SR1410
Outdoor Wireless Mesh Router

Installation and User Guide

Version 0.01
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Record of Changes

Manual Version / Date	Description
0.01 Aug, 2013	Preliminary version

Notices

The software and methods implemented in this product may be protected by US Patents:

Patent Application Name	Patent Application Number	Jurisdiction of Grant
DYNAMIC ROUTING WITHIN A WIRELESS MESH NETWORK	61/794,869	U.S.
DYNAMIC ADJUSTMENT OF QUALITY OF SERVICE PARAMETERS IN RESPONSE TO CHANGING NETWORK CONDITIONS	61/785,074	U.S.
SYSTEM FOR MINIMIZING INTERFERENCE THROUGH SIMULTANEOUS CHANNEL SWITCHING WITHIN A MESH NETWORK, AND METHODS, DEVICES, SOFTWARE, AND COMPUTER-READABLE MEDIA ASSOCIATED THEREWITH	61/784,795	U.S.
MULTICAST TRAFFIC MANAGEMENT WITHIN A WIRELESS MESH NETWORK	61/794,968	U.S.
BANDWIDTH ESTIMATION BASED ON LOCATION IN A WIRELESS NETWORK	61/793,415	U.S.
SYSTEMS AND METHODS FOR EXTENDING BROADBAND ACCESS THROUGH A WIRELESS MESH NETWORK	61/793,177	U.S.

This device complies with FCC Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Caution, changes or modifications not expressly approved by Vivint could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiated radio frequency energy and, if not installed and used in accordance with the

instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense."

RF Exposure: In order to comply with radio frequency (RF) exposure limits, the antennas for this product should be positioned no less than 20 cm from your body or nearby persons.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

This radio transmitter SR1410 [or IC number if desired] has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet émetteur radio SR1410 [or IC number if desired] a été approuvé par Industrie Canada pour fonctionner avec les types d'antennes énumérés ci-dessous avec le gain maximal admissible et l'impédance requis pour chaque type d'antenne indiqué. Types d'antennes ne figurent pas dans cette liste, ayant un gain supérieur au gain maximum indiqué pour ce type sont strictement interdits pour une utilisation avec cet appareil.

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The manual must provide the maximum antenna gain permitted for devices in the bands 5250-5350MHz and 5470-5725MHz.

High power radars are allocated as primary users (meaning they have priority) in the 5250MHz to 5350MHz and 5650MHz to 5850MHz bands. These radars could cause interference and/or damage to Wireless LAN devices used in Canada.

Les utilisateurs de radars de haute puissance sont désignés utilisateurs principaux (c.-à-d., qu'ils ont la priorité) pour les bandes 5 250 - 5 350 MHz et 5 650 - 5 850 MHz. Ces radars pourraient causer du brouillage et/ou des dommages aux dispositifs LAN-EL.

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TABLE OF CONTENTS

Introduction

The Vivint SR1410 is a beamforming indoor/outdoor-rated wireless access point/Wireless Distribution System (WDS) router that is designed for the deployment of advanced IEEE 802.11 wireless services in harsh environments. As an outdoor wireless access point, the SR1410 can provide IEEE 802.11 wireless service to local wireless clients. The SR1410 is also able to create multipoint connections over wireless backhaul radios. A SR1410 equipped with POE injector can also provide 802.11 n.

When deployed for wireless bridging, two or more SR1410 models provide point-to-point or point-to-multipoint router links between remote Ethernet LANs, and can simultaneously serve wireless service for local clients on the non-bridging radio. The wireless router system offers a fast, reliable, and cost-effective solution for connectivity between remote Ethernet LANs or to provide Internet access to an isolated site.

The SR1410 is capable of filtering, classifying, shaping, forwarding Layer 3 traffic.

The SR1410 is a stand-alone device that operates independently of a Vivint Network Controller. It provides the following capabilities:

- Stand-alone wireless access point (802.11n) with support for wireless backhaul over 5 GHz
- Point-to-point WDS router and router functions for 5 GHz
- Point-to-multipoint WDS Router for 5 GHz
- Four 2.4 5Ghz SMA female detachable antenna interfaces
- Stand-alone wireless access point (802.11n) with support for wireless backhaul over 5 GHz
- One Ethernet interfaces

☑ The SR1410 requires detachable antennas, sold separately.

Vivint Mesh Points are radio transmission devices and as such are subject to governmental regulations. Vivint mesh points are NOT sold through authorized, non-retail, distribution channels and are required to be deployed by a Professional Vivint Installer / Qualified Network Administrator. The professional installer responsible for the configuration and operation of Access Points must ensure that the installation complies with local regulations, frequencies, channels and output power.

Product Improvements and Upgrades

Vivint reserves the right to make changes and/or improvements to its products, without notification and without incurring any obligation to incorporate such changes or improvements in products previously sold or shipped.

To receive notification about upgrades or bulletins that may become available from time to time, please complete the enclosed Warranty Card and mail or fax it to Vivint.

1.1.1 Data rates

Under ideal deployment conditions (low line of sight, low interference, and low moisture content), the SR1410 router can operate over a range of up to 1 km or provide a high-speed connection of 100 Mbps The range also depends on the type of antenna used. The maximum data rate for a link decreases as the operating range increases.

When planning a wireless router link, take into account the maximum distance and data rates for the various antenna options.

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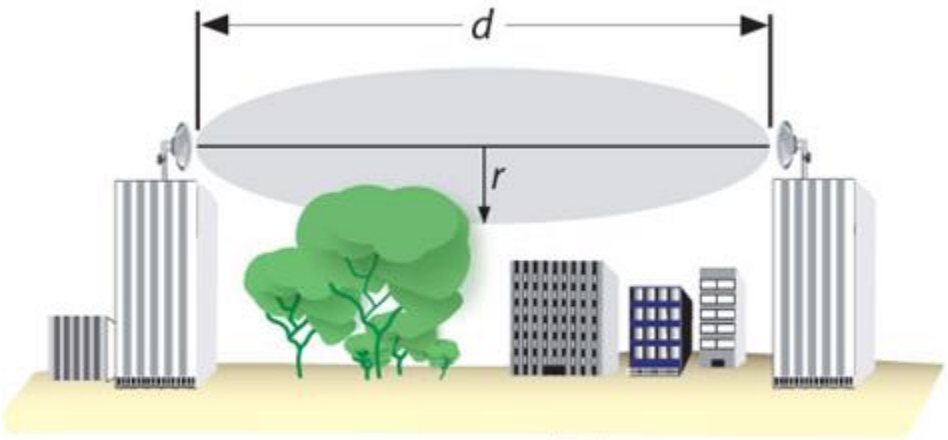
1.1.2 Radio Path Planning

The wireless router link requires a “radio line of sight” between the two antennas for optimum performance.

The concept of radio line of sight involves the area along a link through which the bulk of the radio signal power travels. This area is known as the first Fresnel Zone of the radio link. For a radio link, no object (including the ground) must intrude within 60% of the first Fresnel Zone.

The following figure illustrates the concept of a good radio line of sight.



$$r = 72.6 \times \sqrt{\frac{d}{4f}}$$

If there are obstacles in the radio path, there may still be a radio link but the quality and strength of the signal will be affected. Calculating the maximum clearance from objects on a path is important as it directly affects the decision on antenna placement and height. It is especially critical for long-distance links, where the radio signal could easily be lost.

NOTE: For wireless links less than 500 m, the IEEE 802.11a radio signal will tolerate some obstacles in the path and may not even require a visual line of sight between the antennas.

When planning the radio path for a wireless router link, consider these factors:

- Avoid any partial line of sight between the antennas
- Be cautious of trees or other foliage that may be near the path, or may grow and obstruct the path
- Be sure there is enough clearance from buildings and that no building construction may eventually block the path
- Check the topology of the land between the antennas using topographical maps, aerial photos, or even satellite image data (software packages are available that may include this information for your area)

1.2 Antenna Height

A reliable wireless link is usually best achieved by mounting the antennas at each end high enough for a clear radio line of sight between them. The minimum height required depends on the distance of the link, obstacles that may be in the path, topology of the terrain, and the curvature of the earth (for links over 3 miles). For long-distance links, the AP may have to be mounted on masts or poles that are tall enough to attain the minimum required clearance. Use the following table to estimate the required minimum clearance above the ground or path obstruction (for 5 GHz router links).

Antenna Minimum Height and Clearance Requirements

Total Link Distance	Max Clearance for 60% of First Fresnel Zone at 5.8 GHz	Approximate Clearance for Earth Curvature	Total Clearance Required at Mid-point of Link
0.25 mile (402 m)	4.5 ft (1.4 m)	0	4.5 ft (1.4 m)
0.5 mile (805 m)	6.4 ft (1.95 m)	0	6.4 ft (1.95 m)
1 mile (1.6 km)	9 ft (2.7 m)	0	9 ft (2.7 m)
2 miles (3.2 km)	12.7 ft (3.9 m)	0	12.7 ft (3.9 m)
3 miles (4.8 km)	15.6 ft (4.8 m)	1.8 ft (0.5 m)	17.4 ft (5.3 m)
4 miles (6.4 km)	18 ft (5.5 m)	3.2 ft (1.0 m)	21.2 ft (6.5 m)
5 miles (8 km)	20 ft (6.1 m)	5 ft (1.5 m)	25 ft (7.6 m)
7 miles (11.3 km)	24 ft (7.3 m)	9.8 ft (3.0 m)	33.8 ft (10.3 m)
9 miles (14.5 km)	27 ft (8.2 m)	16 ft (4.9 m)	43 ft (13.1 m)
12 miles (19.3 km)	31 ft (9.5 m)	29 ft (8.8 m)	60 ft (18.3 m)
15 miles (24.1 km)	35 ft (10.7 m)	45 ft (13.7 m)	80 ft (24.4 m)

Note that to avoid any obstruction along the path, the height of the object must be added to the minimum clearance required for a clear radio line of sight. Consider the following simple example, illustrated in the figure below.

1.2.1 Antenna Position and Polarization

Once the required antenna height has been determined, other factors affecting the precise position of the wireless router must be considered:

- Be sure there are no other radio antennas within 2 m (6 ft) of the wireless router. These include other WiFi radio antennas
- Place the wireless router away from power and telephone lines
- Avoid placing the wireless router too close to any metallic reflective surfaces, such as roof-installed air-conditioning equipment, tinted windows, wire fences, or water pipes. Ensure that there is at least 5 feet clearance from such objects
- The wireless router antennas at both ends of the link must be positioned with the same polarization direction, either horizontal or vertical. Proper alignment helps to maximize throughput.

The wireless router's integrated antenna sends a radio signal that is polarized in a particular direction. The antenna's receive sensitivity is also higher for radio signals that have the same polarization. To maximize the performance of the wireless link, both antennas must be set to the same polarization direction.

1.2.2 Radio Interference

The avoidance of radio interference is an important part of wireless link planning. Interference is caused by other radio transmissions using the same or an adjacent channel frequency. You should first scan your proposed site using a spectrum analyzer to determine if there are any strong radio signals using the 802.11a,n channel frequencies. Always use a channel frequency that is furthest away from another signal.

If radio interference is still a problem with your wireless link, changing the antenna polarization direction may improve the situation.

1.2.3 Weather Conditions

When planning wireless links, you must take into account any extreme weather conditions that are known to affect your location. Consider these factors:

- **Temperature** — The wireless router is tested for normal operation in temperatures from -33°C to 55°C. Operating in temperatures outside of this range may cause the unit to fail.
- **Wind Velocity** — The wireless router can operate in winds up to 90 miles per hour and survive higher wind speeds up to 125 miles per hour. You must consider the known maximum wind velocity and direction at the site and be sure that any supporting structure, such as a pole, mast, or tower, is built to withstand this force.
- **Lightning** — The wireless router includes its own built-in lightning protection via chassis grounding. However, you should make sure that the unit, any supporting structure, and cables are all properly grounded. Additional protection using lightning rods, lightning arrestors, or surge suppressors may also be employed.
- **Rain** — The SR1410 is weatherproofed against rain. Also, prolonged heavy rain has no significant effect on the radio signal. However, it is recommended to use weatherproof boots on cables connecting to the SR1410 or to apply weatherproof sealing tape around connectors for extra

protection. If moisture enters a connector, it may cause a degradation in performance or even a complete failure of the link.

- **Snow and Ice** — Falling snow, like rain, has no significant effect on the radio signal. However, a buildup of snow or ice on antennas may cause the link to fail. In this case, the snow or ice

1.3 Ethernet Cabling

When a suitable antenna location has been determined, you must plan a cable route from the SR1410 wireless router outdoors to the equipment indoors. If a power injector/adapter module is used, it is for indoor installation only. Consider these points:

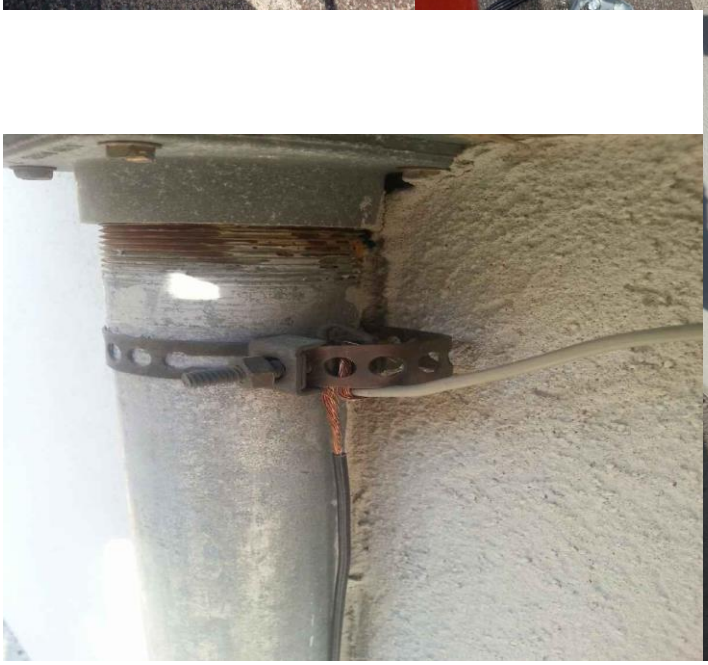
- The Ethernet cable length should never be longer than 90 m (295 ft)
- Determine a building entry point for the cable
- Determine if conduits, bracing, or other structures are required for safety or protection of the cable
- For lightning protection at the power injector end of the cable, consider using

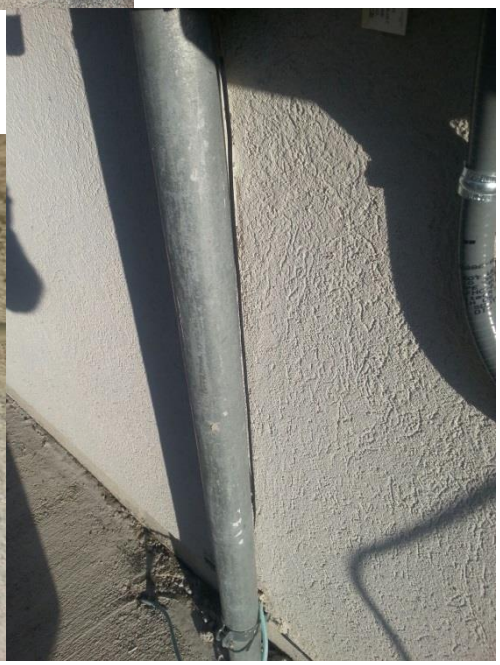
Example Installations:

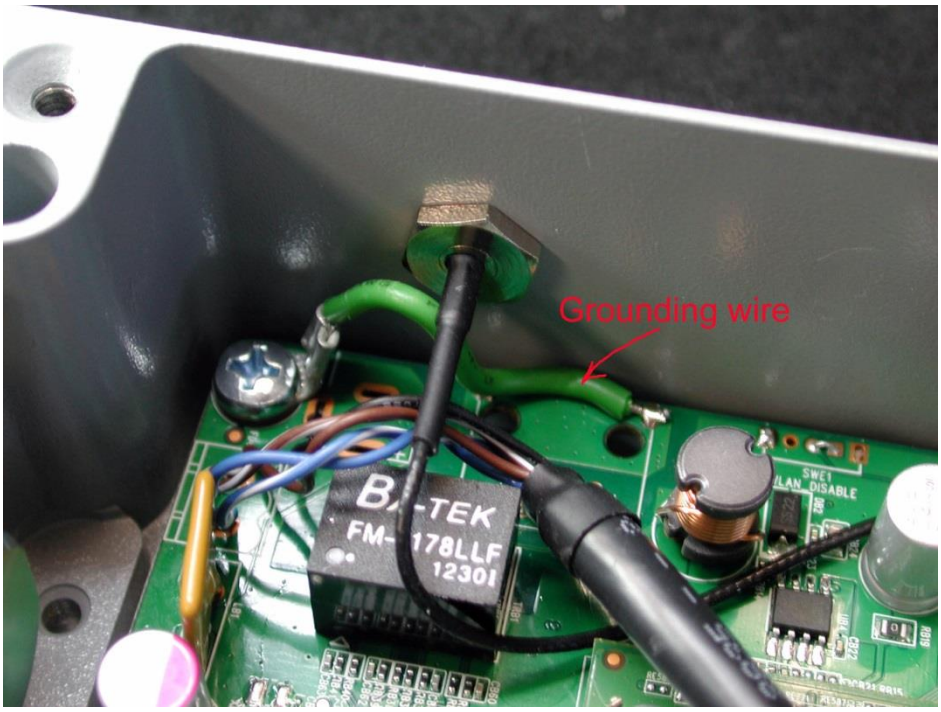
1.4 Grounding

It is important that the wireless router, cables, and any supporting structures are properly grounded. The wireless router unit includes a grounding screw for attaching a ground wire. Be sure that grounding is available and that it meets local and national electrical codes.







1.5 System Setup

1.5.1 Factory Default Configuration

To reset to factory defaults, login as '**root**' and issue the command '**restore_default_config'**. The command will first backup the current configuration to a TFTP server first before restoring the configuration to factory defaults.

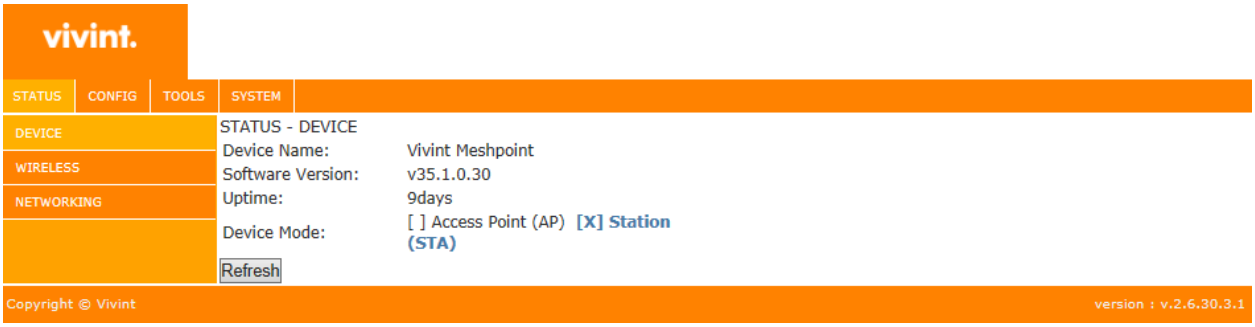
1.5.2 Connecting SR1410 for the First Time

Default factory password for 'root' account is 'turnkey'.

Factory default IP address for eth0 is 192.168.1.100

1.5.3 Using the Web-based Configuration Setup Wizard

Provision the ‘eth0’ interface on SR1410 to be in the default subnet as the accessing machine and use HTTP to access the node.



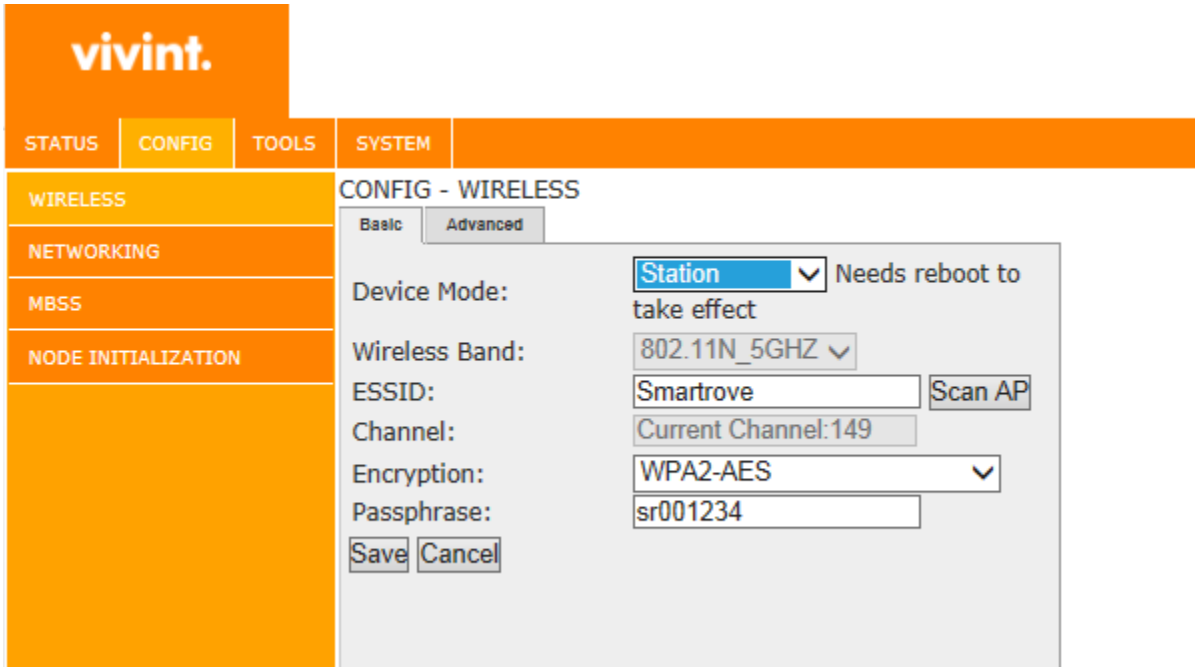
SR1410 console:

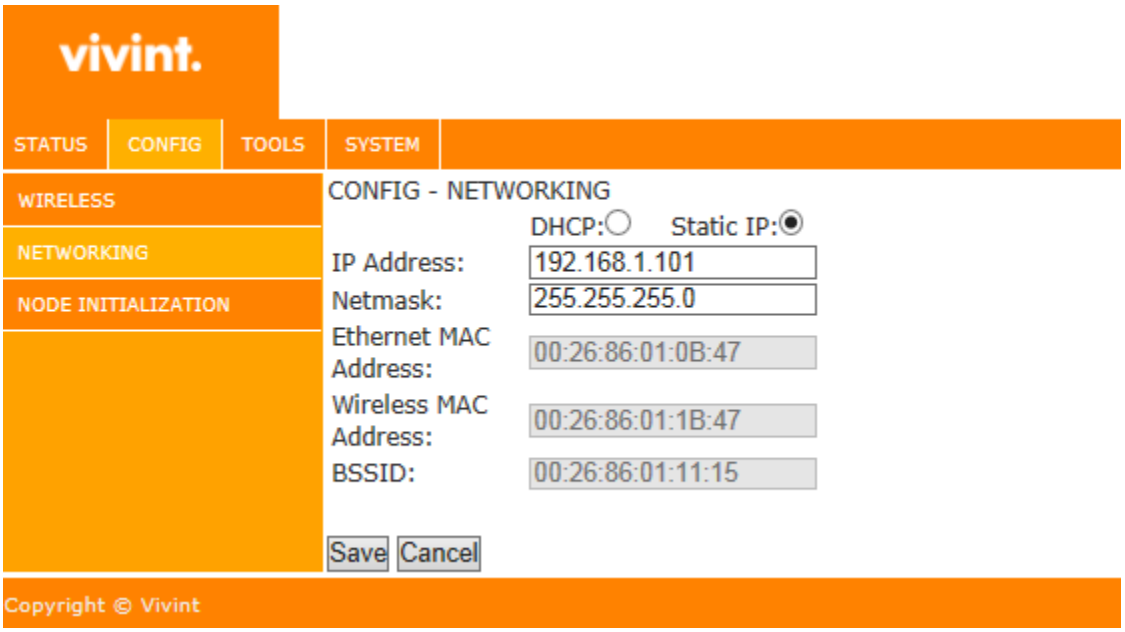
root@Vivint:~# ifconfig eth0 192.168.1.1 netmask 255.255.255.0 up

Accessing computer:

http://192.168.1.100/

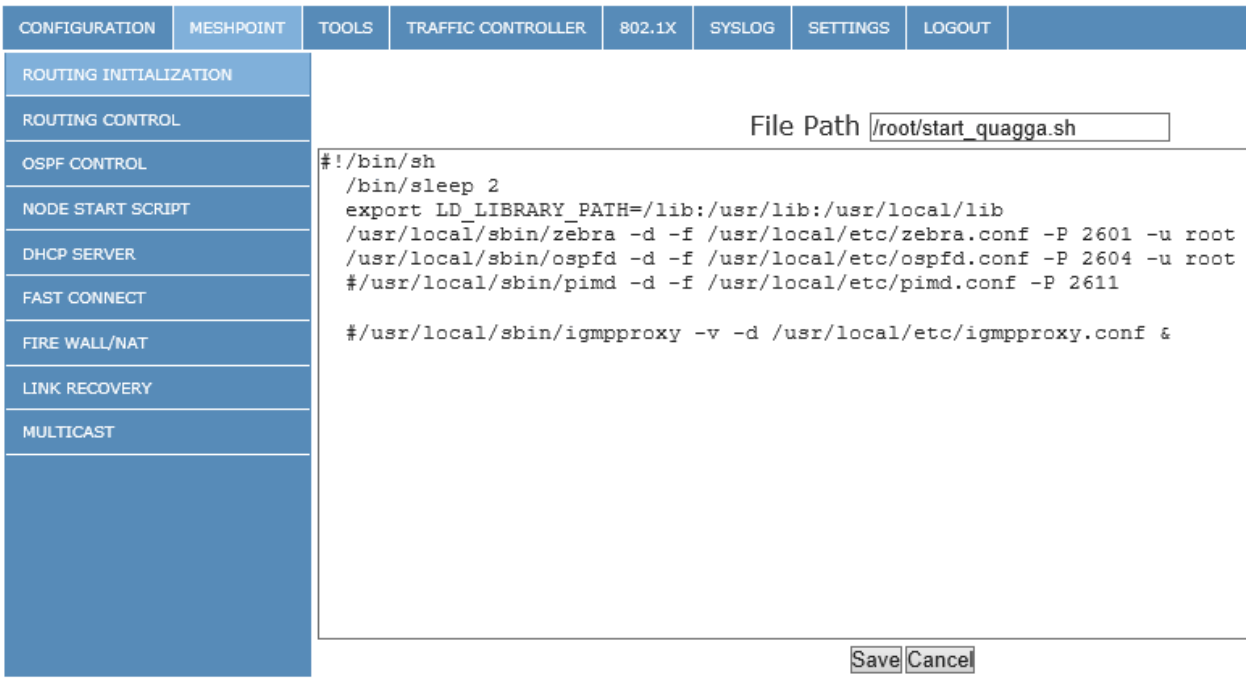
1.6 System Configuration




vivint.
STATUS
CONFIG
TOOLS
SYSTEM
WIRELESS
NETWORKING
NODE INITIALIZATION
CONFIG - NETWORKING
DHCP:
Static IP:
IP Address:
192.168.1.101
Netmask:
255.255.255.0
Ethernet MAC Address:
00:26:86:01:0B:47
Wireless MAC Address:
00:26:86:01:1B:47
BSSID:
00:26:86:01:11:15
Save
Cancel
Copyright © Vivint


MESH MONITOR
MESH PROVISION
MESH BLOCK CONTROL
ALARMS AND EVENTS
TRAFFIC
TRAFFIC STATS
LOGIN
TOPOLOGICAL VIEW
ACTIVE ELEMENTS
W111°59'24"
N40°37'48"
440 ft
© 2013 Google

1.7 Advanced Configuration



1.8 Traffic Control

IP	MAC	Interface	
192.168.99.7	ac:8d:14:00:06:b6	eth1	Egress Flow Control
192.168.99.81	00:00:00:00:00:00	eth1	Egress Flow Control
192.168.99.61	ac:8d:14:00:07:56	eth1	Egress Flow Control
192.168.99.42	ac:8d:14:00:07:0a	eth1	Egress Flow Control
192.168.99.57	64:70:02:f9:44:ad	eth1	Egress Flow Control
192.168.99.148	74:44:01:85:ec:43	eth1	Egress Flow Control
192.168.99.125	ac:8d:14:00:04:0e	eth1	Egress Flow Control
192.168.99.150	64:70:02:f9:37:8d	eth1	Egress Flow Control
192.168.99.25	ac:8d:14:00:06:ba	eth1	Egress Flow Control
192.168.99.76	4c:60:de:3b:e5:5d	eth1	Egress Flow Control
192.168.99.82	64:70:02:eb:50:75	eth1	Egress Flow Control
192.168.99.149	ac:8d:14:00:06:64	eth1	Egress Flow Control
192.168.99.24	64:70:02:f9:44:8b	eth1	Egress Flow Control
192.168.99.118	84:1b:5e:46:1c:32	eth1	Egress Flow Control
192.168.99.68	64:70:02:eb:40:59	eth1	Egress Flow Control
192.168.99.135	00:00:00:00:00:00	eth1	Egress Flow Control
192.168.99.86	64:70:02:eb:3f:49	eth1	Egress Flow Control
192.168.99.62	64:70:02:f9:37:19	eth1	Egress Flow Control
192.168.99.9	ac:8d:14:00:06:ee	eth1	Egress Flow Control
192.168.99.73	ac:8d:14:00:04:14	eth1	Egress Flow Control
192.168.99.33	00:00:00:00:00:00	eth1	Egress Flow Control

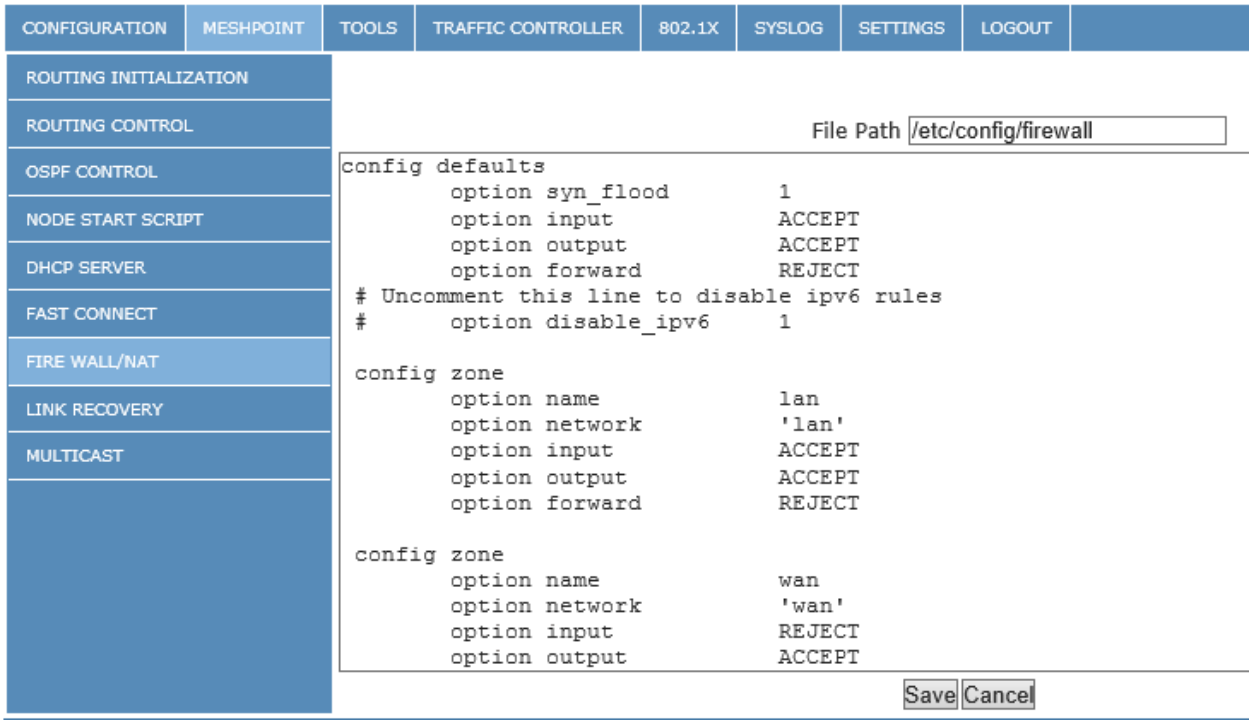
The Hierarchical Token Bucket[HTB] creates a hierarchy of software queues called qdiscs which represent the flow of traffic on a network interface. A parent (base) qdisc can have multiple child qdiscs which in turn can be parents to other qdiscs. A leaf qdisc is the one which has no children.

The HTB is a classfull qdisc which means that traffic flowing through the interface can be classified into flows. The classification can be performed using various filters assigned to the qdisc. The parameter "rate" in the above command specifies the base or guaranteed bit rate of the qdisc corresponding to the class. The parameter burst corresponds to the amount of data in bytes that will be processed at a time for that qdisc. For an ingress qdisc it represents the bytes send up to the network stack for processing. For an egress qdisc it represents the amount of data sent to the hardware for transmitting out. The parameter "ceil" or ceiling represents the maximum bit rate for the qdisc. HTB qdiscs have the capability to borrow bandwidth from peers which will be explained in the subsequent sections.

Example: **tc class add dev eth0 parent 1:1 classid 1:10 htb rate 50mbit burst 1mbit ceil 60mbit**
tc class add dev eth0 parent 1:1 classid 1:11 htb rate 20mbit burst 1mbit ceil 40mbit

The above commands create qdiscs of class labeled "1:10" and "1:11" for the qdisc "1:1". The parameter "rate" represents the guaranteed or base bit rate for the qdiscs. The parameter "burst" is the amount of data transmitted/received for the qdisc in a given time period. The parameter "ceil" is the maximum bit rate for the qdisc. As mentioned before peer qdiscs can borrow bandwidth from each other if one of the qdiscs is using less than base bandwidth or there is unused bandwidth available. Suppose qdisc 1:10 uses 50mbits but requires a total of 60mbps due to the bandwidth intensive nature of the application.. On the other hand class 1:11 is using 10mbits out of the assigned 20mbits base bandwidth. In this case class 1:10 can borrow the additional 10mbps from 1:11 and use up its maximum assigned bandwidth of 60mbps.

1.9 NAT/Firewall

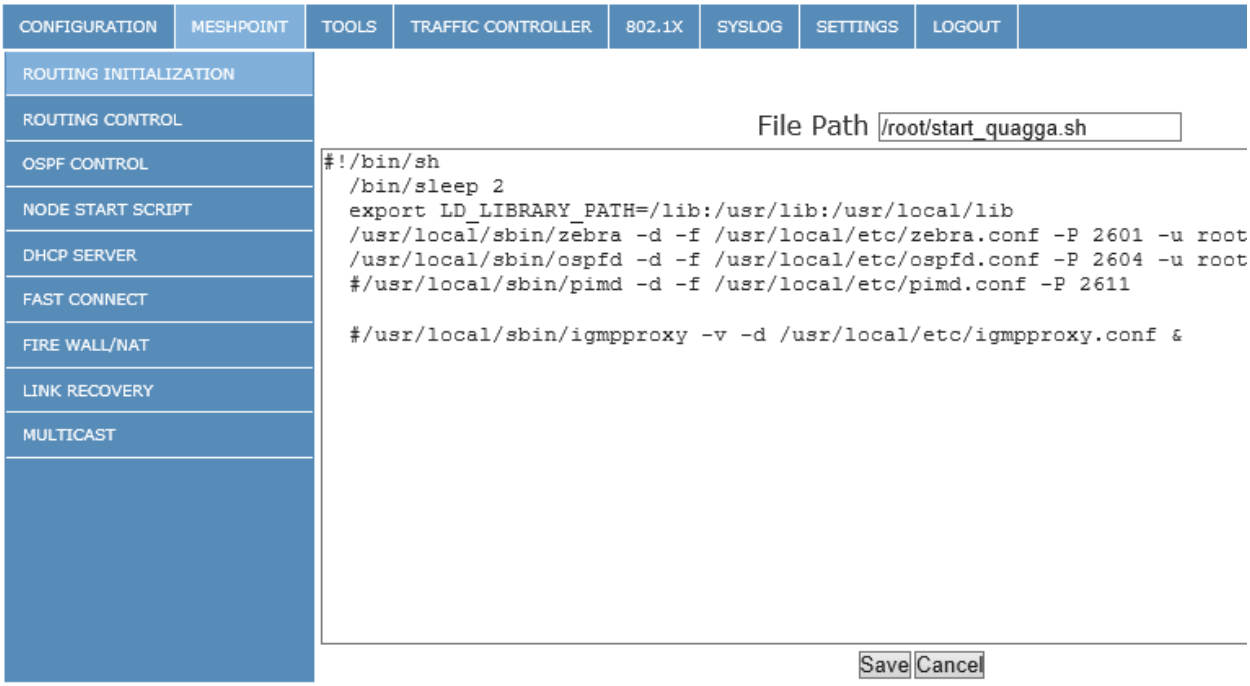


1.10 Routing Protocols

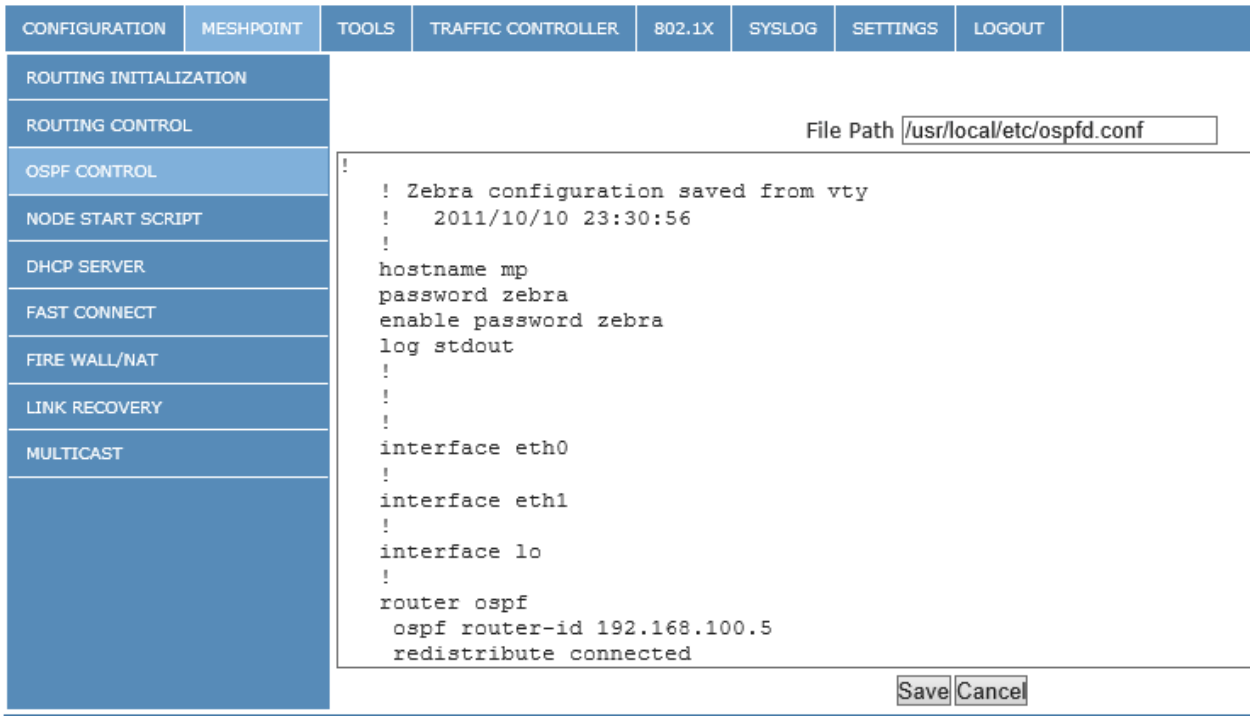
All Routing protocols can be started from CLI or from the web-interface. Mesh links are ad-hoc links.

In ad-hoc networks, nodes do not start out familiar with the topology of their networks; instead, they have to discover it. The basic idea is that a new node may announce its presence and should listen for announcements broadcast by its neighbors. Each node learns about nodes nearby and how to reach them, and may announce that it, too, can reach them.

IP routing protocol which is optimized for mobile ad-hoc networks but can also be used on other wireless ad-hoc networks. SR1410 uses proactive link-state routing protocol which uses Hello and Topology Control (TC) messages to discover and then discriminate link state information throughout the mobile ad-hoc network. Individual nodes use this topology information to compute next hop destinations for all nodes in the network using shortest hop forwarding paths.


CONFIGURATION
MESHPOINT
TOOLS
TRAFFIC CONTROLLER
802.1X
SYSLOG
SETTINGS
LOGOUT
ROUTING INITIALIZATION
ROUTING CONTROL
OSPF CONTROL
NODE START SCRIPT
DHCP SERVER
FAST CONNECT
FIRE WALL/NAT
LINK RECOVERY
MULTICAST
File Path /root/start_quagga.sh
#!/bin/sh
/bin/sleep 2
export LD_LIBRARY_PATH=/lib:/usr/lib:/usr/local/lib
/usr/local/sbin/zebra -d -f /usr/local/etc/zebra.conf -P 2601 -u root
/usr/local/sbin/ospfd -d -f /usr/local/etc/ospfd.conf -P 2604 -u root
#/usr/local/sbin/pimd -d -f /usr/local/etc/pimd.conf -P 2611
#/usr/local/sbin/igmpproxy -v -d /usr/local/etc/igmpproxy.conf &
Save
Cancel

1.10.1 OSPF


CONFIGURATION
MESHPOINT
TOOLS
TRAFFIC CONTROLLER
802.1X
SYSLOG
SETTINGS
LOGOUT
ROUTING INITIALIZATION
ROUTING CONTROL
OSPF CONTROL
NODE START SCRIPT
DHCP SERVER
FAST CONNECT
FIRE WALL/NAT
LINK RECOVERY
MULTICAST
File Path /usr/local/etc/ospfd.conf
!
! Zebra configuration saved from vty
! 2011/10/10 23:30:56
!
hostname mp
password zebra
enable password zebra
log stdout
!
!
!
interface eth0
!
interface eth1
!
interface lo
!
router ospf
ospf router-id 192.168.100.5
redistribute connected
Save
Cancel

Example:

```
!
  ! Zebra configuration saved from vty   - zebra.conf
  !   2009/07/10 23:30:56
  !
  hostname mpp
  password mysecret
  enable password mysecret
  !
  interface eth0
   link-detect
   multicast
  !
  interface eth1
   link-detect
   multicast
  !
  interface lo
  !
  interface ra_sta0
   link-detect
   multicast
  !
  interface ra_sta1
   link-detect
   multicast
  !
  interface ra_ap0
   link-detect
   multicast
  !
  interface ra_ap1
   link-detect
   multicast
  !
  ip forwarding
  ipv6 forwarding
  !
  !
  line vty
  !
```

```
!
   ! Zebra configuration saved from vty – ospfd.conf
   !   2009/07/10 23:36:59
   !
   hostname mpp
   password mysecret
   enable password mysecret
   log stdout
   !
   !
   !
   interface eth0
   !
   interface eth1
   !
   interface lo
   !
   interface ra_sta0
   !
   interface ra_sta1
   !
   interface ra_ap0
   !
   interface ra_ap1
   !
   router ospf
    ospf router-id 192.168.249.5
    redistribute connected
    network 192.168.249.0/24 area 0.0.0.0
    network 10.131.5.0/24 area 0.0.0.0
    network 10.15.0.0/24 area 0.0.0.0
    network 10.17.0.0/24 area 0.0.0.0
    network 10.130.9.0/24 area 0.0.0.0
    network 10.131.9.0/24 area 0.0.0.0

   !
   line vty
   !
```

For each of the networks present at the mesh router, a line is inserted to instruct the OSPF protocol to advertise the routes to its neighbor/s.

1.10.2 RIP

Distance vector Routing Information Protocol[RIP] configuration file is located at /usr/local/etc/ripd.conf

1.10.3 IGMP

Internet Group Management Protocol[IGMP] configuration file is located at /usr/local/etc/igmpd.conf

1.10.4 PIM

Protocol Independent Multicast[PIM] configuration is located at /usr/local/etc/pimd.conf

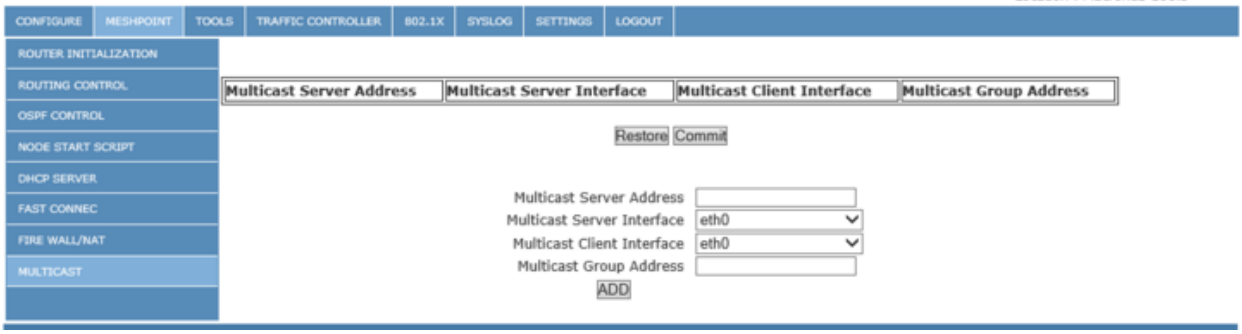
1.10.5 BGP

Border Gateway Protocol [BGP] configuration is located at /usr/local/etc/bgpd.conf

1.11 Multicast Control

Multicast servers and clients can be on any of the node interfaces. To provision multicast rules, the source and destination of the stream and the multicast address on which the stream flows needs to be identified. The screen below shows a typical multicast configuration.

Example: To enable multicast flows from 192.168.1.92 [attached on the wired segment – eth0] IGMP multimedia server, to all wireless [ra_ap0] clients who are recipients, insert a rule as shown. There can be multiple rules and these rules are launched upon restart of mesh router.



Upon provisioning the multicast rule, the node boot script is updated. The multicast rules take affect upon reboot of the node. The boot script shown below illustrates the rule entry.

1.12 Administration

1.12.1 Adding Users & Changing Password

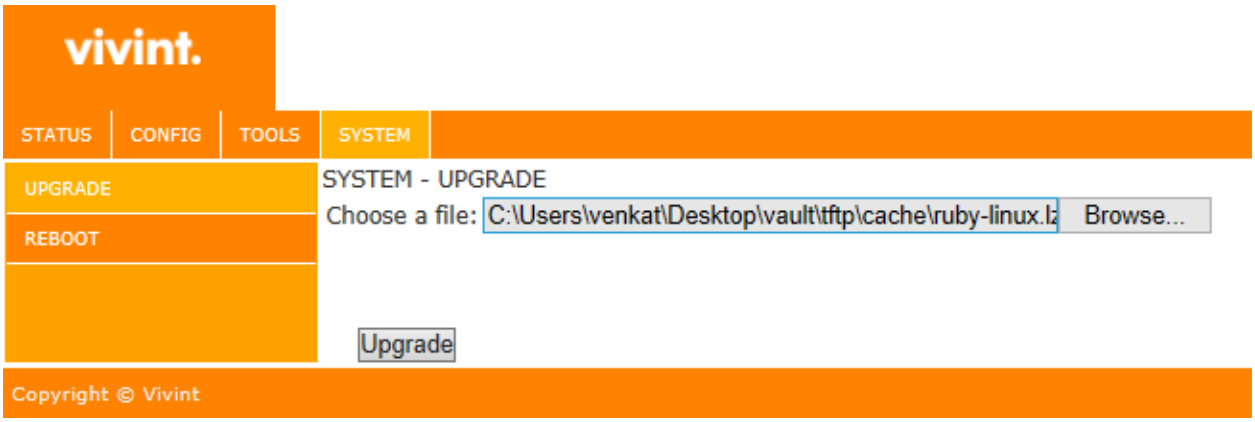
```
Usage: adduser [OPTIONS] user_name
Add an user
Options:
        -h DIR          Home directory
        -g GECOS        GECOS field
        -s SHELL        Login shell
        -G GROUP        Add user to existing group
        -S              Create a system user
        -D              Do not assign a password
        -H              Do not create home directory

Usage: passwd
Change password of an user
```

1.12.2 Upgrading Firmware

The System Reset directly resets the microprocessor and the on-board flash memory (as opposed to the Compact Flash memory). Assertion of the System Reset causes an IO Reset to be asserted.

The System Reset is asserted by any of the following conditions:

- An assertion of the Power-On Reset
- A press of the reset button
- A watchdog timeout



1.13 System Log

/var/log/message keeps a circular log in memory, no filesystem activity involved.

1.13.1 Enabling System Logging

To read the logfile from **syslogd** you should use the ***logread*** command, which outputs the messages in syslogd's circular buffer.

Logging is always enabled.

1.14 DHCP Configuration

The SR1410 can be configured as a controller less Mesh Point Portal [MPP] or a controller based Mesh Point [MP]. When configured as MPP, the DHCP addresses are allocated by the node itself. The DHCP

Directives in the main configuration screen drive the behavior of the mesh node.

Normally, the dhcp server running on the network manager serves all the clients connecting to the nodes within a mesh block.

The dhcp server needs to be aware of the subnets at the mesh node access points and be able to assign dynamic addresses based on those subnets.

The dhcp server shall assign a common dns server to all the clients within the mesh block.

The dhcp server shall be aware of the mesh node access point IP address from which the dhcp lease request is received for a client. This AP address is the default router which shall be assigned to the client requesting dhcp lease.

The Mesh block network topology comprises several nodes and each node may have an AP within a subnet different from that of the DHCP interface. It is therefore necessary that the DHCP server detect the subnet of the AP from which the DHCP request was originally received on behalf of a client. Once it has the subnet information of this AP, it should assign the requesting client an IP address within the same subnet as the AP.

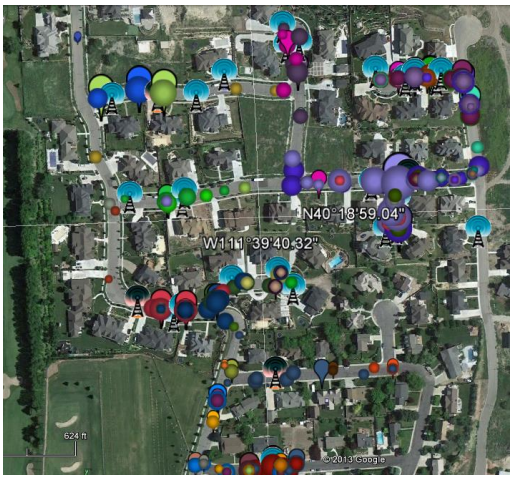
The SR1410 can also be operated an MP where it relies on the network manager to allocate DHCP addresses. On the other hand, it can also act as a DHCP server for a cluster of MPs. The node that is elected to run DHCP service is the MPP.

Network, DHCP Server sub-menu, contains the network address, subnet, and range as shown in example below.

```
authoritative;
   ddns-update-style interim;
   default-lease-time 600;
   max-lease-time 1200;
   option domain-name "dtsdcinema.com";
   option domain-name-servers 192.168.249.1;
            subnet 10.131.5.0 netmask 255.255.255.0 {
                     range 10.131.5.60 10.131.5.200;
                     option broadcast-address
10.131.5.255;
            }
            subnet 10.130.9.0 netmask 255.255.255.0 {
                     range 10.130.9.60 10.130.9.200;
                     option broadcast-address
10.130.9.255;
            }
            subnet 10.131.9.0 netmask 255.255.255.0 {
                     range 10.131.9.60 10.131.9.200;
                     option broadcast-address
10.131.9.255;
            }
            subnet 10.150.9.0 netmask 255.255.255.0 {
                     range 10.150.9.60 10.150.9.200;
                     option broadcast-address
10.150.9.255;
            }
            subnet 10.151.9.0 netmask 255.255.255.0 {
                     range 10.151.9.60 10.151.9.200;
                     option broadcast-address
10.151.9.255;
            }
            subnet 10.140.9.0 netmask 255.255.255.0 {
                     range 10.140.9.60 10.140.9.200;
                     option broadcast-address
10.140.9.255;
            }
            subnet 10.141.9.0 netmask 255.255.255.0 {
                     range 10.141.9.60 10.141.9.200;
                     option broadcast-address
10.141.9.255;
            }
            subnet 10.150.5.0 netmask 255.255.255.0 {
                     range 10.150.5.60 10.150.5.200;
                     option broadcast-address
10.150.5.255;
            }
            subnet 10.151.5.0 netmask 255.255.255.0 {
                     range 10.151.5.60 10.151.5.200;
                     option broadcast-address
10.151.5.255;
            }
            subnet 10.140.5.0 netmask 255.255.255.0 {
                     range 10.140.5.60 10.140.5.200;
                     option broadcast-address
10.140.5.255;
            }
            subnet 10.141.5.0 netmask 255.255.255.0 {
                     range 10.141.5.60 10.141.5.200;
                     option broadcast-address
10.141.5.255;
            }
            subnet 192.168.249.0 netmask 255.255.255.0
{
            }
```

1.15 Site Survey

Radio frequencies in the neighborhood can be scanned and reported.



Monitoring menu tab and “Neighborhood Info” will output results.

1.16 Status Information

Status of the radio or interfaces can be queried through commands **iwconfig** and **ifconfig**

1.16.1 AP Status

root@Vivint:/etc/init.d# **iwconfig**

lo no wireless extensions.

eth1_0 no wireless extensions.

br0 no wireless extensions.

wifi0 IEEE 802.11na40 ESSID:"bh3-ap" Nickname:""

Mode:Master Frequency:5.5 GHz Access Point: AC:8D:14:00:07:3A

Bit Rate:0 kb/s Tx-Power:0 dBm Sensitivity=1/1

Retry:off RTS thr:off Fragment thr:off

Encryption key:1A13-B96F-9901-9FD3-2D35-3BBA-4D5D-9BFC Security mode:restricted

Power Management:off

Link Quality=0/70 Signal level=0 dBm Noise level=-181 dBm

Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0

Tx excessive retries:55 Invalid misc:3986 Missed beacon:0

2.0 Hardware Installation

The SR1410 Outdoor Wireless Access Point/Router is designed to be deployed outdoors, exposed to all elements (extreme heat or sun, rain, snow, ice, cold) and mounted on a wall, pole, or mast. The SR1410 is supplied complete with its own mounting hardware kit for attaching the unit to a 1-2.5" diameter metal pole or tube or as part of a radio mast or tower structure.

The supplied SR1410 48V power supply is suitable for outdoor use.

The optional SR1410 indoor-rated Power over Ethernet injector (Vivint part #9004H49000) must be deployed indoors, or within an enclosure protecting it from the elements.

Hardware installation of the wireless router involves these steps:

1. Mount the SR1410 unit on a wall, pole, mast, or tower using the mounting hardware.
2. Mount external antennas on the same supporting structure as the router and connect them to the router unit.
3. Connect a grounding wire to the SR1410 unit.
4. Connect the Ethernet cable to the SR1410 unit.
5. Connect the power supply to the SR1410, and to an AC power source.
6. Connect the power injector (if used) to the Ethernet cable, a local LAN switch, and an AC power source.
7. Align antennas at both ends of the link.

Before mounting antennas to set up your wireless links, be sure you have selected appropriate locations for each antenna. Follow the guidance and information in "Link Planning."

Also before mounting units in their intended locations, you should first configure the devices as described in Section 1.5 "System Setup" and Section 1.6 , "System Configuration." You should also test the basic operation of the wireless router links in a controlled environment over a very short range, as described in "Testing Basic Link Operation", Section 2.1.1.

2.1 Before Installing

Before installing your SR1410 Outdoor Wireless Access Point/Router, verify that you have the following:

- Outdoor Ethernet cable of required length of 50 meters (164 feet), or a cable meeting the pin-out configuration specification to the required length (not to exceed 90 meters total), shielded CAT-5 Ethernet 8-pin DIN to RJ-45
- Power supply shipped with the SR1410
- An appropriate and stable mounting location
- A suitable electrical grounding point (on AP mounting mast/pole)
- Appropriate tools (wrench for mounting bolts, Phillips head screwdriver, DC voltmeter (if RSSI-based link alignment is to be performed))

Mounting items not supplied with the SR1410 — screws, bolts, and straps — should be available and at hand prior to installation.

Due to the typically inaccessible location often best suited to deploying an outdoor wireless router (for example, on rooftops, sides of buildings, or on a radio tower) it is recommended that the network administrator pre-provision the SR1410 system to be installed (taking note of settings, passwords, Channel, MAC and IP addresses) prior to physical installation, and confirm that the device is fully operational and free from fault.

2.1.1 Testing Basic Link Operation

Set up the units over a very short range (15 to 25 feet), either outdoors or indoors. Connect the units as indicated in this chapter and be sure to perform all the basic configuration tasks outlined in "System Setup." When you are satisfied that the links are operating correctly, proceed to mount the units in their intended locations.

2.2 Connect External Antennas

When deploying a SR1410 Master router unit for a router link or an access point operation, you need to mount external antennas and connect them to the router. Typically, a router link requires a 5 GHz antenna, and an access point or station operation.

Perform these steps:

1. Mount the external antenna to the same supporting structure as the router, within 3 m (10 ft) distance, using the bracket supplied in the antenna package.

2. Connect the antenna to the router's N-type connector using the RF coaxial adapter provided in the antenna package.

3. Apply weatherproofing tape to the antenna connectors to help prevent water entering the connectors.

2.2.1 Frequency, Wavelength and Velocity

Instead of saying "cycles per second", we use the word Hertz (abbreviated Hz) in honor of Heinrich Hertz who discovered radio waves. Also, since we are dealing with high frequencies, we use prefixes like kilo (1,000), Mega (1,000,000) and Giga (1,000,000,000) in front of Hertz, to further simplify the terminology.

5 cycles per second = 5 Hz

5,000 cycles per second = 5 kHz

5,000,000 cycles per second = 5 MHz

5,000,000,000 cycles per second = 5 GHz

We know that radio waves travel at the speed of light (~186,000 miles per sec. or 3 x 10^8 meters per sec.) and we can measure the frequency of the radio waves, therefore we can find out how far the wave travels in 1 cycle by dividing its' speed by its' frequency. We call this a wavelength

Frequency Wavelength

150 MHz 2.0 m

900 MHz 33.3cm

2.4 GHz 12.5cm

5.8 GHz 52cm

2.2.2 The Decibel

The decibel (dB) is a ratio, measured in logarithm, used to measure quantity. A dB has no dimensions. The decibel is used to compare one power (or voltage level) to another.

Ratio in dB = 10log10 (Power Ratio) = 20log10 (Voltage Ratio)

(Power is proportional to the voltage squared)

20 dB means a power ratio of 102 to 1 or 1,000:1

10 dB means a power ratio of 10 to 1 or 100:1

0 dB means a power ratio of 1 to 1 or 1:1

Because the dB is a ratio, it is dimensionless, however many times reference is made to the unit that is made as a ratio.

e.g. dBm in the case of milliwatts 20 dBm means 100:1 over 1 milliwatt or 100mW

e.g. converting 4W into dBm 10log10 4000mW / 1mW = 36 dBm

Later on we will see that if an antenna has twice the power gain of a half wave dipole (an antenna used as a standard reference), that is a power ratio of 2 over the 1/2 wave dipole, then the antenna is said to have a gain of 3dBd. (3db over the1/2 wave dipole)

10log2=3

A +3dB gain represents a doubling of power while a -3dB loss represents 1/2 of the power

2.3 Align Antenna

After wireless router units have been mounted, connected, and their radios are operating, the antennas must be accurately aligned to ensure optimum performance on the router links. This alignment process is particularly important for long-range point-to-point links. In a point-to-multipoint configuration the SR1410 uses an omni-directional or sector antenna, which does not require alignment.

- **Point-to-Point Configurations** – In a point-to-point configuration, the alignment process requires two people at each end of the link. The use of cell phones or two-way radio communication may help with coordination. To start, you can just point the antennas at each other, using binoculars or a compass to set the general direction. For accurate alignment, you must set the transmitter to output in continuous transmit mode, and set the receiver to be in continuous receive frame mode. As the antenna moves horizontally and vertically, the RSSI values vary and are indicated on the management interface.
- **Point-to-Multipoint Configurations** – In a point-to-multipoint configuration all Slave routers must be aligned with the Master router antenna. The alignment process is the same as in point-to-point links, but only the Slave end of the link requires the alignment.

Steps for aligning antenna:

Initialize the transmitting radio to be in continuous transmit mode. The interface shall be enabled at the main screen as shown below, by selecting the red rectangle on mouse-over

2.4 Command Line Interface

Commands that perform the most functions are:

ifconfig – Network related

iwpriv – WLAN related

iwconfig – WLAN related

iptables – Traffic filter, classification, forwarding, NAT

tc – traffic queuing

2.4.1 Getting Help on CLI Commands

2.4.1.1 ifconfig

root@Vivint:~# ifconfig --help

BusyBox v1.11.2 (2010-08-07 08:17:48 PDT) multi-call binary

Usage: ifconfig [-a] interface [address]

Configure a network interface

Options:

[add ADDRESS[/PREFIXLEN]]

[del ADDRESS[/PREFIXLEN]]

[[-]broadcast [ADDRESS]] [[-]pointopoint [ADDRESS]]

[netmask ADDRESS] [dstaddr ADDRESS]

[hw ether ADDRESS] [metric NN] [mtu NN]

[[-]trailers] [[-]arp] [[-]allmulti]

[multicast] [[-]promisc] [txqueuelen NN] [[-]dynamic]

[up|down] ...

2.4.1.2 iwpriv

root@Vivint:~# iwpriv --help

Usage: iwpriv interface [private-command [private-arguments]]

2.4.1.3 iptables

root@Vivint:~# iptables --help

iptables v1.4.0

Usage: iptables -[AD] chain rule-specification [options]

iptables -[RI] chain rulenum rule-specification [options]

iptables -D chain rulenum [options]

iptables -[LFZ] [chain] [options]

iptables -[NX] chain

iptables -E old-chain-name new-chain-name

iptables -P chain target [options]

iptables -h (print this help information)

Commands:

Either long or short options are allowed.

--append -A chain Append to chain

--delete -D chain Delete matching rule from chain

--delete -D chain rulenum

Delete rule rulenum (1 = first) from chain

--insert -I chain [rulenum]

Insert in chain as rulenum (default 1=first)

--replace -R chain rulenum

Replace rule rulenum (1 = first) in chain

--list -L [chain] List the rules in a chain or all chains

--flush -F [chain] Delete all rules in chain or all chains

--zero -Z [chain] Zero counters in chain or all chains

--new -N chain Create a new user-defined chain

--delete-chain

```
        -X [chain]          Delete a user-defined chain
  --policy  -P chain target
                        Change policy on chain to target
  --rename-chain
        -E old-chain new-chain
                        Change chain name, (moving any references)
Options:
  --proto       -p [!] proto    protocol: by number or name, eg. `tcp'
  --source      -s [!] address[/mask]
                        source specification
  --destination -d [!] address[/mask]
                        destination specification
  --in-interface -i [!] input name[+]
                        network interface name ([+] for wildcard)
  --jump        -j target
                        target for rule (may load target extension)
  --goto      -g chain
                      jump to chain with no return
  --match       -m match
                        extended match (may load extension)
  --numeric     -n            numeric output of addresses and ports
  --out-interface -o [!] output name[+]
                        network interface name ([+] for wildcard)
  --table       -t table        table to manipulate (default: `filter')
  --verbose     -v            verbose mode
  --line-numbers                print line numbers when listing
  --exact       -x            expand numbers (display exact values)
[!] --fragment  -f            match second or further fragments only
  --modprobe=<command>          try to insert modules using this command
  --set-counters PKTS BYTES     set the counter during insert/append
[!] --version   -V            print package version
```

2.4.1.4 tc

root@Vivint:~# tc

```
Usage: tc [ OPTIONS ] OBJECT { COMMAND | help }
```

tc [-force] -batch file

where OBJECT := { qdisc | class | filter | action | monitor }

OPTIONS := { -s[tatistics] | -d[etails] | -r[aw] | -b[atch] [file] }

2.4.1.5 iwconfig

root@Vivint:~# iwconfig --help

Usage: iwconfig [interface]

interface essid {NNN|any|on|off}

interface mode {managed|ad-hoc|master|...}

interface freq N.NNN[k|M|G]

interface channel N

interface bit {N[k|M|G]|auto|fixed}

interface rate {N[k|M|G]|auto|fixed}

interface enc {NNNN-NNNN|off}

interface key {NNNN-NNNN|off}

interface power {period N|timeout N|saving N|off}

interface nickname NNN

interface nwid {NN|on|off}

interface ap {N|off|auto}

interface txpower {NmW|NdBm|off|auto}

interface sens N

interface retry {limit N|lifetime N}

interface rts {N|auto|fixed|off}

interface frag {N|auto|fixed|off}

interface modulation {11g|11a|CCK|OFDMg|...}

interface commit

3.0 Specifications

3.1 Product features

- Wireless accesspoint and station
- Various antenna options
- Protocol-independent networking functionality
- Supports IEEE 802.11n, 40Mhz operation as an AP
- Supports IEEE 802.11n, 40 Mhz operation as an STA
- Seamless connectivity to wired LANs augment existing networks quickly and easily

3.2 Ethernet Compatibility

The SR1410 Outdoor Wireless Access Point/router attaches to 10/100 Mbps Ethernet (FE) LAN segments that utilize 10Base-T/100Base-TX (twisted-pair) wiring. The device appears as an Ethernet node and performs a routing function by moving packets between the wired LAN and remote workstations on the wireless infrastructure.

3.3 Power Over Ethernet

The SR1410 Outdoor Wireless Access Point/router supports non-standard Power Over Ethernet (POE)

3.4 Radio Characteristics

The SR1410 Outdoor Wireless Access Point/router can be configured to support IEEE 802.11n operation as an AP or STA, and supports both IEEE 802.11n and IEEE 802.11n operation as an AM (where allowed):

- 802.11n provides a high data rate and reliable wireless connectivity 802.11n operation uses a radio modulation technique known as Orthogonal Frequency Division Multiplexing (OFDM), and a shared collision domain (CSMA/CA). It operates in the 5 GHz Unlicensed National Information Infrastructure (UNII) band. Data is transmitted over a half-duplex radio channel operating at up to 300 Megabits per second (Mbps)