SEMTECH

LoRa®

Calgary

# LoRa Technology: Remote and Real-time Acoustic Monitoring

**IMPROVING NOISE MONITORING IN URBAN ENVIRONMENTS**

## IMPROVING QUALITY OF LIFE FOR CITIZENS

Noise pollution is a persistent problem for residents in urban environments. Recent studies have estimated that 9 in 10 people in major cities are exposed to noise levels exceeding international guidelines daily. The negative health effects of excess noise include disturbed sleep, hearing loss, cognitive disorders, and high blood pressure.

Municipal noise ordinances aim to reduce noise pollution, but assessments of noise and monitoring are performed infrequently and are primarily complaint-driven. The City of Calgary set out to build a network of low-cost acoustic sensors to enable continuous monitoring in its urban environment.

> "Measuring noise is important to everyone's quality of life. Noise monitoring is difficult to characterize and has traditionally been expensive."
>
> – Nan Xie, Sr. IT Engineer, City of Calgary

## INNOVATING WITH SEMTECH'S LORA TECHNOLOGY

The Urban Alliance, a research partnership between the City of Calgary and the University of Calgary, was created to eliminate legal and financial red tape, and coordinate the transfer of technology and research for the community's benefit. Dr. Henry Leung heads the Robotics and Sensor Networks Group in the Department of Electrical Computer Engineering at the University of Calgary. He collaborated with the Urban Alliance to build a LoRa®-based sensor using Edge analytics to characterize noise and initiate a pilot use case on Calgary's LoRaWAN™-based network.

"Our inspiration was the result of analyzing existing smart city noise monitoring applications. In New York City, they approached it using Wi-Fi and live streaming. This was rather expensive and took significant resources to reliably operate and sustain," said Leung. "We proposed developing our own solution without an electrical power supply to the device – just a battery."

Leung's team's first contribution to the project was the hardware design of the sensor. Their fabrication used low-power wide area radio transceivers to enable data transmission between the nodes and network server. The LoRa-based sensors are battery operated for ease of deployment, low-power to limit network maintenance, robust for continuous operation in extreme weather conditions, and possess a limited amount of in-situ data processing.

The second contribution by the team was the development and testing of analytic algorithms allowing sensors to autonomously detect and classify acoustic events. The researchers will use machine learning to distinguish between noise sources such as construction, traffic, gunshots, and music.

# DNA of IoT Use Case

### IoT Challenge

- Cost-effective solutions for continuous and real-time monitoring of noise
- Development of acoustic sensors with embedded intelligence
- Detection at multiple frequencies and characterization of sound

### LoRa Technology Used

- Semtech's LoRa Technology used for sound propagation acoustic sensing
- City-owned LoRaWAN-based network achieves unrivaled range and scale
- Ability for machine learning to be implemented at the sensor level

### Business Value

- Proactively address common non-emergency hotline noise complaints, saving time and money
- Ability to support city noise ordinance violations with accurate data
- Plans for historic sound metric score map to be provided for home purchasing

## TEST, INVEST, ITERATE

To put these innovations to test, several of the new LoRa-based sensors were placed at the Circle Carnival event at Shaw Millennium Park in September 2018. Installed at different locations around the park, the sensors were programmed to compute the average noise level every three minutes. When the noise level rose above 85dBC, the sensors sent a warning packet through the LoRaWAN-based network. In the future, this feedback can be proactively provided to concert promoters to ensure noise restriction compliance.

"From this testing, we observed that LoRa-based sensors are very easy to deploy with minimum infrastructure requirements. We were able to accurately detect noise thresholds without false alarm triggers."

– Henry Leung, PhD, Professor, Schulich School of Engineering, University of Calgary

## HOW IT WORKS: THE CITY OF CALGARY



The step-by-step process of The City of Calgary's LoRa-enabled solution.
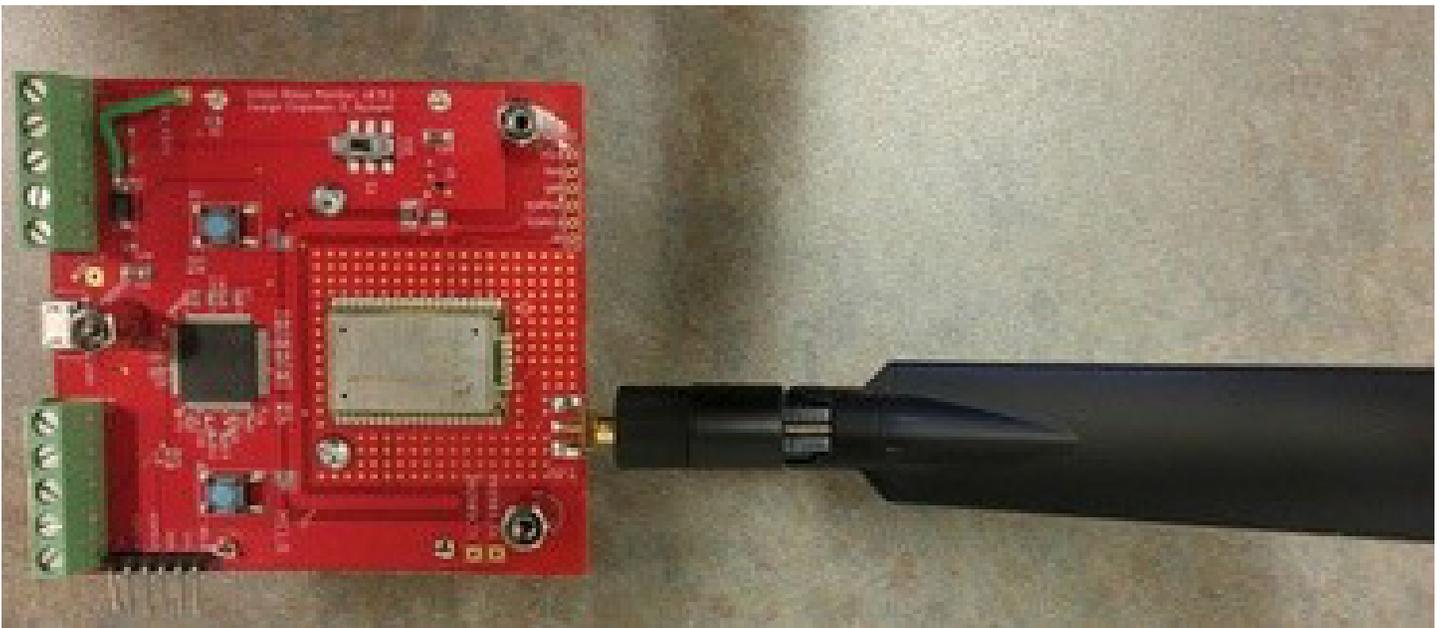


Above is an image of the LoRa-based sensor used by the Urban Alliance.
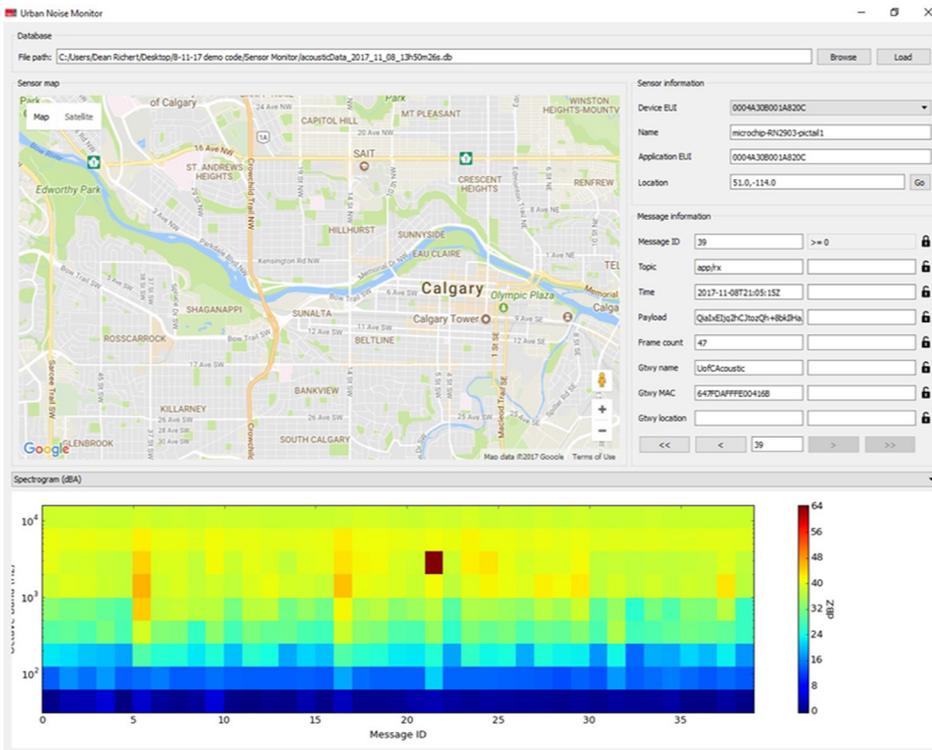
*Above is an example of noise measurements taken.*

The next evolution will be categorizing sounds such as trains, road noise, drag racing, gun shots and construction, and spatially correlating it over time and location. This data will help improve noise management and enforcement during public events by automatically alerting law enforcement when noise thresholds are exceeded, saving The City time and money.

## For more information on the Urban Alliance visit: www.calgary.ca

Semtech's LoRa devices and wireless radio frequency technology is a widely adopted long-range, low-power solution for IoT that gives telecom companies, IoT application makers and system integrators the feature set necessary to deploy interoperable IoT networks, gateways, sensors, module products, and IoT services worldwide. IoT networks based on the LoRaWAN™ specification have been deployed in over 100 countries and Semtech is a founding member of the LoRa Alliance™, the fastest growing IoT Alliance for LPWAN applications.

Semtech Corporation is a leading supplier of high performance analog, mixed-signal semiconductors and advanced algorithms for high-end consumer, enterprise computing, communications, and industrial equipment. Semtech, publicly traded since 1967, is listed on the Global Select Market under the symbol SMTC and has more than 32 sales and application support offices in 14 countries as well as representatives and distribution support locations in more than 30 countries. Semtech is dedicated to providing proprietary platforms, differentiated by innovation, size, efficiency, performance, and reach.

The LoRa Alliance is an open, nonprofit association that has become one of the largest and fastest-growing alliances in the technology sector since its inception in 2015. Its members closely collaborate and share experiences to promote the LoRaWAN protocol as the leading open global standard for secure, carrier-grade IoT LPWAN connectivity. With the technical flexibility to address a broad range of IoT applications, both static and mobile, and a certification program to guarantee interoperability, the LoRaWAN protocol has already been deployed by major mobile network operators globally and connectivity is available in over 100 countries, with continuing expansion ongoing.