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

**Smart Connected Devices**
- Local embedded algorithms
- Data reduction

**Analytic IoT Platform**
- Online analytics
- Visualization and reporting

**Algorithm Development**
- Historical analytics
- Sensor analytics

**Communication**

**Connectivity**

**Deploy analytics to cloud**

**Deploy algorithm to device**
IoT Analytics Challenges

- **How do I collect enough data to build my algorithm?**
- **How do I deploy my algorithms to the cloud?**
- **How do I develop my algorithms?**
- **How do I deploy my algorithms on a smart device?**

**Communications Network**

**Smart Connected Devices**

**Data Aggregation & Analytics**

**Algorithm Development**

**Sensor Analytics**

Deploy analytics to server/cloud

Deploy algorithms to nodes/devices

How do I deploy my algorithms on a smart device?
What Is ThingSpeak?

Web Site For People

Web Service for Devices

- [https://thingspeak.com](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
Example: ThingSpeak Weather Station Data Visualizations

Collect

Analyse

Act
IoT Analytics Challenges

How do I collect enough data to build my algorithm?

Communications Network

How do I deploy my algorithms to the cloud?

Deploy analytics to server/cloud

Deploy algorithms to nodes/devices

How do I deploy my algorithms on a smart device?

Smart Connected Devices

Algorithm Development Sensor Analytics

How do I develop my algorithms?
Sensor Analytics and Development of Smart Connected Devices

- 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

- How do I collect enough data to build my algorithm?
- How do I deploy my algorithms to the cloud?
- How do I develop my algorithms?
- How do I deploy my algorithms on a smart device?
ThingSpeak for Small Scale Deployment

External Data & Business Systems

Ingest → Store → Compute

Deploy analytics To cloud

Algorithm Development
Sensor Analytics

Smart Connected Devices
Integrating MATLAB with Third Party IoT Cloud Platforms

External Data & Business Systems

IoT Platform

Ingest

Store

Compute

MATLAB Production Server

Deploy analytics To cloud

Algorithm Development Sensor Analytics

Gateway

Smart Connected Devices

Algorithm Development

Sensor Analytics
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!