Leveraging the power of IoT with MATLAB
“It’s not an Internet of Things, It’s an internet of People”

Neil Lawrence
inverseprobability.com

intel.com
Internet of (every)Things (IoT), what it’s really about…

Mostly, though, the IoT is about collecting industrial data on an industrial scale. Tracking vibrations in buildings to measure their stability. Tracking smells via adsorption, … Tracking noises, lights, moisture, toxins. And then making this data available despite the physical restrictions of battery power and radio networks.
Anatomy of an “IoT” ecosystem

1. Things sending DATA (embedded systems &/or sensors)
2. (Cloud) Infrastructure hosting both DATA & Application Servers
3. Development Platform(s) Enable Domain Experts to Access, Develop, Scale & Deploy analytics on both Things & Infrastructure
4. Business Application Enable end-users to visualize & take decisions

Business/External Systems
(ERP, CRM, EHR, Weather, Market, Social data...)

DATA Lake
• Engineering, Scientific & Field
• Business, Transactional, Social, Clinical...

PRODUCTION Environment
• Real-Time &/or
• On-Demand Analytics
Anatomy of an “IoT” ecosystem & main challenges associated

1. Things sending DATA (embedded systems &/or sensors)
   - Power & Volume restrictions
   - Access & Deploy on sensors

2. (Cloud) Infrastructure hosting both DATA & Application Servers
   - Integration & Scaling into Production
   - Security

3. Development Platform(s)
   - Enable Domain Experts to Access, Develop, Scale & Deploy analytics on both Things & Infrastructure

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   - Enable end-users to visualize & take decisions

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Development Platform(s)
Enable Domain Experts to Access, Develop, Scale & Deploy analytics on both Things & Infrastructure

Multiple development software
How can you leverage & address the challenges of IoT?

**Accessing Aggregators/Data**

- **Aggregators**
  - RDBMS/SQL
  - SQLite/No-SQL Databases
  - Google Cloud/Big Query
  - AWS
  - Homegrown
  - **ThingSpeak**

- **Web services**
  - `webread/websave`
  - RESTful, SOAP

- **Protocols** (e.g., Xively, SDMX)

- **API for social interaction data**
  - Indico/Twitter
How can you leverage & address the challenges of IoT?
Accessing & Deploying at the Edge nodes

- **Hardware Connectivity & Support Packages**
  - DAQ/Instruments Control/Low-Cost HW/iOS/Android…

- **Communication**
  - M2M (e.g., DDS)
  - Device to aggregator (e.g., ThingSpeak)
  - Device to analyst (e.g., XBee®)
  - 2-4G/RF/WLAN

- **Automatic Code Generation**
  - Embedded processors and FPGAs
  - Popular IoT devices (RaspberryPi, Arduino, ARM,STM…)

- **Verification/Validation & Process Support***
  - Model & Code proving
  - IEC Certification /DO Qualification kits
How can you leverage & address the challenges of IoT?

Deploying Analytics into Production environments

- Desktop/Mobile Application
- Dashboards & Webpages
- Hadoop servers
- Databases
- Custom environments (e.g., Google Earth, TIBCO Spotfire, Qlik…)

MATLAB

- Standalone Application
- Excel Add-in
- Hadoop
- C/C++
- Java
- .NET
- .py
- Web/Application Server

Spotfire

TIBCO Software

QlikView
Anatomy of an “IoT” ecosystem & main challenges associated

1. Things sending DATA (embedded systems &/or sensors)
   - Communication Stack
   - Power & Volume restrictions
   - Access & Deploy on sensors

2. (Cloud) Infrastructure hosting both DATA & Application Servers

3. Development Platform(s)
   - Enable **Domain Experts** to Access, Develop, Scale & Deploy analytics on both Things & Infrastructure

4. Business Application
   - Enable **end-users** to visualize & take decisions

Integration & Scaling into Production

- **DATA Lake**
  - Engineering, Scientific & Field
  - Business, Transactional, Social, Clinical...

**PRODUCTION Environment**
- Real-Time &/or
- On-Demand Analytics

**Development Platform(s)**
- Enable **Domain Experts** to Access, Develop, Scale & Deploy analytics on both **Things & Infrastructure**
Anatomy of an “IoT” ecosystem & main strengths of MATLAB

1. Things sending DATA (embedded systems &/or sensors)
   - ✓ Communication Stack
   - ✓ Power & Volume restrictions
   - ✓ Access & Deploy on sensors

2. (Cloud) Infrastructure hosting both DATA & Application Servers
   - ✓ Security

3. Development Platform(s)
   - Enable Domain Experts to Access, Develop, Scale & Deploy analytics on both Things & Infrastructure

4. Business Application Enable end-users to visualize & take decisions
   - ✓ Integrate & Scale into Production

DATA Lake
- Engineering, Scientific & Field
- Business, Transactional, Social, Clinical…

PRODUCTION Environment
- Real-Time &/or On-Demand Analytics
- Enable Domain Experts to Access, Develop, Scale & Deploy analytics on both Things & Infrastructure
- ✓ Single development software
Thanking You with examples of MATLAB saving lives (& money) *(running as we speak)*

**Opportunity**
- Crash detection

**Working with MathWorks has enabled:**
- Rapid data analysis during development of ACD1 solution
- A toolset for developing ACD2 which **within a unified environment** for:
  - Signal processing
  - Machine learning algorithms
- Easy deployment of these tools into existing AWS / .NET based environment

**RAC Telematics**
A system of innovation

[Link to Story](#)
Thanking You with examples of MATLAB saving lives (& money) *(running as we speak)*

**Opportunity**
- Asthma crisis detection

**Analytics in cloud & embedded**
- Captures windpipe sound & clean/processes the data locally
- Spectral processing & Pattern-detection (NN & KNN) on the cloud

**Benefit (Provides feedback to patient & alert doctors)**
- Eliminates error-prone self-reporting & visits to the doctor
- Quick hospitalization in case of emergency alarm

**Results with Mathworks**
- Manual coding effort reduced
- Algorithm development iterations faster
- Code maintenance overhead reduced

[Link to Story]