Wi-Fi Cool Box Sensor

User Manual

Version 1.1
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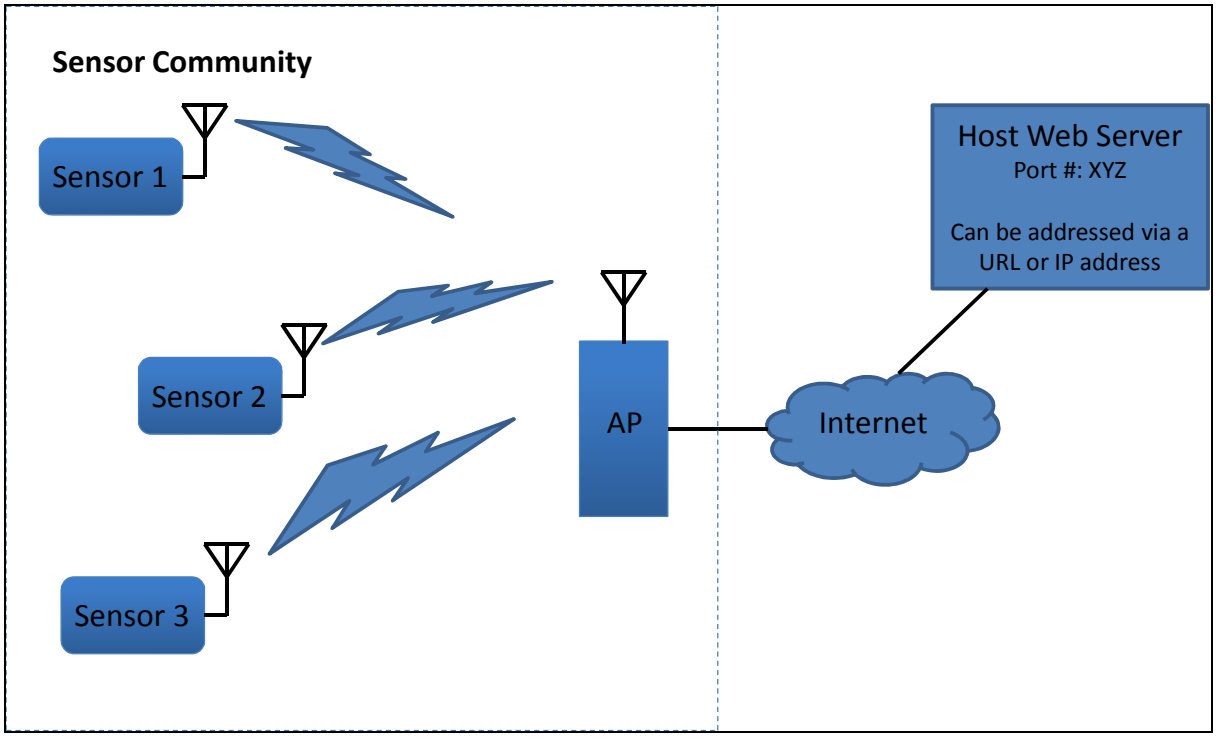
1.0. Overview

The remote temperature sensor network is built upon a standard 802.11 b/g WiFi infrastructure. The System contains three main components: wireless sensors, access points and the server application that collects and presents sensor data from any location which has access to the internet.

Remote sensors are deployed in the field and wirelessly transmit data from internal and external sensors such as temperature, pressure and humidity. Data is cached on the sensor and routinely sent to the application server listening at a particular port number at a known URL or IP address.



Sensors and Access Points can be viewed as a community, or several distinct communities. Typically the sensor community is distributed across an IP network and the server is located in a data center.

1.1. Sensor Community

Remote sensors are wireless 802.11g, battery powered monitoring and data logging devices. Each sensor functions independently within the system, sending data to the Wireless Sensor System server via access points that are connected to the network. This allows remote sensors to be placed anywhere wireless access points are present. Each sensor sends the following information:

- Data – temperature, humidity, etc
- Health such as battery, uptime, firmware version
- Logical and physical information like ID #, serial number, type, etc…

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1.2. Access Points (AP)

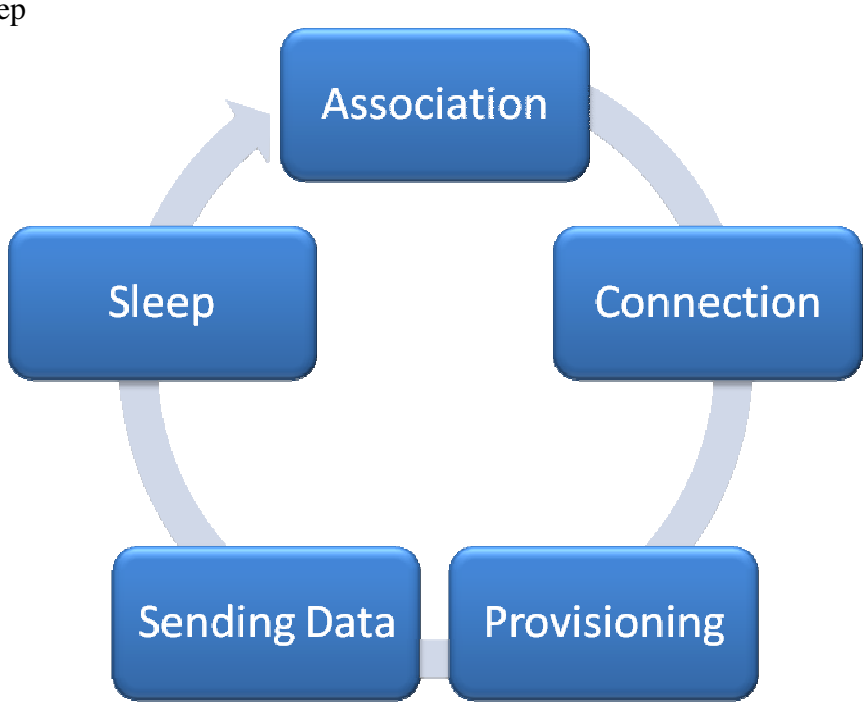
Access Points use standard 802.11 Wi-Fi running in secure mode with WPA2 authentication and encryption. The AP provides DHCP and DNS services for the sensor. If sensors are within range of multiple access points they will choose the AP with the strongest signal strength. Access points are used only for wireless connectivity. No sensor data or configuration information is stored on the AP.

2.0. Sensor's communication with the server

This section describes the intercommunication operations, which take place between the remote sensor and application server. In this environment all communication between the sensor and application server is initiated by the sensor and uses JSON formatted http operations

Sensors communicate with the server to send back the data in a five step process, namely

1. Associating to an AP
2. Connecting to the Server
3. Provisioning
4. Sending Data
5. Sleep



2.1. Association:

When the module wakes up from sleep, it tries to associate to a set network. It scans the wireless channels for the AP with the SSID and the passphrase that is set in the module's configuration. Once it finds the AP, it associates with it and gets an IP address.

2.2. Connection:

Once the module is associated to an AP and has a valid IP address, it then tries to establish a connection to the server. The module does this by using either the URL of the server or the server's IP address stored in the configuration along with the port number on which the server is listening. The module connects out to "<IP address> <Port Number>" or "<URL> <Port Number>"

2.3. Provisioning:

After the connection to the server is established, the server database provisions the sensor and sends out provisioning message which informs the sensor on how often to report the data back to the server.

The provisioning message format is as shown below:

Request
GET /inform?sn=sensor1&type=RV_TH1&fw=rv123&bsid=apmachere HTTP/1.0
Host: server.com

Normal response is a JSON string of configuration values related to the sensor's data collection operation.
Response
HTTP/1.0 200 OK
Content-Length: XXXX

[["firmware","rv123.bin"],["data_interval","120"],["pass_phrase","space2001"],["now","1261012756"]]

2.4. Communication:

The sensor sends telemetry data on an interval configured by SMMS.
The sensor sends provision requests in three different cases;

1. User pressed the button on the front of the sensor case.
2. Once every 100 data intervals.
3. In response to a data message that includes a provision flag.

Sensor API is usually configured to be available at http://server.com:3131

Telemetry Message

Request
POST /entrym?sn=00:12:b8:00:34:b7 HTTP/1.0
Host: server.com
Content-Length: xxx
{"entrys":[{"TS":"1255500578","BA":"1970","TT1":"21727","SS":"65497","TM1":"235","HU1":"525"}]}

Data Field Definition

sn - MAC address of the sensor, this is unique for every sensor

Host – current DNS entry for sensor

TS – Sequence number

BA – Battery level measured in mV, the sensor requires at least 2000mV

TTI – Transaction time measured in mSec, This is a function of AP association and Application server response time. This is the time the sensor is awake. Hence reducing this time increases battery life.

SS - SSID signal strength to the associated AP.

TM1 – Temperature measured in Celsius

HM1 – Relative Humidity as a percentage

Response Message

This message is sent by the server application to acknowledge receipt of the sensor data. If the sensor does not receive the response it will store the data and try to send it in the next transaction.

```
HTTP/1.0 200 OK
Content-Length: xxx

{"code":200,"message":"OK"}
```

The body must have the code “200” in the message.

2.5. Sleep:

After the module has sent the sensor data to the server, it goes back to sleep to conserver battery. For extended battery life, it is recommended that the sensors sleep as often as possible and send out sensor readings to the server infrequently.

3.0. Sensor Hardware and Configuration

Included in the delivery of the initial phase of your system is the following:

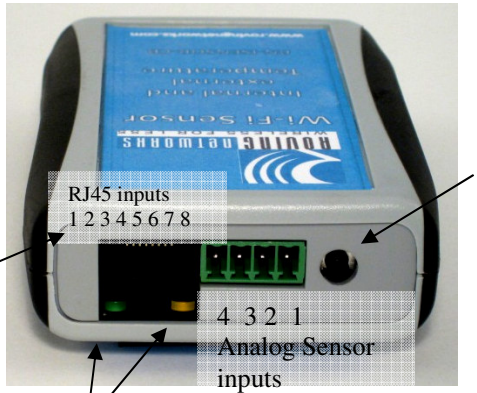
- Sensor
- USB configuration board

The Coolbox sensor can be configure to support many different types of analog and digital sensors. The default configuration is one internal temp sensor and one external RTD temp sensor (Note: the external RTD temperature probe is not included with the Coolbox.)

The Coolbox has an external RJ45 connector for programming via that USB configuration board and connecting external digital or analog sensors.

Note: Using external digital sensors requires special firmware. Contact Roving Networks for more information.

Additionally, the Coolbox has a 4 port terminal block for connecting 2, 3 and 4 wire analog RTD temperature sensors. See Appendix A - 2, 3 & 4 wire RTD configurations for details on connecting external probes.



Provisioning/Wake Button
Press button to:

- Wake up sensor and send data
- Enter command mode (using the USB configuration board)

RJ-45 Connector

Pin	Function
1	Power (3.3V)
2	PIO8
3	RXDB
4	Power (5.0V)
5	GND
6	TXDB
7	SENS2 via J5
8	PIO6

Status LEDs

LED	Associated	Not associated	Re-associate
Green	One Blink	One Blink	One Blink
Yellow	One Blink	One Long Blink	Multiple Blinks until all sensor readings are restored

Configuration is done from a simple terminal emulator running on a PC connected to USB configuration board which is in turn connected to the RJ45 plugging to the Coolbox.

Warning: The USB configuration board is designed to charge the AA batteries in the Coolbox. The Coolbox should be used with rechargeable batteries. Leaving the USB configuration board connected for long periods of time with alkaline batteries will cause permanent damage.

Your computer should recognize USB configuration board once it is plugged into your computer. If your machine does not recognize the USB configuration board, you should down load the driver file from the FTDI or Roving Networks Support website. After installation, a virtual COM port will be created and associated with the device. The COM port of the USB configuration board can be discovered from the device manager.

Open a terminal emulator on the COM port of the USB configuration board. The baudrate setup should be 9600, NP, 8, 1. We suggest you use TeraTerm as your terminal emulator which can be downloaded from the Roving Networks support website. Please **DO NOT** use HyperTerminal as it is known to have issues with our products. TeraTerm can be downloaded from our website:
http://www.rovingnetworks.com/support/teraterm.zip.

Press the Provisioning/Wake up button. By default, the sensor will stay wake for 10 seconds. You will see a number of messages printed on the screen. Type **$$$** in the terminal emulator. You should see "**CMD**" returned to you indicating that the module is now in command/configuration mode. This will verify that your cable and comm. settings are correct. Most valid commands will return an "**AOK**" response, and invalid ones will return an **"ERR"** description. The module will go back to sleep after 10 seconds of inactivity. To get into command mode again, press the Provisioning/Wake up button and type **$$$**.

Type **"get e"** to get a complete display of all the configuration settings

At this point you can use the commands below to configure the sensor. For example to set the network SSID and Passphrase

set wlan ssid my_network
set wlan passphrase my_passwd

After configuration, issue the **save** command to store the setup and then the **reboot** command to restart the sensor with the new settings.

To exit command mode, type **"exit"<cr>**

4.0. Batteries and charging

The Coolbox is designed to work with two AA batteries. It can run on rechargeable or alkaline batteries. Please insert the batteries as indicated on the battery holder.

NOTE: Inserting batteries with the wrong polarity may permanently damage the Coolbox.

NOTE: Do not leave the USB configuration board plugged in to the RJ45 jack of the Coolbox when using alkaline batteries. Doing so can cause the alkaline batteries to leak and damage the board. The USB configuration board provides small current to trickle charge the rechargeable AA batteries.

Battery Life of greater than 2 years can be achieved when the sensor is configured to wake up every 5 minutes

5.0. Sensor Commands

5.1. DNS Parameters

set dns address <addr>	sets the IP address of the DNS sever. This is auto-set when using DHCP, and needs to be set in STATIC IP or Auto-IP modes.
set dns name <string>	sets the name of the host for TCP/IP connections.
set dns backup <string>	sets the name of the backup host for TCP/IP connections.
set ip address <addr>	sets the IP address of the WiFly GSX module. If DHCP is turned on, the IP address is assigned and overwritten during association with the access point. IP addresses are "." delimited. Note this is different from the RN-111b module which is space delimited! Example: "set ip a 10.20.20.1"
set ip backup <addr>	sets a secondary host IP address.
set ip dchp <value>	enable/disable DHCP mode. If enabled, the IP address, gateway, netmask, and DNS server are requested and set upon association with access point. Any current IP values are overwritten. DHCP Cache mode can reduce the time it takes the module to wake from deep sleep thus saving power. In cache mode, the lease time is checked and if not expired the module uses the previous IP settings. If the lease has expired the module will attempt to associated and use DHCP to get the IP settings. DHCP cached IP address does not survive a power cycle or reset.

Mode	Protocol
0	DHCP OFF, use stored static IP address
1	DHCP ON, get IP address and gateway from AP
2	Auto-IP, generally used with Adhoc networks
3	DHCP cache mode, Uses previous IP address if lease is not expired (lease survives reboot)
4	Reserved for future use

set ip gateway <addr> sets the gateway IP address, If DHCP is turned on, the gateway IP address is assign and overwritten during association with the access point.

set ip host <addr> sets the remote host IP address. This command is used for making connections from the WiFly module to a TCP/IP server at the IP address <addr>.

set ip localport <num> sets the local port number.

set ip netmask <value> sets the network mask. If DHCP is turned on, the net mask is assign and overwritten during association with the access point.

set ip remote <value> sets the remote host port number.

5.2. SYSTEM Parameters

set sys printlvl <value> sets numerous print functions. 0 = quiet 1 = connect information Default is 1.

5.3. WLAN Parameters

set wlan auth <value> Sets the authentication mode. Not needed unless using auto join mode 2. i.e. ***set wlan join 2***

Note: During association the WiFly module interrogates the Access Point and automatically selects the authentication mode.

The current release of Wifly firmware supports these security modes:
• WEP-128 (open mode only, NOT shared mode)
• WPA2-PSK (AES only)
• WPA1-PSK (TKIP only)
• WPA-PSK mixed mode (some APs, not all are supported)

Value	Authentication Mode
0	Open (Default)
1	WEP-128
2	WPA1
3	Mixed WPA1 & WPA2-PSK
4	WPA2-PSK
5	Not Used
6	Adhoc, Join any Adhoc network

set wlan channel <value> sets the wlan channel, 1-13 is the valid range for a fixed channel. If 0 is set, then scan is performed, using the ssid, for all the channels set in the channel mask.

set wlan join <value> sets the policy for automatically joining/associating with network access points. This policy is used when the module powers up, including wake up from the sleep timer.

Value	Policy
0	Manual, do not try to join automatically
1	Try to join the access point that matches the stored SSID, passkey and channel. Channel can be set to 0 for scanning. (Default)
2	Join ANY access point with security matching the stored authentication mode. This ignores the stored SSID and searches for the access point with the strongest signal. The channels searched can be limited by setting the channel mask.
3	Reserved – Not used
4	Create an Adhoc network, using stored SSID, IP address and netmask. Channel MUST be set. DHCP should be 0 (static IP) or set to Auto-IP with this policy. (unless another Adhoc device can act as DHCP server) This policy is often used instead of the hardware jumper to creat a custom Adhoc network

set wlan hide <0, 1> Hides the WEP key and WPA passphrase. When set, displaying the wlan settings shows ****** for these fields. To unhide the passphrase or passkey, re-enter the key or passphrase using the set wlan key or set wlan passphrase command. Default = 0, don't hide.

set wlan key <value>

sets the 128 bit WEP key. If you are using WPA or WPA2 you should enter a pass phrase with the set wlan passphase command. Key must be EXACTLY 13 bytes (26 ASCII chars). Data is expected in HEX format, "0x" should NOT be used here.

Example : "set w k 112233445566778899AABBCCDD"

Hex digits > 9 can be either upper or lower case.

The Wifly GSX only supports "open" key mode, 128 bit keys for WEP. WEP-128, shared mode is not supported as it is known to be easily compromised and has been deprecated from the WiFi standards.

set wlan mask <value>

sets the wlan channel mask used for scanning channels with the auto-join policy 1 or 2, used when the channel is set to 0. Value is a bit-map where bit 0 = channel 1. Input for this command can be entered in decimal or hex if prefixed with 0x. Default value is 0x1FFF (all channels)

set wlan num <value>

sets the default WEP key to use. 1-4 is the valid range.

Example : "set w n 2" sets the default key to 2.

set wlan phrase <string>

sets the passphrase for WPA and WPA2 security modes. 1-64 chars. The passphrase can be alpha and numeric, and is used along with the SSID to generate a unique 32 byte Pre-shared key (PSK), which is then hashed into a 256 bit number. Changing either the SSID or this value re-calculates and stores the PSK.

If exactly 64 chars are entered, it is assumed that this entry is already an ASCII HEX representation of the 32 byte PSK and the value is simply stored.

For passphrases that contain spaces use the replacement character $ instead of spaces. For example "my pass word" would be entered "my$pass$word". The replacement character can be changed using the optional command **set opt replace <char>**.

Example : "set w p password" sets the phrase.

set wlan ssid <string>

sets the wlan ssid to associate with. 1-32 chars.

NOTE: If the passphrase or ssid contain the SPACE (' ') characters, these can be entered using substitution via the "$" character.

For example, if the ssid of the AP is “yellow brick road”
You would enter “yellow$brick$road”

Using the ‘get w” command will properly display the value:
SSID=yellow brick road.

set wlan window <value> sets the IP maximum buffer window size. Default is 1460 bytes.

5.4. GET Commands

These commands begin with “get”. They display the current values.

get everything displays all configuration settings, useful for debug.

get dns display DNS settings.

get ip display IP address and port number settings**.**

get sys display system settings, sleep, wake timers, etc.

get wlan display the ssid, chan, and other wlan settings**.**

ver return the software release version

5.5. ACTION Commands

$$$ enter command mode Characters are PASSED until this exact sequence is seen. If any bytes are seen before these chars, or after these chars, in a 250ms window, command mode will not be entered and these bytes will be passed on to other side.

exit exit command mode. Exit command mode. “EXIT” will be displayed.

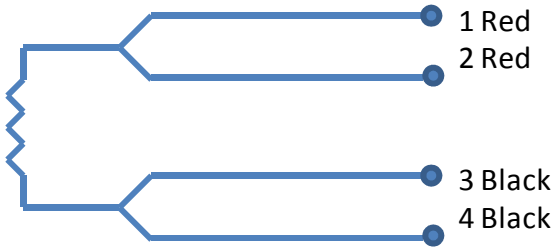
factory RESET Loads factory defaults into the RAM configuration. **Note that the RESET must be capitalized**. After this command the new settings must be save to the config file using the ***save*** command and the module rebooted for them to take effect.

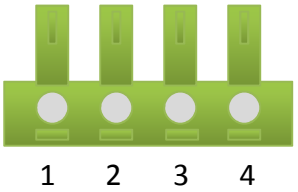
Appendix A - 2, 3 & 4 wire RTD configurations

The external temperature sensors can have either a four wire, three wire or a two wire configuration. It is important that the wire be connected in the following order to the terminal block: wire 4 (GND) → wire 3 → wire 2 → wire 1 irrespective of the configuration. In other words, always first connect the GND pin.

The following diagrams illustrate the various configurations.

- **4 Wire Configuration:**

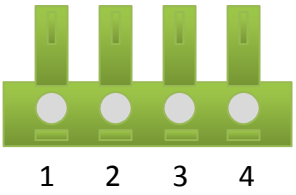




Terminal block: Top View

The sensors usually have two pairs of wires of the same color. Connect One pair of the same color wires (say Red) to pins 1 and 2 and the other pair of same color wires (say black) to pins 3 and 4.

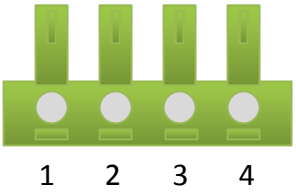
- **3 Wire Configuration:**



Terminal block: Top View

Connect one pair of the same color wires to pins 1 and 2. Connect the other wire to pin 3. Connect a jumper wire between pins 3 and 4.

- **2 Wire Configuration:**



Terminal block: Top View

Move to below.

Connect one wire to pin 1 and the other wire to pin 4. Connect a jumper wire between pins 1 and 2 and also between pins 3 and 4 as shown above.

For more information on the various configurations of the RTD, please visit the Conax website at http://conaxbuffalo.com/default.aspx

Appendix B - Calibration of External Temperature and Analog Sensors

The iSensor T2 and iSensorA2 measure temperature and current through a resistor network connected to the WiFi module analog sensor inputs. The resistors in this network can have slight variances and hence need to be calibrated once during manufacturing or prior to deployment.

Calibration is done from the command interface with the iSensor device in command mode. You will need two (2) 108.5 ohm resistors connected to the terminal block in a 4-wire configuration. Note the resistors values should be measured and confirmed to be 108.5 ohms. Most resistors have +/- 5% variance. You will also need a golden current source of 17.8 mA. W

The following instructions

1.
2. Connect the debug cable to the sensor
3. Open up Teraterm on the COM port associated with the serial cable. (9600 baud, No-parity, 1 Stop
4. Push the "synch" button, you should see output from the sensor as it tries to connect to smms.atk.com
5. Go into command mode, type $$$
6. Calibrate the sensor
    a. T2 sensors
        i. Plug into both port a golden reference resistor of 108.5 Ohms
        ii. Type the command "set s c 0"
        iii. Both ports are now calibrated, remove the golden resistors,
        iv. Calibrate the next T2 sensor
    b. A2 sensors
        i. With nothing plugged into the ports
        ii. Type the command "set s c 1", this set the offset calibration value
        iii. Plug into port 1 a reference current source, the golden sample uses and regulator and 9V battery, the golden reference current is 17.8 mA with a fully charged battery
        iv. Type the command "set s u 1 17800", this sets the slope calibration value for port 1
        v. Plug into port 2 golden reference current source
        vi. Type the command "set s u 2 17800", this sets the slope calibration value for port 2

Both ports are now calibrated, you can view the calibration with the "get s" command

The external temperature sensors can have either a four wire,