



• 2015 •
TECHNOLOGY
exchange

OCTOBER 4-7
CLEVELAND OH

**INTERNET OF THINGS (IOT):
INNOVATION WORKING GROUP MEETING**

FLORENCE HUDSON

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INTERNET2

IOT: INNOVATION WORKING GROUP MEETING

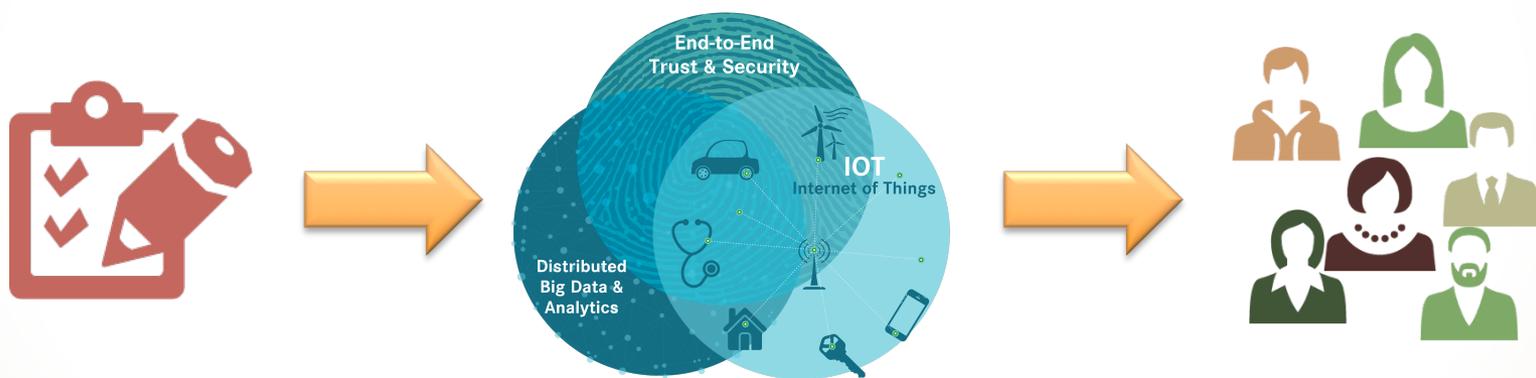
AGENDA

- Welcome and Introductions
 - Review of the Collaborative Innovation Community
- Status of Current Plans & Next Steps
- IBM Bluemix/Indiana University IOT Sandbox Demo
- Other Innovations
- Closing



Collaborative Innovation Program

Established three new Collaborative Innovation Working Groups based on March 2015 Member Survey



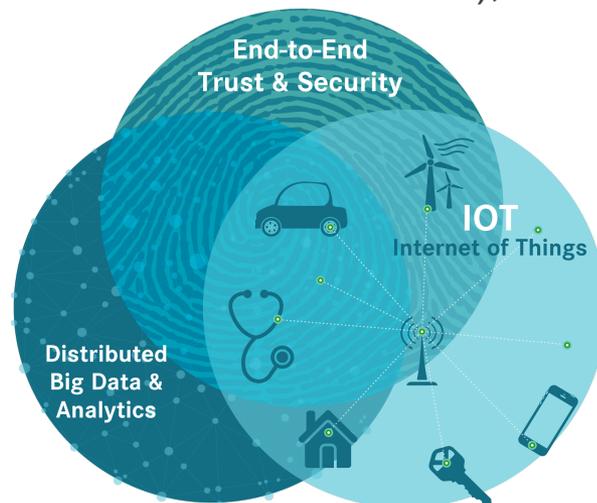
Collaborative Innovation Program Current Focus Areas

E2E Trust & Security:

- End to End Trust and Security for IOT
- TIPS – Trust, Identity, Privacy & Security
- SDP (Software Defined Perimeter), Network Segmentation

Distributed Big Data & Analytics:

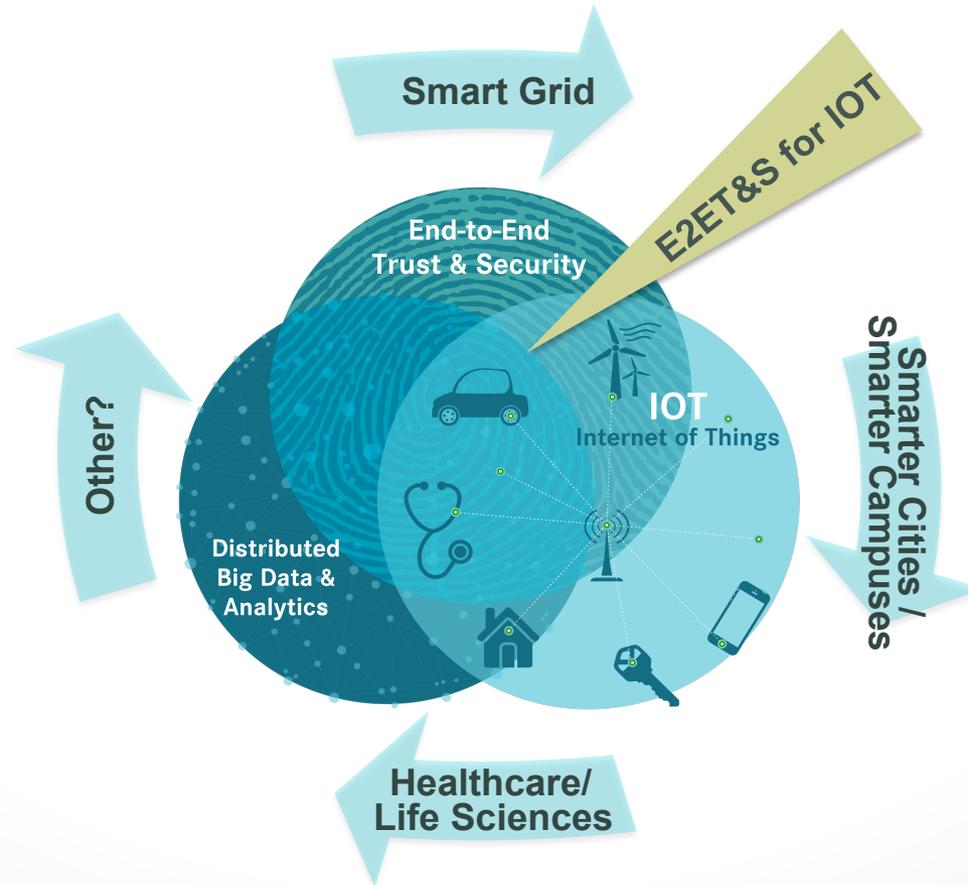
- Genomics
- Smarter Cities / Smarter Campuses
- Digital Humanities



Internet of Things:

- IOT Sandbox
- Smarter Cities / Smarter Campuses
- Smart Grid Testbed

Members Can Participate in Collaboration Opportunities Across the Collaborative Innovation Community Working Groups



Smarter Cities and Healthcare/Life Sciences are beacons of the future economy, and will provide the use cases that bring new applications and technologies to life

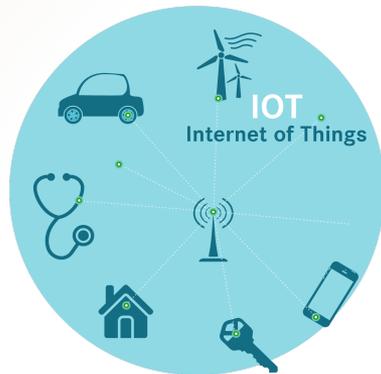
Smarter Cities

- Grid
- Campus



Healthcare/ Life Sciences

Collaborative Innovation Program Working Groups: IOT



Co-Chairs

- Ed Aractingi, Marshall University
- Raj Veeramani, University of Wisconsin-Madison
- Steve Wallace, Indiana University

80+ Members Representing Universities, Industry, Affiliates, Regional & International R&E Networks

Scope:

- *The IOT will incorporate many physical devices, sensors and facilities into a variety of public and private networks. This possibility presents many opportunities and challenges for our members and the world.*



IOT Use Cases and Plans (Page 1 of 2)

- Thank you to our members who submitted – Indiana University, Marshall University, University of Pittsburgh

Initiative/Use Case	Description	Plan
Smarter Cities / Campuses: Smart Grid with E2E IOT Trust & Security Architecture	<p>Use of the Internet2 network to enable research on smart grid communication and collaboration, to extend to smarter cities</p>	<ul style="list-style-type: none"> • Draft whitepaper (available on our Wiki: http://bit.ly/1iJ0N5V) on opportunity to leverage the Internet2 network for Smart Grid R&D with End to End Trust & Security
Building & Wireless Waterways Testbed	<p>Collaboration between the Port of Pittsburgh Commission, University of Pittsburgh, and Internet2 to bring cyberinfrastructure as a service to researchers</p>	<ul style="list-style-type: none"> • Collaborating with NIST, member universities and utilities on how to best leverage the Internet2 network as a Smart Grid testbed
Electric Vehicles		<ul style="list-style-type: none"> • Consider demo using SDN for IOT authentication, configuration, and security
End to End Trust & Security Open Architecture for IOT	<p>Create a point of view and recommended next steps to develop a comprehensive End to End Trust & Security Open Architecture for the Internet of Things</p>	<ul style="list-style-type: none"> • Develop proposal for a workshop in 1H16 in cooperation with NSF, NIST, IEEE, DHS, OSTP, and IIC



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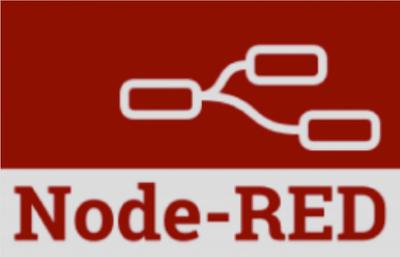
IOT Use Cases and Plans (Page 2 of 2)

Initiative/Use Case	Description	Plan
IOT Sandbox and IOT Stack	Determine the components of IT infrastructure for IOT enablement and create a sandbox environment for university researchers to test and pilot	<ul style="list-style-type: none">• Develop IOT Sandbox technical model and business model for IOT collaborative development, with IBM and extend to others• Demo and Pilot Deployment (4Q15)
Power Over Ethernet	Provide overview and practical examples of Power Over Ethernet and how it relates to IOT, including PoE devices, capabilities, campus facilities that can be part of PoE, and funding sources	<ul style="list-style-type: none">• Develop whitepaper (4Q15)
Internet of Medical Things	How to best leverage – securely – IOT for medical devices	<ul style="list-style-type: none">• Develop plan for Healthcare / Life Sciences including Internet of Medical Things (2H15)



Enterprise IoT

tinyurl.com/bluemix-demo
(ssw@iu.edu)

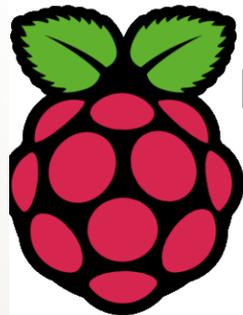


Node-RED

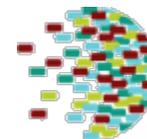
IBM Bluemix



MQTT.ORG



RaspberryPi 2



GlobalNOC
Global Research Network Operations Center



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Enterprise IoT Principles



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Islands or Webs? IoTs 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 sytem.
- 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.

IoTs should be lonely



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

- IoTs are either secret agents infesting your enterprise, or trusted soldiers allied to your mission.
- To keep IoTs lonely, secure (e.g. patches applied, etc.), and compliant (e.g., conforms to university privacy policies), require a consistent architecture, implementation, and operations.
- Deploying IoTs 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”?



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.



A taste of IoT with Bluemix

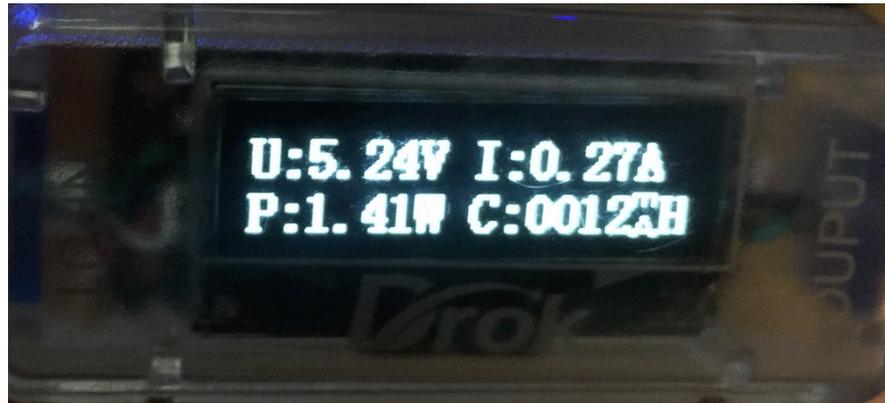


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Raspberry PI 2

- 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)





Jumpstarting a Bluemix IoT application...

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

```
Curl 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>

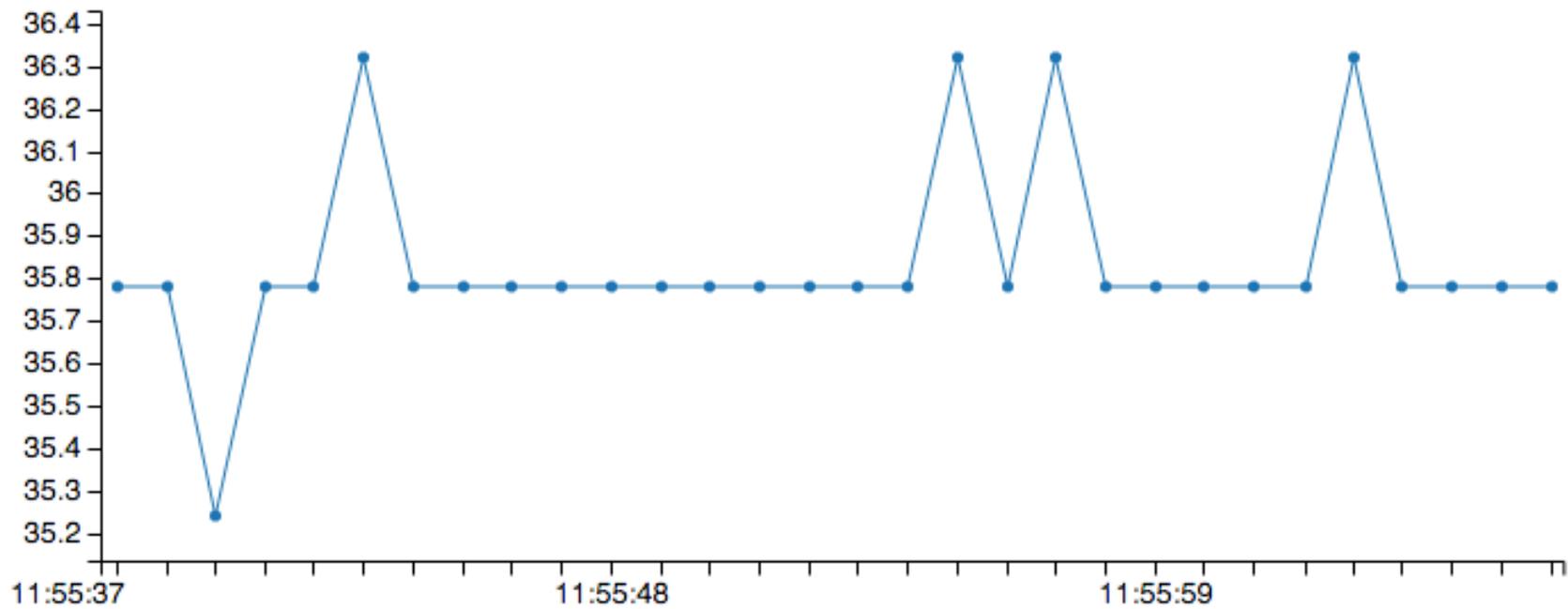


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myPi

status.cputemp





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)

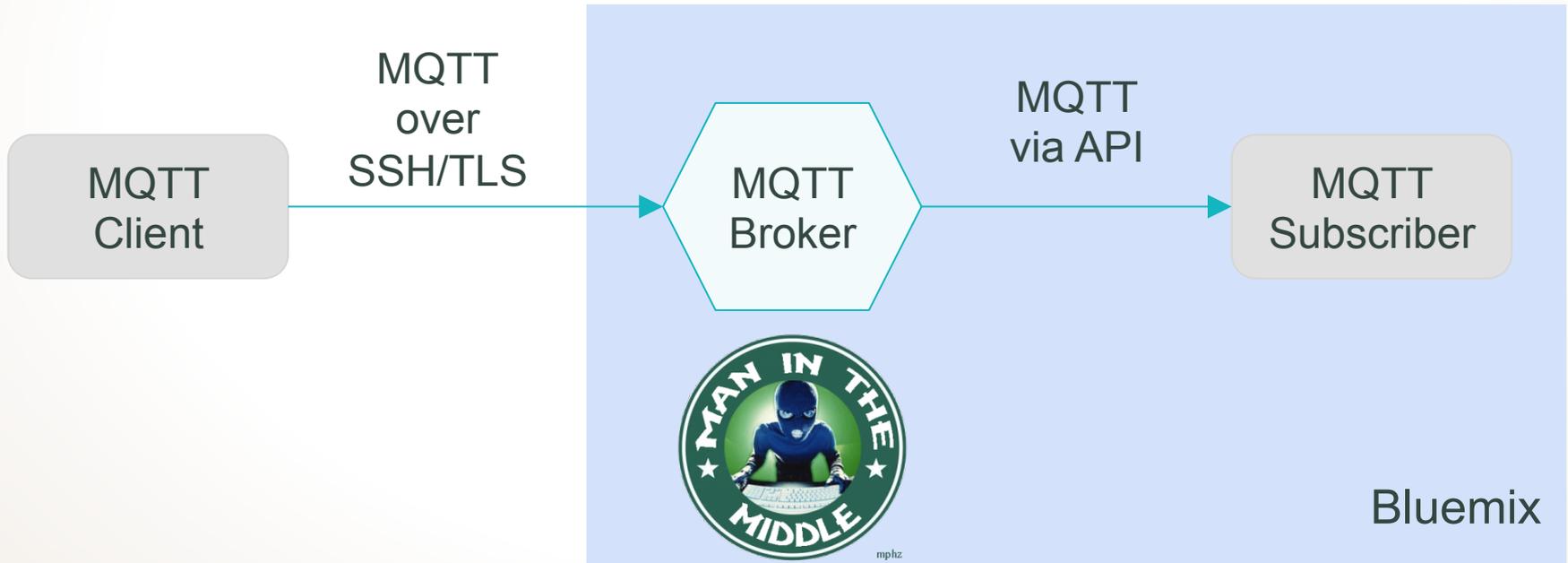


MQTT on the wire

```
.=..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"
```



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



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)



Thank you
ssw@iu.edu



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Brainstorm Other IOT Innovations

- What's missing?



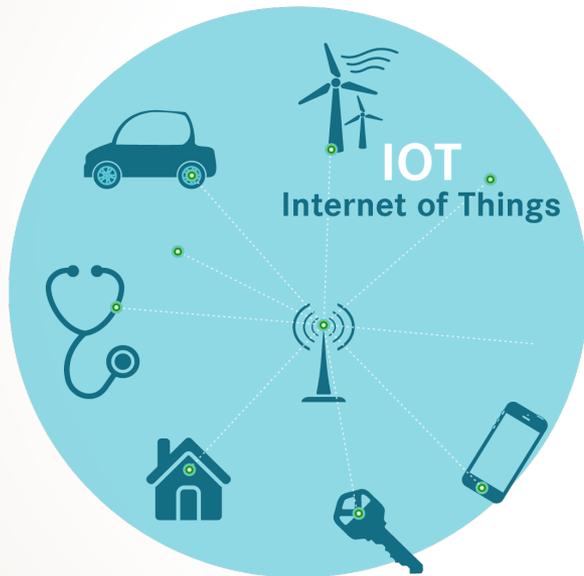
One last thing...

Building and Testing IOT Solutions BoF
Tomorrow, 2:00PM-3:30PM
Room 13

- This BoF will include in depth demos from both IBM and Microsoft, and feature how your colleagues are using the technologies



Closing: How You Can Get Involved



- **Have your campus be on the leading edge, participate in our new Smarter Campus focus group**
 - Email CINO@Internet2.edu
- **Provide feedback on the Smart Grid white paper**
 - <http://bit.ly/1iJ0N5V>
 - Email CINO@Internet2.edu
- **Want to play and test leading edge IOT technology platforms? Be a part of the IOT Sandbox**
 - Email CINO@Internet2.edu
- **Interested in participating in the E2E Trust and Security Open Architecture for IOT workshop?**
 - Let us know! Email CINO@Internet2.edu
- **Join the IOT Working Group**
 - Email CINO@Internet2.edu
- **Check out our Wiki for more detailed IOT information:**
 - <http://bit.ly/1KFAwir>

Collaborative Innovation Program



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