SR1520
Outdoor Wireless CPE/Client

Installation and User Guide

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Record of Changes

Manual Version / Date	Description
0.01 Jan 29, 2015	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.

Note: This equipment has been tested and found to comply with the limits for a Class B 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 residential 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. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation distance between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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.

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.

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1.0 Introduction

The Vivint SR1520 is an 802.11n beamforming indoor/outdoor-rated wireless client (CPE) router is designed for the deployment of advanced IEEE 802.11 wireless services in harsh environments. SR1520 is a POE device.

The SR1520 devices are NOT sold through authorized or non-retail distribution channels. They are installed and commissioned professional Vivint Installer / Qualified Network Administrator. The professional installer ensures that the configuration and operation of CPE's 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.

1.1.1 Data rates

Under ideal deployment conditions (low line of sight, low interference, and low moisture content), the SR1520 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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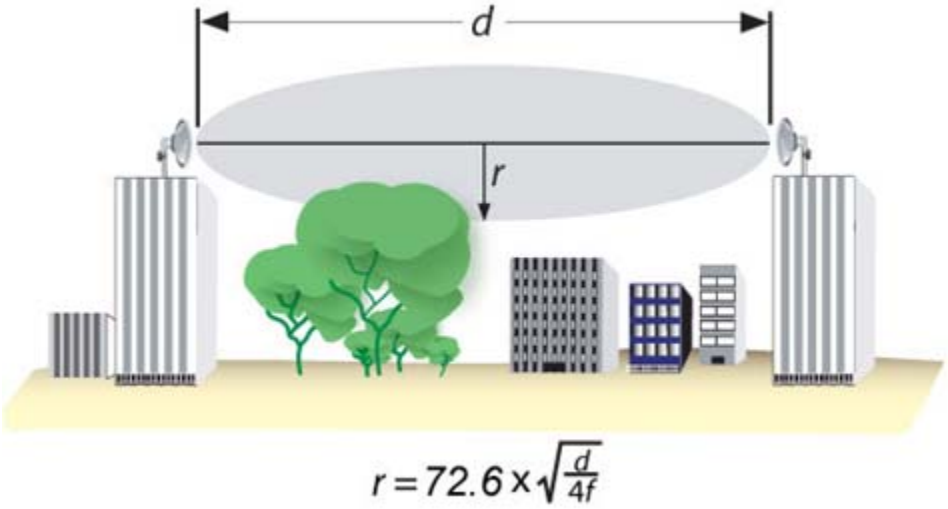
1.1.2 Radio Path Planning

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.



If there are obstacles in the radio path, there may still be a radio link but the quality and strength of the signal would 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)
- Install the device at the customer home rooftop at a spot that meets the above requirements.

1.1.3 Device Height

A reliable wireless link is achieved by mounting the antennas at each end, high enough for a clear radio LOS (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). Use the following table to estimate the required minimum clearance above the ground or path obstruction.

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.

1.1.4 Antenna Position and Polarization

Once the required antenna height has been determined, other factors affecting the precise position of the CPE to be considered are given below.

- Ensure that there are no other radios/antennas within 2 m (6 ft) of the wireless router. These include other WLAN radios/antennas.
- Place the wireless router away from power and telephone lines
- Avoid placing the CPE 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 CPE should be aligned/matched polarization to the AP to maximize throughput.

1.1.5 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 and change the physical location of the device.

1.1.6 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 SR1520 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 SR1520 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 SR1520 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 SR1520 is weatherproof. 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 SR1520 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

1.2 Ethernet Cabling

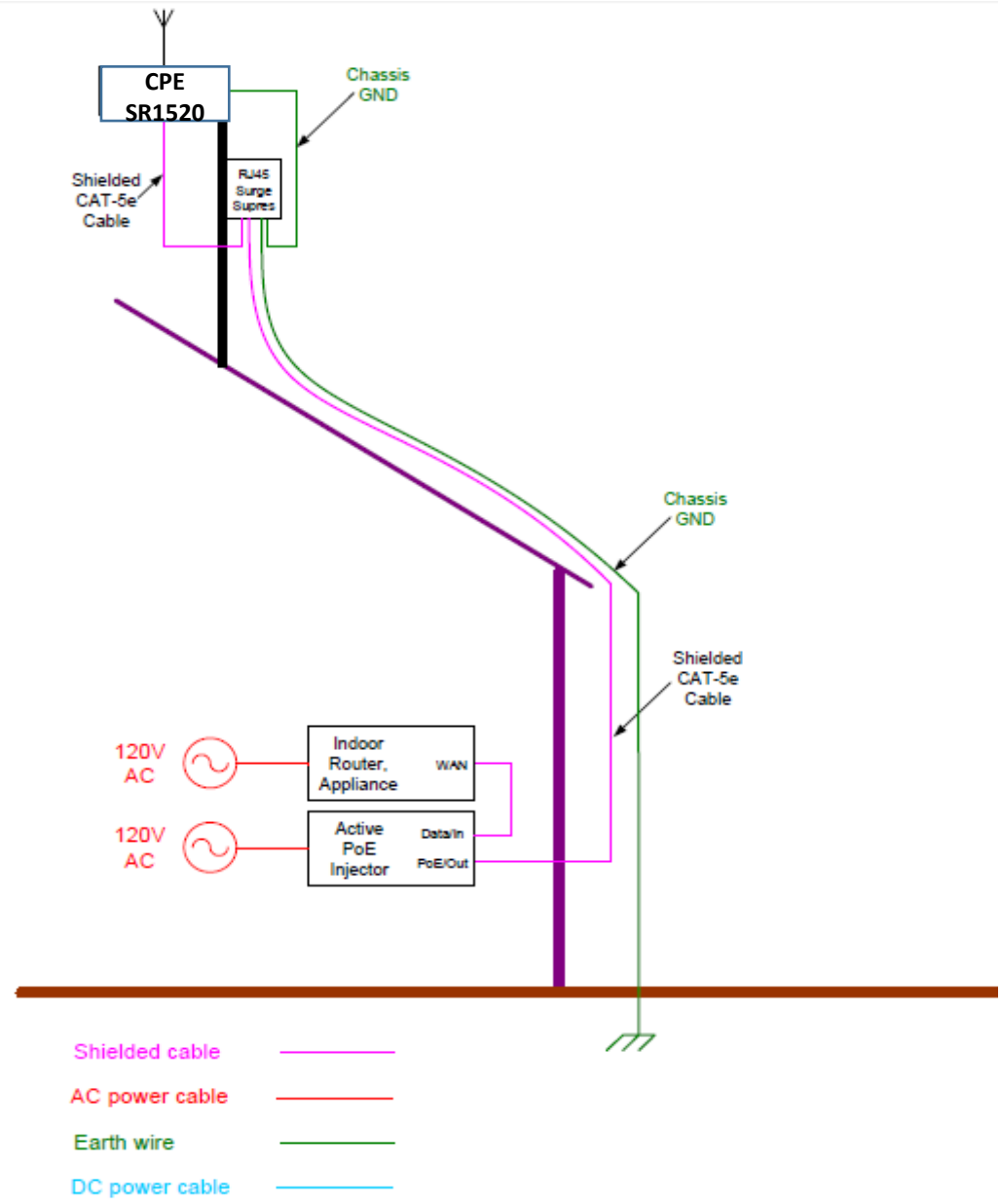
When a suitable antenna location has been determined, you must plan a cable route from the SR1520 wireless router outdoors to the equipment indoors. If a power injector/adapter module is used, it is for indoor installation only. Consider these points:

- 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 Surge protectors.

Example installations are shown below.

1.3 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.



The installation sequence is given below.

1. Mount the CPE on its fixture without touching the pins of the Radio RJ45 connector.
2. Patch cable from radio to Citel - Make a shielded CAT5e cable such that its shielding foil is grounded to the metal shielding of the RJ45 connectors at either end as shown in slide#10
3. Connect one end of the cable to the radio and the other end to the “IN” port on the Citel surge suppressor
4. Use 12AWG wire to connect the surge suppressor center ground ping to building common ground
5. Make another shielded CAT5e cable that has RJ45 shielded connectors at both ends. Connect one end to the remaining RJ45 port on Citel suppressor, and the other end to the PoE injector as shown in slide #12
6. Check for GND continuity as shown in slide#12
7. **Power up the PoE injector last** and check functionality.

System Setup

The SR1520 is setup by the Vivint professional installer/technician.

1.4 Administration

1.4.1 Adding Users & Changing Password

- The administration of the SR1520 is governed by the Vivint-NOC (Network Operations Center)

```
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
```

1.4.2 Upgrading Firmware

- The SW/FW upgradation is governed by the Vivint-NOC (Network Operations Center) and the end-user doesn’t have access to the device.

1.5 System Log

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

1.5.1 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.

2.0 Hardware Installation

The SR1520, is a wireless Client device 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 SR1520 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 SR1520 48V power supply is suitable for outdoor use.

The optional SR1520 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 SR1520 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 SR1520 unit.
4. Connect the Ethernet cable to the SR1520 unit.
5. Connect the power supply to the SR1520, 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 0 "System Setup" and Section **Error! Reference source not found.** , "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 the SR1520, verify 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 SR1520
- 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 SR1520 — 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 SR1520 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.

3.0 Specifications

3.1 Product features

- IEEE802.11n/ac Wireless Client/STA, 20/40/80MHz operation.
- Seamless connectivity to wired LANs augment existing networks quickly and easily

3.2 Ethernet Compatibility

The SR1520 Outdoor Wireless Client 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 SR1520 Outdoor Wireless Client supports non-standard Power Over Ethernet (POE)

3.4 Radio Characteristics

The SR1520 is an IEEE802.11n/ac/ac compliant outdoor Wireless Client.

- 802.11n provides a high data rate and reliable wireless connectivity. IEEE 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)