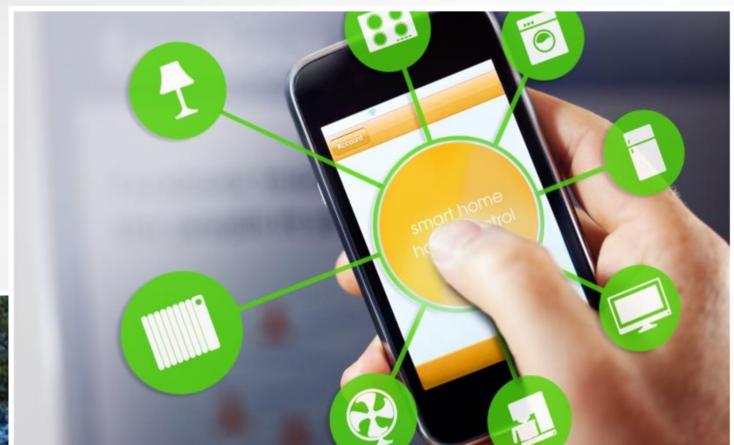



Buildings Equipment Connectivity Interoperability for Energy Applications


Steve Widergren, PNNL

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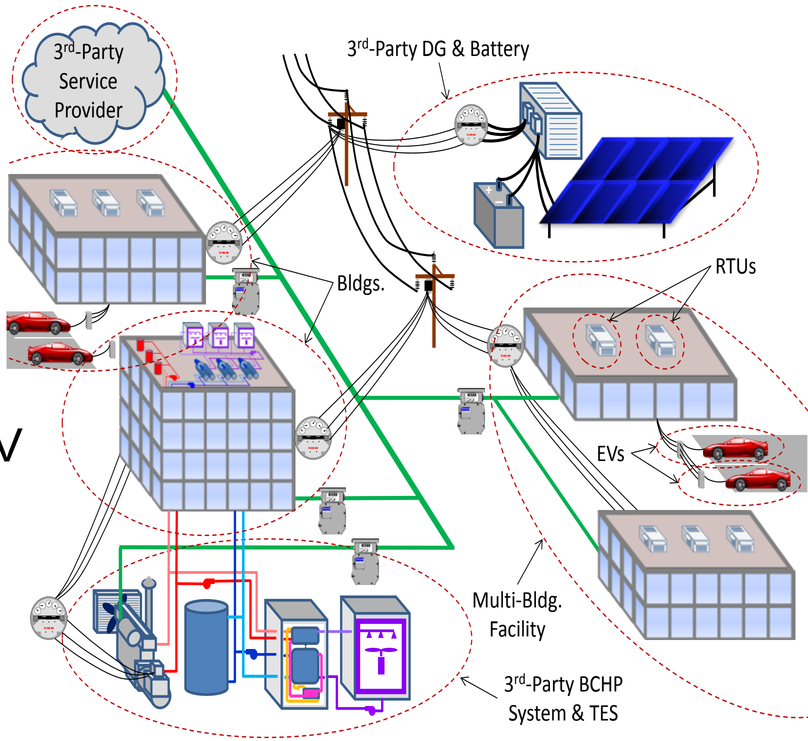
IEA-DSM Panel Demand Flexibility
Eindhoven, The Netherlands

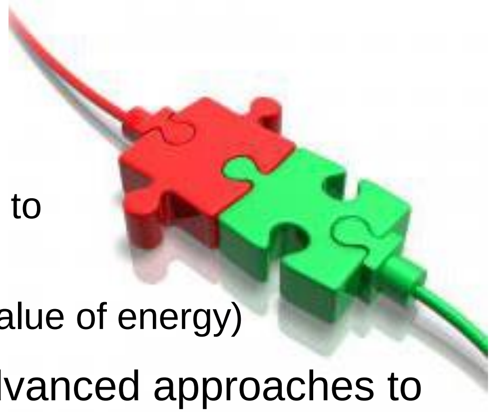
The Connected Building

- 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

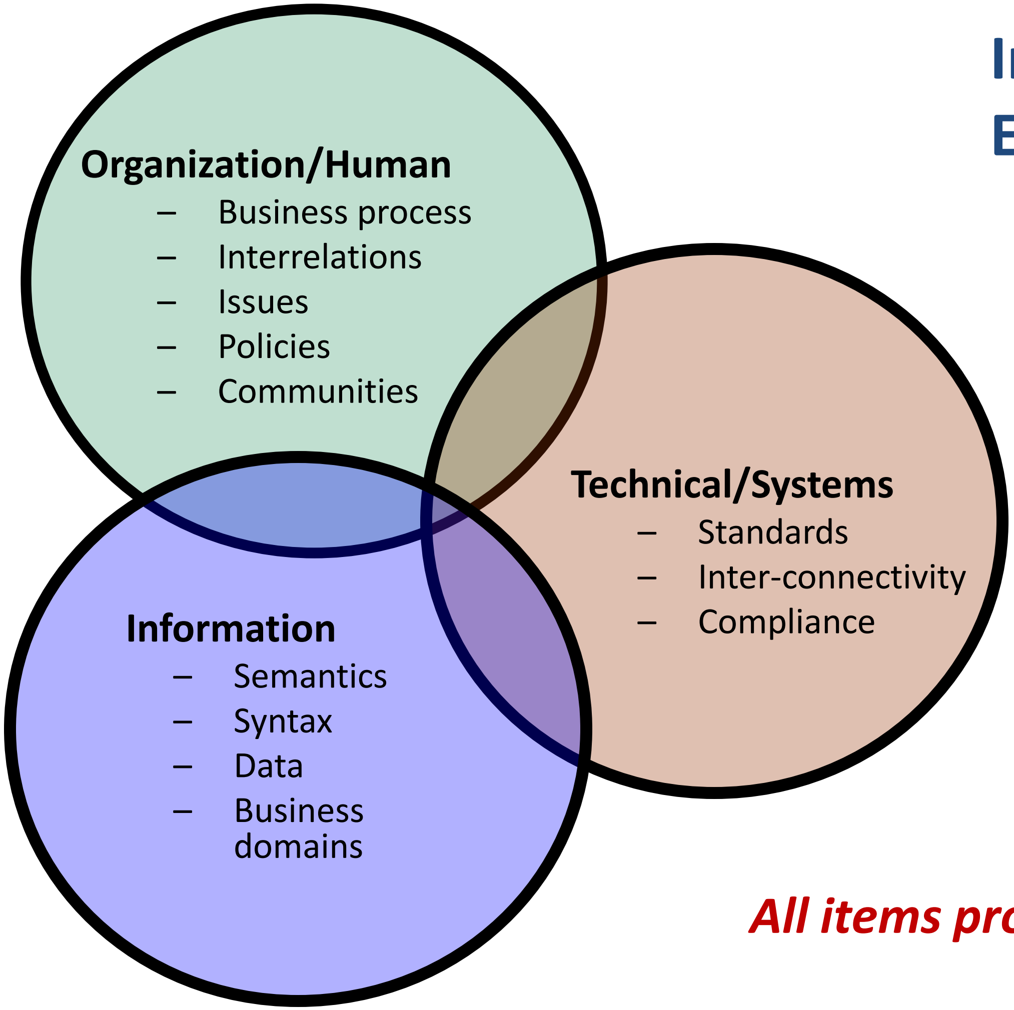
Interoperability is essential for information exchange within buildings and with external parties

*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

Interoperability Benefits

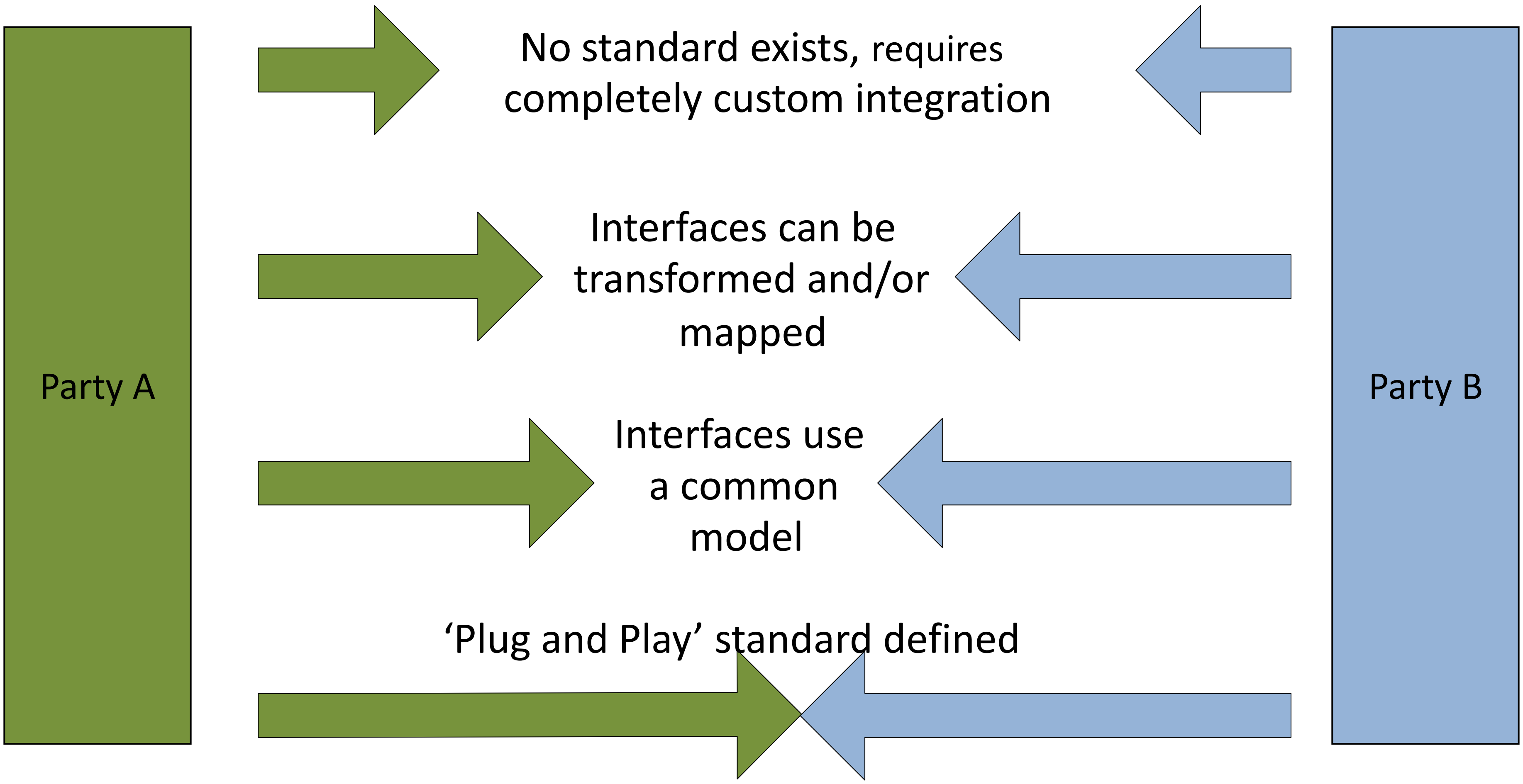


Interoperability - Expected Impact:

- **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 Implies an Ecosystem

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

Buildings 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

Buildings Interoperability Gaps and Challenges (cont.)

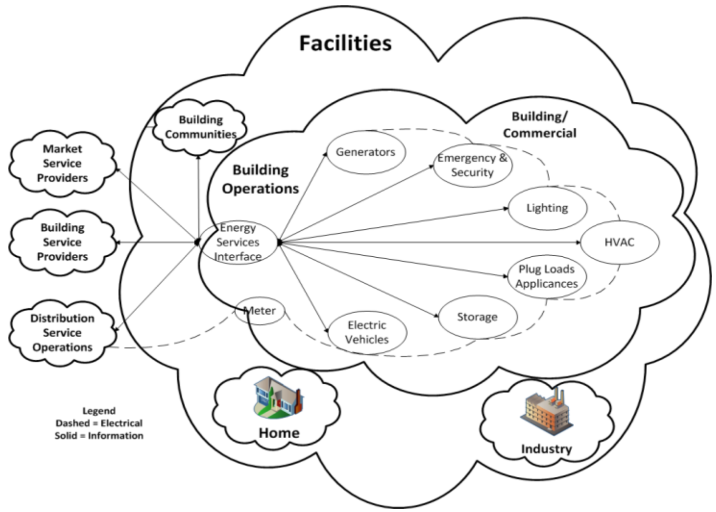
- **Interoperable configuration and evolution capabilities lacking**
  - Resource discovery is not supported, rely on manual setup
  - Equipment identity management is not standardized
  - Physical connectivity models between devices is done manually and is error prone
- **Operation and performance often 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

Buildings Interop Landscape

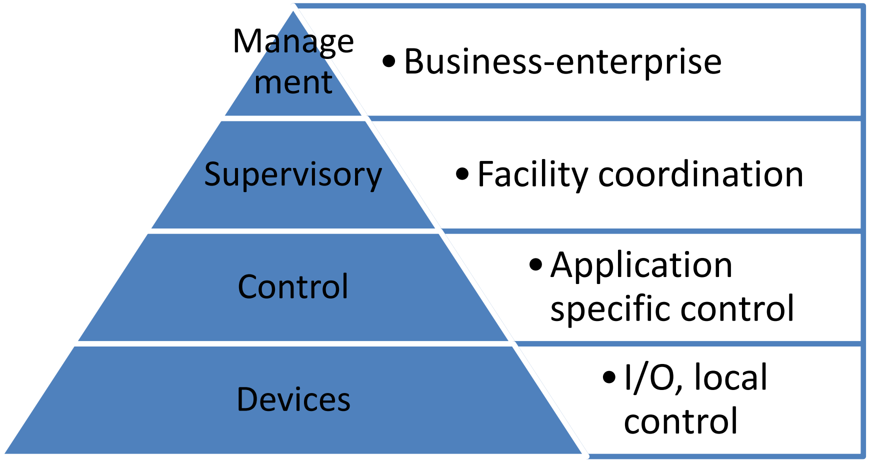
A point of departure to describe today's situation as we look to the future

- **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 characteristics 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

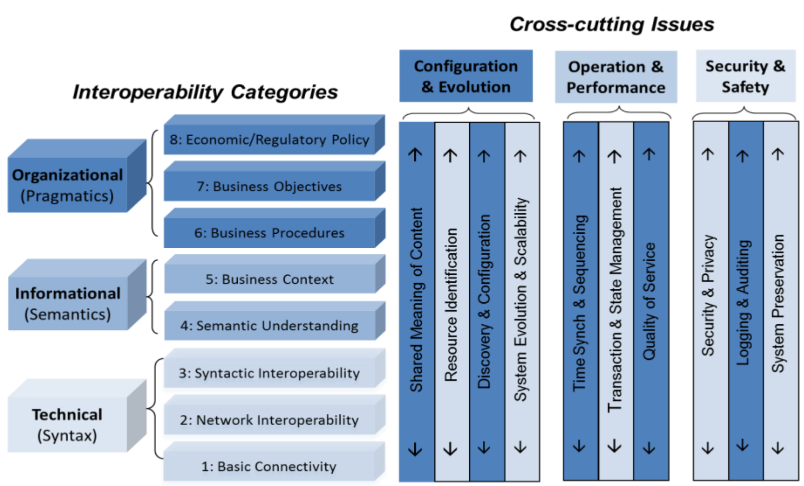
Inspirations for a Buildings Interop Framework



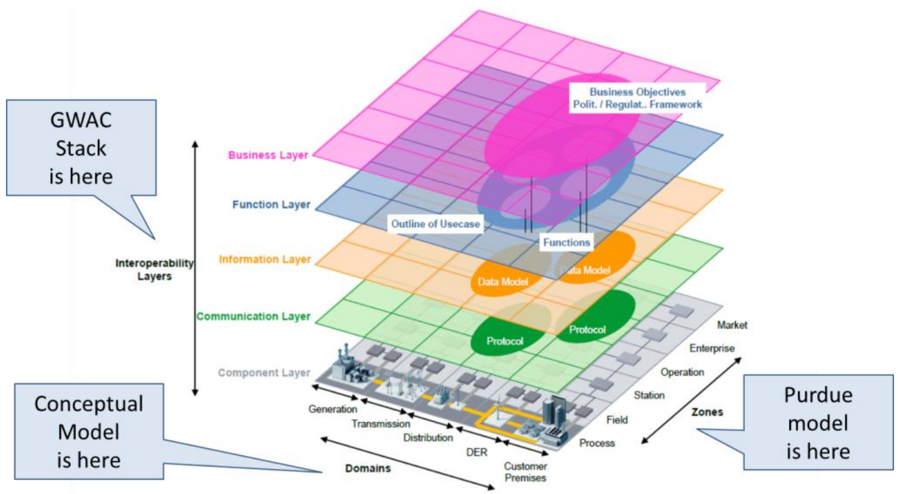
Derived from the SGIP conceptual model for the customer domain



ASHRAE automation model, from Purdue Enterprise ref model

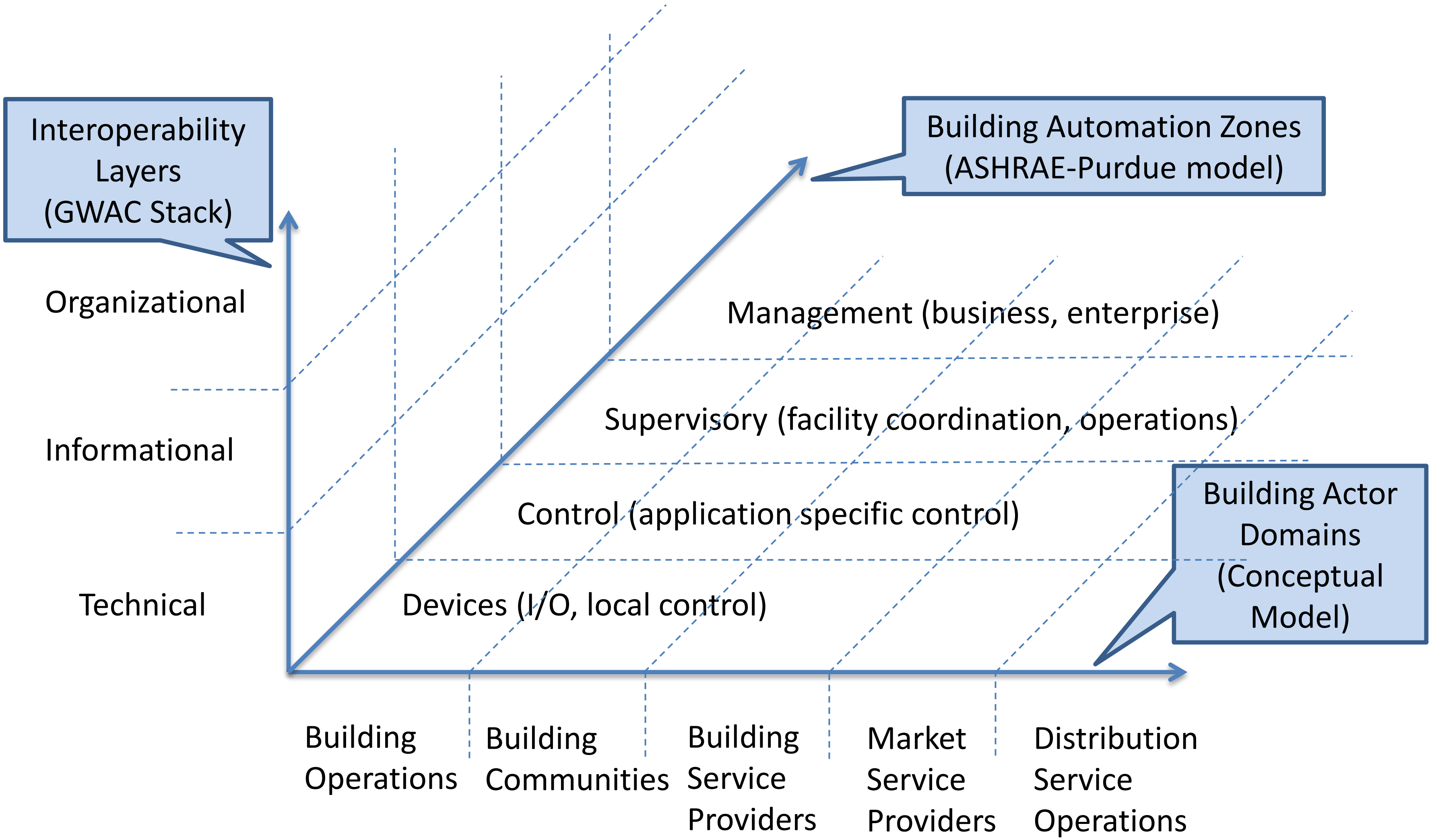


GWAC interoperability context-setting framework



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

Result: Buildings Interoperability Framework



Transmission services work through market and distribution

Standards Landscape – Zones & Interop Levels

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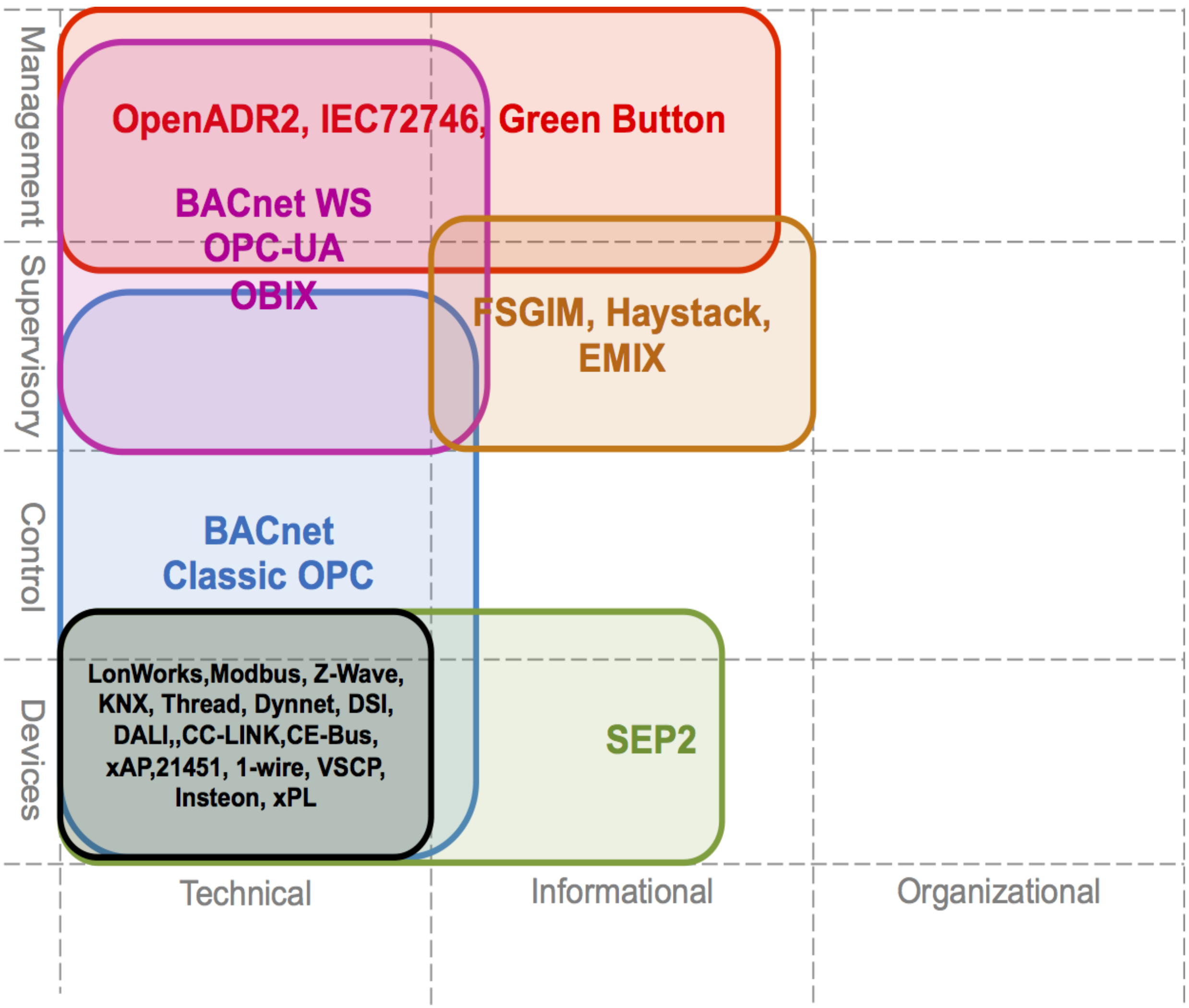

Strategy

> *"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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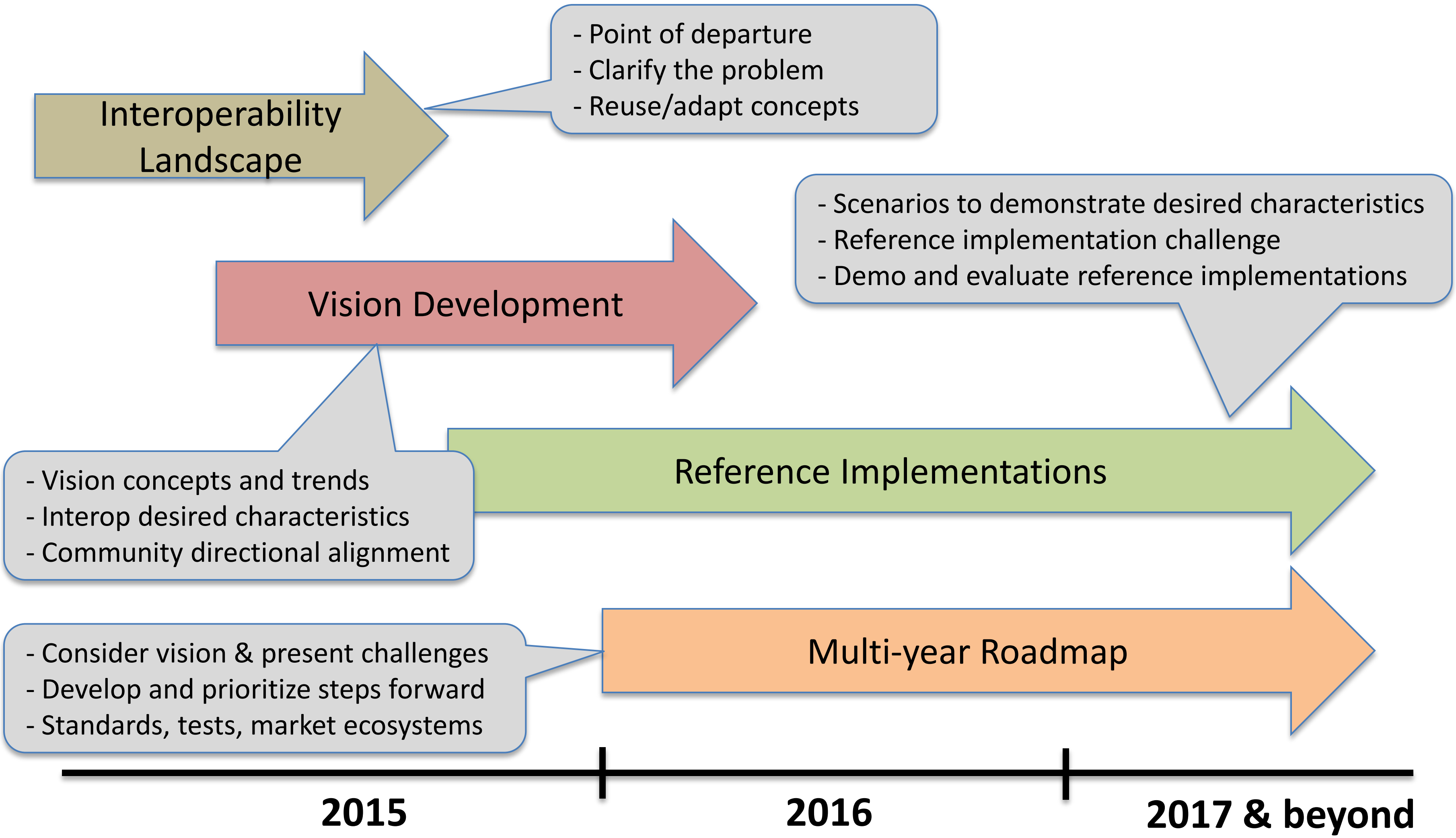

More Information

- Please review Buildings Interoperability Landscape draft doc
  - http://energy.gov/eere/buildings/downloads/buildings-interoperability-landscape-draft
  - In process of addressing comments for the next version
- 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
- Interested in contributing to interoperability vision and roadmap?
  - Contact

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