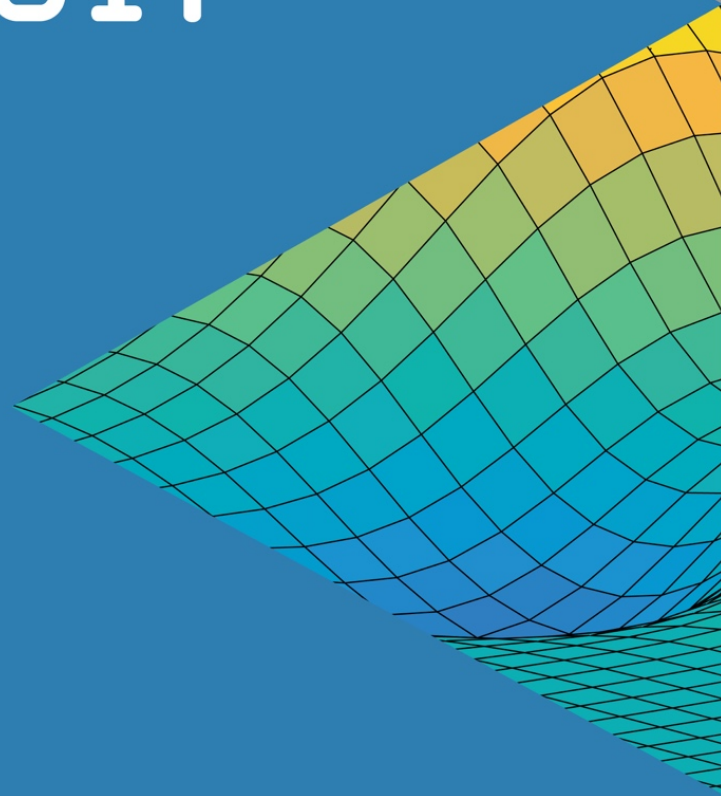


MATLAB EXPO 2017

Developing Analytics and
Deploying IoT Systems

Antje Dittmer



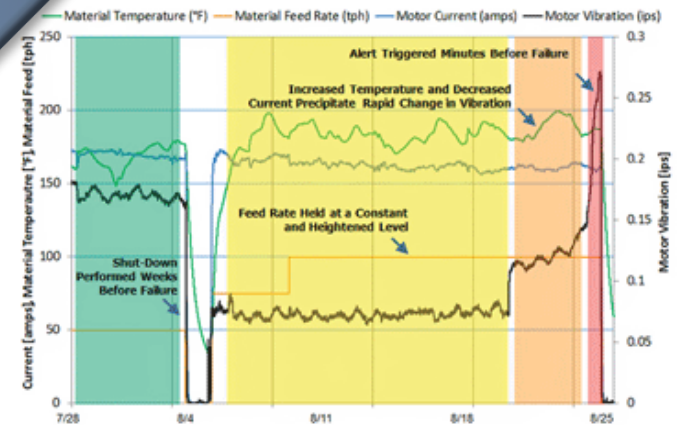
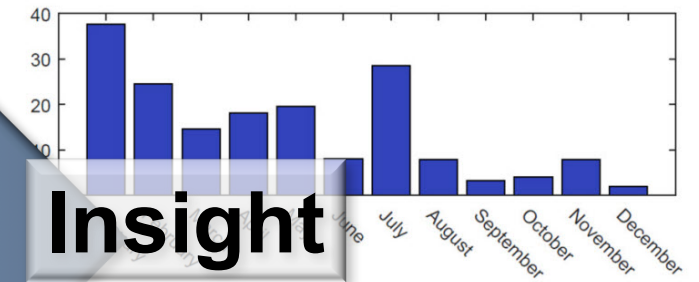
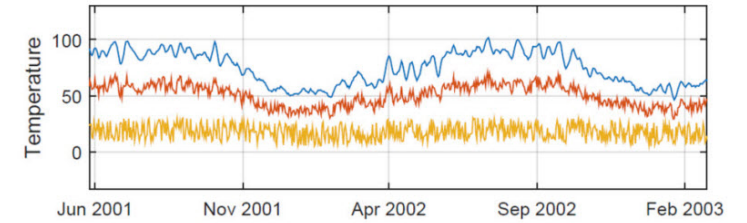
What is IoT?



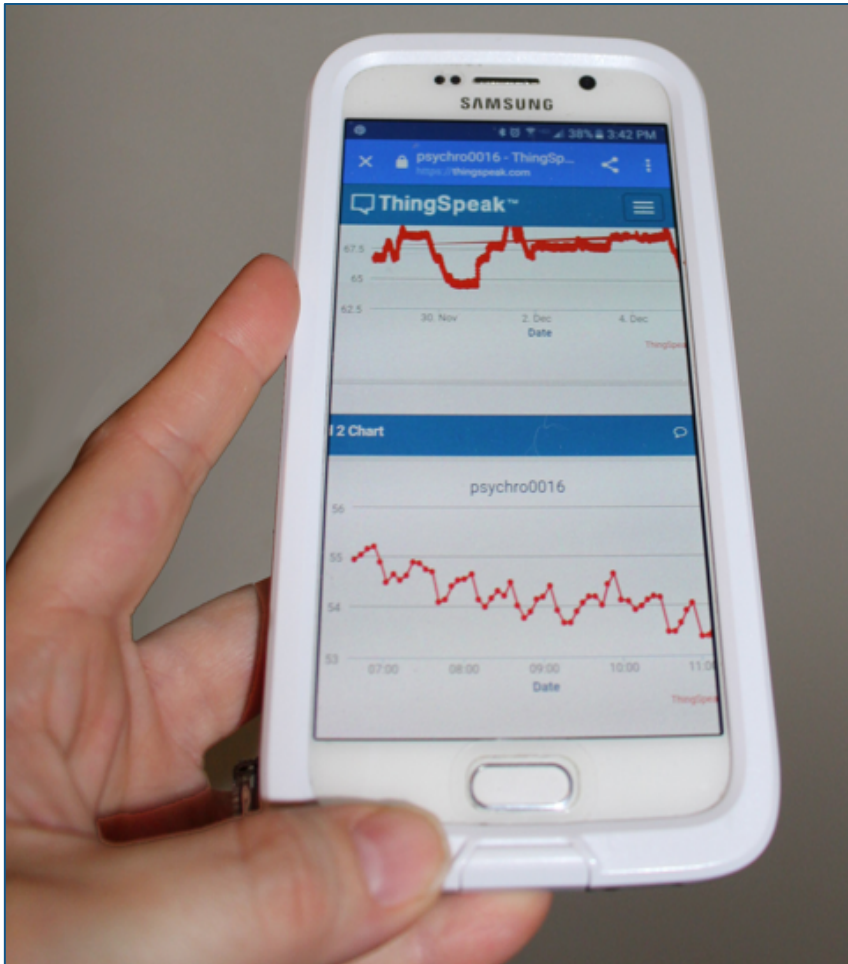
Devices

Analytics

Insight



Example from Cadmus

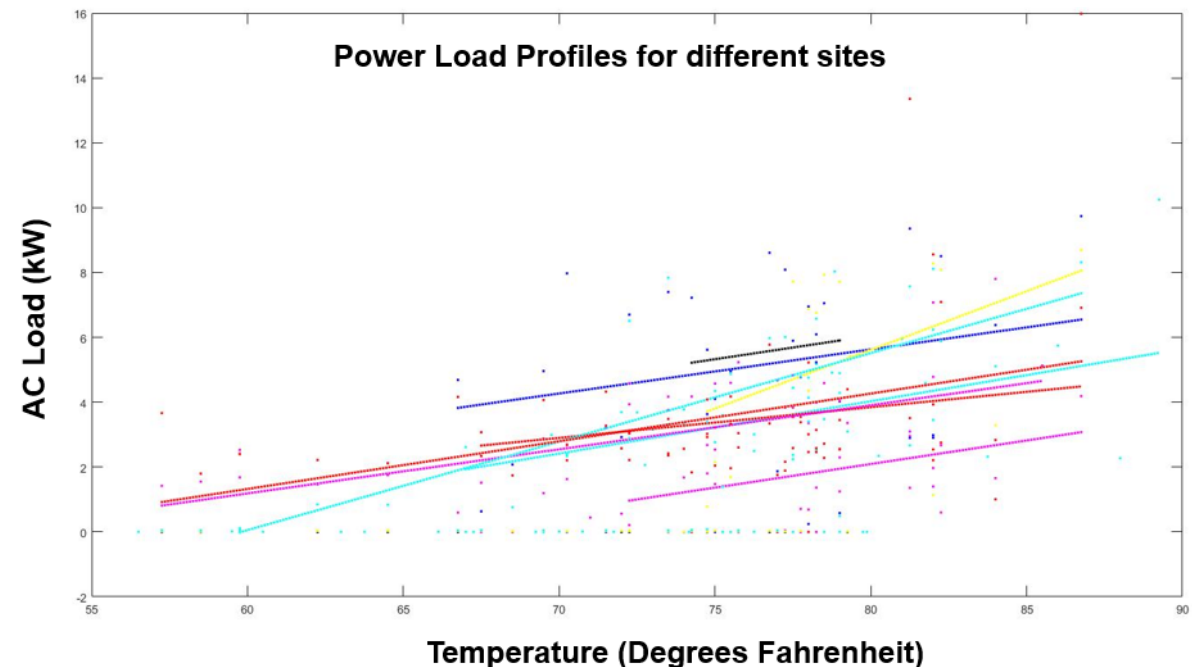


Challenge: Measure and evaluate energy efficiency of buildings based on onsite sensor data

Solution: **ThingSpeak:** collect data (temperature, humidity, power usage), **MATLAB:** analyze and visualize data

Results

- Market opportunity seized
- Development effort cut by two-thirds
- Sensor networks quickly deployed

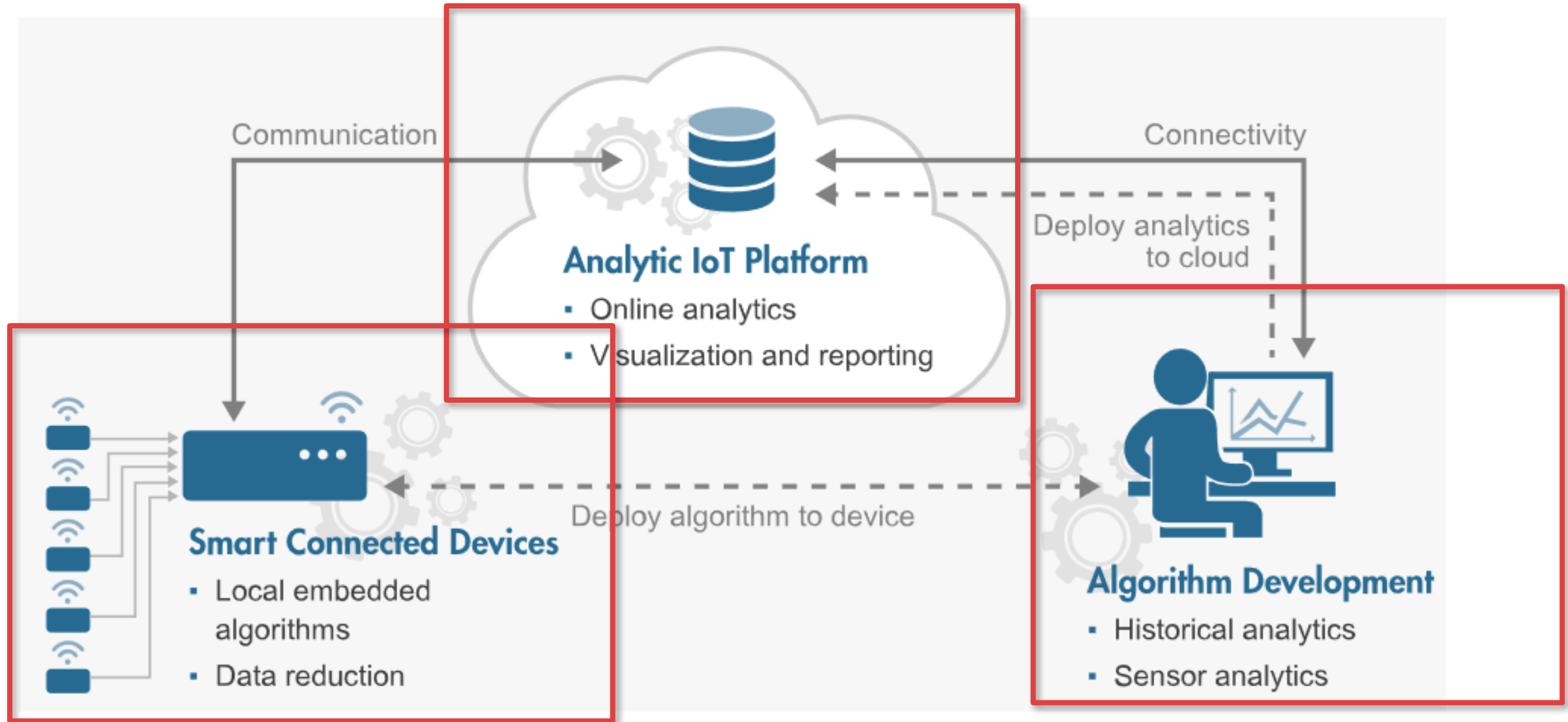


Algorithms are Key to IoT Systems: MATLAB Can Help

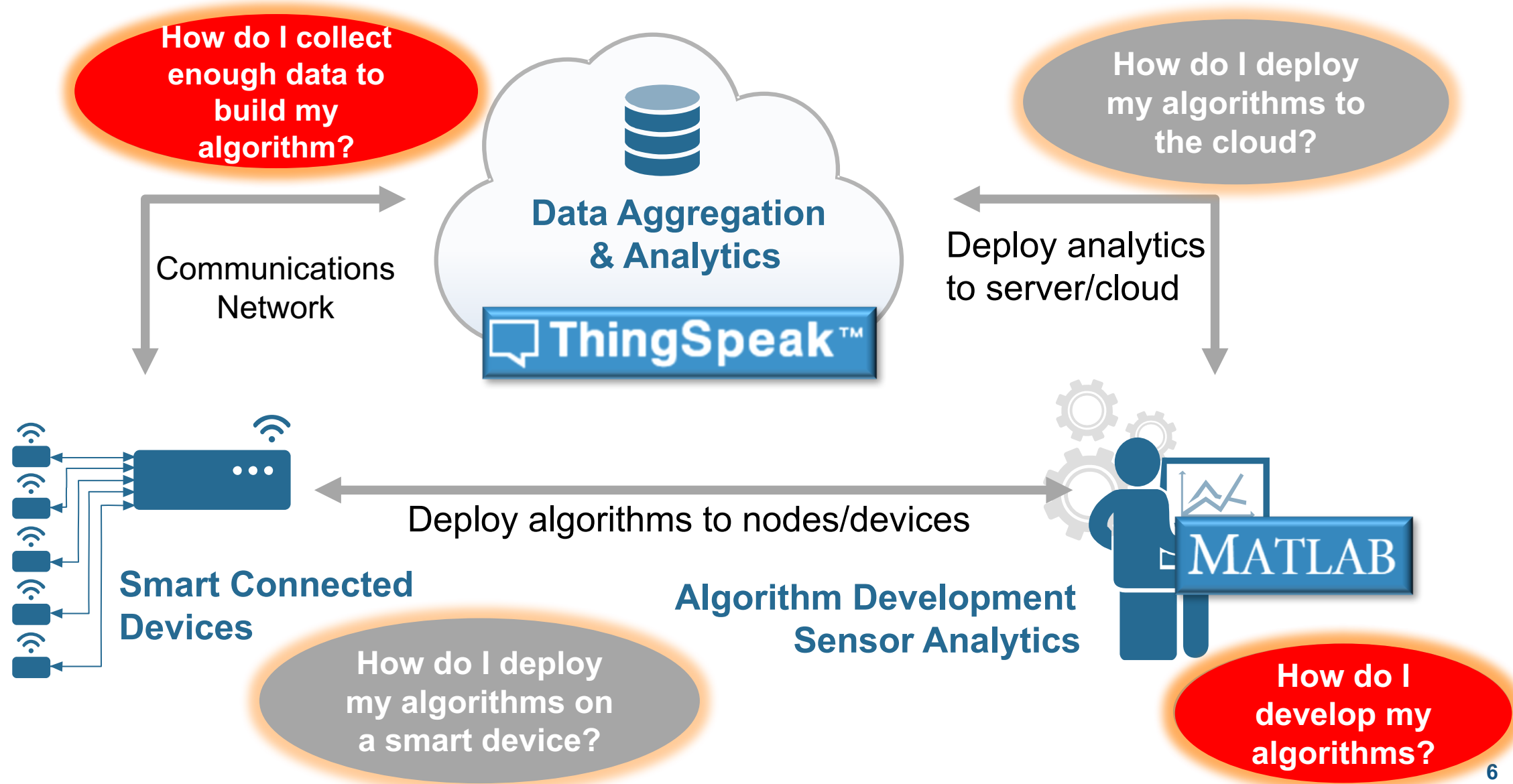
- Signal processing
 - Real data is messy and needs to be cleaned up
 - Missing data points need to be handled
- Image processing
 - Objects need to be detected
- Statistics/Machine Learning
 - Objects need to be classified
 - Predictions need to be made



IoT Analytics Framework

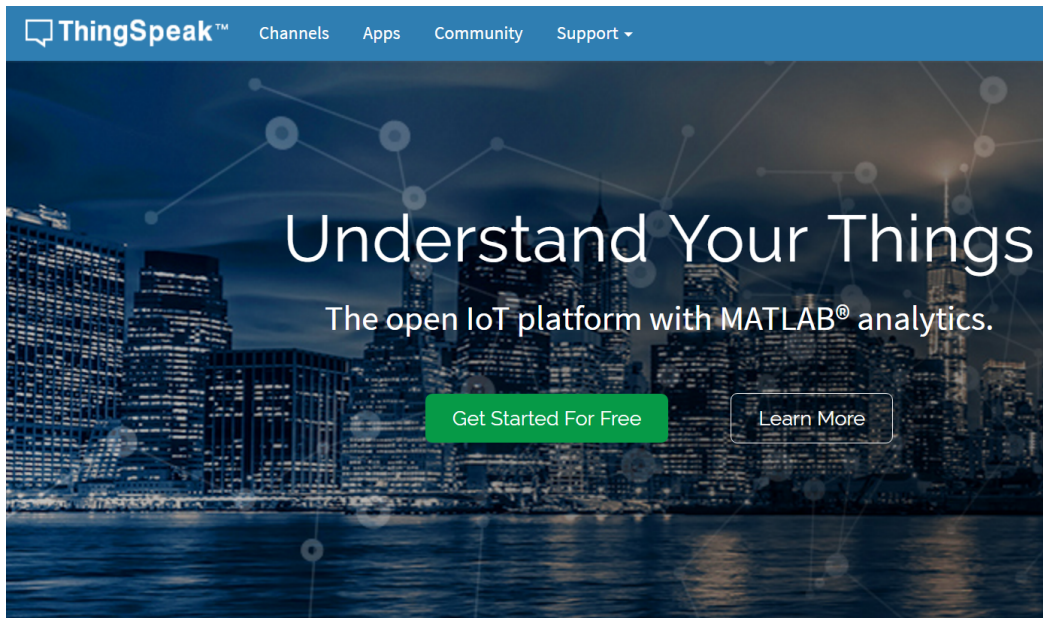


IoT Analytics Challenges



What Is ThingSpeak?

Web Site For People



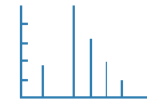
Web Service for Devices

```
{
  - channel: {
    id: 38629,
    name: "Car Counter",
    description: "Counting number of cars passing a reference line in 15 sec interval",
    latitude: "42.28",
    longitude: "-71.35",
    field1: "Number of Westbound Cars",
    field2: "Number of Eastbound Cars",
    created_at: "2015-05-19T20:14:03Z",
    updated_at: "2016-05-19T10:36:35Z",
    last_entry_id: 1477231
  },
  - feeds: [
    - {
      created_at: "2016-05-19T10:36:20Z",
      entry_id: 1477230,
      field1: "18.000000",
      field2: "8.000000"
    },
  ],
}
```

- <https://thingspeak.com>
- New MathWorks web service hosted on AWS: collect, analyze and act on data from “things”
- Over **130,000** users worldwide
- It has **MATLAB** for IoT Analytics
- It's **free** to get started



Collect



Analyze

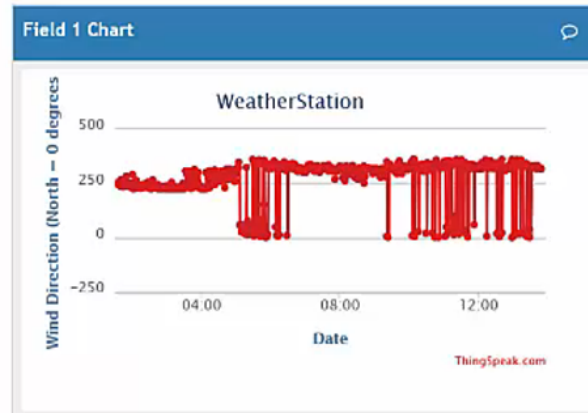
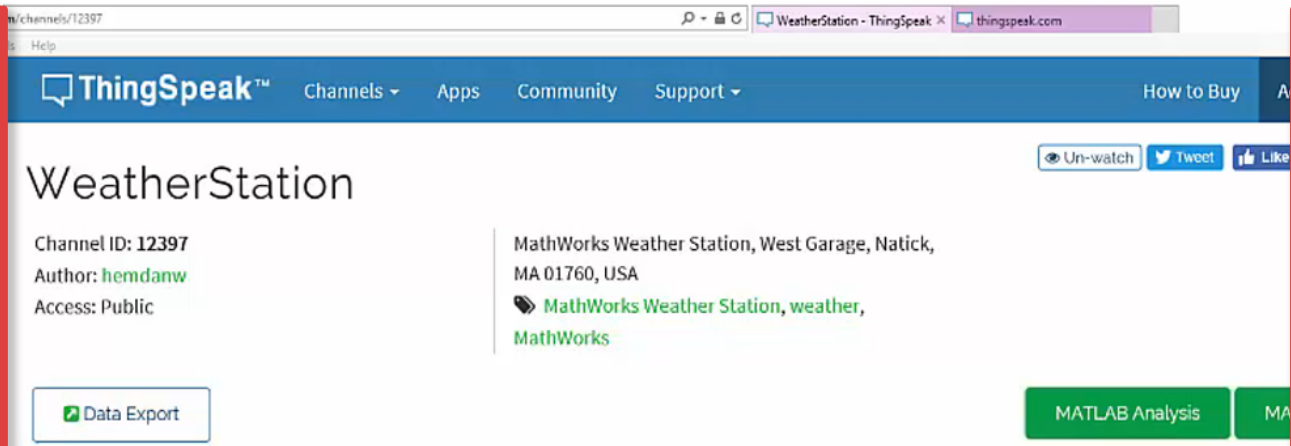


Act

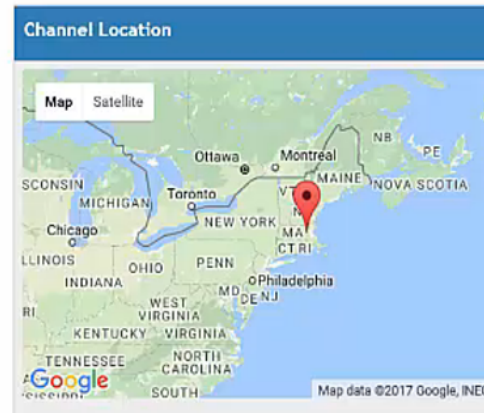
Example: ThingSpeak Weather Station Data Visualizations



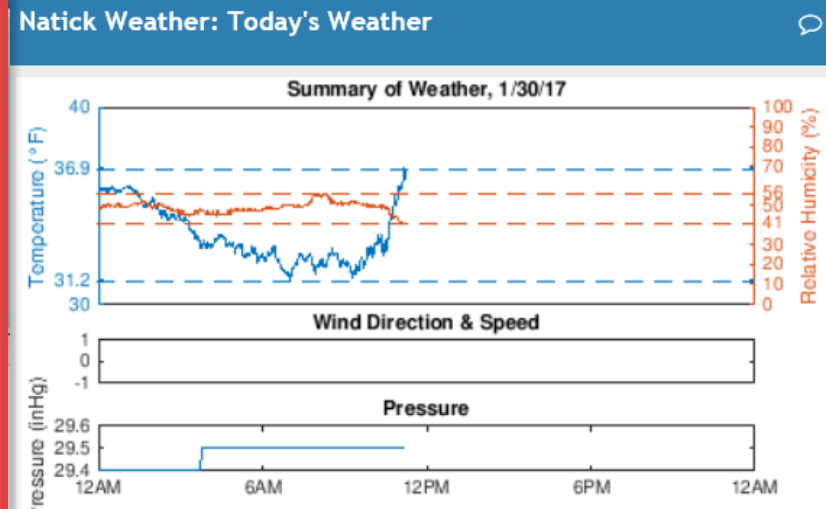
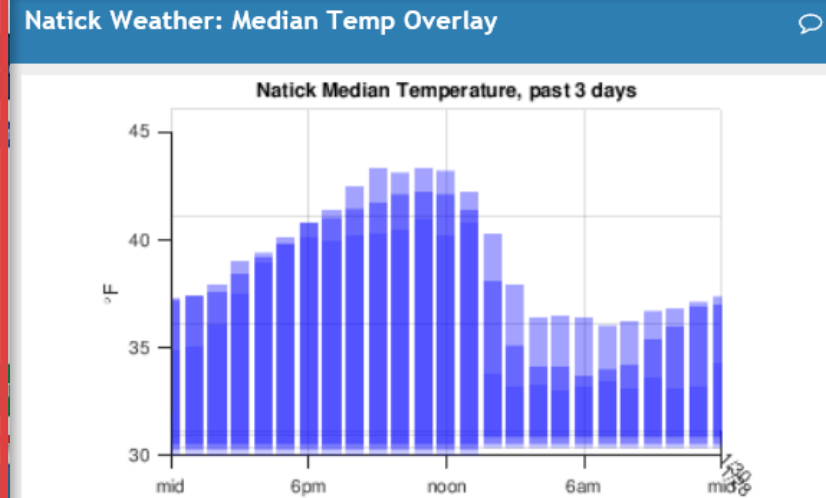
Collect



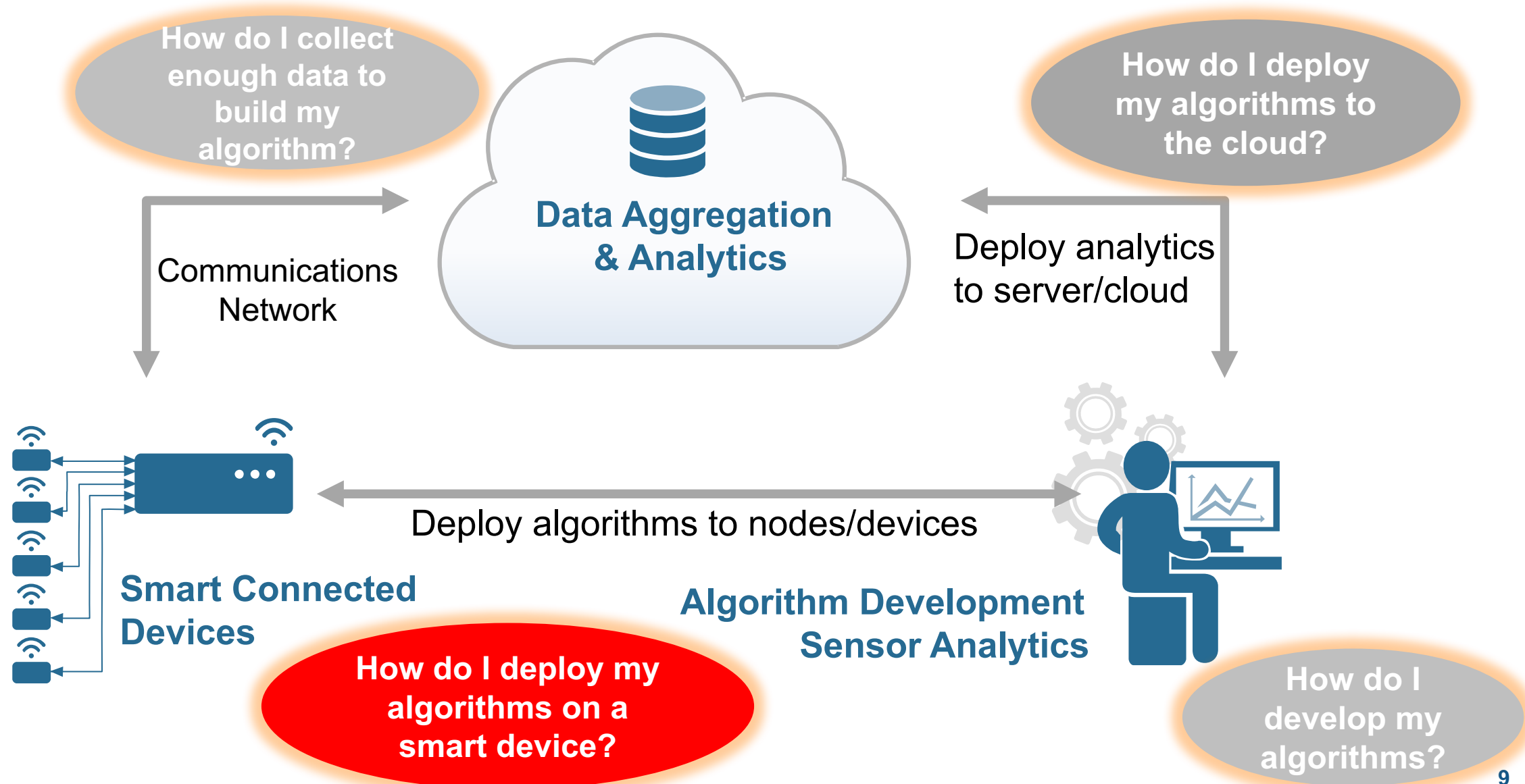
Analyze



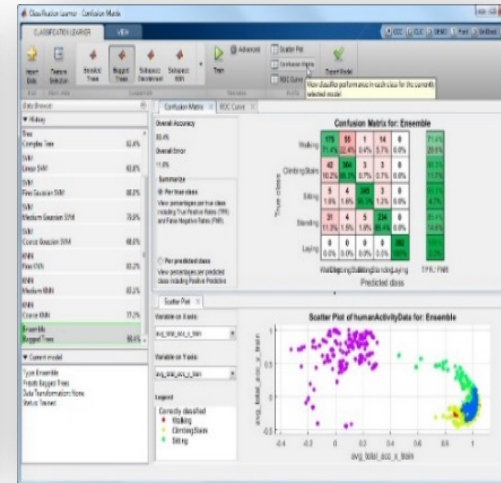
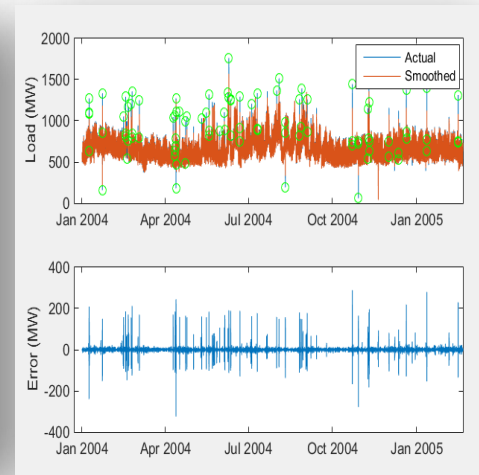
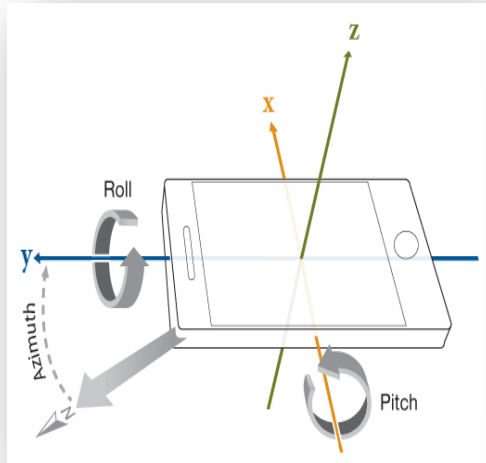
Act



IoT Analytics Challenges



Sensor Analytics and Development of Smart Connected Devices



Connect and Acquire

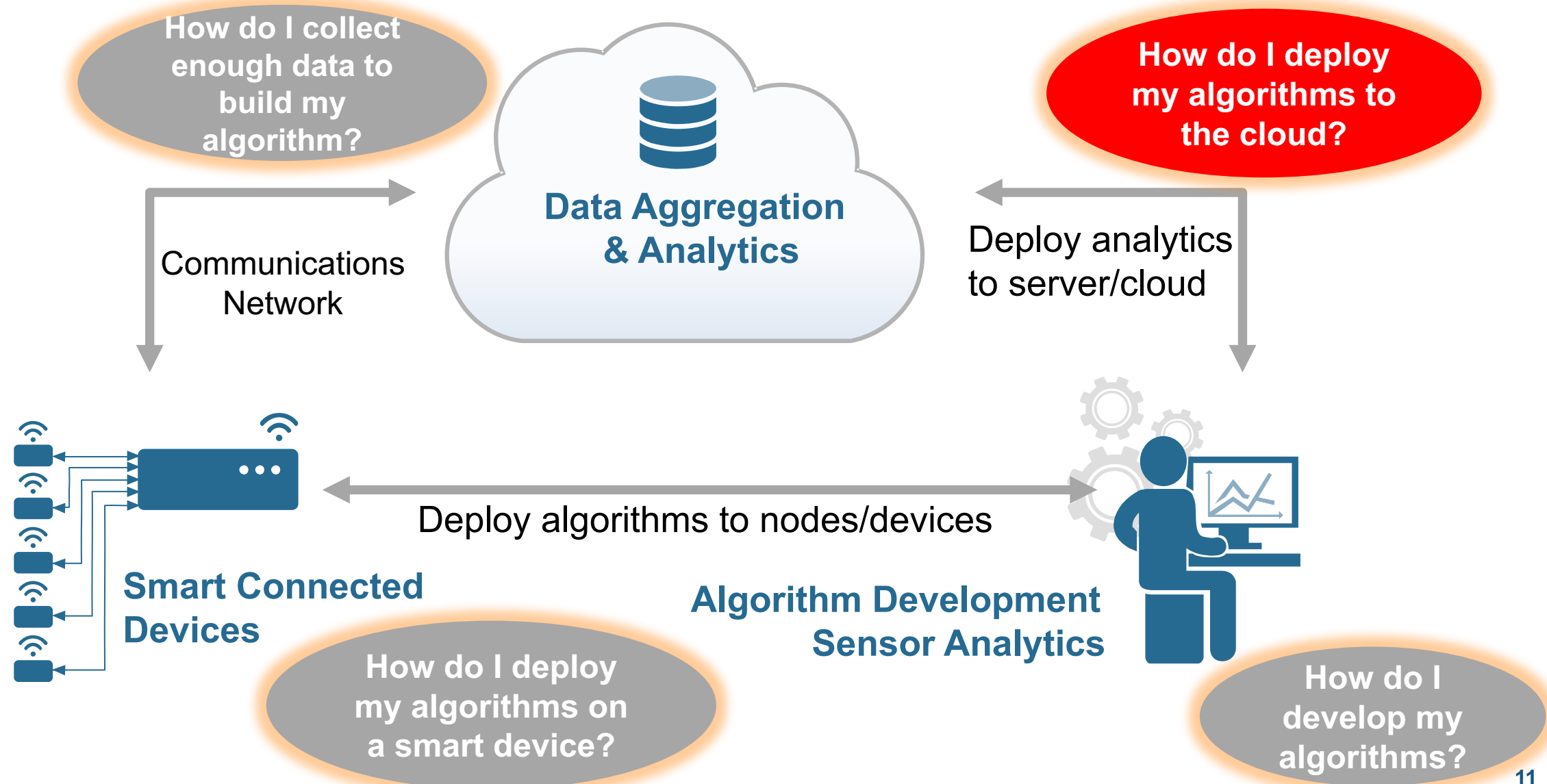
Signal
Processing

Machine
Learning

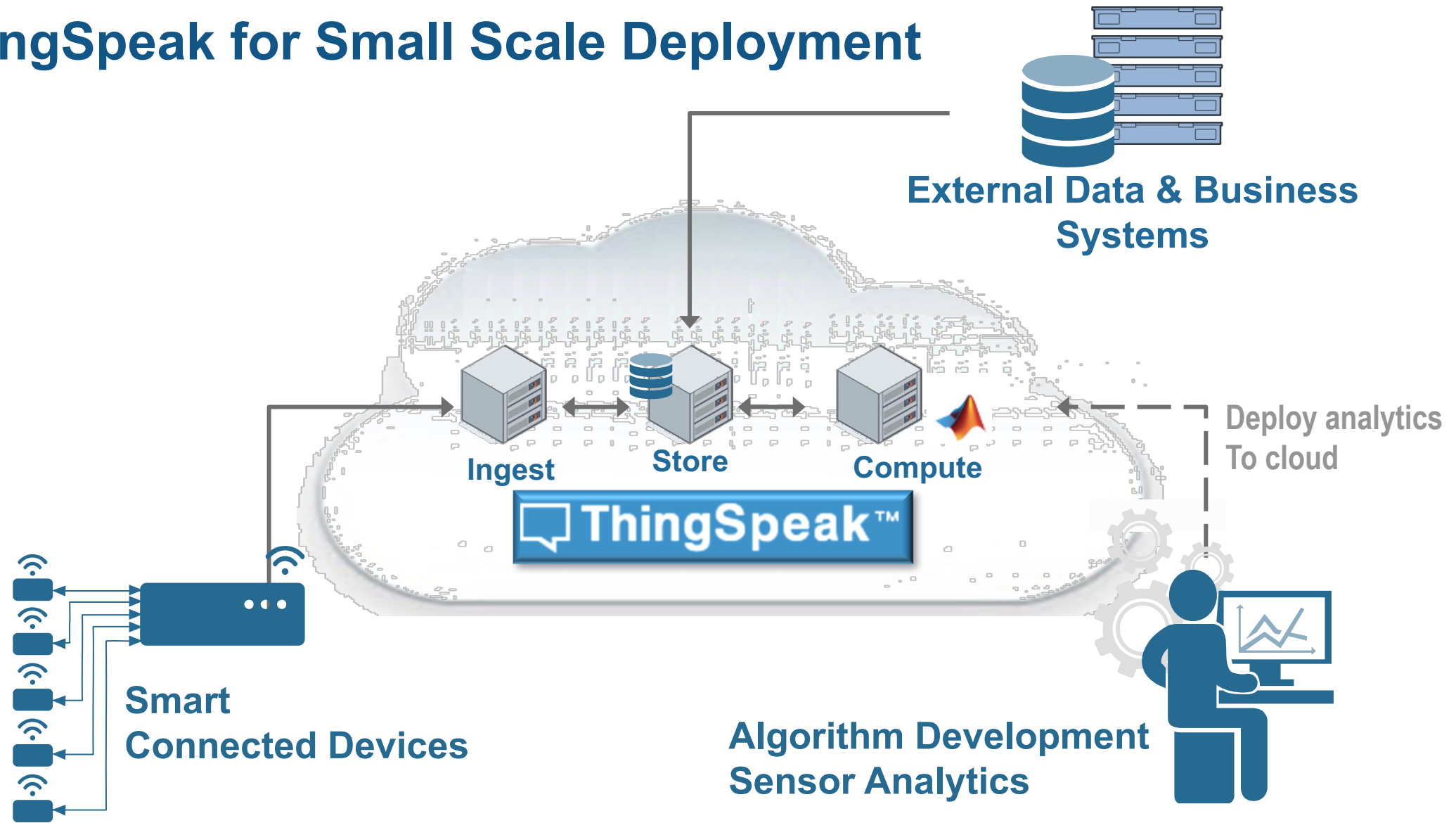
Embedded
Implementation

- Gather data from sensors using I2C/SPI and other interfaces
- Use pre-built libraries for signal processing, computer vision, machine learning and more
- Automatically generate C / C++ and HDL code
- Embedded targeting packages for a wide variety of hardware

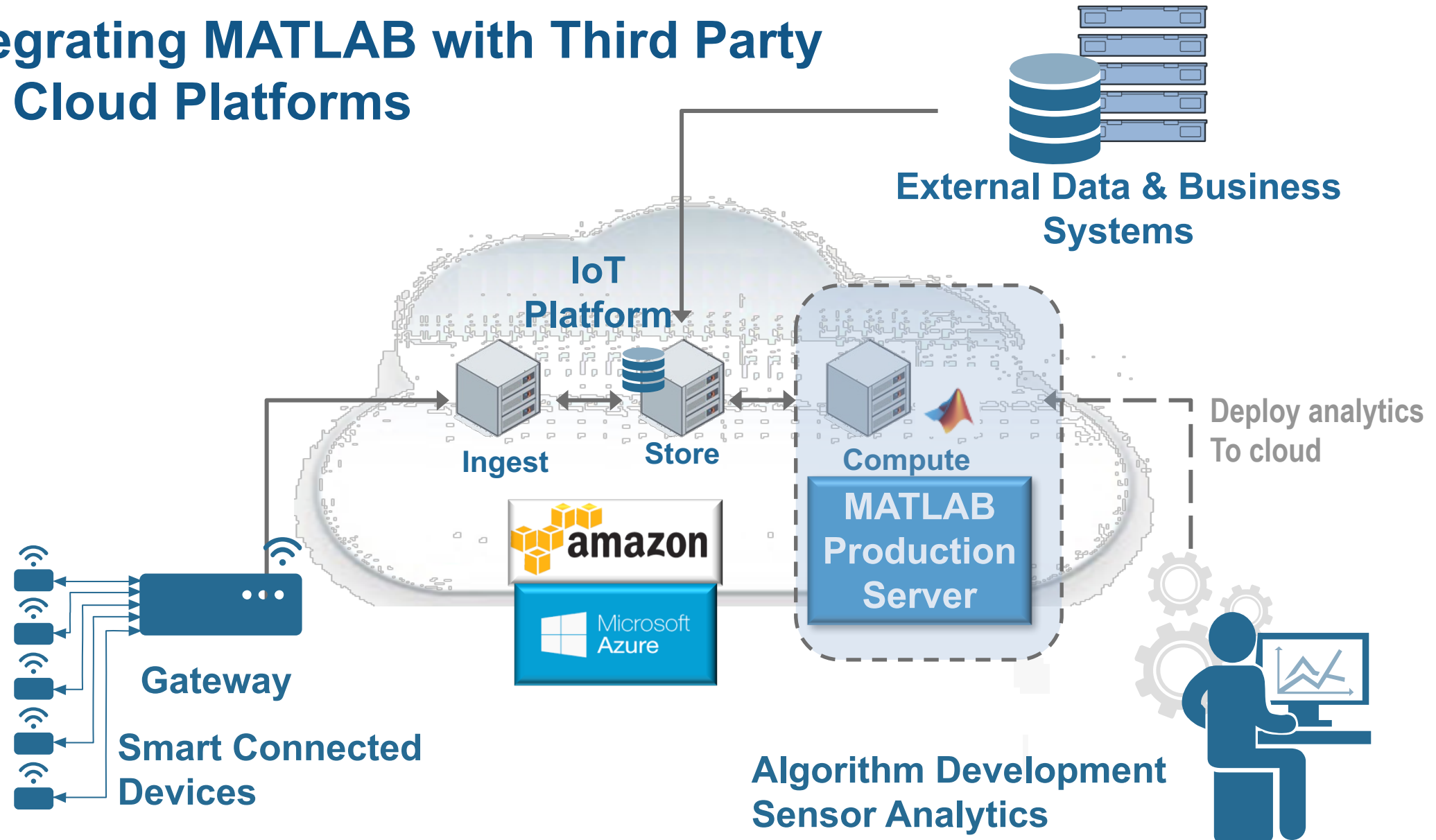
IoT Analytics Challenges



ThingSpeak for Small Scale Deployment



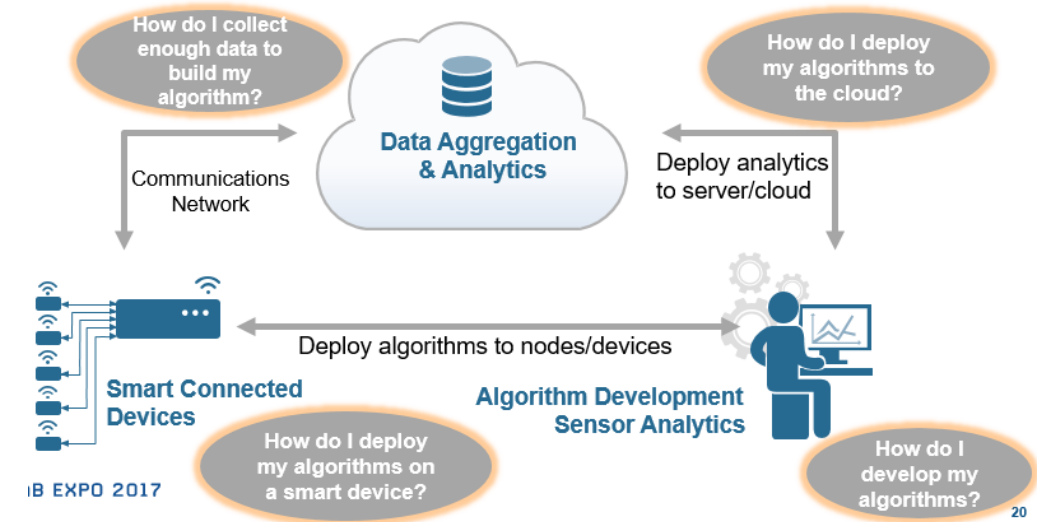
Integrating MATLAB with Third Party IoT Cloud Platforms



MathWorks Solutions to IoT Challenges

Summary

- Collect and analyze IoT data with **ThingSpeak** and **MATLAB**
- Develop analytics algorithms using **MATLAB** and toolboxes
- Deploy on smart devices using code generation and embedded target support
- Deploy on cloud using **ThingSpeak** and **MATLAB Production Server**



Your Next Steps

- [Log-in to ThingSpeak with your MathWorks account and explore](#)
- [View a webinar on Machine Learning with MATLAB](#)
- [Read a Technical Article on Forecasting Tides with MATLAB](#)
- [Read a tutorial on how to send data to ThingSpeak over MQTT](#)

Developing Analytics and Deploying IoT Systems

Thank you for your attention!