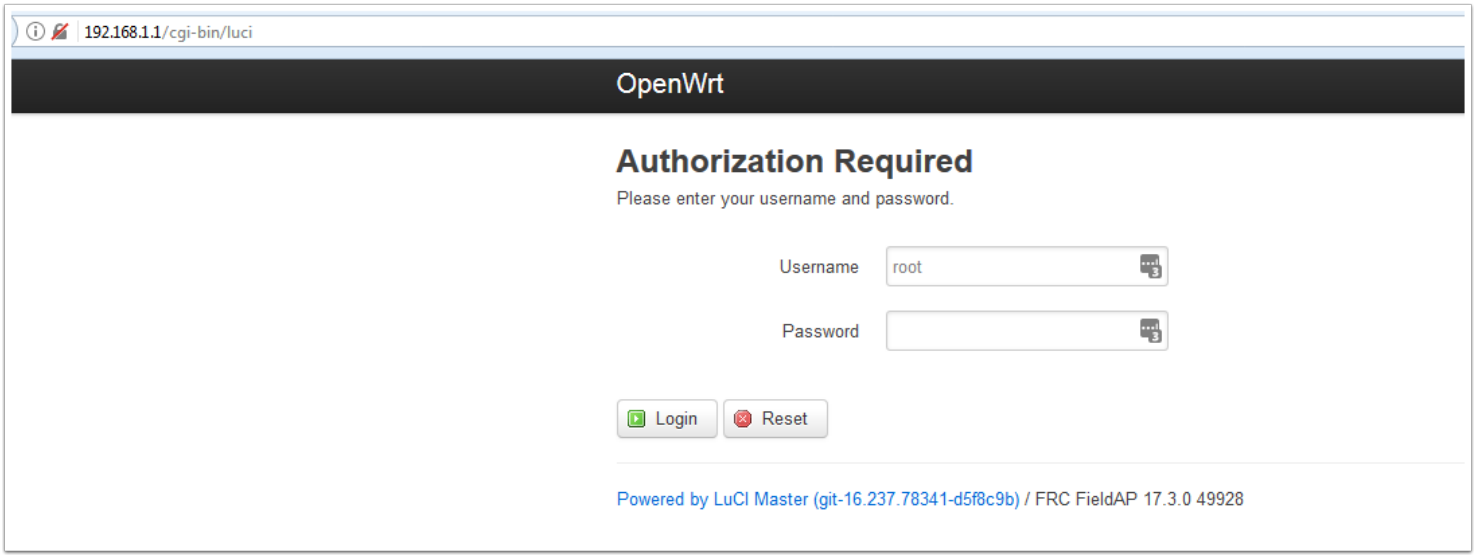
1. In the **Manual** section, click **Choose File** and browse to the downloaded firmware image, the correct image should end in "factory.img".
2. Click **Start**
3. In the dialog that pops up, click **Yes.**
4. In the next dialog that pops up, click **Yes.**
5. A progress bar will appear indicating firmware update progress. After it completes, click **Ok.**

To reconnect to the radio at the 192.168.1.1 address, you will need to move the Ethernet cable to the yellow "Internet" port on the AP. Alternately, you can change your computer back to DHCP to connect to the radio at 10.0.100.2

OpenWRT upgrade

The following section describes how to load the FRC OpenWRT image onto the device when OpenWRT has already been installed (including updating from previous FRC image).

Connecting to the AP



For both a stock OpenWRT image and an FRC image, the most reliable way to connect to the AP is to set your computer to a static IP on the 192.168.1.* subnet. The AP is reachable at 192.168.1.1 so it is recommended to set your computer to 192.168.1.2 with a netmask of 255.255.255.0. If you are connecting to stock OpenWRT, plug your PC into one of the 4 ports labeled "Ethernet" on the back of the AP; if you are connecting to an FRC image, use the yellow port labeled "Internet".

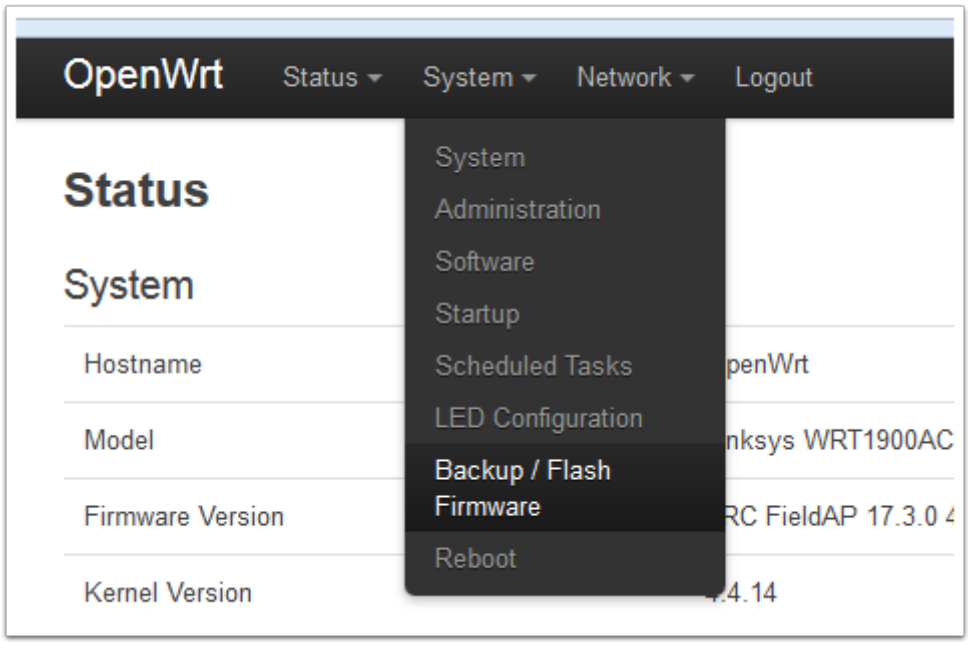
Open a webbrowser and enter 192.168.1.1 into the address bar. The browser will automatically re-direct you to the LuCI login page.

Username: root

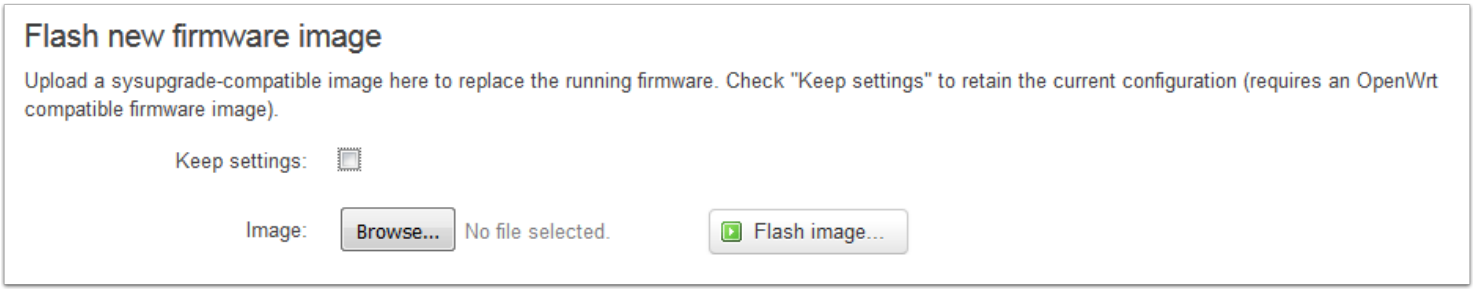
Password: "root" (for an FRC image) or blank for default OpenWRT

Then click **Login**.

Flash firmware



From the **System** menu, select **Backup / Flash Firmware**



1. Locate the **Flash new firmware image** section of the page
2. Uncheck the **Keep settings** box. This will erase any changes you have made to settings such as wireless network configuration, firewall, etc. but is required to get any updates to the FRC default settings.
3. Click **Browse...**
4. Locate the image file. The correct image will end in "sysupgrade.tar".
5. Click **Flash image...** and wait for the process to complete. If you are upgrading from a stock OpenWRT image, the page may never reconnect after the firmware flash. Wait about 5 minutes

to be sure the process is complete, then change your connection to the yellow "Internet" port to reconnect on the 192.168.1.1 address or change your PC to DHCP to connect on the 10.0.100.2 address.

Default Settings

This article describes the default values of various settings in the FRC Offseason Simple image for the Linksys WRT1900 ACS AP.

Network

Yellow "Internet" port: This port is configured with an IP of 192.168.1.1 (Note: The FRC Offseason Simple image is **not** intended to allow connectivity to the Internet from the field network by plugging an Internet connection into this port.). This port is intended as a maintenance connection in case any added firewall rules or network settings prevent access from the other interface.

4 "Ethernet" ports: These ports are bridged together and configured with an IP of 10.0.100.2

5GHz wireless: This network is bridged with the "Ethernet" network and accessible at the same 10.0.100.2 address

2.4GHz wireless: If enabled, this network is bridged with the "Ethernet" network and accessible at the same 10.0.100.2 address

DHCP

Yellow "Internet" port: DHCP disabled

4 "Ethernet" ports: DHCP enabled, will serve addresses on the 10.0.0.* subnet with a subnet mask of 255.0.0.0

5GHz wireless: same as "Ethernet"

Wireless

5GHz Wireless

SSID: OffseasonFMS

Encryption: WPA2 AES

Key: DefaultKey

Channel: Auto

Width: 20MHz

Hidden SSID: No

2.4GHz Wireless

DISABLED BY DEFAULT

SSID: OffseasonFMS24

Encryption: WPA2 AES

Key: DefaultKey

Channel: Auto

Width: 20MHz

Hidden SSID: No

Firewall

Firewall enabled by default with a default deny policy for traffic passing through. Allowed ports are the ports specified in the Game Manual, the network management ports allowed in the regular season firewall (e.g. ICMP, DHCP, etc.), plus the following additional ports:

- UDP 1110 - Used for DS->Robot traffic when not connected to FMS. This allows the AP to be used for non-FMS offseason scenarios

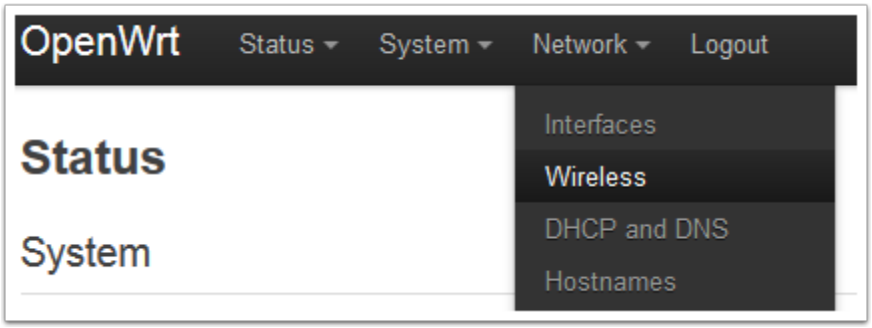
The default policy for traffic into/out of the AP (i.e. not through) is to allow. This allows you to connect to the AP webpage, SSH into the AP, etc.

This firewall policy means that many services will be blocked between the robot and DS such as SSH, code deploys, FMS controlling a DS connected wirelessly, etc.

Wireless Settings\Status

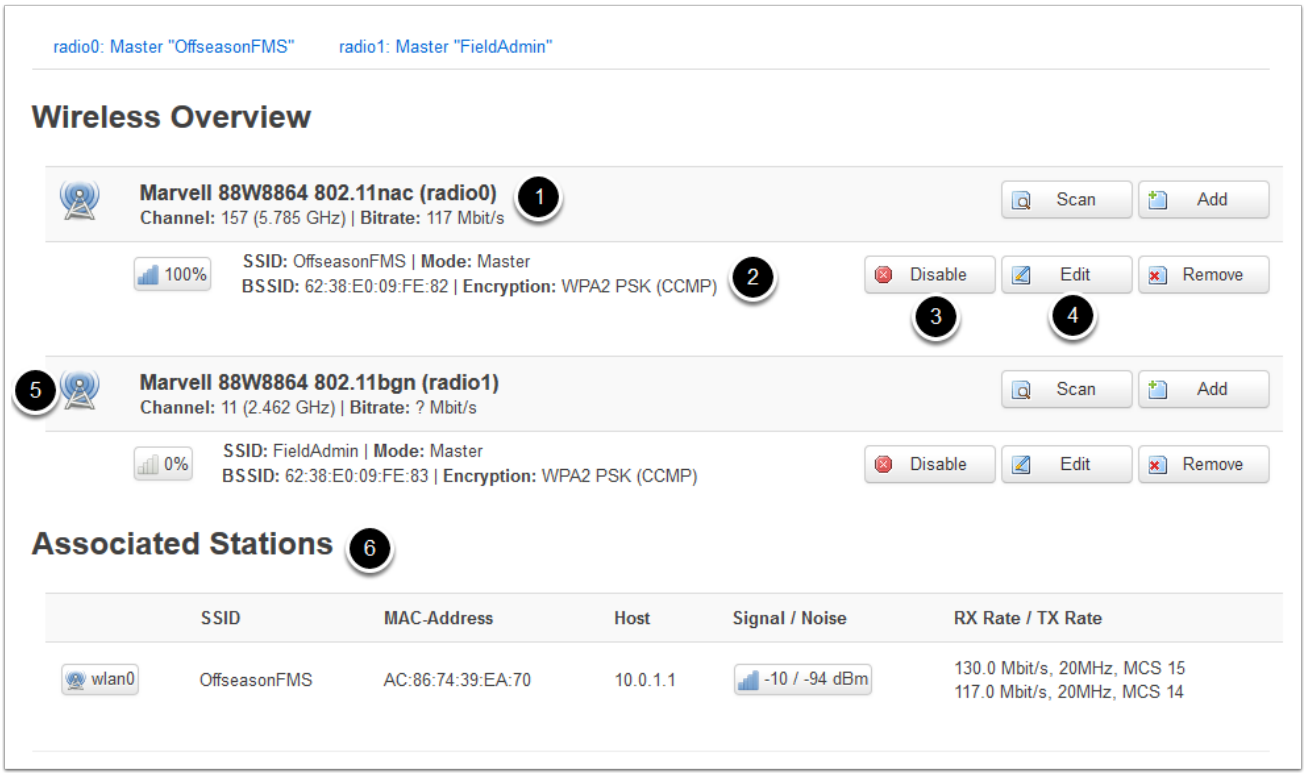
This article details how to view the wireless status and change the wireless settings for the FRC OpenWRT image

Accessing the Wireless Overview



1. Using a web-browser, enter in the appropriate address based on how you are connected to the AP (192.681.1.1 for the "Internet" port, 10.0.100.2 otherwise). If the web page does not come up, make sure the AP is powered on (both plugged in and power switch turned on), and that your computer is set to an approriate IP (192.168.1.* for the Internet port, DHCP otherwise).
2. Log in using the default username/password of root/root
3. From the AP home page, hover over the **Network** menu and select the **Wireless** entry to navigate to the Wireless Overview page.

Wireless Overview Page

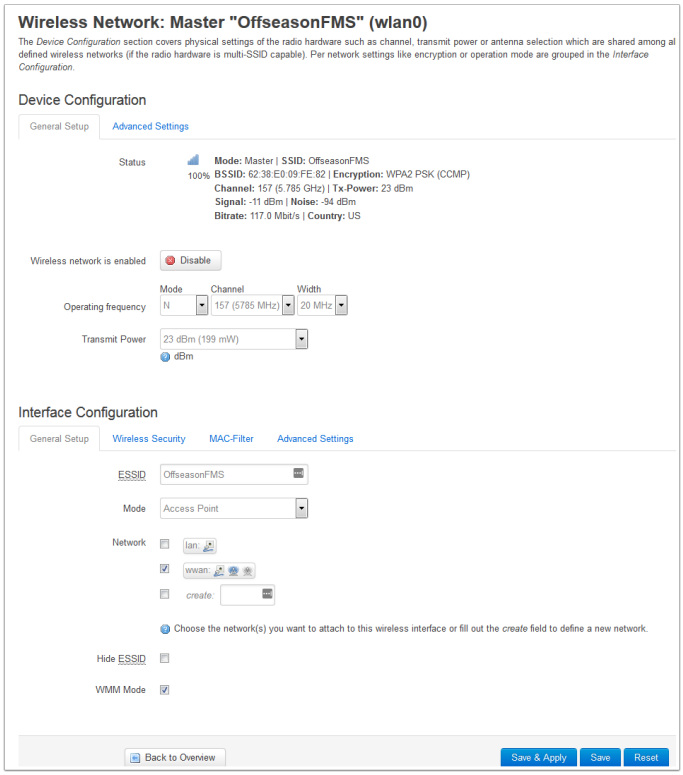


The Wireless Overview page contains information about the status of the wireless adapters and networks of the AP as well as a few buttons to change settings:

1. 802.11nac radio: This section contains information on the status of the 5GHz adapter (channel and current bit rate)
2. Wireless Network: This section contains information on a specific wireless network on the adapter it is listed under. This information includes the SSID (network name) and encryption type
3. Disable/Enable: This button disables the particular network selected. If the network is currently disabled, this will change to an Enable button.
4. Edit: This button brings you to the Wireless Network page for the particular network where you can edit settings such as channel, SSID, security, etc.
5. 802.11bgn radio: This section contains all of the same details as 1-4 above, but for the 2.4GHz adapter
6. Associated Stations: This section provides details on any clients currently connected to the AP wirelessly such as what SSID they are linked to, the client MAC address, the client IP address,

the signal-to-noise ratio on frames recieved from the client and the RX rate (the bitrate the client is sending data at) and TX rate (the rate the AP is sending data to the client) of the client.

Wireless Network Page



The Wireless Network page contains settings for the Wireless Adapter (top section) and specific wireless network (bottom section). Note that the Offseason image has 1 network per adapter by default.

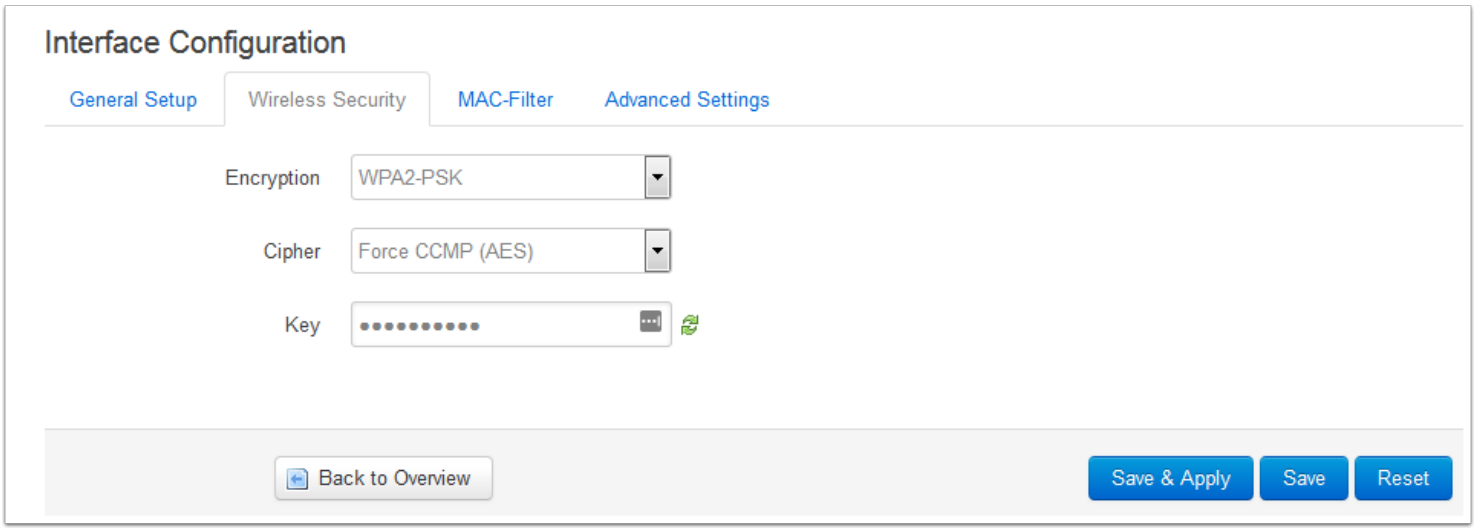
- **Operating Freqency:** Contains the Channel and Channel Width settings for the wireless adapter. The image comes with this set to "auto" by default, but you may wish to do a channel scan (there are free applications available to do this on iOS, Android, PC, etc.) and choose the least congested channel. If you have at least 40MHz (2 channels) of clear space, you may wish to use this setting to minmize the chance of bandwidth issues. Note: This AP image and the OpenMesh radio have only been tested using the Band 1 (36-48) and Band 3 (149-165) channels. Use of the Band 2 DFS channels is not recommended.
- **Transmit Power:** This setting is actually controlled by the legal limits embedded in the radio firmware and the setting on the web page has no effect.

Interface Configuration

- **Wireless Security Tab:** Clicking this tab will bring you to the Wireless Security settings (detailed below). Click **General Setup** to return to the pictured screen.
- **ESSID:** The SSID (network name) of the wireless network
- **Mode:** The mode the network is operating in. Should not be changed off of **Access Point.**
- **Network:** The OpenWRT "network" the Wireless Network is associated with. Should not be changed off of **wwan**
- **Hide ESSID:** Hides the SSID in the beacon frames. This means that this network will not show up or will be listed as "unknown" in the network listings of PCs, phones, etc. The OpenMesh radios are capable of connecting to the network even if the ESSID is hidden.
- **WMM mode:** Controls whether WMM is enabled or not. Leave this checked.

⚠ Note: After changing any settings on this page, you must click **Save & Apply** in order for the settings to be saved and loaded into the radio.

Wireless Security



The Wireless Security tab contains the settings for the security of the wireless network. To return to the general settings, click **General Setup**.

- **Encryption:** Controls the encryption scheme used for wireless security. It is recommeneded to set this to either **Disabled** (for no security) or **WPA2-PSK** (for enabling security)

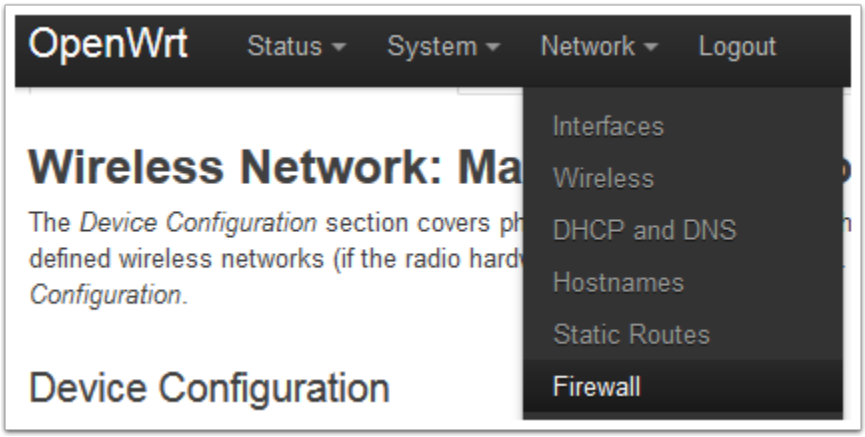
- **Cipher:** Controls the cipher used with the selected security. Recommended to leave as **Force CCMP (AES)**
- **Key:** The encryption key used for the wireless security. Defaults to being displayed in dot-mode, click the green arrows to toggle to regular character display. TO change the key, enter the new key here and click **Save & Apply** below.

⚠ **Note:** After changing any settings on this page, you must click **Save & Apply** in order for the settings to be saved and loaded into the radio.

Firewall Settings

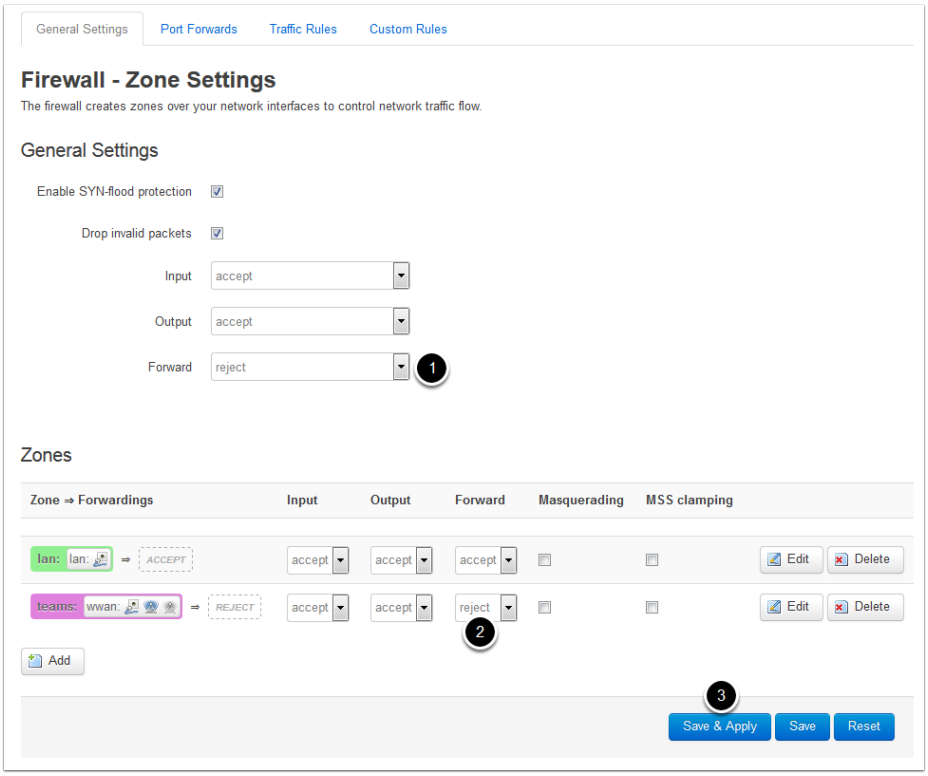
As detailed in the Default Settings article, the image comes with the firewall enabled by default. This article describes how to disable and re-enable the firewall. This article does not go into detail on how to add additional rules to the firewall, if you wish to do this, we recommend editing the /etc/firewall file directly (either via ssh or copying it off the device and then back on) and using the existing rules as a template.

Accessing the Firewall Page



1. Using a web-browser, enter in the appropriate address based on how you are connected to the AP (192.681.1.1 for the "Internet" port, 10.0.100.2 otherwise). If the web page does not come up, make sure the AP is powered on (both plugged in and power switch turned on), and that your computer is set to an approriate IP (192.168.1.* for the Internet port, DHCP otherwise).
2. Log in using the default username/password of root/root
3. From the AP home page, hover over the **Network** menu and select the **Firewall** entry to navigate to the Firewall page.

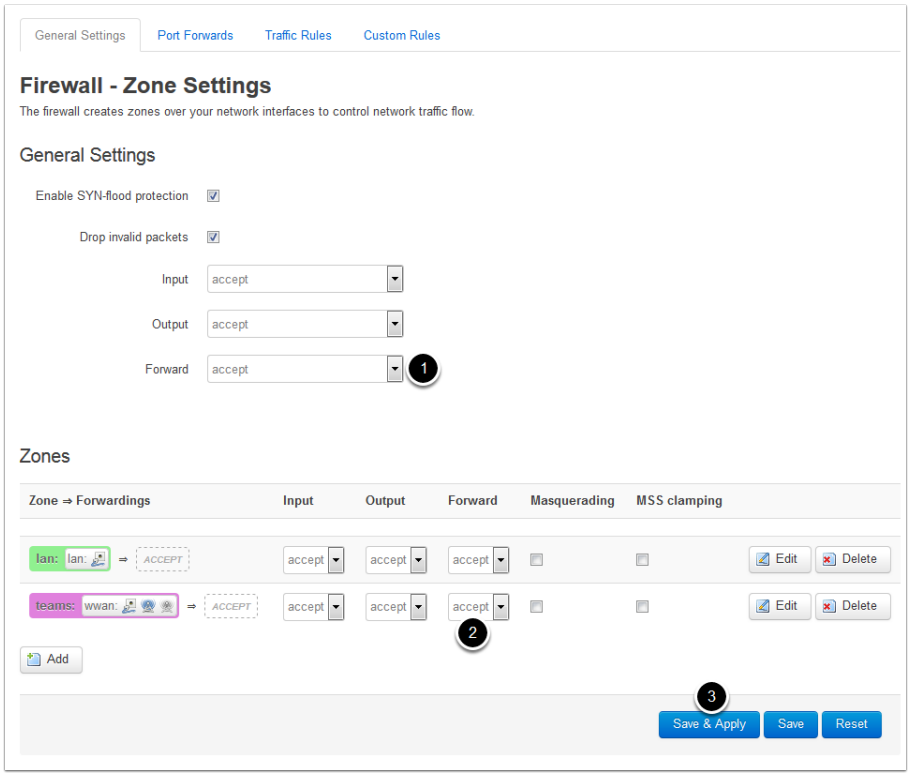
Disabling the Firewall



To disable the firewall:

1. Set the default Forward rule to **accept**
2. Set the Forward rule for the teams zone to **accept**
3. Click **Save & Apply**

Re-enabling the Firewall



To re-enable the firewall

1. Set the default Forward rule to **reject**
2. Set the teams zone forward rule to **reject**
3. Click **Save & Apply**

Warning: Setting other entries to reject may prevent you from accessing the AP web page and/or SSH. If this happens, you may be able to access the web page via the alternate address (192.168.1.1 ont he Internet port vs 10.0.100.2 on the other ports.) If you are still unable to access the AP, you may need to perform the recovery procedure described in the Recovery Procedure article.

Recovery Procedure

In the event you are unable to access your AP that has been flashed with the FRC OpenWRT firmware, there is a recovery procedure available to boot to the backup partition. This will restore all settings to the image defaults (as described in Default Settings) which should allow you to access the device again.

Recovery

1. Power off router with power switch.
2. Turn power back on and Power LED will light.
   - As soon as all LEDs turn off (~2s), power off router with power switch
3. Turn power back on and Power LED will light.
   - As soon as all LEDs turn off (~2s), power off router with power switch
4. Turn power back on and Power LED will light.
   - As soon as all LEDs turn off (~2s), power off router with power switch
5. Turn power back on and allow router to fully boot.
   - It should now be booted to the alternate firmware partition