



Internet of Things

Internet2 CINO Initiative Working Group Meeting #2

July 7, 2015

Chairs:

Ed Aractingi, Marshall U.

Raj Veeramani, U Wisconsin-Madison

Steve Wallace, Indiana U.



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Introduction and Meeting Objectives

- Comments on initiative objectives and status
- Discussion of eight candidate use cases and projects
- Possible funding sources – government and corporate
 - Why is Internet2 the right organization for this work?
- Formation of sub-groups to develop approaches to selected use cases/projects
- Next steps and major milestones

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Eight Candidate Use Cases and Projects



- Power over Ethernet – Steve Wallace (IU)
- University Electric Vehicle Project – Brian Stengel (Pitt)
- Wireless Waterways IOT Testbed -- Brian Stengel (Pitt)
- Large Campus Building IOT Testbed -- Brian Stengel (Pitt)
- IoT Stack -- Brian Stengel (Pitt)
- Internet2 and the Smart Grid – Bob Brammer (Internet2)
- Internet of Medical Things – Florence Hudson (Internet2)
- Open End to End IOT Security Architecture – Florence Hudson (Internet2)



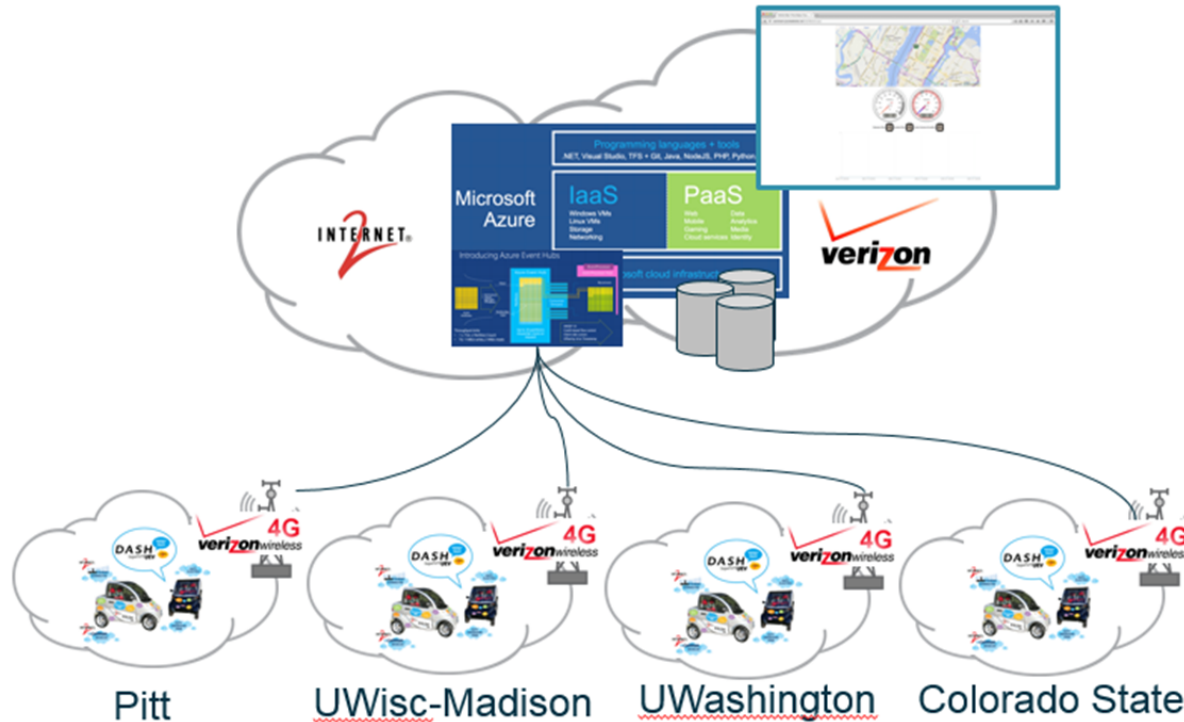


Power over Ethernet

- Power over ethernet (PoE) is a key enabler of many IOT applications
- The goal of this project is to produce a white paper that provides campuses with insights into the drivers and implications of PoE, including:
 - Survey selected examples of campus uses of PoE (e.g., data center operations, video networks for campus safety)
 - Survey of emerging PoE devices (e.g, lighting, sensor platforms, displays, etc.)
 - Description of current PoE capabilities and what is on the horizon
 - Discussion of PoE implications for network design, including edge devices (e.g., switches), power and HVAC requirements, etc.
 - Identify typical campus units that should be included in the PoE planning process (physical plant services, architectes, safety, etc.)
 - Examples of possbile project funding sources



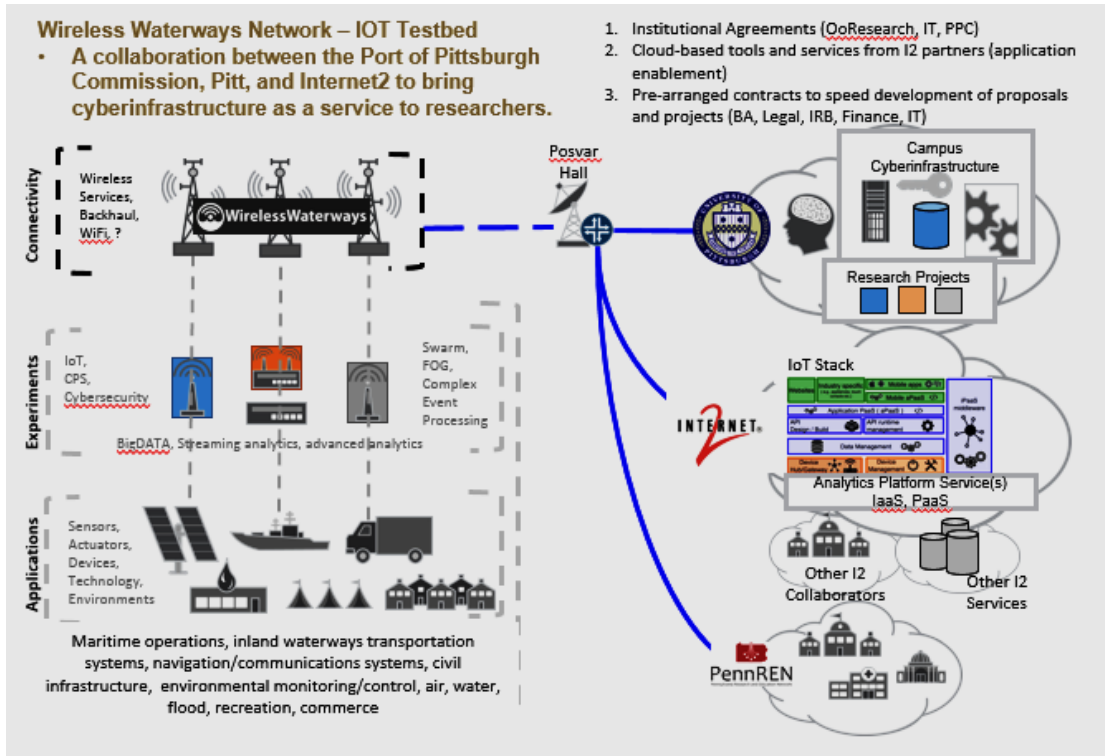
Internet2 of Things University Electric Vehicle Project



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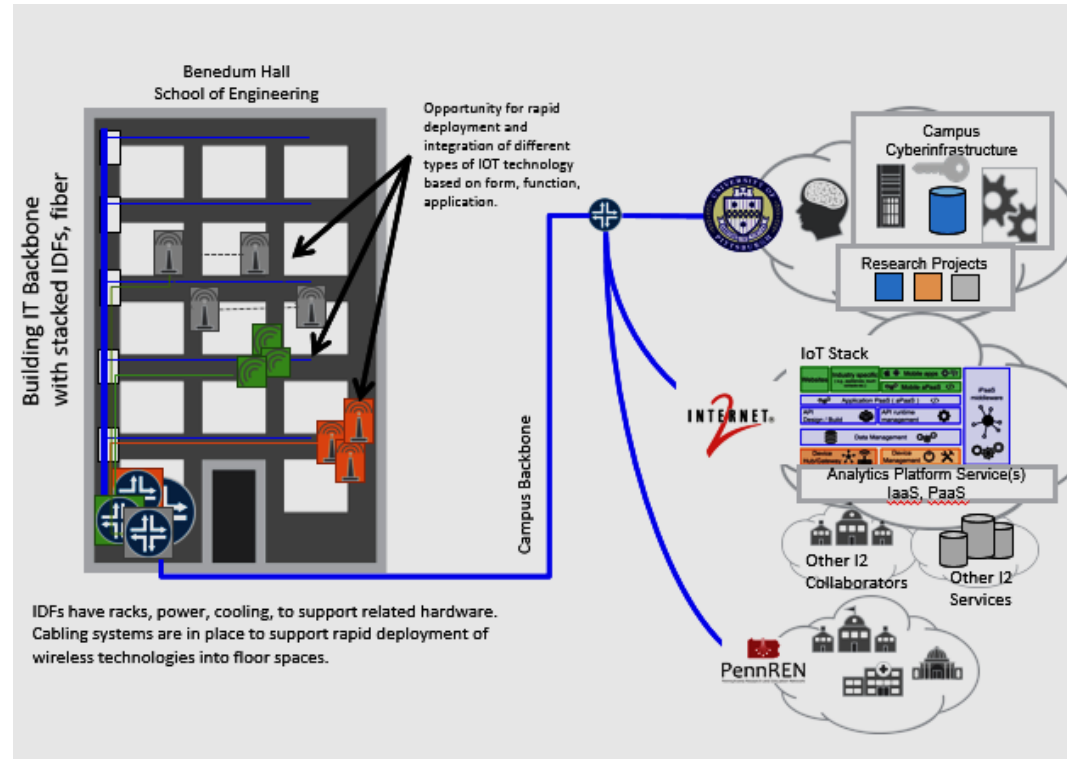
Wireless Waterways Network – IOT Testbed





Benedum Hall IOT Test Bed – Large, campus building

The first three floors are a microcosm of campus life (classrooms, labs, library, retail, student, staff, etc.)



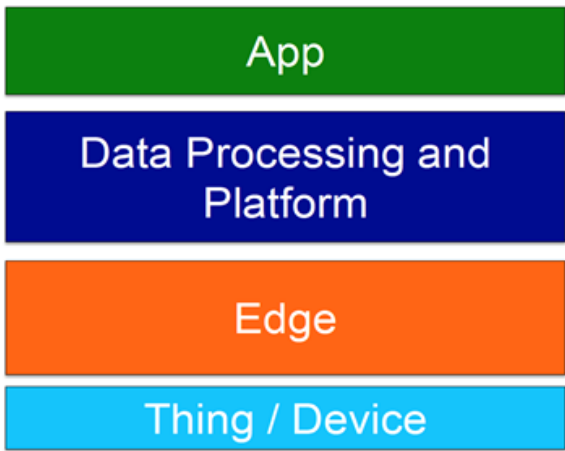
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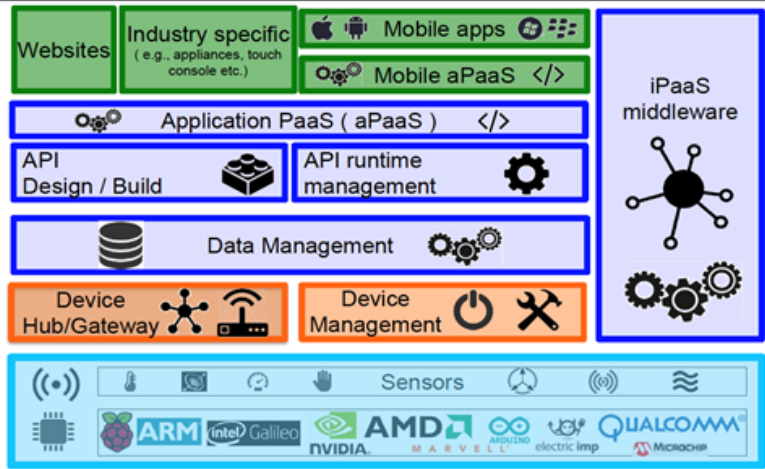
IOT Stack



At a high level this is the general IoT stack



IoT Stack



Architectural Patterns in an IOT Stack
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 (Source: Sharma 2014 MuleSoft Inc.)



Internet2 and the Smart Grid

- Many large research campuses have already begun to build smart grids under DOE/NREL sponsorship
 - http://www.nrel.gov/tech_deployment/climate_neutral/smart_grid.html
- Some Internet2 corporate members are developing technology to address the large communication requirements for Smart Grid management and operation
 - E.g., Ciena, Cisco
- Can we create a proposal for the use of the Internet2 network to enable research on regional smart grid communication and collaboration?



ciena

A SMARTER COMMUNICATIONS NETWORK FOR THE SMART GRID

Driving smart grid transformation with Ethernet-based packet-optical networks

Introduction
As electric utilities evolve to the smart grid, they need a comparable evolution of the underlying communications network. A flexible and future-proof network is critical for meeting a utility's business goals and ensuring that smart grid applications perform securely and reliably. However, most utility networks today are not up to the challenge, and some next-generation network solutions can be very costly and cumbersome when deployed on a large scale.

The smart grid requires an advanced network that:

- Supplies critical voice and data services for grid operations and management
- Meets increased requirements for performance, scalability
- Enhances the flexibility, reliability, security, and efficiency of all smart grid elements
- Enables monitoring, automation, and optimization of grid operations

Today's utility networks, based on SONET/SDH technology, are difficult and expensive to maintain, and cannot support the long-term needs of a smart grid. Additionally, many utilities will need to replace multiple, special-purpose legacy networks that were created to support legacy devices and specific IT and operations requirements.

Continuing to meet these legacy networks is not viable for the smart grid transition. Instead, utilities should look at options for a next-generation communications network that fully realize the benefits.

Cisco Smart Grid
Solutions for the Next-Generation Energy Network

What is Cisco Smart Grid?
Cisco Smart Grid is a holistic, cross-technology solution that enables utilities and other organizations in the energy industry to build secure, standards-based IP networks to efficiently meet the demands of energy generation, distribution, storage, and consumption. Cisco Smart Grid is a combination of products, technologies, services, and ecosystem partners that optimize communications, improve resilience, and reduce the operational cost and complexity of the energy grid.

The Energy Landscape Today
Most of the nation's electricity systems were built when primary energy was relatively inexpensive. Grid reliability was mainly assured by having excess capacity in the system with inflexible electricity flow to consumers from centrally dispatched, coal-fired power plants. Investments in the electric system were made to meet

Increasing demand—not to change fundamentally the way the system works. The lack of innovation, along with increased demand and green initiatives that are promoting the need for technology modernization has resulted in:

- Inefficiency in the energy system
- Complex integration of alternate, distributed power sources
- No common management, visibility, and coordinated control
- Lack of reliability and resilience

With the trend of rising energy consumption and higher costs, utilities must be able to incorporate changing systems to manage supply and demand. They need to be agile enough to replace alternate forms of energy generation such as wind and solar power and integrate these sources into their framework. Finally, they need to make sure that their

Infrastructure is reliable, resilient, and secure to reduce the risk of costly outages and breakdowns.

Cisco Smart Grid Solution: Framework and Components
The Cisco strategy for enabling the transformation is to provide an end-to-end, secure communications fabric to help utility companies optimize power supply and demand. To effectively deliver this vision, the Cisco Smart Grid solution is built on a framework that covers the different aspects of the energy system.

Energy Transmission and Distribution Infrastructure and the Communication Network
We start with the physical and logical components that interconnect the grid to enable the common communications fabric. Shared data sources are required to make the smart grid effective, and this leads to data down to the individual electrical meter at a residential home. This information needs to be accessible and secure and communicated across the fabric. From a product and technology standpoint, this is delivered by ruggedized Integrated Services Routers, hardened Catalyst switches, and integrated security and software services that are used across the primary places in the network utility framework:

- Substation automation/Integration (SA/I)
- Neighborhood area network (NAN)
- Business area network (BAN)
- Home area network (HAN)

Computing Platform
Data centers play an important role in sharing and engineering the appropriate information across the fabric. Cisco's use of the art, standards-based data center portfolio provides the underlying computing platform and infrastructure to enable sophisticated data collection, techniques and storage solutions for power grid data analysis and optimization.



Internet of Medical Things



- The Internet2 community has a long history of research in uses of advanced networking for medical applications
 - Many research demonstrations of our network for teleradiology, telesurgery, telepathology, etc.
- However, there are still many factors limiting scalable applications for widespread use
 - Need to mitigate risks in TIPS – Trust, Identity, Privacy, and Security
 - In particular, risks associated with devices and cloud services
 - Need to improve energy efficiency for sensors, networking, IT operations, etc.
 - Need to address “standards wars” in order to increase interoperability and reduce costs
- Are there use cases and pilot projects in your institutions that we should consider as part of our IOT Working Group activities?

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Open End to End IOT Security Architecture

- Some of our members (e.g., Stanford, Berkeley, Michigan, NIST, Cisco) have current projects to address IOT security
- Our members need a flexible architecture that can be adapted to a broad range of applications (e.g., all preceding use cases)
- Can we build on previous work, including our other CINO Working Groups to create an effective architecture?

Stanford Secure Internet of Things Project

Stanford, Berkeley, Michigan

NIST

Cybersecurity Framework



Securing the Internet of Things: A Proposed Framework



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Next Steps



Call to Action for IOT Working Group

Send a note to the IOT Working Group leadership team iotchairs@internet2.edu with your interests in working to develop concepts in one or more of these candidate use cases

- Need to create subgroup teams
- Need to develop specific project definitions and approaches
- Need to identify required resources and potential funding sources

Monthly team meeting – next one late July

Joint Collaborative Innovation Community call with all 3 working groups bi-monthly

Preparation for TechEx meeting in October



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Thank You

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A small lightbulb at the bottom right corner, filled with a variety of colorful icons representing different fields of study and technology.