Singapore Zoo Reduces Energy Consumption with LoRa Technology

BY CLAIRE SWEDBERG

An IoT solution from Sindcon, using Semtech's LoRaWAN protocol chip, is enabling the zoo to reduce its energy and water consumption by 10 percent, while cutting labor hours previously required for checking meters.

Dec 05, 2021   The Singapore Zoo, also known as the Mandai Zoo, is capturing real-time data regarding energy and water usage across its 69 acres, with an Internet of Things (IoT)-based system that receives and manages sensor data about water and energy use, while also detecting water leaks. Since the solution was deployed in 2018, the zoo has found that it has reduced the number of labor hours employees previously spent physically checking its energy and water meters, and that it can now monitor power and water use, as well as detect leakage.

In this way, the zoo says it can address problems more quickly, while also using the collected data to reduce its energy and water consumption. The IoT solution, provided by Singapore technology company Sindcon, consists of a wireless smart metering system, leveraging LoRa connectivity from Semtech, that measures the power and water that is used to support animal health and exhibits, as well as the business's overall operation.

The Singapore Zoo is using the technology not only to reduce the amount of time workers must physically walk throughout the zoo recording meter readings on paper, but also to capture more information about how much energy and water are being consumed, as well as when and how. "Our strategy of energy-saving is based on the mass data of meter reading," explains a spokesperson for the zoo who has asked to remain unnamed. Since the system was taken live, this spokesperson reports, the zoo estimate that it has reduced energy consumption by approximately 10 percent.

The facility consists of 69 acres of wildlife, safari areas and bird exhibits. It attracts more than two million annual visitors and displays animals in open exhibits, with hidden barriers, moats and protective glass between the animals and visitors. Among its collection is the largest captive colony of orangutans in the world. It also features such events as "Elephants of Asia," "Tiger Track" and "Treetops Trail." The animal exhibits at three parks (Singapore Zoo, along with River Safari and Night Safari) span 800,000 square meters (8.6 million square feet) in total and have been covered with the IoT network.

The zoo relies on a large supply of energy and water to operate its three parks in such a way that is beneficial to the animals and to visitors. Before implementing the IoT solution, the parks typically relied on its personnel to physically go to meters and read the results once daily. That manual process was time-consuming for workers, the zoo spokesperson says, and it generated only limited information that could, at times, be incorrectly recorded. Therefore, the zoo sought a system that would be relatively low in cost but would reliably capture data that management could access on a real-time basis.

The facility found that a cellular 3G/4G system would be too expensive, and that connectivity could be unstable, so it instead chose to test LoRa technology. It conducted a proof of concept for approximately eight months to prove it could effectively capture and forward the data. The deployment that followed consisted of 1,000 sensor devices from Sindcon, each with a Semtech chip providing LoRa technology using the LoRaWAN standard.

Every sensor device is installed inside switch rooms within electrical panels throughout the three parks, according to Deyu Chen, Sindcon's CEO. The devices measure the cubic meters of water throughput, as well as the kilowatt hour (kWh), voltage, current and power consumption from the electric meters. Every 15 minutes, the units forward that data to a Kerlink gateway device which, in turn, transmits the information to a cloud-based server. The devices used for water metering are battery-powered, while the energy meters can be plugged directly into a power outlet.

Sindcon installs new water and energy meters with Semtech's LoRa chips built in, while upgrading some existing traditional meters with LoRa chips and customizing the LoRa gateways to interface with those existing meters, from multiple manufactures. With the implementation completed, Chen says, "We are able to provide readings every 15 minutes." Exceptions, such as unusual water or power use, can be detected in near-real time, he adds. "For example, a certain water meter should not have a reading at night, but it was found to have a reading. Therefore, we can have reason to suspect that there is a water leak somewhere."

Sindcon provides applications and software on its hosted server so zoo personnel can access the data remotely. The zoo can view the information via mobile phones or computers, and it can share the data with a third-party vendor that provides the energy and water savings strategy. Deploying the solution at the zoo posed a few technical challenges, Chen recalls. First, he says, "the wireless signal is attenuated badly" due to the expansive area and the heavily forested terrain. What's more, since Singapore Zoo is a tourist attraction, the LoRa devices had to be hidden from public view. "This makes the radio transmission even tougher."

All the LoRa devices utilized for the water meters need to be powered by battery, says Marc Pégulu, Semtech's VP of IoT product marketing and strategy, and the battery life should be more than three years with a transmission every 15 minutes. This means the battery should be able to support at least 394,200 uplink radio transmits, according to Chen, and that the LoRa device should have very low standby power consumption. In fact, the zoo reports that after three years, most of the devices still have more than 50 percent battery life. The system also monitors battery levels and sends that data to the server. An alarm is triggered is battery voltage falls below a specific threshold.

Another challenge involves the outdoor environment, as most of the devices are exposed to the hot, rainy and humid climate of Southeast Asia. "This poses a huge challenge to equipment performance," Chen says. However, the zoo reports, the installation of devices has been configured in such a way that they provide data with 97 percent accuracy. Since the system was deployed in 2018, the zoo has continued to add LoRa devices not only in its water and power meters, but also with other sensors, such as water-level monitors.

Sindcon has deployed similar systems at schools and shopping centers in Singapore, such as the Singapore American School. The company provides what it calls "smart meter systems" for a variety of other businesses and agencies as well. "We have deployed LoRa metering systems in most of the major shopping malls, universities and industrial parks in Jakarta," Chen reports, adding, "We will start to deploy LoRa smart gas meters for the Indonesian government for residential [sites] in the coming December, after two years of POC (proof of concept) and testing with Indonesia government agencies." In addition, several cities are trialing Sindcon's LoRa-based sensors for smart streetlighting.

In contrast with traditional LED streetlights, Chen says, LoRa-based connectivity can deliver smart solutions and energy savings by transmitting data regarding streetlight status and power consumption that cities can use to adjust lighting levels or power consumption. Semtech has also worked with Sindcon to provide water-metering solutions with its LoRa-based technology in Indonesia, Pégulu says, noting that businesses and government agencies are opting for LoRa solutions where cellular wireless is limited or too costly.

Systems like those used by Singapore Zoo require very low power, Pégulu says. "One of the beauties of LoRa is the light infrastructure needed for full coverage," he states. LoRa provides a similar transmission range to that of cellular systems, though it can achieve power consumption that is approximately 100 times lower. "That would be enough, in an application like this, to have batteries lasting even 10 or 20 years."

Such a deployment could include a feature by which the devices could transmit less often—once an hour, for example. Some utilities are adding a feature to support at least issue an alert in the event of a detected water leak. LoRa technology use by utilities can also include the detection of methane gas leaks, and it can help companies to address challenges involving aging infrastructure. "We see a lot of installations going through aging pipes that have more risks of accidents," Pégulu says.