"Smart Manhole" System Design
Revolution11 takes 1st Place at IoT Hackathon

Overview

The Revolution11 "Smart Manhole" project originated from a hackathon hosted by AT&T and the GSMA in San Francisco, CA September 9-11, 2017. Read the story here.

The goal of the "Smart Manhole" project is to address the following needs in utility hole maintenance and infrastructure wiring: 1) the ability to know the inside wiring layout before opening a utility hole, 2) the wireless tracking of temperature, humidity and other telemetry data without having to open the utility hole, and 3) receipt of alerts to prevent unauthorized or incorrect access to the infrastructure when a utility hole cover has been opened.

Components

The overall system consists of three main subsystems:
the IoT Device, the Cloud services and the iOS application.

1. IoT Device

The IoT Device is a prototype constructed with the AT&T IoT Starter Kit. The device, once properly enclosed and weather-sealed, is to be adhered to the underside of the utility hole cover. The device serves functions including telemetry data gathering and transmitting, as well as utility cover locating/identification.
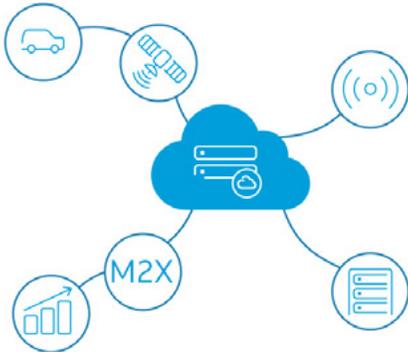
- Sensors: temperature, humidity and acceleration sensors are integrated in the NXP K64F Development Board.

- NXP K64F Development Board: part of the AT&T Starter Kit, the main development board that hosts and runs the software which handles and controls the cellular shield to transmit the data gathered by the sensors.

- Avnet Cellular Shield: part of the AT&T Starter Kit, uses the WNC M14A2A LTE module to connect to the AT&T cellular network to transmit data over HTTP.

- Bluetooth Beacon: a passive bluetooth beacon which serves locating and identification purposes.

▶*Learn more about the AT&T Starter Kit here:*
https://www.business.att.com/enterprise/Service/internet-of-things/iot-platforms-development/starter-kit/

▶*Revolution11 provides a thorough overview of Beacon technology here:*
https://revolution11blog.com/2016/05/27/using-sensors-to-get-information-sent-to-your-mobile-device/

2. Cloud Services

The Cloud consists of all databases and services that are hosted in servers, VMs or other connected computer resources.

- AT&T Flow: single point of entry for all transmissions from the IoT device. Processes the data received, appends derived data to the payload and stores to AT&T M2X. Based on the derived calculations, the Flow also pushes data to the email services to generate alerts.

- AT&T M2X: a time-series database with GET/POST APIs. Used to store all sensor and derived time-series data.

- External Email Service: An API that the Flow application calls to send emails for temperature/humidity/opening alerts. Currently a PHP service hosted on Amazon EC2 as a temporary measure for prototyping needs.

- External Database: stores all non-sensor related data from external sources (e.g., utility company's database) that pertain to the utility holes.

- Data Services APIs: API services that the mobile app or other front-end applications can call to obtain all data available that pertain to a particular utility hole. Currently, a set of PHP services hosted on Amazon EC2 serves as a temporary measure for prototyping needs.

▶*Find more information on AT&T's Flow Design tool here:*
https://www.business.att.com/enterprise/Service/internet-of-things/iot-platforms-development/flow-designer/

▶*AT&T M2X information found here:*
https://m2x.att.com

▶*Amazon's EC2 cloud services, go here:*
https://aws.amazon.com/ec2/

---

3. Mobile App

The Mobile App is the front-end interface (other than email alerts) that interacts with the end user. The mobile app obtains the UUID and location information from the bluetooth beacons on the IoT device via Bluetooth-Low-Energy 4.0 standard and then, if the user requests, queries the Data Services APIs with the UUID to obtain the sensor time-series data as well as data from the external database to display on the mobile interface. The mobile app queries the Data Services APIs periodically (depending on configuration) to ensure the data displayed are refreshed and up to date.

Flow
System design & data flow diagram:
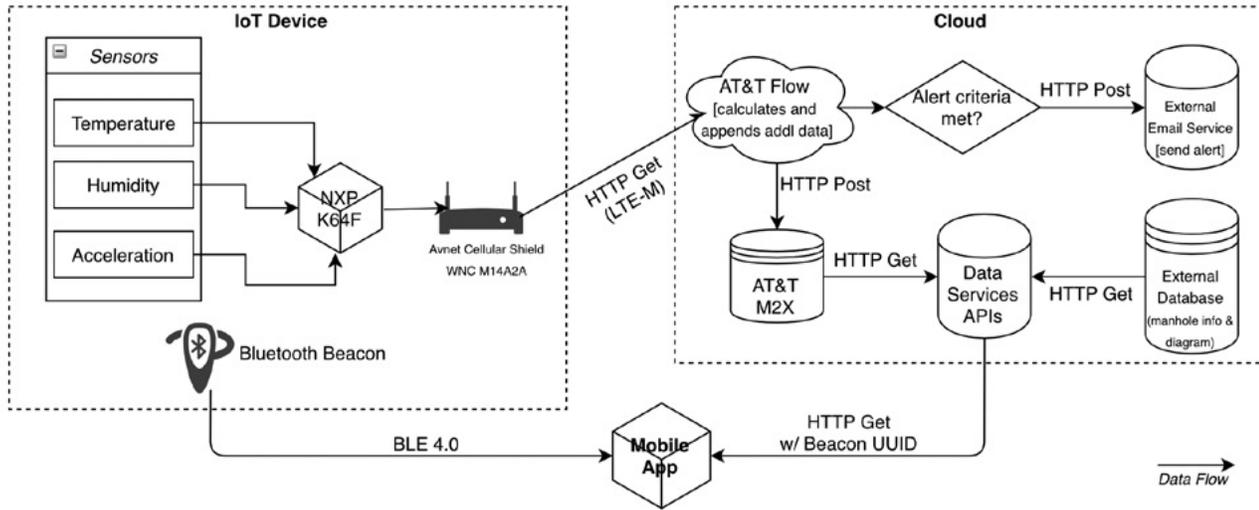
Conclusion

This prototype, when fully developed, has the potential to save utilities and municipalities both time and money. It will also help increase the security around critical infrastructure.

Revolution11 looks forward to continuing to offer leadership in the IoT space.

Have Questions?
Revolution11 provides a free initial consultation. Contact us and we would be happy to discuss your situation and needs.

1.415.969.8595 • inquiries@revolution11.com