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**BUILDING AND TESTING IOT SOLUTIONS BOF**

# Agenda

- Welcome and Introductions
- Technologies available to support university research in IoT
  - Researcher Support through Microsoft, OsiSoft and Neal Analytics
  - Early IoT experiences with IBM BlueMix and IoT Foundations
- Some campus perspectives on developing and deploying IoT Solutions
- Q&A and Open Discussion



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# The Researcher Support through Microsoft, OsiSoft and Neal Analytics

Microsoft and Partner Support for IoT Development and Deployment

- *Cameron Evans, National Technology Officer, US Education*

OSISoft and Academia: The Experience from Carnegie Mellon University

- *Mike Mihuc, Academic Principal, OSISoft*
- *Bertrand Lasternas, Senior Researcher, Carnegie Mellon University*

Cortana and the IoT Suite

- *David Brown, Neal Analytics*

# Industry View on IoT

**Cameron Evans**

National Technology Officer, US Education

Microsoft

- Introduction
- What is Microsoft doing?
- Role of Partners



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# OSIsoft & Academic

Mike Mihuc

Academic Principal

- Introduction to OSIsoft
- OSIsoft Academic Program Goals
- Microsoft Azure IoT and OSIsoft PI System 2015

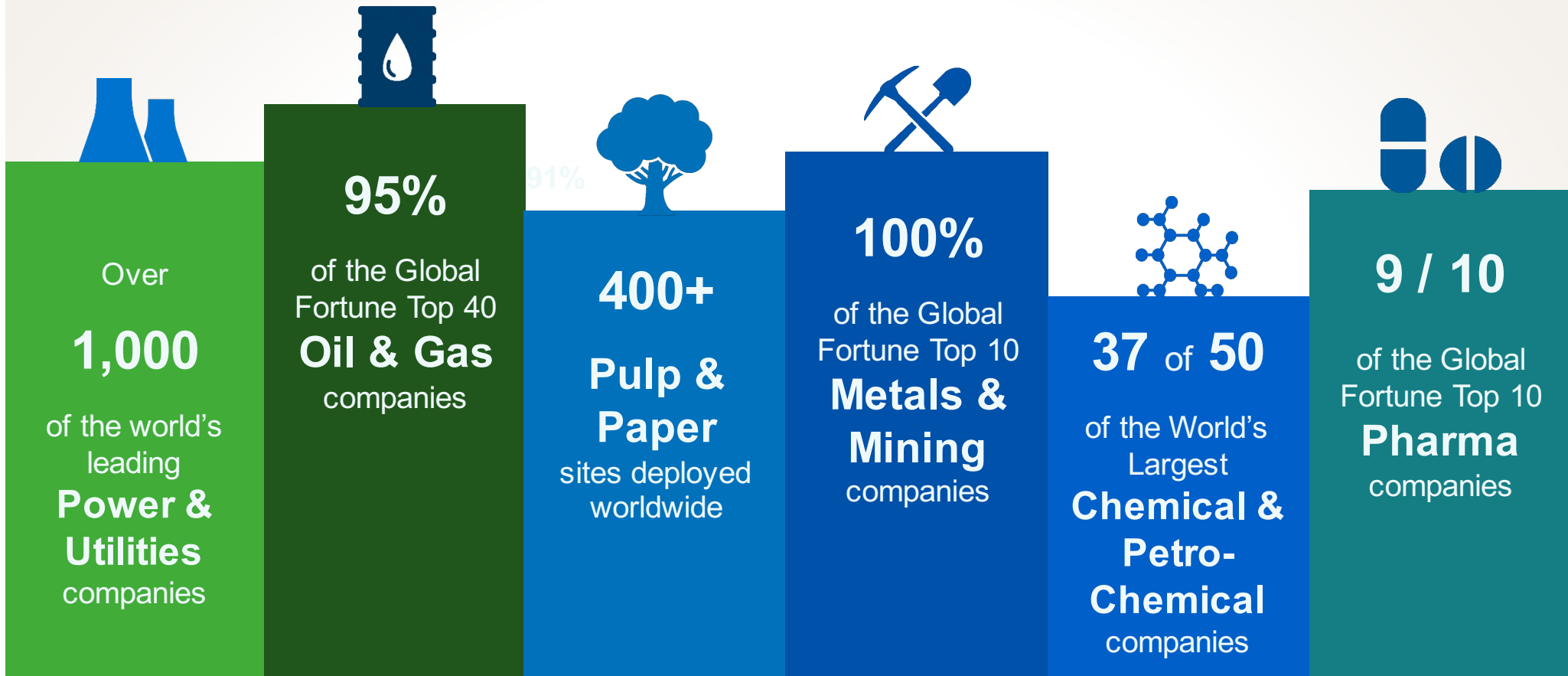


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# OSIsoft is trusted by the world's leading companies



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# OSIsoft Academic Program Goals

## Why

- Changing Academic Market to One of Industry Collaboration and Data Analytics
- Paying Back To Universities >> Paying Forward To Students
- Enhancing Customer Value via a Deeper Partnership

## What

- Providing Complementary Software, Jumpstart Services, Coaching & Learning
- YouTube Learning – About 2,000 lessons each 2-10 min long
- Grant Partnering

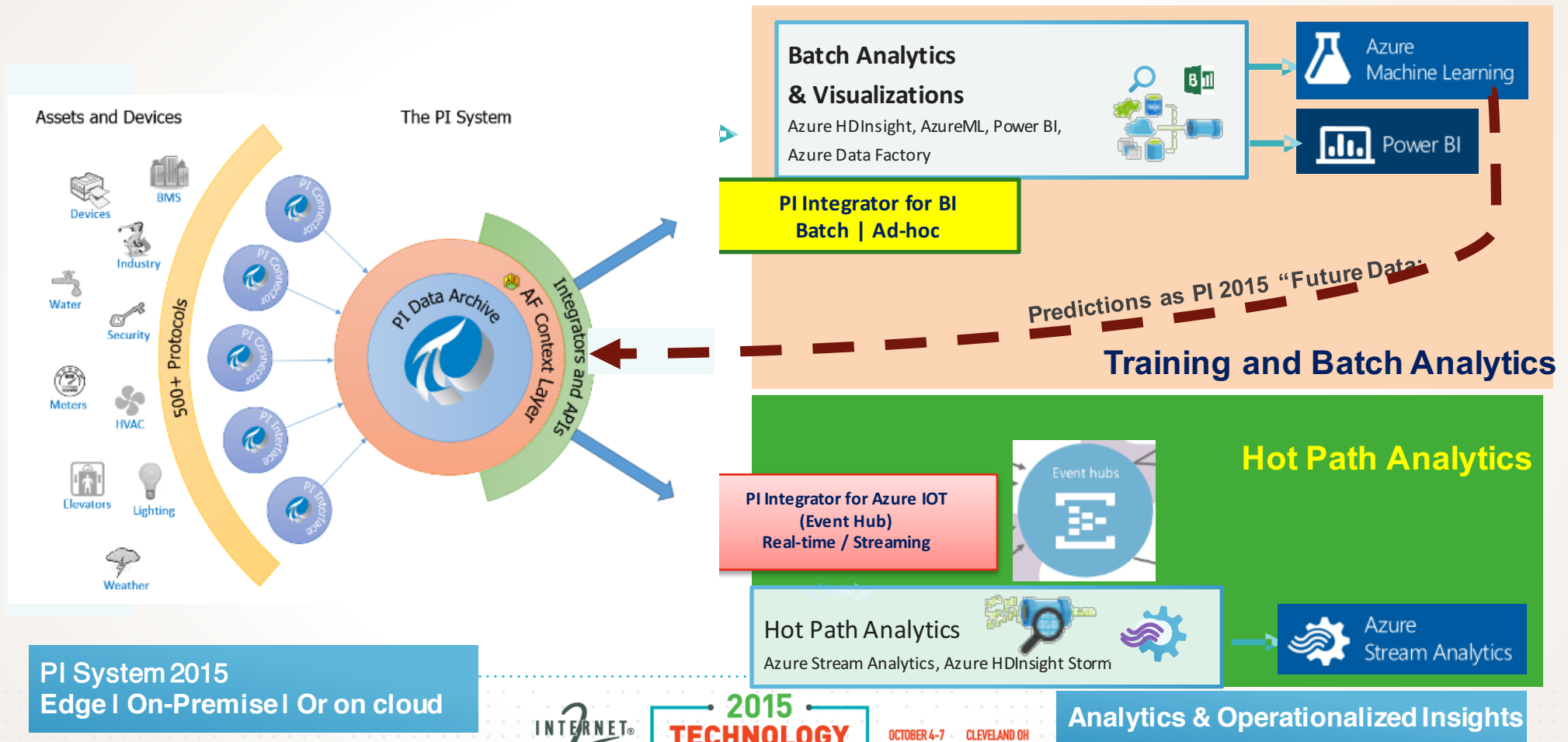
## How

- Collaborative Innovation – Joint Vision OSIsoft/Academic Institution
- The Triple Helix – Academic, Government & Industry Drive Innovation



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# Microsoft Azure IoT and OSIsoft PI System 2015`



# Carnegie Mellon University



**“With OSIsoft and Microsoft data, cloud technologies and IOT, we can integrate almost any device interface and data type.”**

**Bertrand Lasternas, Researcher  
Carnegie Mellon**



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# University Use Case

**Bertrand Lasternas**

Senior Researcher

Carnegie Mellon University

- Data in buildings
  - Collection of data
  - CMU results
- Data Analytics
- How does IoT Support Research



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# Background: Carnegie Mellon University

Founded in 1900  
by Andrew  
Carnegie

12,991 Students  
(6223  
undergraduate)

CMU annual  
utility budget  
over \$20M

That's over  
\$1,600 per year  
per student!

Goal:

Oakland 2030  
District: 50%  
Energy Savings  
by 2030

About 6.500 000  
sqft  
65 + Buildings  
80 000 data points



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Pittsburgh, PA

[ 11 ]

# Why didn't we save energy?

- We had no idea what we were using
- We had no idea how important it was
- There was no easy way to change outcomes
- We could not do numbers



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## Challenges

- Monitor, diagnose and optimize building performance in real time
- Predict faults and system failures

## Solutions

- Use advanced machine learning solution for predictive analytics
- Predict / forecast / anticipate systems performance



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# The Intelligent Workplace

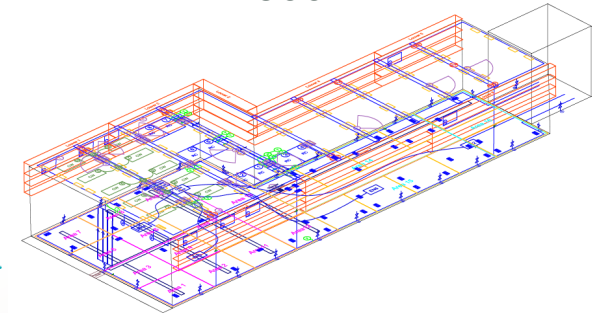
The Robert L. Preger Intelligent Workplace, built in 1997, is a 7000 square foot living laboratory of office environments and innovations located on the campus of Carnegie Mellon University.

## Test and Integration of several systems:

- Heating
- Cooling
- Ventilation (mechanical and natural)
- Lighting, and day-lighting
- Electrical
- Plug load



View of the sensors/actuators density  
1500+



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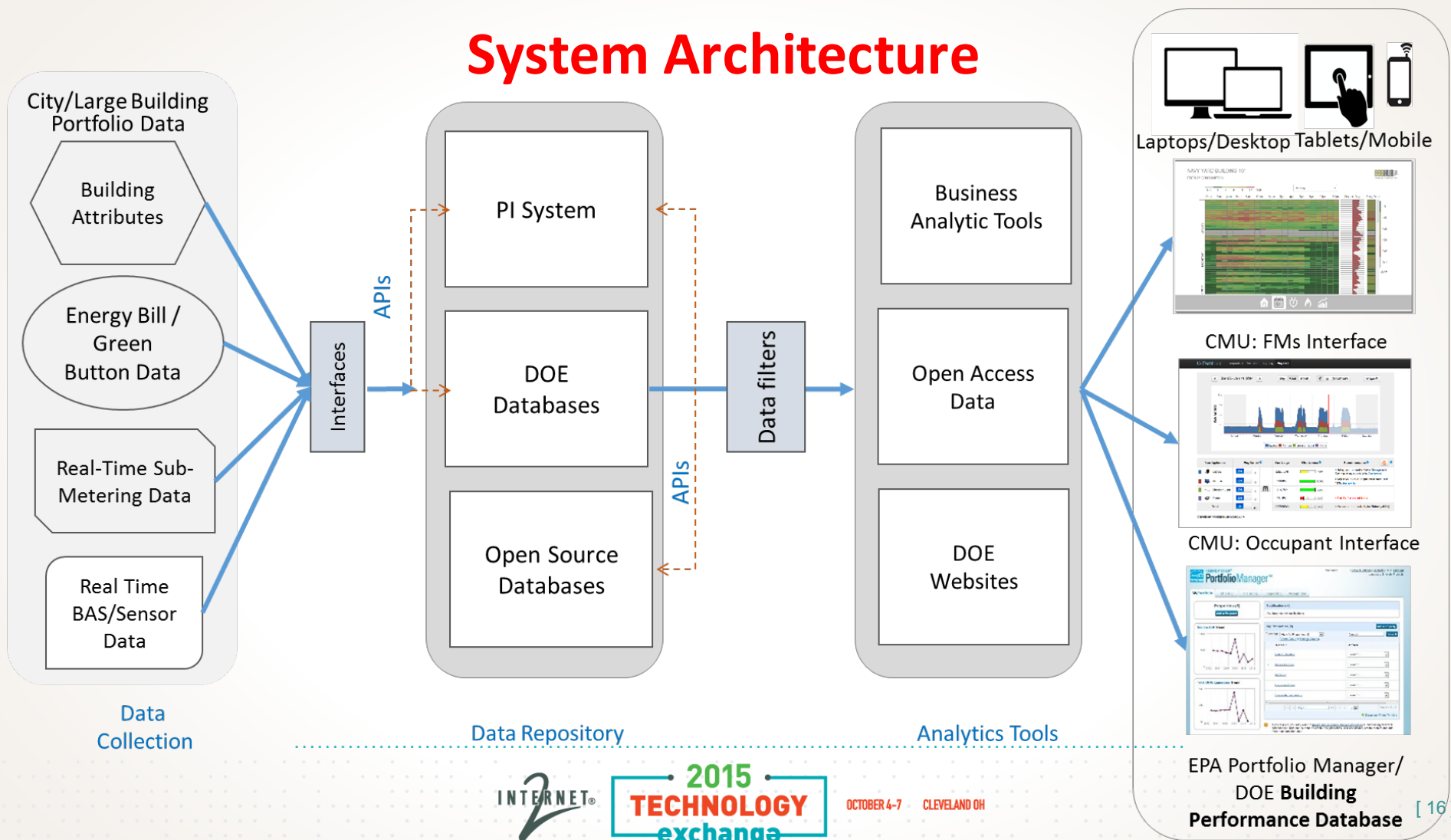
# What are the steps?

1. Integrate all information
2. Continuously **monitor and diagnose** building performance
3. Make information accessible to **Facility Managers and Executives**
4. Display information for **Building Occupants**
5. Display information for **the Public (Disclosure)**
6. Enable Building Occupants to **control their environment**



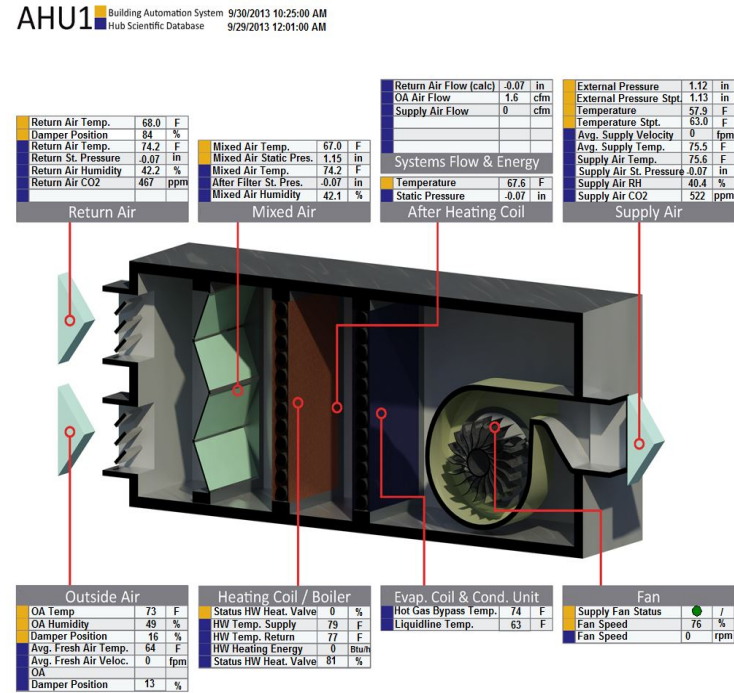
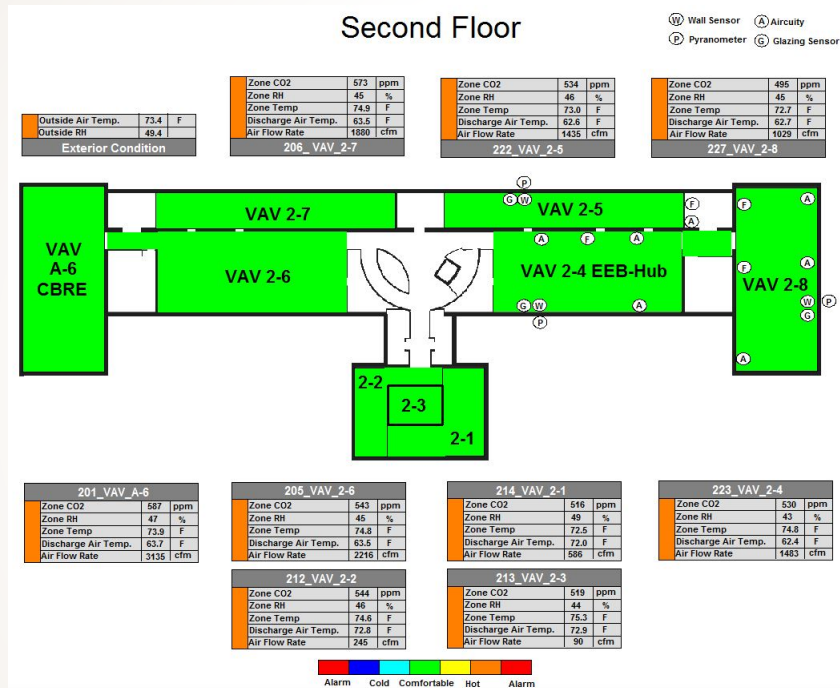
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# System Architecture



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# Facility Manager Space and System Read-outs



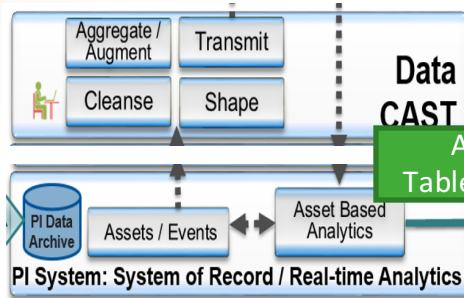
## Integrating Building Systems for Sustainable Energy



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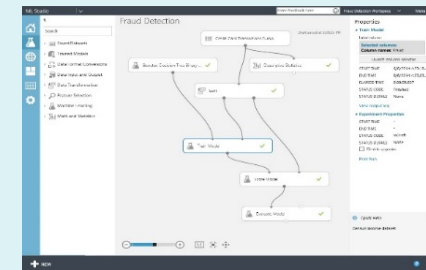
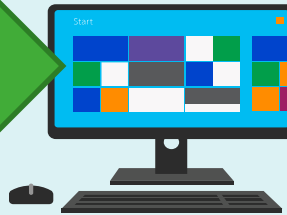


# Advance Cloud Base Analytics

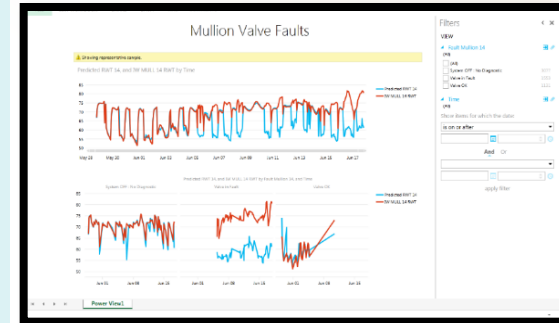


Azure Tables/Blobs

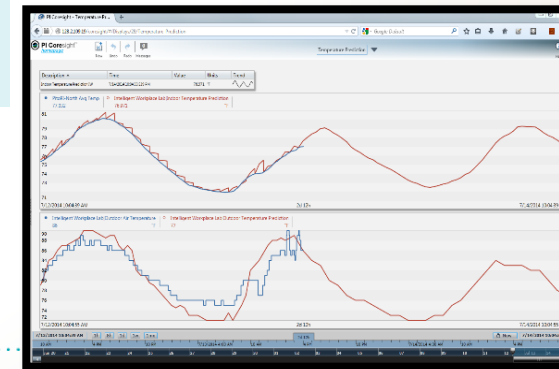
ML Studio



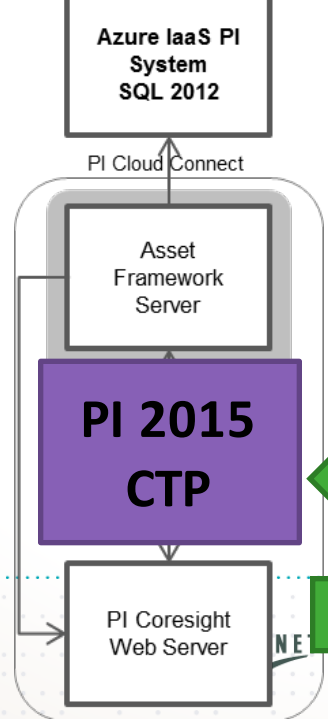
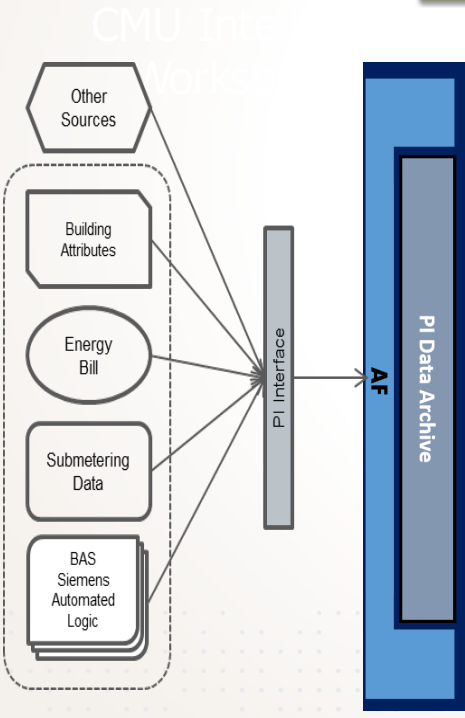
C# Code, Python Script, R, AzureMLAPI



Office 365  
**Power BI for Office 365**  
Self-service analytics for all your data



PI Coresight [18]



Future Data / Predictions

Plotting Real-time and Future Data

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# Fault Detection and Diagnostic (Predictive Maintenance)

1/Collect Data  
Real-Time

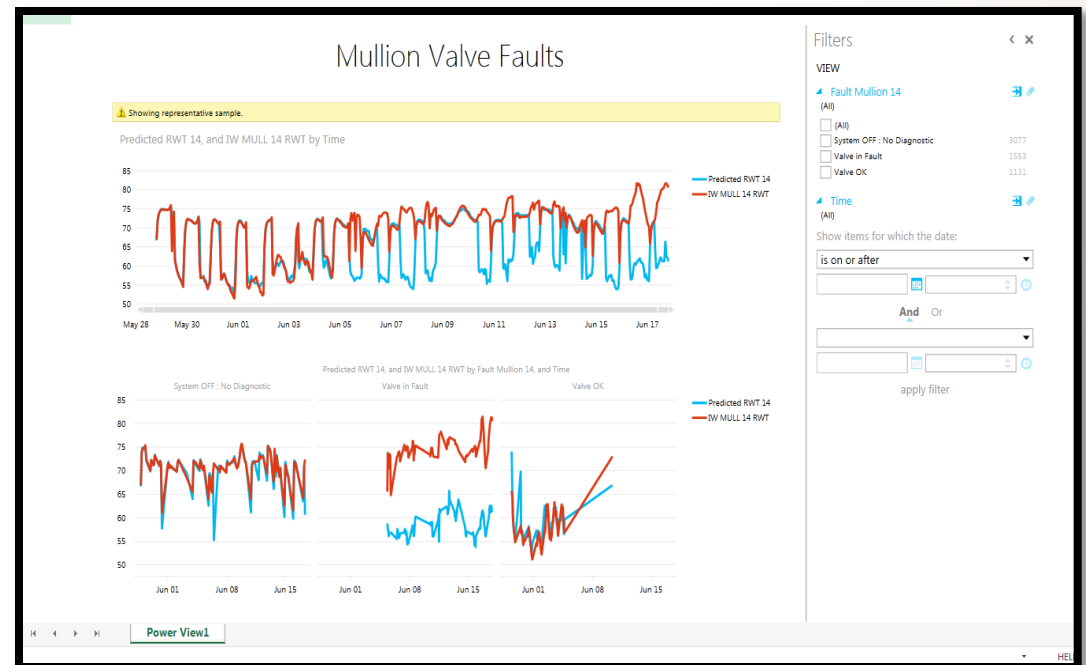
2/ Train Model  
against baseline

3/ Predict (project)  
baseline behavior

4/ Measure variation between  
prediction and measured behavior

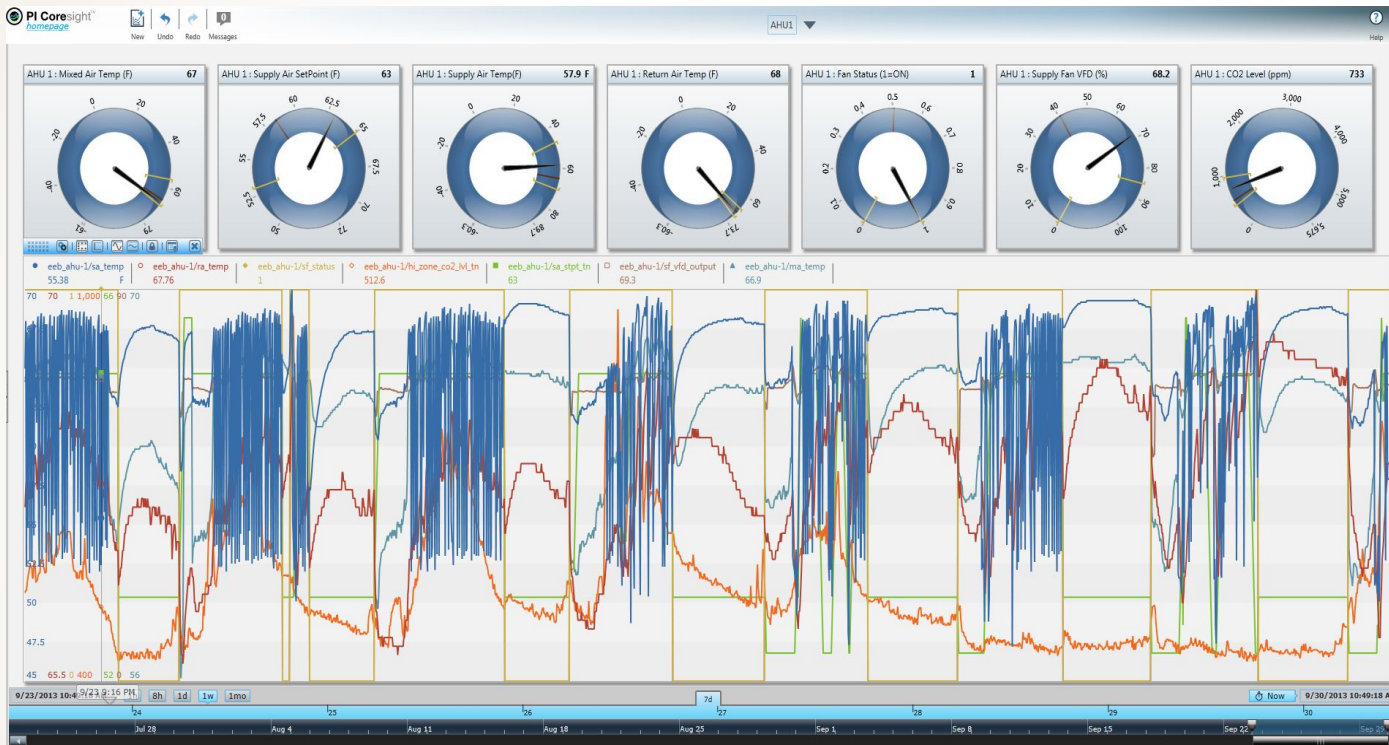
5/ Trigger notification, corrective actions

Save Time, Money, and Energy

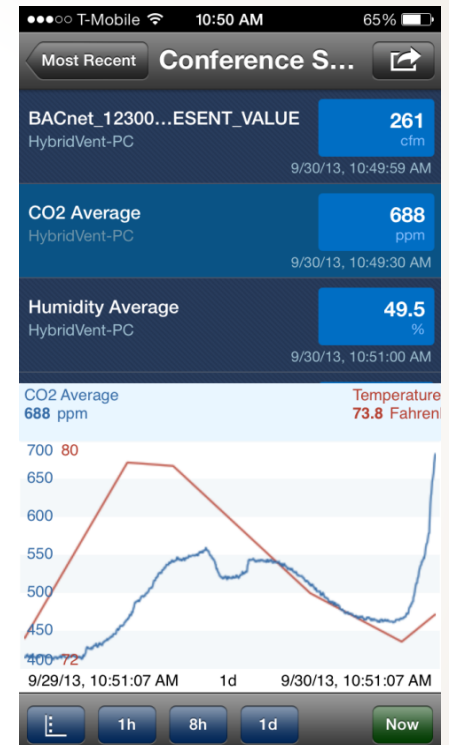


Power BI for Office365  
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# Tablet-toting (mobile) field service



Online webpage and tablets interface



Smartphone interface



# Temperature and Energy Prediction

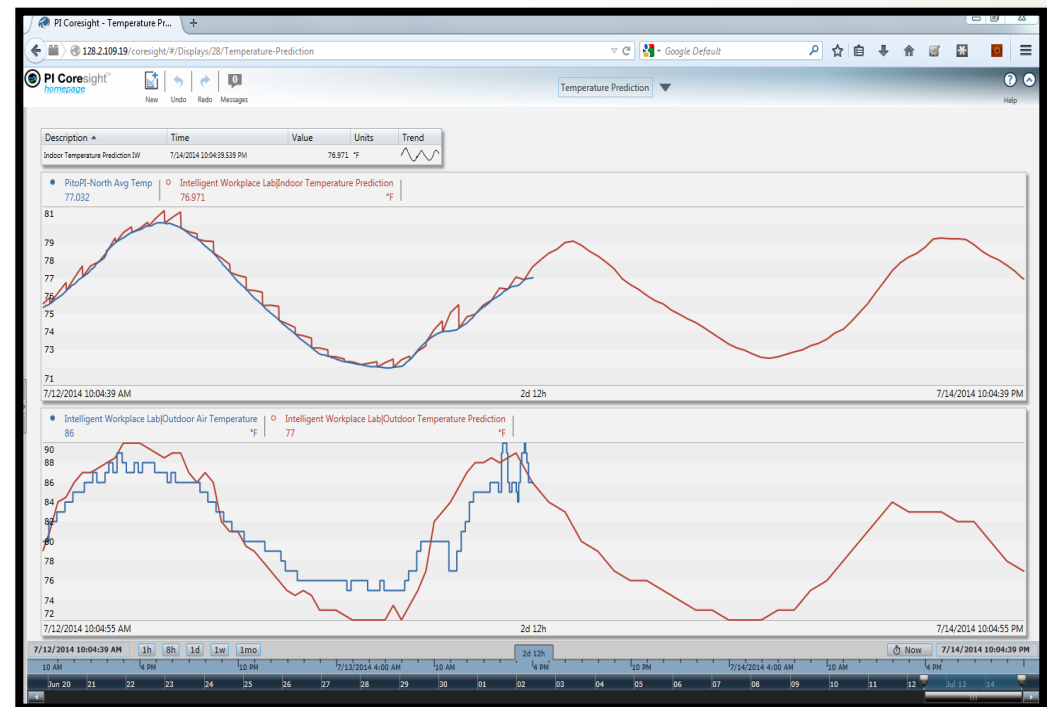
1/Collect Data Real-Time

2/ Train Model

3/ Predict temperature and energy at different horizons (up to 48h)

4/ Detect potential energy savings  
\* Over-Cooling/Heating  
\* Space conditioned without occupancy

5/ Corrective Actions:  
\* Adjust Control Logics  
\* Turn Off systems

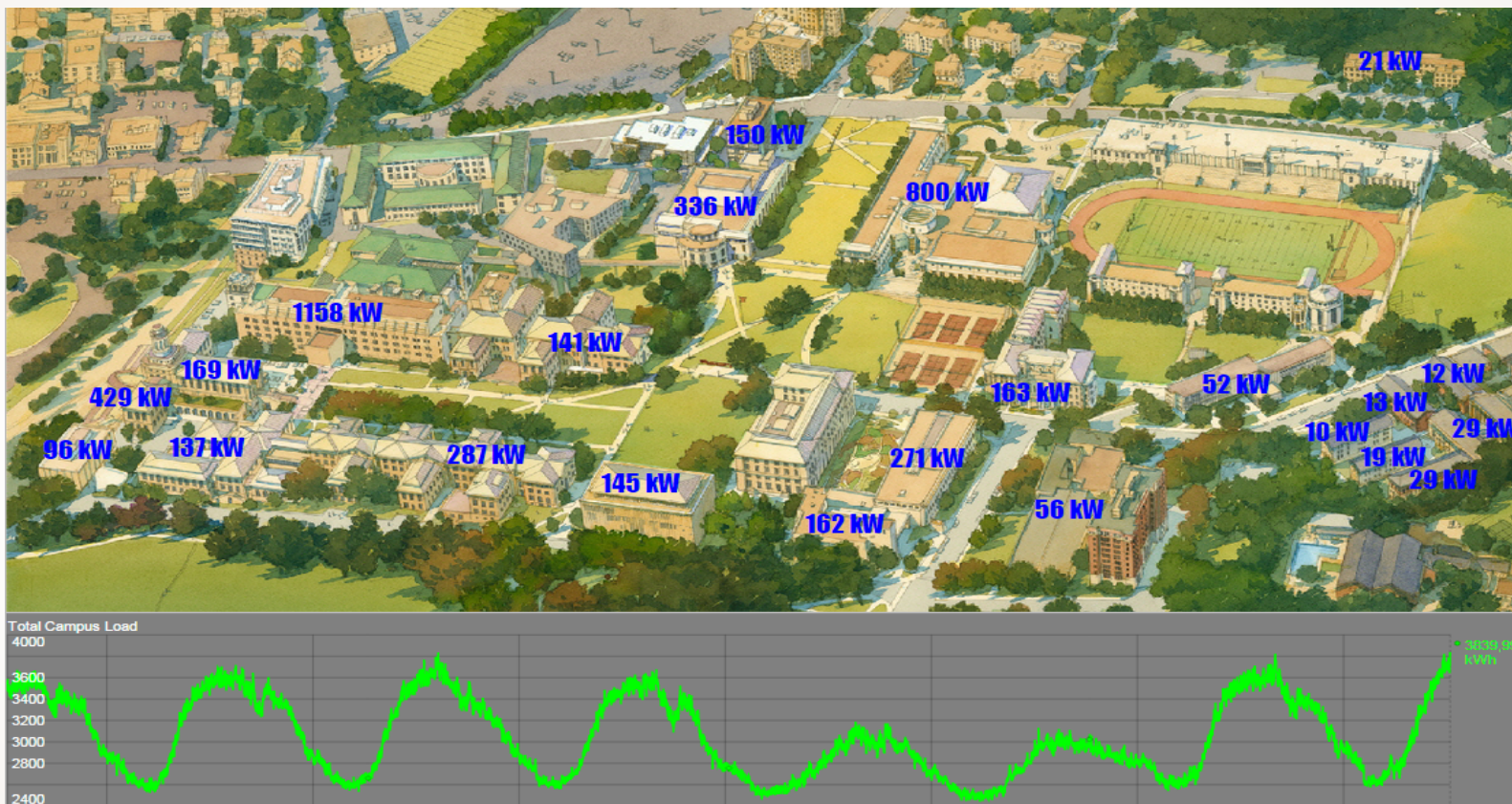


OSisoft PI Coresight



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# Campus Wide Load Prediction



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# Intuitive Control of Smart Buildings

- Sebastian Peters
- Korbinian Breu
- Johannes Lechner
- Steffen Bauereiss
- Simina Pasat
- Matthias Schwab
- Masashi Beheim
- Arno Schneider
- Nadine von Frankenberg

## The Idea

The idea is to control intelligent house equipment like blinds, heating or lights with a mobile device such as the iPhone by simply pointing on the target and doing a specific gesture

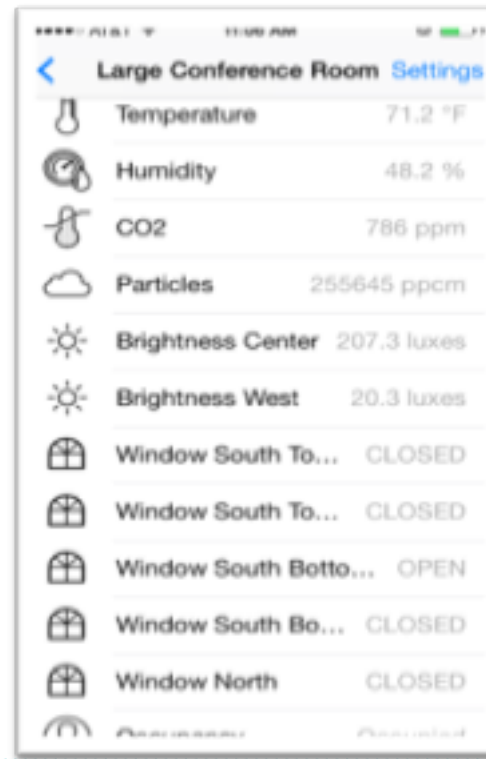
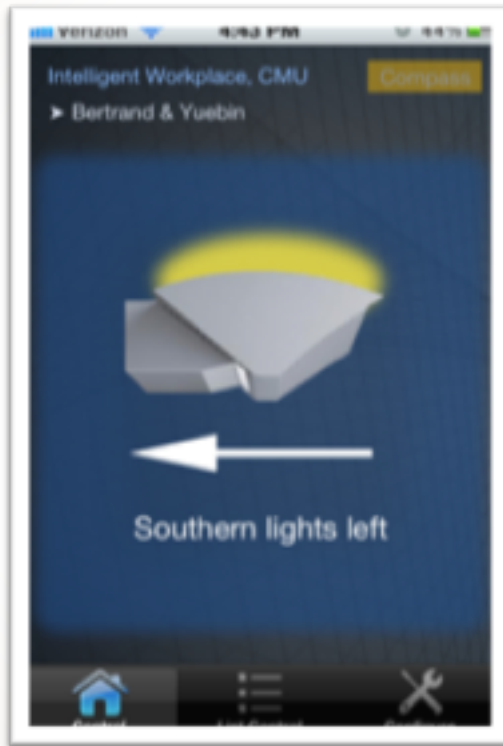


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# Smartphone User Interface – Sensors, Controllers, Energy Lights, Blinds, Task Lights



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# Intelligent Dashboards for Occupants with individualized plug load meter/controllers



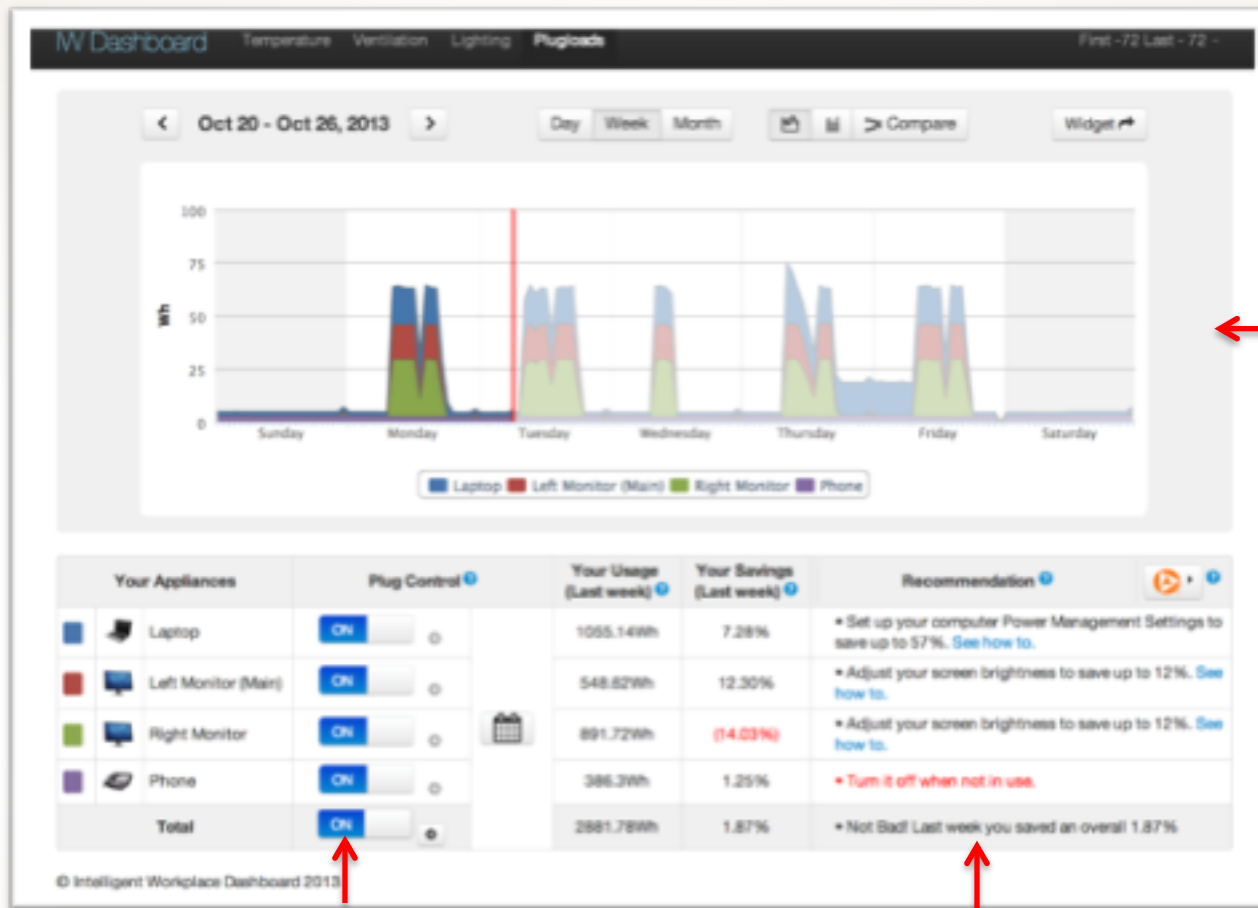
setting up  
workstation  
energy detection



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Features



← communication

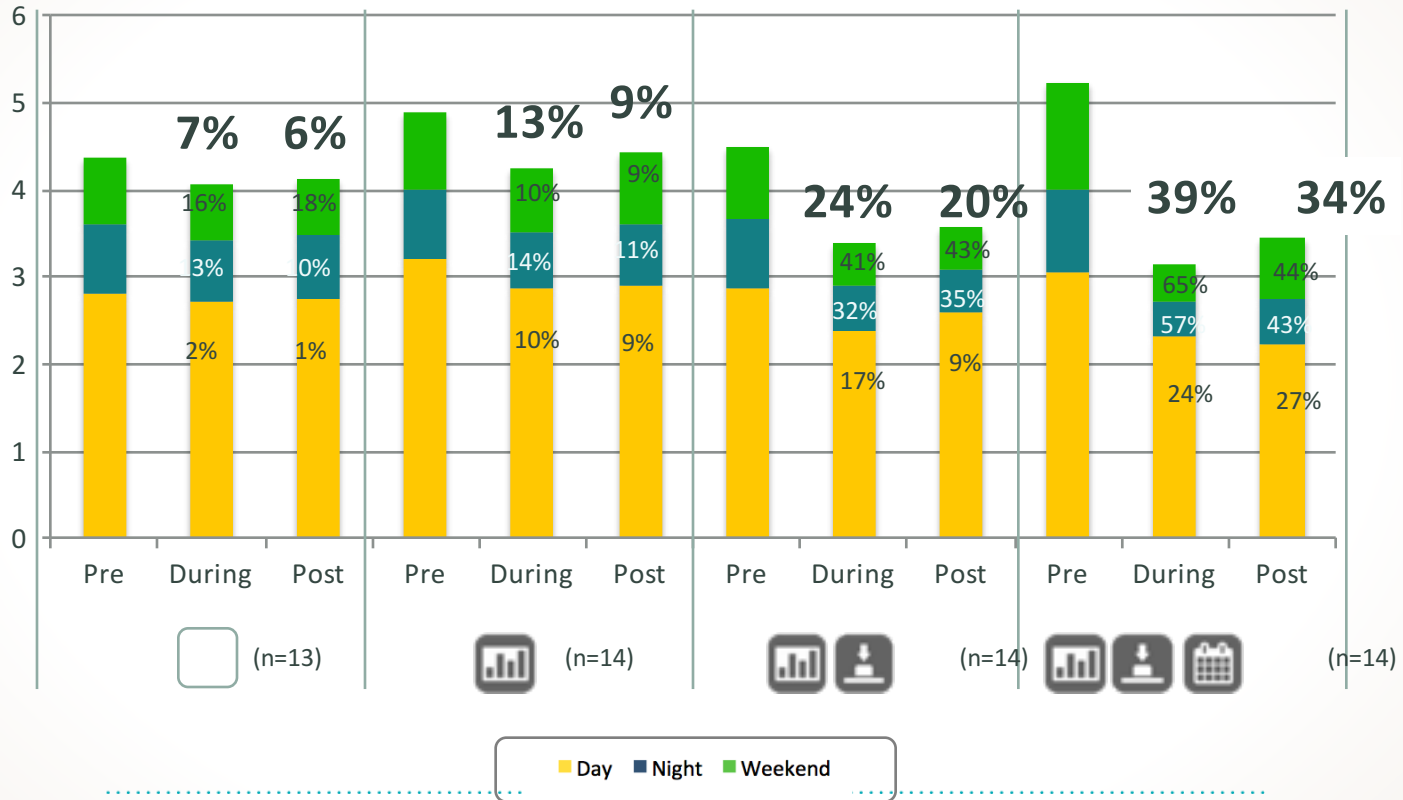
control

expert consulting



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## Energy Savings Per Group (Pre – During – Post)



# What Need To Be Considered For IEQ?

## Physical factors

### Air Quality

- CO2, CO,
- PM 2.5, PM 10
- TVOCs, formaldehydes
- air flow
- ventilation effectiveness

### Acoustic Quality

- Background sound levels
- Speech intelligibility
- Sound attenuation in spaces



### Visual Quality

- Light/Daylight level
- Brightness, contrast
- Spectrum
- Light level variability
- Glare

### Thermal Quality

- Air temperature
- Relative Humidity
- Air velocity
- Radiant temp.



Envirobot cart

### Spot measurement with an Envirobot Cart

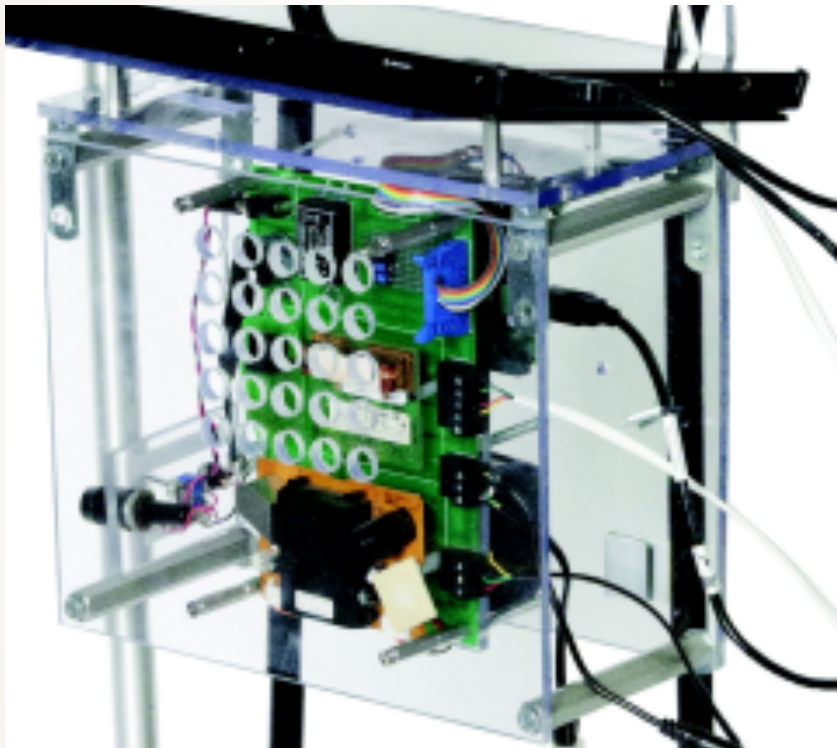
- Temperature
- Humidity and CO2 level
- Lighting on work surfaces
- Noise



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## New Plug and Plug and Play Technologies



Vs



<http://maya.com/work/interstacks>

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# Partnership: Cortana & IOT Suite

**David Brown**  
Sales Director  
Neal Analytics

- A Brief Introduction to Neal Analytics
- Creating an “Enlightened Organization”
- Some Industry Use Cases of IoT and Analytics
- Cortana Deployment



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# Neal Analytics: Microsoft Partner



## Our Mission

Drive customer value with Predictive Analytics on the Microsoft platform, and use Azure Machine Learning to drive IT & business partnership in our clients.

## Our Company

We are Seattle-based company with 25 data engineers and scientists that have helped dozens of customers improve their businesses. We were founded in 2011.

## Manu., Retail, Energy

Our objective is to make analytics accessible to companies of all sizes across our verticals. Our team specializes in creation of analytical practices to help companies grow and scale.

## Partnerships

We are a Microsoft partner that develops solutions on using Azure ML, Azure marketplace, HDInsight, Stream Analytics, Azure Data Factory, and Event Hubs.

## Our Focus

Demand forecasting, decision modelling, resource forecasting, predictive maintenance, systems integration and creating more profitable customers.

## OUR PROCESS

Prove ROI

Broadly Engage Leaders

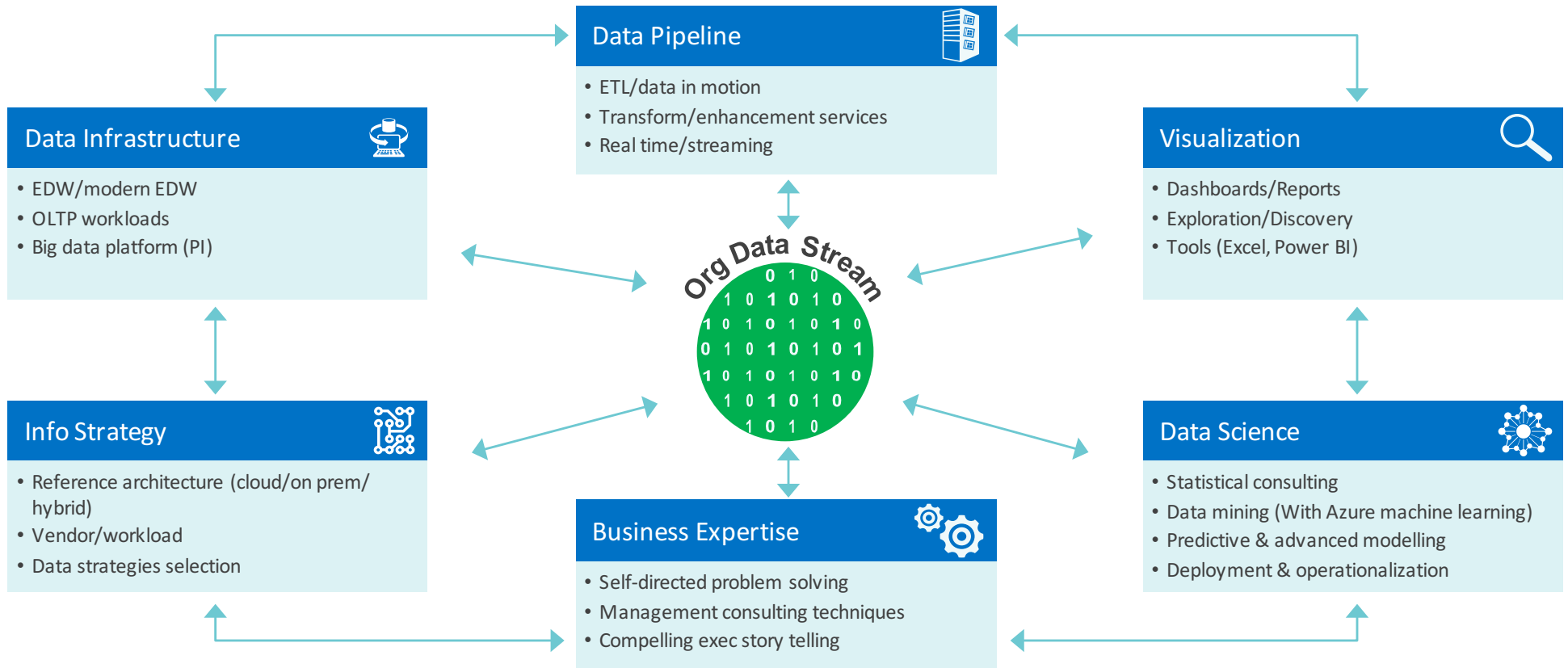
Production

Solution Sales Director: David Brown, 425-283-6842, davidb@nealanalytics.com  
<http://www.nealanalytics.com>











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# Neal Analytics Services



# Industry Use Cases of IoT & Analytics

<p><b>Financial Services</b></p> <ul style="list-style-type: none"> <li>• New account risk screens</li> <li>• Fraud prevention</li> <li>• Trading risk</li> <li>• Facial &amp; Biometric Recognition</li> <li>• Insurance underwriting</li> <li>• Accelerate loan processing</li> </ul> 	<p><b>Retail</b></p> <ul style="list-style-type: none"> <li>• 360° view of the customer</li> <li>• Analyze brand sentiment</li> <li>• Localized, personalized promotions</li> <li>• Website optimization</li> <li>• Optimal store layout</li> <li>• Beacons &amp; kiosk</li> </ul> 	<p><b>Telecom</b></p> <ul style="list-style-type: none"> <li>• Call detail records (CDRs)</li> <li>• Infrastructure investment</li> <li>• Next product to buy (NPTB)</li> <li>• Real-time bandwidth allocation</li> <li>• New product development</li> </ul> 	<p><b>Manufacturing</b></p> <ul style="list-style-type: none"> <li>• Supplier consolidation</li> <li>• Supply chain and logistics</li> <li>• Assembly line quality assurance</li> <li>• Proactive maintenance</li> <li>• Crowd source quality assurance</li> </ul> 
<p><b>Healthcare</b></p> <ul style="list-style-type: none"> <li>• Genomic data for medical trials</li> <li>• Monitor patient vitals</li> <li>• Reduce re-admittance rates</li> <li>• Store medical research data</li> <li>• Recruit cohorts for pharmaceutical trials</li> </ul> 	<p><b>Utilities &amp; Energy</b></p> <ul style="list-style-type: none"> <li>• Smart meter stream analysis</li> <li>• Slow oil well decline curves</li> <li>• Optimize lease bidding</li> <li>• Compliance reporting</li> <li>• Proactive equipment repair</li> <li>• Seismic image processing</li> </ul> 	<p><b>Public Sector</b></p> <ul style="list-style-type: none"> <li>• Analyze public sentiment</li> <li>• Protect critical networks</li> <li>• Prevent fraud and waste</li> <li>• Crowd source reporting for repairs to infrastructure</li> <li>• Fulfill open records requests</li> </ul> 	<p><b>Goods and Manufacturing</b></p> <ul style="list-style-type: none"> <li>• Identify hidden revenue opportunities</li> <li>• See and predict changes in supply or demand</li> <li>• Market price volatility and production planning</li> <li>• Promotional demand</li> <li>• Purchase Engine</li> </ul> 

# IT

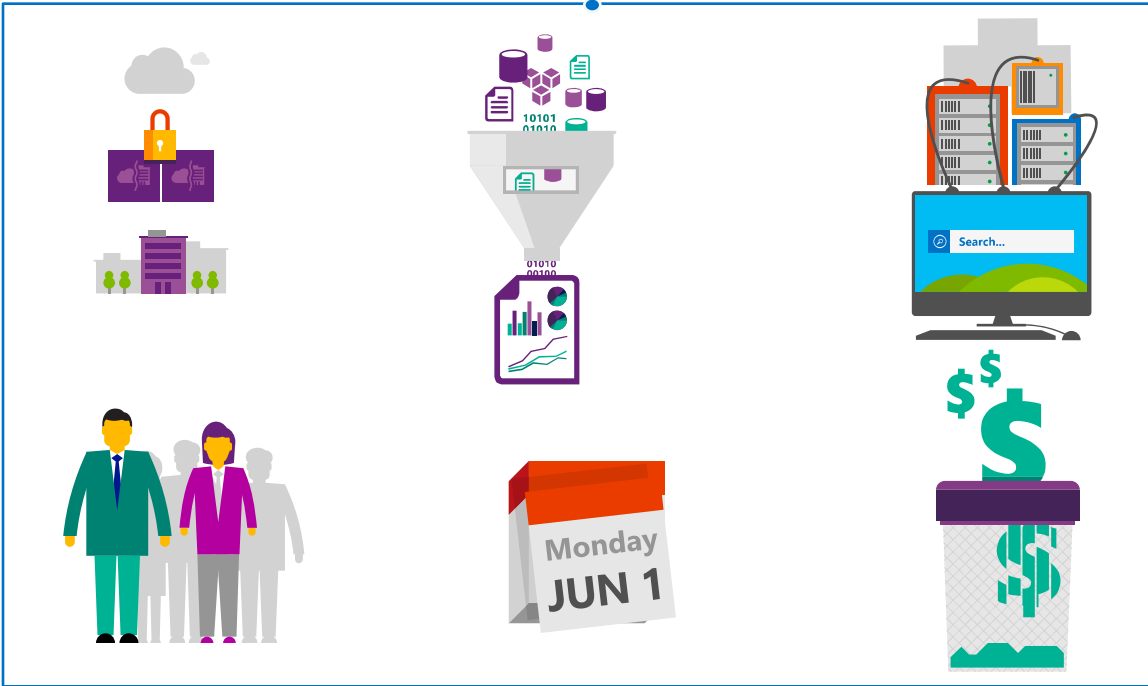
- Managed by central IT authority
- Deep Microsoft recognition & engagement
- Focus on cost reduction

# OT

- Managed by operational & financial authorities
- Limited Microsoft recognition & engagement
- Focus on profitability improvement

# Cortana Workshops: Make IT a Hero

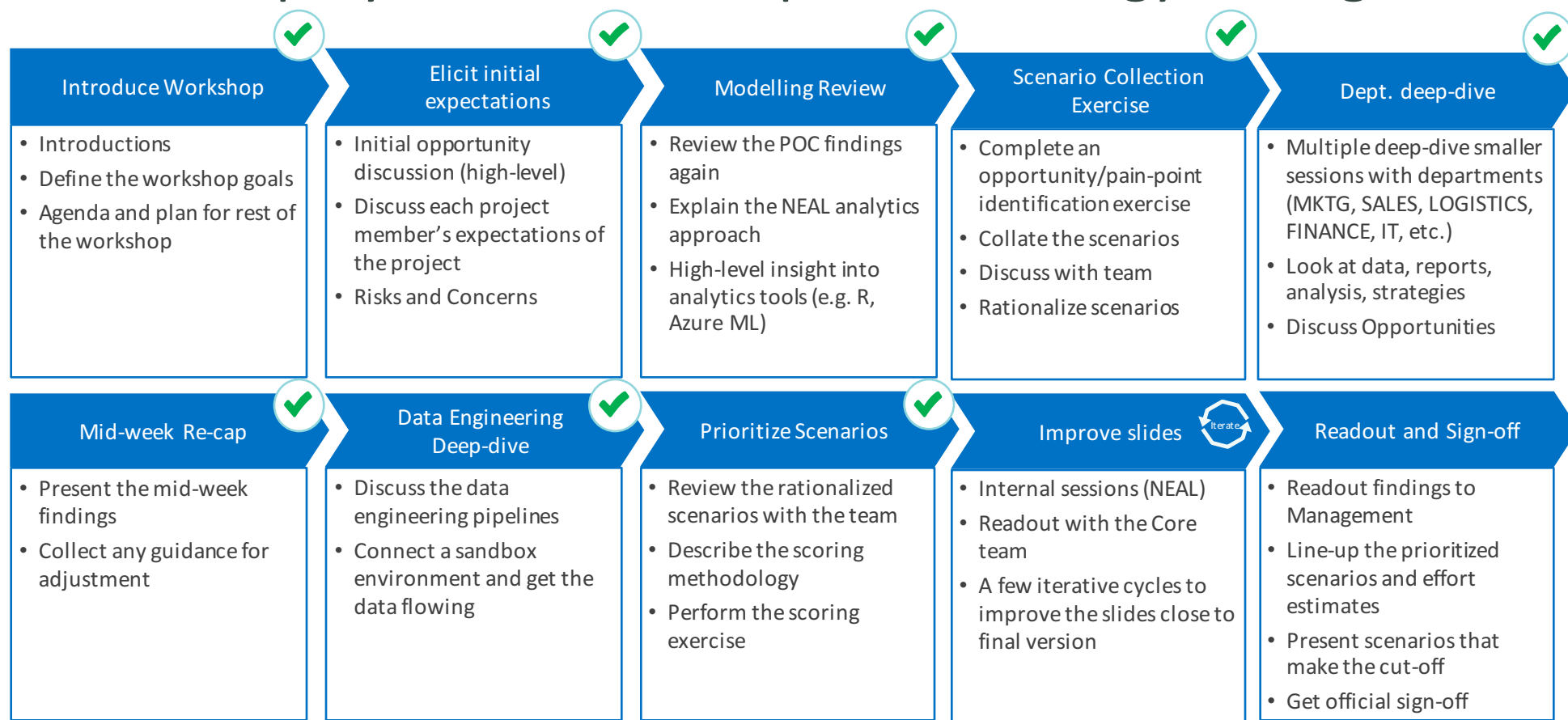
## Emerging Challenges



## Desire



# Cortana Deployment Workshop Methodology & Progress





# Use of IBM BlueMix and IoT Foundations to Support Campus IoT Initiatives

## IBM IoT solutions for a Smarter Planet

- *Gaya Srinivasan, Business Development Executive, Internet of Things, IBM Analytics*

## IBM IoT Foundation Platform and BlueMix

- *Jay Venenga, Internet of Things Solution Architect*

## Enterprise IoT

- *Steven Wallace, Network Engineer, Indiana University*

# IBM delivering IoT solutions for a Smarter Planet *even pre-IoT campaign launch in 2008*



Gaya Srinivasan  
IBM



## INSTRUMENTED

Digital technologies (sensors and other monitoring devices) are being embedded into many objects, systems and processes



## INTERCONNECTED

In the globalized, networked world, people, systems, objects and processes are connected, and they are communicating with one another in entirely new ways



## INTELLIGENT

Leveraging the data generated by digital technology provides intelligence to help us do things better, improving our responsiveness and ability to predict and optimize for future events



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## eWeek: IBM as #1 leader in companies investing in IoT



**IBM's \$3 billion investment places it No. 1 in the world on the list of companies that are betting a whole lot on this market, which is already quite active.**

IBM isn't often mentioned in the media as being a leader in the rapidly growing Internet of things market, but it is quietly putting out a substantial corporate investment in it.

Back in March, the venerable all-purpose IT provider announced that it was investing a cool \$3 billion and hiring 1,400 workers into a new business unit that would create, develop and market products and services that would fit

into the Internet of things bucket. That investment places it No. 1 in the world on the list of companies that are betting a whole lot on this market, which is already quite active.

According to a listing compiled by the research firm [IoT Analytics](#), IBM—with that huge \$3 billion commitment—is now No. 1 in the world in IoT investment, followed by Google, Intel, Microsoft and Cisco Systems. Apple, SAP, Oracle, Samsung and Hewlett-Packard round out the top 10.

The second 10 are ranked in this order: Ericsson, Amazon, GE, Qualcomm, AT&T, Orange, BlackBerry, Facebook, Dell and Verizon.

# Mission

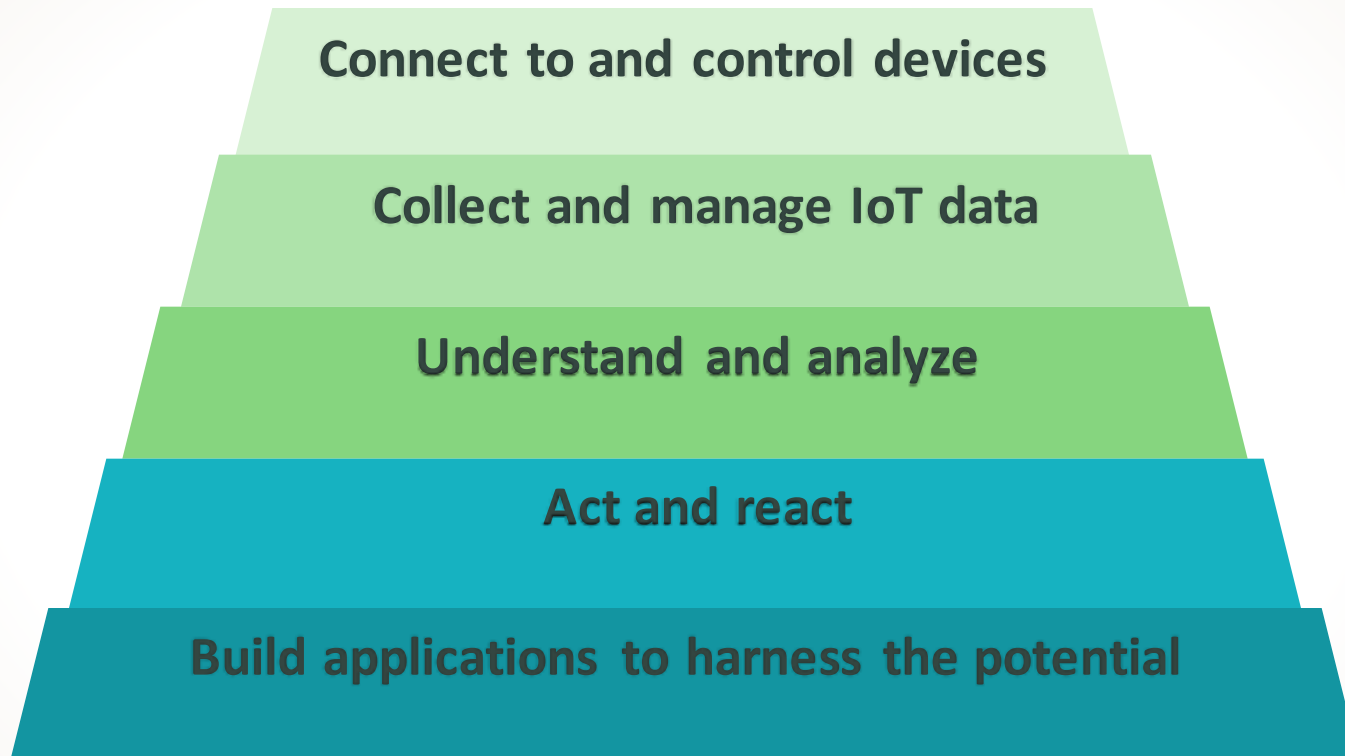


## Mission Statement:

- Provide a **no-charge program** to educators to teach IBM IoT Foundation that
  - includes required training material, curriculum guides, software & the cloud environment
  - gives students hands-on, real-world IoT and IBM IoT foundation experience
  - makes students able to use the learned technology & skills in their future careers
- **Get feedback** from faculty/students on the ease of use, technology barriers etc. & feed it to the product teams for product/process improvements
- Leverage IBM and partners to **scale** extensively
- Leverage **faculty events** to create awareness, train and enable

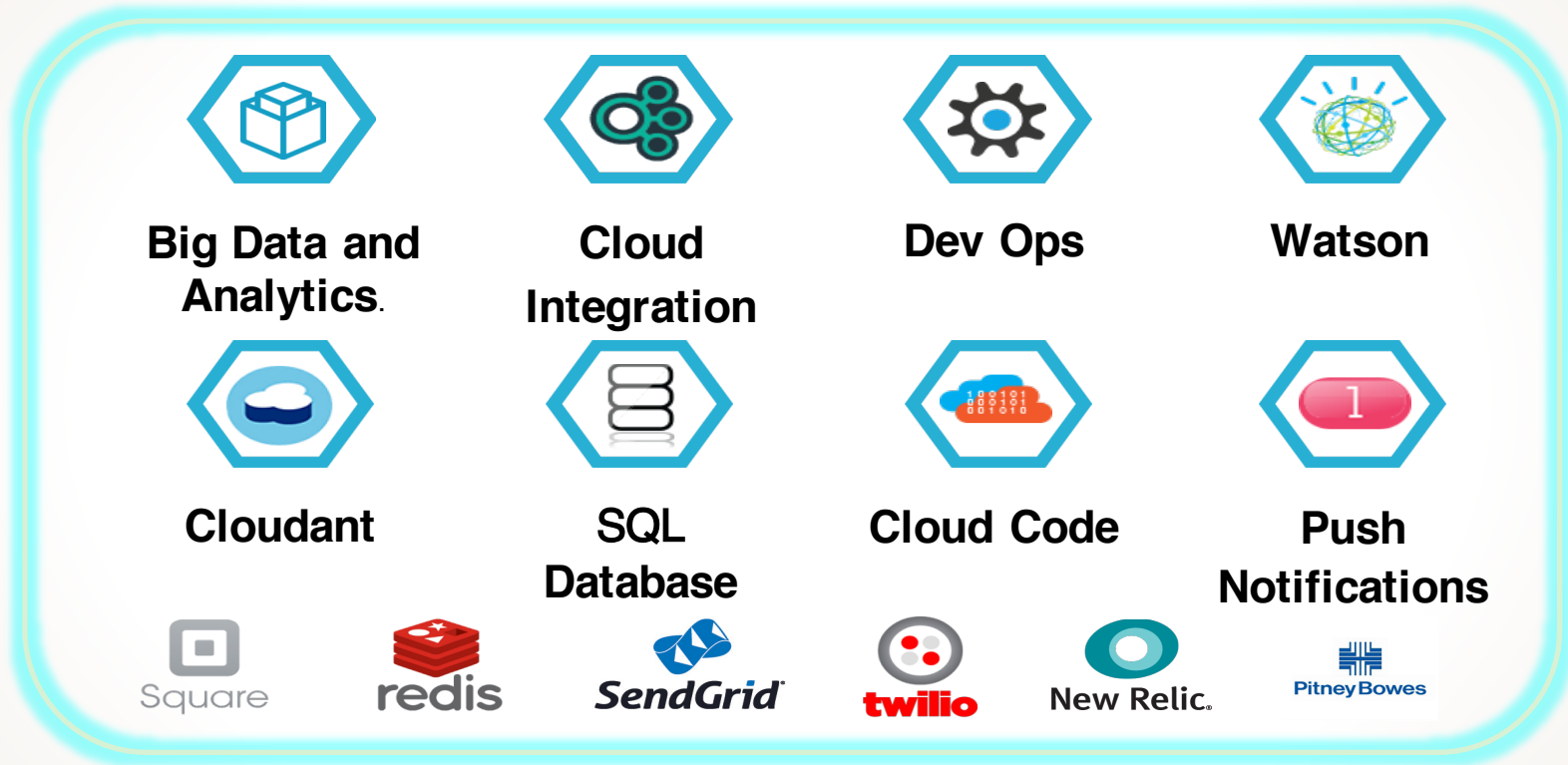


# Five keys to tap into IoT Value



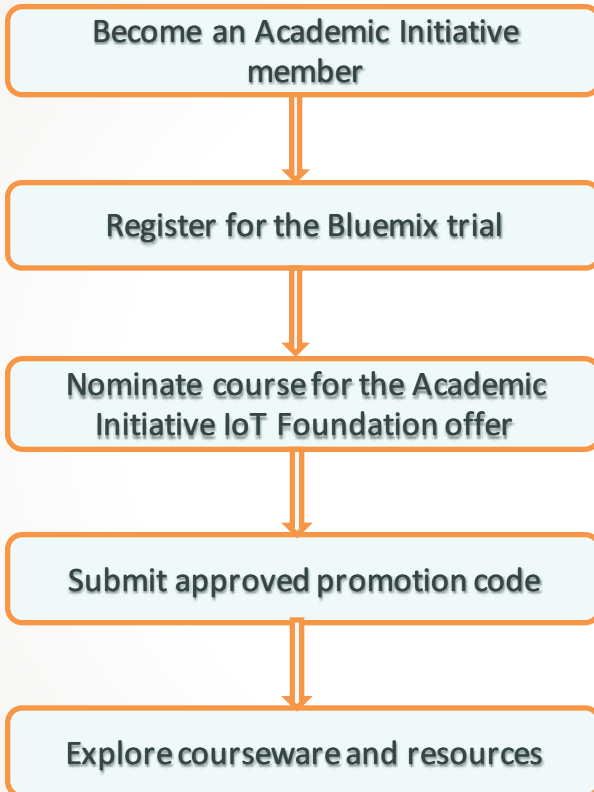
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# Building an IoT PaaS on the power of BlueMix



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# Getting started with IBM Academic Initiative for IoT



## STEP 1: Join the Academic Initiative

You will be prompted to create an IBM ID.

## STEP 2: Sign up for the Bluemix trial

Already have a trial account? Proceed to step 3.

## STEP 3: Nominate course

Click on 'Sign in to Academic Initiative' button in Faculty section; Sign in with your IBM ID created in Step 1.

## STEP 4: Sign in to Bluemix

Enter promo code by signing into your Bluemix trial account ID used in Step 2.

## STEP 5: Use resources

Explore the courseware assets and faculty guides



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# Resources

- Faculty Guide: IBM [Academic Initiatives](#) IoT [Faculty Guide](#)
- Redbook: [The Interconnecting of Everything](#)
- **Whitepaper:**
  - [Is your business ready](#) for the Internet of Things
  - [Four ways to drive service innovation](#) with the Internet of Things
  - [Deriving business value](#) from the Internet of Things
  - [The rise of the machine data](#) - Are you prepared?
  - [IBM MessageSight](#) in the Automotive Industry
  - [IBM Point of View: Internet of Things Security](#)
- **Demo:**
  - Intro to Bluemix and Internet of Things Foundation - [Part 1](#)
  - Intro to Bluemix and Internet of Things Foundation - [Part 2](#)
  - [Connected Car](#)
  - IBM IoT overview and [Connected Car](#) demo
  - [Smart Buildings](#) with Sogeti (Recorded)
  - [Smart Buildings](#) with Sogeti (Manual; password: sogetiibm)
  - Bluemix and [Internet of Things](#)
  - [IBM Python app](#) with a Raspberry Pi and Bluemix
- **Tutorial:**
  - [IoT Python app](#) with a Raspberry Pi and Bluemix
  - [Build a connected-car](#) IoT app with Geospatial Analytics



# Customers capturing results with IBM IoT solutions



**40%**

*Reduction in operating costs*

**TPVISION**



**99%**

*Reduction of time for software error correction*

**100%**

*Prediction of ground events for high risk engines*



Pratt & Whitney



*Shorten customer service call time by*

**70%**

**20%**

*Improvement in steering decisions due to quality insight*



**BOSCH**  
Invented for life



**\$700M**

*In cost and performance benefits*

**95%**

*Elimination of manual operations*



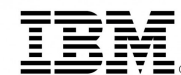
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# Case Studies



- [SilverHook Powerboats](#) lead with IBM IoT Solutions
- [Technicolor](#) solution on the cloud
- [Lafarge S.A.](#) advanced asset management solution
- [Kiwi Weareables](#) fast time to market
- [Hildebrand](#) revolutionary new IoT services
- [University of Alberta](#) understanding climate and environment change
- [Dubai Airport](#) is a smarter airport
- [Ireland Electricity Board](#) minimize cost of electric vehicle charging
- [Lysi Energy](#) saves energy costs in smarter homes
- [Bangalore Water Supply and Seward Board](#) reduce waste and supply equitable water
- [E. & J. Gallo Winery](#) conserve water and increase fertilizer efficiency
- [Waratahs Rugby](#) prevent player injuries
- [Dublin City Council](#) reduce traffic congestion
- [Miami-Dade Police Department](#) break cold cases
- [Sun Life Stadium](#) running sports complex like a smart city
- [City of Dubuque](#) smart city solution
- [Yarra Valley Water](#) keeping water service flowing to millions of customers
- [Chaotic Labor](#) reduces labor cost
- [Florida State University](#) speeds investigation
- [Palava by Lodha Group](#) sets benchmark for 21<sup>st</sup> century urban living
- [US Federal Agency](#) manages full lifecycle of assets
- [Staples](#) provides better online experience to customers
- [City of Madrid](#) cuts costs
- [Sao.Paolo.State.Transportation.Agency](#) promotes driver safety



# Next Steps

## 1. Learn more

Start using [Bluemix](#)

Experiment with [Node-Red](#)

Try out Internet of Things on Bluemix [ibm.biz/try\\_iot](http://ibm.biz/try_iot)

## 2. Get Involved

[Use the Internet of Things Foundation](#)

## 3. Learn more about IBM's point of view on the [Internet of Things](#)

## 4. Join us in our IoT conversations @IBMIoT

## 5. Join the [IBM Academic Initiatives](#) and offer the course



We're here to help



Gayathri Magie  
IBM IoT  
Academic Initiative  
[gayathri@us.ibm.com](mailto:gayathri@us.ibm.com)



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# IBM IoT Foundation Platform and BlueMix



Jay Venenga  
IBM

- IoT Strategy
- IBM IoT Foundation platform
- Ecosystem
- What's coming next
- Where to go for more information



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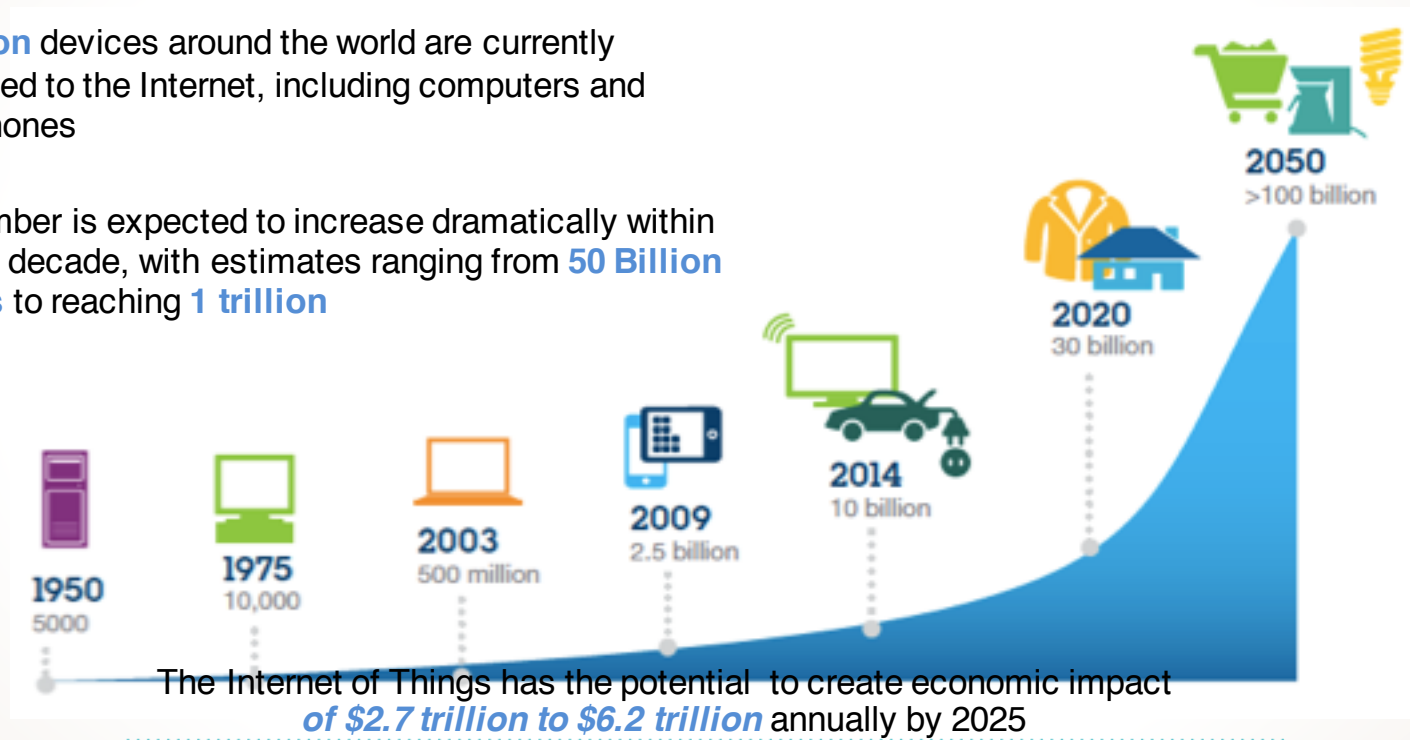
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# We are on the threshold of massive explosion of connected things



10 billion devices around the world are currently connected to the Internet, including computers and smartphones

The number is expected to increase dramatically within the next decade, with estimates ranging from 50 Billion devices to reaching 1 trillion



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# IoT is revolutionizing the market and a tremendous growth opportunity

## Top 3 ways IoT will change how business operates

- 1 Unlock new revenue from existing products/service
- 2 Inspire new working practices or processes
- 3 Change or create new business model or strategy

**75%** of Companies are exploring IoT

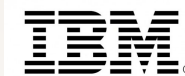
**62%** Of C-suite execs believe failure to adopt IoT will mean getting left behind

**36%** Growth in sensing, communicating devices

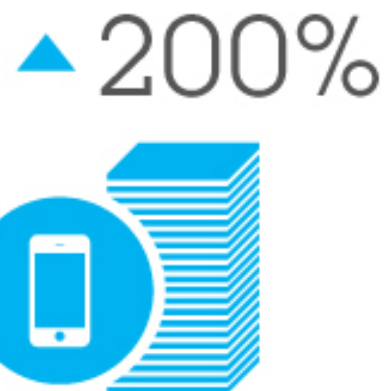
**400%** Growth in Google search interest



# The barriers have been broken



Increase in connected machine-to-machine devices over past 5 years<sup>3</sup>



Increase in Mobile Network connections speeds from 2013 to 2018<sup>2</sup>



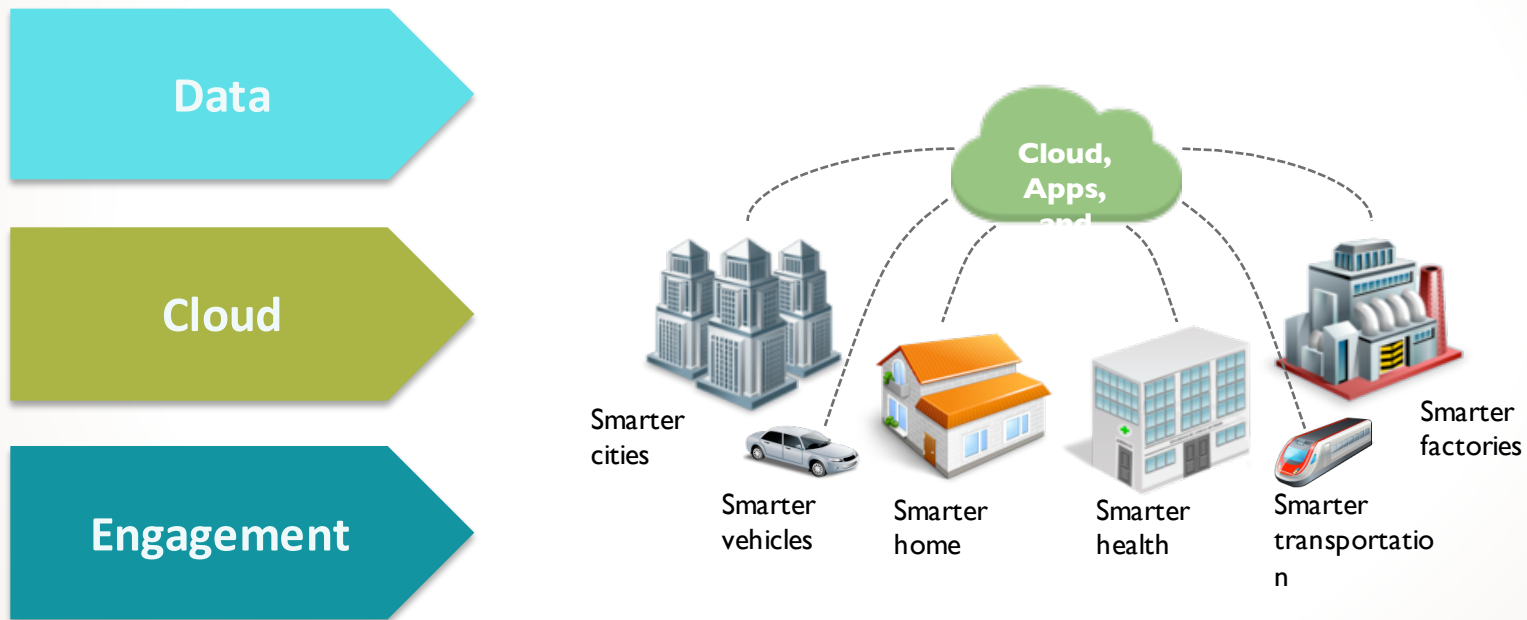
Price decline in MEMS (microelectromechanical systems) sensors in last 5 years<sup>3</sup>

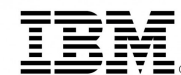


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Internet of Things digitizes our world, providing us with prolific amounts of data and new delivery models that allow business to engage in new value creation





# IoT value is realized in four foundational areas

## Industry Transformation

Evolving new business models

### Representative IBM Products

IoT for Automotive, IoT for Electronics, IoT for Insurance

## Applications & Solutions

Optimizing operations and enhancing performance

Maximo, Tririga, PMQ,

## Platform

Building and managing IoT solutions

Continuous Engineering  
IoT Foundation (IBM IoT Platform)

## Devices & Networks

Connecting what matters



IBM Ecosystem partners



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# Devices and Networks include the hardware, gateways and operating infrastructure that serve as the foundation of IoT solutions

## Four Foundations

Industry

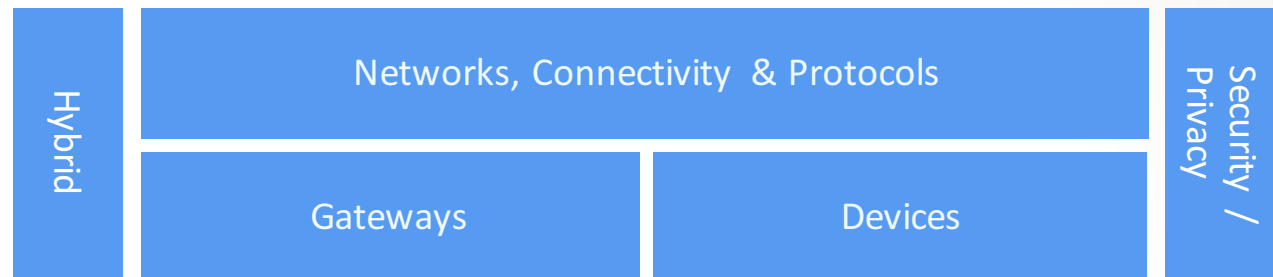
Transformations

Applications &

Solutions

Platforms

**Devices & Networks >**



**Expansive, scalable and secure ecosystem** that drives interoperability via open source and standards bodies

- ✓ Driving convergence in IoT industry standards
- ✓ Connect devices into platforms and vendor specific IoT centric solutions seamlessly and securely



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# Ecosystem and partnership strategy extends the IBM IoT capabilities to include Devices and Networks



Devices & Networks

Derive IoT insight from data through strong industry partnerships and open ecosystem

Examples:

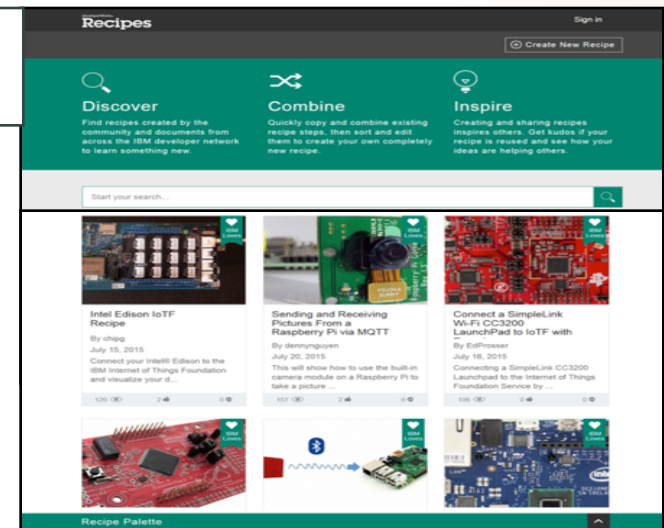


## Connecting Devices to the IBM IoT Foundation platform:



Wide variety of supported devices

- ✓ Self Service
- ✓ Open ecosystem
- ✓ Simple tutorials
- ✓ Connect in moments



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# Device recipe examples



## Devices & Networks

### ARM® mbed™ IoT Starter Kit

Use an ARM® mbed™ IoT Starter Kit, Ethernet edition for IBM Internet of Things Foundation, enabled microcontroller to connect to the IBM Internet of Things Foundation and visualize the data in real time.

#### Ingredients

Hardware Requirements



ARM®mbed™ Ethernet Starter Kit (<http://developer.mbed.org/platforms/IBMEthernetKit/>)

Containing

- Temperature
- Acceleration
- Potentiometer
- Joystick

If you have completed the simple steps to connect your device and visualize your device data then you are ready to prepare.

#### Prepare

Get your device ready

- 1 Plug your boards together as shown in the quick start guide.
- 2 Connect to a network with internet access.
- 3 Connect to your computer using the USB cable, as shown on the quick start guide.
- 4 The microcontroller appears in the IBM Internet of Things Foundation.



### Network Gateway & Wizzard™ Edge Node

This recipe has been provided by an IBM Business Partner

Use the Spectre router and Wizzard device(s) to connect to the IBM Internet of Things Cloud. Then you can visualize the data generated by any Wizzard connected sensor on the Quickstart page. This demo uses a thermocouple sensor attached to a Wizzard Edge Node to generate the temperature data to be sent to the cloud.

#### Ingredients

Hardware Requirements



- Spectre Network Gateway
- IBM Module for Spectre Network Gateway
- Wizzard Intelligent Edge Nodes
- Sensors
- Wizzard Android App

#### Prepare

Get your device ready

- 1 Connect the Spectre router to the internet. Refer to the Gateway Quickstart Guide as the first step for instruction on how to commission your network gateway

### TEXAS INSTRUMENTS CC2650 SensorTag

This recipe has been provided by an IBM Business Partner

Connecting the TI Simplelink SensorTag to the IBM IoT foundation service is beautifully simple. Follow these steps to connect your SensorTag to the IBM quickstart cloud service in less than 3 minutes.

#### Ingredients



Hardware Requirements



The SensorTag is packed with low power sensors and a battery to allow wireless, battery powered applications with up to 5 years of battery life. To learn more about the SensorTag, visit our website or your own go to [www.ti.com/sensortag](http://www.ti.com/sensortag)

#### Prepare

Get your device ready

- 1 Download the SensorTag app from the Apple Store or Google Play.  
 
- 2 Pull the tab on the SensorTag battery to power on.



### National Instruments LabVIEW

This recipe has been provided by an IBM Business Partner: Espotel

Use LabView to transfer measurement data from PC or RT-Target to IBM Internet of Things Foundation and visualize the data available.

#### Ingredients

Hardware Requirements



National Instrument's myRIO, CompactRIO, FlexRIO, SingleBoardRIO, SOM RIO

#### Prepare

Get your device ready

- 1 Download and install LabVIEW (2013 or newer) on your host PC
- 2 Download IoT Foundation library for LabVIEW from: <https://github.com/Espotel/LabVIEW-IOTFoundation>
- 3 Extract the library zip package

#### Connect (Quickstart)

Internet of Things Foundation Quickstart connection

- 1 Launch `IOFoundation\examples\quickstart.vi`



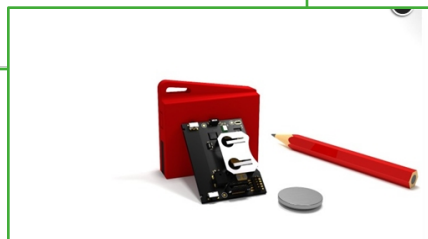
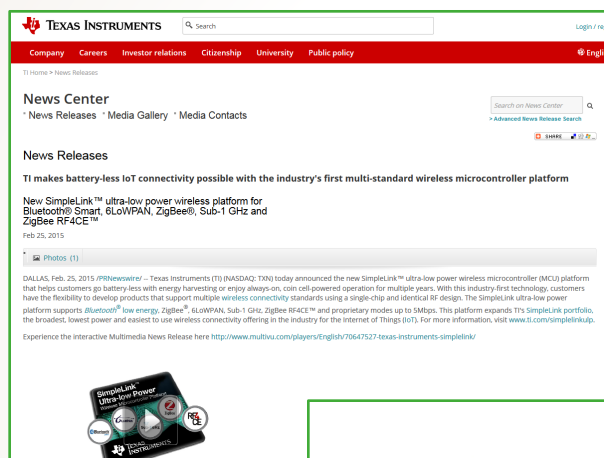
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# Texas Instruments new SimpleLink MCUs and SensorTags



Devices & Networks



- And what's really exciting, is the **SensorTags auto home to IBM IoT Foundation** using the TI phone app as a gateway...
- ***"OKAY - this is cool. So I actually ordered the new SensorTag from ti.com I downloaded the app, pulled the plastic tab and lo and behold I was connected to the cloud. Simply AWESOME"*** (IBM User)



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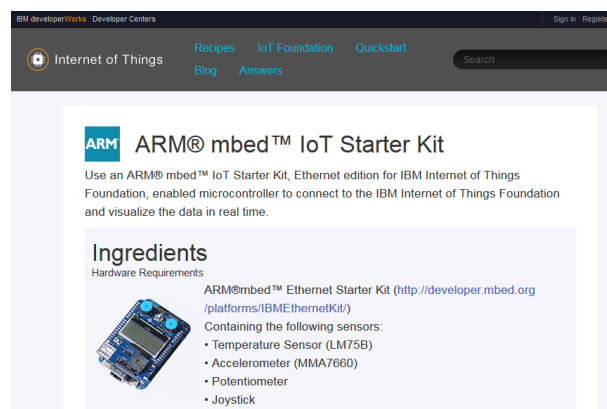
[ 57 ]



# ARM mbed IoT Starter kit

Devices & Networks

ARM mbed IoT Starter Kit for IBM Internet of Things  
... makes it incredibly quick and easy to get started with IoT

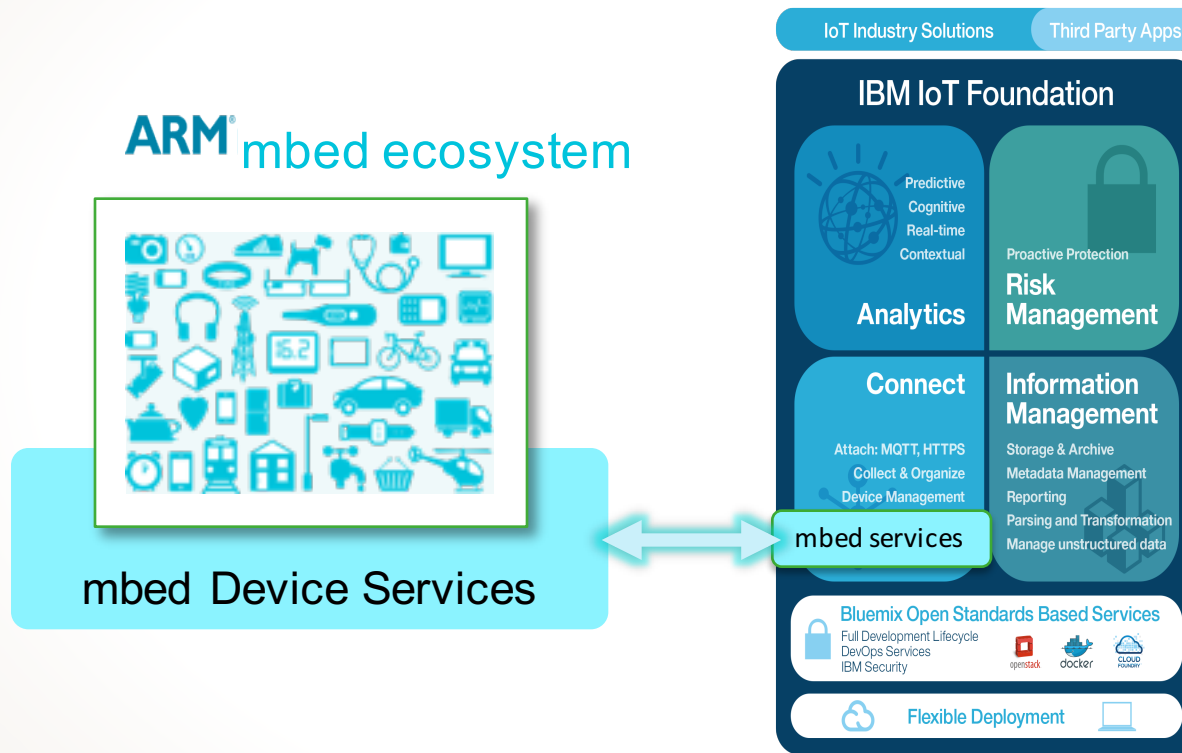


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# IBM teams with ARM – the first unified chip-to-cloud enterprise class IoT platform



Devices & Networks



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Platforms provide a foundation for building and managing IoT solutions and bridge between device manufacturers higher value outcomes



### Four Foundations

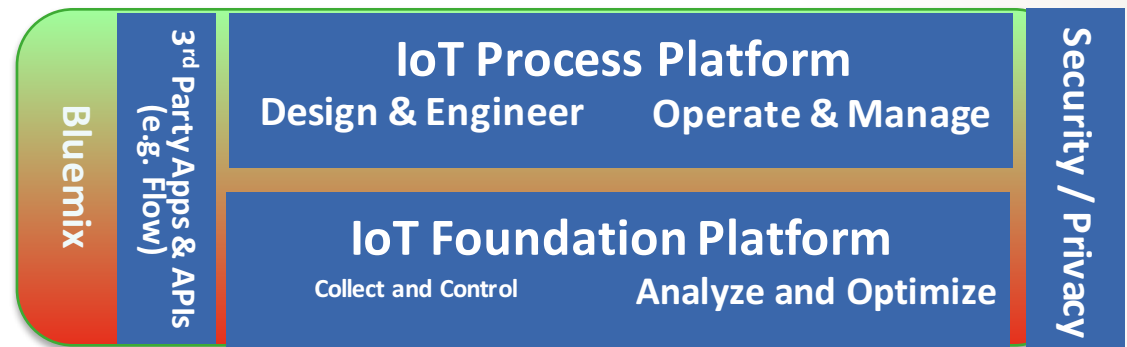
Industry Transformations  
Applications & Solutions  
Platforms >  
Devices & Networks

### Product Family

### Continuous Engineering

### IoT Foundation

Connect, Information  
Management, Analytics,  
Risk Management



**Global, innovative platforms** to deliver high performance at cost-effective scale

- ✓ Reduce the cost while supporting innovation
- ✓ Utilize a flexible platform that provides best practices and better processes



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# IBM Bluemix

Composable services development, runtime and operations for your IoT apps



Platform

## Run Your Apps

The developer can choose any language runtime or bring their own.

## DevOps

Development, monitoring, deployment and logging tools allow the developer to run the entire application.

## APIs and Services

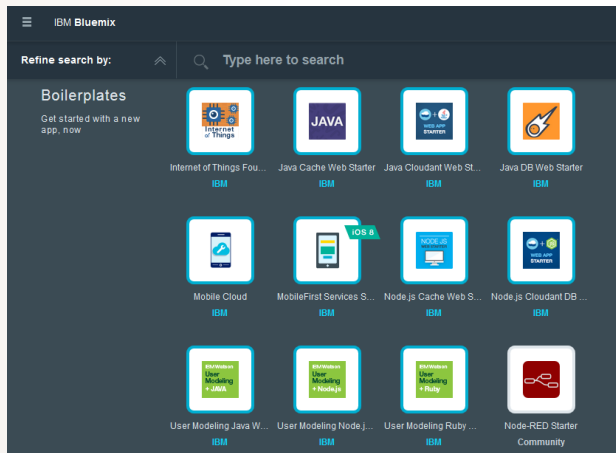
Broad catalog of IBM, 3<sup>rd</sup> party, and open source, APIs and services to compose an application in minutes.

## Cloud Integration

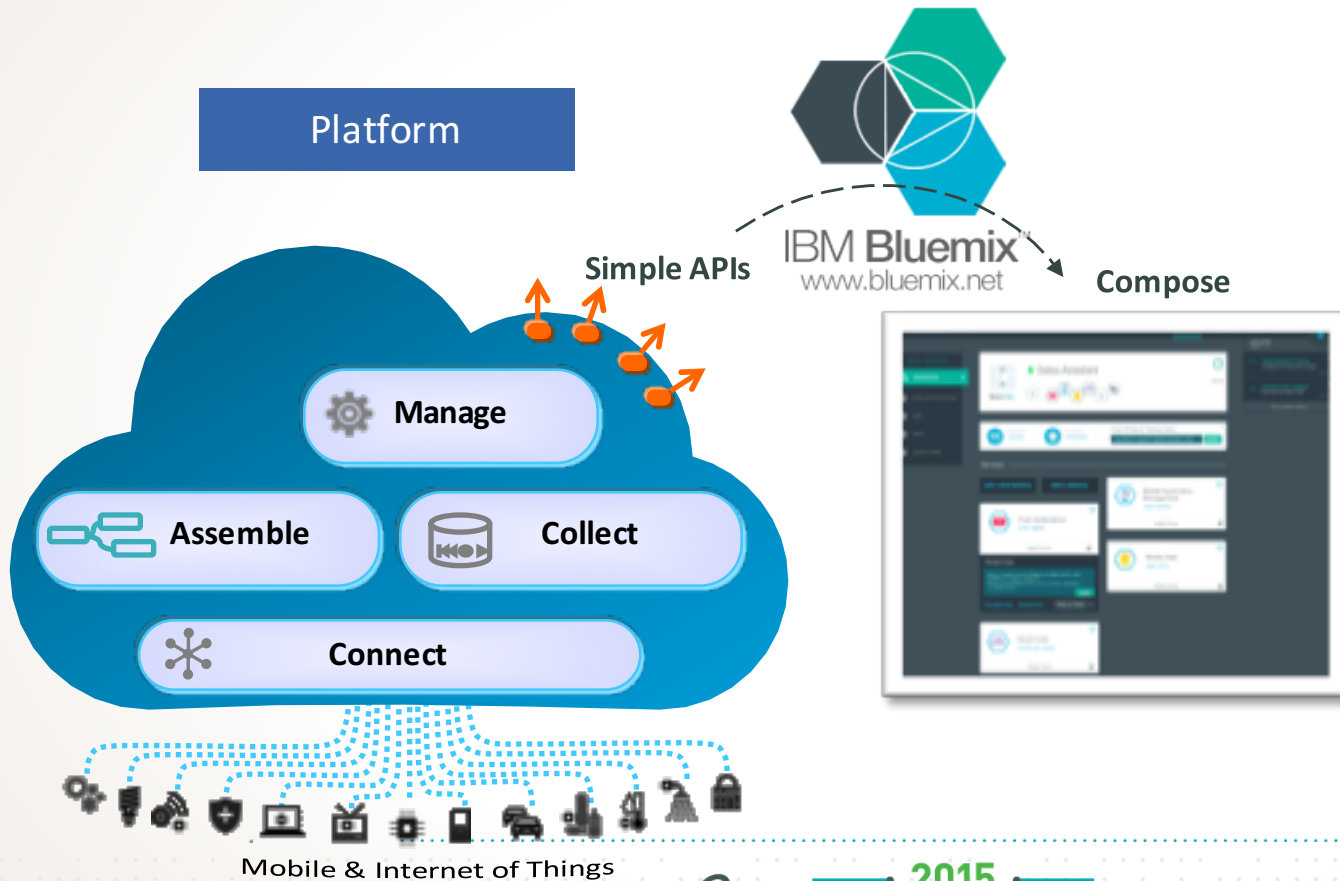
Build hybrid environments. Connect to on-premises systems of record plus other public and private clouds. Expose your own APIs to your developers.

## Built on IBM SoftLayer

No need to worry about provisioning or managing infrastructure.



# IBM Internet of Things Foundation Service



- Secure Device Registration
- Scalable Device Connectivity
- Device Management new!
- PAYG SaaS pricing
- Powered by IBM MessageSight technology

INTERNET<sup>2</sup>

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# IoT Foundation Service Pricing structure

Platform

Pick a plan Monthly prices shown are for country or region: [United States](#)

Plan	Features	Price
✓ Free	Includes up to 20 active devices, 100 MB of data traffic and 1 GB of storage Maximum of 20 active devices Maximum of 100 MB data exchanged Maximum of 1 GB data storage (with 30 day expiry) Maximum of 10 application bindings	Free
<p><b>i</b> The Free service plan for Internet of Things Foundation includes up to 20 active devices, 100 MB of data traffic and 1 GB of online data storage per month.</p>		
Bronze	Includes up to 100 active devices, 100 MB of data traffic and 1 GB of storage Charge per device thereafter Charge per MB data exchanged thereafter Charge per GB data stored online thereafter	\$20.00 USD/Instance \$0.20 USD/Active Device \$0.01 USD/Megabytes Exchanged \$1.00 USD/Gigabyte Month
Silver	Includes up to 3,000 active devices, 100 MB of data traffic and 1 GB of storage Charge per device thereafter Charge per MB data exchanged thereafter Charge per GB data stored online thereafter	\$120.00 USD/Instance \$0.04 USD/Active Device \$0.01 USD/Megabytes Exchanged \$1.00 USD/Gigabyte Month
Gold	Includes up to 15,000 active devices, 100 MB of data traffic and 1 GB of storage Charge per device thereafter Charge per MB data exchanged thereafter Charge per GB data stored online thereafter	\$450.00 USD/Instance \$0.03 USD/Active Device \$0.01 USD/Megabytes Exchanged \$1.00 USD/Gigabyte Month

- Monthly PAYG pricing
- SUBSCRIPTION pricing



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# IBM delivers IoT connectivity across deployment options

Platform

Virtual appliances in datacenter

\*physical appliances withdrawn from market from July 2015, focusing on virtual appliance form factor

Virtual appliances, Public or private cloud deployed

Fully managed as-a-service, PAYG Public Cloud



INTERNET<sup>2</sup>

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# IoT Analytics - meaningful insights from devices in the field

Platform

- **What is going on with all the ‘things’ I am responsible for?**
  - I need to monitor device behaviors to understand anything that isn’t working as expected – in real-time
- **If I have an issue with one of my ‘things’, how can I get it fixed faster?**
  - I need to detect that something is wrong and drive automation to rectify the situation using appropriate, prescribed actions
- **Can I avoid problems before they occur?**
  - I need to forecast problems or situations and initiate appropriate response(s) to avoid unplanned down time
- **How can I design and build better things?**
  - I need insights from devices in the field to adjust designs and manufacturing processes based on actual operating conditions and performance
- **How do I become smarter?**
  - Everything in my world behaves differently under different operating conditions, I need to understand my world so I can determine if / when / how I might want to change it.....

## Example usage Maker

### Appliance Manufacturer

**Role:** Asset Analyst

**Pain points:** I need to understand product performance in the field under different operating conditions and identify product defects or failure patterns under real-world conditions

**How IoT Analytics helps:** IoT Analytics integrates IoT data from the appliances and augments it with additional context including master data, anonymized owner information, location, and manufacturing details. The Asset Analyst can then use a variety of analytical tools to gain insight about performance, usage patterns, and failures.

## Operator

### Energy Production

**Role:** Maintenance Manager / Reliability Engineer

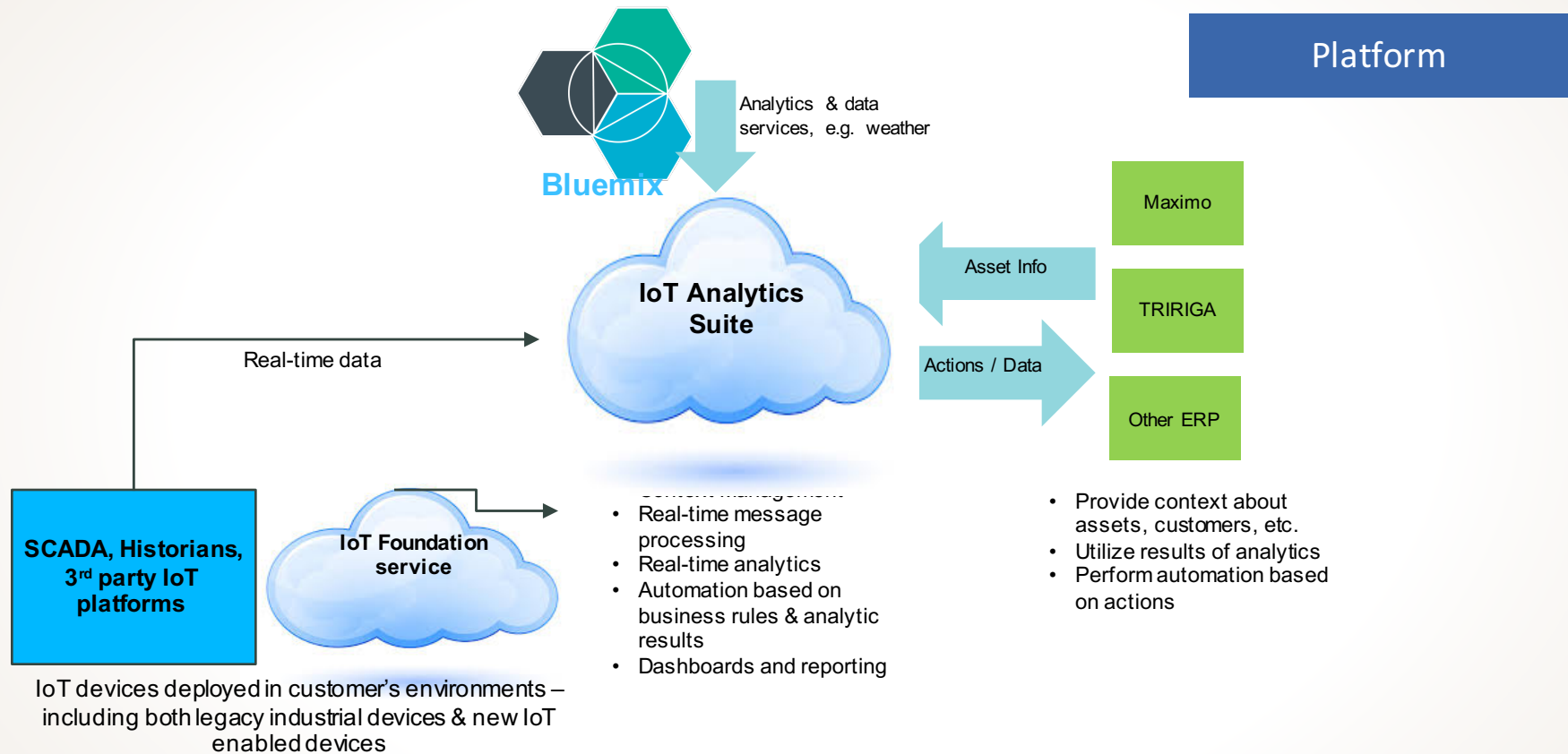
**Pain points:** I have dozens of remote power plants, and I can't afford to have people on site. In addition, my equipment is processing a variable quality source gas source which causes a high degree of variability in wear patterns in the equipment, so it's difficult to plan my maintenance.

**How IoT Analytics helps:** Leveraging data from the remote SCADA systems, IoT analytics provides analytical tools to enable condition based maintenance, helping them understand what is happening or what might happen and automatically dispatch a technician to avoid failures and down time.



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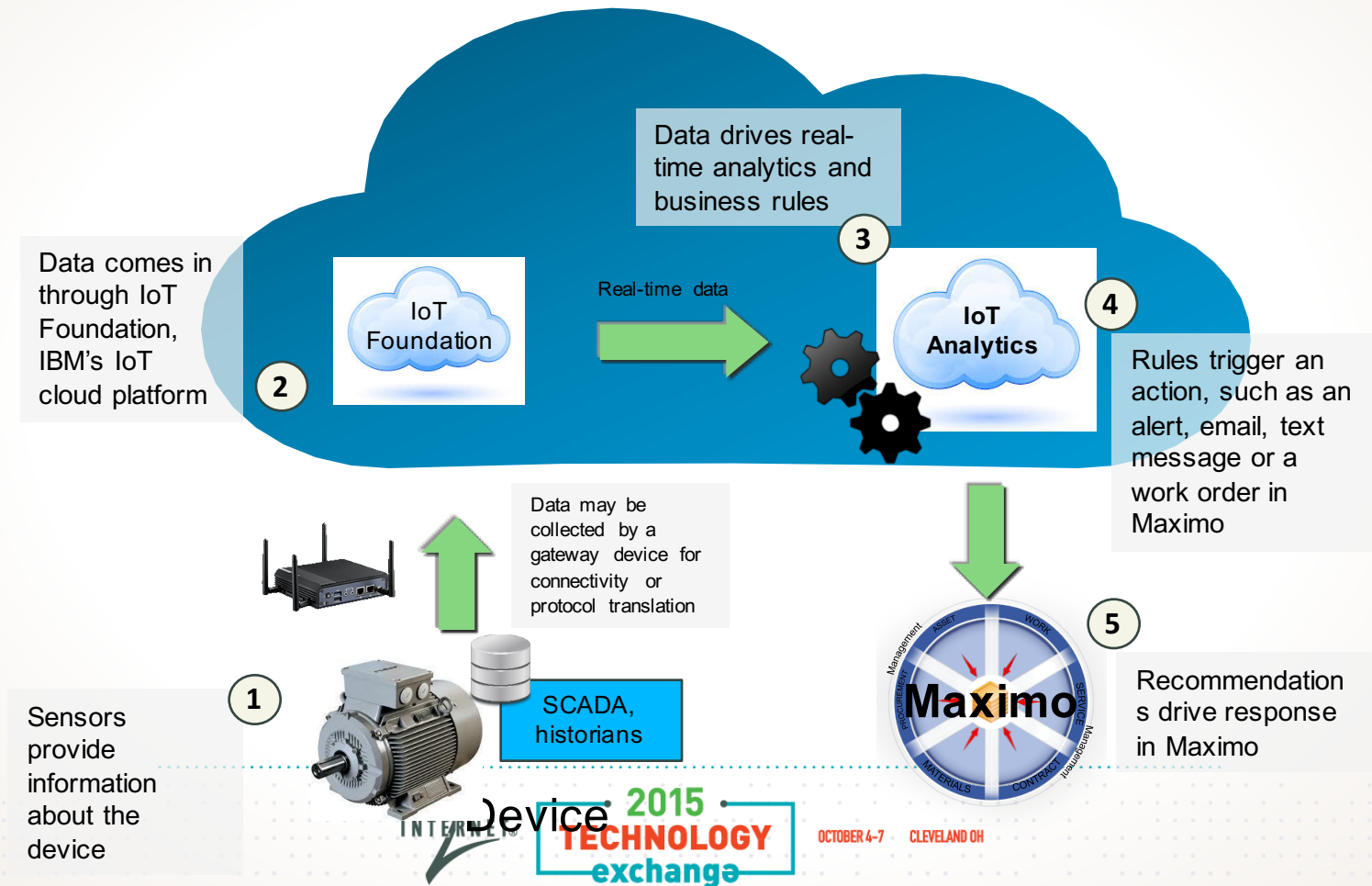
# IBM IoT Real-time Insights - Architecture Overview



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# How "IoT Real-Time Insights" works

Platform





# The IBM IoT Foundation - our next generation IoT platform

## IBM IoT Foundation Offerings

### IBM IoT Foundation Connect

Attach, Collect & Organize, Device Management, Secure Connectivity, Visualization

### IBM IoT Foundation Information Management

Storage & Archive, Metadata Management, Reporting, Streaming data, Parsing and Transformation, Manage unstructured data

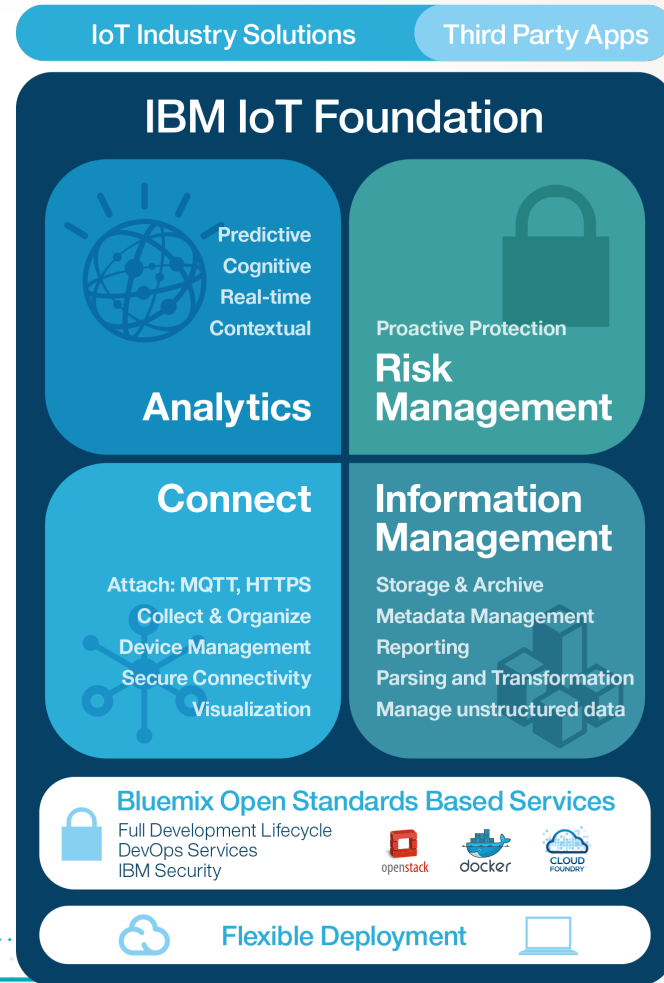
### IBM IoT Foundation Analytics

Predictive, Cognitive, Real-time, and Contextual

### IBM IoT Foundation Risk

Platform

Security Analytics, Data Protection, Auditing/Logging, Firmware Updates, Key/Cert Mgmt, Org Specific Security



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## IBM IoT Foundation Connect & Information Management expand capabilities

### Today ...

- ✓ Composable services
- ✓ Rapid innovation with Bluemix
- ✓ Dashboard/console for each service
- ✓ Pricing per service
- ✓ Integrate at the application level
- ✓ Focused on device connectivity & data storage
- ✓ Device Management

### Tomorrow ...

- ✓ Pre-integrated services
- ✓ Single console
- ✓ Simple predictable pricing
- ✓ Support for consuming other IoT platform data
- ✓ Integrate at the business services level
- ✓ Focused on device connectivity, management & data storage, caching & transformation



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# Extend insight with IBM IoT Foundation Analytics

## Today ...

- ✓ IoT Real-Time Insights (individual service)
- ✓ Real-time dashboards
- ✓ Other services from IBM, e.g. Hadoop Big Insights, Streams
- ✓ Maximo integration

## Tomorrow ...

Pre bundled set of Analytics capabilities by use case

- ✓ Real-Time
- ✓ Descriptive analytics – reporting, BI, and discovery
- ✓ Predictive analytics, trending, & machine learning
- ✓ TRIRIGA Integration
- ✓ Multiple deployment options – local/dedicated/public



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# Enhanced security with IBM IoT Foundation Risk Management

## Today ...

- ✓ Device-Cloud communication security
- ✓ Device-Cloud authentication
- ✓ App authentication
- ✓ Underlying cloud infrastructure security
- ✓ Different across each IoT related service

## Tomorrow ...

- ✓ Base level security in the IoT Foundation with consistent approach across all elements
- ✓ Extra level of proactive security purchasable



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Applications and solutions provide further differentiated value through unique capabilities, products and industry specific expertise

**Four Foundations**

Industry Transformations

**Applications & Solutions**

Platforms

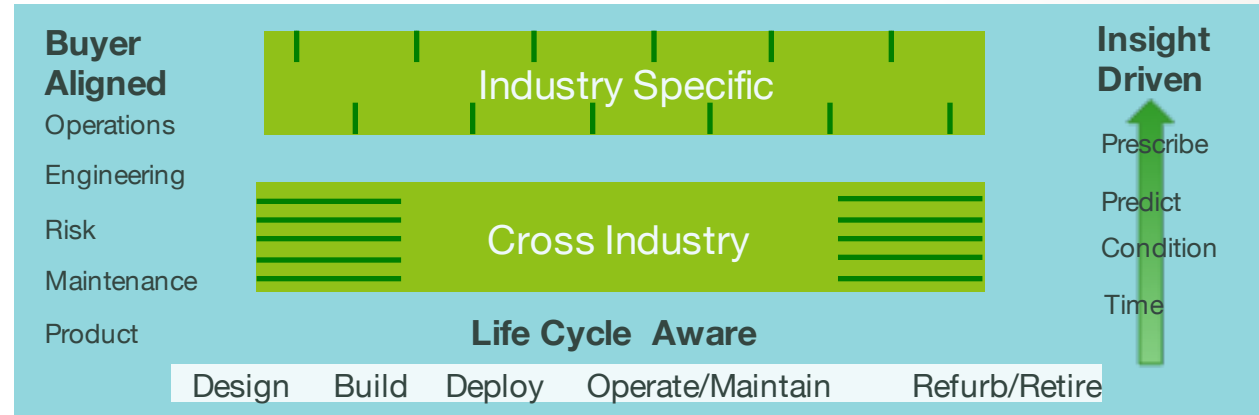
Devices & Networks

**Product Family**

Maximo

Tririga

PMQ



**Breadth and depth of applications** to uncover opportunities in all types of sources

- ✓ Maximize the value of your existing assets and investment
- ✓ Optimize your existing operations with real-time analytics and



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Industry Specific Transformations combine service, expertise, ecosystem and scale to evolve the enterprises to create and deliver new revenue with new models

#### Four Foundations

Industry Transformation

Applications & Solutions

Platforms

Devices & Networks

#### Product Family

IoT for Electronics Ann 3<sup>rd</sup> Sept 15

IoT for Auto Ann 14<sup>th</sup> Sept 15

IoT for Insurance Coming in 2H

IoT for Aviation Coming in 2H



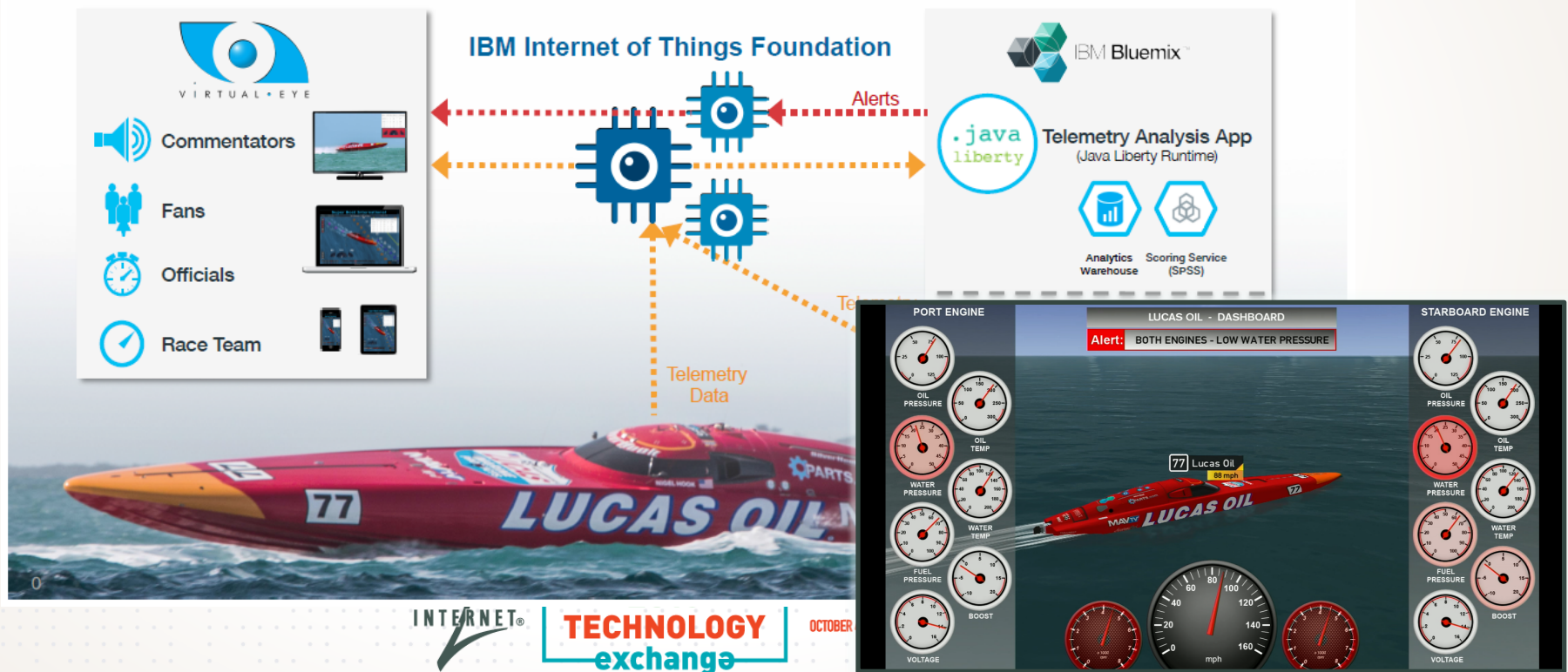
**Vertical integration and industry focus** to accelerate transformation with industry specificity

- ✓ Get you to your business objectives faster
- ✓ Apply the right technologies with the right expertise to expedite adoption



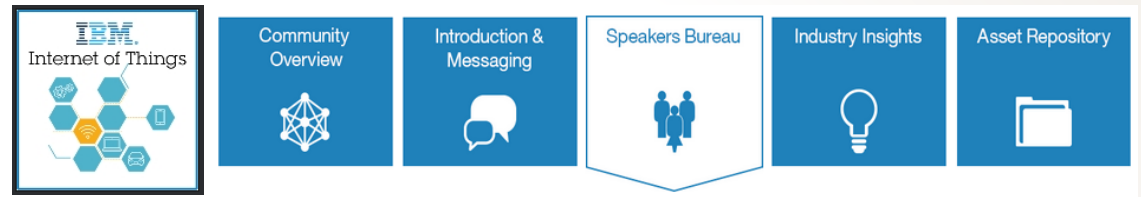
Our favourite use case !

## SilverHook and Virtual Eye: Driving the Powerboat Experience with IBM Bluemix



# Internal resources

Internal one stop shop for IoT  
**[ibm.biz/loTWiki](http://ibm.biz/loTWiki)**



## THINK ACADEMY

[https://w3.ibm.com/ibm/thinkacademy/index.html](https://w3.ibm.com/ibm/thinkacademy/index.html#/internet-of-things/learning-for-a-new-era)  
[#/internet-of-things/learning-for-a-new-era](https://w3.ibm.com/ibm/thinkacademy/index.html#/internet-of-things/learning-for-a-new-era)



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# World Wide Sales Team

- WW Sales Team
- Michael Riley, WW IoT Business Unit Executive, [mariley@us.ibm.com](mailto:mariley@us.ibm.com)
- Ted Connell, NA and Japan, [ted.connell@us.ibm.com](mailto:ted.connell@us.ibm.com)
- Tim Henrion, Europe and MEA, [tjhenrio@us.ibm.com](mailto:tjhenrio@us.ibm.com)
- Lu Lanier, Asia Pacific and GCG, [llanier@us.ibm.com](mailto:llanier@us.ibm.com)
- Bernadine Stephens, NA IMTs as well as the Latin America market, [bernadine.stephens@us.ibm.com](mailto:bernadine.stephens@us.ibm.com)
- WW Technical Sales
- David Dougherty, WW Tech Sales Lead, [ddougher@us.ibm.com](mailto:ddougher@us.ibm.com)
- Peter Jenkins, WW Tech Sales Lead, [Peter.Rhys.Jenkins@us.ibm.com](mailto:Peter.Rhys.Jenkins@us.ibm.com)
- Jim MacNair , WW Tech Sales Lead , [macnair@us.ibm.com](mailto:macnair@us.ibm.com)
- Daniel Tabuenca, WW Tech Sales Lead, [daniel.tabuenca@es.ibm.com](mailto:daniel.tabuenca@es.ibm.com)



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## IBM IoT – Get started today

Learn more about IBM's point of view  
on the Internet of Things

**[ibm.com/loT](http://ibm.com/loT)**

Try out Internet of Things on Bluemix

**[ibm.biz/try\\_iot](http://ibm.biz/try_iot)**

Join us in our IoT conversations

**@IBMIoT**



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# Demo our IoT Zone in Bluemix

Platform

<https://bluemix.net/solutions/iot>

The screenshot shows the IBM Bluemix IoT Zone landing page. At the top left, there is a hamburger menu icon and the text "IBM Bluemix". At the top right, there are two buttons: "SIGN UP" and "LOG IN". The main content area has a dark blue background with a grid of faint icons. The headline "Internet of Things on Bluemix" is displayed in a light blue font. Below the headline, the text reads: "Rapidly compose and extend apps that take advantage of data and analytics from your connected devices and sensors." A prominent "TRY IT OUT" button is centered below this text. At the bottom of the page, there is a navigation bar with four links: "CASE STUDIES", "UNDERSTAND IT", "TRY IT OUT", and "GETTING STARTED".



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# Use of IBM BlueMix and IoT Foundations to Support Campus IoT Initiatives

## IBM IoT solutions for a Smarter Planet

- *Gaya Srinivasan, Business Development Executive, Internet of Things, IBM Analytics*

## IBM IoT Foundation Platform and BlueMix

- *Jay Venenga, Internet of Things Solution Architect*

## Enterprise IoT

- *Steven Wallace, Indiana University*

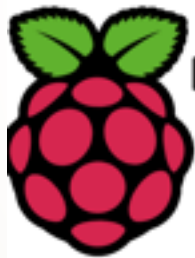


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# Enterprise IoT

Steven Wallace  
Indiana University



Raspberry Pi 2



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# Islands or Webs?

## IoT should be loney.

- There once was a temperature sensor in room 101. It reported directly to the building's HVAC system.
  - Along comes another temperature sensor in room 101. It reports to the university's electrical load predictions system.
  - Alongs comes a fancy sensor to room 101. It knows the temperature, humidity, and pollen count. It reports to the university's health surveillance system.
  - Room 101 has a happy family of duplicate sensors.
- 
- **IoT should be loney**



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# Enterprise IoT Principles



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# IoT's should serve one master. Chain of command is everything!

- IoT's are either secret agents infesting your enterprise, or trusted soldiers allied to your mission.
- To keep IoT's lonely, secure (e.g. patches applied, etc.), and compliant (e.g., conforms to university privacy policies), require a consistent architecture, implementation, and operations.
- Deploying IoT's in an enterprise requires coordination of stakeholders, and the authority to ensure a good overall system.
- Let's call a university's IoT system its IoT cloud. This cloud is not locked in the data center, rather is engulfs the entire university.
- Potential need for “University office of IoT”?



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# Exceptions

an exception requires a policy from which you deviate

- Universities are made of fine people; staff, faculty, and students. These fine people are the core of the university. They're also infested with IoTs.
- The "I" in "IoT" means that their IoTs become part of the university's network.
- Their range of IoTs is broad, from insulin pumps to writing pens.
- This arena will be shaped largely by policy and education. Much potential for the Internet2 community, as well as others such as Educause, to collaborate.
- Universities were light years ahead of the popular BYOD movement. We're well positioned to provide BYO-IoT leadership.



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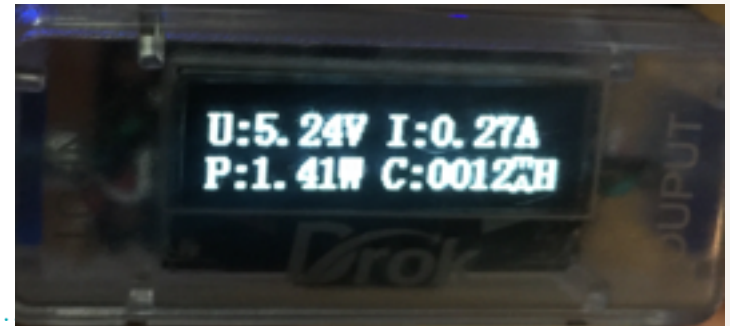
# A taste of IoT with Bluemix



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# Raspberry PI 2

- Linux raspberrypi 4.1.6-v7+
- 1 GB of RAM
- Built-in 10/100 Ethernet
- USB WiFi
- Pretty powerful, runs wireshark over X-windows surprising well
- Low power (1.4 watts while running wireshark)



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# Jumpstarting a Bluemix IoT application...

<https://developer.ibm.com/recipes/tutorials/raspberry-pi-4/>

```
curl -LO https://github.com/ibm-messaging/iot-raspberrypi/releases/download/1.0.2/iot_1.0-1_armhf.deb
```

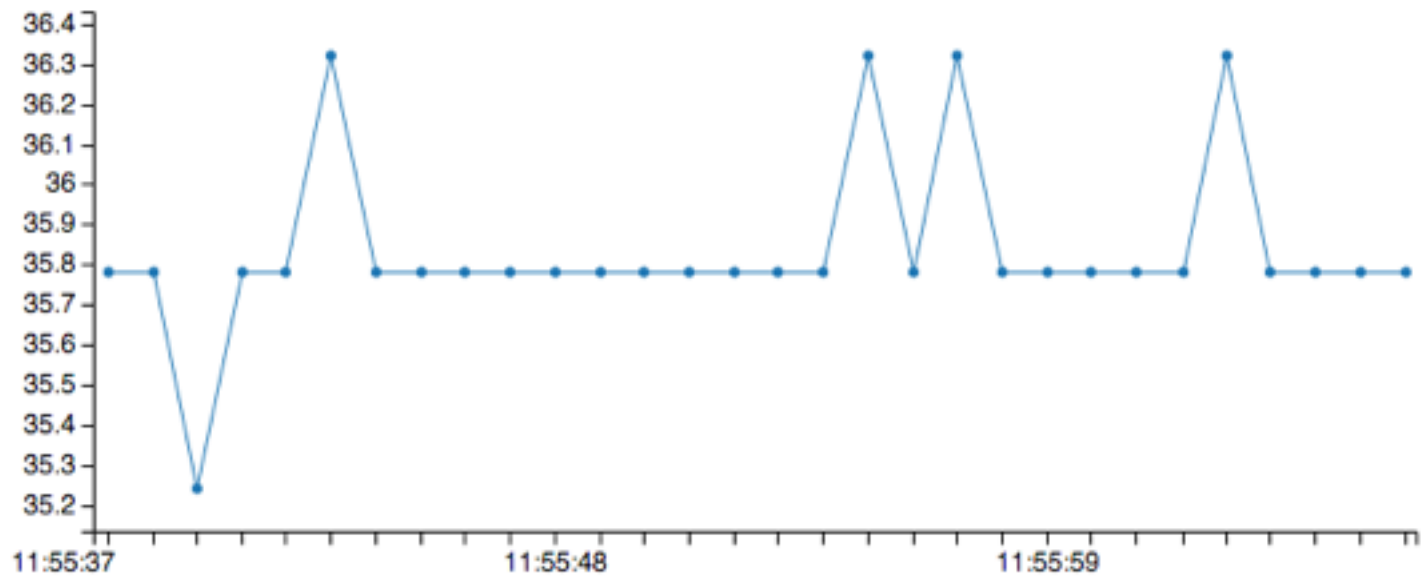
```
sudo dpkg -i iot_1.0-1_armhf.deb
```

```
service iot getdeviceid b827eb4db983
```

<https://quickstart.internetofthings.ibmcloud.com/#/device/b827eb4db983>

myPi

status.cputemp



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# Selecting a Protocol



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# MQTT.org

(MQ Telemetry Transport)

- Light weight (no security included)
- Open Standard
- Library implementations for most languages
- Publish/Subscribe
- Broker based, clients publish to broker, broker is responsible for satisfying subscribe requests
- Can carry any type of data, no support for data typing (e.g., No ASN.1, CORBA, JSON, etc.)
- MQTT relies on TLS/SSL for security (this can be an issue as there's no end-to-end security, due to the "broker" model)
- Requires persistent TCP session per IoT (scale issues)

# MQTT on the wire

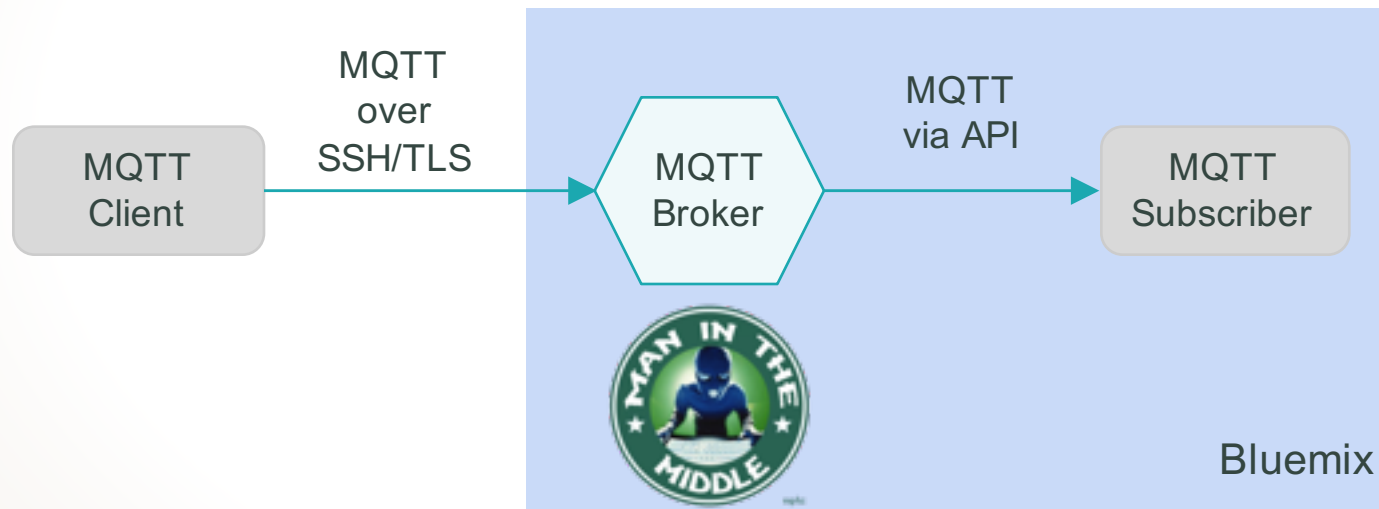
```
.=.MQIsdp...../d:quickstart:iotsample-raspberrypi:b827eb4db983  
...0]..iot-  
2/evt/status/fmt/json{"d":{"myName":"myPi","cputemp":37.93,"cpuload":0.13,"sine":0.38}}0]..iot-  
2/evt/status/fmt/json{"d":{"myName":"myPi","cputemp":36.86,"cpuload":0.13,"sine":0.71}}0]..iot-  
2/evt/status/fmt/json{"d":{"myName":"myPi","cputemp":36.86,"cpuload":0.13,"sine":0.92}}0]..iot-  
2/evt/status/fmt/json{"d":{"myName":"myPi","cputemp":36.86,"cpuload":0.13,"sine":1.00}}0]..iot-2/evt/status/fmt/json{"d"
```



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# MQTT.org

## Security Concerns



# Suggestion for Bluemix IoT

- Native IPv6 support
- Direct support for two-factor authentication (development environment)
- Option for MQTT broker to operate inside of user application space
  - allows control over CA, also can implement bi-directional TLS trust
  - provides for end-to-end TLS
- Additional IoT Foundation that supports protocols other than MQTT
- All recipes implement TLS
- Default broker require TLS by default



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# Moving Forward



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## Explore Technology and Develop a Shared Base of Knowledge

- Protocols
- Development environments (e.g., Bluemix)
- Privacy Policy
- Proof-of-Concept deployments
- Best Common Practices
- Legal...

## Collaborate and Coordinate to Establish Leadership

- Develop community-wide standards
- Engage industry leaders (help them "normalize" their services to better fit our needs)
- Develop IoT workshops
- Establish/Define the governance model for enterprise IoT (e.g., office of IoT)



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Thank you  
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# Campus experience with engaging researchers in the use of IoT Solutions

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Marshal University*

Brian Stengel,

*Information Technology – CSSD, University of Pittsburgh*



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