


Connected Buildings Interoperability Vision Webinar



Kevin Lynn
U.S. Department of Energy
20 May 2015

U.S. DEPARTMENT OF ENERGY

DOE: EERE…

The Office of Energy Efficiency and Renewable Energy’s mission is to:

- **Enhance energy efficiency** and productivity;
- **Bring clean, reliable and affordable energy technologies** to the marketplace; and
- **Make a difference in the everyday lives** of Americans by enhancing their energy choices and their quality of life.

EERE spent $16.8 billion in ARRA funds to stimulate jobs and help create a clean-energy economy in the US.

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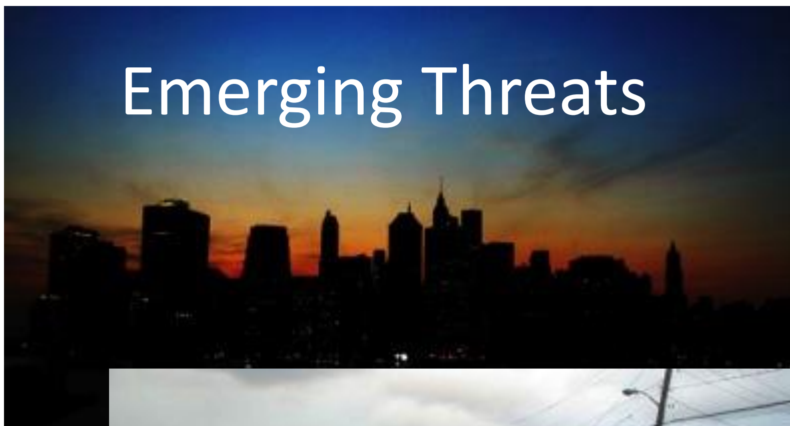
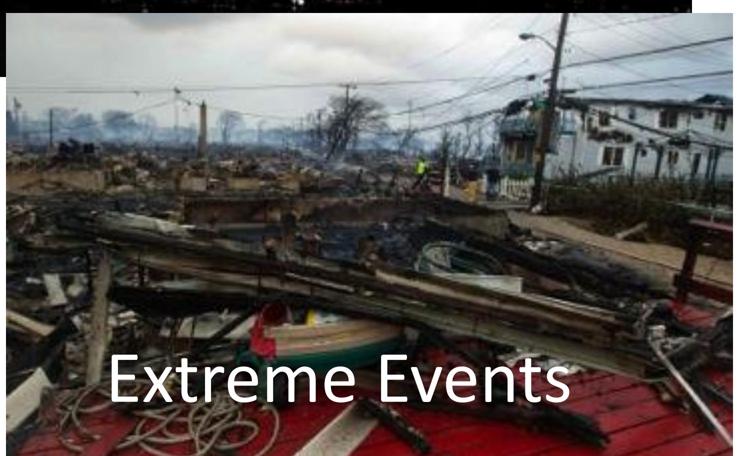
Why Grid Modernization Initiative

The existing U.S. power system has served us well…

but our 21st Century economy needs a 21st Century grid.





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Grid Modernization Vision

*The future grid provides a critical platform for U.S. prosperity, competitiveness, and innovation in a global clean energy economy. It must deliver **reliable, affordable,** and **clean electricity** to consumers where they want it, when they want it, how they want it.*

Enhance the Security of the Nation

- Extreme weather
- Cyber threats
- Physical attacks
- Natural disasters
- Fuel and supply diversity
- Aging infrastructure

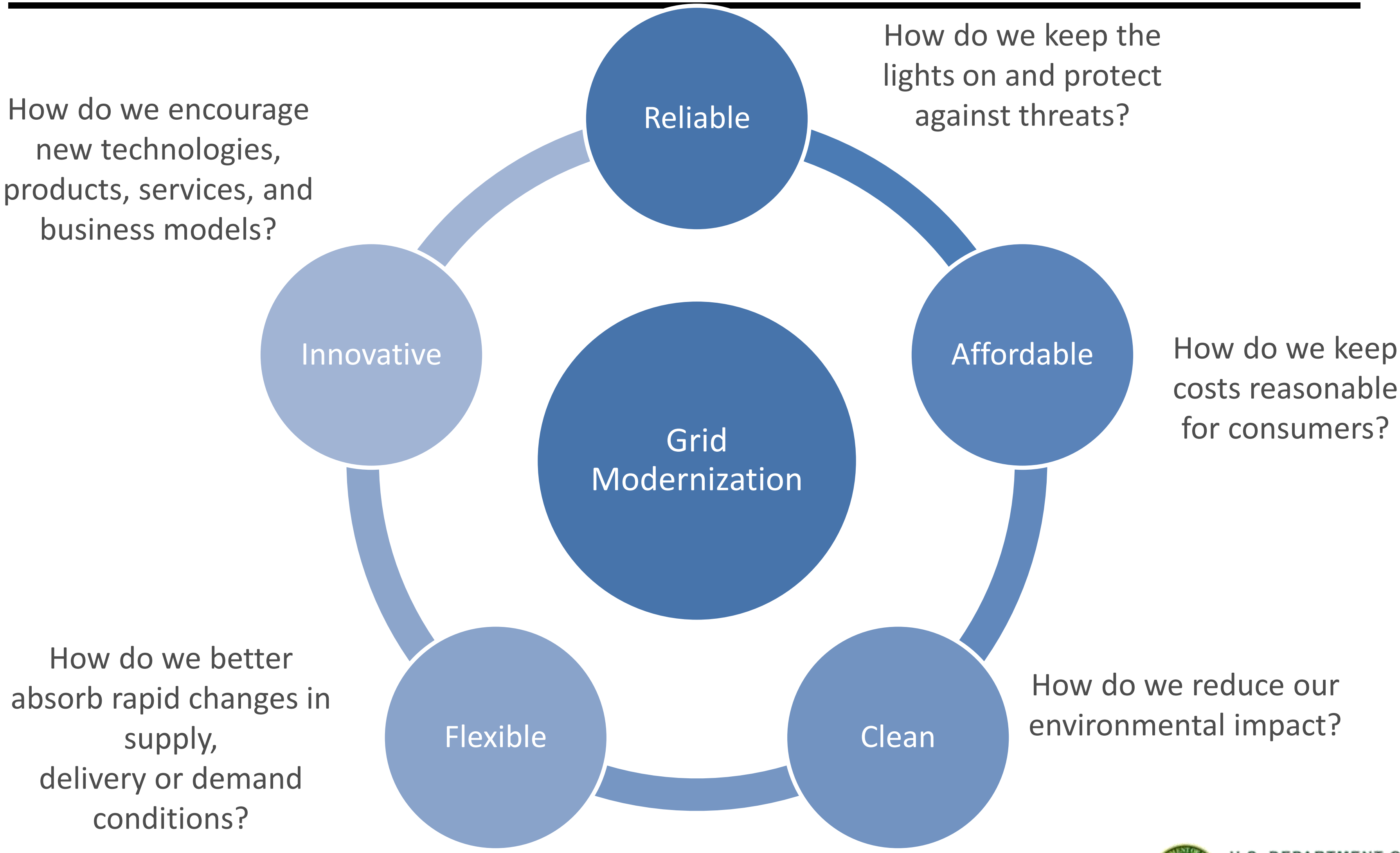
Sustain Economic Growth and Innovation

- New energy products and services
- Efficient markets
- Reduce barriers for new technologies
- Clean energy jobs

Achieve Public Policy Objectives

- 80% clean electricity by 2035
- State RPS and EEPS mandates
- Access to reliable, affordable electricity
- Climate adaptation and resilience

Key Attributes of a Modernized Grid



Goals and Outcomes

- This new crosscutting effort will build on past successes and current activities to help the nation achieve at least three key outcomes within the next ten years:
  - **A 10% reduction in the economic costs of power outages by 2025**
  - **A 33% decrease in cost of reserve margins while maintaining reliability by 2025**
  - **A 50% decrease in the net integration costs of distributed energy resources by 2025.**
- If achieved, these three key outcomes would yield more than $7 billion in annual benefit to the U.S. economy
- In addition, our efforts will ensure the future modernized grid is a flexible platform for innovation by entrepreneurs and others who can develop tools and services to empower consumers and help them make informed energy decisions.

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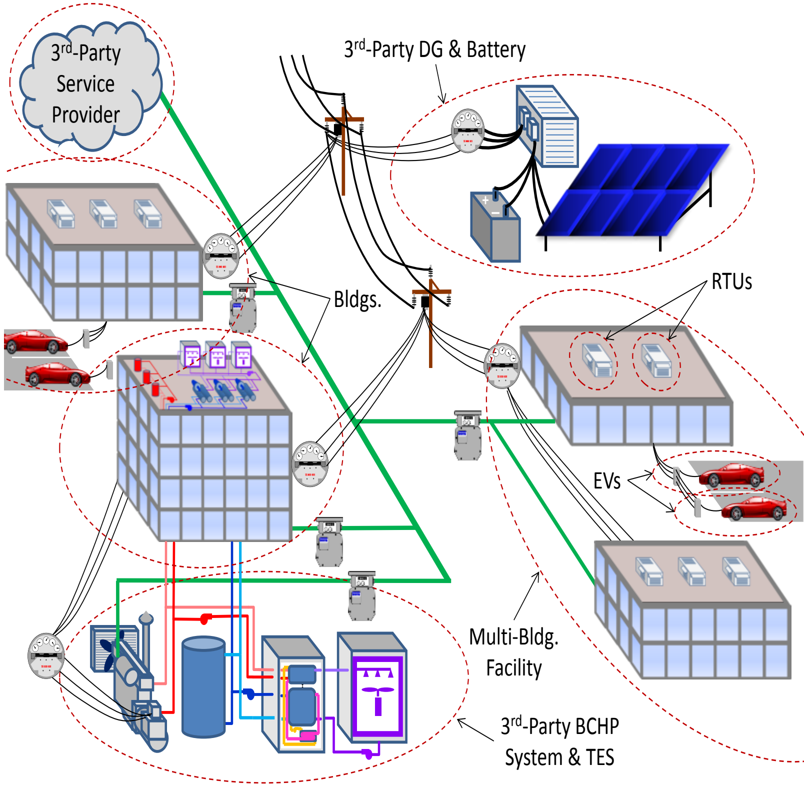
Six Activity Areas

Sensing and Measurements	• Visualization tools that enable complete visibility of generation, loads and grid dynamics across the electric system
Devices and Integrated Systems	• Establish common test procedures and inter-operability standards for devices that can provide valuable grid services alone and/or in combination
System Operations and Power Flow	• Develop advanced real-time control technologies to enhance the reliability and asset utilization of T&D systems
Design and Planning Tools	• Create grid planning tools that integrate transmission and distribution and system dynamics over a variety of time and spatial scales
Security and Resilience	• Develop advanced security (cyber and physical) solutions and real-time incident response capabilities for emerging technologies and systems
Institutional Support	• Provide tools and data that enable more informed decisions and reduce risks on key issues that influence the future of the electric grid/power sector

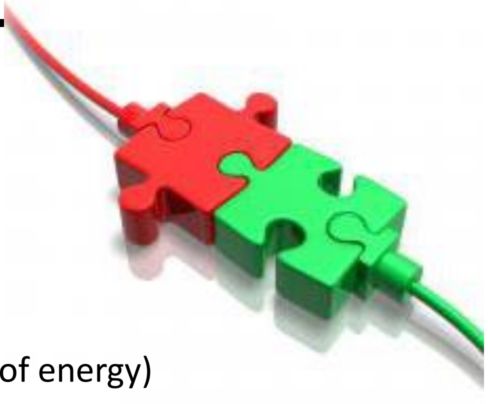
The Connected Building

- Negotiates and transacts energy services across the meter
- Integrates and coordinates connected equipment* (load/generator/storage) for energy efficiency and financial benefits
- Supports the scalable integration of clean and efficient technologies such as PV and EV chargers
- Provides awareness, visibility, and control to serve the preferences of its managers, operators, and occupants



* Connected equipment knows how it is performing, how it could perform, and is capable of communicating that to others.

Why We Need Connected Buildings



- Today's stock of buildings are noticeably "un-connected"
  - Limited by existing control and coordination technology
  - Advanced automation deployments constrained to large buildings due to automation equipment, installation, and maintenance costs
  - Value streams are often hidden and untapped (e.g., time dependent value of energy)
- Large-scale deployment of clean energy technologies requires advanced approaches to building equipment integration and electric grid coordination
- Improved integration approaches for deploying technology can enable new services
  - Examples include advanced power electronics, operations diagnostics, grid-responsive building technologies, vehicle charging coordination
- Greater energy and business efficiencies can be mined through co-optimization approaches that reach across the meter
  - Allow intelligent trade-offs between comfort/quality of service and consumption

Interoperability is essential for buildings information exchange (within buildings and with external parties)

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Connected Buildings Interoperability Vision Webinar



Steve Widergren
PNNL
20 May 2015

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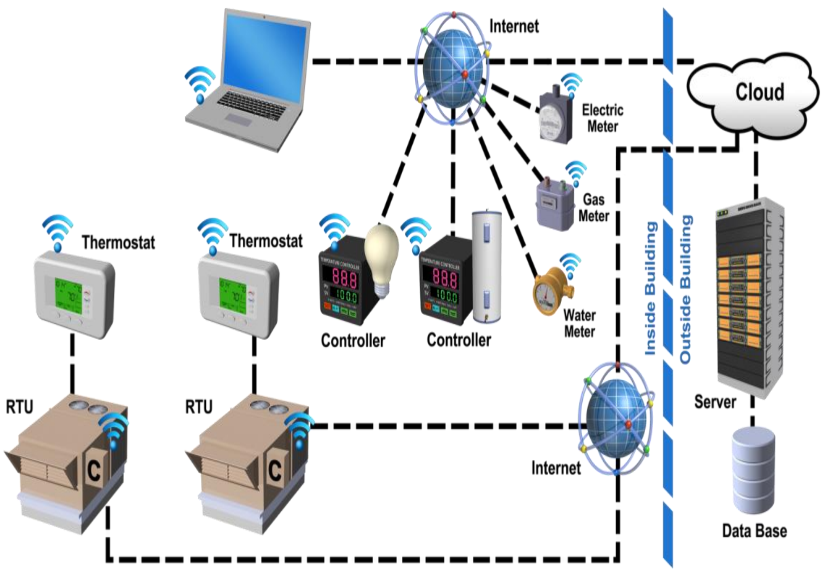
Webinar Subjects

- Context for connected buildings interoperability activities
  - Why interoperability is important to advance energy efficiency and EERE technology integration
  - Connected buildings interoperability landscape - our point of departure
- A National Strategy for Buildings Interoperability
  - Project strategy - our line of attack
  - Steps for aligning the buildings automation community on interoperability
- Connected buildings interoperability vision technical meeting
  - A summary of 10-11 March meeting with industry experts

Sample Scenarios:
Diagnostic and Automated Commissioning Services

Approach

- Customer signs up with service provider (SP)
- Data streams sent from building management system (BMS) to SP
- Diagnostic/commissioning information delivered by SP to customer electronically
- Customer pays for services provided or optionally problems identified/fixed



Technology requirements

- Web applications
- Map data streams to diagnostic procedures

Expected outcomes

- Energy and operating cost savings
- Efficient buildings

From "Transaction-Based Building Controls Framework, Volume 1: Reference Guide"
http://energy.gov/eere/buildings/downloads/technical-meeting-buildings-interoperability-vision

Sample Scenario
Tenant Contracts with Building Owner for Energy

Approach

- Owner allocates tenants / divisions allowance on energy bill
- Tenants receive penalties if exceed allowance
- Owner broadcasts dynamic rate to BMS
- Markets used for tenants to buy surplus allowance from others

Technology requirements

- Wide-area network (WAN) & local-area network (LAN)
- BMS / EMS
- Tenant-level sub-metering or non-intrusive load monitoring

Expected outcomes

- Cost savings for tenants / building owners
- Smart buildings

From "Transaction-Based Building Controls Framework, Volume 1: Reference Guide"

*Inter*operability – Integration at Arm's Length

What do we mean by interoperability?

- Exchange of actionable information
  - between two or more systems
  - across component or organizational boundaries
- Shared meaning of the exchanged information
- Agreed expectation, with consequences, for the response to the information exchange
- Requisite quality of service in information exchange
  - reliability, fidelity, security

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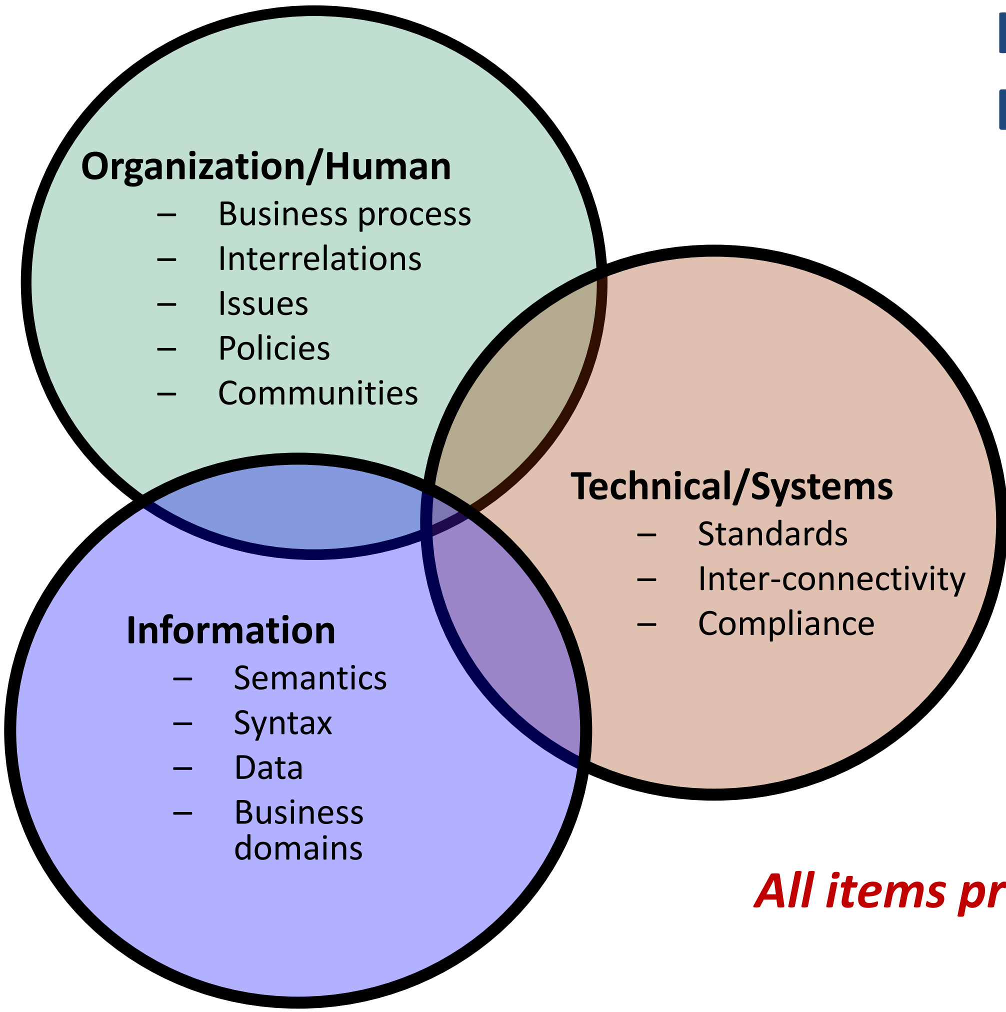
Interoperability Benefits

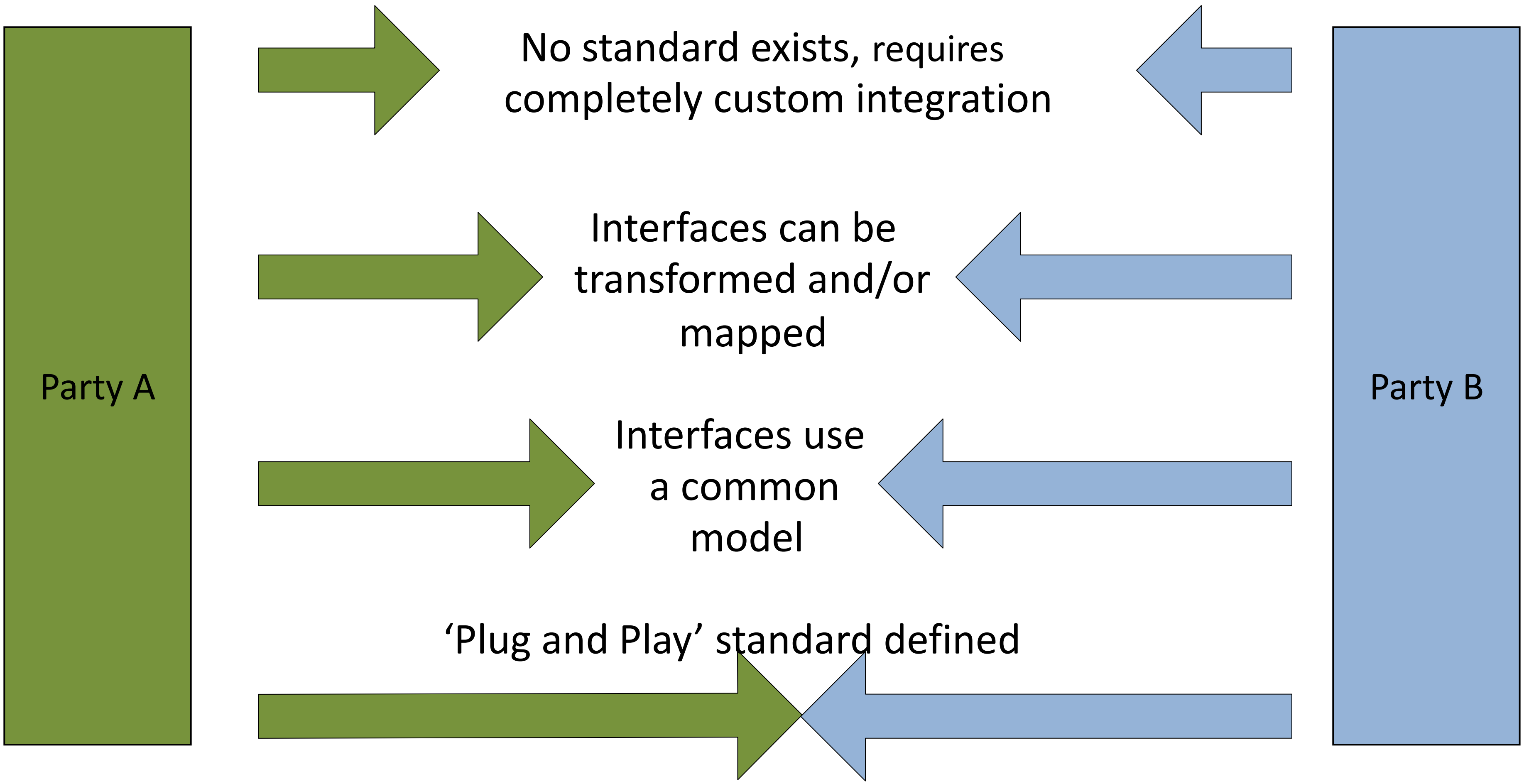


Interoperability - Expected Impact:

- **Reduces integration cost**
- **Reduces cost to operate**
- **Reduces capital IT cost**
- **Reduces installation cost**
- **Reduces upgrade cost**
- **Better security management**
- **More choice in products**
- **More price points & features**

All items provide compounding benefits

Reducing Distance to Integrate



Credit: Scott Neumann, UISol GWAC position paper

Interoperability

Market Ecosystem

Acquire interoperable products and supporting services

Testing and Certification

Trust interoperability before going to market

Interoperable Interfaces

Simple to install, update, and manage products

- Discover building automation products, their services, and how to interact with them
- Access the physical and energy characteristics and behaviors of connected equipment and systems
- Discover and interact with other buildings, energy markets, 3rd party service providers, and distribution system operators

Importance of Ecosystems

- General customer needs
  - Cost vs benefits
  - Security and privacy
  - Ease of installation and commissioning
  - Ease of use
  - Ease of ongoing support
- General provider needs
  - Cost vs benefits
  - Security and privacy
  - Customization and flexibility
  - Adaption to customer capabilities
  - Market growth
  - Ease of installation, commissioning and support
  - Open technology standards

Ecosystem Example Contributors

debian

Java

ANSI
American National Standards Institute

python

Google

android

REST API

open source hardware

RDF

W3C®

MySQL

Apache

UNIFIED MODELING LANGUAGE

hadoop

I E T F®

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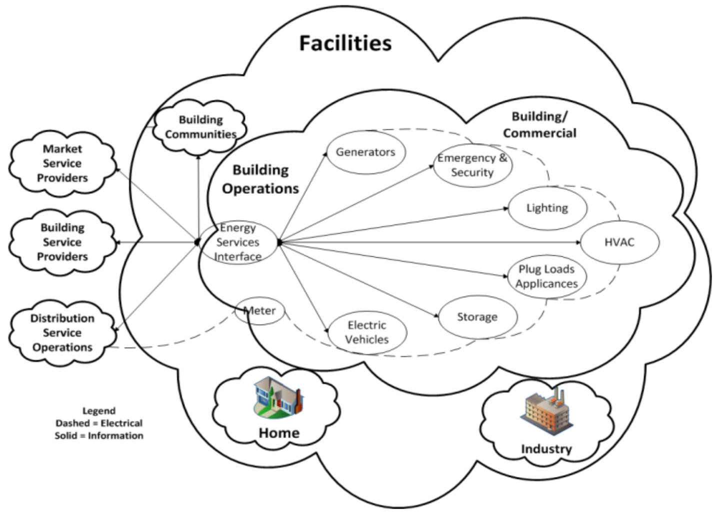
Buildings Interop Landscape

A point of departure to describe today's situation as we look to the future

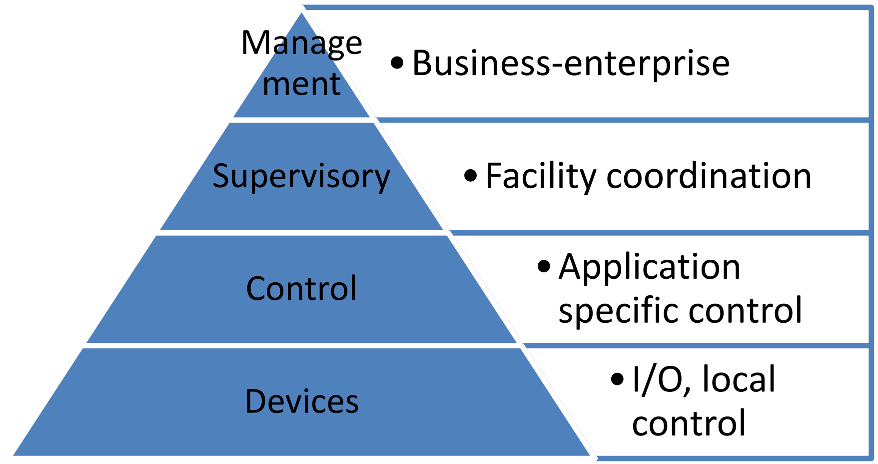
- **Buildings interoperability framework**: Provide organizational structure by adopting and adapting existing interoperability architecture material to buildings
- Use the framework to present and relate the following
  - **Classes of use cases:** presents previously identified use cases for interoperability purposes with the help of the framework
  - **Relevant standards:** presents the relevant standards used in buildings connectivity deployments using the framework
  - **Taxonomy of stakeholders:** presents classes of stakeholders involved in buildings connectivity using the framework including **significant organizations** for involvement
- **Interop goals**: articulate attributes to evaluate for interoperability
- **Challenges and gaps:** describe interoperability issues derived from stakeholder engagement using the context of standards & interop goals
- **Emerging interoperability standards**: potential to align buildings with mainstream directions of ICT

* http://energy.gov/eere/buildings/downloads/buildings-interoperability-landscape-draft

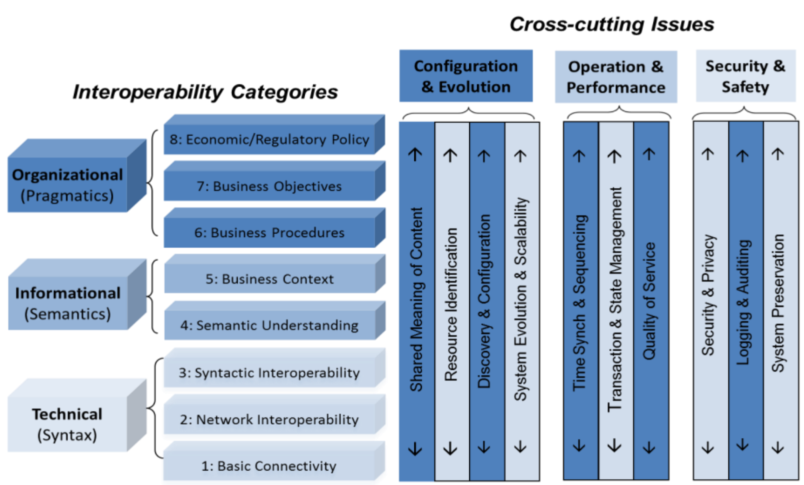
Inspirations for a Buildings Interop Framework



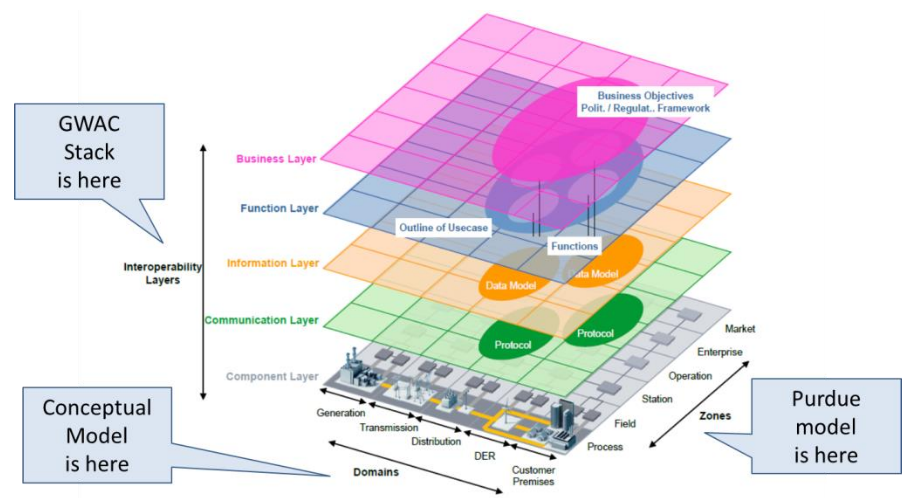
Derived from the SGIP conceptual model for the customer domain



ASHRAE automation model, from Purdue Enterprise ref model



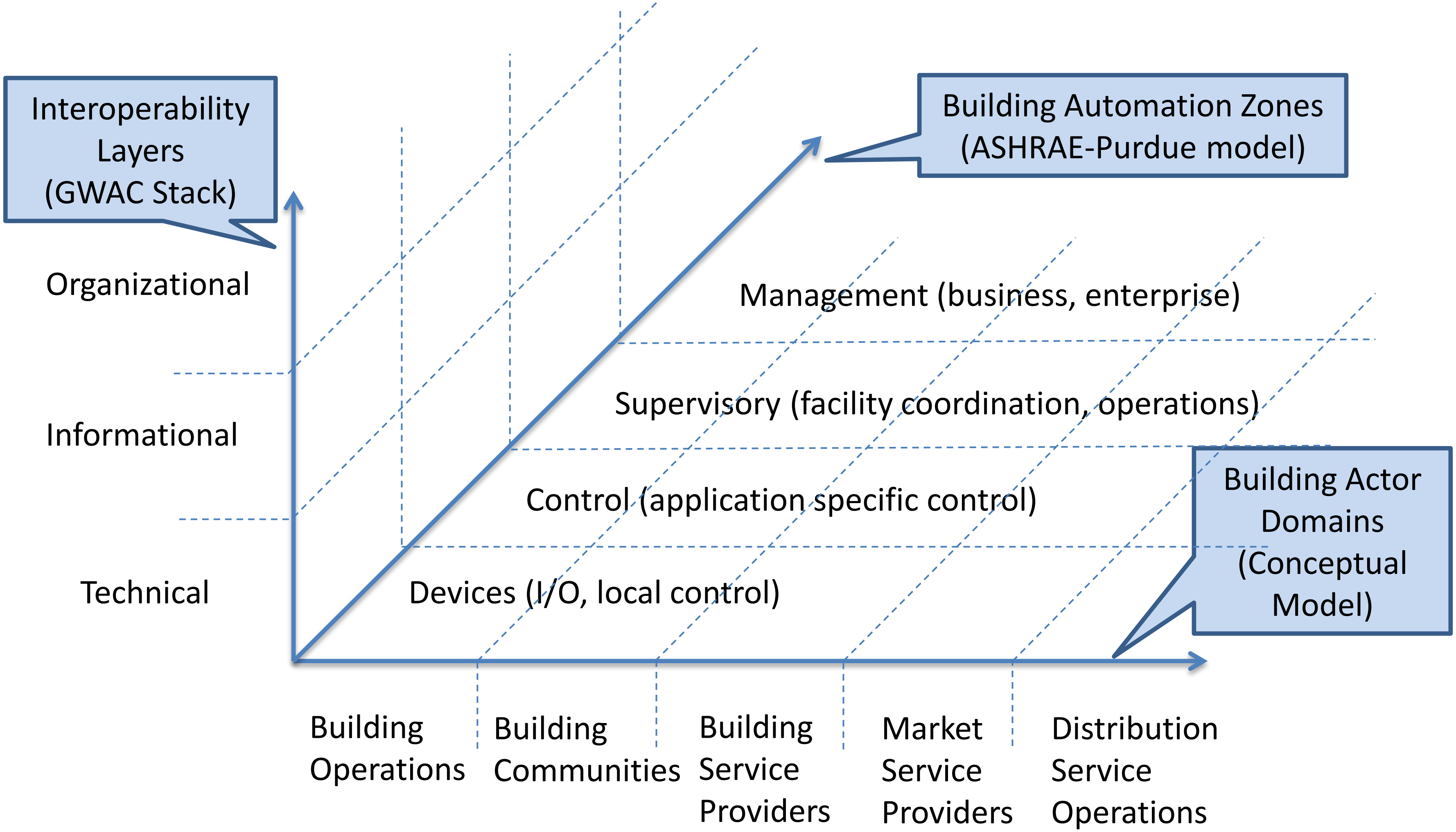
GWAC interoperability context-setting framework



EU-SGAM (smart grid architecture model) combines 3 previous models

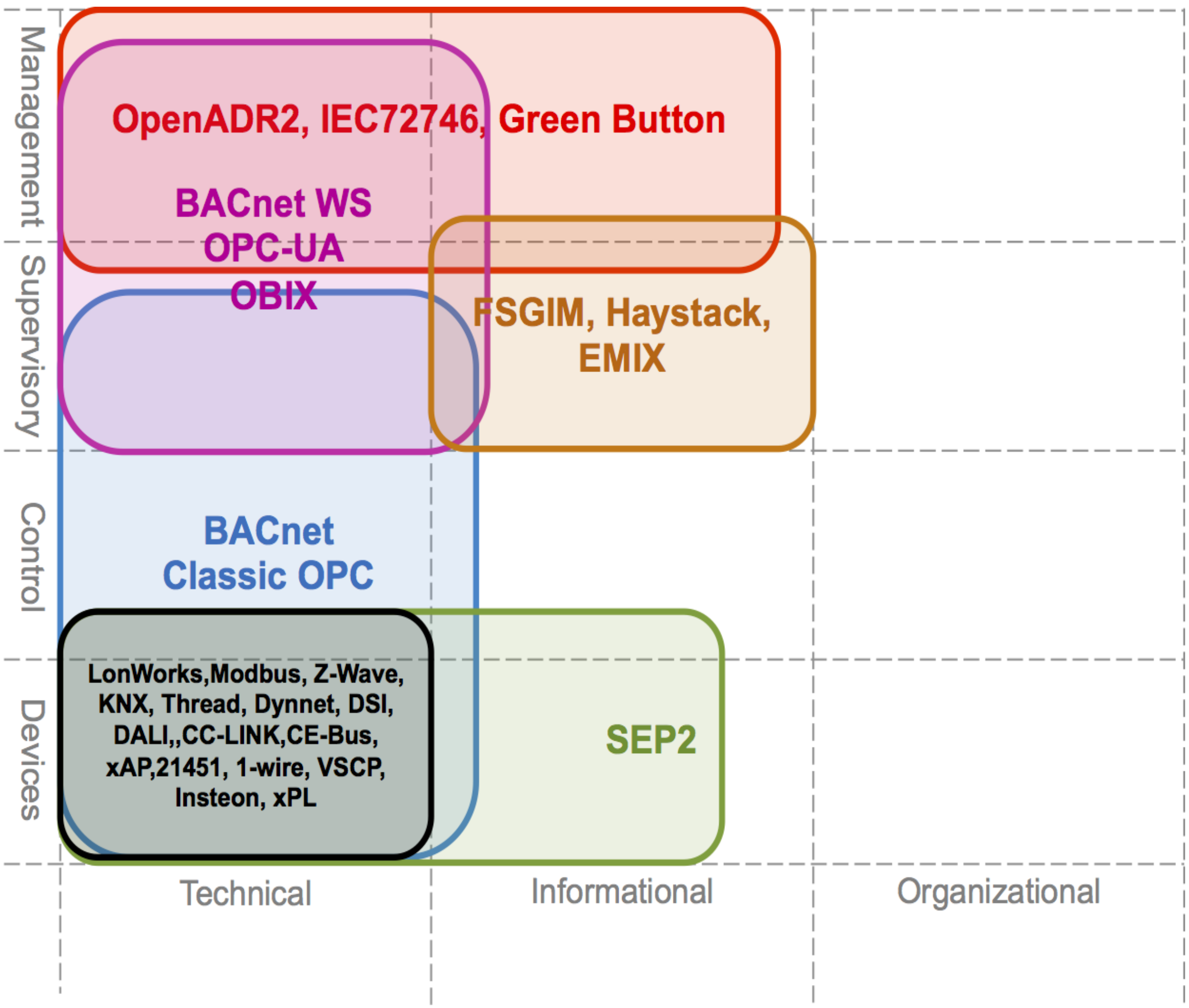
ENERGY

Buildings Interoperability Framework



Transmission services work through market and distribution

Standards Landscape – Zones & Interop Levels Example



Some Interoperability Gaps and Challenges

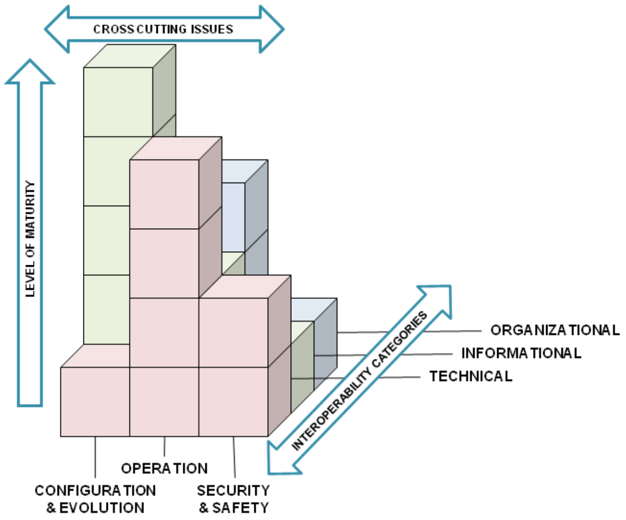
- **Interoperability is lacking at the organizational level**
  - Business/government policies do not encourage interoperability
  - Interoperability can be seen as a commoditization threat
  - Not aligned within stakeholder group or nationally
  - State of standards making has not encompassed business processes or aligned business objectives
- **Interoperability entering informational level**
  - Energy information models are emerging
  - Most models generic: point name/data value w/o rich equipment model
  - Too many point name/data value naming conventions to choose from
  - Time to enter/map generic model data is time consuming & error prone
- **Interoperability choices confusing at technology level**
  - Wide variety of communication and syntactic technology choices
  - Communications layers are often not cleanly separated from information
  - A unifying approach, such as Internet Protocol, has performance and policy challenges

Interoperability Gaps and Challenges (cont.)

- **Interoperable configuration and evolution capabilities lacking**
  - Resource discovery is not supported, rely on manual setup
  - Equipment identity management is not standardized
  - Physical connectivity models between devices is done manually and is error prone
- **Operation and performance often not scalable**
  - Centralized control paradigm requires greater information exchange and is prone to central component failure
  - Unclear separation between communications medium and messages standards, means that performance options can be limited
- **Security, privacy, and safety concerns often an afterthought**
  - Older standards do not have security or integrate fully
  - Security and sensitive data policies only emerging
  - Safety and systemic fail-safe requirements often not addressed

Can we measure interoperability?

- Identify desired attributes to integrate equipment and systems
  - Articulate interoperability goals and objectives (e.g., GWAC IMM)*
- Examples
  - Organizational goal
    - Compatible business processes exist across interface boundaries
  - Informational goal
    - There is an information model relevant to the business context
  - Configuration and Evolution goal
    - A migration path from older to newer versions exists
  - Security, Privacy, and Safety goal
    - Security policies (e.g., confidentiality, integrity, availability, and accountability) are defined, maintained, and aligned among parties



* GridWise Architecture Council, *Smart Grid Interoperability Maturity Model*, Beta Version, December 2011. http://www.gridwiseac.org/about/imm.aspx

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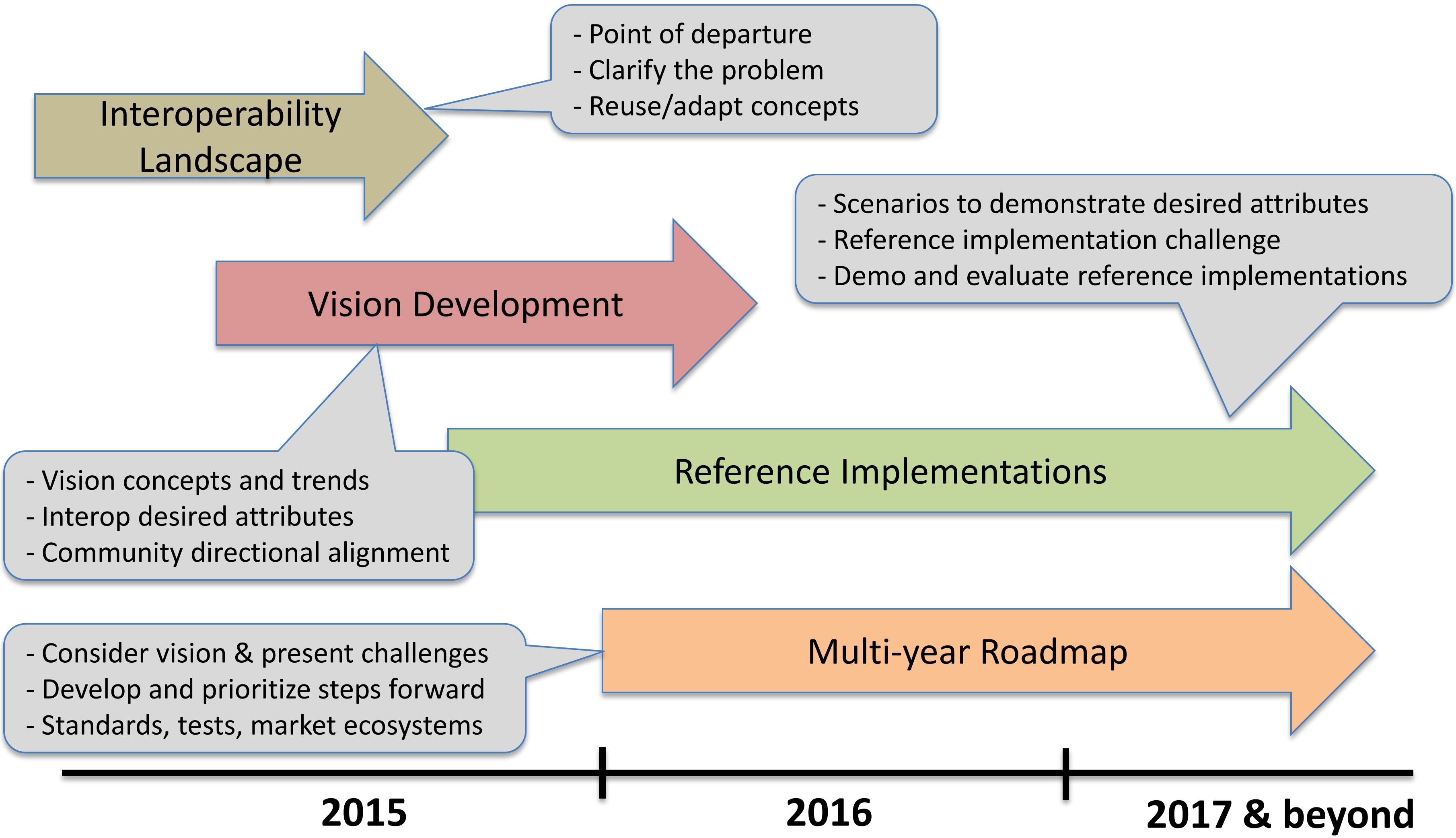
Strategy to Advance Buildings Interoperability

*"The deployment of connected equipment is an untapped national opportunity – for operational efficiency, for new business growth, and to lessen the effects and burdens of climate response."**

- Initially target small-medium commercial building scenarios
  - Requires low cost installation to penetrate market
  - Simpler (unitary) components and systems
  - Most to gain from interoperability advancements
  - Example for other types and sizes of buildings
- Offer an alternative to entering a standards process
  - Engage stakeholders to develop a building interoperability vision
  - Leverage work of related efforts: ANSI-EESCC, SGIP, GWAC, IEC, ASHRAE, …
  - Develop open, examinable reference implementations
- Define interop roadmap informed by vision and reference implementations
  - Roadmap considers reference-inspired interface standards, testing, and the market ecosystems to support related products
  - Roadmap addresses approaches to work with existing technology investments
  - Roadmap acknowledges that new methods, tools, and technology will emerge

* Joe Hagerman, "Towards a National Strategy for the Interoperability of Connected Equipment," 14 Aug 2014

Buildings Interoperability Plan of Attack



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Connected Buildings Interoperability Vision Meeting

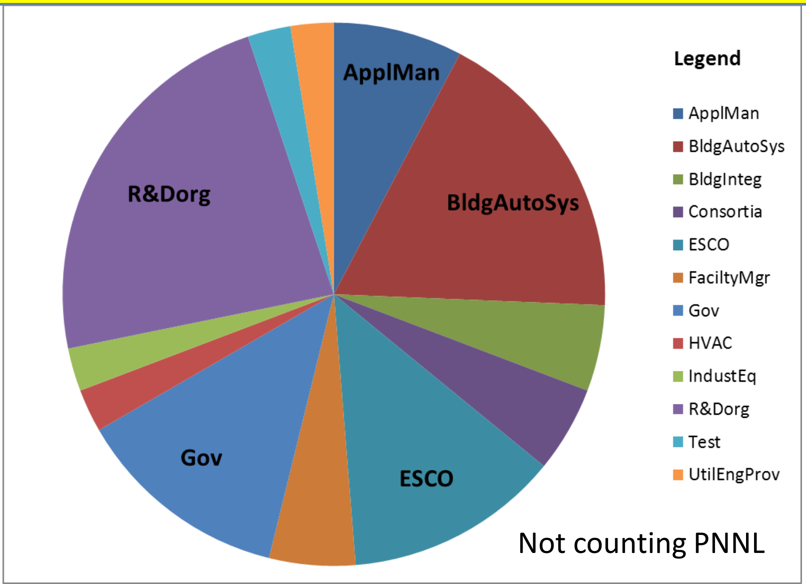
- Attendees
- Vision concepts
  - Provocative buildings interaction stories
  - Interoperability desired attributes
- Industry presentations on transformational directions
  - Emerging directions from Internet of Things initiatives
  - Buildings automation industry directions
- Buildings interoperability vision discussion topics
  - What does the future look like?
  - What are the interoperability attributes to consider?
  - What should a buildings interoperability vision include?
- Desired outcomes
  - Outline the scope and contents of a buildings interoperability vision
- Meeting observations
  - What we learned from the meeting

Attendees

Organization	Attendees
Appliance Manufacturer	**3**
Bosch	2
Samsung	1
Building Automation Systems	**7**
Honeywell	1
Independent	1
Lutron Electronics	1
Siemens Building Technologies	2
United Technologies Research Center	2
Buildings Integrator	**2**
Engenuity	1
Iconics	1
Consortia	**2**
AllSeen Alliance	1
SunSpec Alliance	1
Energy Services Company	**5**
Building Intelligence Group	1
Energy Technology Savings, LLC	1
NorthWrite	1
SkyFoundry	1
SmartCloud	1
Facility Manager	**2**
McKinstry	2
Government	**5**
DOE	5
HVAC	**1**
Carrier	1
Industrial Equipment	**1**
Eaton	1
R&D Organization	**9**
Argonne National Laboratory	1
Drexel University	1
Lawrence Berkeley National Laboratory	2
National Renewable Energy Laboratory	2
Oak Ridge National Laboratory	2
VPI (VA Tech)	1
Test & Certification	**1**
Quality Logic	1
Utility Energy Provider	**1**
Duke Energy	1
Host Staff	**11**
Pacific Northwest National Laboratory	9
Planit Meetings	1
UpperBay	1
Grand Total	**50**

Stakeholder Categories Represented

Stakeholder Name	Abbreviation	Stakeholder Name	Abbreviation
Appliance Manufacturers	ApplMan	**Smart Meter Manufacturers**	MeterMan
Consumer Electronics Manufacturers	ConsumElec	**Distributed Generation and Storage Manufacturers**	DGMan
HVAC and Water Heating Equipment Manufacturers	HVAC	**Communication Infrastructure & Service Providers**	Comm
Elevator/Escalator Manufacturers	Elevator	**Computing Service Providers**	CompServ
Industrial Equipment Manufacturers	IndustEq	**Distributed Energy Service Providers**	DisEngServ
Plug-in Hybrid or Electric Vehicle Manufactures	EVMan	**Information Technology Application Developers**	ITApp
Electric Vehicle Charging Infrastructure Companies	EVCharge	**Trade Associations**	TradeAssoc
Building Automation and Control System Manufacturers	BldgAutoSys	**R&D Organizations and Academia**	R&Dorg
Building Control Systems Integrators	BldgInteg	**Government Agencies**	Gov
Energy Service Companies	ESCO	**Standards Development Organizations**	SDO
Building Information Modeling Software Developers	BIMDev	**Facility Managers-Owners-Operators-Occupants**	FaciltyMgr
Aggregators	Aggregator	**Industry Consortia**	Consortia
Utility Energy Providers	UtilEngProv	**Testing Organizations**	Test



Transformational ICT Directions Presentations

Samsung

Bosch

SmartCloud

The Allseen Alliance

Honeywell

Siemens

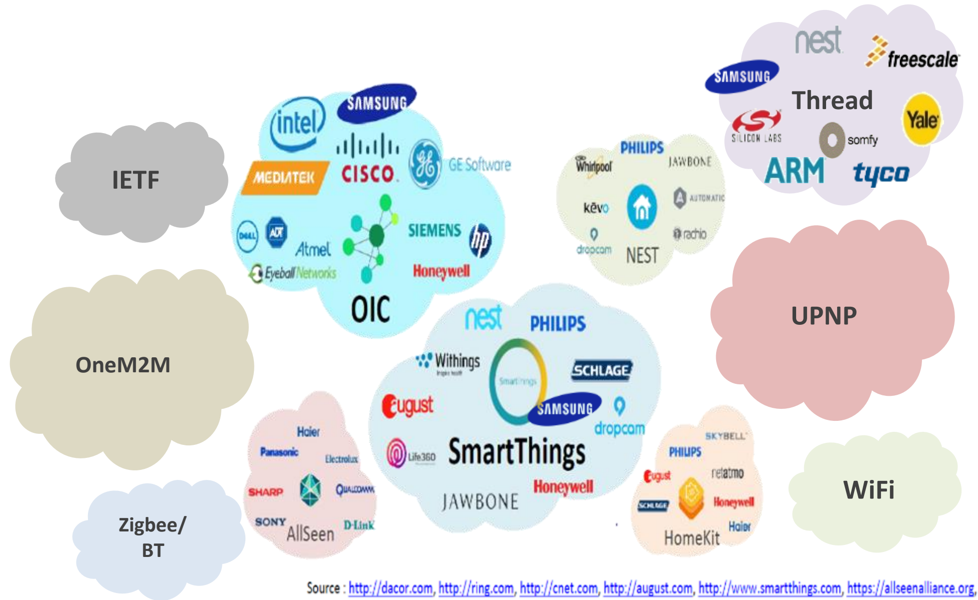
Iconics

SkyFoundary

ETS

Samsung

- IoT's Problem:
  - Proprietary ecosystems
  - Changing platforms
  - Devices added later
- Many groups and de facto standards have formed
  - But fragmented and disconnected
- Open Source Ecosystems may be a better route



Source : http://dacor.com, http://ring.com, http://cnet.com, http://august.com, http://www.smartthings.com, https://allseenalliance.org, http://www.nest.com, https://developer.apple.com/homekit, http://openinterconnect.org

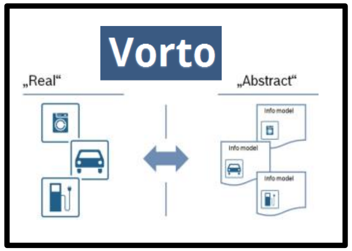
BOSCH

- Too many application level protocols currently
  - ~30 communication protocols
  - ~70 Java communication frameworks
  - Varying degrees of overhead
  - Many not suited for "systems of systems" use
- For IoT to succeed, must be based on open source standards and software
- BOSCH Pittsburg RTC Demo
  - M2M Interfaces focused on energy, environment
  - Thousands of data feeds integrated

Mortar.io
An Extensible Sensing and Control Platform for Building Energy Management

Semantic Sensor Network Ontology

Author
W3C Semantic Sensor Network Incubator Group



OSGi Alliance

EnFuse Panel Meters
Electricity usage
11 x 48 = 528 feeds

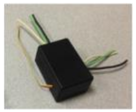
Lutron Lighting Controller
277 VAC lighting control

AutoMatrix PUP Controller
HVAC
30 x 6 (inter-building) x 24 = 4320 feeds

FireFly Environmental
Light, temp, humidity, sound, motion, vibration, pressure
120 feeds

Thermostat
802.15.4 Pneumatic thermostat with branch pressure monitoring
70 feeds

Chilled Water and Steam
Temperature and flow-rate
2 x 2 = 4 feeds

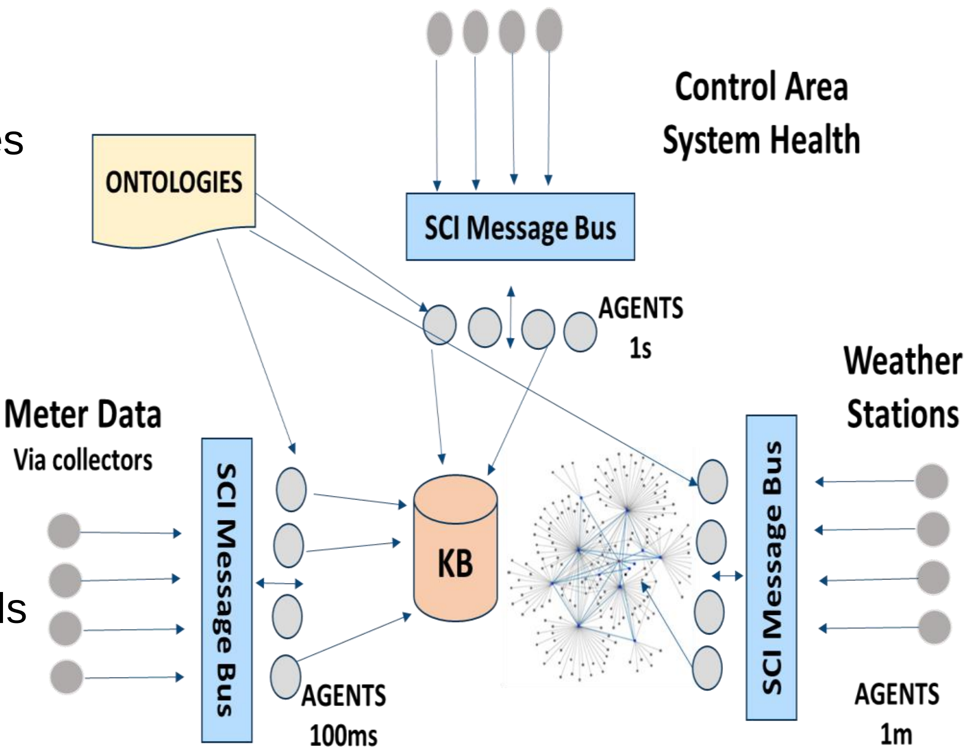


Fan Control Units
802.15.4 units for heat exchangers in each room
Control and power metering
170 feeds

Localization
ALPs + VLC Localization
Feed per person

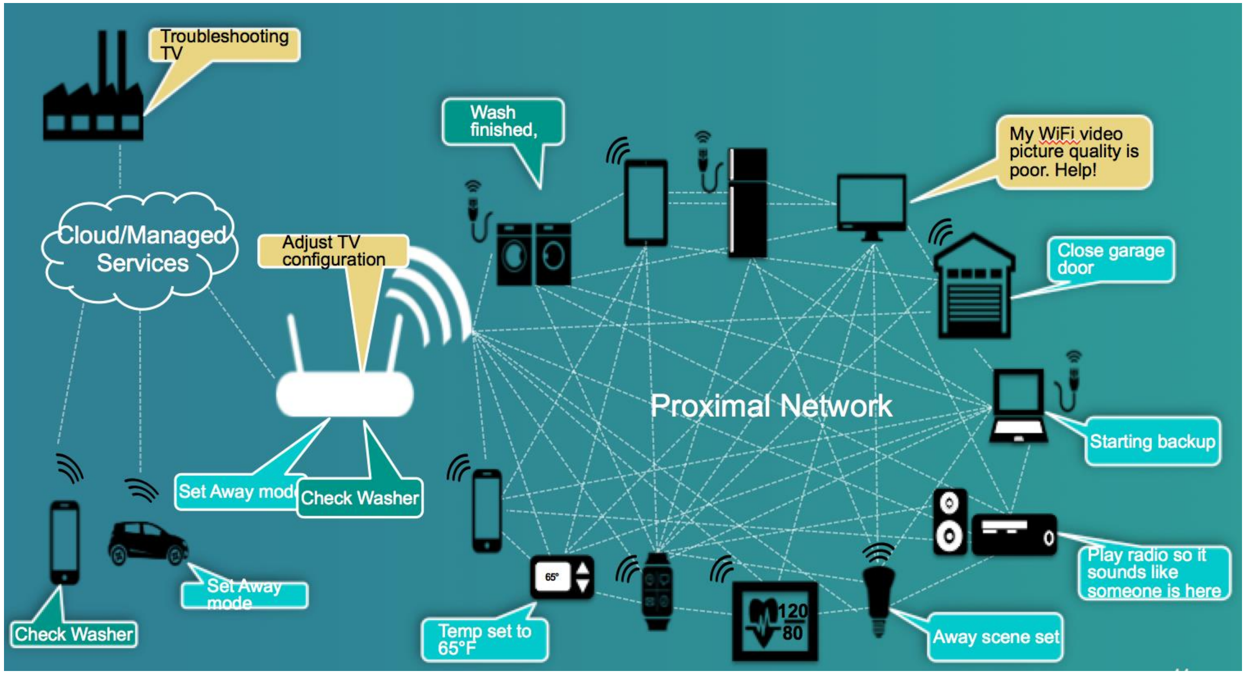
SmartCloud

- Semantic Historian
  - Database stores data as knowledge
  - SSN and CIM are base ontologies
  - Physical storage scalable, distributed
- Lessons Learned
  - Cost effective provisioning requires standardization
  - Requires simple secure communication
  - Getting through customer firewalls is a problem
  - Need to organize information as collected
  - Need to provide individuals perspectives of information for end users, utility, ISO



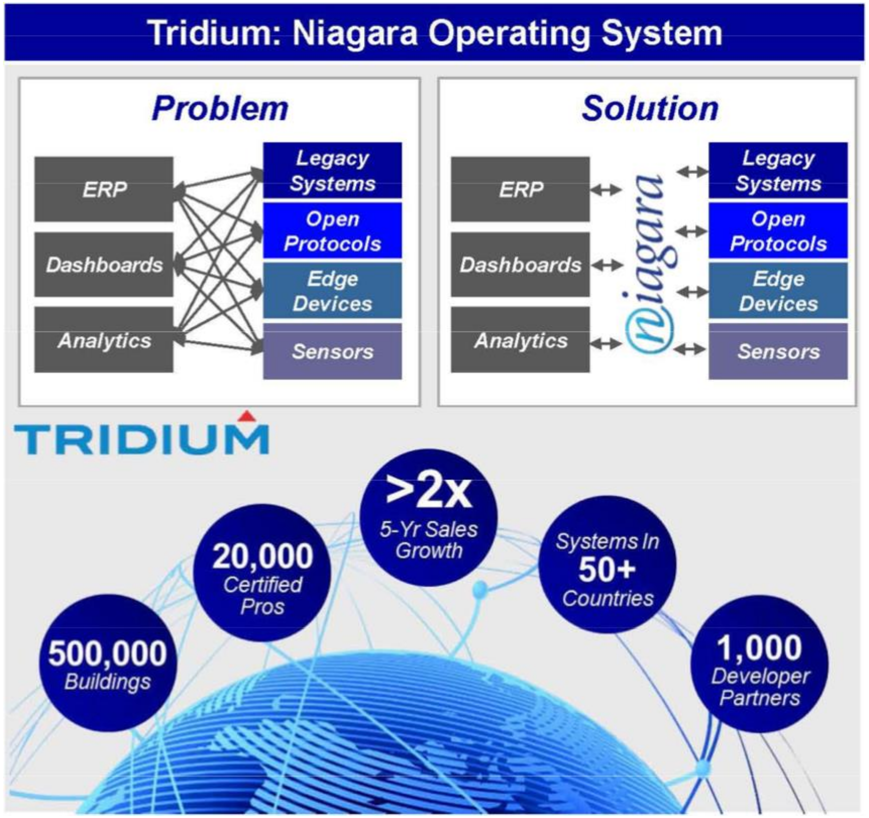
Allseen Alliance – AllJoyn Framework

- AllJoyn Framework
  - Single protocol allows apps to expose capabilities and interact
- Spans network transports, integrates protocols
  - “Mesh of Stars” network topology
- Gateway agent
  - Provides remote access, management, privacy controls



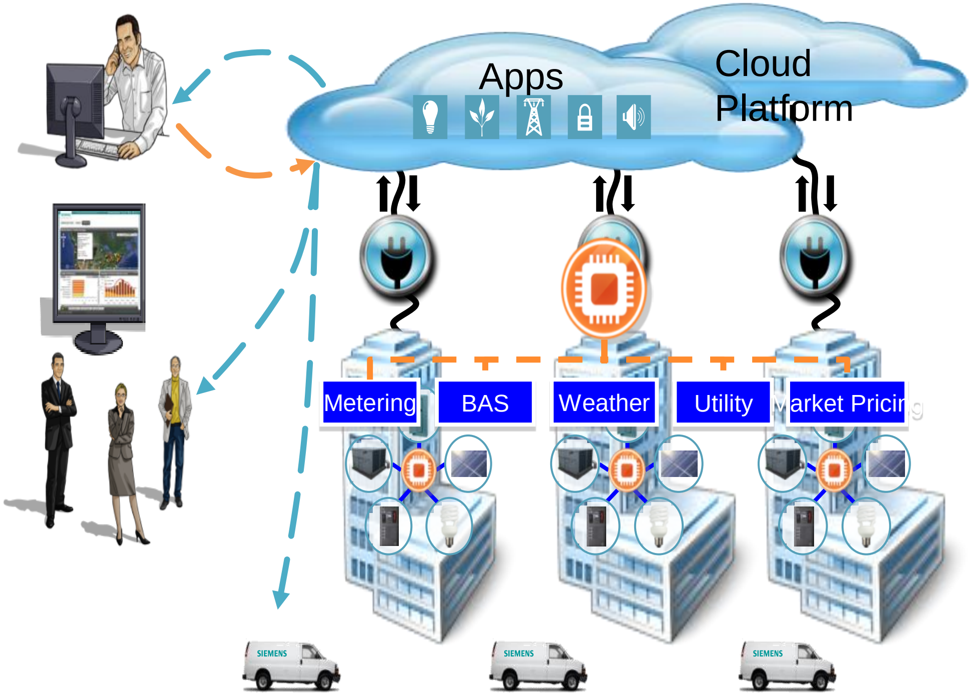
Honeywell

- Connected homes are a platform for growth
  - Technology trends
    - Home energy management
    - Connectivity
    - Geo-fencing
    - Occupancy
- IoT for Buildings, Factories and Data Centers
  - Tridium open s/w platform for IoT
  - Niagra OS
    - Energy management
    - Fault diagnostics
    - Parking management
    - Operations management
    - Identity management
    - Access control



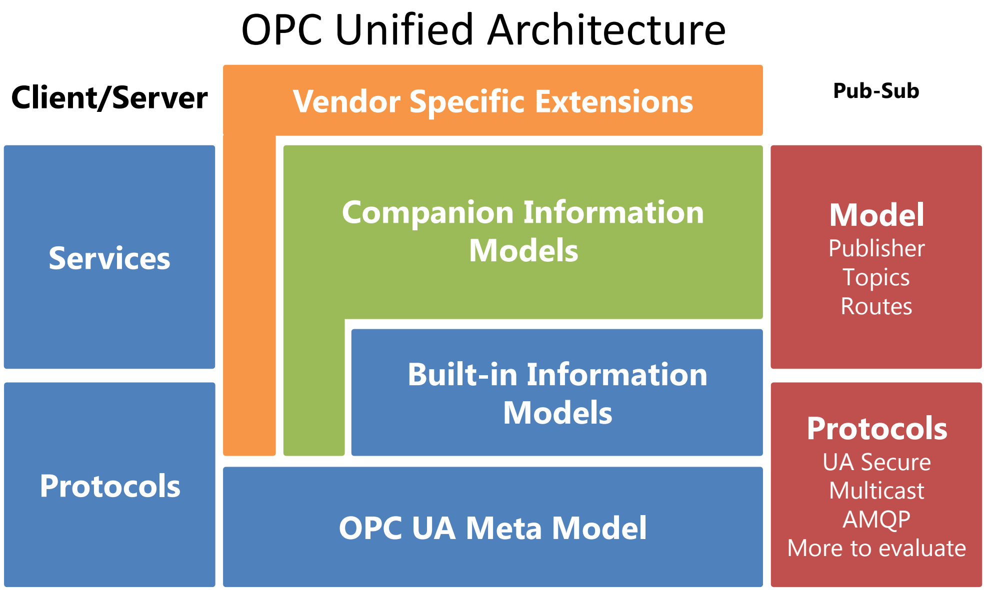
Siemens

- Data Fatigue
  - Increasingly complex systems
  - Large amounts of data
  - Limited human and capitol resources
  - Tools to leverage for buildings are missing
- Siemens' DESIGO platform
  - Spans energy, fire safety, access, power, BAS
  - Spans OPC, BACnet, Modbus protocols
- Requires bottom-up approach
  - Connect
  - Collect
  - Analyze
  - Optimize
  - Communicate



ICONICS

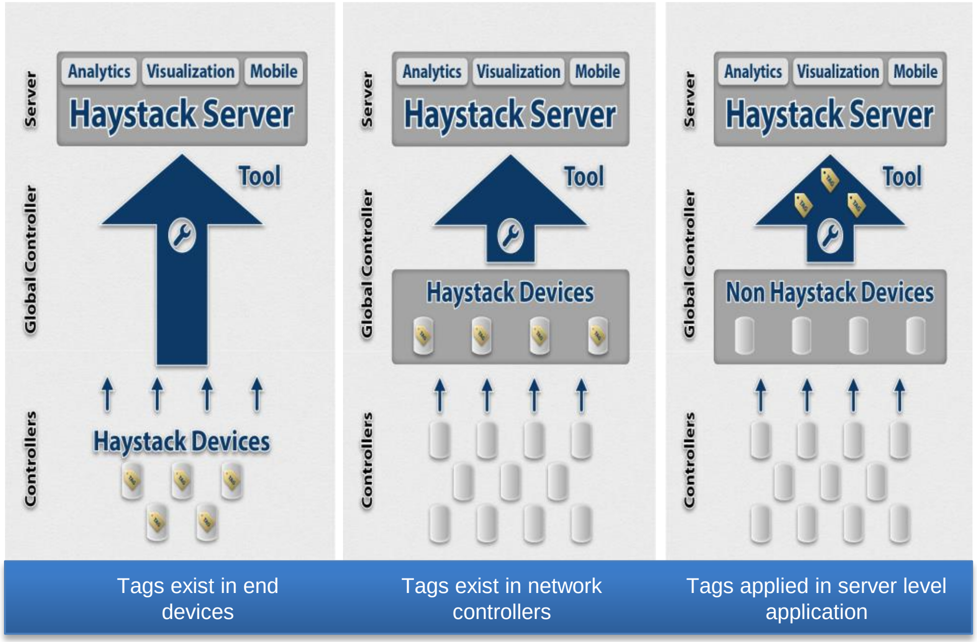
- Interoperability Requirements
  - Standard, Secure Transports
  - Application Protocols
    - Point/Value Interoperable Services
    - Full Object Discovery
    - Independent Certifications
  - Information Models
  - Standardized
    - Objects/Classes
    - Properties Naming and Logic



- OPC Unified Architecture
  - Pub/Sub communication model
  - Generic Pub/Sub information model under development
  - Ongoing evaluation of existing protocols

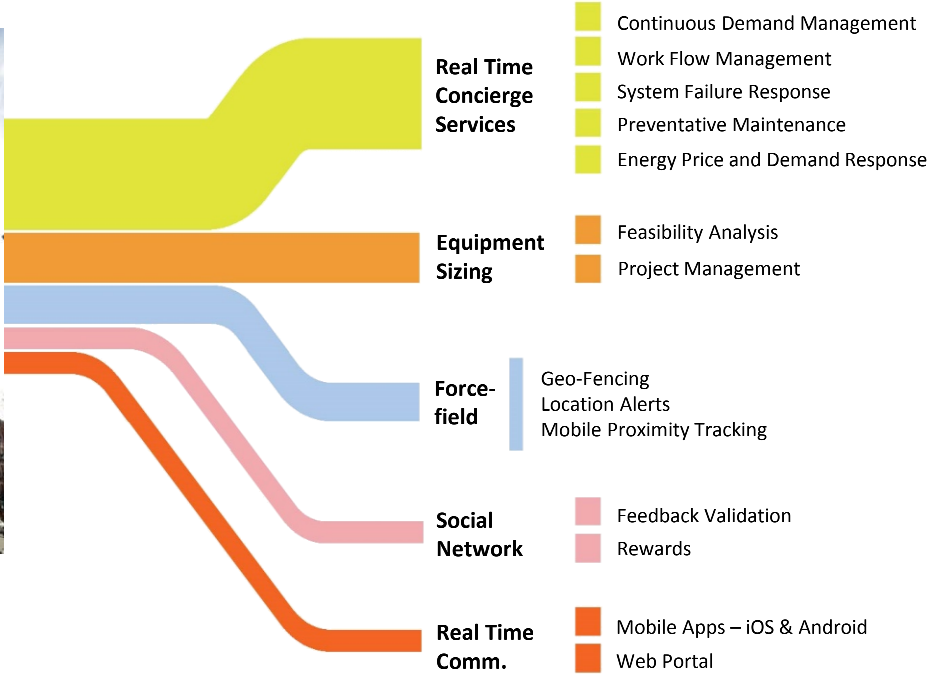
SkyFoundry – Project Haystack

- Current problem
  - Lack of standardized naming conventions makes data mapping labor intensive effort
  - Point names can't solve the challenge – too much information to be carried in a name
- Project Haystack addresses these problems
  - Data includes meta data to describe the meaning
  - Assists automatic interpretation
  - Reduces engineering effort
  - Machine and people readable



ETS

- Technological barriers to ICT platforms for building energy services
  - Twelve monthly meter data points per year
  - Manual HVAC load control
  - Lack of building diagnostics
  - Lack of continuous engagement program
- Solution: open source, open platform, multiple protocols and mobile app provisioning
  - Upgrade meter to digital age
  - Install wireless HVAC load control
  - Deploy smart building sensor diagnostics
  - Provide continuous engagement with apps/alerts



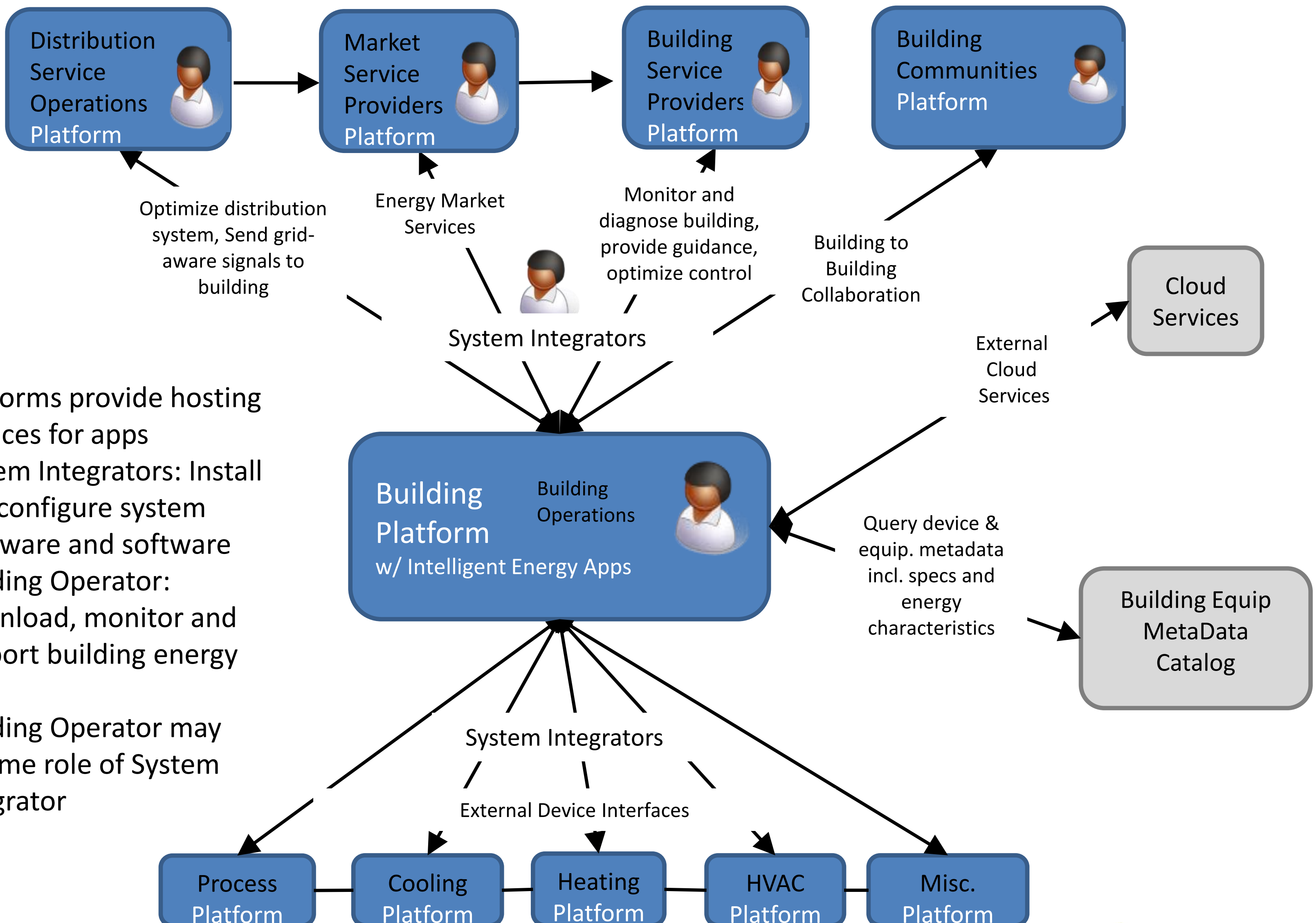
Vision Stories Breakouts

Inspirations for a Buildings Interop Vision

- Vision scenarios for building interoperability in-line with mobile equipment (phone/tablet) and home electronics connectivity that is emerging

- Emerging Industry Interoperability Standards
  - Open data initiative and standards
    - ANSI, IETF, W3C, Data.gov, Open Knowledge Foundation
  - Community vocabularies and ontologies
    - ASHRAE Facility Smart Grid Information Model
  - Secure and open messaging
    - MQTT (Message Queue Telemetry Transport)
    - AMQP (Advanced Message Queuing Protocol)
  - Business Process Modeling
    - OMG BPMN
  - Internet of Things
    - IETF, IEEE P2413, 1547
  - Business to business interoperability
    - Construction Operations Building Information Exchange (COBie)

A Concept for Buildings Integration Vision Stories



NOTES:

1. Platforms provide hosting services for apps
2. System Integrators: Install and configure system hardware and software
3. Building Operator: Download, monitor and support building energy apps
4. Building Operator may assume role of System Integrator

Buildings Integration Vision Stories

- Building Internal Interaction Story
  - Focuses on technology integration but draws from familiar (e.g., smart phone) interaction patterns
- Building Service Provider Story
  - A building operator interaction with a third-party that provides building commissioning services, energy guidance and diagnostics
- Market Service Provider Story
  - A building operator interaction with an energy market to purchase energy and how a market operator interacts with the building
- Distribution Service Operations Story
  - A building operator supplies spinning reserves to a DSO ancillary service market, and how the DSO interacts with the building

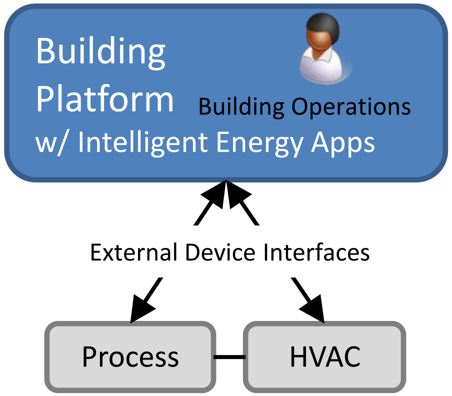
Building Internal Interaction Story

Use Case

- Automated Building Energy Efficiency

Actors

- Building Operations (BO)



Description

A view of applying automation to a small building through the eyes of its operator. It focuses on technology integration but draws from familiar (e.g., smart phone) interaction patterns.

Value Proposition

Improving the ability of building devices and systems to interoperate will result in lower costs and other benefits including increased energy optimization and efficiency.

Building Internal Interaction Comments

- Need to consider integrator with appropriate configuration expertise versus a small building owner
- Story needs to be more decentralized (platform concept was interpreted as centralized)
  - Concentrate more on device intelligence and then how that integrates with other building components
  - Treat devices as each having a platform as well
  - Highlight self-learning aspects of devices
- Customer choice is important to emphasize
  - Products, data privacy and authorization, level of security
- Need to add lessee and lessor and regulators as actors
- Attributes covered the Interoperability Maturity Model (IMM) attributes list provided for consideration
- Ecosystem needs a regulatory requirement, an industry leader for change, or both
  - Virtuous cycle example: regulatory mandate reporting on a desired metric and an incentive to reach a desired level

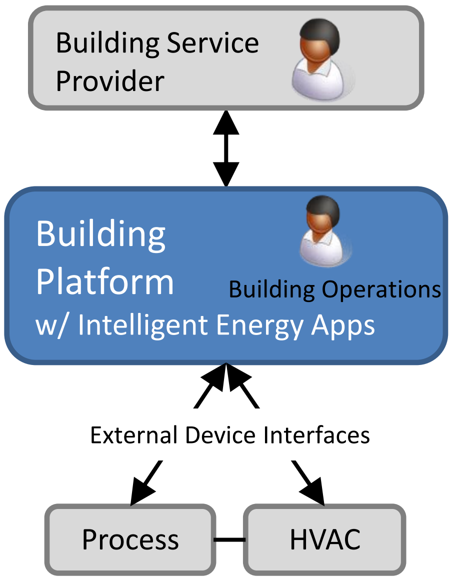
Building Service Provider Story

Use Case

- "Diagnostics and Automated Commissioning Services" (PNNL TE Ref)

Actors

- Building Operations (BO)
- Building Service Provider (BSP)



Description

A first person view of how a building operator might interact with a third-party that provides building commissioning services, energy guidance and diagnostics on behalf of the building operator.

Value Proposition

Minimizing the costs of supporting efficient operation of building systems and providing value-added services.

Building Service Provider Comments

- Divergent views expressed from less than visionary to a futuristic dream
  - Some thought there was too much manual integration effort
- Story could be expanded to entertain the complexity and choices surrounding data privacy and cybersecurity
- Need key performance indicators identified for comparing performance (
- Information modeling does not exist today
  - To some it is hard to imagine its availability
  - Others felt a vision of a self-built building model should be portrayed
  - Move BIM/COBie to operations information model
- Need to adopt commissioning standards (and maintain updates) to govern operations targets
- Lack of incentive for interoperable products by suppliers
- Need to integrate while building operates. Accommodate legacy investments
- Ecosystem needs openness, information model, business process standards, IT education/training, certification – not just technology but people issue as well.
- Interoperability attributes include self-describing devices, test beds, self-diagnostics, resilience/failure planned response, unified regulatory framework, Carfax for buildings
- Local versus virtual (e.g., cloud-directed) diagnostic services makes defining actors difficult

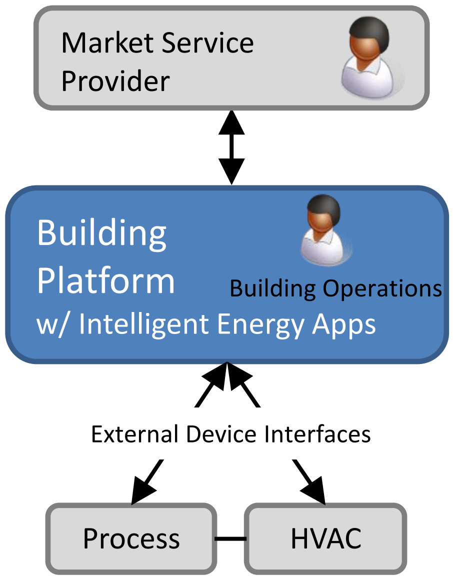
Market Service Provider Story

Use Case

- "Transactive Energy Market Exchange" (PNNL TE Ref)

Actors

- Building Operations (BO)
- Market Service Providers (MSP)



Description

A view of how a building operator might purchase energy from an energy market and how a market operator may interact with the building operator.

Value Proposition

Forward contracts may result in reduced peak demand and congestion, increased operational efficiency, better capacity planning, and increased integration of renewable resources. Energy consumers will have a broad range of purchasing options to better manage their energy costs with their demand flexibility.

Market Service Provider Comments

- Concerns about structuring a market approach, gaming, incentives, how to represent building flexibility, and impact to occupants
  - Proxy for occupant values (i.e., comfort) needed with opt-out feature
  - Needs good forecasting mechanisms to make this work
  - Assumes high level of storage to contribute to flexibility
  - Assumes critical mass of buildings to support the market
- Regulator actor needed to keep from gaming etc.
  - Auditing and adjudicating contract disputes needed
- Ecosystem needs industry alliance to drive market and standards
  - Regulations need to accommodate the story
  - Test and certification program
  - Expand stakeholders to include financial organizations and insurers
- Desired interoperability attributes seem to be covered in the IMM list

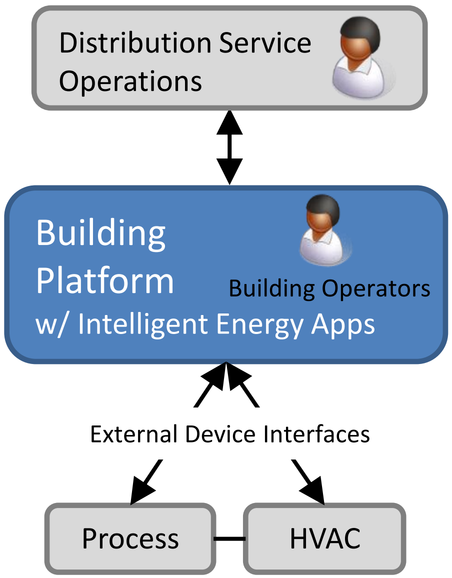
Distribution Service Operations Story

Use Case

- "Transactive Acquisition of Ancillary Services" (PNNL TE Ref)

Actors

- Building Operations (BO)
- Distribution Service Operations (DSO)



Description

A view of how a BO might supply spinning reserves to a DSO ancillary service market, and how the DSO may interact with the BO.

Value Proposition

Increased renewables are resulting in more grid fluctuations. Buildings can be a less expensive near-term alternative than distributed generation. Winning bidders are compensated for their ability to reduce load if called upon.

Distribution Service Provider Comments

- The owner needs to know participation requirements and value, not that it is a spinning reserve service
  - A "killer app" is needed for interoperability; this does not seem like it
  - Many questions about the nature of the story's app and local v remote control
- Cybersecurity is a major issue with app deployment and trust
- Needs to be very simple with defaults, configuration wizards, etc.
- M&V important for DSP and BO, also liability needs clarification
- Information needed to help identify which buildings are good candidates with apps for type segments
- Clarify the hierarchy of DSP to building app and the coordination of equipment in the building
- Ecosystem requires many items identified in IMM suggestions
  - All the security and privacy attributes suggested
  - Baseline agreement v competitive market interaction clarified
  - Open protocols and standards
  - Information model with shared semantics
  - Self-learning, self-tuning

Vision Outline Input

- Articulate a vision statement with objectives and desired outcomes
  - How do you measure success?
  - Consider 5 and 10 year goals
- Identify the audience, customer, user of the vision
  - Value propositions, open opportunities
- Emphasize distributed control and coordination
- Anticipate arguments of naysayers
- Use stories, but describe needs and differences with use cases
- Describe buildings classifications with desired interoperability targets
- Identify interoperability metrics and assure they are measureable
  - Interoperability functional layers
  - Benchmarking process/service
  - Scalability – need simulation of scalability and demonstrations
  - User interface interoperability

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Vision Outline Input (cont.)

- Heterogeneous technology mix with legacy investments must be accommodated
- Shared information model for buildings
- Education on interoperability for buildings needed
- Commitment to safety, cybersecurity and privacy issues
- Leverage expertise from other IT communities (IoT, IETF, W3C, etc.)
- Who needs to be involved?
  - Self-organizing associations, colleges, suppliers, owners/REITs, occupants, standards bodies, energy service providers
  - Encouraging government policy, states, clean-energy agencies, Corps of Engineers has interop specs
- Marketing and promotion needs to be part of the plan
  - Imagine a smart building index (like EnergyStar)

Meeting Observations

- Significant opportunity exists to advance interoperability in connected buildings
  - Putting tags on points and attempting to standardize the tag names (Project Haystack) is today's cutting edge
  - Attributes of interoperability are abstract and difficult to appreciate and internalize
- The audience for the work needs better definition
  - Why should buildings automation stakeholders be interested in advancing interoperability?
  - The government role needs to be better articulated
  - Technical experts can be more difficult to engage than business developers
  - IoT players have other forums and many more use cases to address
- A compelling application was not obvious, but could be a catalyst if identified
  - The vision stories seemed too far out for the comfort of many attendees
  - Addressing information modeling is an immediate gap
  - Application of a an information model to an import/export data map is needed

Next Steps

- Revise Buildings Interoperability Landscape draft document
- Continue education and outreach
  - Better communicate the value and potential to advance interoperability
  - Improve the buildings interoperability message and offer concrete examples
  - Plan future webinars, whitepapers, and outreach
- Draft a buildings interoperability vision document
  - Expand outline from the technical meeting
- Develop a roadmap – engage stakeholder community
  - Consider initial value propositions – is there a "killer app"? Such as,
    - Auto-mapping tools of data between buildings automation systems and applications
    - Buildings commissioning – diagnostics device model import/export
- Prototype reference implementations
  - Identify advanced interoperability characteristics to demonstrate
  - Define reference implementation requirements
  - Consider potential demonstration projects, challenges, competitions

Parting Notes

- Proceedings from the 10-11 Mar 2015 vision tech meeting
  - http://energy.gov/eere/buildings/downloads/technical-meeting-buildings-interoperability-vision
  - Webpage includes proceedings, meeting materials, and all presentations
- Please review Buildings Interoperability Landscape draft doc
  - http://energy.gov/eere/buildings/downloads/buildings-interoperability-landscape-draft
  - Comment by 31 May 2015 for inclusion in next revision
- Interested in contributing to interoperability vision and roadmap?
  - Contact

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QUESTIONS?