ShotSpotter® Gunshot Location System

1

ShotSpotter® Gunshot Location System

Sensor Installation Guide

August 31, 2008
Initial Draft
Document Number: 630-0028-01 Rev A

Copyrights

Statement of Conditions

NOTE: Some screenshots for the Radio Diagnostic Tool in this Guide have been redacted to protect private information.

Information in this document is subject to change without notice.

WARNING: Changes or modifications to the installation instructions given in this manual, including opening of equipment, not expressly approved by ShotSpotter Inc. will void system maintenance and support, and could void the user's authority to operate the equipment.

Electronic Emission Notices

This device complies with part 15 of the FCC Rules.

Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.
(2) This device must accept any interference received, including interference that may cause undesired operation.

FCC Radio Frequency Interference Statement

The sensor with integrated radio 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 radiate 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 the user’s own expense.

Contents

COPYRIGHTS 2
STATEMENT OF CONDITIONS ..... **ERROR! BOOKMARK NOT DEFINED.**

CONTENTS 4

INTRODUCING THE SHOTSPOTTER GLS SYSTEM 5

OVERVIEW 5

BENEFITS 5

SHOTSPOTTER GLS SYSTEM COMPONENTS 6

HOW DOES THE SHOTSPOTTER GLS WORK? 7

SYSTEM PERFORMANCE AND ACCURACY 7

INSTALLING THE WIRELESS SENSOR 8

OVERVIEW 8
WIRELESS SENSOR COMPONENTS 8

INSTALLING A WIRELESS SENSOR - BACKGROUND 9

VISUALLY INSPECTION WHEN RECEIVING NEW EQUIPMENT FROM FACTORY 9
Inspect the Acoustic Sensor 9
Inspect the Radio Unit 10
Inspect the Power Subsystem 10
EQUIPMENT LIST 11

ASSEMBLE THE WIRELESS SENSOR 12

STEP 1. ASSEMBLE THE MOUNTING SUBSYSTEM 12
Non-penetrating roof top mounting assembly: 12
STEP 2. ATTACH THE SENSOR AND ANTENNA TO THE MOUNTING SUBSYSTEM 16
STEP 3. LEVEL THE ACOUSTIC SENSOR 17
STEP 4. INSTALL THE RADIO UNIT 17
STEP 5. INSTALL THE AC POWER SUBSYSTEM 19
STEP 6. VERIFY COMMUNICATION WITH THE BASE STATION 22
STEP 7. COMPLETE THE SENSOR DOCUMENTATION 23
USING THE RADIO DIAGNOSTIC TOOL (RDT) 23
References 23
Radio Diagnostic Setup 23
PDA Software 23
Cabling 24
Basic Usage 24
Loading default settings 27
Writing settings to a file 29
Advanced Usage 29
File content 30

Introducing the ShotSpotter GLS System

Overview

ShotSpotter, Inc. is the world leader in gunshot detection and location systems. With its patented technology, for over a decade, the company has delivered gunshot location systems to an increasing number of law enforcement agencies throughout the United States.

The ShotSpotter Gunshot Location System® (GLS) is a mission critical tool, public safety, law enforcement, homeland security and military agencies rely on to raise awareness of all gunfire-related activity, and thereby proactively reduce gun-related violence. When combined with crime analysis and proactive policing, the ShotSpotter GLS contributes to reductions in violent crime and overall lawless gunfire. Agencies consistently report reductions of violent crime by 30% and reductions of errant or celebratory gunfire rates from 60% to 80%.

In addition to typical alert-and-dispatch applications, the ShotSpotter GLS is used for:

- Short and medium duration tactical operations
- Dignitary protection
- Organized gang violence suppression
- Sniper deterrence
- Long-term crime trend intelligence and mapping

Similarly, in military and other homeland security settings, the ShotSpotter GLS protects small to large areas such as forward operating bases and critical infrastructures by detecting and locating sniper gunfire and explosive attacks.

In addition to providing the precise location of gunfire events, the system captures and permanently stores actual geo-referenced, time-stamped audio of events as heard by each sensor. Incident information as well as this audio is readily available to units and personnel in the field as well as to command and control centers via IP-based networks for fusion into a common operating picture environment.

The GLS information allows dispatchers, law enforcement officers, military personnel and commanders to have invaluable situational awareness prior to arriving at the scene. Additional information available to dispatchers, patrol officers, and investigators include the number of shots fired, number of shooters, an indication of the weapon type and caliber, direction, speed and sequence of shots fired from weapons.

Benefits

Law enforcement agencies using the ShotSpotter GLS enjoy the following benefits:

- Added Safety for officers and first responders– the ShotSpotter GLS increases situational awareness, and commanders can prioritize and adjust manpower as a situation develops, giving valuable details as to the exact location, terrain and area involved, the nature of the event, including multiple weapons or shooters and rounds fired.

- Added Safety for citizens – Officers and first responders reach victims faster because ShotSpotter GLS displays accurate street address, allowing first responders to get onsite without guesswork.
- Faster Response – Within 10 to 15 seconds, the ShotSpotter GLS alerts call-takers and dispatchers of an incident.
- Pinpoint Areas of Interest – Find and target high crime areas and hotspots for enforcement. Residents often do not call law enforcement when shots are fired; the ShotSpotter GLS captures data to help law enforcement apply targeted enforcement.
- Find evidence – Detectives and crime scene investigators quickly find evidence to solve crimes using data gathered and stored by the ShotSpotter GLS because of the accuracy of reported incident locations.
- Arrests and confiscation – the ShotSpotter GLS helps law enforcement find and arrest miscreants, and confiscate illegally-possessed firearms.

Shotspotter GLS System Components

The hardware and software components of the ShotSpotter GLS include:

- ShotSpotter acoustic sensors
- ShotSpotter Location Server hardware and software
- ShotSpotter Public Safety Console® (PSC) client software (desktop and/or mobile)

NOTE: Depending on the configuration that is purchased, the system may also contain radio network equipment.

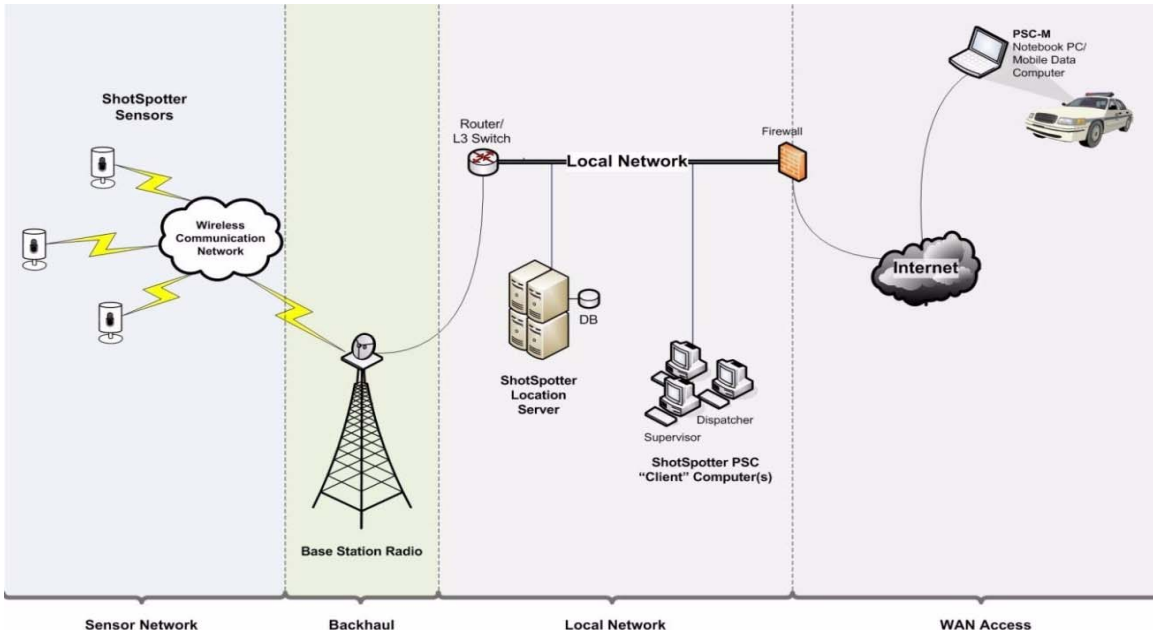


Figure 1. ShotSpotter GLS System Diagram

How Does the ShotSpotter GLS Work?

ShotSpotter GLS detects gunfire using specialized acoustic sensors installed in elevated locations throughout the coverage area.
The sensors detect loud and impulsive sounds and transmitts them to the ShotSpotter Location server via IP network connections. The ShotSpotter Location server uses accoustic triangleation and “Classifier” algorithms that look for the unique acoustic fingerpints of various sounds and classifies each type of incident accordingly, only notifying on gunshots and fireworks.

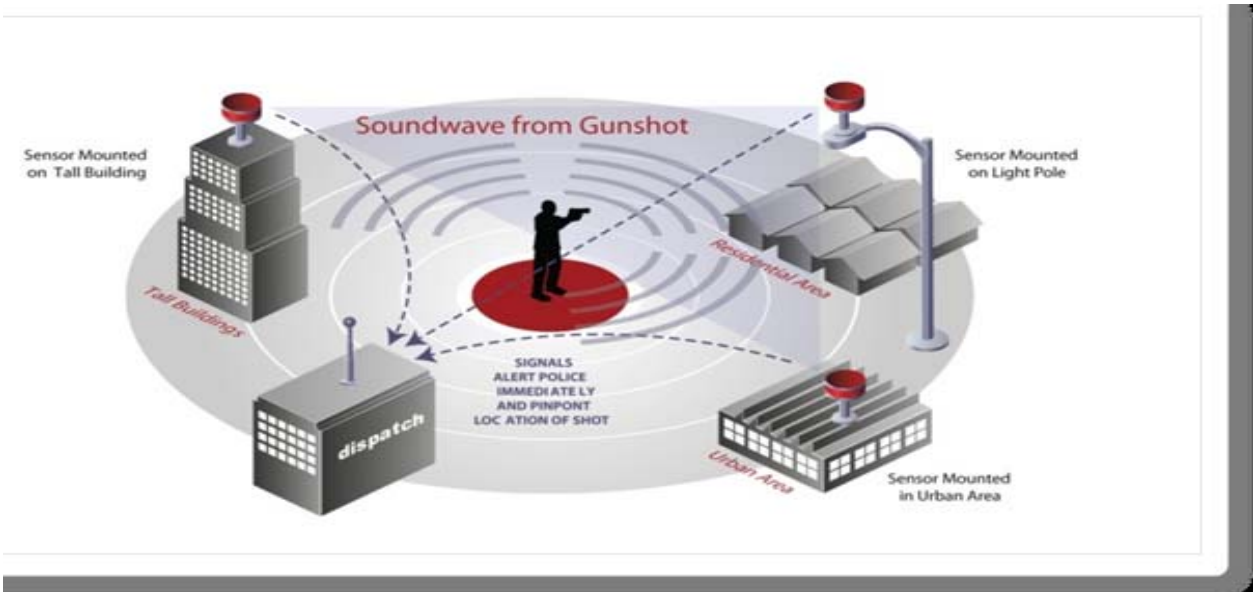


Figure 2. The ShotSpotter GLS Sensors Detecting Gunfire

The results are displayed on the ShotSpotter PSC workstations in the dispatch center and readily available to to units and personnel in the field. Geo-referenced, time stamped audio of events as heard by each sensor is available for review and allows dispatchers, law enforcement officers, and commanders to have invaluable situational awareness prior to arriving at the scene.

System Performance and Accuracy

The system guaranteed to alert on a minimum of 80% of gunfire events with an accuracy of 25 meters or better. While it is common to locate events outside the array, caution should be used in dispatching to these sites, as locations tend to become less accurate. ShotSpotter will train dispatch personnel to determine which events outside an array may warrant action.

Installing the Wireless Sensor

Overview

This chapter is an Instruction Guide for ShotSpotter Project Managers and a Reference Guide for Subcontractor Installers who will install and oversee installing the wireless sensor system. Some elements of this document may be applicable to wired sensor systems (wired sensors are no longer used), however, the primary intent of this document is wireless sensor system.

Wireless Sensor Components

The ShotSpotter wireless sensor unit has the following component types, subsystems, etc:

Table 1. Wireless Sensor Components

Component Type	Choices (Depending on System Deployment)
Mounting Hardware	Pole Attachments for approved pole sites, typical pole attachments include two set pole clamps with threaded rods for attachment and two brackets for mounting acoustic sensor and radio.
	For roof top assembly; Non-pen cinder-block base unit with stabilizing pole
Audio sensor unit	Audio sensors with GPS receiver.
Radio unit	Alvarion Radio (integrated)
	Proxim Radio
	Motorola Radio
	AirLink Raven X Cellular Modem
Power subsystem	AC power adapter and up to 200ft, 2 conductor 16 AWG UV and water-resistant, non-plenum cable, and crimp contacts with instructions.

When installing sensors on roof tops, it is best to locate the sensor such that it is invisible from the street (but they should be at least one or two feet above any parapet when mounted on the roof of a building).
Choose sites and mounting locations that are not easily accessible to the public or to children.

Installing a Wireless Sensor - Background

Installation cannot begin until the site selection has been completed. Site selection and permissions of the property owners should be completed at least two weeks prior to scheduling installers to begin sensor installation. It is the Project Manager's responsibility to compile a list of sites, Site Excel Document, with all necessary details required to gain access to property and properly locate the sensor at the site. The list must provide contact names and phone numbers of persons providing authorization.

It is the responsibility of the installer to contact authorizing persons at each site and schedule a time to complete installation. It is recommended that up to 2-3 hours be allowed for each sensor installation. Allow sufficient time to travel from site to site and set a half to an hour time window for arrival at each site.

Visually Inspection when Receiving New Equipment from Factory

It is extremely important that all systems delivered form the ShotSpotter factory be immediately inspected for any shipping damage. All damage claims must be made by the customer to the trucking company. If you can visually see that the product has been damaged in transit, make a notation on the Bill of Lading before signing it. It is also helpful if you can take a photograph of the damage. It is important to make your claim to the shipper within 24 hours of receipt of the damaged product. Call the ShotSpotter Project Manager (PM) if there is shipping damage. The PM is responsible for making sure the claim is filed within 24 hours. Contact the ShotSpotter Shipping Department if you need further assistance in filing your claim.

If you can visually see that the product has been damaged, REFUSE to accept the shipment from the carrier. If you discover damage to the product after you have already accepted and signed for the shipment, contact the Shipping Department at ShotSpotter Inc immediately. (Important note: DO NOT SHIP THE PRODUCT BACK TO US AT THIS TIME! Doing so will void any damage claim with carrier.) ShotSpotter Inc will contact the shipping carrier and arrange to have an inspector come to your premises and visually inspect the package for damage. If the carrier approves the claim, ShotSpotter Inc will then send you a replacement product, and the carrier will pick up the damaged product for return to ShotSpotter Inc.

Inspect the Acoustic Sensor

The acoustic sensor should be free of dents, scratches, or other obvious signs of mis-handling during shipping. Gently shake the unit to determine if internal hardware may have come loose in transit. It should not rattle. The unit should be clean and free of

debris. The pins of both connectors on the underside should not be bent or pushed in. Make sure there is a serial number label securely affixed to the unit. The acoustic sensor package must be a complete assembly with swivel mounting brackets attached.

Inspect the Radio Unit

The radio box (if not integrated) should be clean, sealed, and free of dents, scratches, or other obvious signs of mis-handling during shipping. Gently shake the unit to determine if internal hardware may have come loose in transit. It should not rattle. Make sure there is a serial number label securely affixed to the radio box. This label is usually found on the back of the unit.

Inspect the Power Subsystem

Make sure the data and power cables do not have any bent pins, none of the pins are pushed in, no connectors are spread open, the plastic connectors are not cracked or bent, and the outer sheath is not kinked anywhere.

The radio system kit should be complete with antenna, power cable, RF cable, and mounting hardware for radio and antenna, where applicable.


Warning: Before installing, it is important to verify the radio system kit to be installed uses the antenna provided along with the minimum cable lengths provided. The use of antenna or cables not approved by ShotSpotter, Inc. is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

Equipment List

Bring the following items and equipment to each site when installing a wireless sensor as listed in the following table:

Table 1. Wireless Sensor Installation Equipment List

Item	Description
Sensor components	Mounting hardware Acoustic sensor Radio Unit Power Subsystem
Tools	Rechargeable drill and power nut driver set Socket set and ½", ¾" and $^{7}/_{16}$" wrenches Allan wrench set Needle nose pliers Electric screw driver and multiple screw drivers/bit set Flat jeweler's and Phillips screwdrivers Wire stripper and snips Scissors or knife Flashlight Bubble level 2-way radios Multimeter or Electrical Socket Power Check Tool The HD-48-00 cord crimping tool
Materials	Tape: double-sided and electrical Banding wire UV-rated cable tie wraps Silicone sealant Coax-seal Miscellaneous screws, nuts, bolts, washers Spool of low voltage wire PN BELDEN 5300UG U-1000 ShotSpotter will provide a Gel Battery for testing Bring extra copies of the installation worksheet Map of the coverage area Rubber matts (1 per sensor install) Cinder blocks (4 per sensor install)

	Pen
Extendable ladder	20 foot (6.1 meter) minimum height at full extension

Before ascending onto any roof, ensure your personal safety. Read the safety guidelines that are listed in Chapter 2.

Assemble the Wireless Sensor

The on-site installation takes a couple of hours at most and follows these general steps:

1. Assemble the mounting subsystem.
2. Attach the wireless sensor and antenna to the mounting subsystem.
3. Level the acoustic sensor.
4. Install the Radio Unit (if not integrated).
5. Install the AC power subsystem.
6. Verify communication with the base station.
7. Complete sensor documentation.

Step 1. Assemble the Mounting Subsystem

This section details the alternative mounting solutions and assembly instruction for each solution. The Site Document provided by the Project Manager should provide details on the desired mounting solution at each site. Mounting options vary:
Installed using various poles that are attached to a building, where incursion is allowed
roof installation with equipment installed on the roof using a non penetrating mount
roof installation with equipment attached to light poles
utility pole installation using appropriate mounting hardware.

Non-penetrating roof top mounting assembly:

If you are using the non-penetrating assembly make sure you have all the parts and the correct number of each part (in parantheses) before ascending the roof:

(1) 5-foot Pold (1.5 M)

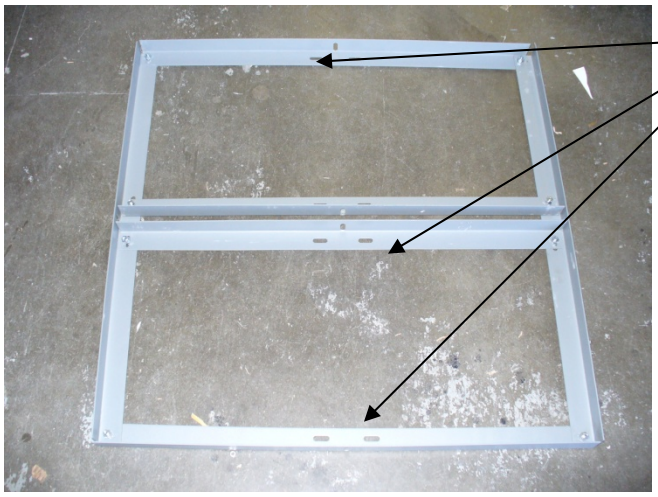
(6) L Brackets
(1) 8-inch Sensor Bracket (20.3 cm)
(4) Stabilizer Brackets
(3) 3-inch Shoulder Bolts (7.6 cm)
(12) ¾ inch Shoulder Bolts (1.9 cm)
(12) Lock Washers
(12) Nuts
(1) Rubber Mat
(4) Cinder Blocks

1. Locate the inventoried hardware on the roof at area specified for sensor install.

2. Assemble square base with cross bars using quantity 8- ¾" inch (22.2 cm) shoulder bolts, washers and nuts. Be sure to assemble the base with side with two slots in the "L" brackets flat on the surface.

3. Do not tighten hardware initially.

2 Slots on the Flat



4. Assemble the mast using the 4 stabilizer bars, 5 ft. (1.52M) poles and 2 – 3”(5.1-7.6 CM) shoulder bolts Again do not tighten the hardware. MOUNTING HOLE ON THE POLE S/B DOWN.

5. Assemble the mast assembly to the square base assembly as shown below.
6. Square up the base assembly and tighten all hardware at this time.
7. Install the 8- ¾” inch (22.2 cm) adapter bracket at the top end of pole to allow for acoustic sensor swivel mount to fit tightly.

8. Place the supplied rubber mat, centered at final location for the assembly and relocate the assembled mount on the mat.

9. The installers are required to <u>acquire locally</u> up to quantity eight 12 X 8 X 4 cinder blocks to stabilize the mounting assembly. The Cinder blocks must be spread evenly internal to the base.

Once the mounting hardware is assembled, the acoustic sensor, radio and antennas must be attached to this assembly as shown below.

Step 2. Attach the Sensor and Antenna to the Mounting Subsystem

The sensor is set on top and the thumb screw tightened. The Antenna is attached using the supplied antenna mounting hardware brackets.

If the radio unit is not integrated, the radio unit is provided with 2 U-bolts that clamp around the mast. It is recommended that the radio unit be placed as low as possible on the mast to lower the center of gravity and avoid tilting.

Detailed sensor and radio mounting instructions are provided in sections 2 and 3 below. Please review these sections prior to completing this task.

There are two versions of the manufactured arm:

- One arm is a straight-through arm
- One arm has a 90 degree bend

This provides for either horizontal or vertical mounting to the light pole. You may need to mount the radio box on the vertical shaft and the Acoustic sensor on the horizontal portion of the light pole shaft. Both arms are attached to pole using two sets of c-clamps that are clasped around the pole using 12-inch (30.5 CM) threaded rods.

.

Step 3. Level the Acoustic Sensor

Attach the swivel mount on top of the stabilizing pole. Adjust the swivel mounts so that the sensor is placed level to the horizon. The sensor must be placed at a location such that the scrub foam has a clear view of the sky. There must not be any obstructions such as overhanging eves, trees, other vegetation, etc.

The swivel mount is designed to allow for freedom of tilt. The Acoustic Chamber must be level to the horizon. Use a level to ensure accuracy.

Note: The GPS antenna is underneath the scrub foam on top of the unit for maximum satellite reception. It needs a clear view of the sky.

You may be asked to attach a bird deterrent spike strip to the top.

Step 4. Install the Radio Unit

Warning: Before installing, it is important to verify the radio system kit to be installed uses the antenna provided along with the minimum cable lengths provided. The use of antenna or cables not approved by ShotSpotter, Inc. is expressly forbidden in accordance to FCC rules CFR47 part 15.204.

Each wireless sensor that does not have an integrated radio unit (Alvarion only) will have one of the following types of Radio Units:

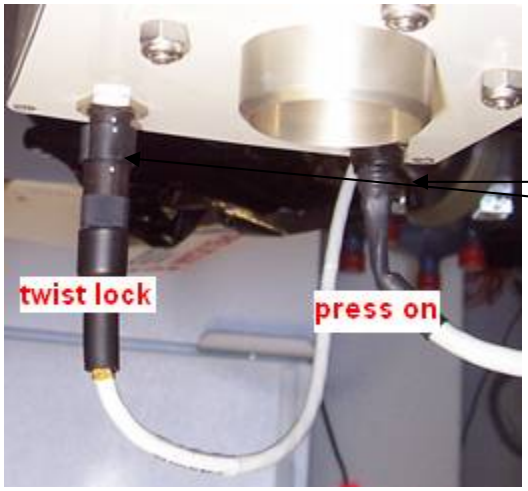
- AirLink Raven X Cellular Modem
- Motorola
- Proxim

Attach the Radio Unit to the mounting pole, orient the radio unit to point roughly south (southern exposure), and open the sun shield to a maximum up tilt.


Face south and tighten the sunshield in place.

Mount the flat panel antenna and align its face directly towards the base station antenna. (The base stations should have been installed first on initial installations). Orient the panel antenna to the vertically polarized position unless instructed otherwise. Do not point too high above the horizon only 1 degree of up-tilt is needed.

Connect the radio to the sensor and to the antenna using the cables provided. Be gentle with these connectors they are fragile and over tightening will damage them.



Note: These connectors are provided with some marking from the manufacturer for alignment help – some units have dots, others have a small arrow indicator, look carefully for these. Do not use force to make this inter-connect- you will damage the connectors!

AirLink Raven X Cellular Modem

Attach the Radio Unit to the mounting pole using the hose clamp.

Connect the blade antenna to the radio box. If necessary, bend the antenna until it is oriented vertically.

Connect the radio to the sensor as outlined above.

Step 5. Install the AC Power Subsystem

This step describes how to install the AC power and perform the following steps:

1. Connect the wall wart power adapter to a standard, 110V outlet.
2. Run the low-voltage power cable from the outlet to the wireless sensor.
3. Cut the power cable to length and crimp the connectors on the end.
4. Connect the wireless sensor to the low-voltage power cable.

5. Several sources are available for power. Rooftop HVAC units usually have available outlets, and every outdoor outlet must be enclosed in weatherproof housings.
6. If an outlet is NOT available on the roof, then find a secure location inside the building. Remember that the plug must never be removed from the outlet. Finding an obscure outlet away from public traffic is necessary. Preferred locations are locked janitor rooms, locked equipment rooms, etc.
7. If no suitable outlet is available, then an electrician will be necessary to provide the power source. If this is the case, it is up to the general contractor to locate the wall wart at the proper location with enough low voltage cable to reach the sensor. Determine the best location then indicate this exact spot on the Installation Worksheet so that the electrician can find the wall wart, and install the outlet.

Other items to remember:

- The system requires a standard, 110V outlet for power.
- It is important to find an outlet that is **not** on a **switched** circuit. You may need to test the outlet with a Multimeter or a power outlet check tool.
- The low-voltage wire's maximum length is 200 feet (61M), so try to find an outlet that is less than 200 feet (61M) from the desired wireless sensor location.
- If non-switched power is not available or if the only outlet is more than 200 feet (61M) from the desired sensor location, an electrician may be hired to install an additional outlet. Contact the Project Manager.
- Use non-GFI outlet only.
- Install the lightning platform.

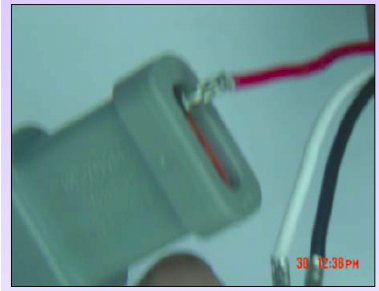
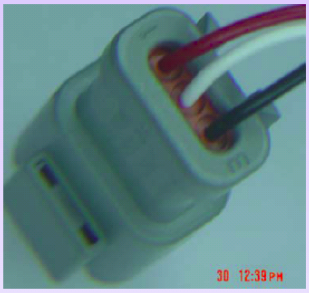
<Picture of DC distribution box and new lightning platform here>

The Deutsch HDT-48-00 crimping tool will initially be provided by ShotSpotter. If you lose or damage this tool it is your responsibility to repair, replace, or pay for replacement of the tool it in a timely manner.

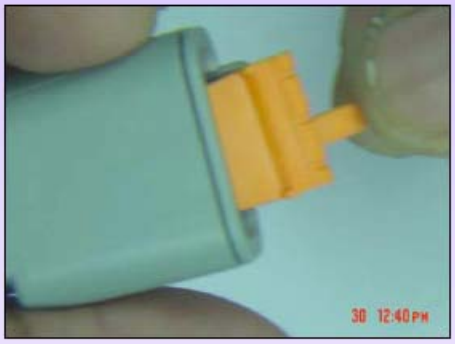
The connectors provided are labeled with the number 1 and the number 3 on either side of the grey plastic. (They are printed in very small lettering).
Slide the cushion onto the wires first. Cut the low voltage wire to length, and

Crimp one pin onto the red wire and one onto the black wire (the white wire is extra).

Push the red wire into the side of the connector that has the number 1 on it. The black wire goes into the side of the connector that has the number 3 on it.


Assemble the connector and push the plastic in place.




Wrap the end of the new connector with tape or coax seal. Connect the end of the new connector to the end of the wall wart and plug in.

Note: Use UV cable tie wraps to secure the radio and power cables along the stabilizing pole. Tidy up all loose wires and cables. Make sure there are no trip hazards and no debris is left behind on the rooftop.

Step 6. Verify Communication with the Base Station

The purpose of this step is to verify that each wireless sensor communicates properly with the Base station as the sensor is installed. The objective is to confirm the sensor is communicating properly while the installer is still on site, rather than having to return later to the sensor site to troubleshoot problems.

Do the following steps:

1. Contact the ShotSpotter PM or designee and report that the sensor is powered up.
2. Follow the instructions given by the ShotSpotter Technician. You may have to do the following things:
3. Double-check that power is available at the power outlet.
4. Confirm that the sensor's Acoustic chamber (which includes the GPS receiver) has a clear view of the sky.
5. Realign the antenna so that it is pointing at the Base station.
6. If you are instructed by the ShotSpotter technician, you may need to remove the cover plate from the radio box to confirm that you see six green lights.

Note: The procedures for the Project Manager to follow are outlined in the document Server Room Install.

Step 7. Complete the Sensor Documentation

Record the serial number of the sensor and the serial number of the radio unit on the worksheet before you leave the rooftop. You can find the numbers of the back of the equipment. You may be able to read these numbers to the PM or ShotSpotter Technician to record on the Site Excel Document.

Perform the Radio Diagnostic steps as explained in the next section.

Using the Radio Diagnostic Tool (RDT)

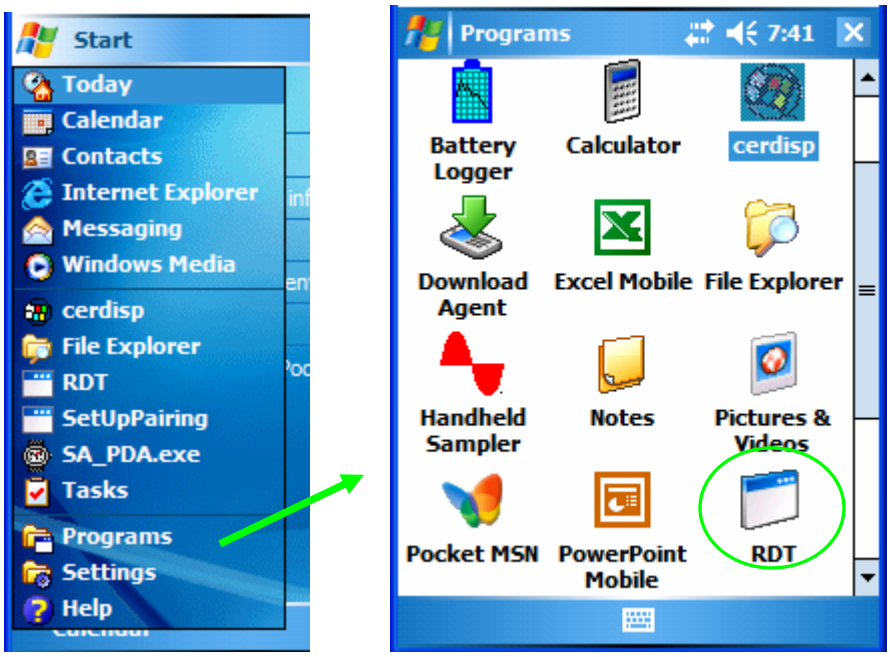
The ShotSpotter Radio Diagnostic Tool (RDT) allows diagnosis of radio connection and the ability to read and write certain radio settings. Currently the Alvarion SU is the only radio supported.

References

1. Alvarion document with all the commands saved online.
2. PDA Radio Diagnostic Tool Installation Instructions.doc

Radio Diagnostic Setup

PDA Software
From the Start menu on the PDA's "desktop", select ***Programs***.
In the Programs folder tap on the ***RDT*** icon to start the application.

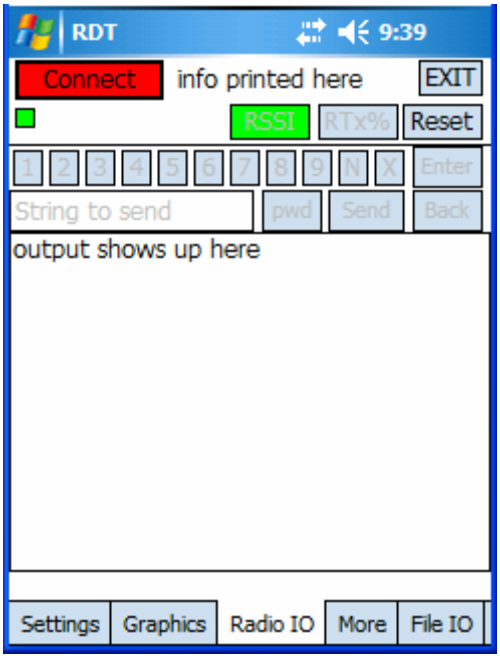


Cabling

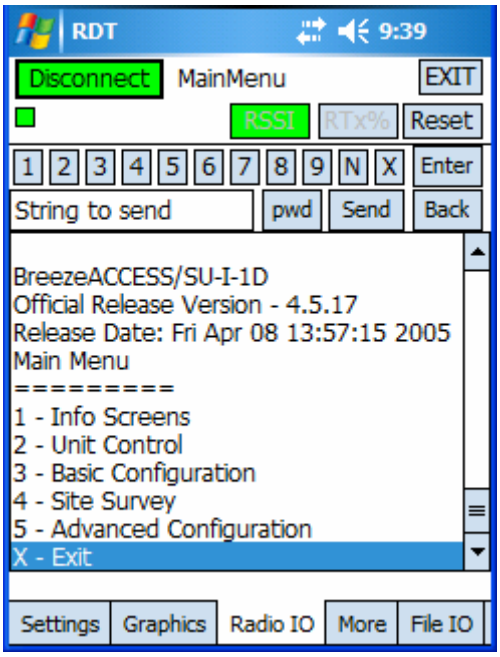
A little text with a picture that needs to be taken at HQ.

Basic Usage

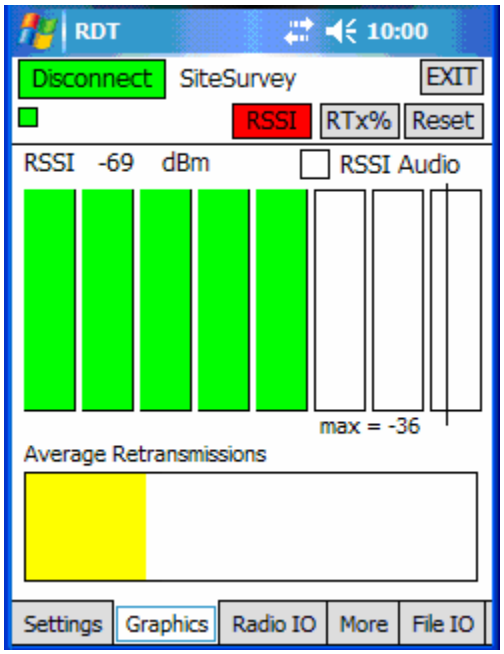
Best (easiest) case - good settings and good signal.



Tap the red Connect button.

1. 

Text will appear in this window. After approximately 15 seconds the PDA is communicating with the radio and initializing data.



Tap on the ***Graphics*** tab then tap on the green ***RSSI*** button. The button will turn red. Move antenna until the best signal is obtained

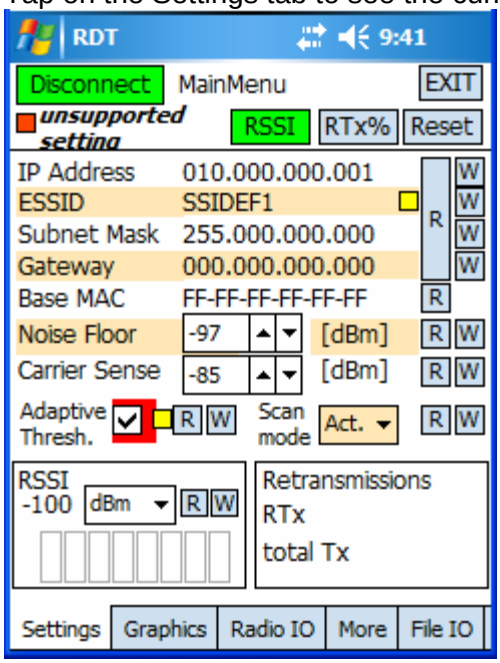
2. Tap on the red ***RSSI*** button and wait for it to turn green.
3. Tap on the ***RTx%*** button.

To exit the application:

1. Tap on the ***Disconnect*** button (upper left corner) and wait for it to turn red.
2. Tap on the ***Exit*** button (top right corner)

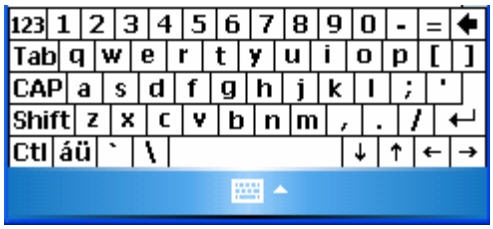
Changing a setting

Tap on the Settings tab to see the current settings.



Brief description:

1. select field
2. change it
3. tap on "***W***" to right of field
4. repeat until all fields are satifactory
5. tap on the ***Reset*** button



soft keyboard

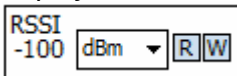
The fields in the middle of the screen show... ***et Mask,*** and ***Gateway*** are writeable fields. Tapping on one of these fields causes the soft keyboard to appear at the bottom of the screen. Use this to change the text in the field. Tap on the keyboard symbol (bottom middle) to get rid of the keyboard. To send the new text to the radio, tap on the W button to the right of the field. Note that the radio must be reset in order for the change to take effect. The yellow square ☐ in the field containing "SSIDEF1" indicates that the value of the field has been changed since the last time the radio was reset.

The ***Noise Floor*** and ***Carrier Sense*** fields can be changed using the up and down arrows. Tap the W button to the right of the field to send the change to the radio. A yellow square ☐ will indicate that this field has been changed since the last time the radio was reset.

The Adaptive Thresholds algorithm is enabled when the ***Adaptive Thresh.*** checkbox is checked. Adaptive Thresh. R W This can be checked while diagnosing and assessing signal strength but should be unchecked during "normal" operation. The area around the box turns red when the box is checked and the message "***unsupported setting***" appears near the top of the screen. The message is visible no matter what tab is being displayed. Tap the W button to the right of the field to send the change to the radio. A yellow square ☐ will indicate that this field has been changed since the last time the radio was reset.

The ***Scan mode*** has a pulldown box with two choices: ***Act.*** (active) or ***Pass*** (passive). During "normal" operation this should be set to ***Act***. Scan mode Act. R W It may be set to ***Pass*** for diagnosis and assessment of signal strength. The box turns red when the

Pass is selected and the message "***unsupported setting***" appears near the top of the screen. The message is visible no matter what tab is being displayed. Tap the W button to the right of the field to send the change to the radio. A yellow square ☐ will indicate that this field has been changed since the last time the radio was reset.

RSSI may be displayed in ***RSSI*** units or ***dBm***. The choice is available near the bottom of the screen. 

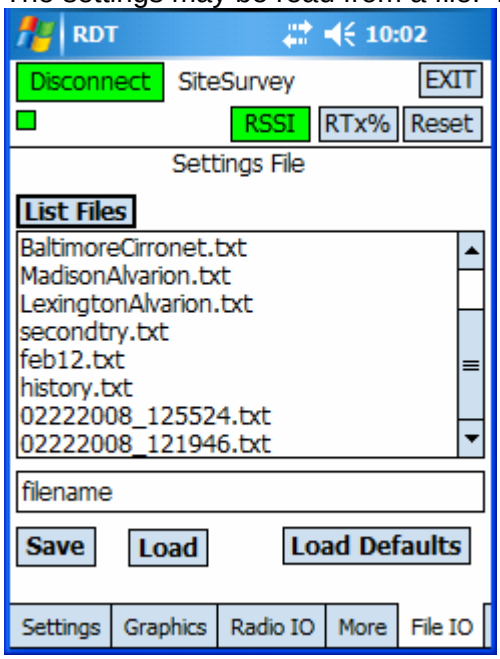
Tap on the W button for the change to take effect. This is the only setting on this tab that takes effect *without* the radio being reset.

Resetting the radio

The ***Reset*** button resets the radio (not the PDA). This must be done for any new values to take effect. After the radio resets, the RDT application must go through the initialization process again which takes about 15 seconds.

Reading settings from a file

The settings may be read from a file. Navigate to the ***File IO*** tab.



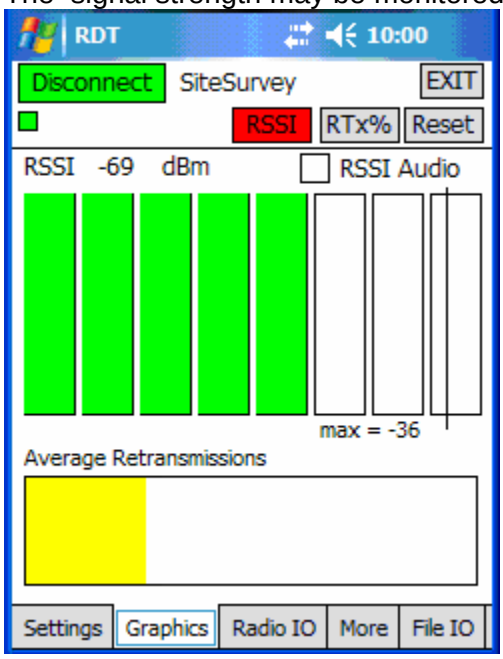
Tap on the ***List Files*** button to display previously saved (i.e. appropriately formatted) files. Tapping on a filename in the list causes that filename to be put in the ***filename*** field (just above the ***Save*** button). Tapping on the ***Load*** button causes the file to be read. The data from the file populates the settings on the Setttings tab and sends them to the radio. The radio must be reset for the settings to take effect.

Loading default settings

On the File IO tab, tapping the ***Load Defaults*** button causes a file with default values to be read. The data from the file populates the settings on the Settings tab and sends them to the radio. The radio must be reset for the settings to take effect.

Observing signal strength

The signal strength may be monitored by watching the activity on the ***Graphics*** tab.



One can observe numerical values as well as graphical and audio representations of the signal's RSSI. The audio can be turned on and off by using the ***RSSI Audio*** checkbox. The maximum RSSI value (since the last reset) is displayed under the bars and a vertical line denotes where it falls within the bars. The updates begin when the green ***RSSI*** button is tapped. The button remains red while the RSSI is updated (at a rate of once per second).

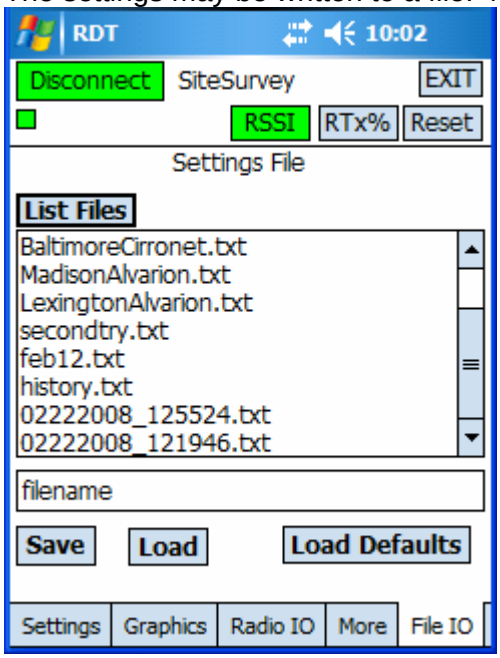
The upper limits on the vertical bars are as follows:

Number of bars	Color	dBm	RSSI units
1	Red	-94	35
2	Red	-88	44
3	Red	-80	56
4	Yellow	-70	71
5	Green	-60	85
6	Green	-50	97
7	Green	-40	107
8	Green	-30	119

To see the Average Retransmissions, tap on the red ***RSSI*** button. After it turns green, tap on the ***RTx%*** button. The bottom graphic should update at this point (one update per button tap). If the avg. retransmission % is < 30 the bar is colored green, if it is > 50 then it is red, otherwise it is yellow.

Writing settings to a file

The settings may be written to a file. Navigate to the ***File IO*** tab.

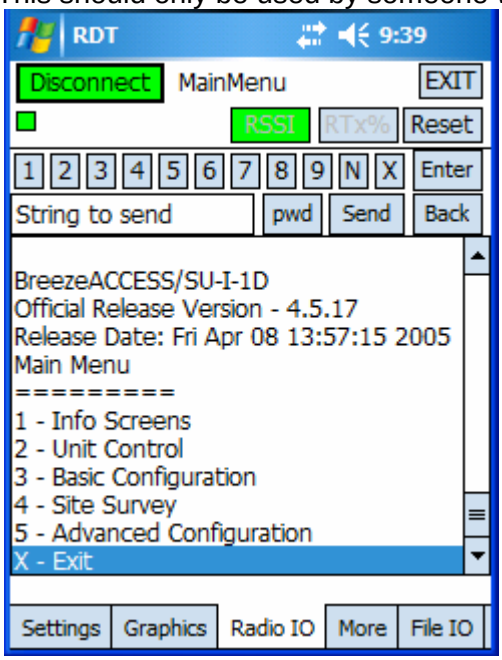


To save to a new file, tap in the ***filename*** field and then tap in a new name using the soft keyboard (that automatically appears). Tap on the small keyboard icon at the bottom of the screen to dismiss the keyboard. Tap on ***Save*** to save the settings to the new file. (An existing file may also be used – just tap on it in the list and it will appear in the ***filename*** field. Then tap ***Save***.)

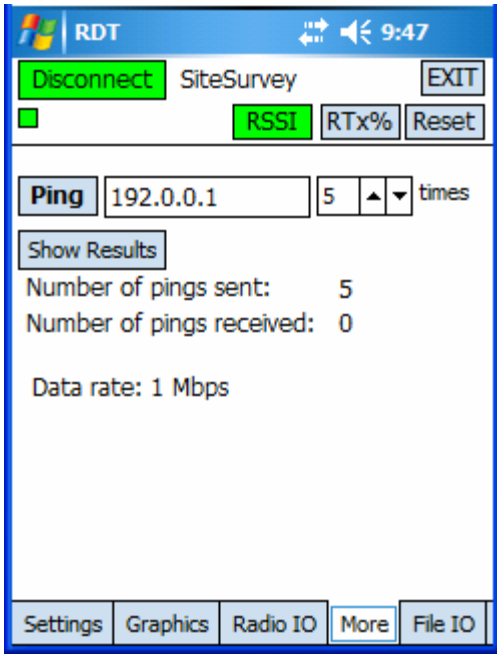
Advanced Usage

Radio IO

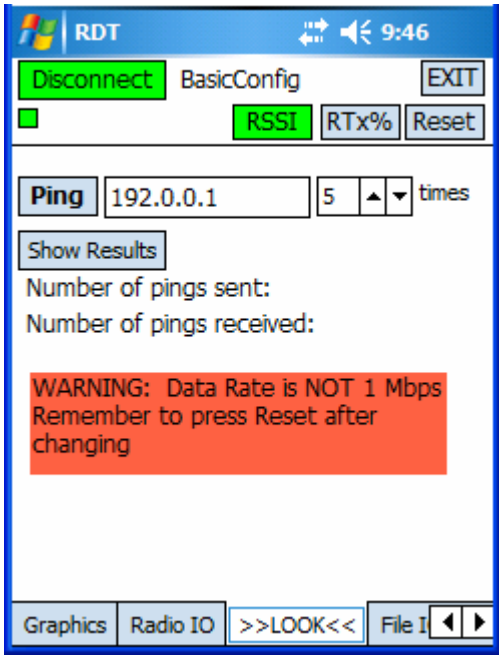
The Radio IO tab allows access to the "Monitor" program that is running on the radio. This should only be used by someone who knows what they are doing!



Input to the radio is through the buttons ***1,2, …, 9, N, X, Enter, pwd, Send,*** and ***Back***. The ***String to send*** field allows the user to tap in a string that can subsequently be sent with the ***Send*** button. Occasionally the Enter button will need to be tapped after the Send (or after a numerical button, depending on the command). The Back button backs up through the menu (escape key for Monitor). ***CAUTION: ONLY AN EXPERIENCED USER SHOULD ATTEMPT USING THIS!!!***



Tap on the field next to the ***Ping*** button and enter an address to ping. The number of times to ping can be adjusted with the up and down arrows. Tap on the ***Ping*** button to start pinging (this uses the Ping capability in the "Monitor" program running on the radio). Tap on the ***Show Results*** button to show the results.

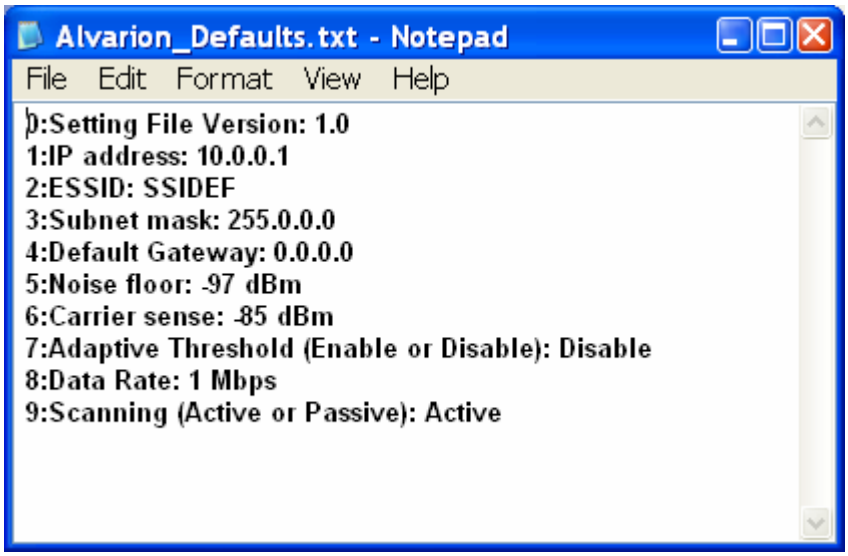


If the data rate ever gets set to a value that is NOT 1 Mbps then a warning appears on the More tab. Further the name of the tab changes to >>LOOK<< . The data rate should always be 1 Mbps.

File content

Default file

The contents of the default file are as follows:



Saved settings file

The format (*number: field name: data*) is the same as the defaults file, but the *data* itself may be different.