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Troubleshooting Connectivity

Silver Glade Class Eversensors

Overview

This document defines steps to understand and resolve connectivity issues for Everactive's Silver Glade-based Eversensors. The audience for this document is a operations personel, field installer, or developer.

The first step is to understand if there is a connectivity problem followed by both remote and on-site actions to take. The basic flow will look like this:

1. Use the sensor health framework and dashboards to evaluate a given fleet for any suspected issues.
2. Remotely evaluate a particular sensor for connectivity issues.
3. Apply remote diagnostics to fix issues.
4. Use on-site tools to evaluate and repair if needed.

The following sections will detail these steps.

Use Sensor Health Framework

This is the framework from which we identify which sensors are considered 'healthy' and which need attention

- Link to Sensor Health documentation (not available yet) – this will explain what sensor health is and what it means

Remotely evaluate a specific sensor for issues

The key here is to use the sensor health framework to identify a group of sensors that need to be evaluated for connectivity issues.

Sensor Health Dashboard

- Sensor Health Dashboard (requires Everactive login)
- See Grafana dashboard User's Guide:

The Sensor Health dashboard is the tool used to identify sensors in poor health for any reason – not just connectivity. A sensor failing any of the 3 categories could be due to connectivity, so this is the starting point to build a list of sensors to check within the fleet.

Using the dashboard, focus in on a customer or site to assess the state of the sensors there. Once sensors with health issues are identified, then proceed to the next step to begin identifying if the issue is connectivity.

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Once you've identified a sensor or fleet of sensors to target go to Evercloud, identify the sensor in question, and open the sensor view.

Evercloud – Look at RSSI

For sensors with tagged as poor throughput for sensor health, a good first check is the make sure the wireless link is adequate between the sensor and gateway. To do that go to the 'Eversensor Health' tab (Note: specify what admin rights are required) and look at the Transmit Signal Strength. This is a measurement of RSSI (received signal strength indicator). If it's low (estimate < -95dB) then the sensor is close to being out of range with the gateway.

Fix: Sensor or gateway placement should be considered to bring them closer together.

Evercloud – Use Packet Counter

Using the packet counter is a good way to evaluate the connectivity quality of a sensor. To find the packet view go to the 'Eversensor Health' tab (Note: specify what admin rights are required) and look at the Radio Packet Counters plot. The radio packet counter is a variable that increments by 1 every time the sensor receives a packet. Once the counter reaches 255 it resets to 1, or when the sensor resets the packet counter will reset to 1 as well. No other conditions influence the packet counter.

In correct operation, the packet counter should increment by 1 every wake-up – by default every minute (as defined by the wake-up rate in the EGW settings). The counter will appear as a linear line up to 255 and then a sharp drop to 1, followed by more incrementing. The overall picture will look like a sawtooth, as seen below.

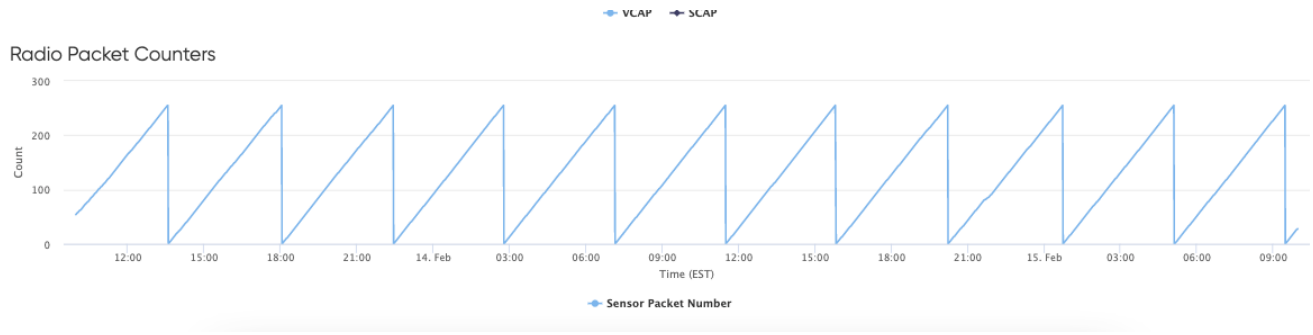

Figure 1: Correct Packet Counter Waveform

Note: make sure to compare the correct sawtooth expectation with the performance of the VCAP/SCAP chart above. If VCAP/SCAP droop low and packets are no longer being received then it is likely due to a lack of energy available to harvest and VCAP/SCAP depleting.

If communication is intermittent, it can be recognized in two ways:

1. The slope of the sawtooth isn't as steep – 1+ min gaps between counts
   This means that the wake-ups aren't being received every time

2. There are gaps in the count
   Gaps in the count mean that the wake-up radio on the sensor received a message, but the following data transmission back to the gateway wasn't successful.

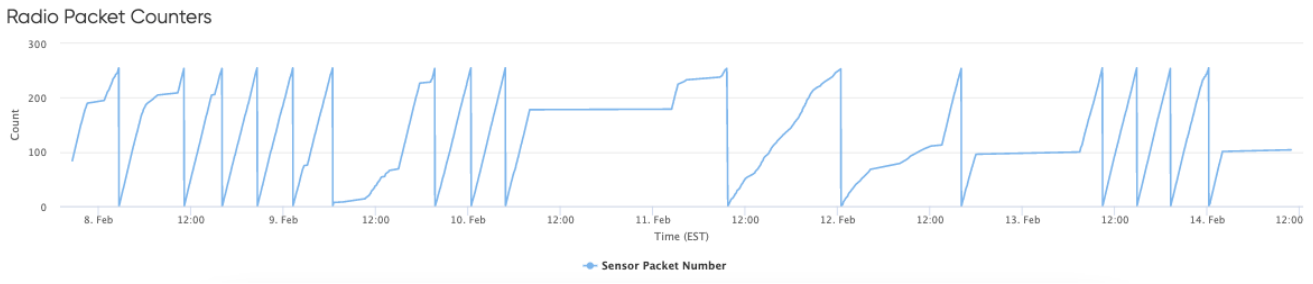

Figure 2: Incorrect packet counter performance

Issue: Resetting Packet Counter:

There is a near term issue where the packet counter gets reset very frequently despite VCAP/SCAP being high and RSSI being acceptable. This is currently being debugged.

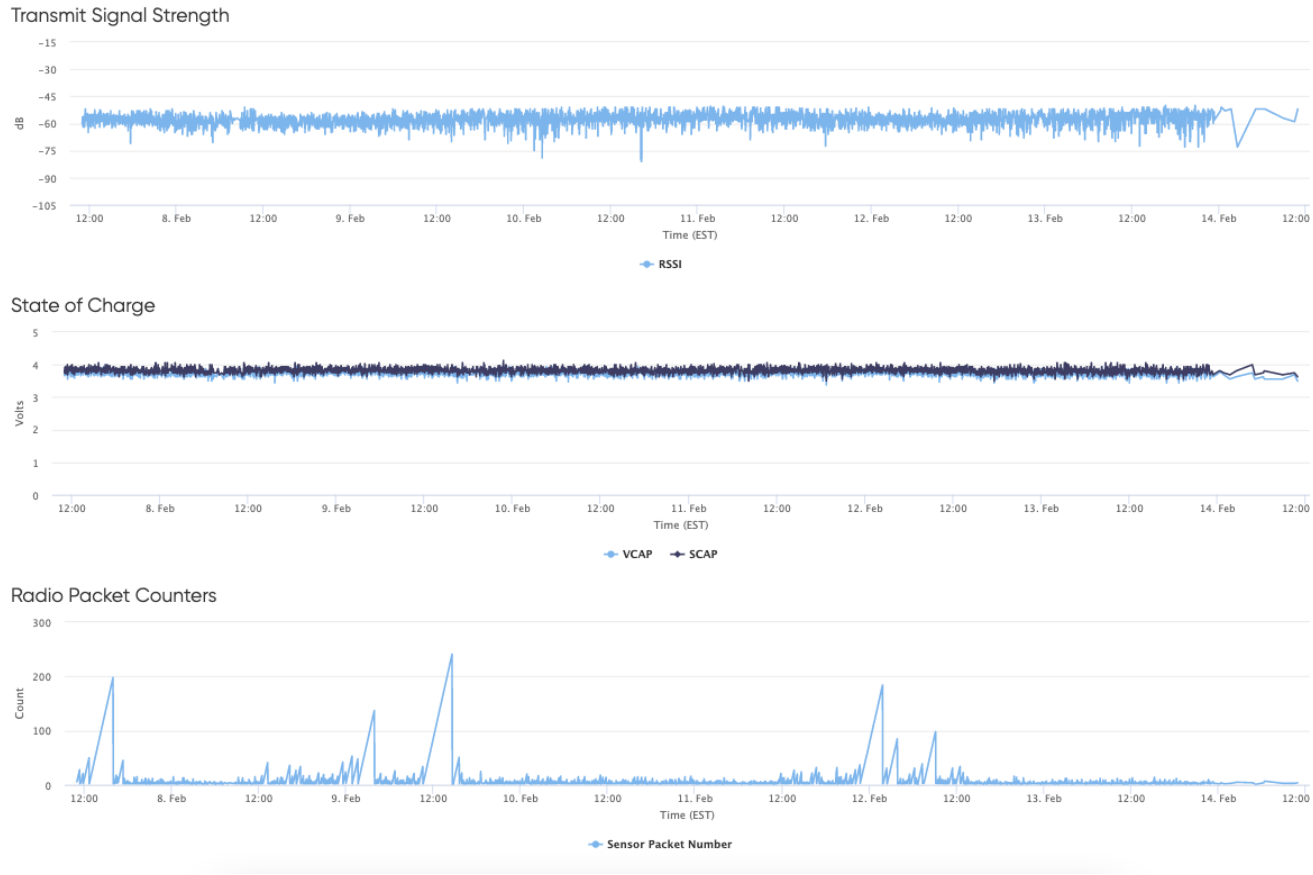

Figure 3: Quick resetting of the packet counter

If you see issues with the packet counter and VCAP/SCAP doesn't droop and the Transmit Signal Strength is acceptable then we need to proceed to the next level of diagnostics below.

Future Improvements

The sensor will produce more diagnostic information in the future and we'll document how to use it here.

Apply Remote Diagnostics

Now we should have a list of sensors under question that have failed the sensor health screening and also been flagged as potential communication issues.

Check Evergateway beacon offsets

One quick check, if you know the location of gateways relative to each other, is to verify that two neighboring gateways have beacon offsets that are different from one another. To check use the following instructions:
Check beacon offsets

Fix: If neighboring gateways have the same beacon offset move one of them to make them different.

Use On-site Tools to Evaluate and Repair

If none of the remote diagnostics work then these are the steps to prepare when on-site.

Check the Sensor-Gateway link using a WRX Sniffer (Proof of Concept Phase)

- WRX Sniffer User's Guide (Doesn't exist yet)

The WRX sniffer has a specific function that it will detect any wake-ups are being sent by a gateway and record them. This device is portable and its hardware closely resembles that of the Eversensor so it can act as an Eversensor proxy and be held in an area where an Eversensor might be installed and provide insight if wake-ups can be detected in that location. This is useful in that it should give very strong confidence if receiving wake-ups is even possible or not.

When troubleshooting a sensor for connectivity, hold the WRX sniffer near the Eversensor in question.

If wake-ups are being received then take the following next steps (detailed description below)

1. Measure Power at VCAP/SCAP – could actually be a power problem
2. Check Evernet association logs and look for LED blink patterns

If wake-ups are not being received, or the success rate is very poor, then that will point to 2 possible next steps (detailed description below):

1. There is some sort of interference that is impacting the sensor
2. The range isn't sufficient in that environment

Measure Power at VCAP/SCAP

Refer to the Troubleshooting: Power/Energy Harvesting Guide for next steps

Fix: Follow troubleshooting guide above if it turns out to be a power issue.

Check Evernet association logs and look for blink patterns

Refer to the Evernet Association Logs User Guide (does not exist yet) to determine if the sensor is connected to the gateway.

Fix: If the sensor is failing to associate to Evernet replace the sensor and return for FA.

Environmental Co-existence Check

- Signal Hound User's Guide

The Signal Hound is a spectrum analyzer which can be used to measure the wireless environment and can detect if third-party wireless networks or other wireless energy is in the environment and could potentially impact Evernet communications. Above is the listed User's Guide for the signal hound which provides instructions on using and uploading the files for evaluation.

Fix: If the wireless environment has too much congestion for Evernet there are a few options we can take, but none are guaranteed fixes. If possible, identify what the source of the interference is and then,

- Place a gateway closer to the affected sensors to try and make the Evernet signal bigger than the interferer.
- Ask the vendor of the interfering device if they can turn their transmitter's power down

Range Isn't Sufficient

If no wake-ups are received and the environment looks clean then we need to improve the link between the sensor and gateway. There is one last debug state we can take to make sure the gateway is sending a strong signal to the sensors. Note this involves powering down the gateway.

(Note this hasn't been done in the field yet. Eng should give this a try before it becomes standard practice).
Power down the gateway (this step is critical!) that should be communicating with the sensor in question. Using the signal hound, an SMA-connected DC block, and a 30dBm SMA-connected attenuator, remove the 915MHz antenna and connect the DC block, 30dBm attenuator, and a cable directly to the SMA. See the picture below for the correct setup

Picture of Signal Hound connected to gateway

Turn on the gateway back on and let it boot – then set the signal hound to max hold and observe the output signal power coming from the gateway. It should be default read 0dBm. If it does this tells us the gateway is

performing as expected. If the power is significantly below that (more than 3dB below) there could be an issue with the Boomerang in the gateway. If that happens you have a few options.

Fix: You can either 1) accept the gateway's reduced range and move sensors closer or 2) you can install another gateway or 3) replace the Boomerang inside the gateway.

Fix: If the gateway output power is acceptable then replace the sensor in question and return for FA.