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Data Center Environmental Monitoring Using Smart Passive Sensors™

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APPLICATION NOTE

Introduction

In data centers, the amount of resources required to accurately monitor environmental variables throughout the entire facility is increasing dramatically. Maintaining the correct ambient air temperature levels throughout the facility is a critical factor to optimize server performance and equipment lifetime. Leak detection sensors are also used extensively to alert of malfunctioning coolant pipes or external sources of water leaks.

Conventional sensors for data center environments are difficult to use on a large scale due to their battery or wiring requirements as well as high individual sensor costs. Different sensors will inevitably use a variety of communication protocols, requiring new software to be written to accommodate new sensors into the existing infrastructure.

Smart Passive Sensors tags are both wireless and battery-free, allowing them to be placed anywhere within range of a compatible UHF reader. All communication with the sensors is handled by the reader, which also provides power to the tags through RF energy harvesting. Moisture and temperature information is collected from all SPS tags within range of the UHF reader, which then bundles the information and sends the data upstream in a standard format such as a JSON data object. Sensor applications in a data center fall into two main categories: sensors inside the rack and sensors outside the rack, both of which will be discussed in further detail in the following sections.

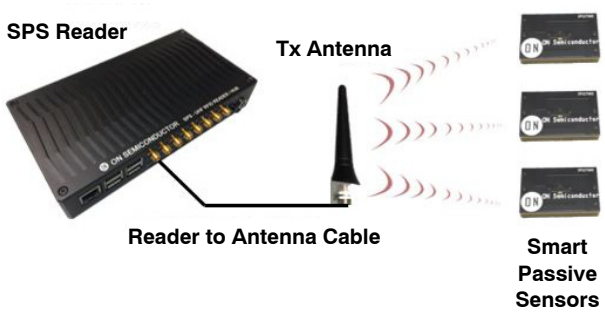

Figure 1. Smart Passive Sensor Ecosystem Components

Intra-Rack Sensor Usage

Sensor antenna designs are optimized based on where they will be placed and the required read range. SPS temperature tags placed on individual pieces of equipment in the server rack are designed to be small in order to take up minimal real estate on the face of the equipment, resulting in relatively shorter read ranges. The impact on read range is mitigated by the fact that multiple reader antennas are used inside of the server rack, meaning that the farthest an SPS tag will be from a reader antenna is 2−3 feet. Other important design factors for SPS include:

- Intra-Rack SPS temperature tags should be placed on metal surfaces for best performance
- Two reader antennas are required to read the front side of the rack from top to bottom. If SPS tags are placed on the back more antennas will be required
- Reader antenna placement should look similar to the system solution shown in Figure 2 in order to minimize the distance between SPS tags and reader antennas

Analyzing Intra-Rack Temperature Data

When queried, the UHF reader will send out the data from each SPS tag that it read from. Readers can be programmed to package all of the data (Tag ID, EPC, temperature, timestamp) in a convenient way for upstream servers to analyze. The central server must then handle the analysis of all of this data, which can multiply quickly when many readers are used to cover a large area, such as a full-scale data center.

The unique 128-bit EPC identifier for each SPS tag allows the sensor data to be sorted and mapped, and even to monitor a single piece of equipment's temperature profile over its lifetime. The visualization shown in Figure 2 demonstrates how the temperatures from a multitude of sensors can be used to generate a heat map of full server racks. Various types of excursions such as isolated hot-spots or rack-wide temperature shifts can be used to trigger automated messages specifying any required actions.

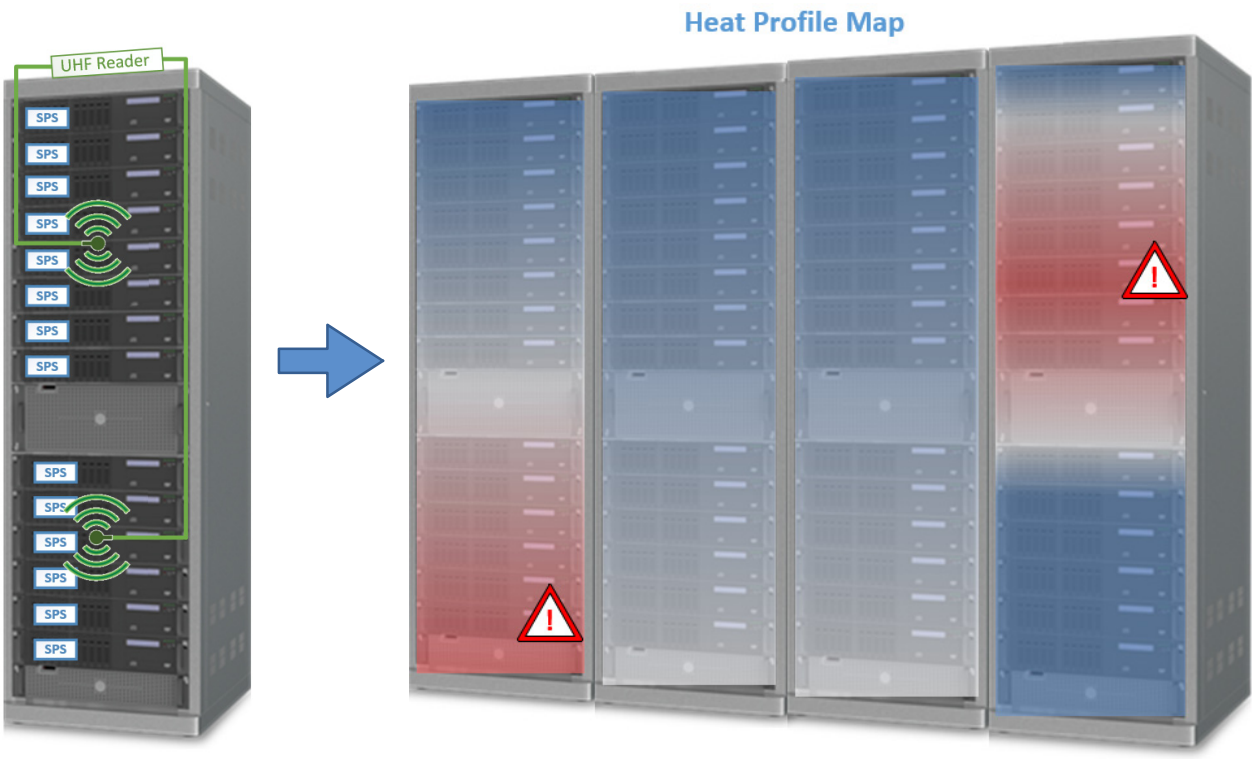

Figure 2. Intra-Rack SPS Solution Implementation

Data Center Environmental Sensing

As mentioned in the introduction, SPS can also be implemented to monitor data center wide environmental variables including temperature and moisture from water leaks. A heat map for the entire data center can be constructed from the temperature sensors placed throughout the room. SPS tags used outside of the server rack can have much longer read ranges since they can be slightly larger than other designs. The long read range of these tags means that fewer central readers and antennas are required, resulting in lower overall solution cost per sensor end point. The diagram in Figure 3 demonstrates a simplified data center layout utilizing both temperature and moisture SPS tags. The visualization of the data collected using the SPS infrastructure shows in-depth heat mapping as well as specialized triggers for any abnormal temperature spiking or water leaks.

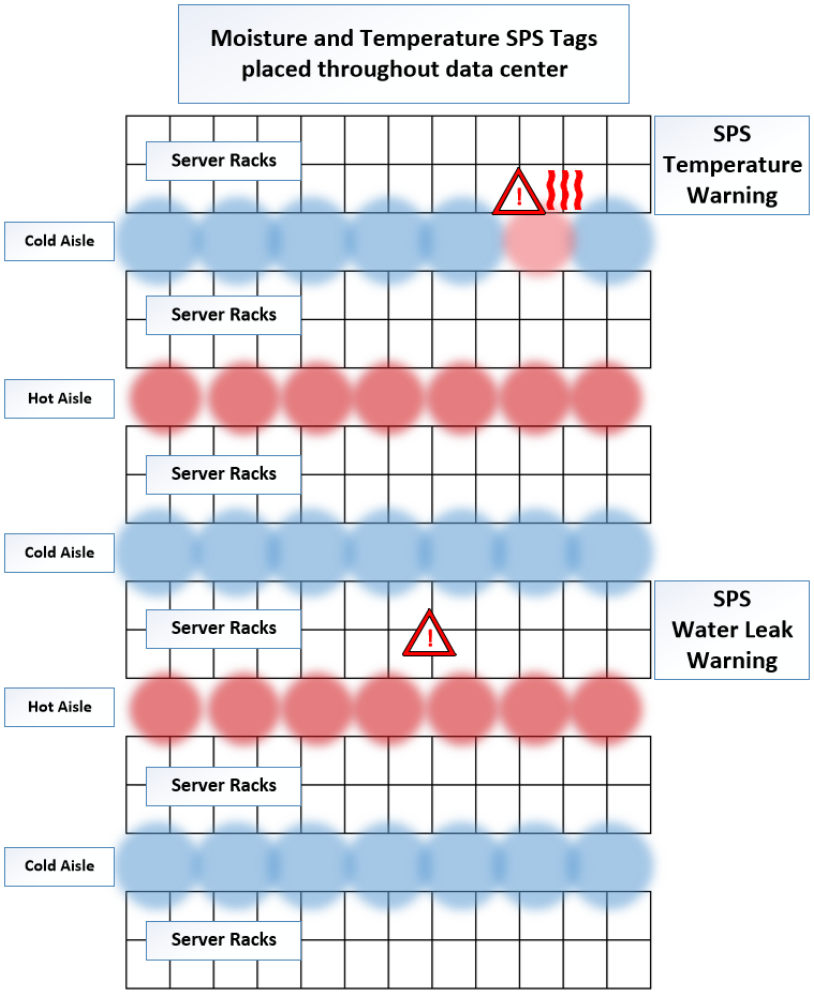

Figure 3. Data Center-wide SPS Solution

Summary

Smart passive sensors can be used to monitor key environmental variables throughout an entire data center. Their wireless and battery-free properties allow for a level of flexibility and scalability that cannot be matched by other solutions. The analysis of the data from a SPS solution can lead to cost savings due to extended equipment lifetime, optimized cooling costs, and early leak detections.

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