FUSION™

HIGH-PERFORMANCE MULTI-BAND LTE ROUTER

CalAmp®
connecting tomorrow today

User Manual
Fusion™ High-Performance Multi-Band LTE Router
PN 001-0000-602 Rev. B
Revised November 2013

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REVISION HISTORY

REV	DATE	REVISION DETAILS
0	April 2012	Initial release. Part number 001-0000-602.
1	June 2012	Updated based on user feedback.
2	March 2013	Updated to reflect new configuration settings and functionality and added model part numbers, carriers, MIL-STD 810, and IEC 61000-4-2 (2009).
A	July 2013	Updated for Firmware version 1.1.7 with DeviceOutlook™.
B	November 2013	Updated for Firmware version 1.2.0: added SMS support for shoulder tap; added enhancements for configuring and editing IPsec tunnels; provider modes are now auto-selected in Carrier Settings for WWAN connections.

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CalAmp reserves the right to modify the equipment, its specification or this manual without prior notice, in the interest of improving performance, reliability, or servicing. At the time of publication all data is correct for the operation of the equipment at the voltage and/or temperature referred to. Performance data indicates typical values related to the particular product. Product updates may result in differences between the information provided in this manual and the product shipped. For access to the most current product documentation and application notes, visit www.calamp.com.

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Modem Use

The Fusion routers are designed and intended for use in fixed and mobile applications. “Fixed” assumes the device is physically secured at one location and not easily moved to another location. Please keep the cellular antenna at a safe distance from your head and body while the modem is in use.

Important

Maintain a distance of at least 20 cm (8 inches) between the transmitter antenna and any person while in use. This modem is designed for use in applications that observe the 20 cm separation distance.

Interference Issues

Avoid possible radio frequency (RF) interference by following these guidelines:

- The use of cellular telephones or devices in aircraft is illegal. Use in aircraft may endanger operation and disrupt the cellular network. Failure to observe this restriction may result in suspension or denial of cellular services to the offender, legal action, or both.
- Do not operate in the vicinity of gasoline or diesel fuel pumps unless use has been approved or authorized.
- Do not operate in locations where medical equipment that the device could interfere with may be in use.
- Do not operate in fuel depots, chemical plants, or blasting areas unless use has been approved and authorized.
- Use care if operating in the vicinity of protected personal medical devices, i.e., hearing aids and pacemakers.
- Operation in the presence of other electronic equipment may cause interference if equipment is incorrectly protected. Follow recommendations for installation from equipment manufacturers.

Mobile Application Safety

- Do not change parameters or perform other maintenance of the Fusion while driving.
- Road safety is crucial. Observe National Regulations for cellular telephones and devices in vehicles.
- Avoid potential interference with vehicle electronics by correctly installing the Fusion. Leveraging the FCC Modular approval of the Cellular and WiFi module requires professional installation to avoid antenna correlation.

UL Listed models only

When operating at elevated temperature extremes, the surface may exceed +70 Celsius. For user safety, the Fusion should be installed in a restricted access location.

WARNING — EXPLOSION HAZARD, do not connect while circuit is live unless area is known to be non-hazardous.

For more information see APPENDIX C — UL Installation Instructions and Non-Incendive Field Wiring.

TABLE OF CONTENTS

1 PRODUCT OVERVIEW

Fusion offers a single, flexible platform to address a variety of wireless communications needs with over-the-air configuration and system monitoring for optimal connectivity. This ready-to-deploy broadband router enables wireless data connectivity over public and private LTE cellular networks at 4G speeds.

For the ultimate in versatility, the Fusion provides high-speed 4G LTE public safety band 14 broadband connectivity for private infrastructure as well as 700 MHz Band 13 or 17 and 1700/2100 MHz AWS Band 4 (with 3G EV-DO/HSPA fallback modes) based on 3GPP Standard E-UTRA Release 8 technologies. Three Ethernet ports support LAN configurations that provide for the unique requirements of third-party VPN middleware providers.

An optional 802.11 b/g/n WiFi interface access point and client operations supports connectivity to IP applications in a variety of different connection scenarios. Dual USB 2.0 host interfaces are provided to support Serial IP communication (using the supported USB to RS-232 Converter cable accessory) and writing event log files to a USB flash drive. Anticipated future uses include connection of other optional USB peripherals such as ZigBee or Bluetooth adapters.

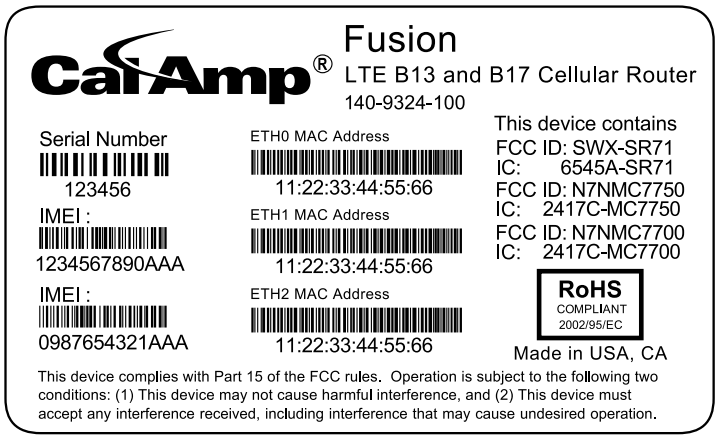
The Fusion includes an easy to use web-based management and configuration interface, and comprehensive remote management facilities are available. Cellular/WiFi/Ethernet rule-based and application port-based switching enables IP control such as segregating traffic specific to designated bearer networks and choosing the WAN fallback order. The Fusion aggregates WANs, including CalAmp's narrowband technology, making it a powerful and unique enabler of interoperable network technologies.

The Fusion includes an IP router that facilitates traffic routing between all of the concurrently operating networks. The integrated router simplifies installation cabling requirements by requiring only a single cable connection with onboard computing equipment, and offloading routing processor burdens and setup complexities. The Fusion fully integrates with CalAmp Gemini narrowband equipment to extend their functionality to include LTE connectivity and access additional Fusion peripherals.

1.1 MODULE IDENTIFICATION

The module identification label can be found on the bottom of your Fusion device. This label contains the product part number, the serial number, FCC and IC IDs as well as carrier specific information that will be required when activating your data account. The following is a sample portrayal of the identification label; identifiers and their placement will vary depending on model and installed options, and actual bar-coded numbers on each unit will differ.

Figure 1 Fusion identification label example



1.2 FEATURES AND BENEFITS OF THE FUSION MULTI-NETWORK LTE ROUTER

- Band 13, 17 or 4 LTE for public infrastructure
- Support for Band 12 or 14 LTE or where permitted (Band 14 pending FCC certification) for private or commercial infrastructure
- Supports dual cell modules for mixing public and private bands or multiple carriers
- Superior RF performance with MIMO capabilities
- Secure IPsec VPN connectivity, HTTPS, and RADIUS
- Autonomous WAAS enabled GPS with local and host reporting
- Supports Dynamic or Static WAN IP
- Inbound and Outbound Ethernet Routing
- DHCP Server and Inbound port mapping/translation (Port Forwarding)
- Firewall configuration for increased network security
- Diversity antenna port/auxiliary port for increased receive sensitivity for dual cell module
- Local or remote configuration using HTML web server
- Inbound IP termination with Static IP
- Persistent Domain Names with Dynamic DNS
- Ethernet and WiFi ports support LAN and WAN operation
- Dual SIM card slot, support multiple carrier contracts
- USB and digital/analog I/O for external devices
- Housed in a rugged metal chassis, Fusion meets MIL-STD-810F certification (for dry heat and cold storage and operation, cold start, humidity, random vibration, and mechanical shock) and IEC 61000-4-2 (2009) for electrostatic discharges
- CalAmp DeviceOutlook remote management service, built on the solid, proven performance of the COLT (CalAmp On-Line Telemetry) platform and CalAmp Enterprise Services (CES)

1.3 GENERAL SPECIFICATIONS

Product specifications are subject to change without notice.

General		
Input Voltage	10 to 30 VDC	
Power Consumption	Single Cellular Module and GPS Rx: 5.5W (no WiFi); 7.7W with WiFi Tx: 9.1W (no WiFi); 13.0W with WiFi	Dual Cellular Modules and GPS Rx: 5.8W (no WiFi); 10W with WiFi Tx: 14W (no WiFi); 16.9W with WiFi
LTE Diversity Support	DL MIMO, UL SISO	
Security	3GPP Rel 8 security sublayer, IPsec IKEv1 and IKEv2 VPN tunnel termination, HTTPS, and RADIUS	
Carrier Approvals	Verizon Wireless, VTEL, PTCRB certified for AT&T	
Certifications	FCC Part 15 Subpart B Class A, IC ICES-003 MIL-STD 810F (dry heat and cold storage and operation, cold start, humidity, random vibration, and mechanical shock), IEC 61000-4-2 (2009) electrostatic discharges	
Connectors/Interface	Antenna connectors and LED indicators vary with device model (installed options)	
Device Management	SNMP, embedded HTTP server for setup and help, DeviceOutlook	

LED Indicators	POWER, STATUS, ETH0, ETH1, ETH2, GPS, WWAN0, WWAN1 (with dual radio option), WiFi (when equipped with WiFi option)
Power	4-pin locking, ignition sense and alarm inputs
Console/Setup	3-wire serial connection in USB Mini-B form factor
Ethernet	(3) 10/100 Mbps RJ-45, auto MDIX, Auto-negotiation
USB	(2) Type A female
I/O	2 digital I/O, 2 analog inputs, 2 outputs (relay driven contact closures)
Antenna	(3) SMA-RP (802.11 b/g/n WiFi, optional) (2) SMA (cellular) WWAN0 (single or dual radio) (2) SMA (cellular) WWAN1 (dual radio option only) (1) SMA (GPS)
Mechanical/Environmental	
Dimensions	1.9 in. (4,8 cm) height × 6.0 in (15,3 cm) width × 5.5 in. (14 cm) depth
Weight	2.5 lb. (1,13 kg)
Temperature Range	-22° to +158° F (-30° to +70° C)
Humidity	5% to 95% non-condensing
LTE Technology/Bands	Supported bands vary with device model.
Band 14	700 MHz “D” Block DL MIMO, UL SISO
Band 13	700 MHz DL MIMO, UL SISO
Band 17	700 MHz DL MIMO, UL SISO
Band 4	1700/2100 MHz AWS DL MIMO, UL SISO
CDMA Technology/Bands	Supported bands vary with device model.
EVDO Rev A (IS-856-A)	800 MHz Cellular/1900 MHz PCS Downlink 3.1 Mbps; Uplink 1.8 Mbps
1xEVDO Rev 0 (IS-856)	800 MHz Cellular/1900 MHz PCS Downlink 2.4 Mbps; Uplink 153.6 kbps
1xRTT (IS-2000)	800 MHz Cellular/1900 MHz PCS Downlink 153.6 kbps; Uplink 153.6 kbps
GSM Technology/Bands	Supported bands vary with device model.
UMTS/HSPA	850/900, 1800/1900, 2100 MHz Downlink 7.2 Mbps, Uplink 2.0 Mbps
EDGE/GPRS	Quad-band 850/900, 1800/1900 MHz Downlink 236 kbps, Uplink 236 kbps
WiFi Technology/Bands	
IEEE 802.11 b/g/n	32 bit mPCI type IIIA high power/performance WiFi
Security	WPA-PSK (TKIP encryption), WPA2-PSK (CCMP encryption), 64-bit/128 bit WEP encryption, WPA Enterprise and WPA2-Enterprise
Data Rates	802.11b: up to 11Mbps 802.11g: up to 54Mbps 802.11n: up to 144Mbps

1.4 MECHANICAL SPECIFICATIONS

The following table and figure show overall dimensions of the chassis of the Fusion Multi-Network LTE Router. Dimensioned drawings of the chassis with mounting options (bracket, mounting plate, or DIN rail mount) are provided in APPENDIX B. The drawings and associated data may be used for layout reference, but it is advised that a physical comparison be made to the unit and bracket before laying out and drilling any holes.

Table 1 Fusion chassis overall dimensions

Dimension	Inches	Centimeters
Height	1.90	4,83
Width	6.00	15,2
Depth (Overall)	5.50	14,0
Depth (Chassis only)	5.28	13,4

Figure 2 Fusion router Mechanical Drawing

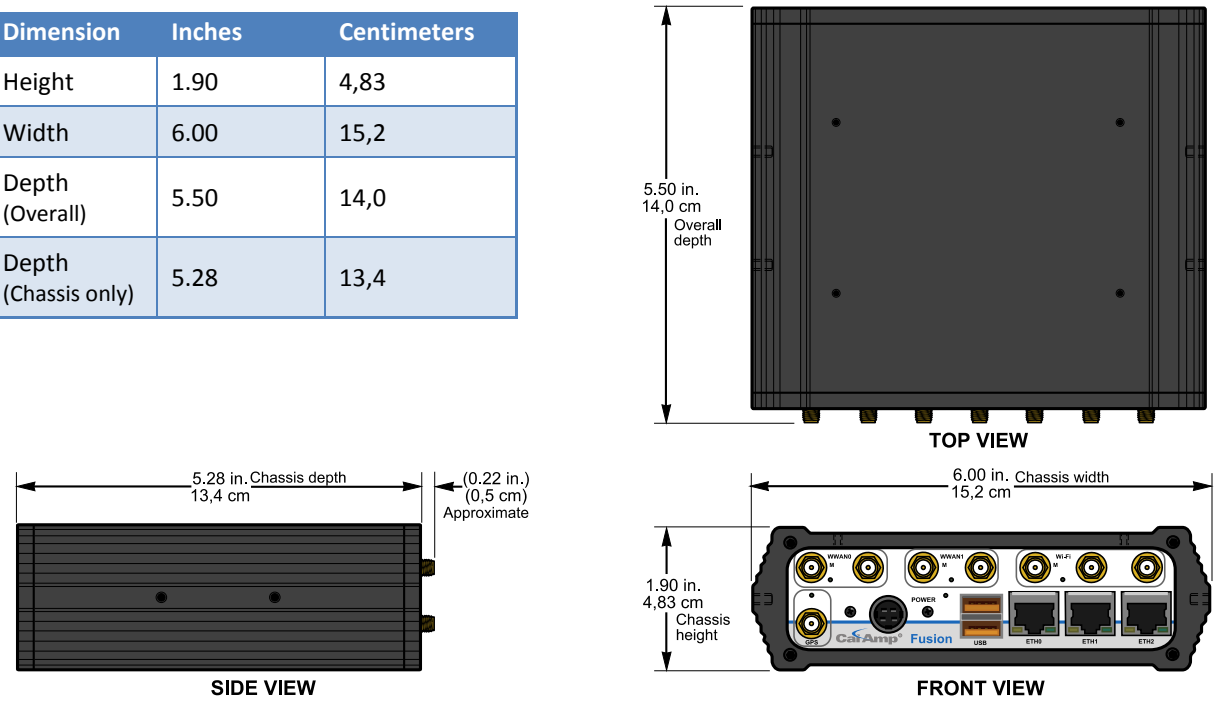
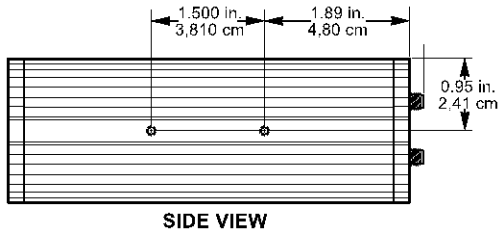
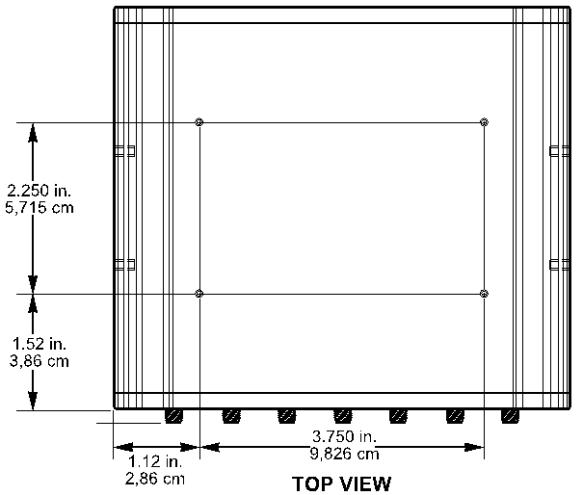


Figure 3 Side tapped mounting hole location detail — typical both sides.



#8-32 UNC – 2B thread × 0.30 in. (0,76 cm) depth
2 holes for mounting both sides (4 holes total).

Figure 4 Tapped mounting hole location detail — top only.



#6-32 UNC – 2B thread × 0.12 in. (0,30 cm) depth
4 holes for mounting (top surface only).

1.5 ORDER INFORMATION

The following table shows the available order options and part numbers required for ordering Fusion routers.

Table 2Fusion LTE router Single Radio Band model part number information

Description			Band	Provider	Model Number
Fusion LTE Router	Fixed/Portable	GPS	Band 13	Verizon	140-9320-000
Fusion LTE Router	WiFi (3 × 3)	GPS	Band 13	Verizon	140-9320-100
Fusion LTE Router	Fixed/Portable	GPS	Band 17	AT&T	140-9340-000
Fusion LTE Router	WiFi (3 × 3)	GPS	Band 17	AT&T	140-9340-100
Fusion LTE Router	Fixed/Portable	GPS	Band 17	VTEL	190-9340-000
Fusion LTE Router	WiFi (3 × 3)	GPS	Band 17	VTEL	190-9340-100
Fusion LTE Router	Fixed/Portable	GPS	Band 12	GDB	190-930G-000
Fusion LTE Router	WiFi (3 × 3)	GPS	Band 12	GDB	190-930G-100

Table 3 Fusion LTE router Dual Radio Band model part number information

Description			Bands	Model Number
Fusion LTE Router	Fixed/Portable	GPS	Band 13 and Band 17	140-9324-000
Fusion LTE Router	WiFi (3 × 3)	GPS	Band 13 and Band 17	140-9324-100
Fusion LTE Router	Fixed/Portable	GPS	Band 12 and Band 13	190-932G-000
Fusion LTE Router	WiFi (3 × 3)	GPS	Band 12 and Band 13	190-932G-100
Fusion LTE Router	Fixed/Portable	GPS	Band 12 and Band 17	190-934G-000
Fusion LTE Router	WiFi (3 × 3)	GPS	Band 12 and Band 17	190-934G-100

1.5.1 ACCESSORIES

Table 4 Fusion Accessory Kits

Description	Comments	Part Number
Fusion Accessory Kit, Vehicle Mount Version	Vehicle mount	150-5500-013
Fusion Accessory Kit, Fixed Version	Fixed/Portable	150-5500-014
Fusion Accessory Kit, Mobile version	Mobile	150-5500-015

Table 5 Fusion Accessories

Description	Comments	Part Number
USB to RS-232 Converter cable		150-9300-010
Mobile Mount, Multiband Antenna (LTE, WiFi, GPS), Black, PCTEL		401-5099-205
Antenna, LTE LProfile HGain (Band 13/Band 17), Mag mount with	Standard antenna	401-9300-001

Description	Comments	Part Number
ground plane disc, SMA, 15 ft., 3G Fallback		
Antenna, GPS, Mag Mount, SMA		401-7100-003
Antenna, WiFi, 9 in. Mag Mount, RP-SMA		401-7100-004
Category 5 100Base 7 ft. (2 m) Red Ethernet Cable		L2CAB0006
DIN Rail Mounting Plate — kit includes DIN mounting plate assembly (with retainer spring and screw), four #6-32 × ¼-inch length cap screws and four #6 lock washers for fastening to top of Fusion router.		250-5800-410

1.6 EXTERNAL CONNECTORS

This section describes the external connectors for the Fusion router.

Figure 5 Front panel connections

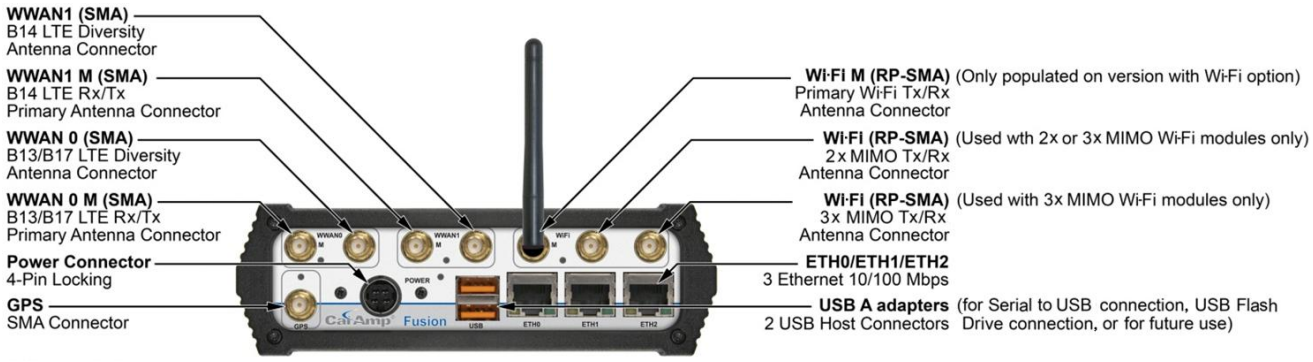


Table 6 Front Panel connectors

Top row, from left to right:

Panel label	Connection	Description
WWAN0 M	SMA	B13/B17 LTE Rx/Tx primary antenna connector
WWAN0	SMA	B13/B17 LTE diversity connector
WWAN1 M	SMA	B14 LTE Rx/Tx primary antenna connector
WWAN1	SMA	B14 LTE diversity connector
WiFi M	RP-SMA	Primary WiFi Tx/Rx antenna connector (only populated on model with WiFi option)
WiFi (center connector)	RP-SMA	2× MIMO Tx/Rx antenna connector (used with 2× or 3× MIMO WiFi modules only)
WiFi (farthest to right)	RP-SMA	3× MIMO Tx/Rx antenna connector (used with 3× MIMO WiFi modules only)

Bottom row, from left to right:

Panel label	Connection	Description
GPS	SMA	GPS Receive antenna
Power	4-pin locking	Power, ignition sense, and alarm input
USB	USB A	2 USB Host connectors *(for future use)*
ETH0	RJ-45	Ethernet 10/100 Mbps
ETH1	RJ-45	Ethernet 10/100 Mbps
ETH2	RJ-45	Ethernet 10/100 Mbps

Figure 6 Rear panel connections

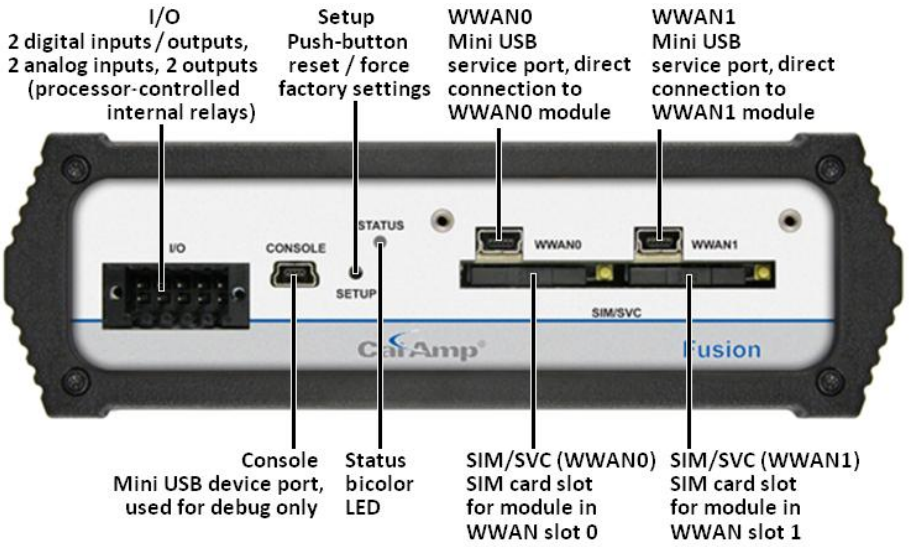


Table 7 Rear panel connectors

Panel label	Connection	Description
I/O	10-position terminal socket	2 digital inputs/outputs, 2 analog inputs, 2 outputs (processor-controlled internal relays)
Console	USB Mini-B	Mini-USB device port used for debug only
Setup	Push button	Push-button Reset / Force Factory Settings
Status	LED	Bicolor Status LED
SIM/SVC (left)	SIM card slot	Slot and tray for mini SIM card for module in WAN slot 0
WWAN0	USB Mini-B	Service port, direct connection to WWAN0 module
SIM SVC (right)	SIM card slot	Slot and tray for mini SIM card for module in WAN slot 1
WWAN1	USB Mini-B	Service port, direct connection to WWAN1 module

1.7 LEDS

Table 8 Status LEDs

Indicator	Off	Solid Green	Flashing Green	Solid Amber	Flashing Amber	Solid Red	Flashing Red
PWR	No power	Running	–	Hardware power-up sequence	Firmware boot sequence / *Power-down timer activated*[1]	Power supply fault	–
STAT	No power	Status: Normal	–	Status: Warning	Status: Factory Defaults	Status: Fault	–
GPS	–	Position Fix Acquired	1 PPS Activity	Failed to Acquire Satellites	Acquiring Satellites	Fault	–
WiFi[2] **(Client)**	I/F Disabled	Connected	Rx/Tx Activity	–	–	Fault	–
WiFi[2] **(AP)**	I/F Disabled	Ready	Rx/Tx Activity	–	–	Fault	–
WWAN0/ WWAN1	I/F Disabled, Idle, or Bypassed	Connected	Rx/Tx Activity	Failed to Connect	Connecting	Fault	–
ETH Link/Act	No link	Link OK	Activity	–	–	–	–
ETH Speed	10 Mbps	–	–	100 Mbps	–	–	–

[1] The “Power-Down Timer Activated” is a transient condition that exists when the “ignition” input is OFF and the “power-management – shutdown when ignition is off” feature is activated. It means that the unit is about to shut down and this will occur when the timer has expired.

[2] WiFi Client has priority over the WiFi AP function. This implies that WiFi Client has ownership of the LED when it is enabled. WiFi AP has ownership of the LED only if the WiFi Client is disabled.

1.7.1 NORMAL POWER-UP SEQUENCE

Step	Action	LED Activity
1	Apply power to the unit.	N/A
2	Internal 5-V power supply turns on.	Power LED on front panel illuminates red for approximately 1 second.
3	Internal 1.8 V and 3.3 V power supply turn on.	Every indicator, (except Ethernet jack indicators) illuminate amber for approximately 400 milliseconds.
4	Hardware initialization.	Every indicator turns off, except Power, which remains amber.
5	Bootstrap program runs.	Power LED blinks amber.
6	Application starts.	Power LED illuminates solid green.
7	Application runs normally.	Power LED remains solid green. Status LED on back panel illuminates solid green.

1.8 ANTENNA

LTE antenna connections are SMA female connectors and must be used with antenna with SMA male connectors. When using a direct mount or rubber duck antenna, choose the antenna specific to your band requirements. Mounting options and cable lengths are user's choice and application specific. Each WWAN interface supports a primary and diversity antenna connector.

Connect an active 3 - 5.5 V GPS antenna, with an average gain greater than -5 dBi, if using the GPS functionality.

Fusion routers are available with WiFi options, using RP-SMA connectors. Depending on the model, connect each WiFi antenna to the proper connector. If equipped with a simple non-MIMO WiFi option, connect the primary WiFi antenna to the connector labeled "M." For Fusions equipped with MIMO WiFi (2×2 or 3×3 MIMO), connect the WiFi antennas to any free RP-SMA connector.

This device is factory configured with default settings and is ready to be customized via the internal HTML interface that can be accessed using a Web browser through an Ethernet connection.

2 GETTING STARTED

2.1 PACKAGE CONTENTS

- Fusion Router
- Power Cable
- Mounting Bracket or Plate (depending on fixed/portable or mobile model) and hardware
- Quick-Start Guide
- Information Card

2.2 POWER SUPPLY CONNECTION

The Fusion router is shipped with a DC power cable used to connect the device to a DC source. The cable includes a fuse holder. Insert the fuse in the power cable fuse holder prior to powering on the unit. The cable connections are listed below.

Table 9 DC Power Cable Pin-out

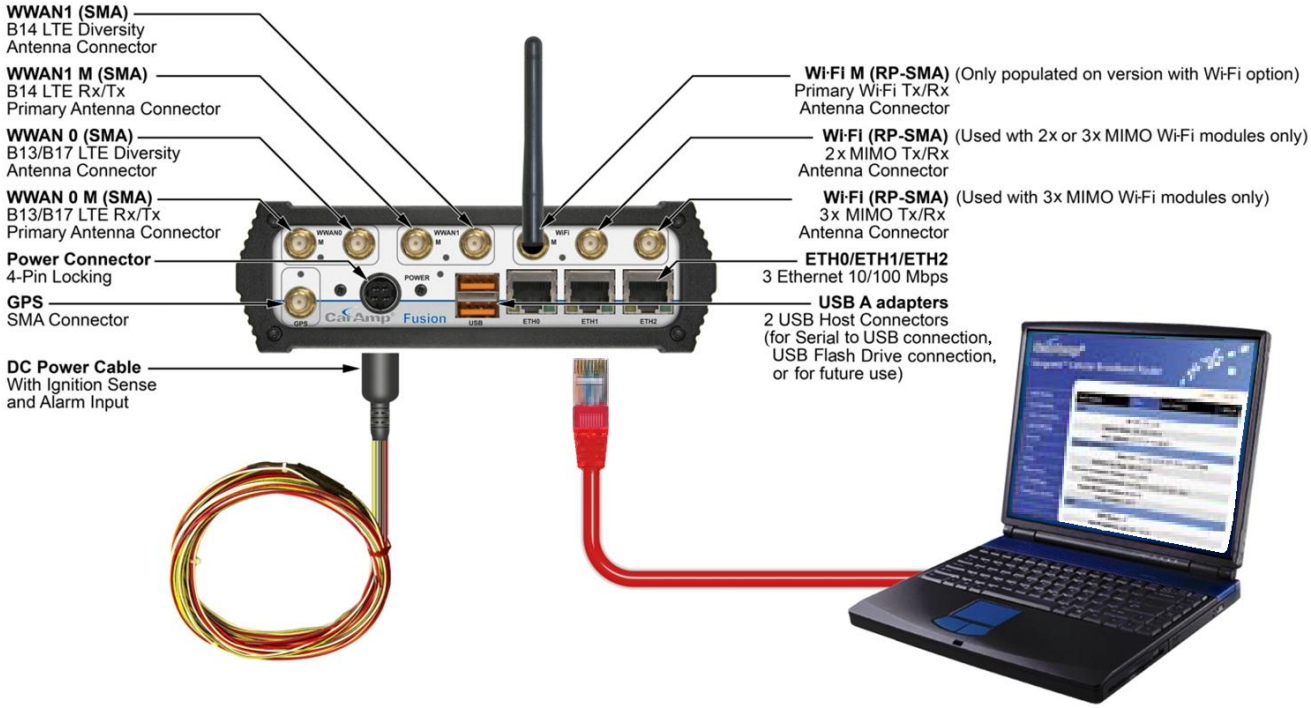
Pin	Wire Color	Description	Notes
1	Red	V_{IN}	DC input power lead, 13.8 V nominal (10 V to 30 V range)
2	Black	Ground	Connect to power supply ground.
3	White	Ignition Sense	Standard ignition-on signal. Maximum voltage above which ignition_sense will be detected as ignition asserted = 9.0 V; **If IGN Sense is not used, then this line must be connected to V_{IN}.**
4	Yellow	External Alarm Input	External alarm input (active low); can be left floating in not used.

2.3 DEVICE CONNECTIONS

Important: Before you begin configuring the Fusion router, you will need an LTE contract with a carrier and an active SIM or UICC card for each carrier / LTE module installed in the Fusion router.

1. Unscrew two screws to remove the cover plate covering the WWAN slots and insert the SIM/UICC card into the WWAN slot(s) as shown. Insert the first SIM into the WWAN0 slot. If you are using a dual card solution, install the second SIM/UICC card into the WWAN1 slot. (Retain the cover plate and attaching screws to reattach the cover plate after setup is complete.)

2. Connect the cellular antennas to the appropriate SMA connectors on the front of the Fusion router as shown in the following figure, matching the antennas for the WWAN0 module with WAN0 connectors, and antennas for the WWAN1 with WWAN1 connectors if applicable. For each antenna pair, connect the main Rx/Tx antenna to the connector labeled M, and MIMO/Diversity to the secondary (unmarked) connector of the pair.



3. Connect a GPS antenna to the SMA connector labeled GPS and connect WiFi antennas to the RP-SMA connectors: one for the Main (WiFi M) and one or more (as equipped) for WiFi MIMO/Diversity (unlabeled).

4. Connect an Ethernet cable into the **ETH1** port (center Ethernet connector) of the Fusion and plug the other end into the Ethernet port of your PC.

5. Connect the Power Cable to the modem PWR port and connect to an acceptable DC power source (10-30 VDC). The DC power cable shipped with the Fusion to connect the unit to DC power includes a fuse holder. Insert the fuse in the power cable fuse holder before powering the unit. Cable connections are listed in the Table 9 DC Power Cable Pin-out.

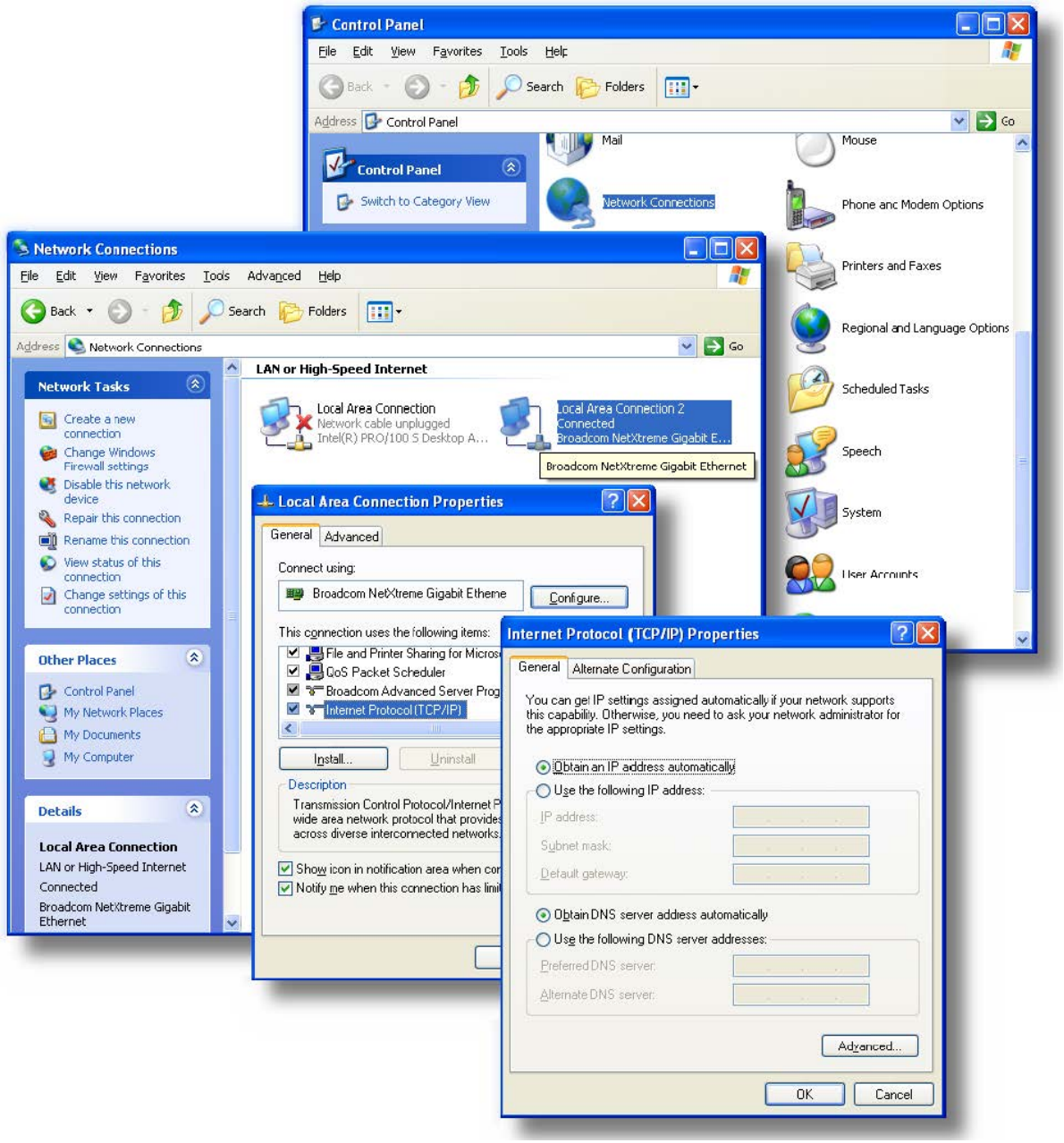
   After power is applied, the Fusion Power LED will illuminate solid red for 1 second, then turn solid amber for 5-6 seconds, blink amber for 6 seconds, and then turn solid green.

2.4 LAN CONFIGURATION

The Fusion contains a DHCP server which will automatically assign an IP address to your PC, however in some cases the user may need to change the network settings on their PC to accept the IP address from the Fusion. Before powering on the unit, confirm that your PCs Ethernet port is set up to receive an IP address from an external DHCP server, confirm it is not set to a static address. The process required to do this differs depending on the version of Windows you are using.

For Windows XP users, select **Start** » **Control Panel** » **Network Connections**. Right click **Local Area Connection** and select **Properties** to open the configuration dialog box for Local Area Connection. Select **Internet Protocol (TCP/IP)** and click **Properties** to open the TCP/IP configuration window. On the General tab, select **Obtain an IP address automatically** and Obtain **DNS server address automatically**. Click **OK** to complete TCP/IP configuration.

Figure 7 LAN Configuration Settings in Windows XP

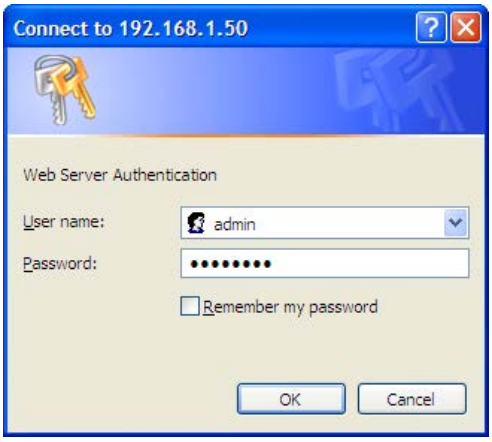


2.5 LOG IN

Start your Web browser and enter **192.168.1.50** in the address bar. A Web Server Authentication window appears.

Note: The Ethernet cable between the Fusion and your PC must be connected to ETH1 for this IP address to work.

Figure 8 Web Server Authentication window



Enter the User Name: **admin** and the Password: **password** and click OK to log into the modem Home Page. Information about the Unit Status is displayed on the Home Page.

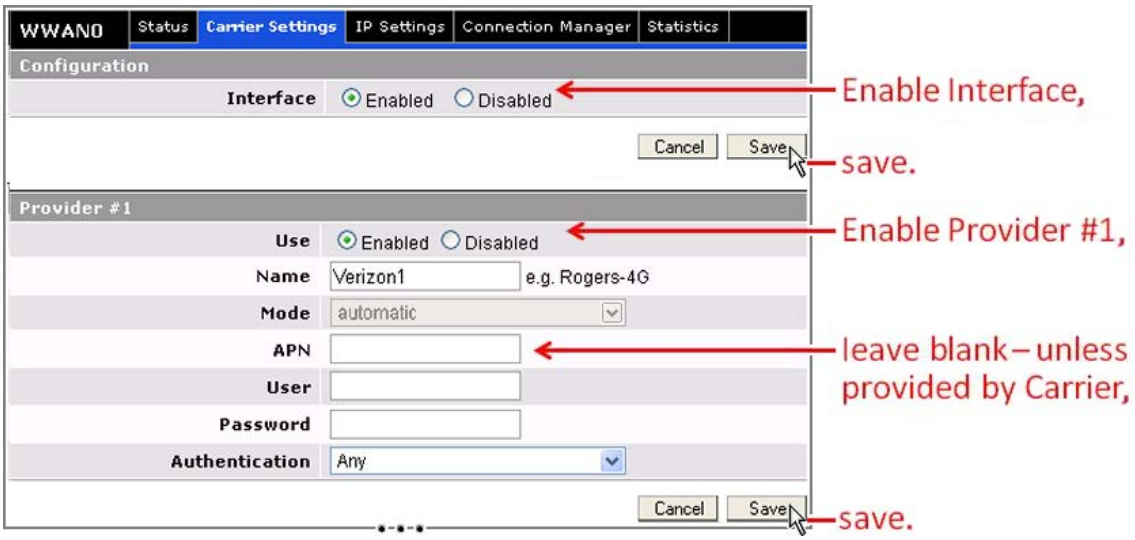
2.6 LTE CONNECTION

Note: Before you begin configuring the Fusion router, you will need an LTE account and an active SIM or UICC card for each carrier / LTE module installed in the Fusion router.

The Fusion Web interface is divided in two sections. In the left pane is the main navigation menu. On the right is the content area for the selected page. Initially, information about the Unit Status is displayed.

From the main navigation menu on the left, select **WWAN0** to navigate to the WWAN0 page. The Status tab for WWAN0 is displayed. Select the **Carrier Settings** tab.

Figure 9 Enable WWAN0 Interface and use Provider #1 for LTE connection



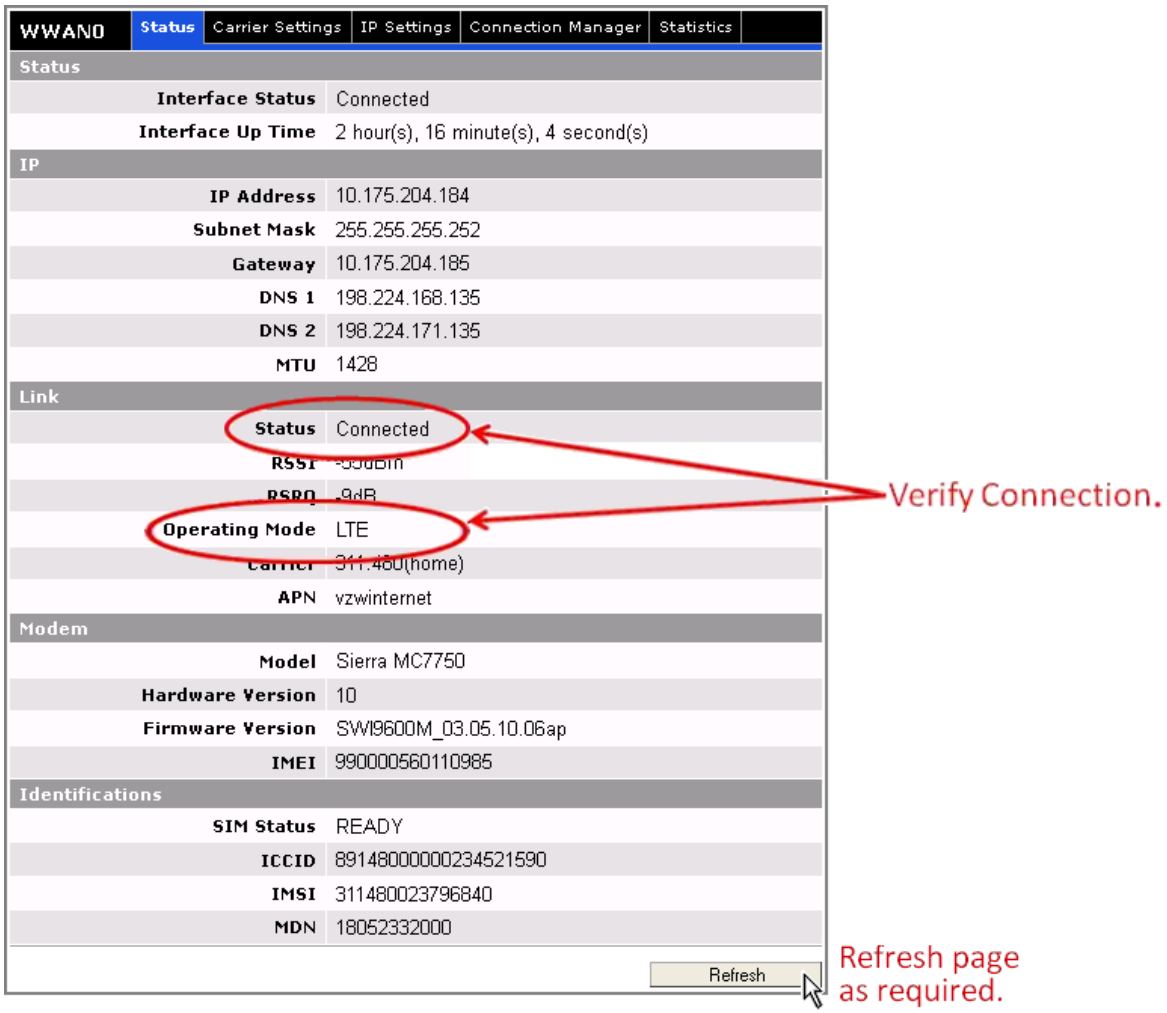
If the interface is not already enabled, in the Configuration section click **Enabled** and in the same section, click **Save** to enable the WWAN0 interface.

In the Provider #1 section, if Provider #1 is not already enabled click **Enabled** and in the same section, click **Save** to enable Provider #1.

Leave **APN**, **User**, and **Password** blank unless you have received specific values from your carrier. For most cases, Authentication should remain set as **Any**.

It may take several minutes to establish the connection after it has been enabled for the first time. Verify the connection is active by clicking the **Status** tab. See the following figure.

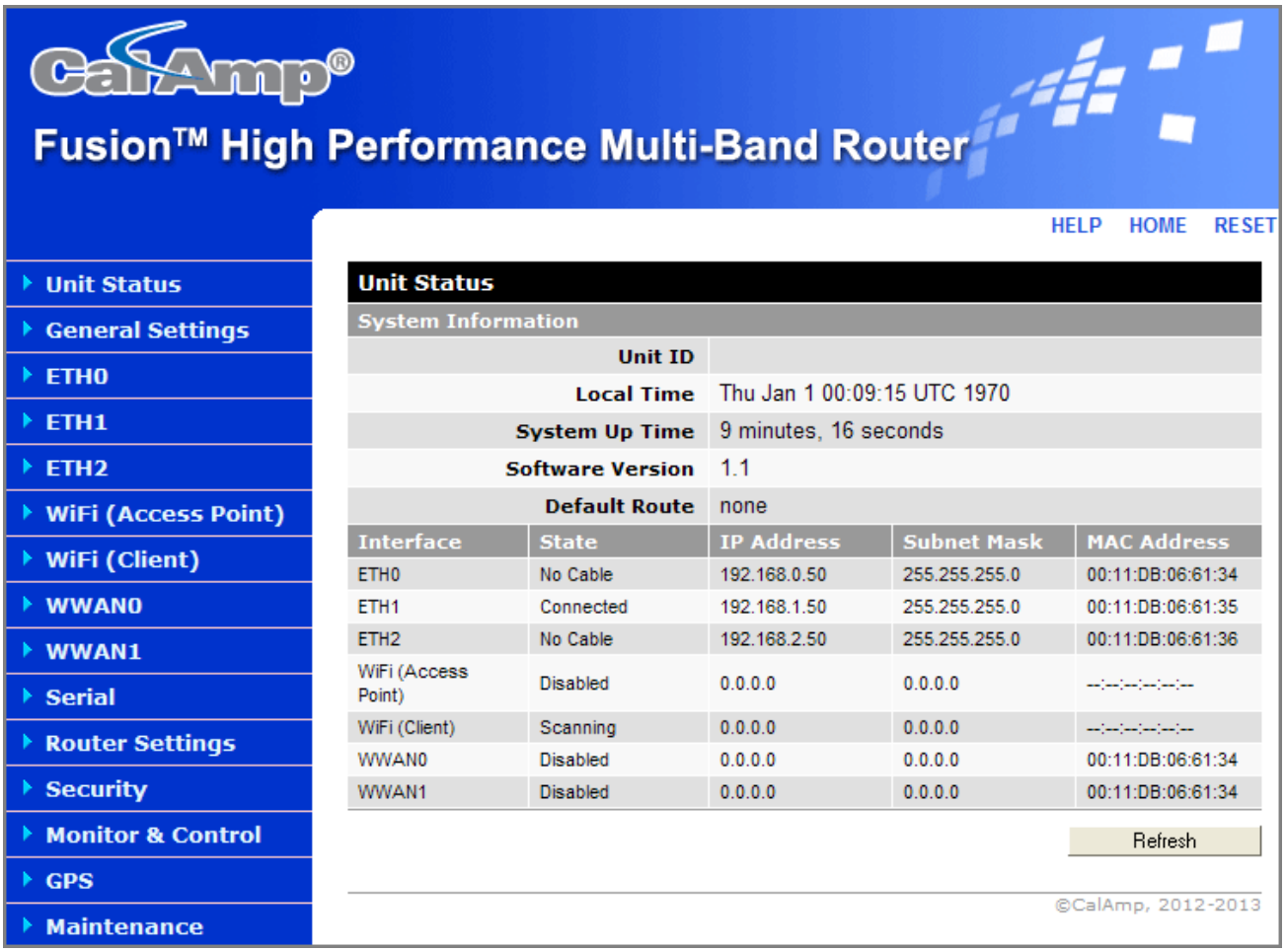
Figure 10 WWAN0 Status tab showing LTE Link connected



3 FUSION WEB INTERFACE

The Fusion Web interface is divided into two sections. In the left pane is the main navigation menu. On the right is the content area for each page.

Figure 11 CalAmp Fusion High Performance Multi-Band Router Web interface displaying Unit Status page



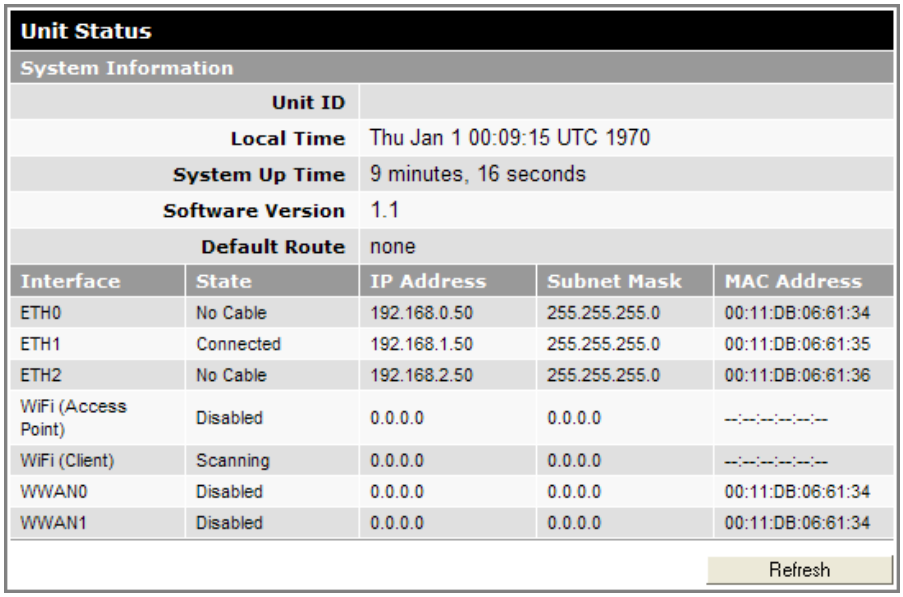
Note: If the computer you are using has previously been used to set up a CalAmp router, you may need to delete the browser history (specifically, temporary Internet files) for some pages of the web interface to display correctly.

The navigation menu for your Fusion may contain fewer sections than shown here depending on which options are installed in your unit.

3.1 UNIT STATUS

The Unit Status is the first page displayed when navigating to the Fusion Web interface and is the home page. Select Unit Status from the main navigation menu (or click Home) to return to this page. From this page you can view unit identification, system status, and Interface information.

Figure 12 Fusion Web interface Unit Status page



Unit Status

System Information

Unit ID	
Local Time	Thu Jan 1 00:09:15 UTC 1970
System Up Time	9 minutes, 16 seconds
Software Version	1.1
Default Route	none

Interface	State	IP Address	Subnet Mask	MAC Address
ETH0	No Cable	192.168.0.50	255.255.255.0	00:11:DB:06:61:34
ETH1	Connected	192.168.1.50	255.255.255.0	00:11:DB:06:61:35
ETH2	No Cable	192.168.2.50	255.255.255.0	00:11:DB:06:61:36
WiFi (Access Point)	Disabled	0.0.0.0	0.0.0.0	--:--:--:--:--:--
WiFi (Client)	Scanning	0.0.0.0	0.0.0.0	--:--:--:--:--:--
WWAN0	Disabled	0.0.0.0	0.0.0.0	00:11:DB:06:61:34
WWAN1	Disabled	0.0.0.0	0.0.0.0	00:11:DB:06:61:34

Refresh

System Information

- **Unit ID**
  User-defined name given to the unit for ease of reference and used by various services.

- **Local Time**
  Displays the current date and time (UTC) as received from the GPS receiver.

- **System Up time**
  Displays the duration the system has been up in hours, minutes, and seconds.

- **Software Version**
  Displays the current system firmware version loaded. Please visit www.calamp.com for the latest updates.

- **Default Route**
  Displays the name of the WAN interface used as the default route. This value can change dynamically, based on the available WANs and WAN failover rules specified.

Interface Information

- **Interface**
  Name of the interface.

- **State**
  Displays the current state of the interface. Possible states are listed in the following table.

- **IP Address and Subnet Mask**
  Displays the IP address and subnet mask of the interface.
  Important concept: Note that the Fusion acts as a *router* between each of its interfaces, ETH0, ETH1, ETH2, WiFi, WWAN0, and WWAN1 (when installed and active), **not** as a *switch* or *hub*. Each of these interfaces, when enabled,

must have a unique IP address that (with the subnet mask) specifies a subnet that is separate (non-overlapping) from subnets specified for any of the other Fusion interfaces.

Table 10 Possible states of Fusion interfaces

ETH (LAN)	ETH (WAN)	WiFi AP	WiFi Client	WWAN	Serial
Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Disabled	Disabled	Disabled	Disabled	Disabled	Down
Inactive	Inactive	Inactive	Inactive	Disconnected	Disabled
No Cable	No Cable	Configuring IP	Scanning	Connecting	Listening
Configuring IP	Acquiring IP	Connecting	Acquiring IP	Connected	No Cable
Connecting	Connecting	Connected	Connecting		Connecting
Connected	Connected		Connected		Connected

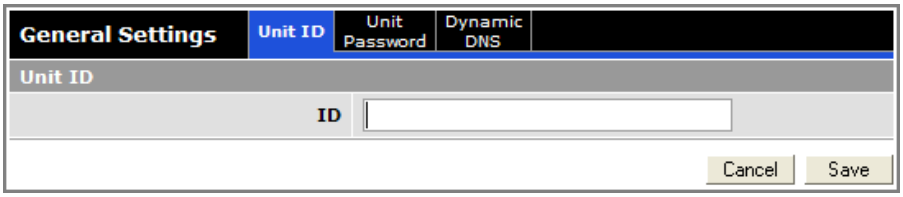
- **IP Address**
  Displays the IP address assigned to this interface.
- **Subnet Mask**
  Displays the subnet mask of this interface
- **MAC Address**
  Media Access Control Address; every interface (i.e. LAN or WAN) has a unique hardware serial number or MAC address to identify each Network Device from all others. Note that the optional WiFi client and Access Point interfaces are provided by the same hardware module and therefore share the same MAC address.

3.2 GENERAL SETTINGS

The General Settings page allows customization of basic settings of the Fusion. Select General Settings from the main navigation menu to navigate to the General Settings page. The General Settings page contains three tabs: Unit ID, Unit Password, and Dynamic DNS.

3.2.1 UNIT ID

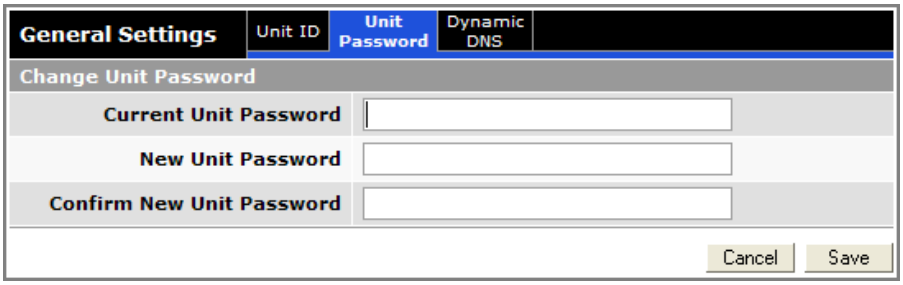
Figure 13 General Settings – Unit ID



- **ID**
  This identifier serves to distinguish this unit from other units in the network. This identification number is also the TAIP identification used for GPS reporting and serves as the *'syslocation'* for the SNMP facility.

3.2.2 UNIT PASSWORD

Figure 14 General Settings – Unit Password

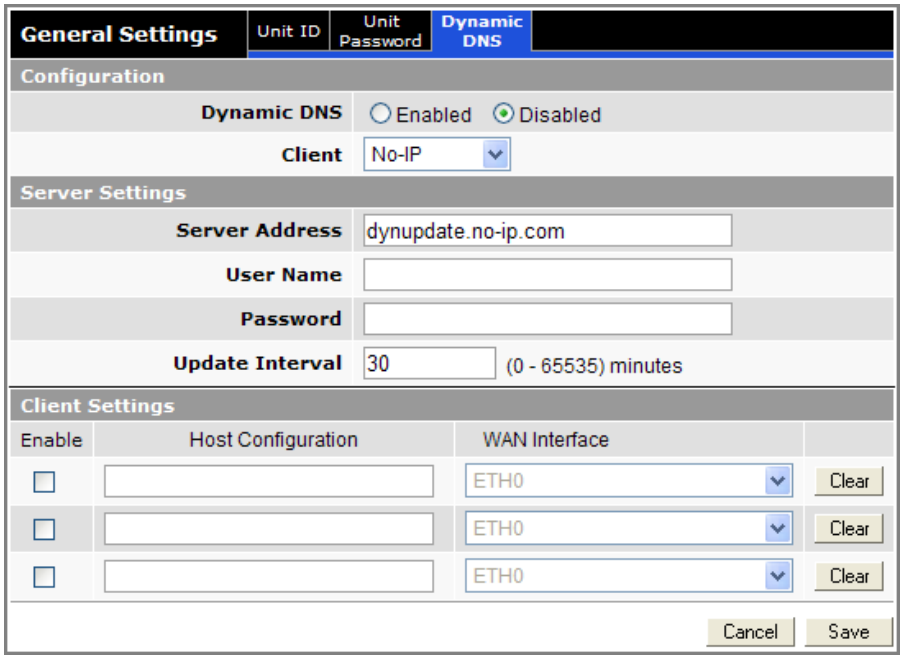


- **Current Unit Password**
  The current unit password must be provided here to enable changing the unit password.
- **New Unit Password**
  Enter new password here.
- **Confirm New Unit Password**
  Re-enter the new password.

This password controls access to the Fusion HTML web interface via a local Ethernet connection and via Remote login. (See the Security section.) Some functions such as SNMP will require an additional password.

3.2.3 DYNAMIC DNS

Figure 15 General Settings – Dynamic DNS



Dynamic DNS is a system that allows the domain name data of a computer with a varying (dynamic) IP addresses held in a name server to be updated in real time in order to make it possible to establish connections to that machine without the need to track the actual IP addresses at all times. A number of providers offer Dynamic DNS services (DDNS), free or for a charge.

Fusion allows publishing a distinct IP address or mnemonic name association for each of its WAN interfaces, as well as for the WAN interface used as the default route. Example: car54 (for the default route), car54_wifi, car54_LTEB14, car54_VZW.

Configuration

- **Dynamic DNS**
  Selecting Enabled will allow the Fusion to provide the selected service dynamic IP address information. Selecting Disabled will stop any IP information from being sent to the selected service.

- **Client**
  Select the Dynamic DNS client to use. No-IP is the default DNS service.

Server Settings

- **Server Address**
  The internet address to communicate the Dynamic DNS information to. Default is dynupdate.no-ip.com.

- **User Name**
  The user name used when setting up the account. Used to login to the Dynamic DNS service.

- **Password**
  The password associated with the account.

- **Update Interval**
  Sets the interval, in minutes (0 to 65,535), the modem will update the Dynamic DNS server of its carrier assigned IP address. Each update is considered a data call by the cellular provider and could deplete low usage data plan minutes. Setting the duration too long could lead to periods of lost connectivity when the device IP address changes.

Client Settings

- **Enable**
  The IP address updates will only be supplied to the service if this radio button is set.

- **Host Configuration**
  The unique device name to register with the DDNS service.

- **WAN Interface**
  The WAN interface whose IP address will be published for this DDNS registration.

The **Clear** button on each entry can be used to remove that particular DDNS configuration.

You must click **Save** for changes to take effect.

3.3 ETH0, ETH1, ETH2 (ETHERNET 0, 1, AND 2)

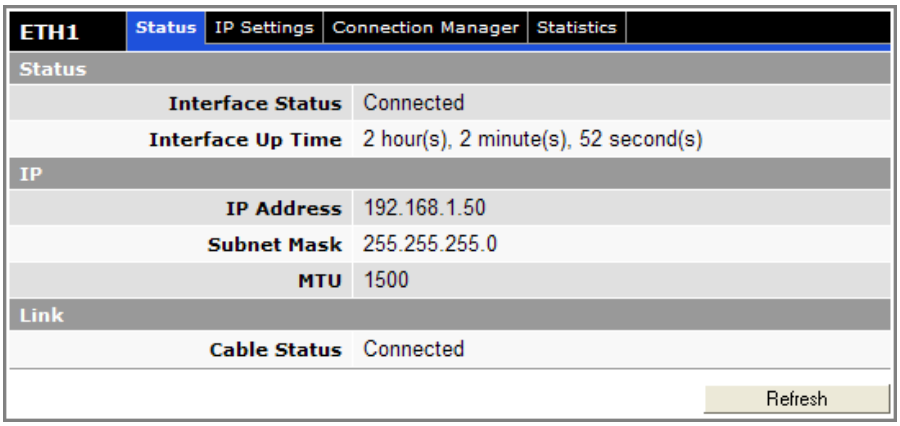
The same instructions apply to settings for all Ethernet interfaces. (Except if the Fusion is equipped with the GeminiG3 narrowband WAN option. If this is the case, see 3.4 GeminiG3 (ETH2)). Each Ethernet interface can be configured as a LAN or a generic WAN. Select the interface, ETH0, ETH1, or ETH2, as applicable, from the main navigation menu to navigate to the page for the interface.

Note: When assigning IP addresses, each interface, ETH0, ETH1, and ETH2 (and WiFi, WWAN0, and WWAN1, when active) must have a unique IP address that (with the subnet mask) specifies it is on a subnet that is separate (non-overlapping) from subnets specified for any of the other Fusion interfaces.

3.3.1 STATUS

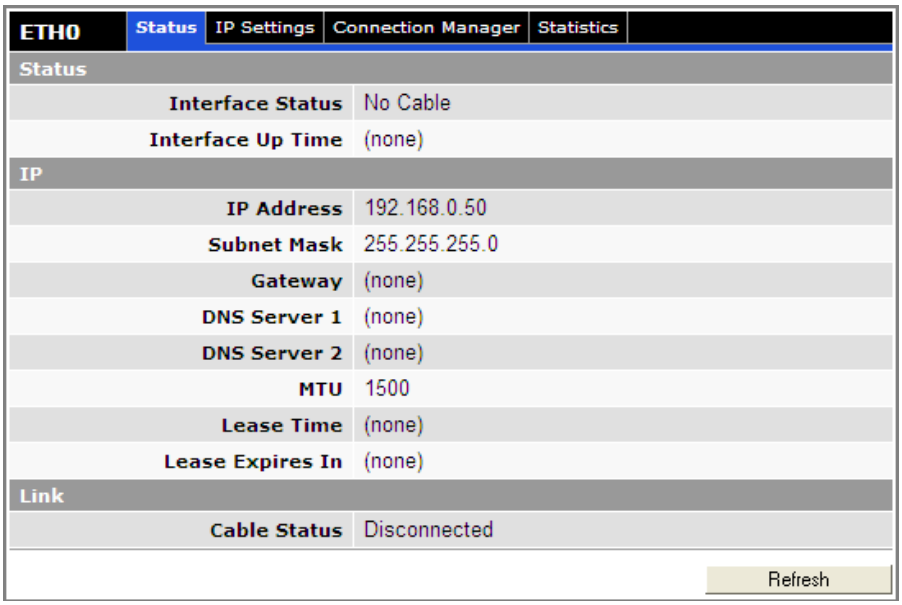
ETH configured as a LAN

Figure 16 ETH0 / ETH1 / ETH2 – Status (configured as LAN)



ETH configured as a WAN

Figure 17 ETH0 / ETH1 / ETH2 – Status (configured as WAN)



Status

- **Interface Status**
  See Table 10 Possible states of Fusion interfaces in Unit Status.

- **Interface Up Time**
  Number of days, hours, minutes, and seconds that the interface has been up (connected state).

IP

- **IP Address**
  IP address assigned to this interface.
  Note: When assigning IP addresses, each interface, ETH0, ETH1, and ETH2 (and WiFi, WWAN0, and WWAN1, when active) must have a unique IP address that (with the subnet mask) specifies it is on a subnet that is separate (non-overlapping) from subnets specified for any of the other Fusion interfaces.

- **Subnet Mask**
  The subnet mask assigned to this interface.

- **MTU**
  The Maximum Transmit Unit size. Should be left as the default value of 1500 bytes in most cases.

Note: The following only apply when the interface is configured as a WAN.

- **Gateway**
  IP address of the WAN gateway. This is used for routing packets to remote networks.

- **DNS Server 1, DNS Server 2**
  IP address of the (1) preferred and (2) alternate DNS server.

- **Lease Time**
  If the interface is set up to request an IP address from a DHCP server, this is the lease duration.

- **Lease Expires in**
  If the interface is set up to request an IP address from a DHCP server, this is the time remaining in the current lease.

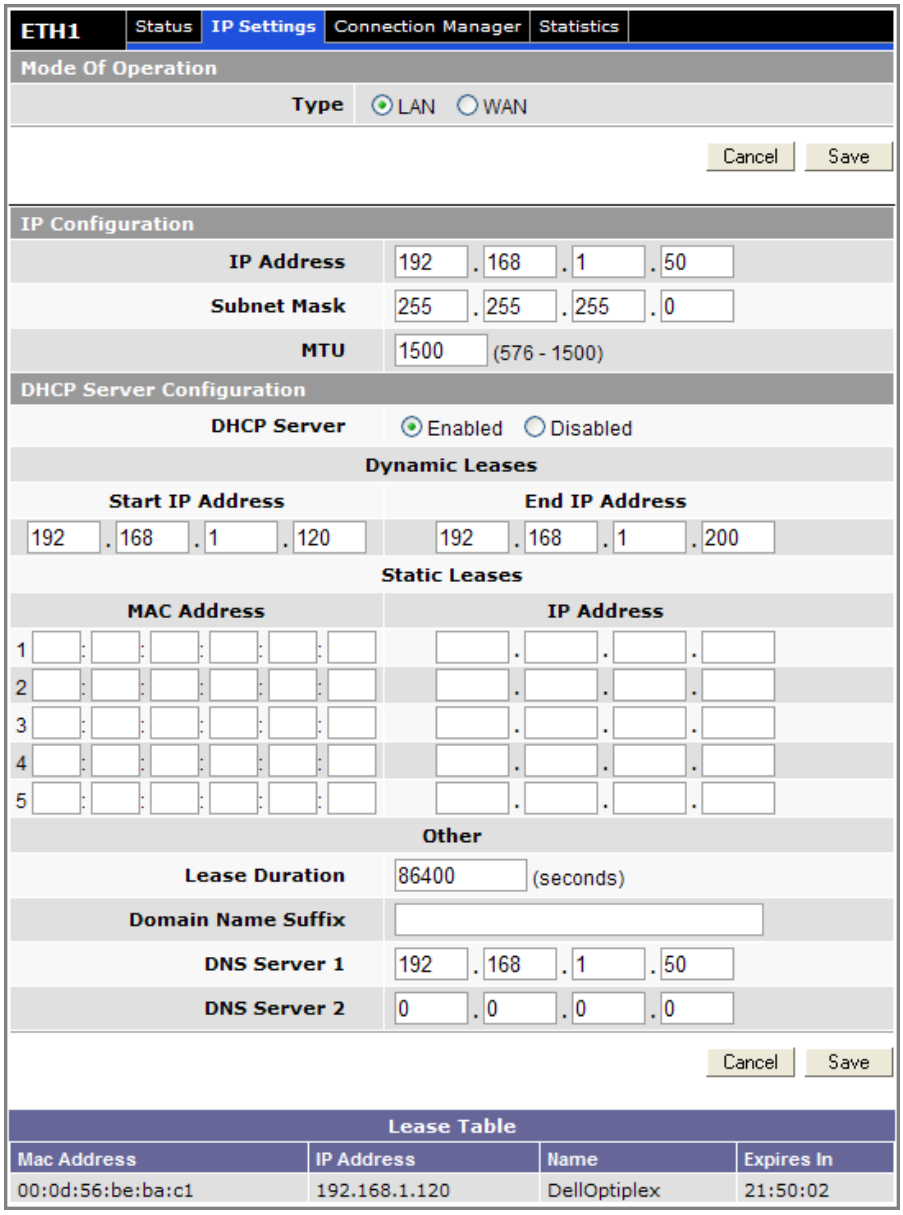
Link

- **Cable Status**
  Connected or disconnected.

3.3.2 IP SETTINGS

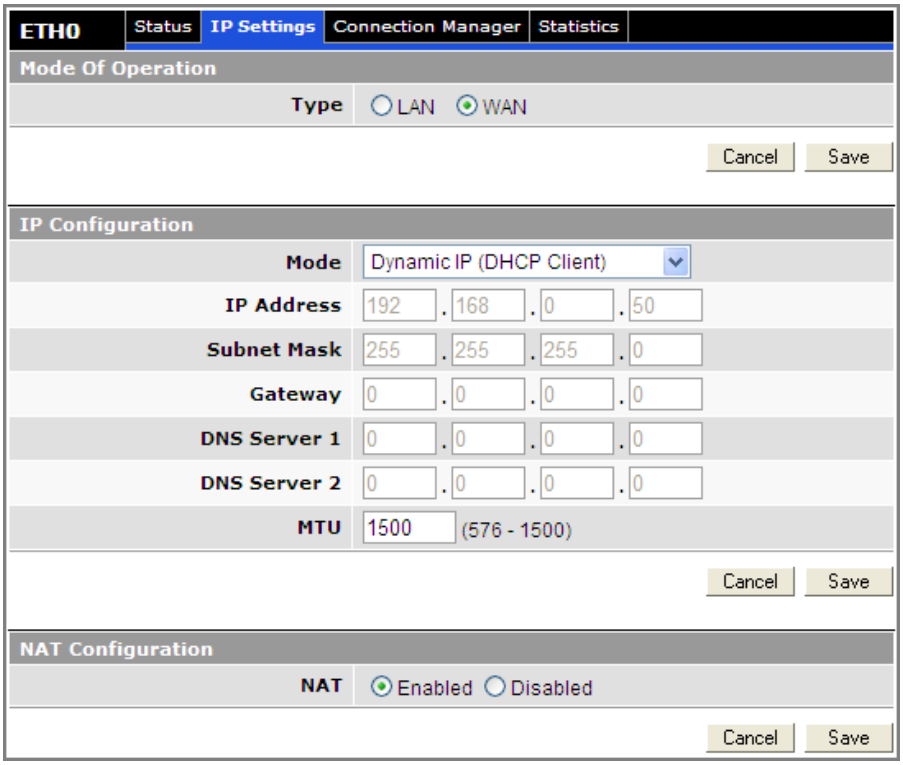
ETH configured as a LAN

Figure 18 ETH0 / ETH1 / ETH2 – IP Settings (configured as LAN)



ETH configured as a WAN

Figure 19 ETH0 / ETH1 / ETH2 – IP Settings (configured as WAN)



Modes of Operation

- **Type**
  Select LAN if this Ethernet port is connecting to a local area network. Select WAN if the Fusion is connecting to a wide area network through an external router or gateway.

IP Configuration

- **IP Address/Subnet Mask**
  Sets the IP Address and Subnet Mask for the Ethernet interface.
  Note: When assigning IP addresses, each interface, ETH0, ETH1, and ETH2, (and WiFi, WWAN0, and WWAN1, when active) must have a unique IP address that (with the subnet mask) specifies it is on a subnet that is separate (non-overlapping) from subnets specified for any of the other Fusion interfaces.

- **MTU**
  Maximum Transmission Unit, maximum packet size allowed to be transmitted. Should be left as default value of 1500 in most cases.

DHCP Server Configuration

- **DHCP Server**
  When enabled, the DHCP server will assign an IP addresses to each device connected to the Ethernet port. IP addresses assigned will be in the defined range (see below) and on the same subnet as the Fusion.

- **Dynamic Leases (Start IP Address/End IP Address)**
  External LAN devices connected to the Fusion will be assigned IP address in this range when DHCP is enabled. This range of IP addresses must be on the same subnet as Fusion (the range must be compatible with the IP address and network mask set for the Ethernet interface).

IP Configuration

- **Mode**
  Select Dynamic or Static. If you select Dynamic, the rest of the entries on this page will be shaded out.

- **IP Address**
  Static address for this interface. It must be on the same subnet as the gateway.

- **Subnet Mask**
  Will be assigned by the gateway.

- **Gateway**
  IP address of the Gateway (DHCP host). If not known this can be left as all zeros.

- **DNS Server 1, DNS Server 2**
  IP address of the DNS server for this unit. If not known, this can be left as all zeros.

NAT Configuration

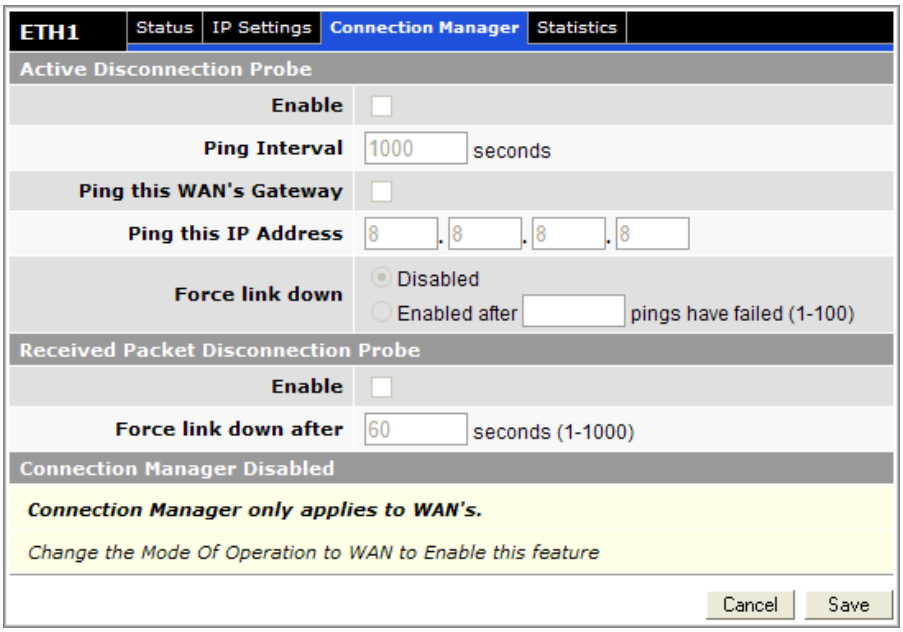
- **NAT**
  Enable or Disable NAT (Network Address Translation)

3.3.3 CONNECTION MANAGER

The Connection Manager tab allows you to configure the Fusion router to set criteria that determine whether a reliable connection exists or the link is down. This feature can also be used to only generate pings on an interface if no traffic is sent via this interface. This can be useful to maintain an active connection. Connection Manager features are available when the interface is configured for WAN mode only and are not applicable or available when the interface is configured for LAN.

ETH Configured as a LAN

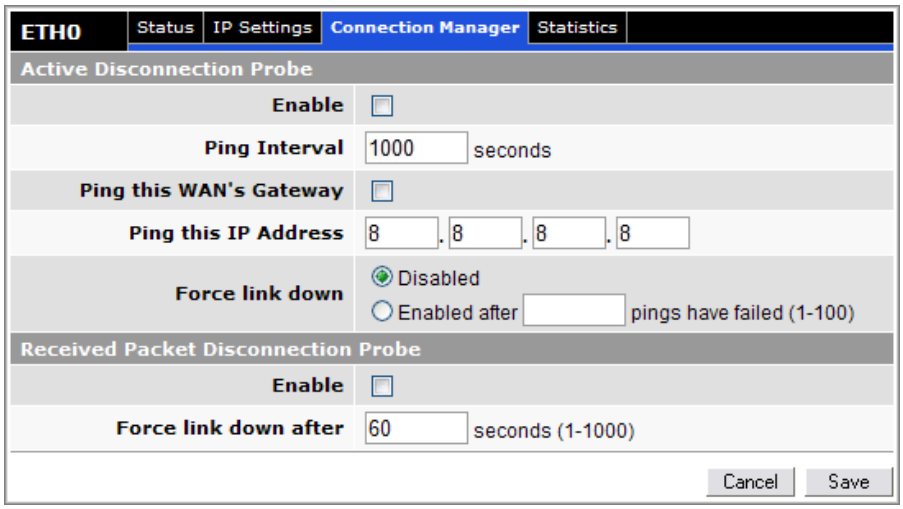
Figure 20 ETH0 / ETH1 / ETH2 – Connection Manager (configured as LAN)



When an Ethernet interface (ETH0, ETH1, or ETH2) is configured as a LAN, settings the Connection Manager are not applicable, so none of the configuration settings are available. Connection Manager settings are only applicable for an Ethernet interface if it is configured as a WAN.

ETH Configured as a WAN

Figure 21 ETH0 / ETH1 / ETH2 – Connection Manager (configured as WAN)



When an Ethernet interface (ETH0, ETH1, or ETH2) is configured as a WAN, settings the Connection Manager are applicable, and so the configuration settings shown in the figure above are available.

Active Disconnection Probe

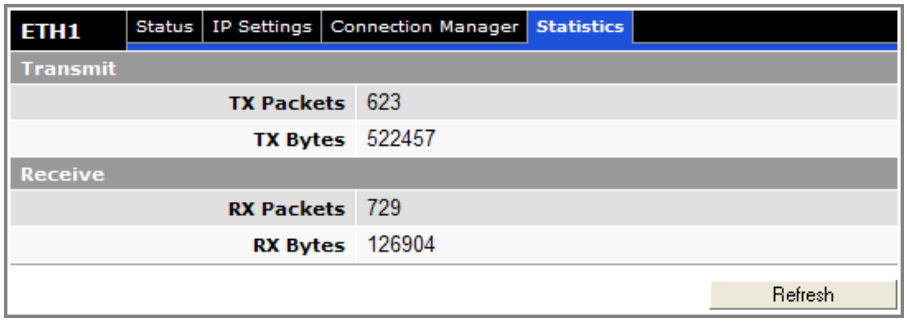
- **Enable**
  Check this box to detect link connection status based on pings to a specified IP address or the WAN's Gateway.
- **Ping Interval**
  Interval in seconds between each ping if no packets have been received.
- **Ping this WAN's Gateway**
  To ping the WAN's Gateway rather than a specific IP address, check this box.
- **Ping this IP Address**
  Enter the IP address that pings will be sent to, to detect the link state. Enter the IP address of a known external reachable server or network (for example, 8.8.8.8).
- **Force link down**
  Specify the number of pings, if which are unsuccessful, the link will be declared down. If disabled, the interface will never be forced down if pings fail.

Received Packet Disconnection Probe

- **Enable**
  Check this box to enable link detection based on whether packets are received.
- **Force link down after**
  Enter the number of seconds after which, if no packets have been received, the link will be declared down.

3.3.4 STATISTICS

Figure 22 ETH0 / ETH1 / ETH2 – Statistics



The statistics page lists the total number of packets and bytes transmitted and received since the time the units status was listed as connected. These numbers reset to 0 when the Ethernet interface disconnects.

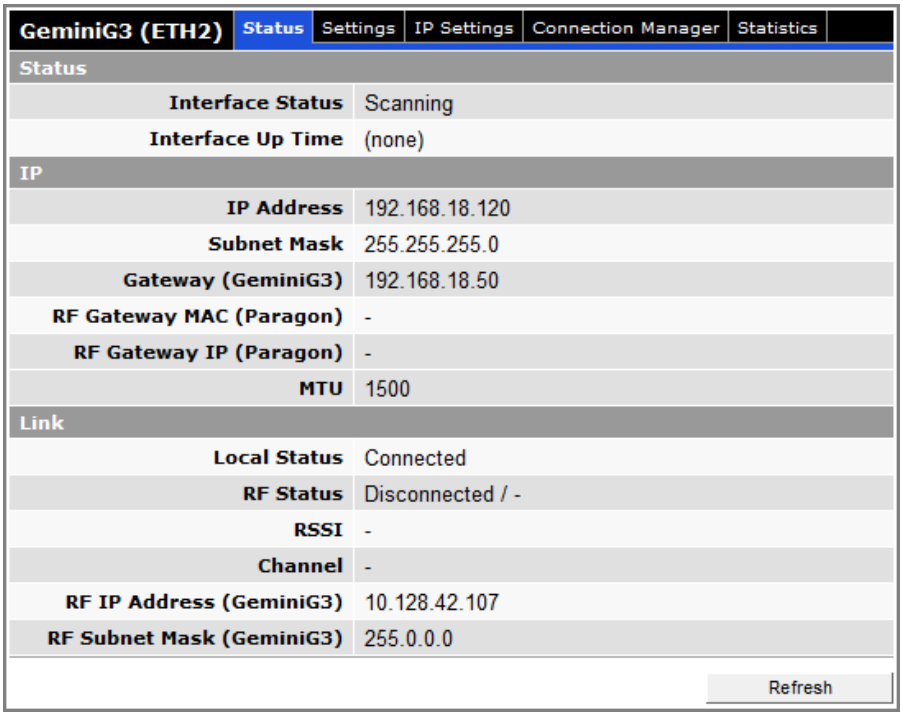
3.4 GEMINIG3 (ETH2)

This menu selection replaces the ETH2 LAN setting and appears in the main navigation pane when the Fusion is equipped with the GeminiG3 narrowband WAN option.

When equipped, this option transforms the ETH2 LAN into a Narrowband WWAN interface by customizing the ETH2 configuration page to the CalAmp Gemini product line.

Refer to CalAmp part number 001-0001-401, *Gemini G3 ADB User Manual* for details on the GeminiG3 configuration.

Figure 23 GeminiG3 (ETH2) – Status



The Gateway and Subnet mask will be assigned by the GeminiG3 in this configuration.

- **RF Gateway MAC**
  The Paragon 4 RF MAC address.
- **RF Gateway IP**
  The Paragon 4 RF IP address.
- **Local Status**
  Status of the local connection between the Fusion and GeminiG3.
- **RF Status**
  GeminiG3 and Paragon4 connection RF status.
- **RSSI**
  GeminiG3 Receive Signal Strength Indicator in dBm.

- **Channel**
  GeminiG3 RF Channel used to communicate with the Paragon4.

- **IP Address**
  GeminiG3 RF IP address.

- **Subnet Mask**
  GeminiG3 RF subnet mask.

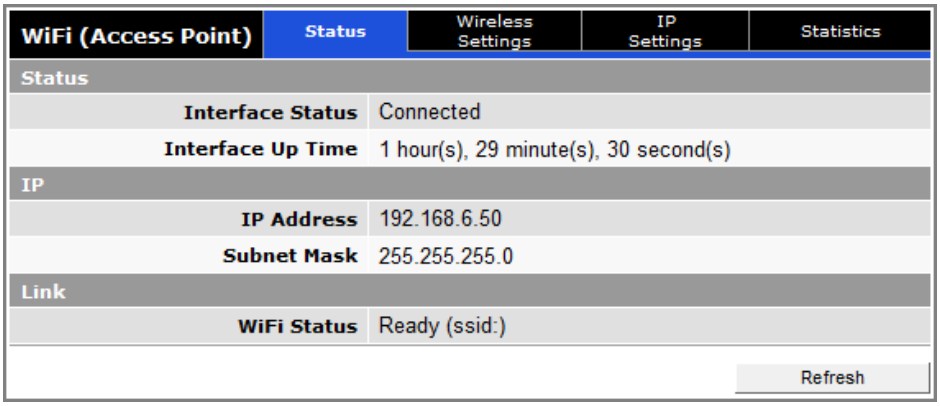
3.5 WIFI (ACCESS POINT)

Select WiFi (Access Point) from the main navigation menu to navigate to the WiFi (Access Point) page, which contains tabs for status and configuration of the WiFi Access Point interface.

Note: Until Release 1.1.7 of the Fusion firmware, the Fusion could only be set to function as either a WiFi Client or a WiFi Access Point, but not both simultaneously. Fusion firmware version 1.1.7 added the capability to configure the Fusion as both a WiFi Client and WiFi Access Point simultaneously. However, since both the Access Point and the Client use the same radio, once the radio channel is set for the Access Point, the Client must use the same channel. The client will only look for external Access Points with the same WiFi radio channel that is selected for its own internal Access Point. The client will not scan for Access Points using any other channels. For more information about using the Fusion WiFi interface in concurrent or non-concurrent modes, see APPENDIX E— WiFi Concurrent Configuration as Access Point and Client.

3.5.1 STATUS

Figure 24 WiFi (Access Point) – Status



Status

- **Interface Status**
  See Table 10 Possible states of Fusion interfaces in Unit Status.

- **Interface Up Time**
  Number of days, hours, minutes, and seconds that the interface has been up (connected state).

IP

- **IP Address**
  IP address assigned to this interface.

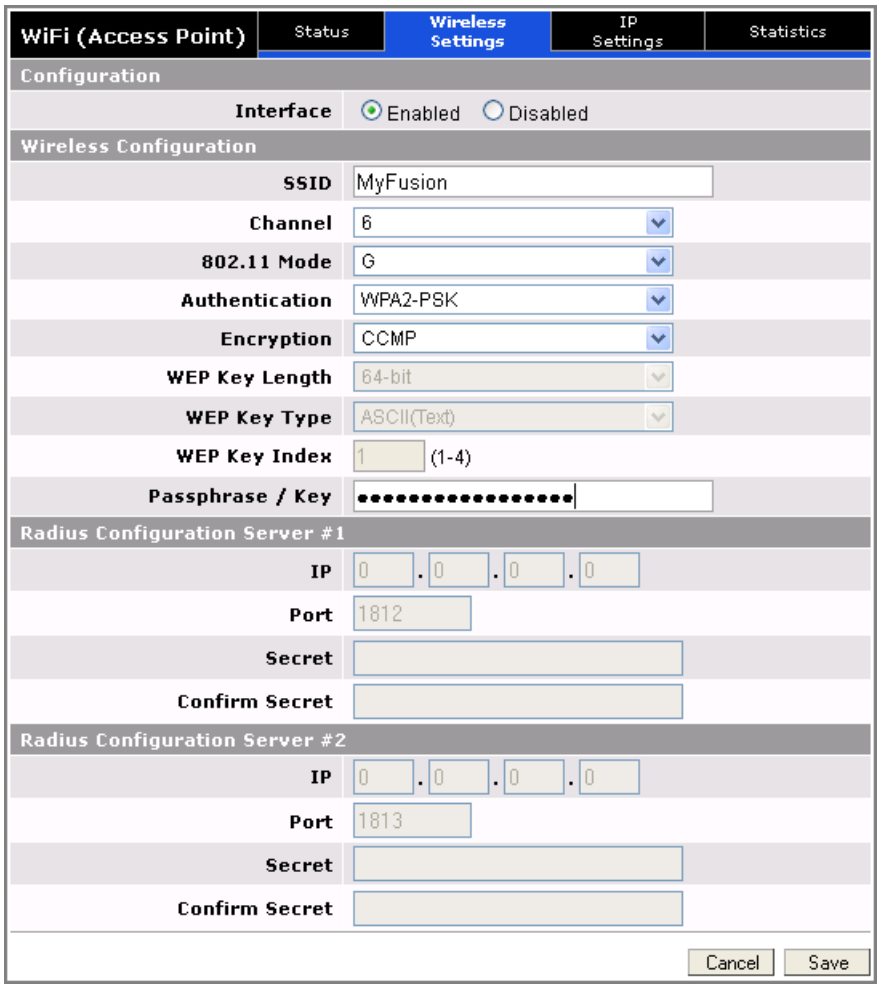
- **Subnet Mask**
  The subnet mask assigned to this interface.

Link

- **WiFi Status**
  When status is listed as N/A, the interface is disabled; When status is listed as Ready: Interface is ready to accept clients.

3.5.2 WIRELESS SETTINGS

Figure 25 WiFi (Access Point) – Wireless Settings



Configuration

- **Interface**
  Selecting Enabled will enable the Wireless interface. Selecting Disabled will disable it.

Wireless Configuration

- **SSID**
  The SSID is the name of the wireless local network. Devices connecting to the Fusion WiFi access will identify the Access Point by this SSID.

- **Channel**
  Select the WiFi channel the module will transmit on. If there are other WiFi devices in the area the Fusion should be set to a different channel than the other access points. **Note:** If you are configuring the Fusion WiFi interface as both a client and an Access Point, because both use the same WiFi radio, the client will be restricted to the channel you select and therefore will only connect to other Access Points that use this channel, and will not scan for Access Points using any other channels.

- **Authentication**
  Select authentication method. Options are Shared; WPA-PSK, WPA2-PSK, WPA-Enterprise and WPA2-Enterprise. WPA2-PSK or WPA2-Enterprise is recommended if security is required.

- **Encryption**
  Select the encryption method. Options are None, WEP, TKIP, or CCMP. Depending on the authentication method selected, some options will not be available here.

- **WEP Key Length**
  Available only if the WEP option is selected for encryption. Choose 64 or 128 bit key.

- **WEP Key Type**
  Available only if the WEP option is selected for encryption.

- **WEP Key Index**
  Available only if the WEP option is selected for encryption. Enter the encryption key.

RADIUS Configuration Server #1, Server #2

- **IP**
  The IP address of the RADIUS server.

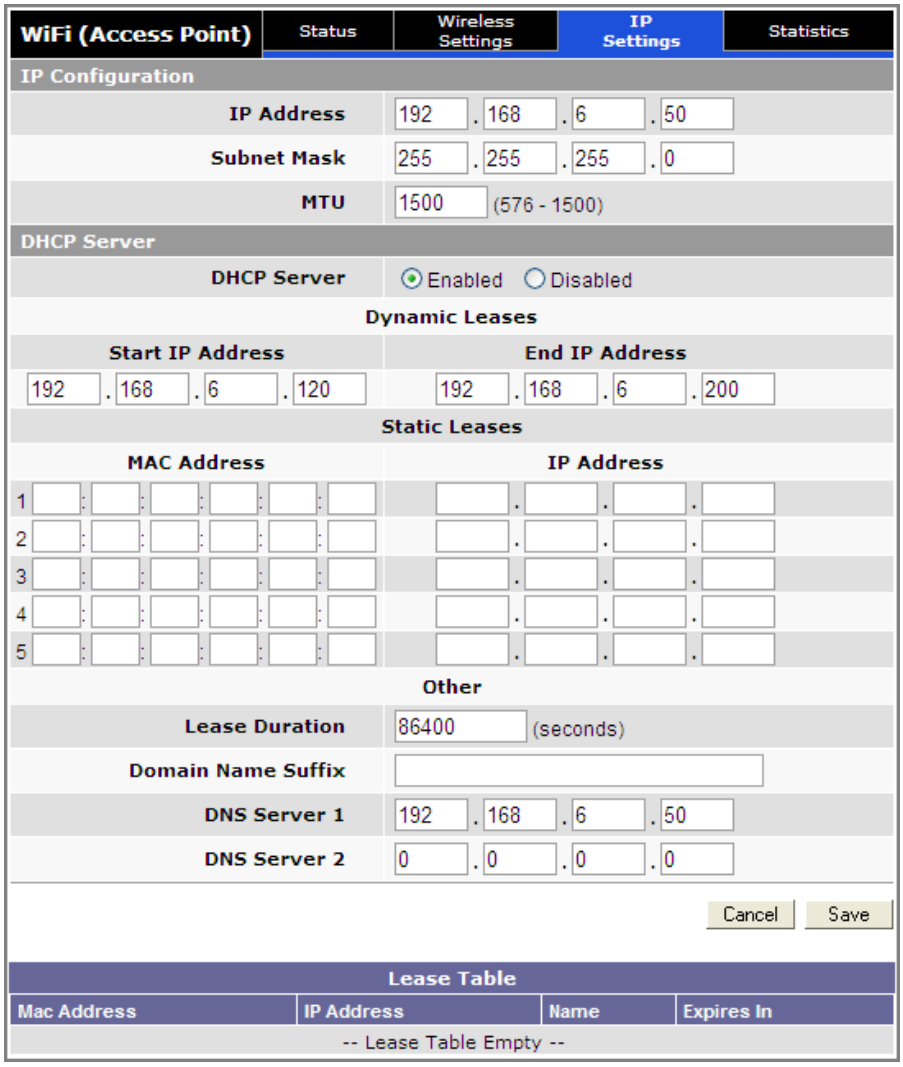
- **Port**
  The port number of the server.

- **Secret**
  Sets the shared Secret to use with the server.

- **Confirm Secret**
  Re-type the server shared Secret to confirm.

3.5.3 IP SETTINGS

Figure 26 WiFi (Access Point) – IP Settings



IP Configuration

- **IP Address/Subnet Mask**
  Sets the IP Address and Subnet Mask for the WiFi interface.
  Note: When assigning IP addresses, each interface, ETH0, ETH1, ETH2,and WiFi (and WWAN0 and WWAN1, when active) must have a unique IP address that (with the subnet mask) specifies it is on a subnet that is separate (non-overlapping) from subnets specified for any of the other Fusion interfaces.

- **MTU**
  Maximum Transmission Unit, maximum packet size allowed to be transmitted. Should be left as default value of 1500 in most cases.

DHCP Server

- **DHCP Server**
  When enabled, the DHCP server will assign an IP addresses to each device connected to the Ethernet port. IP addresses assigned will be in the defined range (see below) and on the same subnet as the Fusion.

- **Dynamic Leases (Start IP Address/End IP Address)**
  External LAN devices connected to the Fusion will be assigned IP address in this range when DHCP is enabled. This range of IP addresses must be on the same subnet as Fusion (the range must be compatible with the IP address and network mask set for the WiFi interface).

- **Static Leases**
  Allows you to assign and lease IP addresses to devices on your network, based on the specific MAC address of each.

Other

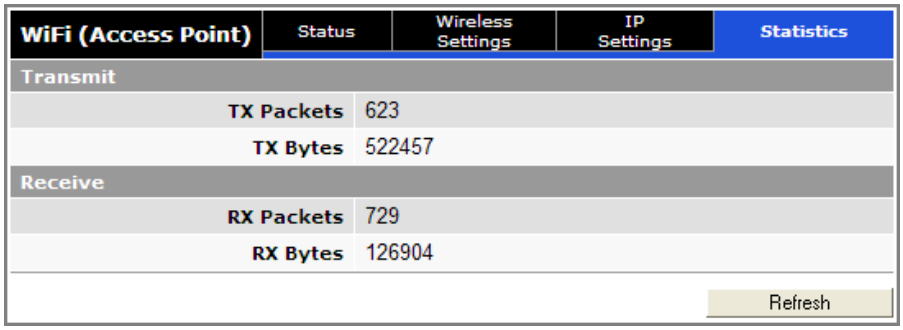
- **Lease Duration**
  Length of time in seconds that leases will last for IP addresses assigned.

- **Domain Name Suffix**
  If not known, this can be blank.

- **DNS Server 1, DNS Server 2**
  IP address of the DNS server for this unit. If not known, this can be left as all zeros.

3.5.4 STATISTICS

Figure 27 WiFi (Access Point) – Statistics



The statistics page lists the total number of packets and bytes transmitted and received since the time the units status was listed as connected. These numbers reset to 0 when the interface disconnects.

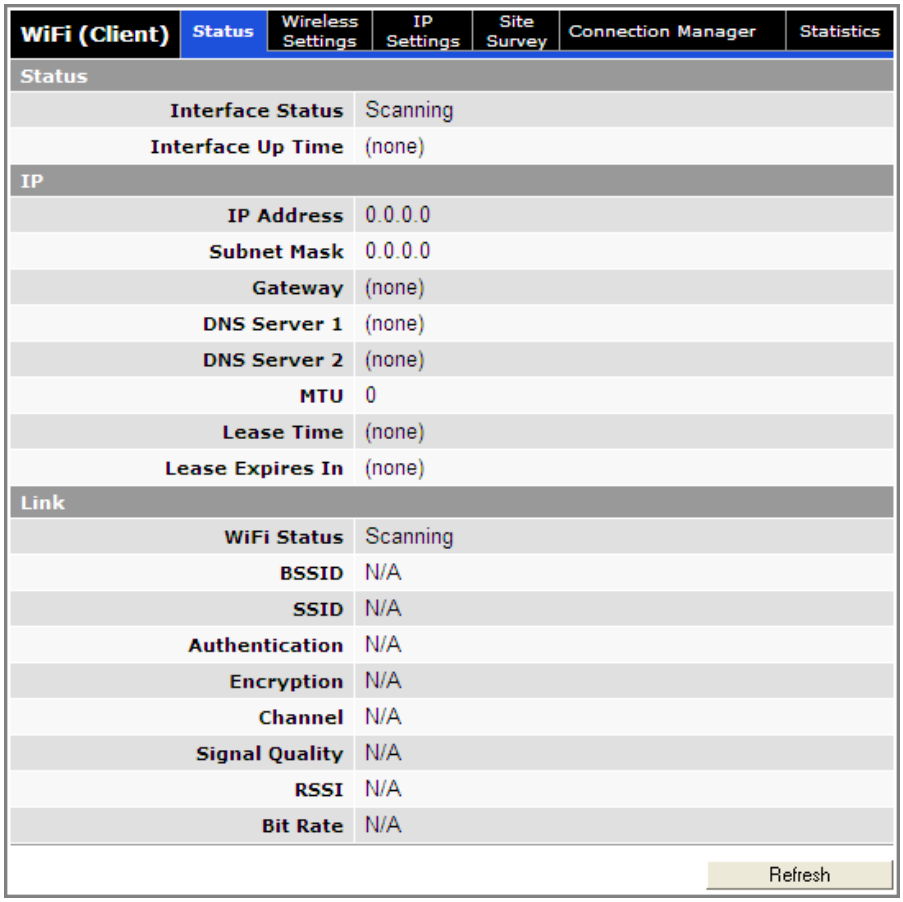
3.6 WIFI (CLIENT)

Select WiFi (Client) from the main navigation menu to access the WiFi (Client) page which contains tabs for status and configuration of the WiFi Client interface.

Note: Until Release 1.1.7 of the Fusion firmware, the Fusion could only be set to function as either a WiFi Client or a WiFi Access Point, but not both simultaneously. Fusion firmware version 1.1.7 added the capability to configure the Fusion as both a WiFi Client and WiFi Access Point simultaneously. However, since both the Access Point and the Client use the same radio, once the radio channel is set for the Access Point, the Client must use the same channel. The client will only look for external Access Points with the same WiFi radio channel that is selected for its own internal Access Point. The client will not scan for Access Points using any other channels. For more information about using the Fusion WiFi interface in concurrent or non-concurrent modes, see APPENDIX E— WiFi Concurrent Configuration as Access Point and Client.

3.6.1 STATUS

Figure 28 WiFi (Client) – Status



Status

- **Interface Status**
  See Table 10 Possible states of Fusion interfaces in Unit Status.

- **Interface Up Time**
  Number of days, hours, minutes, and seconds that the interface has been up (connected state).

IP

- **IP Address**
  IP address assigned to this interface.

- **Subnet Mask**
  The subnet mask assigned to this interface.

- **MTU**
  Maximum Transmission Unit, maximum packet size allowed to be transmitted. Should be left as default value of 1500 in most cases.

- **Gateway**
  IP address of the WAN gateway.

- **DNS Server 1, DNS Server 2**
  IP address of the (1) preferred and (2) alternate DNS server.

- **Lease Time**
  If the interface is set up to request an IP address from a DHCP server, this is the lease duration.

- **Lease Expires in**
  If the interface is set up to request an IP address from a DHCP server, this is the time remaining in the current lease.

Link

- **WiFi Status**
  See Table 10 Possible states of Fusion interfaces in Unit Status.

- **BSSID**
  Refers to the MAC address of the Access Point (AP).

- **SSID**
  Public name of the wireless network. All wireless devices on a WLAN must have the same SSID in order to communicate with each other.

- **Authentication**
  Security mode as set by the WiFi access point (WPA, WPA2, etc.).

- **Encryption**
  Data encryption method as set by the WiFi access point.

- **Channel**
  Transmit and receive channel (defined by the 802.11 specification). Set by the access point.

- **Signal Quality**
  Indicator of the quality of the RF signal.

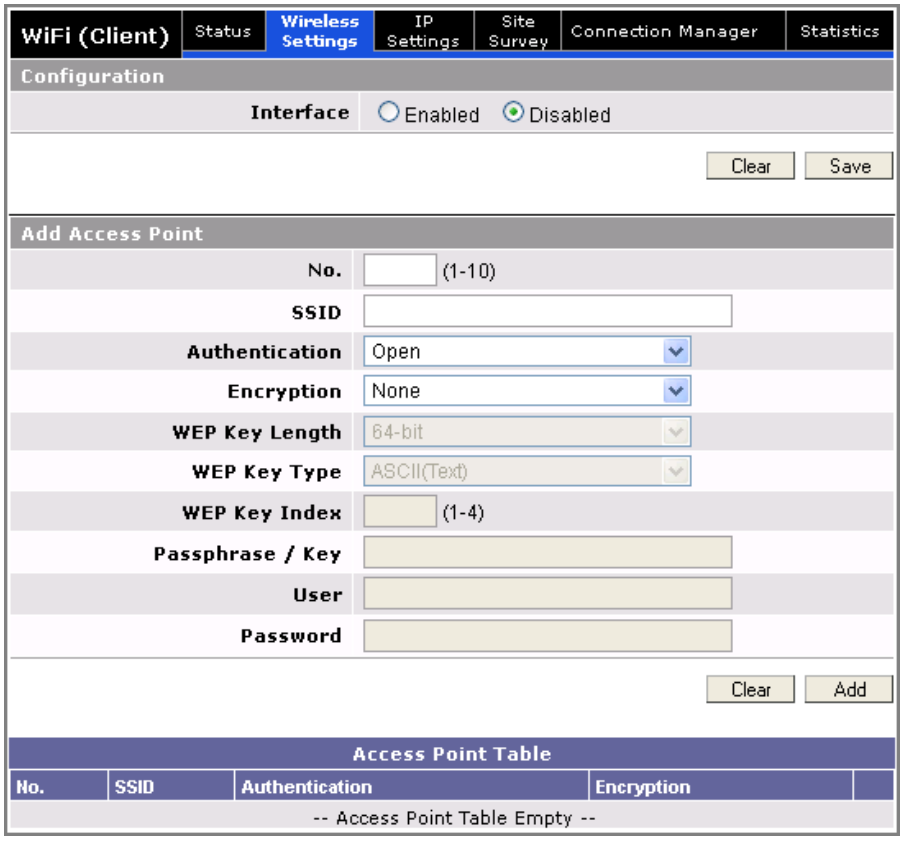
- **RSSI**
  Received Signal Strength indication. An indication of the power level of the signal being received by the wireless interface.

- **Bit Rate**
  Measurement of over-the-air throughput. This will be affected by the type of access point (b, g, or n) and the number of WiFi antennas (1, 2, or 3) installed on the Fusion router.

Click **Refresh** to update the page to show the most current information.

3.6.2 WIRELESS SETTINGS

Figure 29 WiFi (Client) – Wireless Settings



This page allows you to enter settings to allow the WiFi client to connect to access points automatically. The parameters entered on this page are the same as in the WiFi Access Point section, except when operating in the client mode the parameters must match those entered on the access point for the WiFi client to connect successfully.

As you add completed information for each access point, the access point will be listed in the Access Point Table at the bottom of the page.

Configuration

- **Interface**
  Selecting Enabled will enable the wireless client interface. Selecting Disabled will disable it.

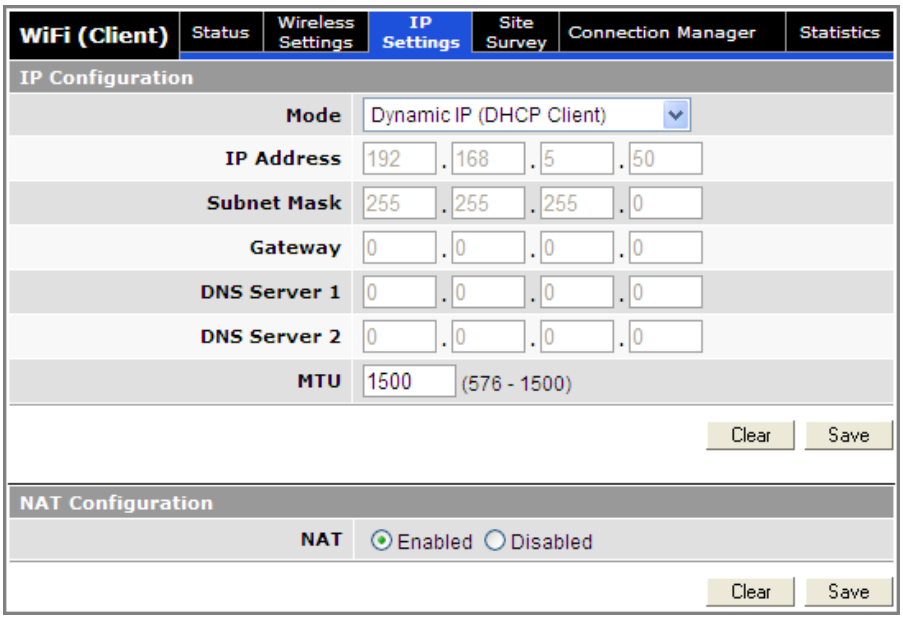
Add Access Point

- **No. (1-10)**
  A number to assign to the access point
- **SSID**
  The SSID of the access point
- **Authentication**
  Select authentication method. Options are Shared; WPA-PSK, WPA2-PSK, WPA-Enterprise and WPA2-Enterprise. WPA2-PSK or WPA2-Enterprise is recommended if security is required.
- **Encryption**
  Select the encryption method. Options are None, WEP, TKIP, or CCMP. Depending on the authentication method selected, some options will not be available here.
- **WEP Key Length**
  Available only if the WEP option is selected for encryption. Choose 64 or 128 bit key.
- **WEP Key Type**
  Available only if the WEP option is selected for encryption.
- **WEP Key Index**
  Available only if the WEP option is selected for encryption.
- **Passphrase / Key**
  Key or passphrase, a sequence of words or other text required to connect to the wireless access point.
- **User**
  User name used for RADIUS authentication; used in WPA-Enterprise and WPA2-Enterprise.
- **Password**
  Password used for RADIUS authentication; used in WPA-Enterprise and WPA2-Enterprise.

Click Add as you complete information for each access point. The access point will be added to the list in the Access Point Table at the bottom of the tab. To remove an access point from the list, highlight it in the table and select “delete entry” to the right.

3.6.3 IP SETTINGS

Figure 30 WiFi (Client) – IP Settings



IP Configuration

- **Mode**
  Select Dynamic or Static. (If you select Dynamic IP, other entries on this section will be dimmed and automatically determined by the DHCP host at connection.)

- **IP Address**
  Static address for this interface. It must be on the same subnet as the gateway.

- **Subnet Mask**
  Will be assigned by the gateway.

- **MTU**
  The Maximum Transmit Unit size. Should be left as the default value of 1500 bytes in most cases.

- **Gateway**
  IP address of the Gateway (DHCP host). If not known this can be left as all zeros.

- **DNS Server 1, DNS Server 2**
  IP address of the DNS server for this unit. If not known, this can be left as all zeros.

NAT Configuration

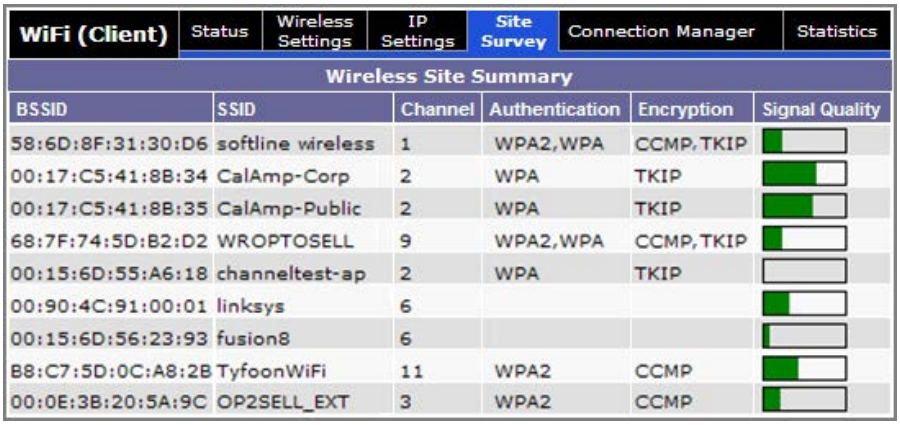
- **NAT**
  Enable or Disable NAT (Network Address Translation)

3.6.4 SITE SURVEY

Note: A site survey is performed once each time the Site Survey tab is accessed.

Warning: Performing a site survey takes the WiFi radio out of its current channel of operation and will therefore disrupt any ongoing active Access Point and Client session, and may result in data loss.

Figure 31 WiFi (Client) – Site Survey

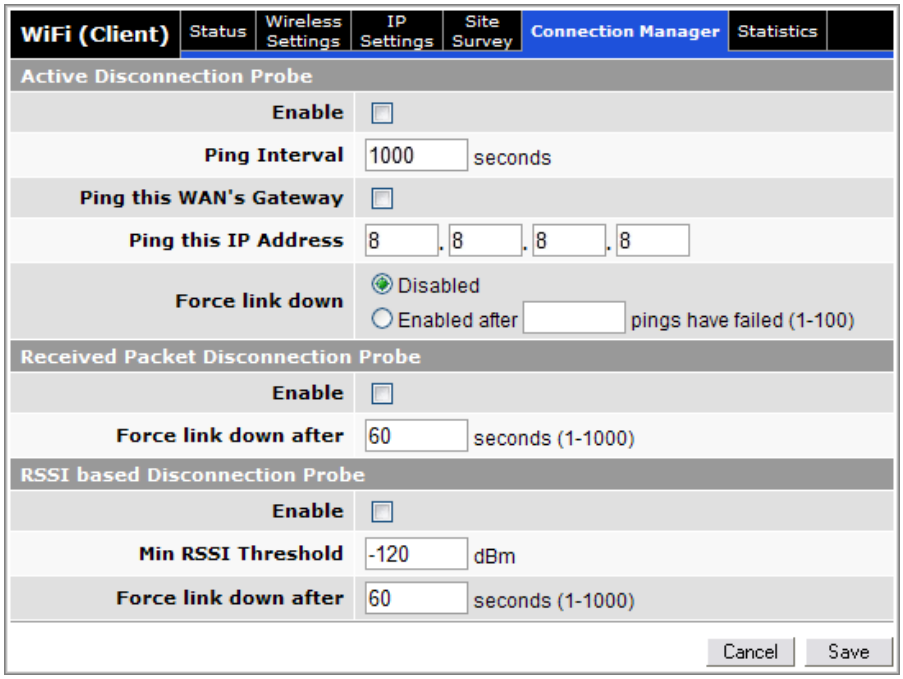


The Site Survey scans for available WiFi networks and returns the BSSID, SSID, WiFi Channel, Authentication method, Encryption, and Signal Quality of available WiFi networks.

3.6.5 CONNECTION MANAGER

The Connection Manager tab allows you to configure the Fusion router to set criteria that determine whether a reliable connection exists or the link is down. This feature can also be used to only generate pings on an interface if no traffic is sent via this interface. This can be useful to maintain an active connection.

Figure 32 WiFi (Client) – Connection Manager



Active Disconnection Probe

- **Enable**
  Check this box to detect link connection status based on pings to a specified IP address or the WAN's Gateway.

- **Ping Interval**
  Interval in seconds between each ping if no packets have been received.

- **Ping this WAN's Gateway**
  To ping the WAN's Gateway rather than a specific IP address, check this box.

- **Ping this IP Address**
  Enter the IP address that pings will be sent to, to detect the link state. Enter the IP address of a known external reachable server or network (for example, 8.8.8.8).

- **Force link down**
  Specify the number of pings, if which are unsuccessful, the link will be declared down. If disabled, the interface will never be forced down if pings fail.

Received Packet Disconnection Probe

- **Enable**
  Check this box to enable link detection based on whether packets are received.

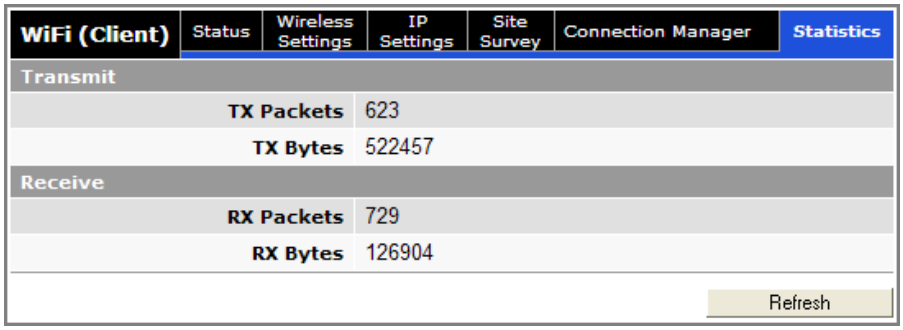
- **Force link down after**
  Enter the number of seconds after which, if no packets have been received, the link will be declared down.

RSSI-based Disconnection Probe

- **Enable**
  Check this box to determine the status of the link based on whether RSSI drops below a minimum threshold for a specified duration.
- **Min RSSI Threshold**
  Enter the minimum RSSI.
- **Force link down after**
  Enter the number of seconds for which, if RSSI drops below the specified threshold, the link will be determined to be down.

3.6.6 STATISTICS

Figure 33 WiFi (Client) – Statistics



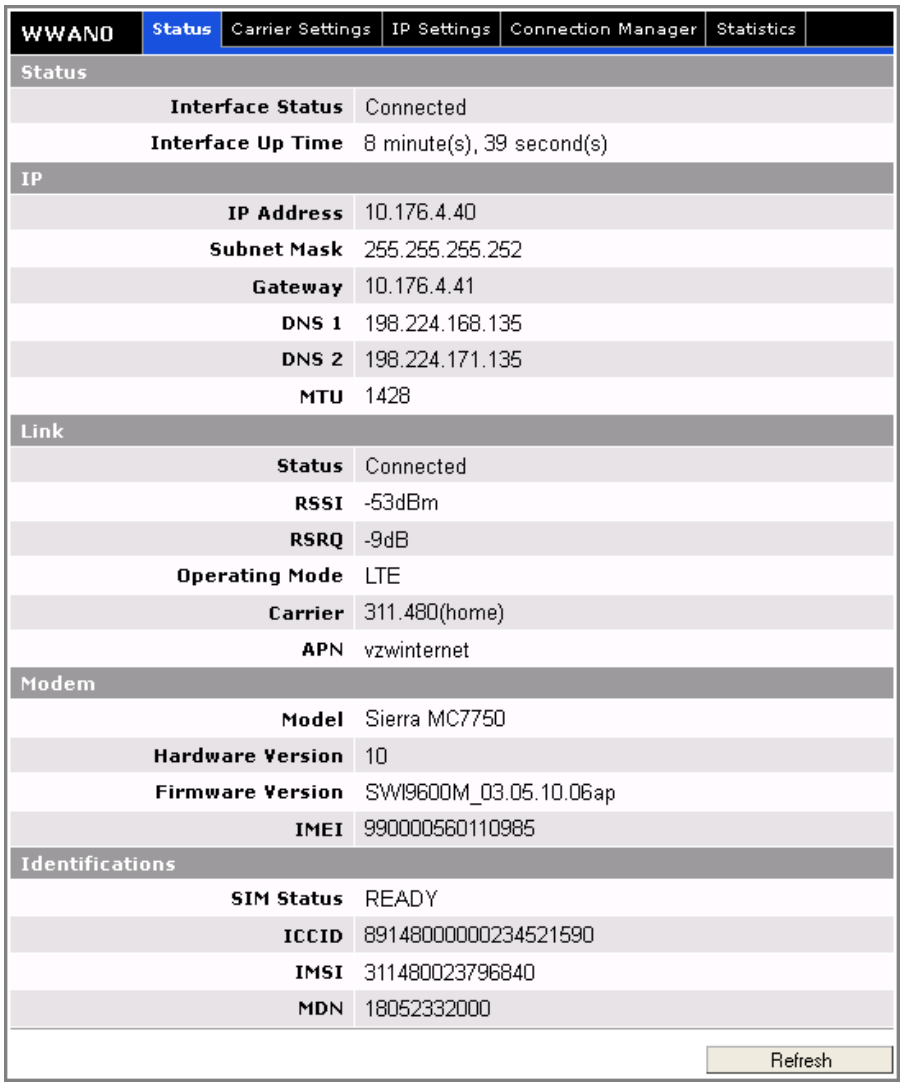
The statistics page lists the total number of packets and bytes transmitted and received since the time the units status was listed as connected. These numbers reset to 0 when the interface disconnects.

3.7 WWAN0 / WWAN1

As a true multibearer router, Fusion can be equipped with two distinct LTE modules, each capable of being operational at the same time. From the main navigation menu, Select the desired interface, WWAN0 or WWAN1, as applicable, to navigate to the page for the interface.

3.7.1 STATUS

Figure 34 WWAN0 / WWAN1 – Status



Click **Refresh** to update the page to show the most current information.

Status

- **Interface Status**
  See Table 10 Possible states of Fusion interfaces in Unit Status.

- **Interface Up Time**
  Number of days, hours, minutes, and seconds that the interface has been up (connected state).

IP

- **IP Address**
  WWAN IP address of the Fusion. This will be assigned by the carrier.

- **Subnet Mask**
  The subnet mask assigned by the carrier. This value will be dictated by the IP address assigned.

  Note: Each of the Fusion interfaces, ETH0, ETH1, and ETH2, WiFi, and WWAN0 (and WWAN1, when active) must have a unique IP address that (with the subnet mask) specifies it is on a subnet that is separate (non-overlapping) from subnets specified for any of the other Fusion interfaces. IP addresses and subnet masks for the Fusion WWAN interfaces are normally determined and set by the network provider or carrier and specify a different subnet class than typically specified for the ETH and WiFi interfaces, and therefore are not likely to incur any overlapping subnet issues.

- **Gateway**
  IP address of the WAN gateway. This is used for routing packets to remote networks

- **DNS Server 1, DNS Server 2**
  IP address of the (1) preferred and (2) alternate DNS server.

- **MTU**
  The Maximum Transmission Unit size, maximum packet size allowed to be transmitted. Should be left as default value of 1500 in most cases.

Link

- **Status**
  See Table 10 Possible states of Fusion interfaces in Unit Status.

- **RSSI**
  Indication of the signal strength of the carrier network.

- **RSRQ**
  Reference Signal Received Quality.

- **Operating Mode**
  The RF technology currently active. Example: LTE, UMTS, or CDMA.

- **Carrier**
  Wireless network provider.

- **APN**
  The Access Point Name currently being used.

Modem

- **Model**
  The manufacturer and model of the modem used by this WWAN interface.

- **Hardware Version**
  Hardware version of the modem used by the WWAN interface. *Note:* This is different from the hardware version of the Fusion itself.

- **Firmware Version**
  Firmware version of the modem used by the WWAN interface. *Note:* This is different than the firmware version of the Fusion itself.

- **IMEI**
  International Mobile Electronic Identifier. Depending on the carrier and technology used, this may be required for the carrier when activating the data contract. In some cases this will be blank.

Identifications

- **SIM Status**
  Shows the status of the SIM card installed with the modem, if any. Should be READY.

- **IMSI**
  International Mobile Subscriber Identity, as read from the SIM. This is the user's network subscription.

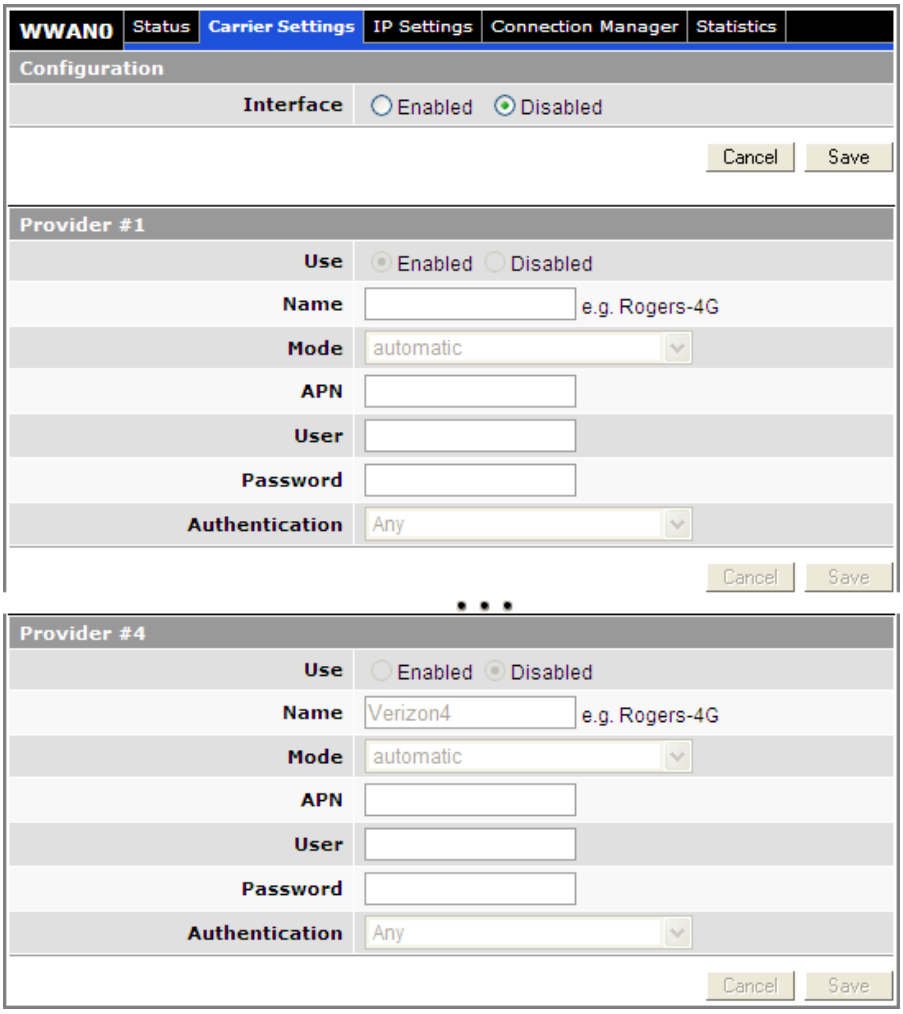
- **ICCID**
  Integrated Circuit Card Identity, as read from the SIM. This is the SIM's serial number.

- **MDN**
  Mobile Directory Number. This is essentially the phone number for the device assigned for SMS-capable devices.

3.7.2 CARRIER SETTINGS

For each WWAN interface, up to four LTE providers can be specified. Fusion will attempt to connect to each in succession when the interface is enabled.

Figure 35 WWAN0 /WWAN1 – Carrier Settings



Configuration

- **Interface**
  Selecting Enabled will enable the Wireless interface. Selecting Disabled will disable it.

Provider #1, Provider #2, Provider #3, Provider #4

- **Use**
  Enabled — the Fusion will attempt connection using the provider information entered in the section.
  Disabled — the Fusion will not attempt connection using information entered in the section.
  If more than one provider is enabled, connection attempts are made with each until one succeeds or all have been tried. Connection attempts then continue with the first. Normally only one network service provider should be enabled.

- **Name**
  Assign a name to easily identify this account.

- **Mode**
  Mode of operation of the cell module, which is based on the LTE module type. Typically automatic, LTE with 3G fallback, or 3G only. For B13, for example, LTE, LTE+CDMA, or CDMA may be possible selections. It is recommended to set this to **Automatic**.

- **APN**
  Access Point Name provided by the carrier. Leave this blank unless a special-user (example: static IP address) SIM is provided by the carrier.

- **User**
  Username to provide when connecting. Leave this field blank unless one is specified by the carrier.

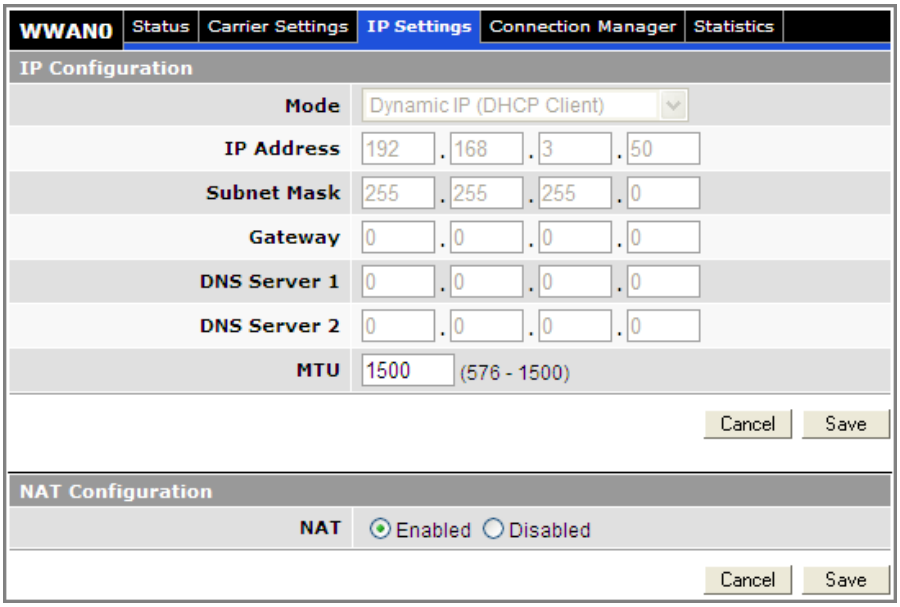
- **Password**
  Password to provide when connecting. Leave this field blank unless one is specified by the carrier.

- **Authentication**
  Authentication method used by the carrier. Possible selections are PAP, CHAP, or Any. If your carrier specifies a setting select the applicable authentication method; otherwise, leave this field set for Any.

3.7.3 IP SETTINGS

Parameter definitions on this page are the same as in the IP Settings tab for the ETH0, ETH1, and ETH2 pages, except these parameters are specified by the WWAN network provider or carrier.

Figure 36 WWAN0 / WWAN1 – IP Settings



IP Configuration

- **Mode**
  Select Dynamic or Static. (If you select Dynamic IP, other entries on this section will be dimmed and automatically determined by the carrier's DHCP host at connection.)

- **IP Address**
  IP address assigned to this interface.

- **Subnet Mask**
  The subnet mask assigned to this interface.

- **Gateway**
  IP address of the WAN gateway. If not known, this may be left as all zeros.

- **DNS Server 1, DNS Server 2**
  IP address of the (1) preferred and (2) alternate DNS server. If not known, these may be left as all zeros.

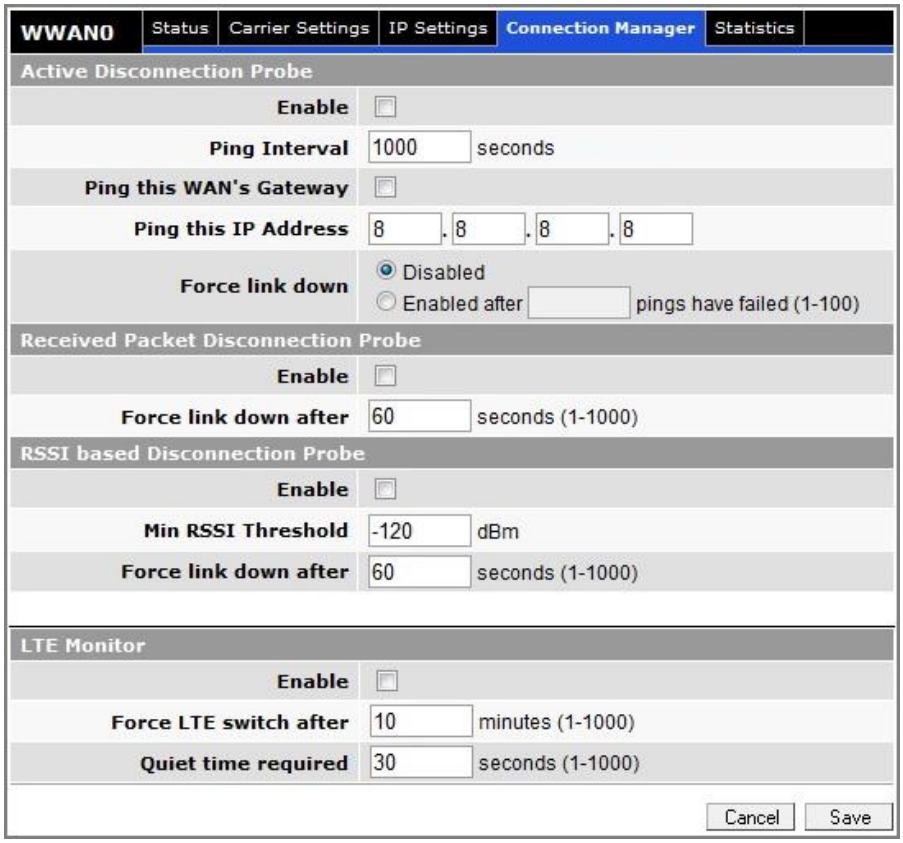
- **MTU**
  Maximum Transmission Unit, maximum packet size allowed to be transmitted. Should be left as default value of 1500 in most cases.

NAT Configuration

- **NAT**
  Enable or Disable NAT (Network Address Translation)

3.7.4 CONNECTION MANAGER

Figure 37 WWAN0 / WWAN1 – Connection Manager



The Connection Manager tab allows you to configure the Fusion router to set criteria that determine whether a reliable connection exists or the link is down. This feature can also be used to only generate pings on an interface if no traffic is sent via this interface. This can be useful to maintain an active connection.

Active Disconnection Probe

- **Enable**
  Check this box to detect link connection status based on pings to a specified IP address or the WAN's Gateway.

- **Ping Interval**
  Interval in seconds between each ping if no packets have been received. Verizon recommends a value of 1000 seconds (16 minutes and 40 seconds) and prohibits values of less than 300 seconds (5 minutes).

- **Ping this WAN's Gateway**
  To ping the WAN's Gateway rather than a specific IP address, check this box.

- **Ping this IP Address**
  Enter the IP address that pings will be sent to, to detect the link state. Enter the IP address of a known external reachable server or network (for example, 8.8.8.8).

- **Force link down**
  Specify the number of pings, if which are unsuccessful, the link will be declared down. If disabled, the interface will never be forced down if pings fail.

Received Packet Disconnection Probe

- **Enable**
  Check this box to enable link detection based on whether packets are received.

- **Force link down after**
  Enter the number of seconds after which, if no packets have been received, the link will be declared down.

RSSI-based Disconnection Probe

- **Enable**
  Check this box to determine the status of the link based on whether RSSI drops below a minimum threshold for a specified duration.

- **Min RSSI Threshold**
  Enter the minimum RSSI.

- **Force link down after**
  Enter the number of seconds for which, if RSSI drops below the specified threshold, the link will be determined to be down.

LTE Monitor

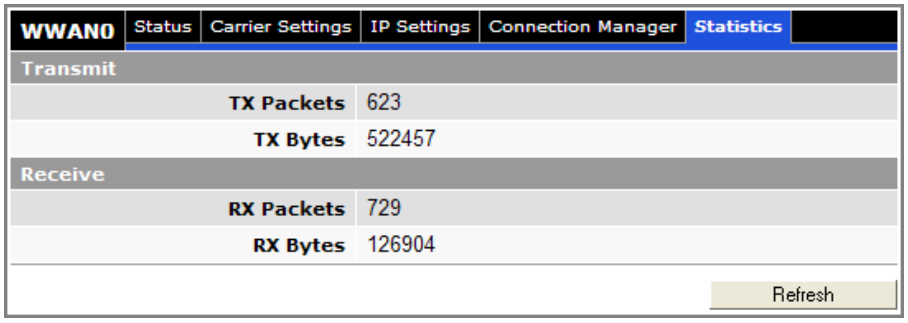
- **Enable**
  Check this box to enable the LTE Monitor.

- **Force LTE switch after**
  Enter the number of minutes between attempts to switch to LTE.

- **Quiet time required**
  Enter the number of seconds for which no traffic on the WWAN interface will cause an attempt to switch to LTE.

3.7.5 STATISTICS

Figure 38 WWAN0 / WWAN1 – Statistics



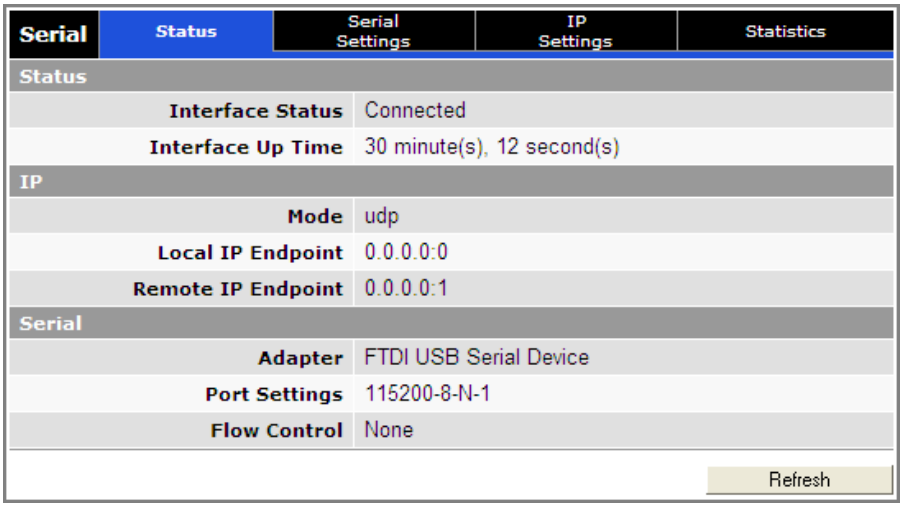
The statistics page lists the total number of packets and bytes transmitted and received since the time the units status was listed as connected. These numbers reset to 0 when the interface disconnects.

3.8 SERIAL

The Serial page contains tabs for making configuration settings for an external USB to RS-232 converter cable accessory approved for use with the Fusion. Select Serial from the main navigation menu to navigate to this page.

3.8.1 STATUS

Figure 39 Serial – Status



Status

- **Interface Status**
  See Table 10 Possible states of Fusion interfaces in Unit Status.

- **Interface Up Time**
  Number of days, hours, minutes, and seconds that the interface has been up (connected state). Automatically resets to zero on disconnect.

IP

- **Mode**
  Displays the IP protocol used to transport serial data over a network: UDP, TCP, or all.

- **Local IP Endpoint**
  Address of the local IP endpoint.

- **Remote IP Endpoint**
  Address of the remote IP endpoint.

Serial

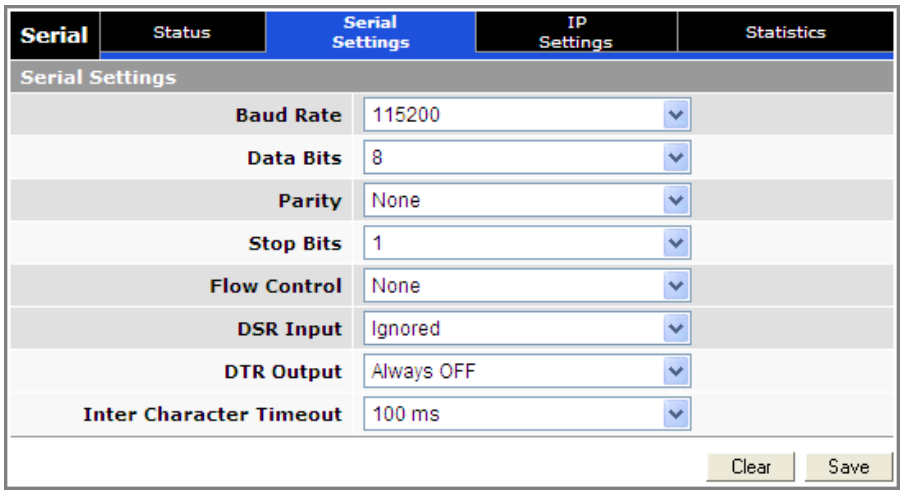
- **Adapter**
  The type of USB to Serial adapter detected on the USB port.

- **Port Settings**
  Serial port communication parameters: baud rate, data bits, parity, and stop bits.

- **Flow Control**
  Flow control settings for the Serial port.

3.8.2 SERIAL SETTINGS

Figure 40 Serial – Serial Settings



- **Baud Rate**
  Sets the serial port baud rate. Supported values are 2400, 4800, 9600, 19200, 38400, 57600, or 115200.

- **Data Bits, Parity, and Stop Bits**
  Sets these parameters, which must be specified for serial communication.
  - **Data Bits**: Supported values are 5, 6, 7 or 8.
  - **Parity**: Supported values are even, odd, none, or mark.
  - **Stop Bits**: Supported values are 1 or 2.

- **Flow Control**
  Supported values for Flow Control are Hardware Control or None.

- **Hardware**: The RTS and CTS lines are used when hardware flow control is enabled in both the Fusion and the remote device. Fusion puts RTS in a mark condition to tell the remote device that it is ready and able to receive data. If Fusion is not able to receive data (typically because its receive buffer is almost full), it will put RTS in the space condition as a signal to the remote device to stop sending data. When Fusion is ready to receive more data (that is, after data has been removed from its receive buffer), it will place RTS back in the mark condition. The complement of the RTS wire is CTS, which stands for Clear To Send. The remote device puts CTS in a mark condition to tell Fusion that it is ready to receive the data. Likewise, if the remote device is unable to receive data, it will place CTS in the space condition. Together, these two lines make up what is called RTS/CTS or hardware flow control. Fusion supports this type of flow control.
- **None**: The RTS line is always in a mark condition (always on) and the CTS line is ignored by the Fusion.

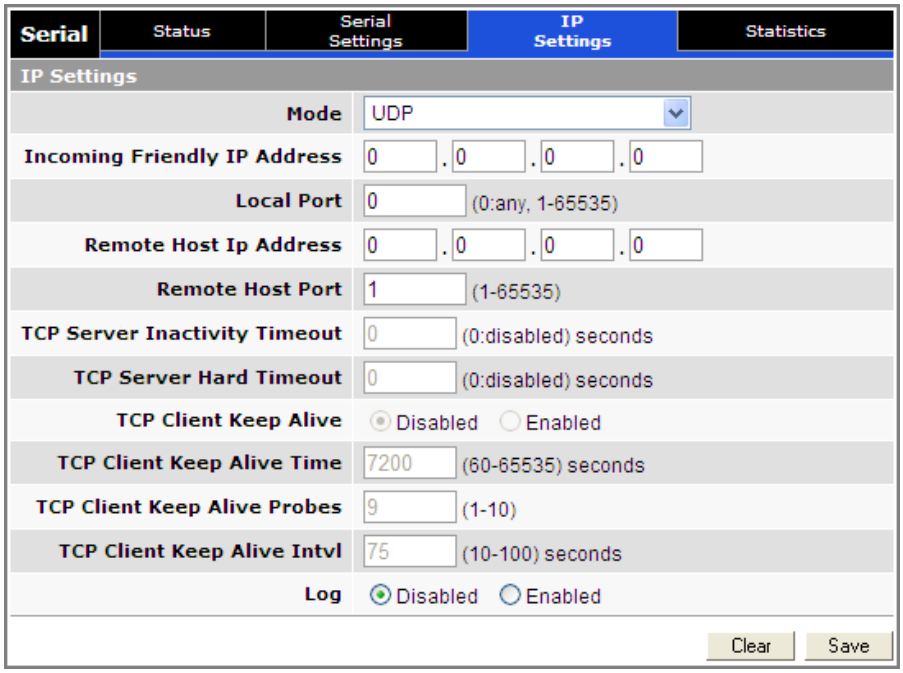
Note: Software flow control (XON/XOFF) is not available on the Fusion.

- **DSR and DTR handshake**
  DTR stands for Data Terminal Ready. DSR (Data Set Ready) is the companion to DTR in the same way that CTS is to RTS. Some serial devices use DTR and DSR as signals to simply confirm that a device is connected and is turned on. Fusion can set DTR to the mark state (i.e. ON) when the serial port is opened and leaves it in that state until the port is closed. Conversely, Fusion can monitor the DSR line to assess the presence and readiness of the remote device.
  - **DSR Input**: Supported values are Ignored or Connect to remote when on.
    If set to **Ignored**, no action is performed by the Fusion.
    If set to **Connect to remote when on**:
    - In **TCP client** mode, the Fusion will attempt to connect to the remote.
    - In **TCP server**, it starts the service and waits for remote connection.
    - In **UDP**, it starts the service, opens the socket, and is ready for data transfer.
  - **DTR Output**: Supported values are Always off, Always On, or On when connected to remote.
    If set to **Always off**, Fusion puts the line in space condition (that is, off) and leaves it there.
    If set to **Always on**, Fusion puts the line in mark condition (that is, on) and leaves it there.
    If set to **On when connected to remote**:
    - In **TCP** client or server mode, Fusion sets the line to mark when connected to a remote.
    - In **UDP** mode, the state is always connected and therefore the line is always set to mark.
- **Inter-Character Timeout**
  Indicates when a packet received from the serial port is to be considered complete. When the time between two successive characters is greater than this value, the packet is considered complete and sent to the remote. Supported values are 100 ms, 200 ms, 300ms, 400 ms, or 500 ms.

Note: Packets received from the serial port are also limited in size to 255 bytes (by the Linux kernel). This means that a packet received from the serial port is considered complete and is immediately sent to the remote as soon as 255 consecutive bytes are received from the serial port. This may have an impact of time-sensitive protocols that make use of packets larger than 255 bytes.

3.8.3 IP SETTINGS

Figure 41 Serial – IP Settings



- **Mode**
  Sets the mode for Serial IP communication. Supported modes are UDP, TCP Server, or TCP Client.

- **Incoming Friendly IP Address**
  IP address from which packets received. This feature can be disabled by entering 0.0.0.0

- **Local Port**
  The port number assigned to the serial IP port on which communications will take place.

- **Remote Host IP Address**
  The IP address of the remote UDP mode serial endpoint.

- **Remote Host Port**
  The port of the remote UDP mode serial endpoint.

- **TCP Server Inactivity Timeout**
  Amount of time (in seconds) to wait when no data is sent or received over the TCP session before closing it.

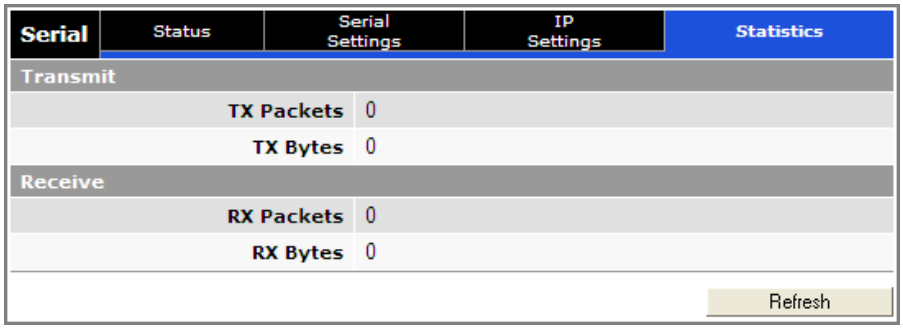
- **TCP Server Hard Timeout**
  Amount of time (in seconds) to wait after a TCP session is established before closing it.

- **TCP Client Keep Alive, TCP Client Keep Alive Probes, TCP Client Keep Alive Intvl**
  The TCP Client keep-alive parameters are used to detect idle TCP client sessions and to close them after inactive for the specified length of time.

- **Log** Disabled/Enabled
  When logging is enabled, the file /var/log/serialpad.log will be created inside the unit. It will contain debugging information about activities related to the serial port. The log is lost when the Fusion is powered down.

3.8.4 STATISTICS

Figure 42 Serial – Statistics



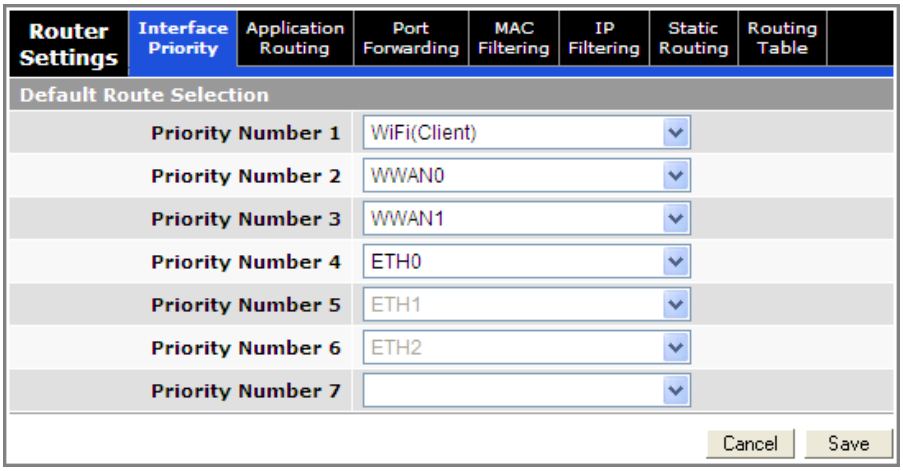
The statistics page lists the total number of packets and bytes transmitted and received since the time the units status was listed as connected. These numbers reset to 0 when the serial interface disconnects.

3.9 ROUTER SETTINGS

The Router Settings page contains tabs for making configuration settings for interface priority and for routing, forwarding, and filtering. Select Router Settings from the main navigation menu to navigate to this page.

3.9.1 INTERFACE PRIORITY

Figure 43 Router Settings – Interface Priority



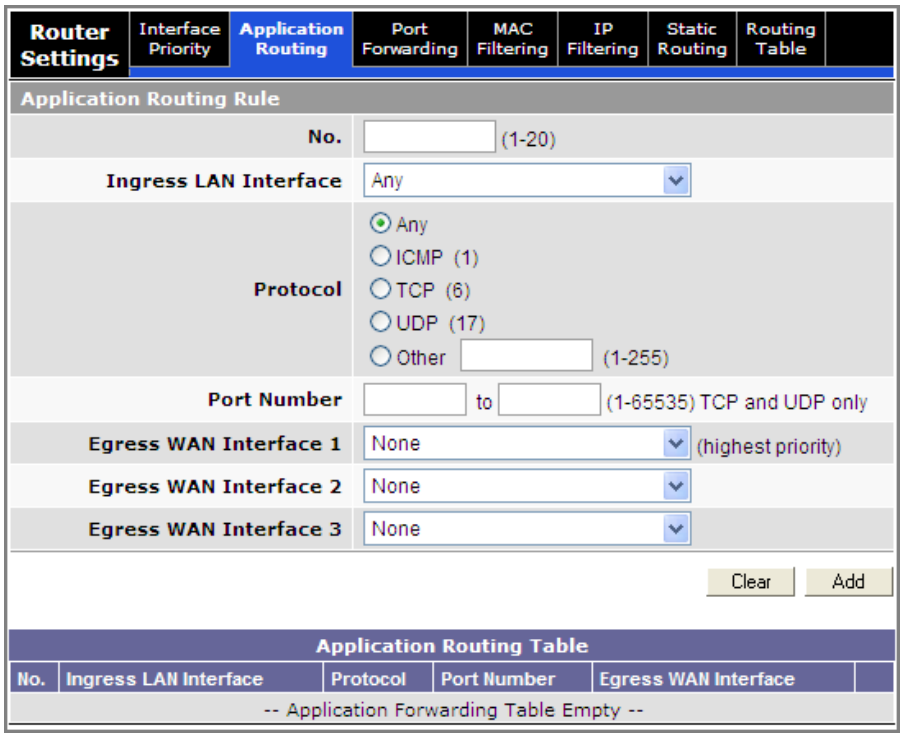
Fusion allows failover of the default route to WAN interfaces in a specific order. This group of settings allows ranking each WAN interface in order of preferred usage for the default route. The default route will always be set to the highest-priority connected WAN interface. This assignment changes as WAN interfaces connect or disconnect from the associated bearer network.

Default Route Selection

- **Priority Number 1, … Priority Number 7**
  Prioritize interfaces in order from 1 (highest priority) to 7 (lowest priority) for which the network will reroute in the event of failover of the preferred interface.

3.9.2 APPLICATION ROUTING

Figure 44 Router Settings – Application Routing



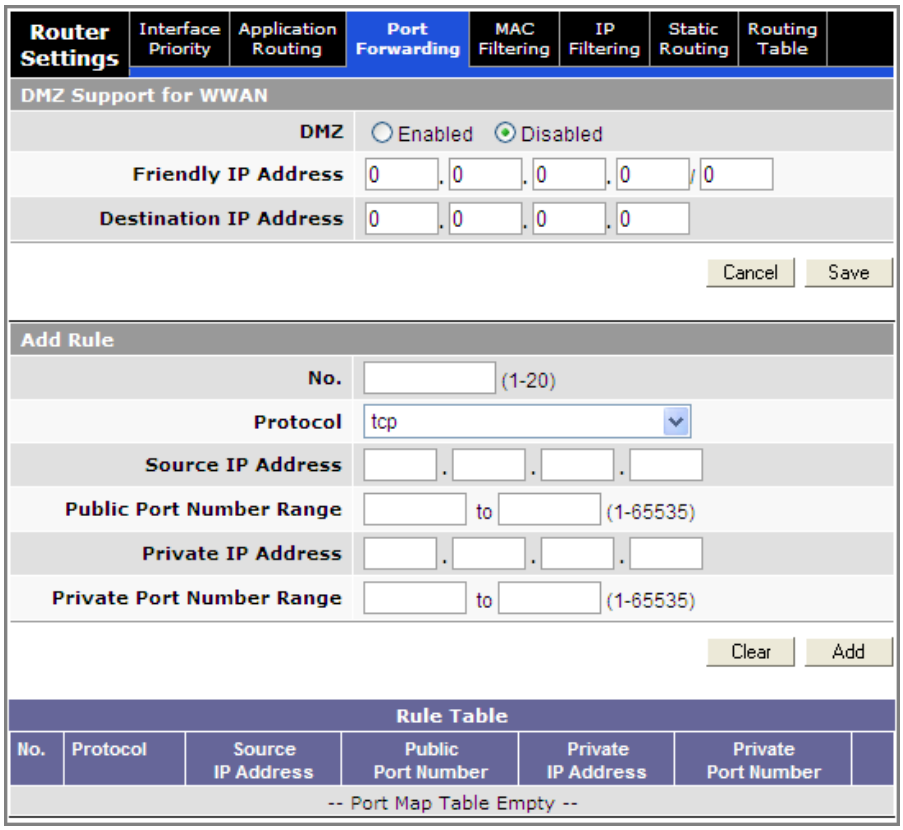
Fusion allows rule-based application traffic forwarding to specific WAN interfaces. Up to 20 rules can be specified, in each case specifying where ingress traffic (traffic entering Fusion from a LAN interface) should be forwarded. Up to 3 egress WAN interfaces can be specified. The traffic meeting the ingress classification rule will be forwarded to the highest priority connected WAN interface. This allows specifying fallback WAN interfaces for different types of traffic.

Ingress classification rules can be specified based on the physical ingress interface, IP protocol, and IP port number.

3.9.3 PORT FORWARDING

Note: Exercise caution when configuring these router settings. Mistakes in setting up Port Forwarding are common. If it appears that data is not passing through the router normally, and if UDP testing fails, double-check the list of Port Forwarding rules.

Figure 45 Router Settings – Port Forwarding



DMZ Support for WWAN

- **DMZ**
  Enable or disable DMZ support for the WWAN.

- **Friendly IP Address**
  Optionally restricts DMZ access to only the specified WAN IP address.

  Caution: If set to 0.0.0.0, the DMZ is open to all incoming WAN IP addresses.

- **Destination IP address**
  The WAN IP address which has all ports exposed except ports defined in the Port Forwarding configuration.

Add Rule

- **No.**
  Number assigned to each rule. This number may be any number from 1 to 20, inclusive, that has not been assigned to another rule.

- **Protocol**
  The data protocol of the rule. TCP, UDP, or both.

- **Source IP Address**
  Specifies a WAN IP address that is allowed to access the modem.

  Caution: If set to 0.0.0.0, this allows all WAN IP addresses access to the modem.

- **Public Port Number Range**
  Sets the external port number range for incoming requests.

  Note: Port Forwarding rules take precedence over the services specified in Security » IPsec or RADIUS.

- **Private IP Address**
  Sets the LAN address of a device connected to one of the Fusion's LAN interfaces. Inbound requests will be forwarded to this IP address.

- **Private Port Number Range**
  Sets the LAN port number range used when forwarding to the destination IP address.

As you complete entry of each rule, click **Add** to save it.

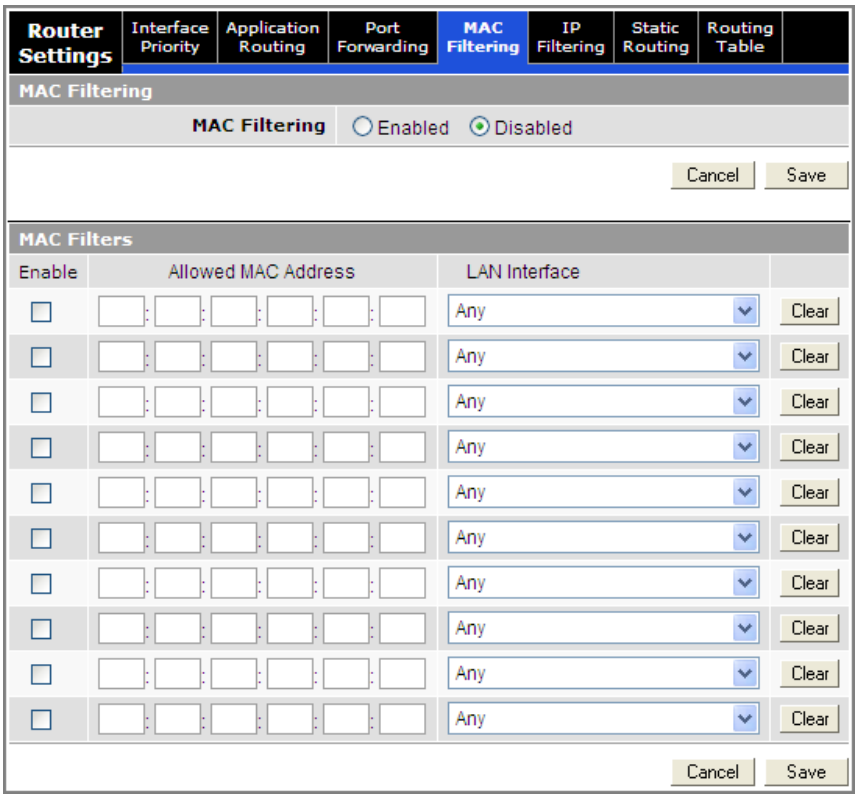
Rule Table

Rules that have been created appear in the rule table at the bottom of the tab.

3.9.4 MAC FILTERING

MAC filtering, when enabled, allows up to ten devices with unique MAC addresses to access the network and blocks any other MAC addresses not in the list.

Figure 46 Router Settings – MAC Filtering



MAC Filtering

- **MAC Filtering**
  Select Enable to enable MAC filtering or select Disable to not use it.

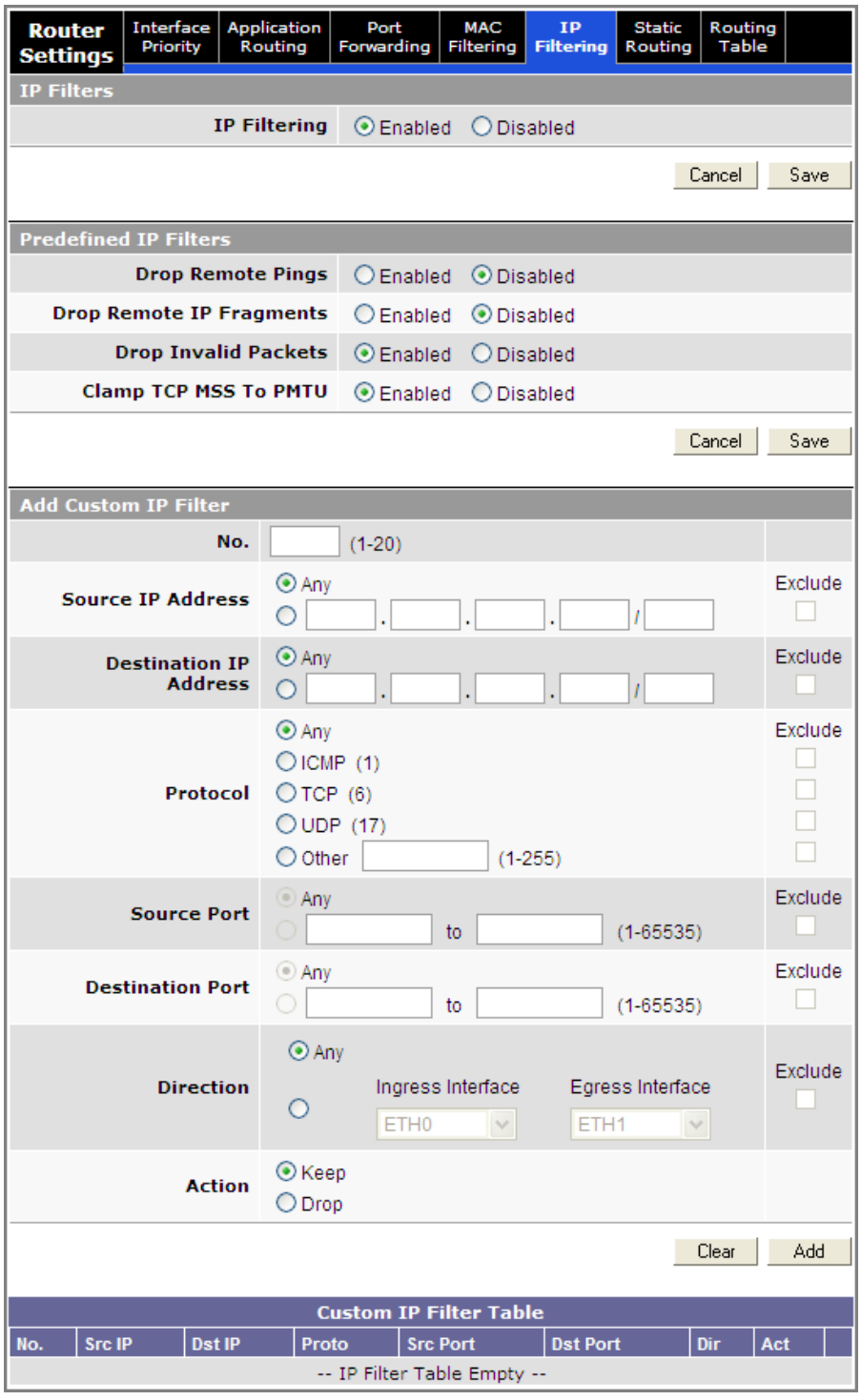
MAC Filters

- **Enable**
  Check box to enable a MAC filter.
- **Allowed MAC Address**
  Enter the MAC address for a device to be allowed on the network.
- **LAN Interface**
  Select which ingress interface the associated MAC address is allowed to use.
- **Clear**
  Shortcut to remove a MAC address.

Click **Save** or **Cancel** to implement or cancel changes.

3.9.5 IP FILTERING

Figure 47 Router Settings – IP Filtering



The IP Filtering tab is used to configure IP filters.

Up to 20 IP filters can be defined. Each IP filter is identified by a unique number (from 1 to 20).
An IP packet goes through the filtering logic when IP filtering is enabled and:

1) The IP packet is received on one of the interface and is destined to the Fusion

   OR

2) The IP packet is sent by the Fusion

   OR

3) The IP packet is forwarded by the Fusion.

The filtering logic is the following:

```
if exists(filter[1]) AND match(packet, filter[1]) then apply(action[1])
else if exists(filter[2]) AND match(packet, filter[2]) then apply(action[2])
else if exists(filter[3]) AND match(packet, filter[3]) then apply(action[3])
. . .
else if exists(filter[20]) AND match(packet, filter[20]) then apply(action[20])
else process packet normally.
```

Where:

exists(filter[n]) -> The user-defined filter number n.
match(packet, filter[n]) -> The IP packet matches filter number n.
apply(action[n]) -> The action identified in filter number n.

IP Filters

- **IP Filtering**
  Enable: IP filtering is enabled. Any custom IP filters entered by the user will be taken into account when processing IP packets. The predefined IP filters will also be taken into account.
  Disable: IP filtering is disabled.

Predefined Filters

- **Drop Remote Pings**
  Set this to Disabled if you do not want the Fusion to respond to pings from the WAN. This can reduce your data usage and improve security, but will make connectivity testing more difficult.

- **Drop remote IP Fragments**
  In some cases large packets sent by a remote IP endpoint will be broken and sent as fragments via the Fusion to a local endpoint. Enable this if you want to drop those packets. In most cases this should be left disabled to ensure reliable end-to-end communication.

- **Drop Invalid Packets**
  Select Enabled to have the Fusion drop any incoming packets that have been determined to be invalid.

- **Clamp TCP MSS to PMTU**
  Select Enabled to set the TCP Maximum Segment Size (MSS) to a good value based on the Path Maximum Transmission Unit (PMTU).

Add Custom IP Filter

- **No.** (1-20)
  A number to assign to the custom IP filter. This number may be any number from 1 to 20, inclusive, that has not been assigned to another custom IP filter.

- **Source IP Address**
  If Any is selected, any source IP address will satisfy this filter.
  A specific host IP address can also be specified, or a range of IP addresses via a bitmask (the box following the /).
  If the Exclude box is checked, it means that in order for a packet to match this filter, it must **not** have the specified source IP address (or **not** be in the specified range of IP addresses).

- **Destination IP Address**
  If Any is selected, any destination IP address will satisfy this filter.
  A specific IP address can also be specified, or a range of IP addresses via a bitmask (the box following the /).
  If the Exclude box is checked, it means that in order for a packet to match this filter, it must **not** have the specified source IP address (or **not** be in the specified range of IP addresses).

- **Protocol**
  Any: Any protocol number.
  ICMP: The ICMP protocol (1).
  TCP: The TCP protocol (6).
  UDP: The UDP protocol (17).
  Other: Any other IP protocol.
  If the Exclude box is checked, it means that in order for the packet to match this filter, it must **not** have the specified protocol number.

- **Source Port**
  Any: Any source port number.
  Specific: Select a specific source port number.
  Range: Select a range of source port numbers.
  If the Exclude box is checked, it means that in order for the packet to match this filter, it must **not** have the specified source port number (or **not** be in the specified range of source port numbers).

- **Destination Port**
  Any: Any destination port number.
  Specific: Select a specific destination port number.
  Range: Select a range of destination port numbers.
  If the Exclude box is checked, it means that in order for the packet to match this filter, it must **not** have the specified destination port number (or not be in the specified range of destination port numbers).

- **Direction**
  The direction of the path taken by the IP packet inside the Fusion router.
  Any: Any direction.
  An ingress interface sets which interface a packet must arrive on to match the filter, and/or egress sets which interface the packet must be forwarded on. A specific ingress (packet entering the Fusion) and egress (packet leaving the Fusion) can also be specified.
  If the Exclude box is checked, it means that in order for the packet to match this filter, it must **not** be processed in the specified direction.

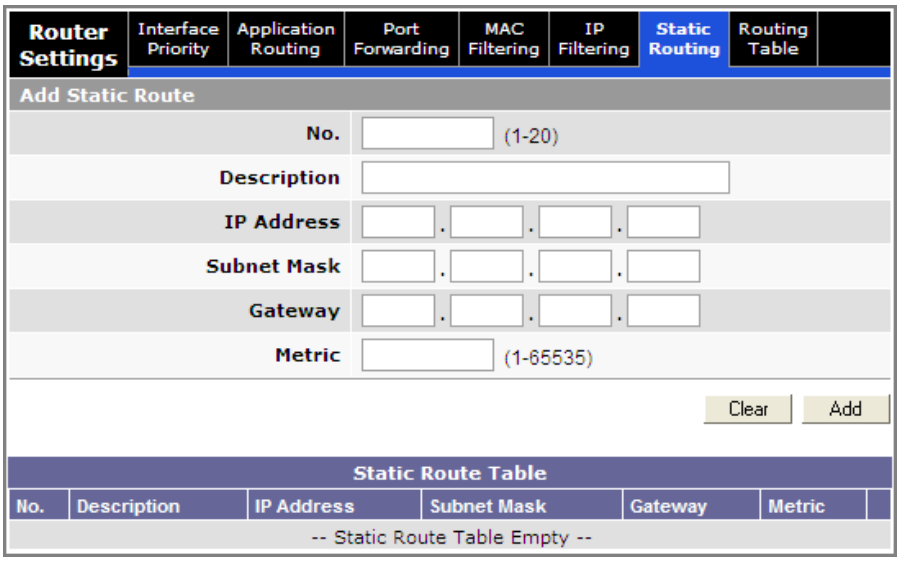
- **Action**
  Keep – If IP filtering is enabled and an IP packet matches all criteria in the IP filter, keep the IP packet (continue normal processing of the IP packet).
  Drop – If IP filtering is enabled and an IP packet matches all criteria in the IP filter, drop the IP packet.

Click Add as you complete information for each IP filter. The IP filter will be added to the list in the Custom IP Filter Table at the bottom of the tab. To remove an IP filter from the list, click Clear next to it in the table.

3.9.6 STATIC ROUTING

Static Routing refers to a manual method of setting up routing between networks. Select the Static Routing tab to add static routes to the Static Route Table. Static routes may be defined using the Static Routing fields and appear in the table at the bottom of the tab.

Figure 48 Router Settings – Static Routing



Add Static Route

- **No. (1-20)**
  A number to assign to the static route. This number may be any number from 1 to 20, inclusive, that has not been assigned to another static route.

- **Description**
  Description of the static route in the Static Route table.

- **IP Address**
  IP address of the destination network.

- **Subnet Mask**
  Subnet mask of the destination network.

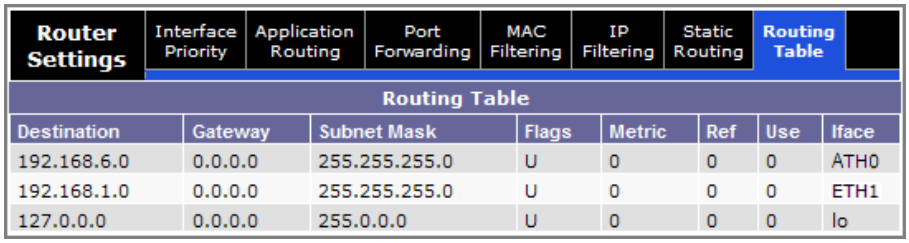
- **Gateway IP Address**
  IP address of the local gateway.

- **Metric**
  Enter a number from 1 to 65535. The lower the metric value, the higher the route priority.

You must click **Add** to add each configured route to the Static Route Table.

3.9.7 ROUTING TABLE

Figure 49 Router Settings – Routing Table



- **Flags**

Flag	Meaning
U	Route is up.
H	Target is host.
G	Use gateway.
R	Reinstate route for dynamic routing.
D	Dynamically installed by daemon or redirect.

Flag	Meaning
M	Modified from routing daemon or redirect.
A	Installed by addrconf.
C	Cache entry
!	Reject route.

- **Metric**
  The “distance” to the target (usually counted in hops).

- **Ref**
  Number of references to this route

- **Use**
  Count of lookups for the route.

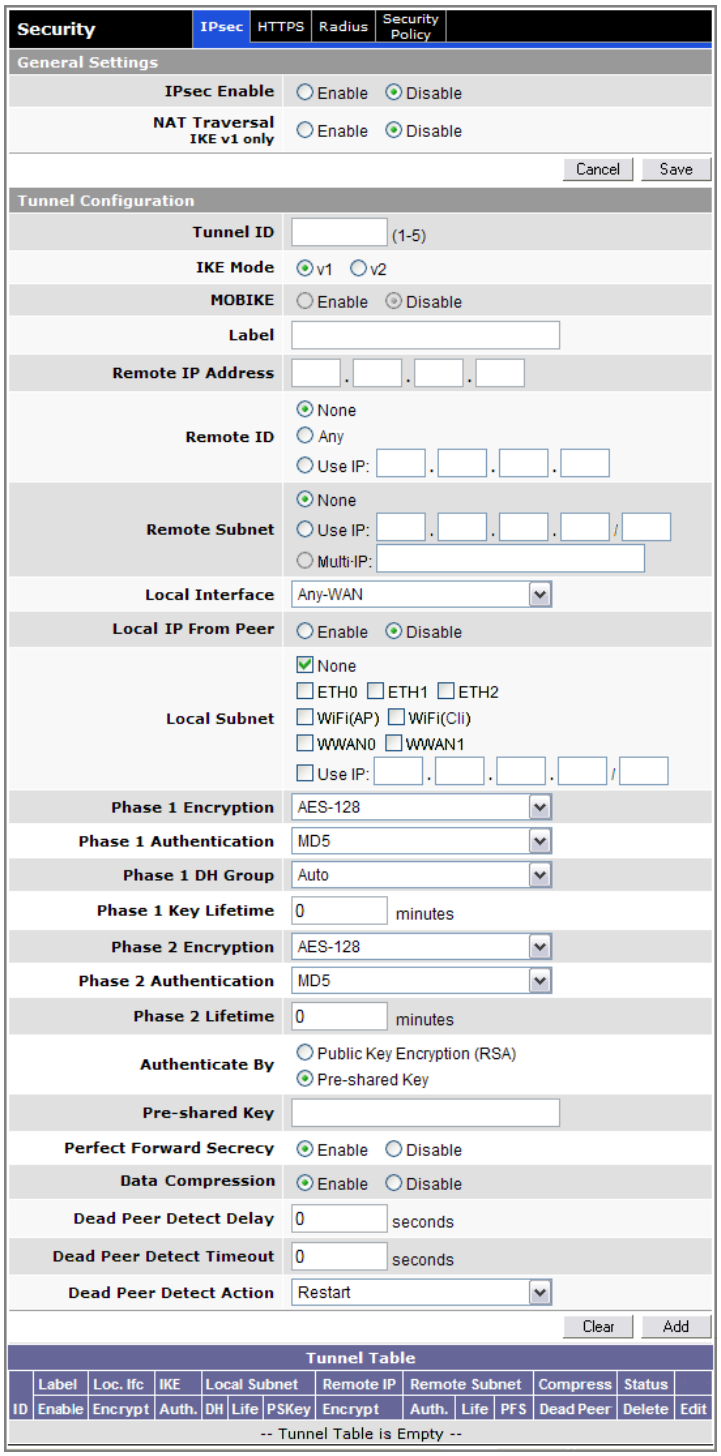
- **Iface**
  The interface the route is bound to.

3.10 SECURITY

Select security from the main navigation menu to navigate to security settings page containing settings for IPsec, HTTPS, RADIUS, and Security Policy for the Fusion router.

3.10.1 IPSEC

Figure 50 Security – IPsec



IPsec facilitates configuration of secured communication tunnels. The various tunnel configurations will be displayed in the Tunnel Table at the bottom of the page. All tunnels are created using the ESP (Encapsulating Security Payload) protocol. Fusion supports IPSEC IKE v1 and IKE v2. For IKE v2 tunnels, MOBIKE can also be enabled.

General Settings

- **IPsec enable or disable**
  Selecting Enable will launch the IPsec process and start all enabled tunnels. Selecting Disable will stop all tunnels and shut down the IPsec process. Note that all enabled tunnels will be launched automatically when the unit connects to the cellular carrier.

- **NAT Traversal**
  This setting applies only to IKE v1 tunnels.
  Determines how packets are addressed. Selecting Enable will allow packets coming from Local Subnet addresses through the NAT firewall unchanged. This may be sufficient when traffic only travels from Local Subnet to Remote Subnet.
  Note: packets generated by Fusion LTE services appear to originate from one of the Fusion's WAN addresses and cannot be sent via subnet-to-subnet tunnels. Use a WAN-to-subnet tunnel for this (see "Local Subnet" below).
  NAT changes the source address to match the IP Address of an outgoing interface used by the tunnel. NAT Traversal enables the NAT-T protocol which can support traffic beyond just the Local and Remote Subnets.

Tunnel Configuration

- **Tunnel ID**
  A number assigned to each tunnel for identification when the tunnel is first configured and saved. Tunnel IDs start from 1 and increment for each new tunnel added. To add a new tunnel, enter a new Tunnel ID number, complete the necessary configuration information below, and click the Add button just above the Tunnel Table.
  Note that for successful tunnel setup most of the following items must match the configuration of the remote VPN host. Please refer to the remote host's configuration.

- **IKE Mode**
  Internet Key Exchange Mode Configuration, select v1 or v2 for version 1 or version 2.

- **MOBIKE**
  Mobility and multi-homing extension to Internet Key Exchange (IKE v2). MOBIKE allows the IP addresses associated with IKE v2 and tunnel mode IPsec security associations to change.

- **Label**
  This is a label to identify a tunnel (use alphanumeric characters only).

- **Remote IP Address**
  The IP address of the remote endpoint of the tunnel.

- **Remote ID**
  The authentication address of the remote endpoint. Use None if this is the same as the Remote IP Address. Use Any if not known. If selecting Use IP, enter the IP address in the spaces provided.

- **Remote Subnets**
  Choose None if encrypted packets are only destined for the Remote IP Address.
  Use an IP address with mask if encrypted packets are also destined for the specified network that is beyond the Remote IP Address. IKEv2 multiple IP address and masks are supported.
  IMPORTANT: *The Remote Subnet and Local Subnet addresses must not overlap!*

- **Local Interface**
  The Local interface that this tunnel applies to. Fusion allows setting up specific tunnels per interface. This specifies the physical interface (typically a WAN interface) that will be used as the "left" IPsec endpoint. Selecting the value of Any-WAN will result in selecting the interface currently pointed to by the default route.

- **Local IP from Peer**
  Also known as Virtual IP. Enable to request an IP address from the peer. This must be enabled when multiple local subnets and IKE v1 are selected.

- **Local Subnet**
  Choose None if only packets generated by Fusion router services will be sent through the tunnel.
  Choose one or more Fusion interfaces (typically a LAN interface) to include the specific local subnet on each.
  Use an IP address with mask if a network beyond the local LAN will be sending packets through the tunnel.
  IMPORTANT: *The Remote subnet and Local subnet addresses must not overlap!*

- **Phase 1 Encryption**
  Use AES-128, AES-256, or 3DES encryption.

- **Phase 1 Authentication**
  Use MDS or SHA1 hashing.

- **Phase 1 DH Group**
  Negotiate (Auto) or use 768 (Group 1), 1024 (Group 2), 1536 (Group 5) or 2048 (Group 14) bit keys.

- **Phase 1 Key Lifetime**
  How long the keying channel of a connection should last before being renegotiated.

- **Phase 2 Encryption**
  Use AES-128, AES-256 or 3DES encryption.

- **Phase 2 Authentication**
  Use MD5 or SHA1 hashing.

- **Phase 2 Lifetime**
  How long a particular instance of a connection should last, from successful negotiation to expiry.

- **Authenticate By**
  Select whether authentication will be by Public-Key Encryption (RSA) or a Pre-shared Key.

- **Pre-shared Key**
  Predetermined key known to both the local unit and the remote side prior to establishing the tunnel.

- **Perfect Forward Secrecy**
  Enable Perfect Forward Secrecy for the session keys.

- **Data Compression**
  Enable this to request IPComp (IP Payload Compression Protocol) data compression to improve performance. This must be supported by the peer.

- **Dead Peer Detection Delay**
  Amount of idle time (no packets received from tunnel) before sending a remote peer probe packet.

- **Dead Peer Detection Timeout**
  Remote peer probe response timer.

- **Dead Peer Detection Action**
  Action to be taken when a remote peer probe timeout value is reached.

As you complete entry of the above fields for each tunnel to be created, click Add to save the new tunnel item and add it to the Tunnel Table.

Tunnel Table

- **Enable**
  Check the Enable box to enable a tunnel once it has been defined and added to the table. This tunnel state is saved across resets of the Fusion.

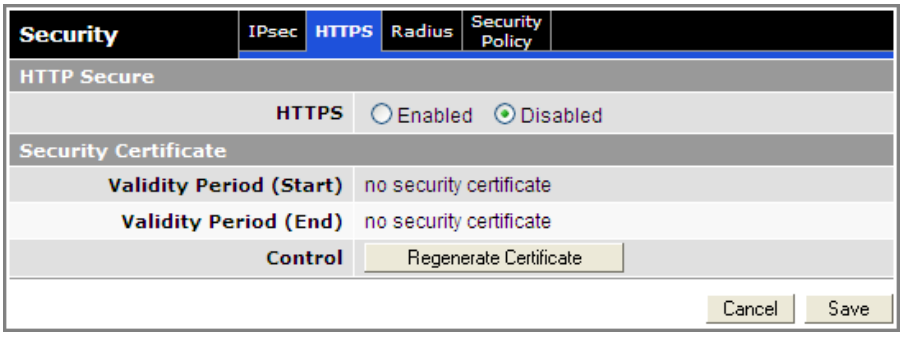
- **Status**
  Click the View link to open a page showing the log of the tunnel's negotiation activity.

- **Edit**
  To edit a tunnel that has been added to the Tunnel Table, click the Edit link for the tunnel. The parameters defining the tunnel are re-loaded into the fields in the Tunnel Configuration section of the tab.
  — Clicking the Add button and leaving the tunnel ID number unchanged saves your changes to the selected tunnel.
  — To perform a "Save as," to create a new tunnel with similar characteristics (except the parameters you change), leaving parameters for the selected tunnel unchanged, enter a new ID and then click Add and the new tunnel is added to the Tunnel Table.

- **Delete**
  If it is necessary to delete a tunnel, click the Delete button that appears in the row for the tunnel to be deleted.

3.10.2 HTTPS

Figure 51 Security – HTTPS



HTTPS Secure

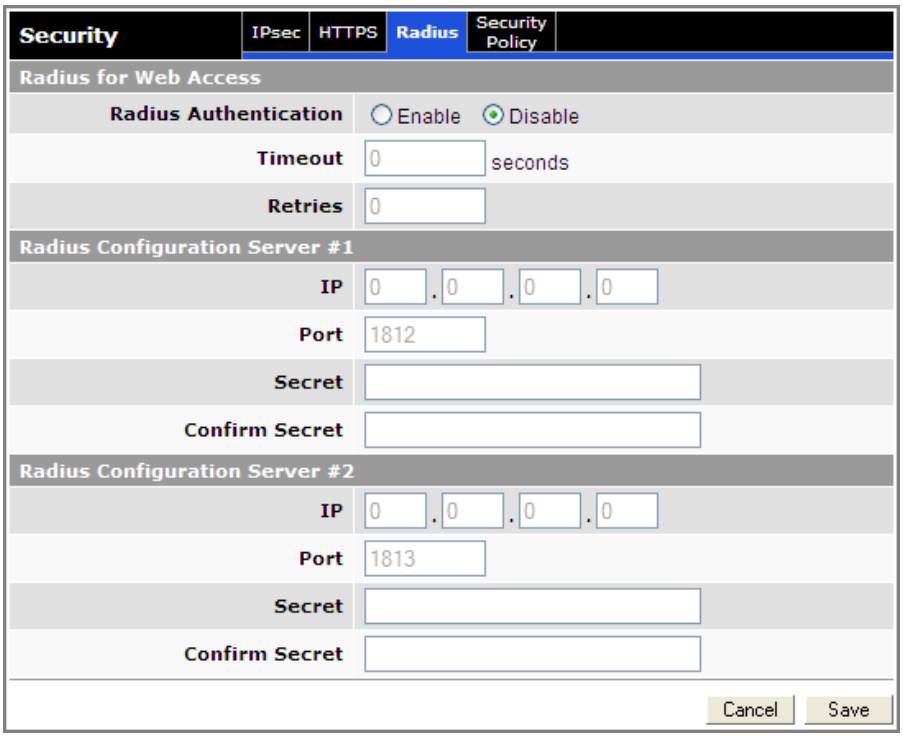
- **HTTPS**
  Click Enabled to enable HTTPS; click Disabled to disable. If HTTPS is enabled, HTTP is disabled; if HTTPS is disabled, HTTP is enabled.

Security Certificate

Validity Period (Start and End) displays information about the security certificate and start and end of the period for which it will be valid. Click Regenerate Certificate to regenerate security certificate credentials.

3.10.3 RADIUS

Figure 52 Security – RADIUS



RADIUS for Web Access

- **RADIUS Authentication**
  Click Enable to enable RADIUS authentication; click Disable to disable it. The state of RADIUS authentication is saved across resets of the Fusion.

- **Timeout**
  Specify how many seconds to wait before a retry.

- **Retries**
  Specify how many times to retry authenticating with the server before giving up.

RADIUS Configuration Server #1, #2

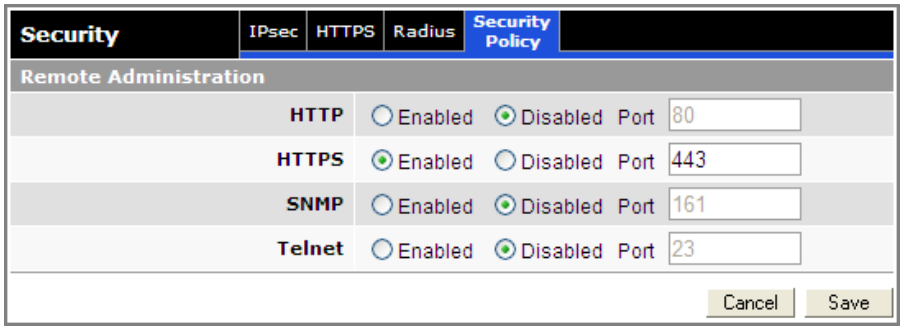
- **IP**
  The IP address of the RADIUS server.
- **Port**
  The port of the server.
- **Secret**
  Sets the secret to use with the RADIUS server.
- **Confirm Secret**
  Re-type the Server Secret to confirm the correct spelling.

Click Save to keep the currently-displayed value for each parameter. Once you have clicked Save, Cancel cannot be used to return to previous settings. Click Cancel to abort changes and redisplay the last-saved parameters for this page.

3.10.4 SECURITY POLICY

Security policy allows enabling or disabling remote (over-the-air, OTA) configuration of the Fusion router via HTTP, HTTPS, SNMP and Telnet. When a protocol is enabled, you may specify the port on which that protocol will be used.

Figure 53 Security – Security Policy



- **HTTP**, Port
  Enable or disable Hypertext Transfer Protocol. A well-known port for HTTP is port 80.
- **HTTPS**, Port
  Enable or disable HTTP Secure. A well-known port for HTTPS is port 443.
- **SNMP**, Port
  Enable or disable Simple Network Management Protocol. A well-known port for SNMP is port 161.
- **Telnet**, Port
  Enable or disable Telnet. A well-known port for Telnet is port 23.

When you have finished making configuration changes in this tab, click Save to save and apply the new settings or click Cancel to clear changes.

3.11 MONITOR & CONTROL

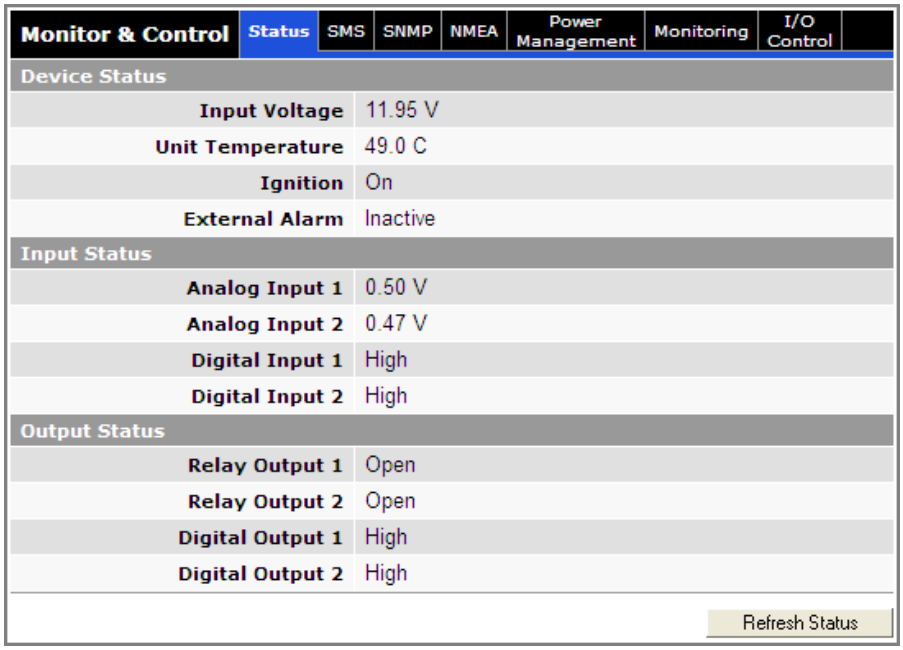
Select Monitor & Control from the main navigation menu to navigate to the Monitor & Control page.

The Fusion embeds a few discrete analog and digital I/Os, some of which can be utilized to obtain local measurements of voltage or control using relays or discrete digital outputs. Some I/Os are monitoring on board physical elements such as temperature, supply voltage, etc.

These values are available using the SNMP protocol or through the Web pages.

3.11.1 STATUS

Figure 54 Monitor & Control – Status



Device Status

- **Input Voltage**
  Displays current power supply voltage applied to the unit, in Volts with precision of ±8%.
- **Unit Temperature**
  Displays temperature inside the FUSION enclosure in degrees Celsius. Precision is approximately ±2°C (±4°F).
- **Ignition**
  Indicates the current state of the Ignition signal.

- **External Alarm**
  Indicates the current state of the External Alarm register. When Active, it indicates that an Alarm event was registered and not cleared yet. An external alarm can only be cleared by SNMP or by rebooting the unit.

Input Status

- **Analog Input**
  Displays the measured input voltage, in Volts with an precision of ±8%.

- **Digital Input**
  By convention, the digital inputs are said to be ¨high¨ when the input voltage is above a threshold value of V_{IH} volts. Conversely, it is said to be ¨low¨ when the input voltage is below a threshold value of V_{IL} volts. Those are defined as LVTTL (3.3V) levels.

  For reference:

  V_{IL} = 0.8 V maximum
  V_{IH} = 2.0 V minimum

Output Status

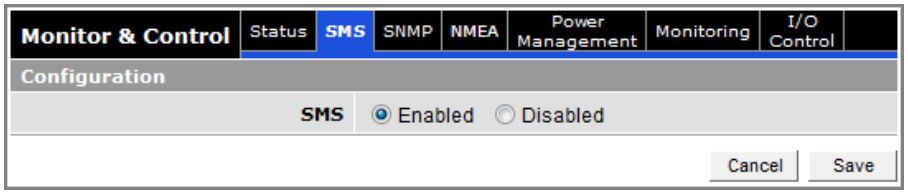
- **Relay Output**
  Displays the current status of the relay output. Closed means the relay coil is energized and contacts are closed.

- **Digital Output**
  Displays the current status of the digital output. Low means that the open collector transistor is on and the output is shorted to GND. Conversely, when deactivated, the transistor stops conducting and the collector is pulled high through the internal 18.2 K pull-up resistor.

3.11.2 SMS

The Short Message Service (SMS) can be used to send a message to the Fusion as a “shoulder tap” to contact the DeviceOutlook™ server. Also referred to as *phoning home*, the Fusion will then contact the DeviceOutlook server with its identity and information necessary to reach it, and DeviceOutlook determines whether a firmware upgrade or configuration updates are scheduled for the unit.

Figure 55 Monitor & Control — SMS



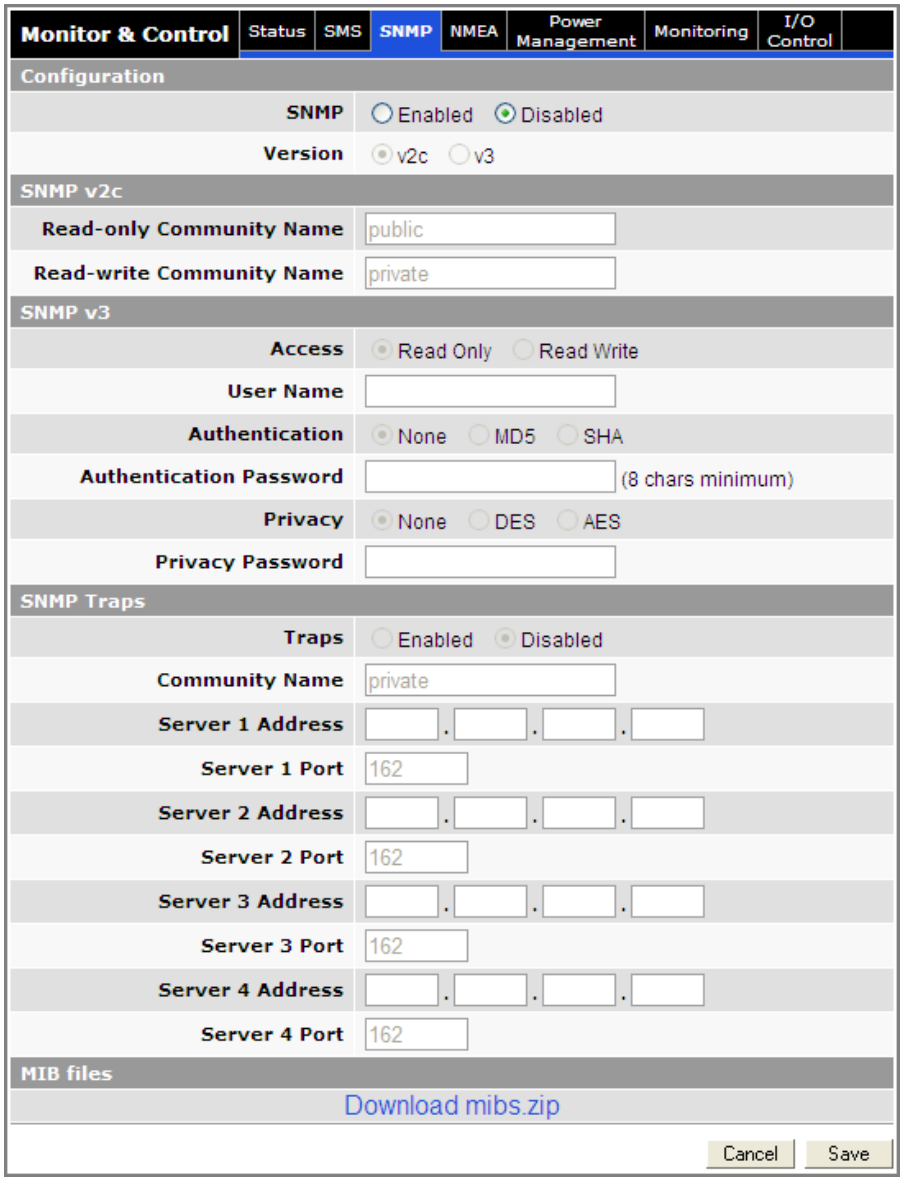
Configuration

- **SMS**
  Under normal circumstances, enable SMS to allow the device to receive shoulder tap SMS messages. Disable this feature only if there is specific reason to do so.

3.11.3 SNMP

The Simple Network Management Protocol (SNMP) is used in network management systems to monitor network-attached devices for conditions that warrant administrative attention. SNMP version v2c and v3 are supported with the exception of INFORM.

Figure 56 Monitor & Control – SNMP



Configuration

- **SNMP**
  Selecting Enable will allow the SNMP functionality. Selecting Disable will shut off SNMP functionality.

- **Version**
  With SNMP Enabled, select the corresponding version that matches the SNMP Manager.

SNMP v2c

- **Read-only Community Name**
  The community string used for accessing the read-only Management Information Bases (MIBs).
- **Read-write Community Name**
  The community string used for accessing all Management Information Bases (MIBs) including writable objects.

SNMP v3

- **Access**
  Access modes can be “Read Only” or “Read & Write.”
- **User Name**
  The user name for secure access to the Management Information Bases (MIBs) observing v3 standard.
- **Authentication**
  Selecting the authentication method for accessing the Management Information Bases (MIBs).
- **Authentication Password**
  The corresponding user password for accessing the Management Information Bases (MIBs) including writable objects.
- **Privacy**
  Selecting the encryption method when communicating data.
- **Privacy Password**
  Selecting the encryption key (password) when communicating data.

SNMP Traps

- **Traps**
  Selecting Enable will allow the active trap events to be reported to the defined server(s). Selecting Disable will deactivate events reporting. Up to four destinations can be specified.
- **Community Name**
  The community name is tagged into traps packets. The recipient can then filters traps for different communities.
- **Server Address**
  IP address of server to which the trap events will be sent to.
- **Server Port**
  The corresponding server port to which the trap events will be sent to (default 162).

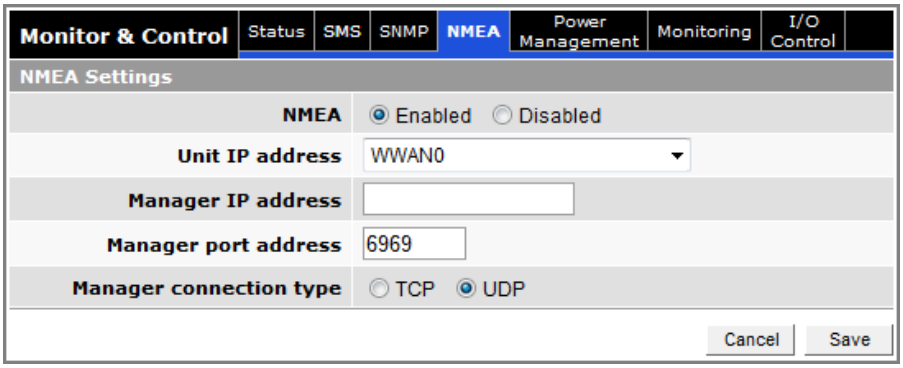
MIB files

Click the link to download the information bases (MIBs).

3.11.4 NMEA

Status reports can be sent via NMEA-based protocol. The Fusion I/O subsystem operates according to a manager/agent model. The PC-hosted manager sends requests to the Fusion I/O agent, which performs the required actions. The Fusion agent reports alarms to the PC-hosted manager.

Figure 57 Monitor & Control – NMEA

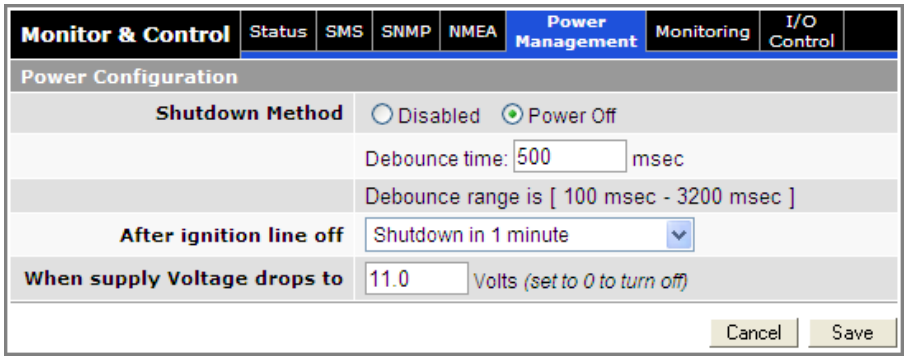


- **NMEA**
  Click Enable to enable NMEA; click Disable to disable it. This setting is saved across resets.
- **Unit IP address**
  Select the unit interface IP address that will be sent to the manager as the source address.
- **Manager IP address / Manager port address**
  The IP address and port of the remote manager.
- **Manager connection type**
  The connection protocol to communicate with the remote manager.

3.11.5 POWER MANAGEMENT

The Fusion is designed to stay ON even if the ignition is turned off. The Fusion can be configured to automatically shut down 1, 5, 30 or 60 minutes after ignition has been turned off or when the supply voltage drops below a certain level (sometimes called “battery charge guard” feature).

Figure 58 Monitor & Control – Power Management



- **Shutdown Method**
  Disabled by default. Select “Power off” to enable power management. If disabled, the Fusion will continue to run indefinitely even without the ignition on.

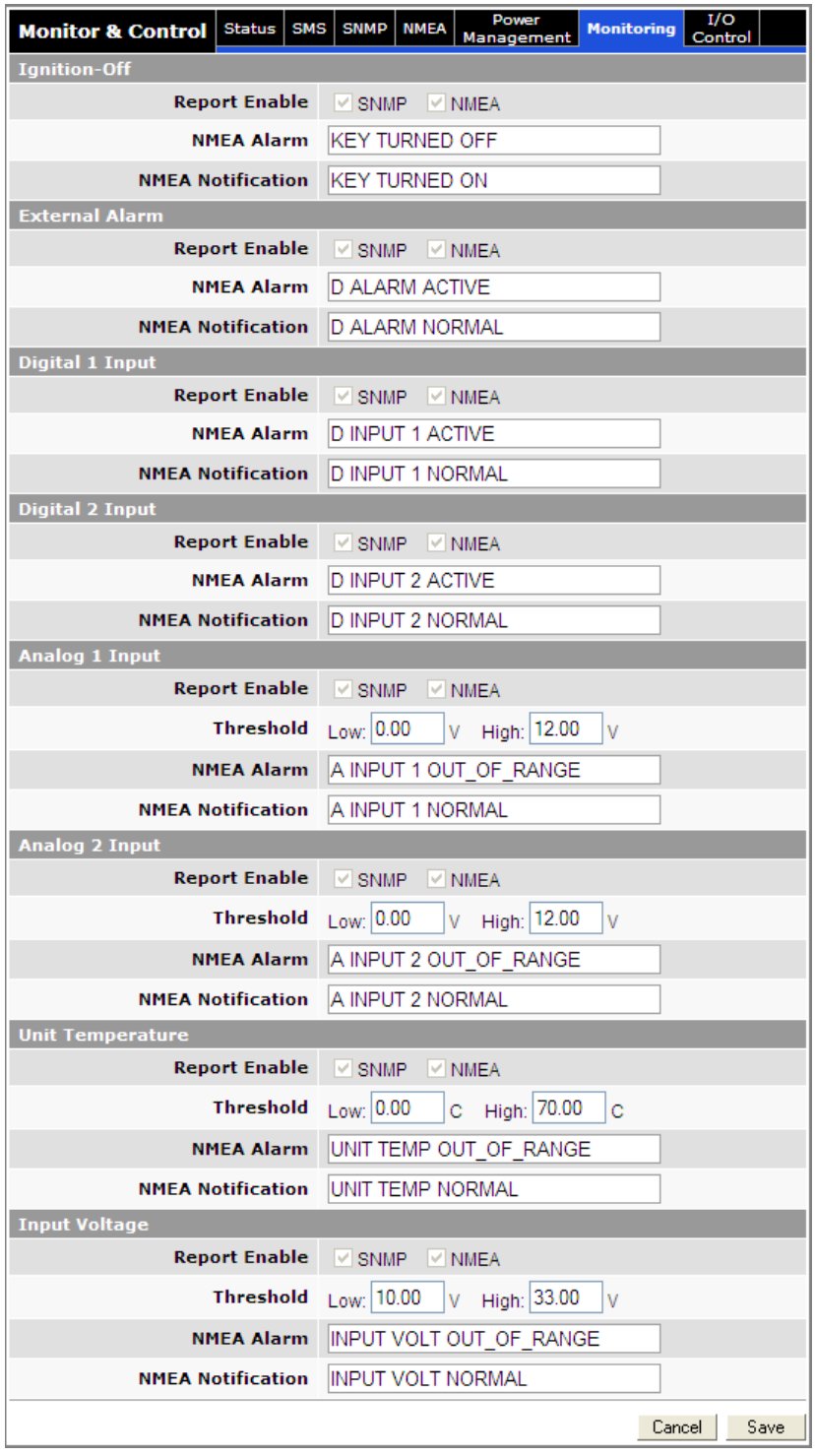
- **After Ignition Line Off**
  Select between the following time intervals: 1, 5, 30 or 60 minutes. The Debounce time serves to avoid false detection and can be configured to values between 100 ms up to 3.2 seconds. This means that the Ignition must be stable for at least this amount of time for it to be recognized as OFF.

- **When Voltage Drops Below**
  Enter desired voltage. Enter "0" to disable (and give precedence to time delay configured under "After ignition time off").

3.11.6 MONITORING

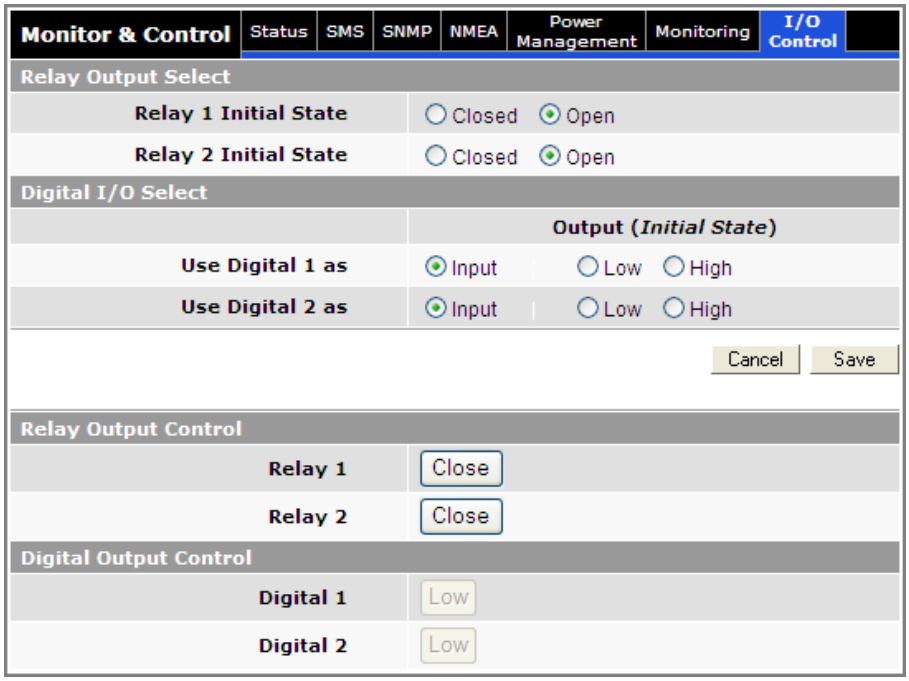
The Fusion monitors some I/O and can report events when certain criteria are met. For example, a report can be generated when the temperature goes above some threshold value. These events can then optionally be reported through SNMP and NMEA independently. When NMEA is enabled, the user can define specific messages indicating normal and abnormal conditions. SNMP reports, on the other hand, are based on a mechanism with traps and defined in the SNMP protocol and the MIB structures.

Figure 59 Monitor & Control – Monitoring



3.11.7 I/O CONTROL

Figure 60 Monitor & Control – I/O Control

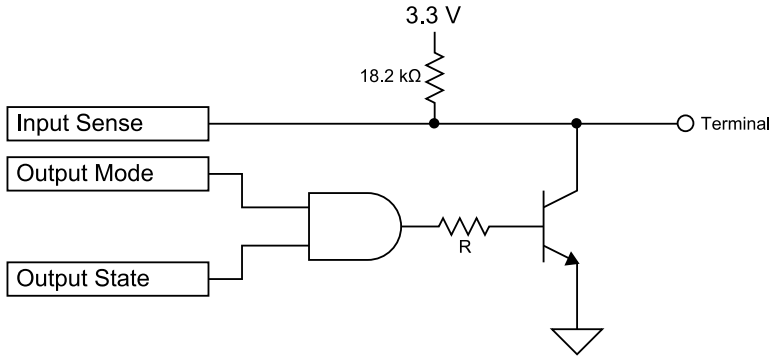


Relay Output Select

Select the initial state of the relays i.e. the state when the system boots up. Note that the "Closed" state is delayed from power-up up to when the firmware has completed its boot process – this is approximately 30-40 seconds.

Digital I/O Select

The Digital I/Os are configurable as input or output signals. The following picture presents a simplified model of the circuitry:



When in Output Mode, the Output State signal serves to control the Open Collector transistor output. When in Input Mode the Input Sense signal is fed into the Fusion and reported.

As inputs:

- Use LVTTL (3.3V) levels.

As outputs:

- Use as an open collector with 100 ohm limiting resistor.

- Maximum Sink Current = 50mA for VCE_sat ≤ 0.3V. Maximum VCE = 30 V DC.

Relay Output Control

This sets the state of the Relay output. Closed means the relay coil is energized and the contacts are closed.

Digital Output Control

These controls are only available when the Digital I/O Select is set to Output. Clicking on “High” means that the open collector transistor is set to conduction (saturation). The transistor can then sink up to 50 mA. Conversely, when it is deactivated, the transistor stops conducting and the collector is left floating through the internal 18.2 kΩ pull-up resistor.

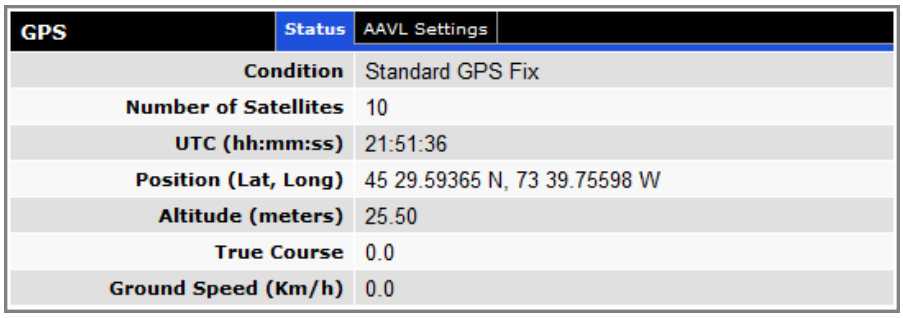
3.12 GPS

The Fusion Cellular Broadband Router contains a standalone, high-accuracy, high-report-rate (12 satellites with WAAS and Differential Correction, 1 report per second) GPS receiver.

Select GPS from the main navigation menu to navigate to the GPS page.

3.12.1 STATUS

Figure 61 GPS – Status



- **Condition**
  Indicates the quality of received GPS reports.

No Fix / Invalid	The GPS receiver has not yet acquired enough satellites to provide an accurate position, or the previous Estimated Position is over 3 minutes old.
Standard GPS Fix	GPS position is reported using no additional correction information.
Differential GPS Fix	Differential GPS corrects various inaccuracies in the GPS system to yield measurements accurate to a couple of meters when the mobile is moving and even better when stationary.
Estimated / Last Known Position	Satellite reception has degraded to the point where only an Estimated position or the Last Known Position can be reported.

- **Number of Satellites**
  Indicates the number of satellite signals being received and used to calculate position.

- **UTC**
  The current time according to Universal Coordinated Time in hh:mm:ss, using a 24-hour clock format.

- **Position**
  The current position in Latitude (North-South) and Longitude (East-West). Positions are reported in degrees and decimal minutes. For example, a Longitude of 73 degrees, 39 minutes and 45 seconds West appears as: 73 39.7555 W.

- **Altitude**
  The current height above Mean Sea Level in meters.

- **True Course**
  Shows the current GPS-generated true course in degrees.

- **Ground Speed**
  Shows travel speed (in Km/h).

The GPS LED on the front panel also provides the status of the receiver.

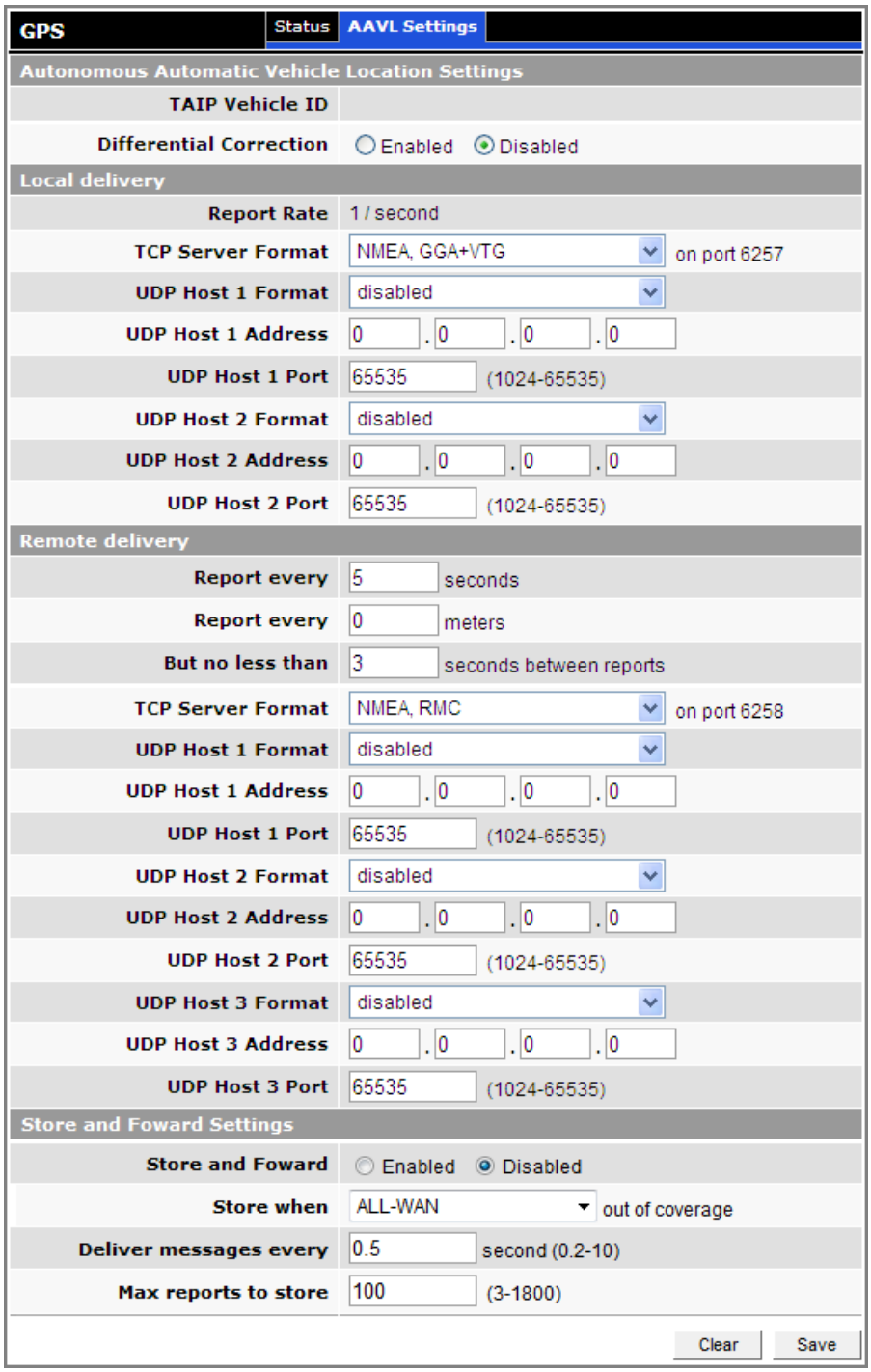
Table 11 GPS LED Color and GPS Status

GPS LED Color	Meaning
Amber	Position lost, reporting last known position.
Green	Valid positions being reported.
Red	Fault.
Flashing Amber	Acquiring Satellites.

3.12.2 AAVL SETTINGS

The Autonomous Automatic Vehicle Location (AAVL) feature adds the ability for Fusion routers to transmit position reports either to a host connected to the local Ethernet port or to a remote host over the cellular network. AAVL allows the system designer to specify the maximum distance or the time interval between remote position reports.

Figure 62 GPS – AAVL Settings



Position reports can be transmitted in a number of possible formats. When the format is disabled or the Address or Port fields are blank, no report is sent.

Table 12 Position report format information

Format	Definition	Example
TAIP, No ID	Trimble ASCII Interface Protocol (TAIP), No ID	>RPV73511+4549542-0736643100035822;*7F<
TAIP, With ID	Trimble ASCII Interface Protocol (TAIP), With ID	>RPV56655+4549542-0736643300000002;ID=ADAM12;*5E<
NMEA, GGA	NMEA GGA (Global Positioning System Fix Data)	$GPGGA,202742.0,4529.7240,N,7339.8585,W,2,9,0.9,28,M,,,,*3E
NMEA, GLL	NMEA GLL (Geographic Latitude & Longitude)	$GPGLL,4529.7241,N,7339.8584,W,202645.0,A,D*7C
NMEA, RMC	NMEA RMC (Recommended Minimum data)	$GPRMC,153716.00,A,4529.72428,N,07339.86082,W,0.007,,180108,,,A*69
NMEA, VTG	NMEA VTG (Vector Track and speed over Ground)	$GPVTG,,T,,M,0.004,N,0.008,K,A*2F

GPS “sentences” are collected the from embedded GPS receiver in the Fusion router. These sentences are provided into the above formats and are available to both local and remote delivery services. Two TCP ports are available for clients to connect to and receive reports at the local or remote reporting rate. Each report from the TCP ports is terminated with carriage-return/linefeed characters (CRLF). Up to two local UDP Hosts and three remote UDP Hosts may be specified. Reports are sent as a datagram with no terminating CRLF.

Autonomous Automatic Vehicle Location Settings

- **Differential Correction**
  Differential Correction allows WAAS correction information to be used to improve accuracy of the GPS position reports.

  Note: WAAS correction applies to North America only. The WAAS satellites currently in service are 48 (Galaxy 15) and 51 (Anik F1R). The previous WAAS satellites 35 and 47 were taken out of service on 2007/07/30. WAAS improves the tracking accuracy of the GPS navigation system to approximately 10 feet.

Local delivery

The Fusion router will produce a report each second and send it to any connected TCP clients and to the specified UDP hosts. **IMPORTANT:** Local reports should only be delivered to addresses reachable through the local LAN or WiFi ports. Sending reports once per second or faster over the cellular network could result in a congested cellular network and/or extremely large network usage charges.

- **TCP Server Format**
  Reports in the specified format (see the table above) are available to local clients that connect to TCP port 6257 of the Fusion router.

- **UDP Host (1,2) Format**
  Reports in the specified format (see the table above) are sent to the specified IP address & port. NOTE: Different reports can be directed to the same UDP Host address & port.

- **UDP Host (1,2) Address**
  IP address of the UDP Host in dotted decimal format.

- **UDP Host (1,2) Port**
  IP Port of the UDP Host (1024-65535).

Remote delivery

The Fusion router can be configured to report after a certain time or distance.

- **Report every () seconds**
  Trigger the sending of a new remote report if the time since the last remote report exceeds the specified number of seconds.

- **Report every () meters**
  Trigger the sending of a new remote report if the distance since the last remote report exceeds the specified distance (in meters).

- **But no less than () seconds between reports**
  To prevent a fast-moving vehicle from reporting too frequently, a lower limit on the time between reports can be specified.

- **TCP Server Format**
  Reports in the specified format (see the table above) are available to remote clients that connect to TCP port 6258 of the Fusion router.

- **UDP Host (1,2,3) Format**
  Reports in the specified format (see the table above) are sent to the specified IP address & port. NOTE: Different reports can be directed to the same UDP Host address & port.

- **UDP Host (1,2,3) Address**
  IP address of the UDP Host in dotted decimal format.

- **UDP Host (1,2,3) Port**
  IP Port of the UDP Host (1024-65535).

Store and Forward Settings

The Fusion router can be configured to store position reports when a connection is unavailable (for example, out of cellular coverage range) and then forward the stored reports when connection is reestablished.

- **Store and Forward**
  Enable or disable the Store and forward feature of the Fusion.

- **Store when**
  Specify when GPS information Is stored if, for example, a WWAN is out of coverage range.

- **Deliver messages every**
  Sets the time duration between consecutive messages. This can be set from one fifth of a second (0.2 s) to ten seconds. Setting messages to be sent too often is not recommended.

- **Max reports to store**
  Sets the maximum number of reports to store. Only the most recent reports, up to the number of reports specified, are stored. Older reports are discarded as new reports are created. This can be set from 3 to 1800. Setting the number to save too many reports is not recommended.

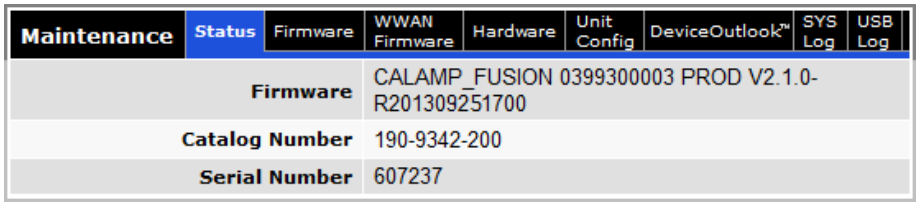
3.13 MAINTENANCE

This section provides information you should have when contacting CalAmp Customer Service. In addition, it allows you to update the firmware when updates become available, and, if directed to, to modify fundamental hardware configuration parameters.

Select Maintenance from the main navigation menu to navigate to the Maintenance page.

3.13.1 STATUS

Figure 63 Maintenance – Status



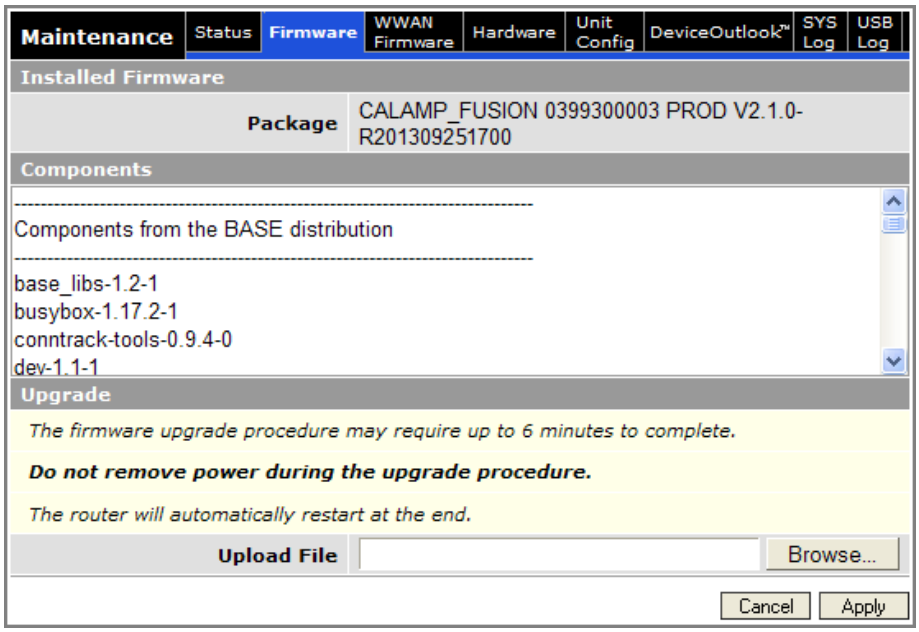
- **Firmware**
  This is the complete identifier of the firmware currently running in the Fusion.

- **Catalog Number**
  The catalog number indicates which optional modules are installed in the Fusion.

- **Serial Number**
  The serial number of the Fusion router. The serial number is also printed on the label affixed to the bottom of the Fusion enclosure.

3.13.2 FIRMWARE

Figure 64 Maintenance – Firmware



Installed Firmware

This is the complete identifier of the firmware currently running in the Fusion.

Components

This is a complete list of component elements of the Fusion firmware. This provides useful information for support technicians when contacting technical support.

Upgrade

When newer versions of Fusion firmware become available, the user can download the firmware from the CalAmp web site and manually update the unit by uploading a package to the unit.

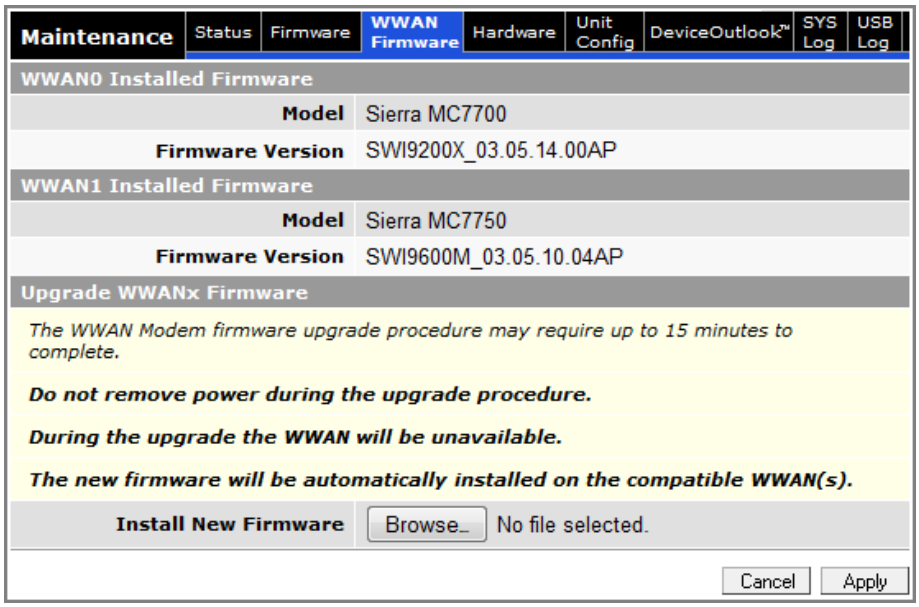
Detailed information and procedures for performing manual firmware upgrades is provided in APPENDIX D — Firmware Upgrades.

Note: The unit remains fully operational for the duration of the upload phase. However, the unit automatically reboots once the upload completes, thus taking the Fusion out of service during approximately 1 minute. Unless otherwise stated, the user is not expected to take any special precautions.

Caution: It is important to have a stable power source and ensure that power to the Fusion is not interrupted during a firmware upgrade.

3.13.3 WWAN FIRMWARE

Figure 65 Maintenance – WWAN Firmware



WWAN0 Installed Firmware

Displays the model and firmware version for the cellular module installed in the WWAN0 position in the Fusion, if installed, and version information when available from the cell module.

WWAN1 Installed Firmware

Displays the model and firmware version for the cellular module installed in the WWAN1 position in the Fusion, if installed, and version information when available from the cell module.

Upgrade WWANx Firmware

When newer versions of cell module firmware that are supported by CalAmp and the cell provider become available, the user can download the firmware from CalAmp and manually update the cell module by uploading the new firmware package to it.

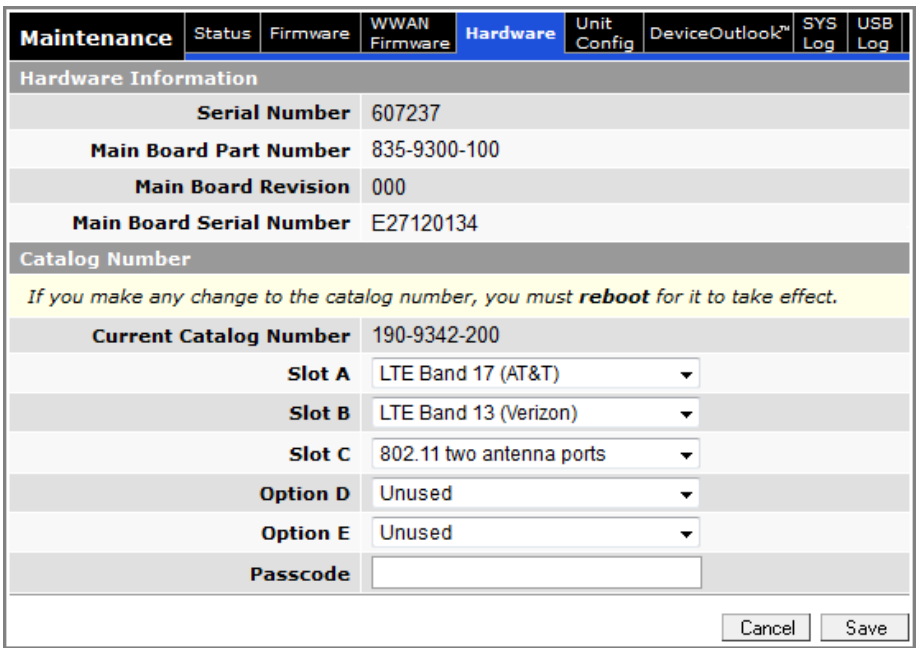
Detailed information and procedures for performing manual firmware upgrades is provided in APPENDIX D — Firmware Upgrades.

Note: The WWAN interface will be temporarily disabled for the duration of the upgrade, which may require up to 15 minutes to complete. Unless otherwise stated, the user is not expected to take any special precautions.

Caution: It is important to have a stable power source and ensure that power to the Fusion is not interrupted during a firmware upgrade.

3.13.4 HARDWARE

Figure 66 Maintenance – Hardware



Hardware Information

This presents the unique serial numbers and other tracking information about components installed in the Fusion.

Catalog Number

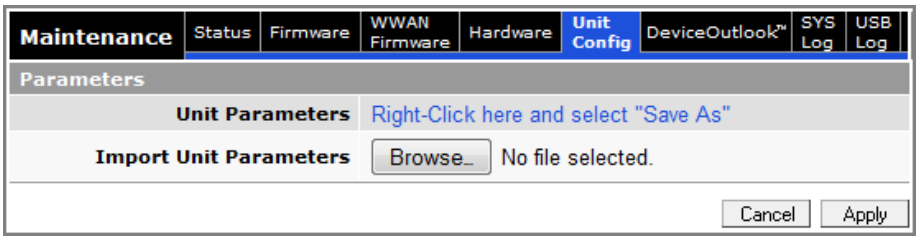
The catalog number is an encoded description of the installed optional modules in the Fusion. Users should not make changes to any of these settings unless directed to do so by CalAmp personnel if assistance is required to change the hardware configuration (for example, to change the LTE module to support another carrier, etc.).

3.13.5 UNIT CONFIGURATION

The Unit Configuration tab allows you to save parameters (settings in the Fusion Web interface) of the Fusion to a file. Conversely, if you have saved settings from the Fusion to a file, you can Import these previously-saved configuration settings to the Fusion.

CAUTION: At the time of this writing, use of Internet Explorer 7, Internet Explorer 9, and Internet Explorer 10 browsers are not recommended for backup ("Save As" as explained in Unit Parameters below) or for importing unit parameters ("Browse…" as explained in Import Unit Parameters below).

Figure 67 Maintenance – Unit Configuration



Parameters

- **Unit Parameters**
  Right-click the link and you will be asked for a destination location for the file to be downloaded. Download the file and you will have a backup of the current configuration settings for your Fusion.

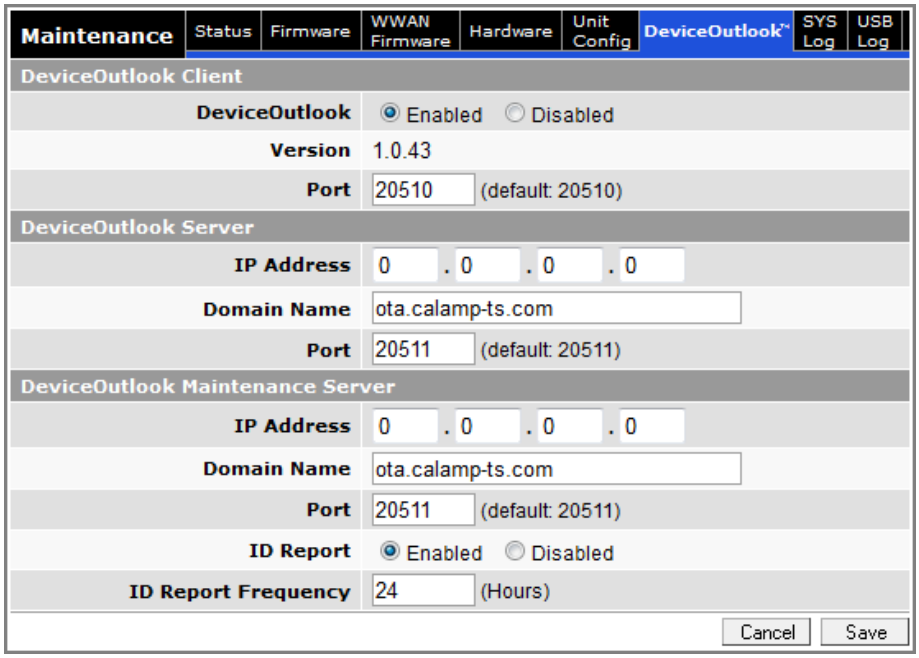
- **Import Unit Parameters**
  Enter the path and filename for the previously-saved Fusion Configuration file, or use the Browse button and navigate to it, and click Apply to import configuration parameters. Click Cancel to clear the field and not import parameters.

  Note: After importing some parameters, some services will be restarted and can cause the WWAN interfaces to be restarted, causing a communication outage. This can take up to 30 seconds to be restored.

3.13.6 DEVICEOUTLOOK™

The DeviceOutlook™ tab allows configuration of the Fusion to work with DeviceOutlook device and network management system, which is built on the CalAmp Online Telemetry System (COLT) platform and CalAmp Enterprise Services (CES).

Figure 68 Maintenance – DeviceOutlook



DeviceOutlook Client

- **DeviceOutlook**
  DeviceOutlook is enabled by default. Only disable this if not using DeviceOutlook or COLT services.

- **Version**
  Displays the version of the DeviceOutlook app currently running in the Fusion.

- **Port**
  The UDP port number on which the DeviceOutlook app listens. (The default UDP port used by DeviceOutlook is 20510.)

DeviceOutlook Server

- **IP Address**
  The IP address of the DeviceOutlook server. The DeviceOutlook app will use this IP address to communicate with the DeviceOutlook server if the Domain Name is not provided.

- **Domain Name**
  The domain name of the DeviceOutlook™ server. When provided, the DeviceOutlook app will use this domain name to communicate with the DeviceOutlook server.

- **Port**
  The UDP port number of the DeviceOutlook server that the DeviceOutlook app uses to send all messages. (The default UDP port used for the DeviceOutlook server is 20511.)

DEVICEOUTLOOK Maintenance Server

- **IP Address**
  The IP address of the DeviceOutlook maintenance server. The DeviceOutlook app will use this IP address to communicate with the maintenance server if the domain name is not provided.

- **Domain Name**
  The domain name of DeviceOutlook maintenance server. When provided, the DeviceOutlook app will use this domain name to communicate with the DeviceOutlook maintenance server.

- **Port**
  The UDP port number of the DeviceOutlook maintenance server that the DeviceOutlook app uses to send all messages. (The default UDP port used for the DeviceOutlook maintenance server is 20511.)

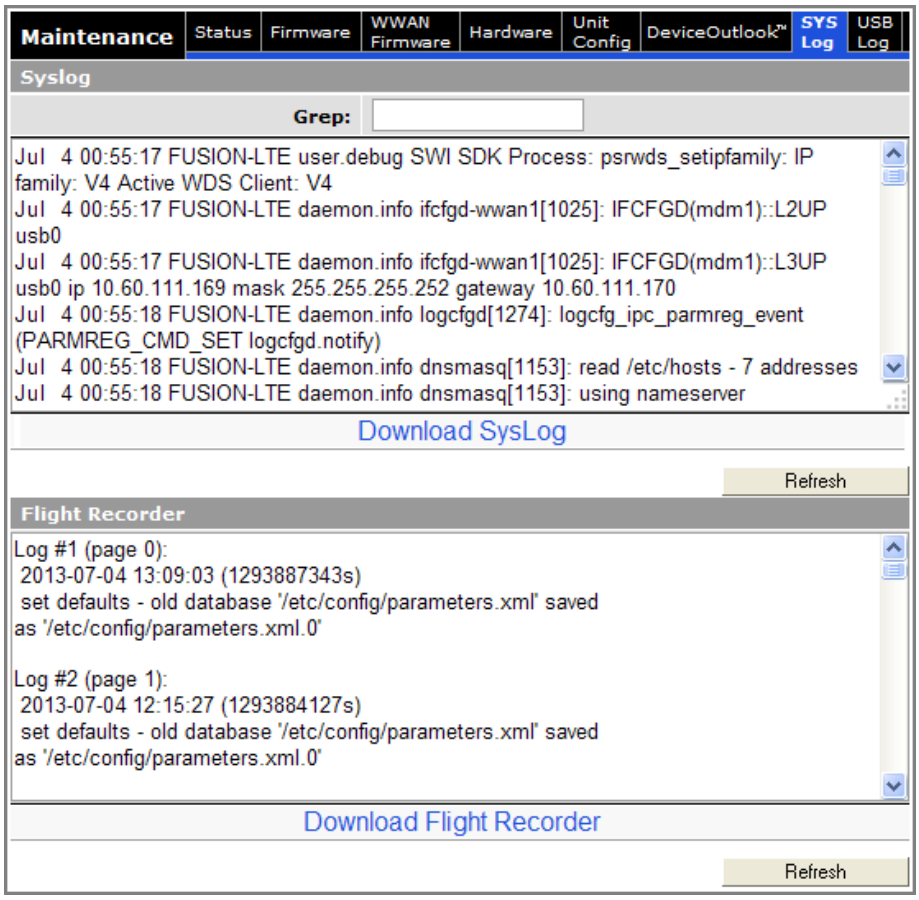
- **ID Report**
  Enable this to have the DeviceOutlook app generate periodic ID reports. Disable it to not generate ID reports. The default setting is to generate reports.

- **ID Report Frequency**
  If ID report generation is enabled, specify how often reports are to be generated by the DeviceOutlook app.

3.13.7 SYSTEM LOG

The System Log tab provides a way to capture the current status log of the device. Log information is useful when contacting CalAmp Technical Support to resolve operational problems. Logs can be downloaded as text files by clicking on the “download” links.

Figure 69 Maintenance – System Log



Syslog

Syslog displays system logs that are stored in the log buffers. These logs are cleared at every system boot.

A Grep function is provided to display only the log entries that contain text specified in the Grep search field.

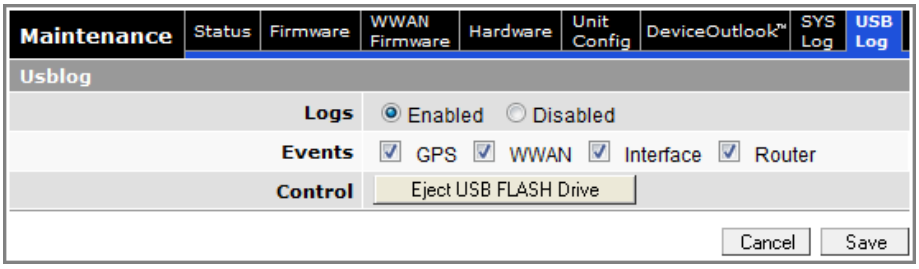
Flight Recorder

Flight Recorder is reserved for those logs that are very critical and which should be available even after a system reboot. They are non-volatile.

3.13.8 USB LOG

The USB Log tab provides a way to save log information to a USB flash drive. Log information is useful when contacting CalAmp Technical Support to resolve operational problems.

Figure 70 Maintenance – USB Log



USB log

- **Logs**
  Enable or disable writing log information to a USB flash drive. Logging is then automatically activated or deactivated with the insertion or removal of USB flash drive to or from either of the two USB A ports in the front panel of the Fusion router.

- **Events**
  Select the type of information to be written to the USB flash drive.
  - GPS – Periodically write GPS status to the log.
  - Interface – Write all changes in interface states.
  - WWAN – Periodically write WWAN interface status information.
  - Router – Write all changes to the default route.

- **Control**
  Always click **Eject USB Flash Drive** and wait a few moments before removing the USB device from the front panel. This is recommended to properly stop the USB interface. Failure to stop the USB interface before disconnecting could cause file corruption on the USB device and cause data loss or make the USB device unusable.

APPENDIX A — ABBREVIATIONS AND DEFINITIONS

AAVL: Autonomous Automatic Vehicle Location

ADC: Analog to Digital Converter

APN: Access Point Name

BSSID: Basic Service Set Identification

CDMA: Code Division Multiple Access

CSD: Circuit-Switched Data

CSMA: Carrier Sense Multiple Access

CTS: Clear To Send

DCD: Data Carrier Detect

DCE: Data Communication Equipment

DHCP: Dynamic Host Configuration Protocol

DTE: Data Terminal Equipment

DNS: Domain Name System or Domain Name Service

ECIO: (Also Ec/IO) A ratio expressed in decibels referenced to a milliwatt (dBm), of received energy on the carrier (Ec) to interference or noise (IO).

EDGE: Enhanced Data rates for Global Evolution

ESN: Electronic Serial Number

EV-DO or **EVDO:** Evolution Data Optimized

FCC: Federal Communications Commission (U.S.)

GPRS: General Packet Radio Service

GPS: Global Positioning System

GSM: Global System for Mobile communications

HSPA: High Speed Packet Access

HSDPA: High-Speed Downlink Packet Access

HSUPA: High-Speed Uplink Packet Access

IC: Industry Canada

ICCID: Integrated Circuit Card Identifier

IMEI: International Mobile Equipment Identity

IMSI: International Mobile Subscriber Identity

kbps: Kilobits per Second

LAN: Local Area Network

LED: Light-Emitting Diode

LTE: 3GPP Long Term Evolution

Mbps: Megabits per Second

MDN: Mobile Directory Number

ME: Mobile Equipment

MEI: Mobile Equipment Identity

MEID: Mobile Equipment Identifier

MHz: Megahertz

MIMO: Multiple Input and Multiple Output

MS: Mobile Station

MSGPS: Multi-Satellite Global Positioning System

NTP: Network Time Protocol

OMA-DM: Open Mobile Alliance Device Management

OTA: Over The Air

PAD: Packet Assembler and Disassembler

PCS: Personal Communications Service

PDP: Packet Data Protocol

PIN: Personal Identification Number

PPP: Point-to-Point Protocol

PPTP: Point-to-Point Tunneling Protocol

PRL: Preferred Roaming List

RADIUS: Remote Authentication Dial In User Service

RF: Radio Frequency

RSSI: Received Signal Strength Indication

Rx: Receive

SIM: Subscriber Identity Module

SMA: SubMiniature version A (connector)

SMS: Short Message Service

SSID: Service Set Identifier

TAIP: Trimble ASCII Interface Protocol

TCP/IP: Transmission Control Protocol / Internet Protocol

Tx: Transmit

UDP: User Datagram Protocol

UTMS: Universal Mobile Telecommunications System

VDC: Voltage, Direct Current

VPN: Virtual Private Network

Wi-Fi or WiFi: Wireless Fidelity

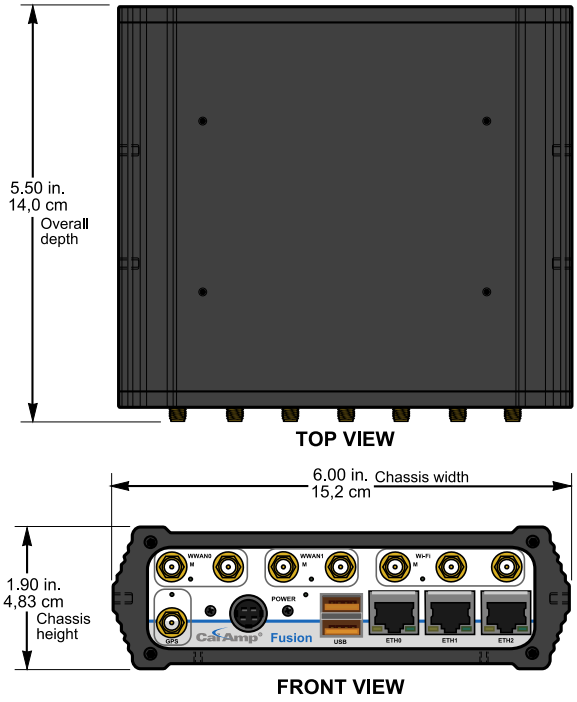
APPENDIX B — MECHANICAL SPECIFICATIONS

Following tables and figures show overall dimensions of the chassis and mounting bracket options for the Fusion router. Mounting brackets allow the Fusion to be secured to any surface that can be drilled for this purpose. The drawings may be used for layout reference, but it is advised that a physical comparison be made to the unit and bracket before laying out and drilling mounting holes.

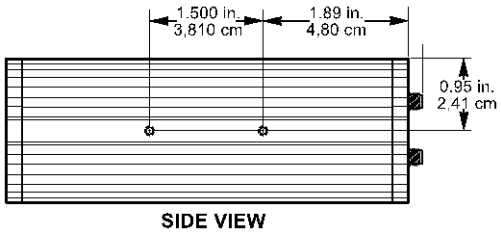
Table 13 Overall Dimensions of the Fusion

Dimension	Inches	Centimeters
Height	1.90	4,83
Width	6.00	15,2
Depth	5.50	14,0
Depth (Chassis only)	5.28	13,4

Figure 71 Fusion overall dimensions

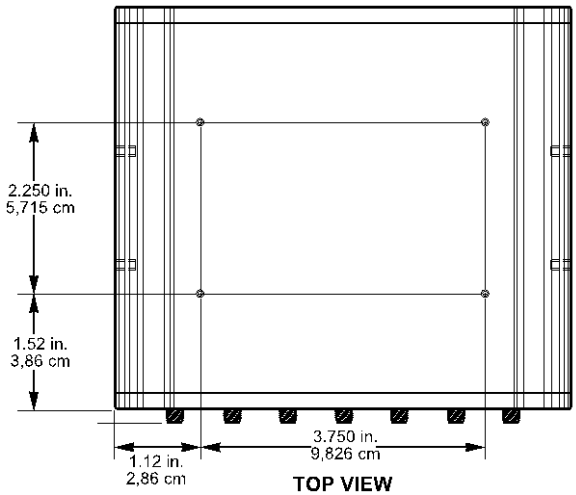


Side tapped mounting hole location detail — typical both sides.



#8-32 UNC – 2B thread × 0.30 in. (0,76 cm) depth
2 holes for mounting both sides (4 holes total).

Tapped mounting hole location detail — top only.

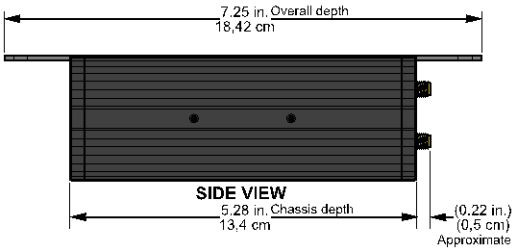


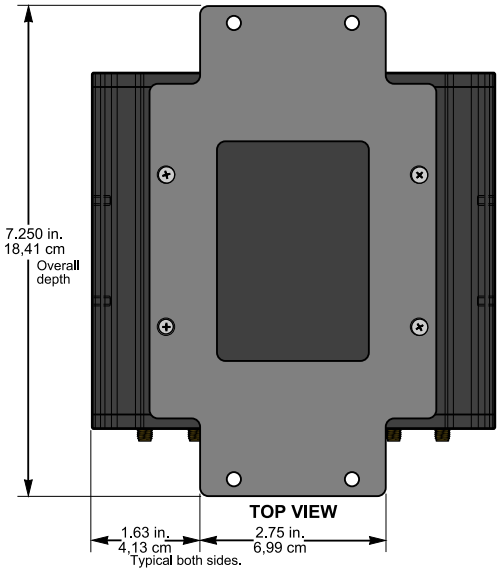
#6-32 UNC – 2B thread × 0.12 in. (0,30 cm) depth
4 holes for mounting (top surface only).

Table 14 Overall Dimensions, Fusion with fixed mounting plate

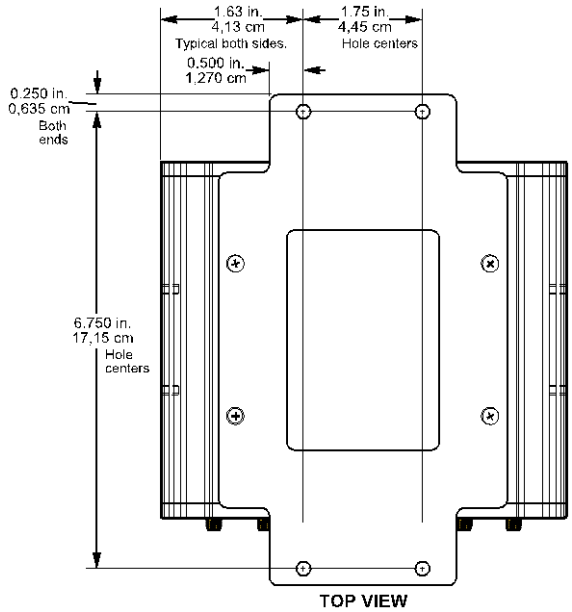
Dimension	Inches	Centimeters
Height	1.91	4,88
Width	6.00	15,2
Depth	7.250	18,42

Figure 72 Fusion with fixed mounting plate overall dimensions





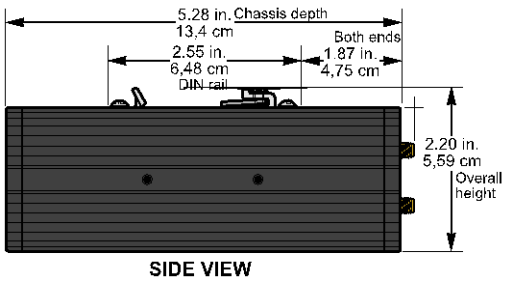
Fixed mounting plate hole location detail



ø 0.176 in. (0,447 cm) – 4 thru holes for securing mounting plate to a surface suitable for mounting.

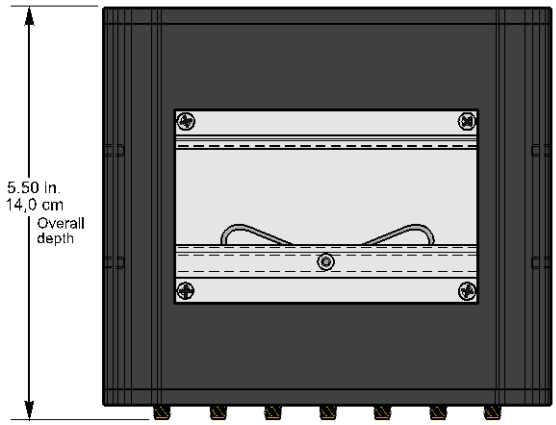
Table 15 Overall Dimensions, Fusion with DIN rail mount

Dimension	Inches	Centimeters
Height	2.20	5,92
Width	6.00	15,2
Depth	5.50	14, 0
Depth (Chassis only)	5.28	13,4

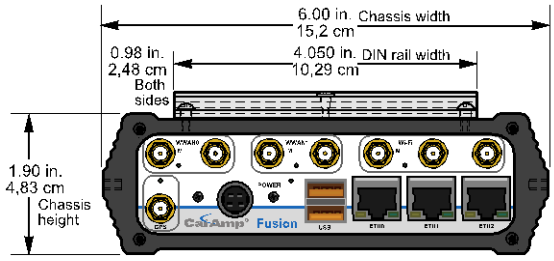


SIDE VIEW

Figure 73 Fusion with DIN rail mount overall dimensions



TOP VIEW



FRONT VIEW

DIN rail mount attaches to top of unit as shown.

Table 16 Overall Dimensions, Fusion with mobile mounting bracket

Dimension	Inches	Centimeters
Height	2.34	5,93
Width	6.88	17,5
Depth	5.50	14,0
Depth (Chassis only)	4.28	10,9
Depth (Bracket only)	2.50	6,35

Figure 74 Fusion with mobile mounting bracket for under-surface mounting

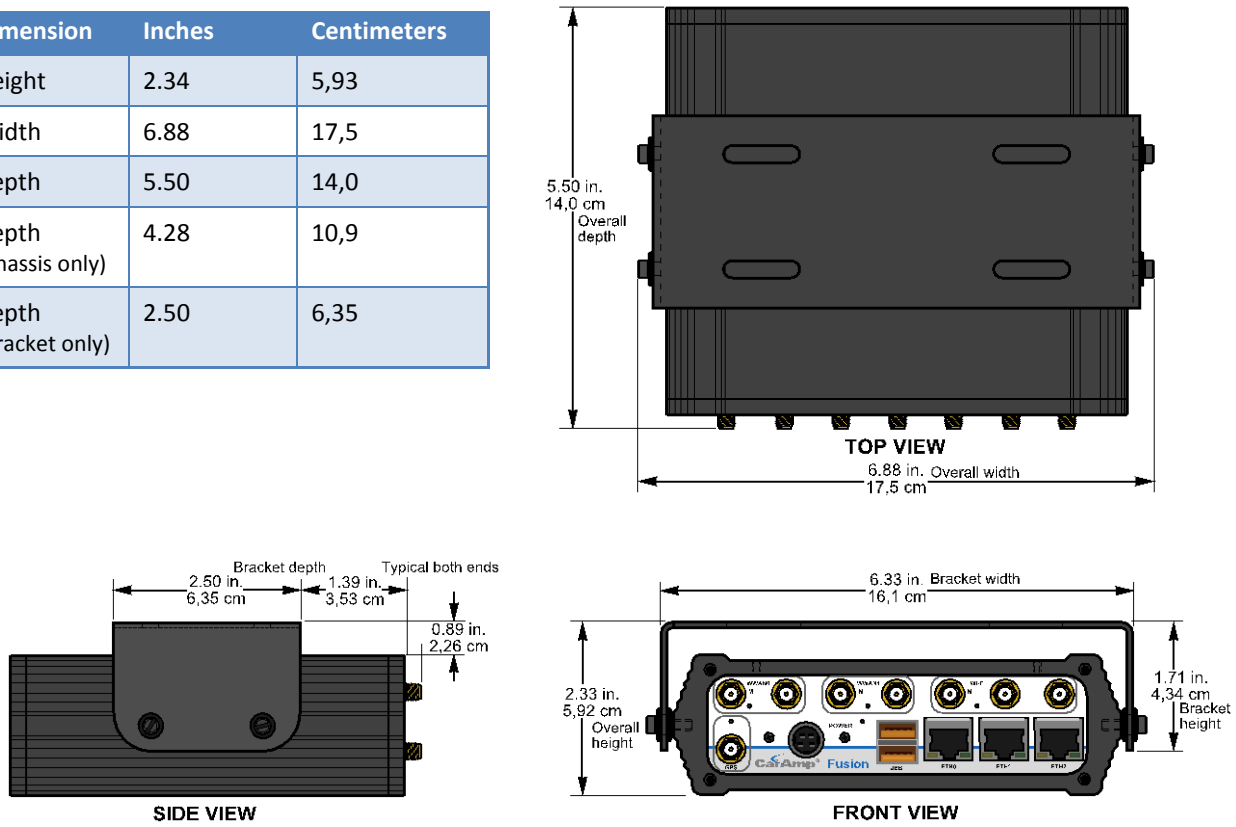


Figure 75 Mobile mounting bracket slot dimension detail

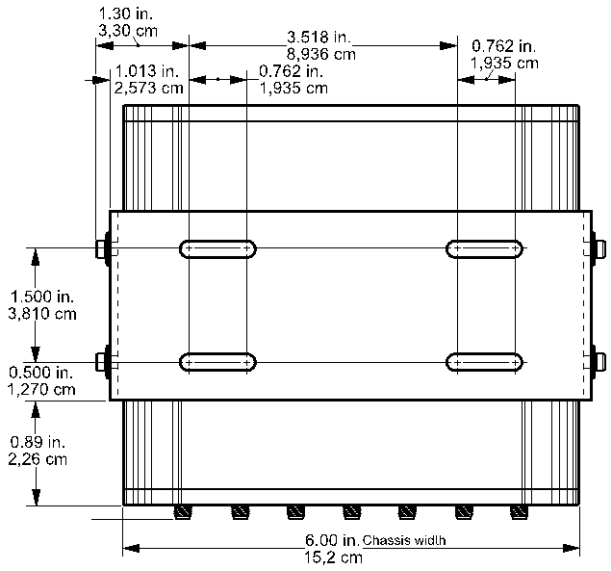
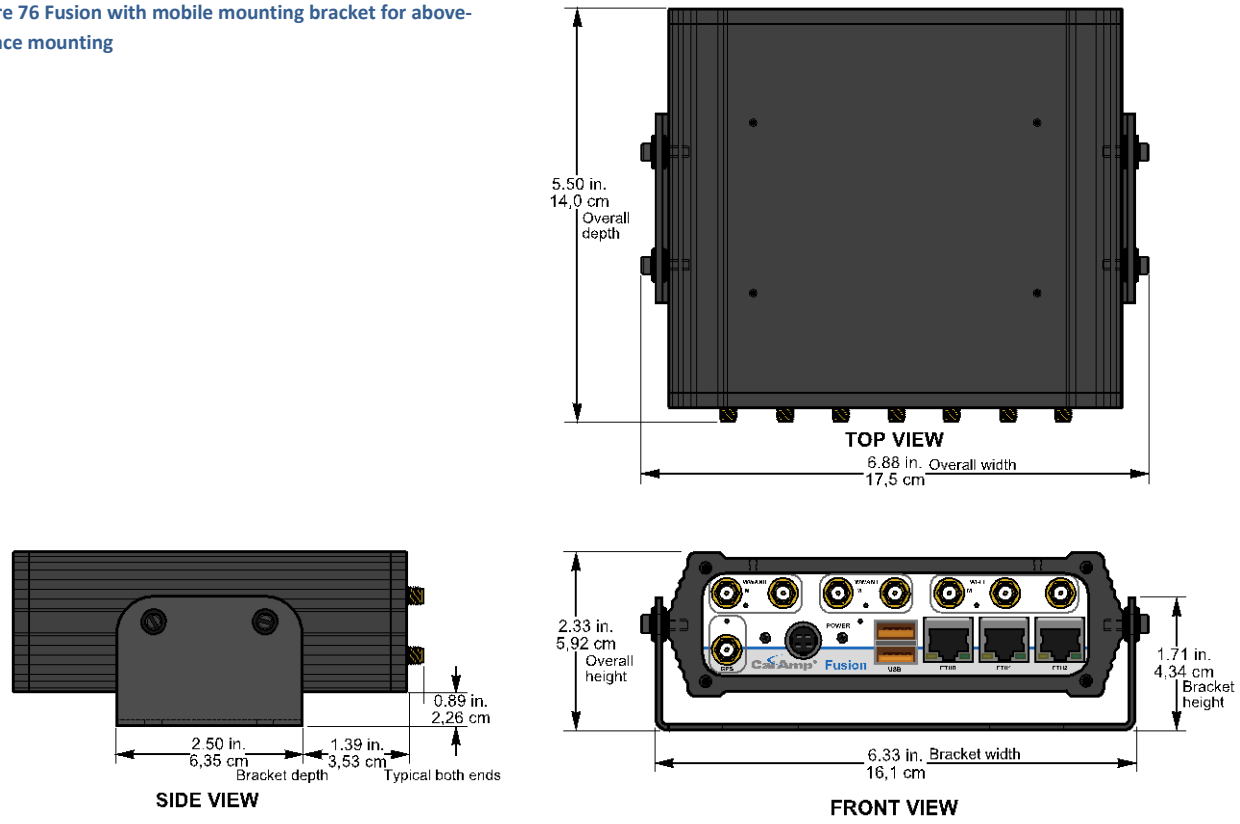


Figure 76 Fusion with mobile mounting bracket for above-surface mounting



APPENDIX C — UL INSTALLATION INSTRUCTIONS AND NON-INCENDIVE FIELD WIRING

UL acceptance requires the following installation instructions. These installation instructions are available and may be downloaded from the www.calamp.com website listed on the CalAmp Product Information Card provided with each unit and include the following:

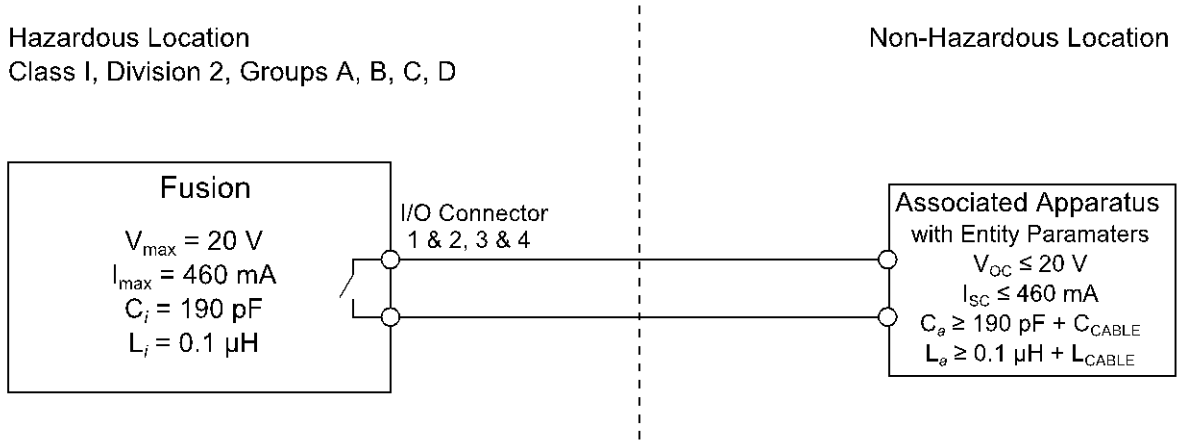
1. This equipment is suitable for use in Class I, Division 2, Groups A, B, C, and D or non-hazardous locations only.

WARNING — EXPLOSION HAZARD — Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous.

WARNING — EXPLOSION HAZARD — Substitution of components may impair suitability for Class I, Division 2.

2. The unit is to be powered with a Listed Class 2 or LPS power supply rated at 9 to 28 VDC or equivalent.
3. Device must be installed in an end-use enclosure.
4. All wiring routed outside the housing, except for the antenna, must be installed in grounded conduit, following acceptable wiring methods based on installation location and electrical code.
5. The USB and SIM connectors are for temporary connection only during maintenance and setup of the device. Do not use, connect, or disconnect unless the area is known to be non-hazardous. Connection or disconnection in an explosive atmosphere could result in an explosion.
6. Do not operate reset switch unless area is known to be non-hazardous.

Fusion Non-Incendive Field Wiring



Installation must be in accordance with the National Electric Code (NFPA 70, Article 504) and ANSI/ISA-RF 12.6. (When the Fusion is located in a non-hazardous location, the maximum voltage is ±30 V and maximum current is 1 A.)

The following table shows accessories that, when approved by the manufacturer, represent antennas and cables used with modules in UL testing.

Table 17 Fusion Accessories used in UL testing

Accessory	Part Number / Description	Quantity
	401-9300-001 Antenna, LTE, LProfile, HGain (Band 13/Band 17), Mag Mount with ground plane disc, SMA, 15 ft., 3G Fallback	2
	401-7100-003 GPS SMA Mag-Mount Antenna	1
	401-7100-004 WiFi Mag-Mount Antenna	1
	150-9300-005 6' DC 3-wire Power Cable (Ignition-sense shorted)	1
	L2CAB0006 7' Ethernet Cable	1

APPENDIX D — FIRMWARE UPGRADES

Upgrading firmware in the Fusion and cell modules is a two-part (or three-part, if two cell modules are installed and both require firmware upgrades) requiring moderate technical know-how and skill. CalAmp has developed detailed instructions to guide you through the process of upgrading the Fusion router and cell module firmware. Completing this requires downloading the firmware upgrade files to a PC, and then uploading to the Fusion or cell module, as applicable.

Firmware upgrades become available occasionally. When upgrading firmware it is important to remember there are two distinct components (or three) involved, each requiring and running with its own version of firmware that is completely different from the firmware required for the other component or components.

- The Fusion itself requires firmware for which upgrades may become available occasionally. Firmware for the Fusion is different and distinct and different from the firmware in the cell modules.
- Each Cell module in the Fusion requires firmware for which upgrades may become available independently of upgrades for the Fusion firmware and possibly different from the firmware upgrades for the other cell module if modules are different models or for different cell providers. Cell module upgrades vary and are specific to the cell module manufacturer, model number, and cellular provider.

When obtaining a firmware upgrade, it is important to know and keep in mind which component the upgrade is for: the Fusion, the WWAN0 cell module, or WWAN1 cell module. Attempting to perform a firmware upgrade for a component using a firmware upgrade file intended for a different component can cause the component (and the Fusion router) to become inoperable.

Generally when CalAmp sends notification that a firmware upgrade or upgrades are available:

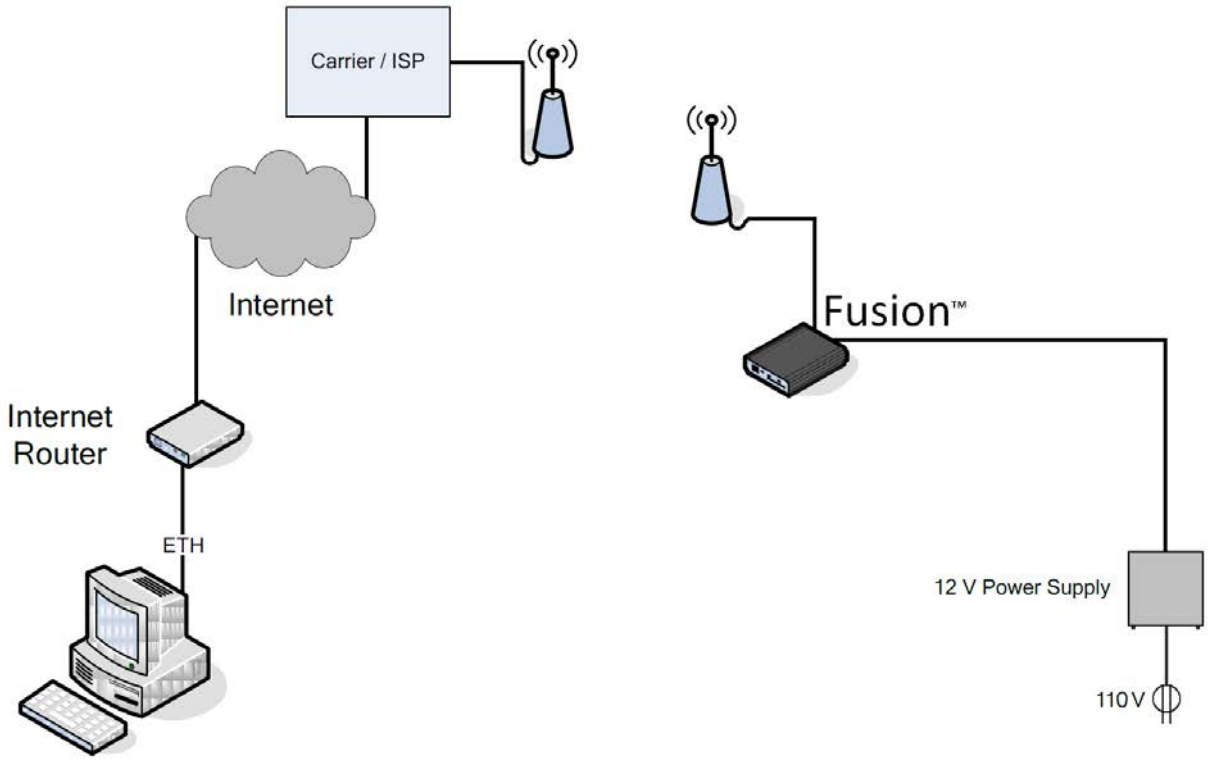
- Cell modules in the Fusion should be upgraded to the most current version supported by CalAmp and available from CalAmp or the cellular provider to ensure compatibility and optimal performance on the cellular network.
- Fusion routers should be upgraded to the most recent router firmware compatible with the latest cell module firmware to take advantage of the most recent improvements and enhancements.

Firmware upgrades may be performed OTA (Over-The-Air) or through a network connection to the Fusion and this is how upgrades are normally migrated in the background using the features of the new DeviceOutlook™ client app. The following figure shows a simplified illustration of a typical network setup for OTA firmware upgrades.

Note: For upgrades of the Fusion firmware, the unit remains fully operational for the duration of the upload phase. However, the unit automatically reboots once the upload completes, thus taking the Fusion out of service during approximately one to two minute. Unless otherwise stated, the user is not expected to take any special precautions. For upgrades of the WWAN cell module, the WWAN interface will be down for the duration of the upgrade procedure, which may require up to 15 minutes to complete.

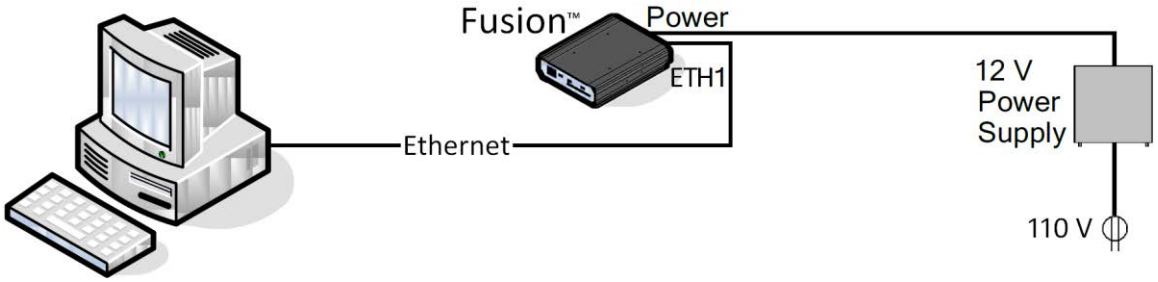
Caution: It is important to have a stable power source and ensure that power to the Fusion is not interrupted during a firmware upgrade.

Figure 77 Simplified illustration of a typical network setup for OTA firmware upgrades



Alternatively, you may perform firmware upgrades via direct cable connection. Normally for a Fusion firmware upgrade (and for cell module firmware upgrades with Fusion firmware version 1.1.7), only 12 V power to the Fusion and an Ethernet cable connection are required, as shown in the following figure.

Figure 78 Fusion connected by Ethernet cable for Firmware upgrade



PROCEDURE FOR UPGRADING FUSION ROUTER FIRMWARE

Note: The unit remains fully operational for the duration of the upload phase. However, the unit automatically reboots once the upload completes, thus taking the Fusion out of service during approximately one to two minutes. Unless otherwise stated, the user is not expected to take any special precautions.

Caution: It is important to have a stable power source and ensure that power to the Fusion is not interrupted during a firmware upgrade.

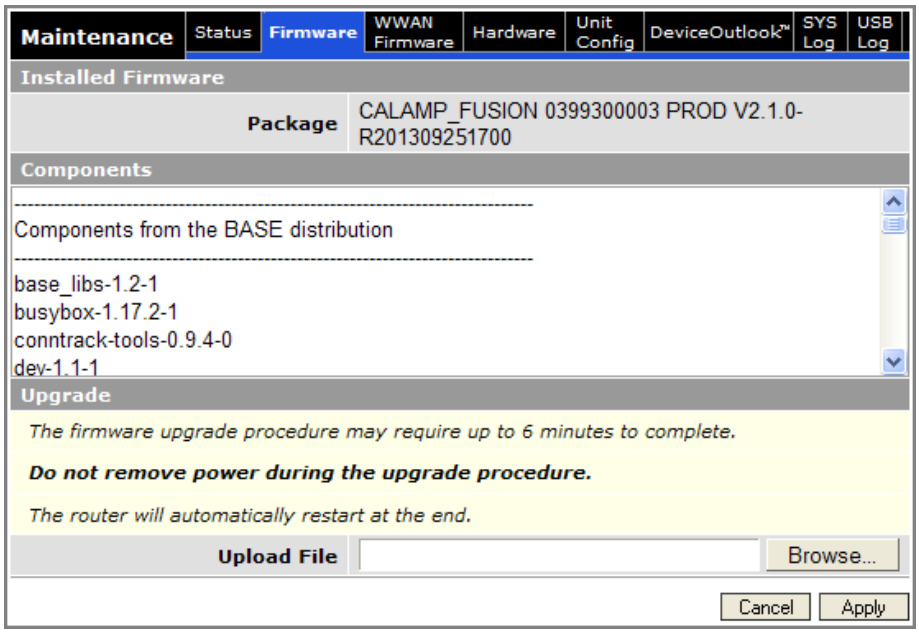
1. Connect a PC running Windows XP or Windows®7 to the Fusion as shown in Figure 77 for OTA firmware upgrade or as shown in Figure 78 for direct cable connection firmware upgrade.
   a. For direct cable connection firmware upgrade, connect the Ethernet cable from the PC to the Ethernet jack labeled **ETH1** (center of the three Ethernet jacks).
   b. Connect the 12 V DC power supply to the Power connector of the Fusion router. Connect the 12 V DC power supply to 110 V AC power.

2. On the PC, open a web browser and enter the IP address of the Fusion router in the address bar.
   - When the PC is connected to the Ethernet jack labeled **ETH1**, the default IP address is **192.168.1. 50**.
   - In the Windows task bar you may need to refresh (click repair) the network connection for the Ethernet port if you connected the cable after booting the PC or Fusion.

3. A Web Server Authentication window appears as shown in Figure 8 on page 13. (This may take up to 90 seconds after power is applied to the Fusion.) For the default User Name and Password see page 13. Click **OK** to log on.

4. Select **Maintenance** from the main navigation menu to navigate to the Maintenance page and then select the **Firmware** tab.

Figure 79 Maintenance – Firmware Upgrade Upload File (Browse to firmware upgrade package.)



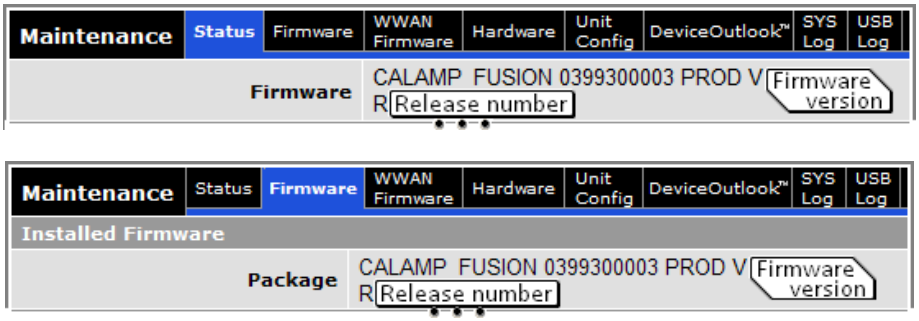
5. Click **Browse** (or **Choose File** in some browsers — the button near the bottom of the Firmware tab) in the Upgrade section and navigate to the firmware upgrade package file (which will have a file name format similar to: CALAMP_FUSION-[*number*]-V[*version.number*]-R[*release.number*].pak) and then click **Open** to select the file. Click **Apply** to upload and apply the firmware upgrade package to the Fusion router.

6. The Fusion router displays the message "Uploading new firmware. Please wait…" as it uploads the firmware upgrade, which may take up to six minutes to finish. When it has finished uploading the upgrade package, the Fusion displays a message that says "Successfully installed the new firmware," followed by the file name and file size of the package file. The Fusion will display this message for approximately 90 seconds while a timer counts down the seconds at the bottom of the window and then reboot automatically.

7. Wait for the Fusion to reboot, then wait a full minute after it has rebooted, and then access the Fusion Web interface again as in steps 2 and 3, earlier in these instructions.

8. Select **Maintenance** from the main navigation menu to navigate to the Maintenance page. Select either the **Status** or **Firmware** tab.
   - In either tab, verify that the firmware/package now displays the current version with the new firmware version number. This number will be in the form PROD V[*version.number*]-R[*release.number*], with the new version and release numbers, as in the .PAK file name.

Figure 80 Firmware/Package version number and release number



All of the Fusion configuration settings are preserved through the firmware upgrade and the Fusion should return to functioning the same as it was before the upgrade (only better and with more versatility).

PROCEDURE FOR UPGRADING CELL MODULE FIRMWARE IN THE FUSION ROUTER

Note: The WWAN interface you are upgrading will be temporarily disabled for the duration of the upgrade, which may require up to 15 minutes to complete. Unless otherwise stated, the user is not expected to take any special precautions.

Caution: It is important to have a stable power source and ensure that power to the Fusion is not interrupted during a firmware upgrade.

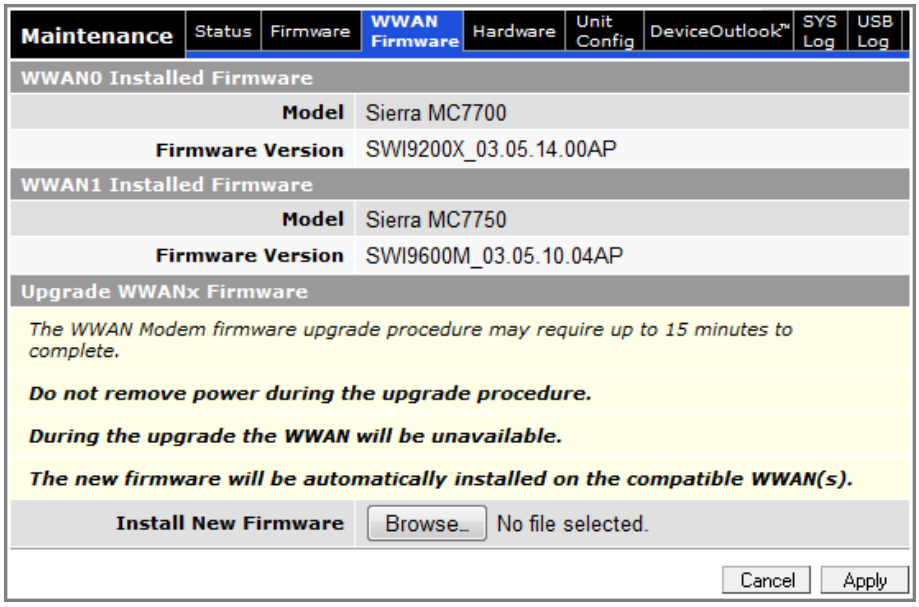
1. Connect a PC running Windows XP or Windows®7 to the Fusion as shown in Figure 77 for OTA firmware upgrade or as shown in Figure 78 for direct cable connection firmware upgrade.
   a. For direct cable connection firmware upgrade, connect the Ethernet cable from the PC to the Ethernet jack labeled **ETH1** (center of the three Ethernet jacks).
   b. Connect the 12 V DC power supply to the Power connector of the Fusion router. Connect the 12 V DC power supply to 110 V AC power.

2. On the PC, open a web browser and enter the IP address of the Fusion router in the address bar.
   - When the PC is connected to the Ethernet jack labeled **ETH1**, the default IP address is **192.168.1.50**.
   - In the Windows task bar you may need to refresh (click repair) the network connection for the Ethernet port if you connected the cable after booting the PC or Fusion.

3. A Web Server Authentication window appears as shown in Figure 8 on page 13. (This may take up to 90 seconds after power is applied to the Fusion.) For the default User Name and Password see page 13. Click **OK** to log on.

4. Select **Maintenance** from the main navigation menu to navigate to the Maintenance page and then select the **WWAN Firmware** tab.

Figure 81 Maintenance – WWAN Firmware Upgrade Upload File (Browse to firmware upgrade package.)



5. Click **Browse** (or **Choose File** in some browsers — the button near the bottom of the WWAN Firmware tab) in the Upgrade WANx Firmware section and navigate to the firmware upgrade package file. (Firmware upgrade package file names may vary by module manufacturer and model and by cell provider.) Click **Open** to select the file and then click **Apply** to upload and apply the firmware upgrade package.
   - If there are more than one cell modules in the Fusion, the Fusion has the intelligence programmed into it to distinguish from the package contents which cell module the firmware upgrade is for.

6. The Fusion router displays the message “Uploading new firmware. Please wait…” as it uploads the firmware upgrade, which may take up to fifteen minutes to finish. When it has finished uploading the upgrade package, the Fusion displays a message that says “Successfully installed the new firmware,” followed by the file name and file size of the package file.

7. Navigate to the WWAN Firmware tab of the Maintenance page or Status tab of applicable WWAN page(s) as explained in the following steps to see the updated version number(s) for cell module firmware.

8. Select Maintenance from the main navigation menu to navigate to the Maintenance page. Select the WWAN Firmware tab.
   - The WWAN Firmware tab shows the Model number and Firmware Version for each installed cell module.

Figure 82 WWAN0 Cell Module Model and Firmware Version

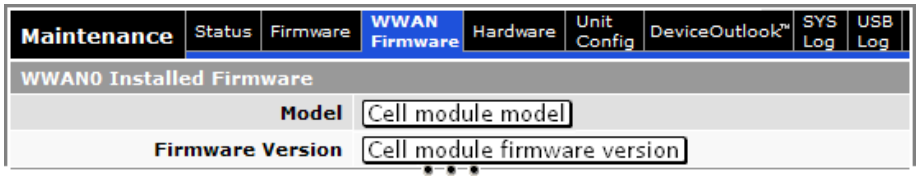
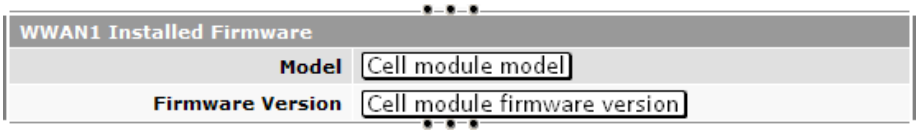


Figure 83 WWAN1 Cell Module Model and Firmware Version (if a second cell module is present)



9. Select the WWAN page (WWAN0 or WWAN1, as applicable) from the main navigation menu and select the Status tab.
   - The Status tab for each WWAN page also shows the Model number and Firmware Version.

Figure 84 WWAN0 Cell Module Model and Firmware Version

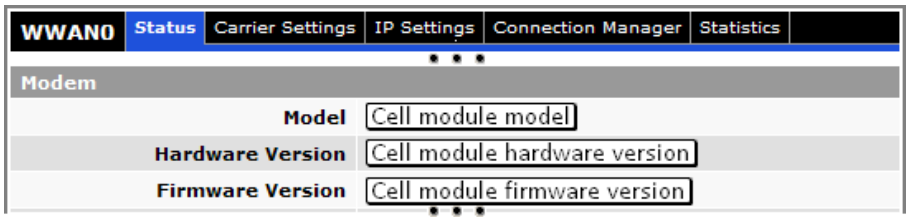
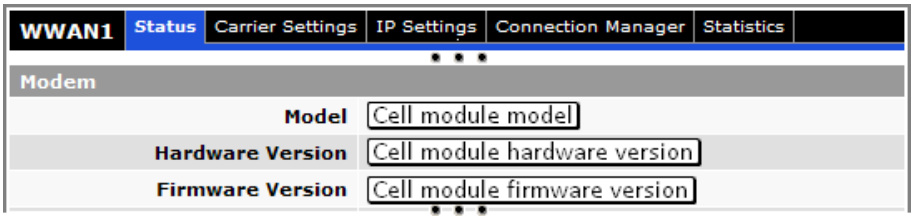
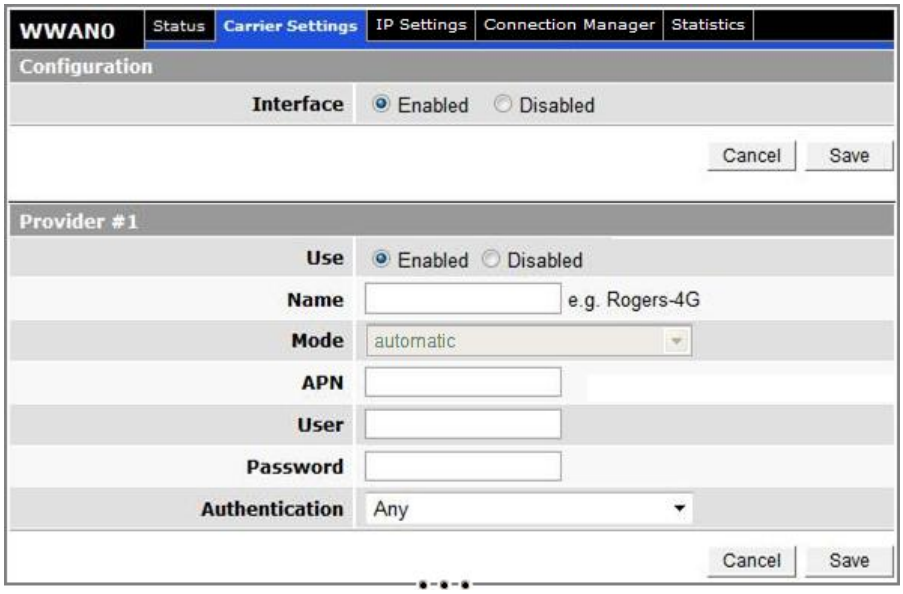


Figure 85 WWAN1 Cell Module Model and Firmware Version (if a second cell module is present)



All of the Fusion configuration settings are preserved through the firmware upgrade and the Fusion should return to functioning the same as it was before the upgrade (only better and with more versatility).



10. In the Carrier Settings tab, verify that the Interface is Enabled and verify that at least one provider is Enabled.

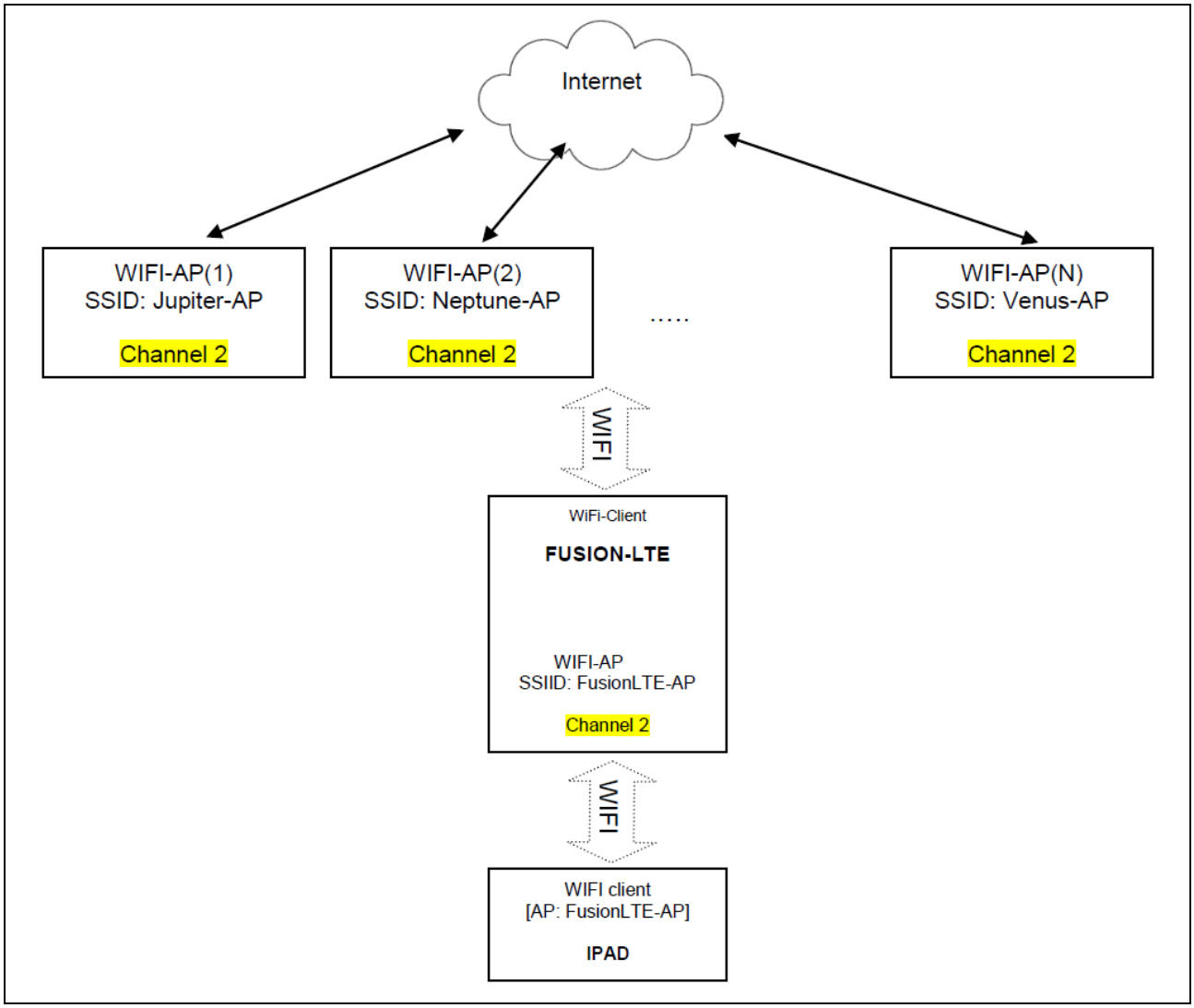
APPENDIX E — WIFI CONCURRENT CONFIGURATION AS ACCESS POINT AND CLIENT

As of firmware version 1.1.7, the WiFi interface of the Fusion router can now be enabled in Access Point mode and Client mode at the same time. (In previous firmware versions, the two modes were mutually exclusive and this was not allowed.)

WIFI CONCURRENT MODE

The most important limitation you must be aware of when working with the Fusion router in concurrent WiFi Access Point mode and Client mode is that the WiFi component of the Fusion has only one radio.

Figure 86 In Concurrent WiFi mode (both Client and Access Point active), the Fusion WiFi Client can only connect to external access points using the same channel that the internal Access Point is configured to use.

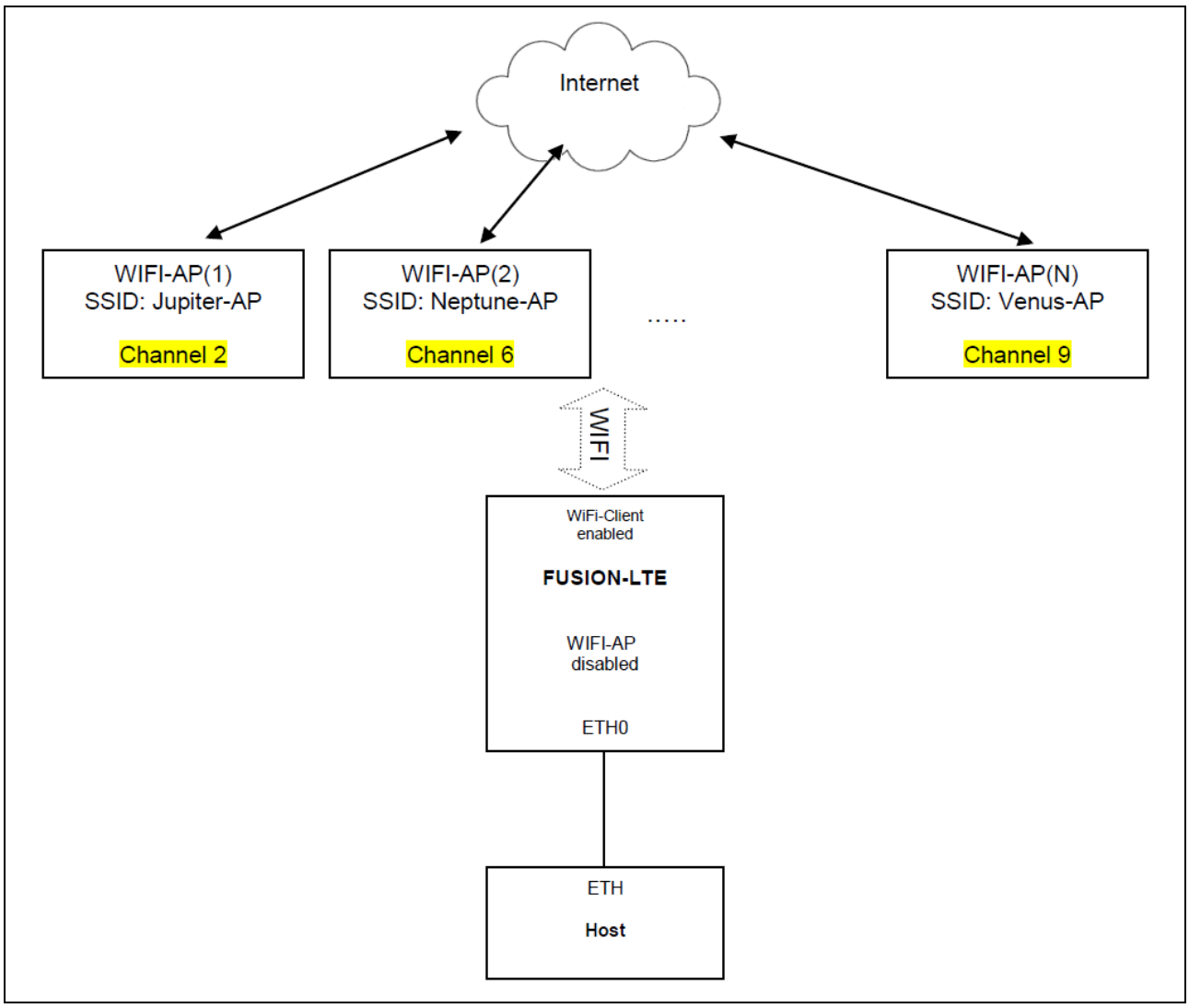


In concurrent mode, the channel used by the WiFi access point of the Fusion router must be the same as the channel used by the external WiFi access points. The WiFi client automatically scans for access points every 60 seconds instead of every 5 seconds to reduce interference with the Fusion's WiFi access point.

WIFI NONCONCURRENT MODE – CLIENT MODE

If only the WiFi Client of the Fusion router is enabled, there is no restriction on the channel selection for the external WiFi access points.

Figure 87 In Non-Concurrent mode (Client mode only), the WiFi client may use any valid channel as necessary to connect to an access point.

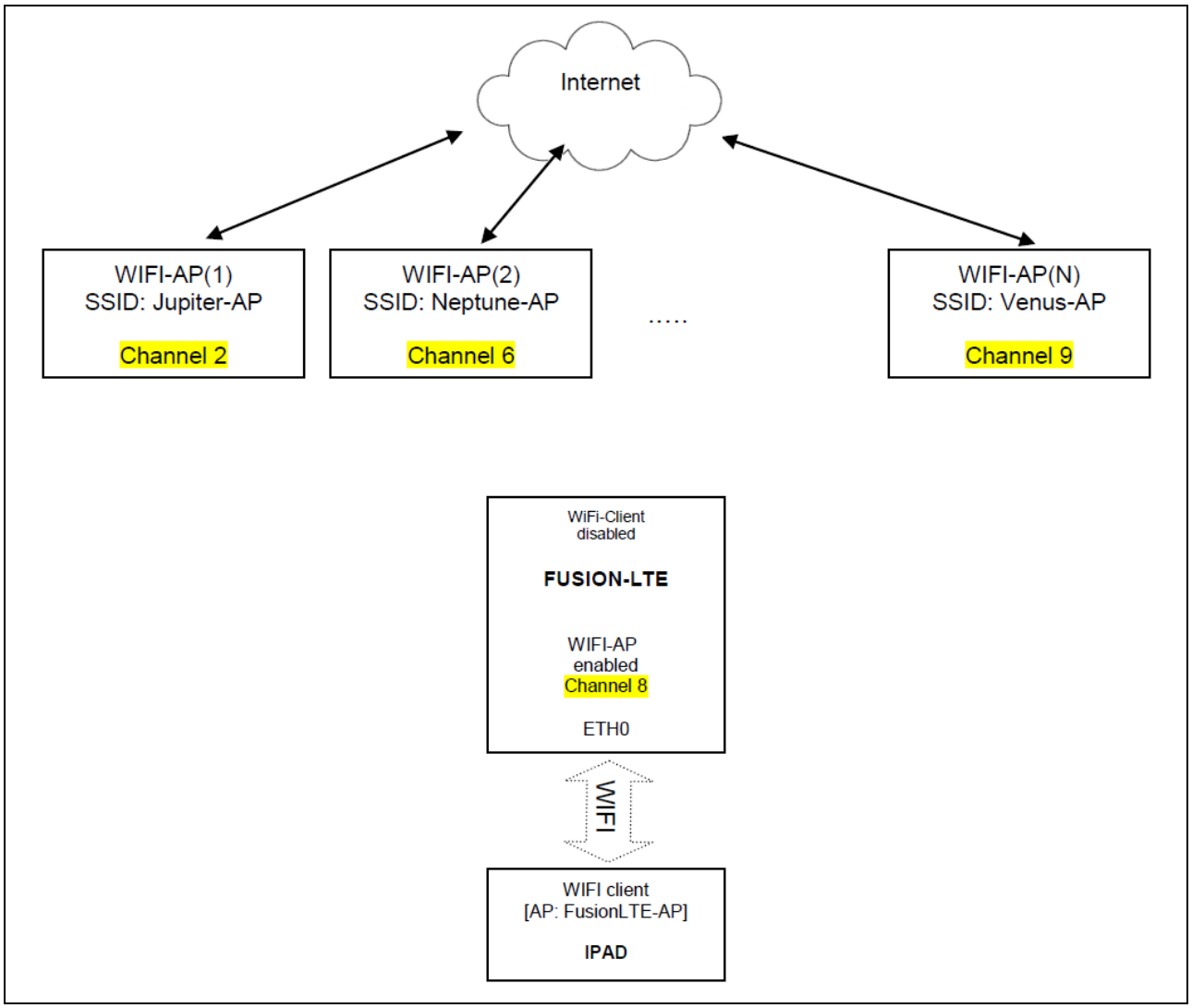


In non-concurrent Client mode only, the channel used by the external WiFi access point can be set to any valid channel.

WIFI NONCONCURRENT MODE – ACCESS POINT MODE

If only the WiFi Access Point of the Fusion router is enabled, the external WiFi access points have no importance and may be set to any valid channel.

Figure 88 In Non-Concurrent mode (Access Point mode only), the Fusion router can use any valid channel independent of any external access points.



In non-concurrent (Access Point mode only), the channel used by external WiFi access points do not matter as long as there is no interference and they can be set to any valid channel.

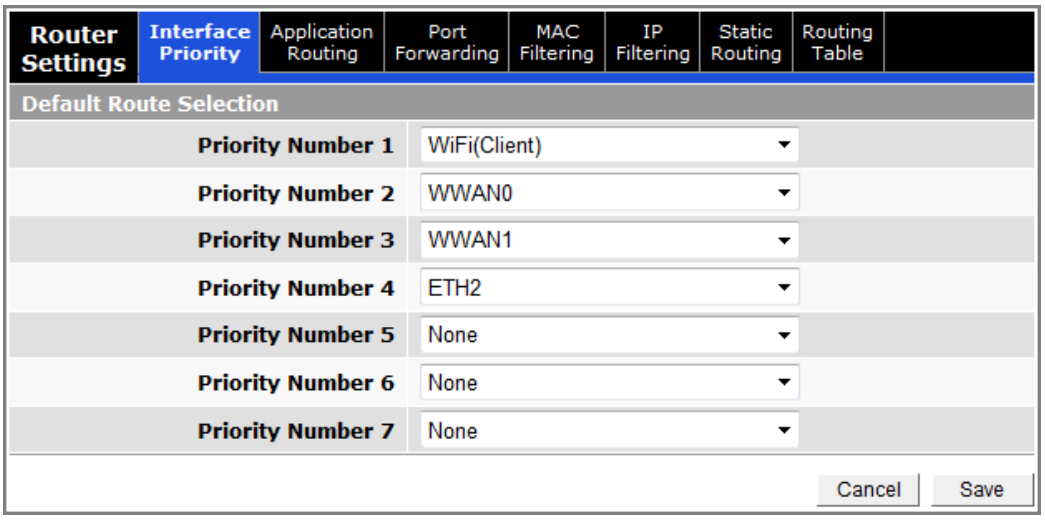
APPENDIX F —USING IPSEC TO CREATE IP PERSISTENCE

This application note describes how the Fusion and connected devices can be easily accessed from a remote application using IPsec tunnels. This method allows for continuous communication even though the Wan IP address changes when a Fusion's WAN interface becomes unavailable and the Fusion uses an alternate method to access the Internet.

1. THE PROBLEM WITH MULTIPLE WANS

The Fusion LTE router supports many methods for accessing the Internet. These include either of two cellular modules, a WiFi module, or potentially any of three Ethernet ports which may be connected to yet another wireless device such as a narrowband Motorola HPD. The Fusion can be programmed to automatically detect which of these interfaces is available at any given time and will choose the highest priority interface for sending traffic.

Figure 89 Router Settings – Interface Priority



Traffic originating from within the Fusion or traffic originating from devices connected directly to the Fusion will automatically be routed out through the active WAN interface and will easily reach its required destination. However, when the user wants to actively poll or remotely access the Fusion and connected devices, the changing Fusion WAN interface can pose a problem. As the Fusion switches between one interface and the next, the IP address used to access the Fusion remotely changes as well. In addition, many cellular accounts will assign the WWAN interface a dynamic IP address, meaning that the IP address used for remote access will be different each time the unit connects to the cellular network.

To solve this particular problem, the Fusion allows secure tunnels to be configured and automatically created between the Fusion and a host server at the user's office or corporate location. This tunnel is automatically reestablished by the Fusion every time the Fusion changes its outgoing interface or whenever there is an interruption in the cellular service. As a result, applications residing behind either end of this secure tunnel can continue to have direct access to each other without needing to know which interface the Fusion is currently using to access the Internet or what IP address is currently assigned to the Fusion's WAN interface.

2. IPSEC TUNNEL

IPsec utilizes the client-server model, where the IPsec client (Fusion) will initiate an encrypted tunnel to the IPsec server using a pre-established security key. The tunnel creates a virtual private network (VPN) linking the networks attached to either endpoint. Once the tunnel is created, data can flow in either direction.

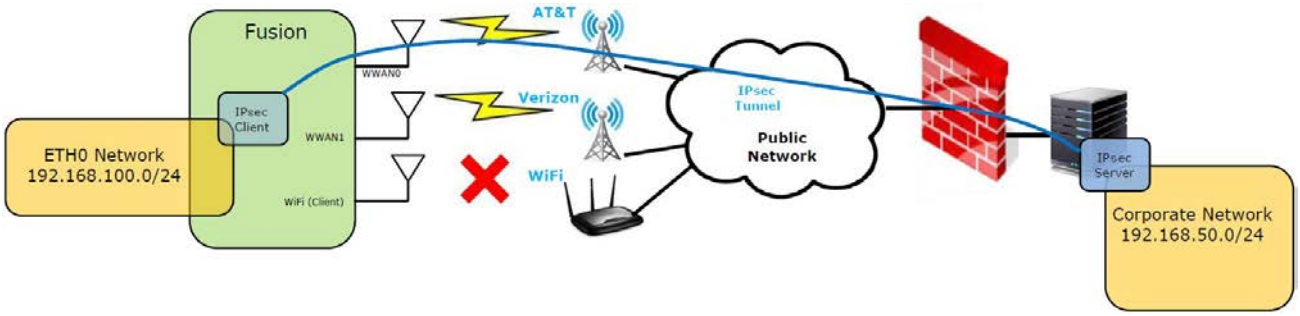
The IPsec protocol encapsulates and encrypts the entire packet destined for the remote network. The packet will have a new IP header, allowing the packet to be forwarded over the public network from the IPsec client to the IPsec server or vice versa. At the receiving end, the IPsec header will be stripped from the packet. The packet will be decrypted and then forwarded into the local area network as if both remote networks were connected directly.

Imagine a scenario where the user programs the Fusion's interface priority as shown in Figure 89 in Section 1.

- Priority #1: WiFi Client
- Priority #2: AT&T WWAN0 – Wireless Wide Area Network 0
- Priority #3: Verizon WWAN1 – Wireless Wide Area Network 1

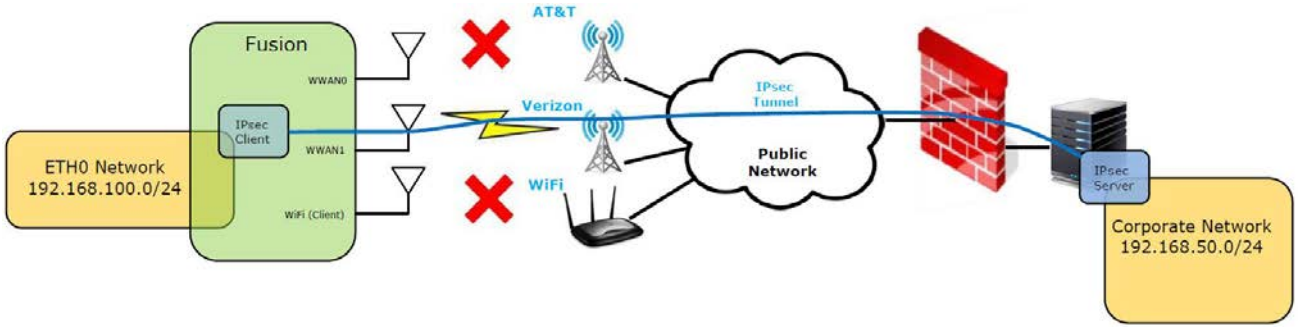
In the diagram below, the Fusion powers up, connects to both cellular providers, AT&T and Verizon. Since no WiFi is available and AT&T (WWAN0) is the highest priority available interface, the IPsec tunnel is established between the Fusion and the IPsec server using WWAN0.

Figure 90 Fusion using WWAN0 as the default interface



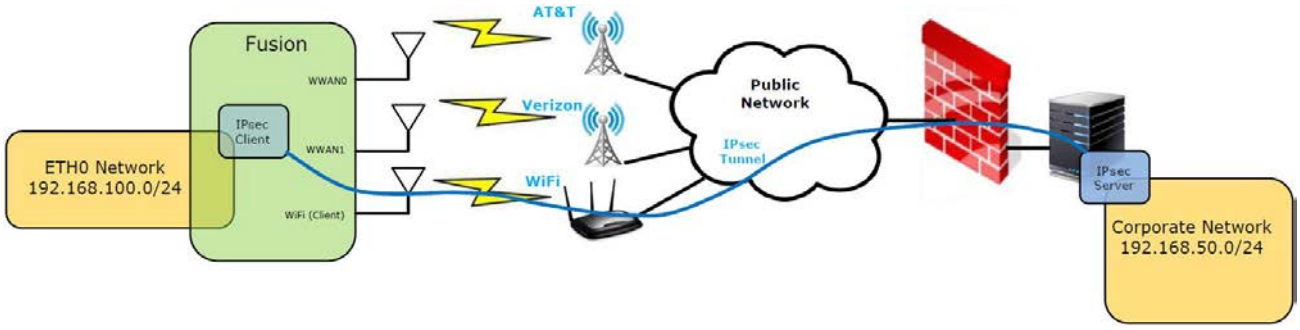
If by chance AT&T becomes unavailable at some later time, the Fusion will switch to the backup cellular provider (in this example, Verizon). The IPsec tunnel will be reestablished through the Fusion's WWAN1 interface, and communications between the remote networks will continue as they had initially.

Figure 91 Fusion using WWAN1 as the default interface



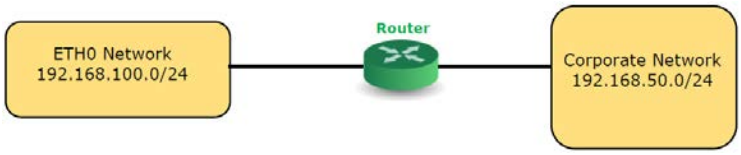
Suppose later in the day the user arrives at a satellite office in another town. The Fusion can be programmed to connect to the local WiFi hotspot, allowing all traffic to be routed through the WiFi access point and avoiding cellular data usage fees. In this example, the Fusion switches from its default WAN interface to WiFi. The IPsec tunnel is reestablished using WiFi, allowing communications to continue between the remote networks.

Figure 92 Fusion using WiFi client as default interface



In all three of the scenarios depicted in the three previous figures, devices or applications running on the Fusion's ETH0 network or the corporate network can access one another through the IPsec tunnel. To those applications, it appears as if the two networks are connected directly together with a single router.

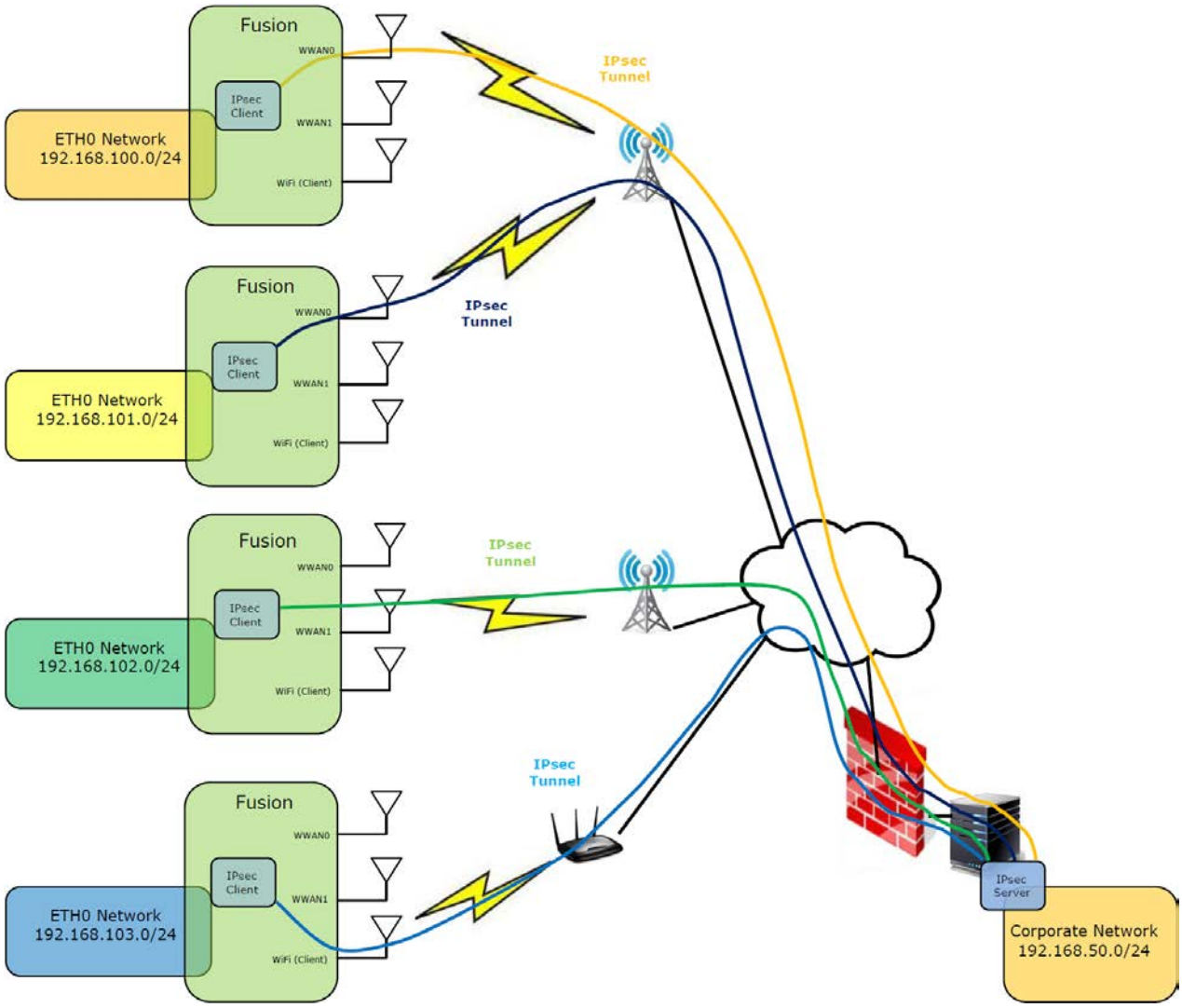
Figure 93 Simplified network topology after IPsec tunnels are established



IPsec with Multiple Fusions

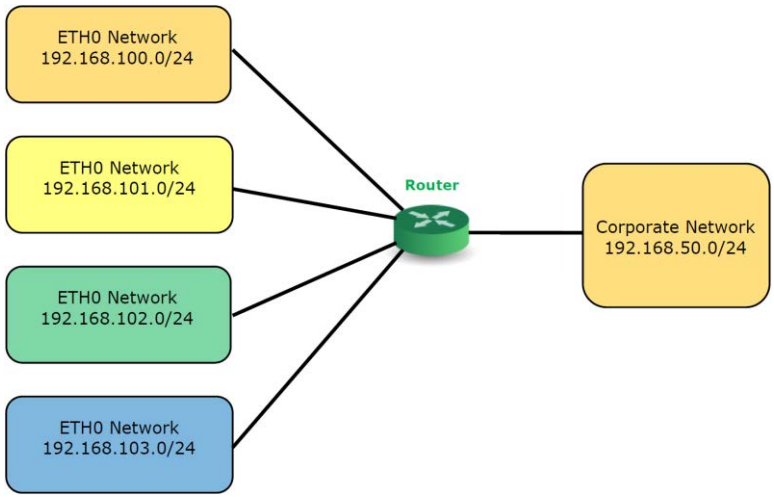
Additionally, many IPsec clients (for example, additional Fusion routers) can connect to a single IPsec server. This allows an entire network of Fusion routers to be easily accessed by a host application residing on the corporate network.

Figure 94 Multiple Fusion routers with IPsec tunnels



The IPsec tunnels create the effect of simplifying the network shown above. Since traffic is routed through the IPsec tunnels automatically, devices located in the end networks view the network as if all the networks were connected through a single router.

Figure 95 Simplified network topology after IPsec tunnels are established



When setting up a system as described above, the user must be careful to select an IP addressing scheme so that the IP addressing range of one linked network does not overlap the IP address range of another linked network. Each network must have a unique IP address range.

3. ADVANTAGES OF USING IPSEC

Using IPsec with the Fusion router provides several key advantages.

- Eliminates the need to have static IP addresses associated with Fusion cellular accounts. After an IPsec tunnel is established, devices from either the corporate network or the remote network can initiate communications.
- One or many devices can be connected to a Fusion router. Each device will have complete access to and from the corporate network without complicated routing or port-forwarding rules.
- IP Persistence: An application running on the corporate network can reach any Fusion router or remote device connected to the Fusion LAN using its private IP address regardless of which WAN interface is currently active on the Fusion.
- IPsec provides enhanced security, protecting critical data as it travels through public networks.

APPENDIX G — SERVICE AND SUPPORT AND WARRANTY STATEMENT

Product Warranty, RMA, and Contact Information

CalAmp guarantees that every Fusion router will be free from physical defects in material and workmanship for one (1) year from the date of purchase when used within the limits set forth in the specifications section of this manual.

The manufacturer's Warranty Statement is available on the following page. If the product proves defective during the warranty period, contact CalAmp Customer Service to obtain a Return Material Authorization (RMA).

RMA Request/Contact Customer Service

CalAmp
1401 North Rice Avenue
Oxnard, CA 93030
Tel: 805.987.9000
Fax: 805.987.8359

BE SURE TO HAVE THE EQUIPMENT MODEL AND SERIAL NUMBER AND BILLING AND SHIPPING ADDRESSES ON HAND WHEN CALLING.

When returning a product, mark the RMA clearly on the outside of the package. Include a complete description of the problem and the name and telephone number of a contact person. RETURN REQUESTS WILL NOT BE PROCESSED WITHOUT THIS INFORMATION.

For units in warranty, customers are responsible for shipping charges to CalAmp. For units returned out of warranty, customers are responsible for all shipping charges. Return shipping instructions are the responsibility of the customer.

Product Documentation

CalAmp reserves the right to update its products, software, or documentation without obligation to notify any individual or entity. Product updates may result in differences between the information provided in this manual and the product shipped. For the most current product documentation and application notes, visit www.calamp.com.

Tech Support

CalAmp
1401 North Rice Avenue
Oxnard, CA 93030
1.805.987.9000
E-mail: wngsupport@calamp.com

WARRANTY STATEMENT

CalAmp warrants to the original purchaser for use ("Buyer") that data telemetry products manufactured by CalAmp ("Products") are free from defects in material and workmanship and will conform to published technical specifications for a period of, except as noted below, one (1) year from the date of shipment to Buyer. CalAmp makes no warranty with respect to any equipment not manufactured by CalAmp, and any such equipment shall carry the original equipment manufacturer's warranty only. CalAmp further makes no warranty as to and specifically disclaims liability for, availability, range, coverage, grade of service or operation of the repeater system provided by the carrier or repeater operator. Any return shipping charges for third party equipment to their respective repair facilities are chargeable and will be passed on to the Buyer.

If any Product fails to meet the warranty set forth above during the applicable warranty period and is returned to a location designated by CalAmp. CalAmp, at its option, shall either repair or replace such defective Product, directly or through an authorized service agent, within thirty (30) days of receipt of same. No Products may be returned without prior authorization from CalAmp. Any repaired or replaced Products shall be warranted for the remainder of the original warranty period. Buyer shall pay all shipping charges, handling charges, fees and duties for returning defective Products to CalAmp or authorized service agent. CalAmp will pay the return shipping charges if the Product is repaired or replaced under warranty, exclusive of fees and duties. Repair or replacement of defective Products as set forth in this paragraph fulfills any and all warranty obligations on the part of CalAmp.

This warranty is void and CalAmp shall not be obligated to replace or repair any Products if (i) the Product has been used in other than its normal and customary manner; (ii) the Product has been subject to misuse, accident, neglect or damage or has been used other than with CalAmp approved accessories and equipment; (iii) unauthorized alteration or repairs have been made or unapproved parts have been used in or with the Product; or (iv) Buyer failed to notify CalAmp or authorized service agent of the defect during the applicable warranty period. CalAmp is the final arbiter of such claims.

THE AFORESAID WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED AND IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. CALAMP AND BUYER AGREE THAT BUYER'S EXCLUSIVE REMEDY FOR ANY BREACH OF ANY OF SAID WARRANTIES IT AS SET FORTH ABOVE. BUYER AGREES THAT IN NO EVENT SHALL CALAMP BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, SPECIAL, INDIRECT OR EXEMPLARY DAMAGES WHETHER ON THE BASIS OF NEGLIGENCE, STRICT LIABILITY OR OTHERWISE. The purpose of the exclusive remedies set forth above shall be to provide Buyer with repair or replacement of non-complying Products in the manner provided above. These exclusive remedies shall not be deemed to have failed of their essential purpose so long as CalAmp is willing and able to repair or replace non-complying Products in the manner set forth above.

This warranty applies to all Products sold worldwide. Some states do not allow limitations on implied warranties so the above limitations may not be applicable. You may also have other rights, which vary from state to state.

EXCEPTIONS

THIRTY DAY: Tuning and adjustment of telemetry radios

NO WARRANTY: Fuses, lamps and other expendable parts

ABOUT CALAMP

CalAmp is a leading provider of wireless communications products that enable anytime/anywhere access to critical information, data, and entertainment content. With comprehensive capabilities ranging from product design and development through volume production, CalAmp delivers cost-effective high quality solutions to a broad array of customers and end markets. CalAmp is the leading supplier of Direct Broadcast Satellite (DBS) outdoor customer premise equipment to the U.S. satellite television market. The Company also provides wireless data communication solutions for the telemetry and asset tracking markets, private wireless networks, railroad Positive Train Control (PTC) radio transceivers, public safety communications and critical infrastructure and process control applications. For additional information, please visit the Company's website at www.calamp.com.