

The logo for Consumers Energy, featuring the company name in blue bold italicized font, with a green swoosh graphic that starts under the 'C' and ends under the 'y'.

***Consumers Energy***

***Count on Us***

***Managing Scale and Agility:  
Transformational Architecture for the  
Smart Grid***

Wayne Longcore

Director Architecture & Standards

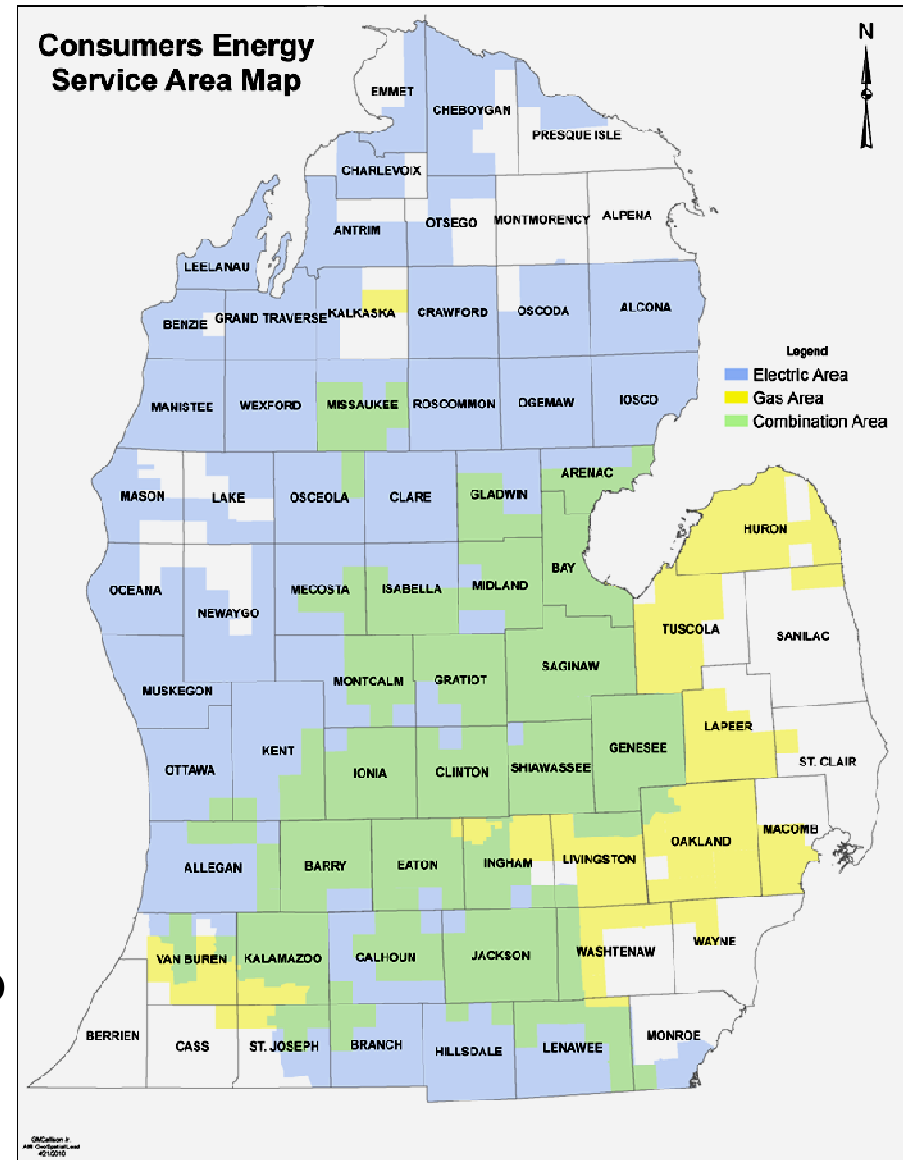
May 20, 2010

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- **What is Consumers Energy?**
  - **What is the Ultra Large Scale systems theory?**
  - **What is the world's largest machine?**
  - **What organizations are involved?**
  - **What is the EISA act of 2007?**
  - **What is the conceptual model of the smart grid?**
  - **What are we doing to be agile architecture?**
  - **What is the vision?**
  - **What is the future?**
  - **What are the three Laws of Robotics?**

# Consumers Energy Overview



- **The Utility**
  - Principal subsidiary of CMS Energy
  - 7,600 employees
  - \$6.2B in annual sales
- **Electric and Gas Service**
  - 1.8 million electric customers
  - 1.7 million gas customers
  - 70,000 miles of electric lines
  - 27,000 miles of pipelines
- **Generation**
  - 37,000 GwH per year
  - Fleet of 28 facilities/plants
  - Mix of coal, natural gas and hydro
  - New 830 MW clean coal plant proposed 2017 completion



- Increasingly complex systems characterized by thousands of *platforms*, sensors, decision nodes, ... connected through heterogeneous wired and wireless networks. ... far beyond the size of today's systems and *systems of systems* by every measure: number of lines of code; number of people employing the system for different purposes; amount of data stored, accessed, manipulated, and refined; number of connections and interdependencies among software components; and number of hardware elements. They will be ***Ultra Large-Scale (ULS) systems***.
- **Research agenda-**
  - **Human Interaction:**
  - **Computational Emergence:**
  - **Design:**
  - **Computational Engineering:**
  - **Adaptive System Infrastructure:**
  - **Adaptable and Predictable System Quality:**



# ***The World's Largest Machine***



# ***What is the Smart Grid***

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## ***The Smart Grid will:***

- **Enable active participation by consumers**
- **Accommodate all generation and storage options**
- **Enable new products, services and markets**
- **Provide power quality for the digital economy**
- **Optimize asset utilization and operate efficiently**
- **Anticipate & respond to system disturbances (self-heal)**
- **Operate resiliently against attack and natural disaster**

# ***What is the EISA Act of 2007***

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## ***Energy Independence and Security Act (EISA) of 2007 Title XIII, Section 1305. Smart Grid Interoperability Framework***

**In cooperation with the DOE, NEMA, IEEE, GWAC, and other stakeholders, NIST has “primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems...”**

# ***May 18, 2009 White House Meeting***

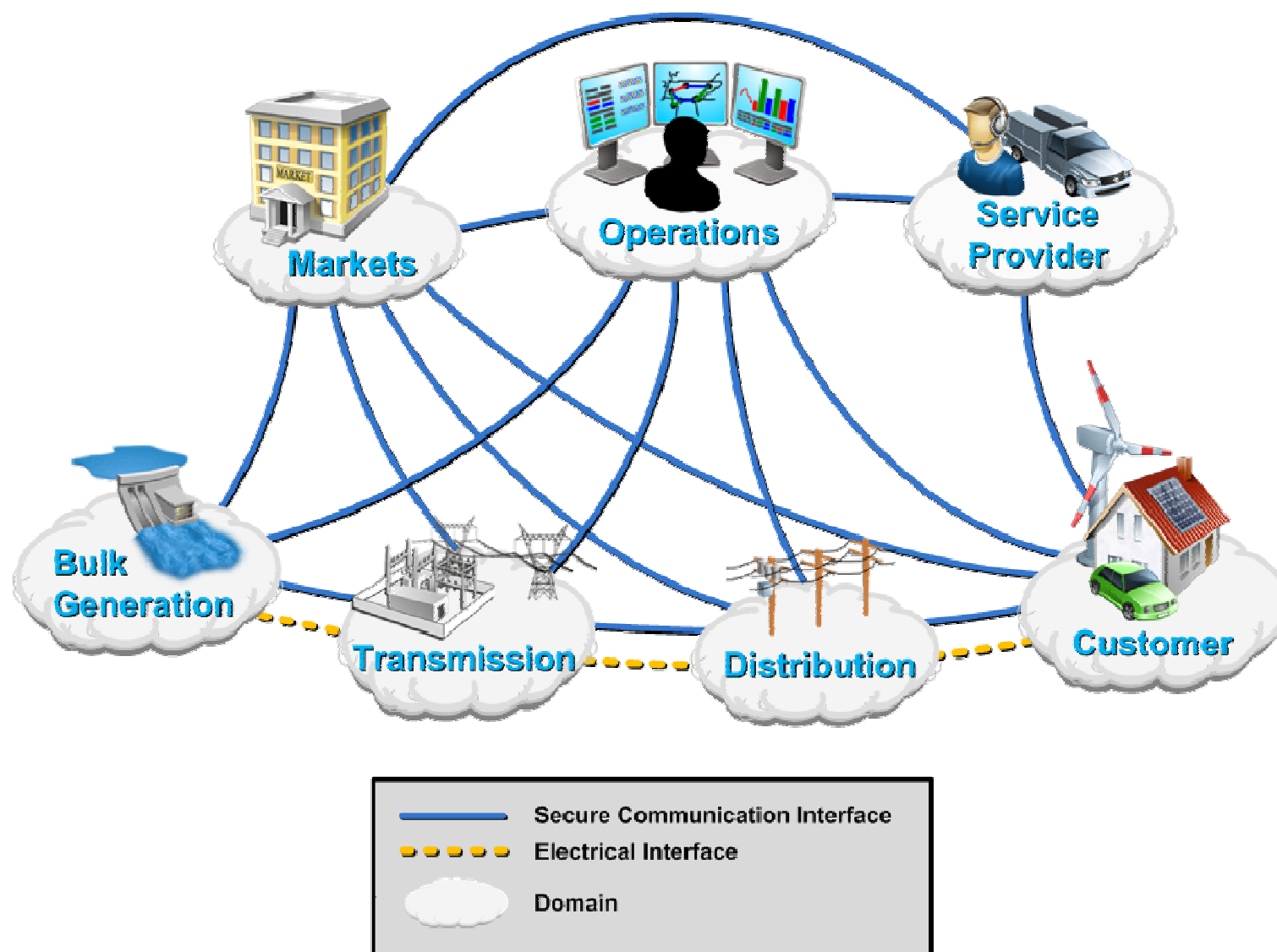
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- Need to move fast - it can be done!
- Consensus does not mean unanimity
- SG investments being made now cannot be ignored
- Standards need to allow innovation
- Open standards are essential
- Today's regulatory assumptions may have to evolve
- Chaired by Secretaries Locke and Chu
- 66 CEOs and senior executives, federal and state regulators

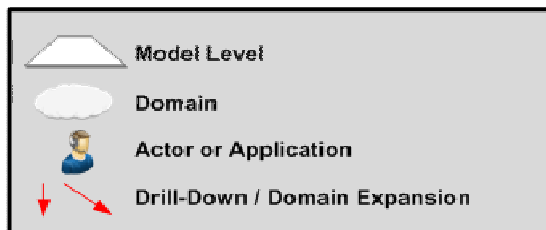
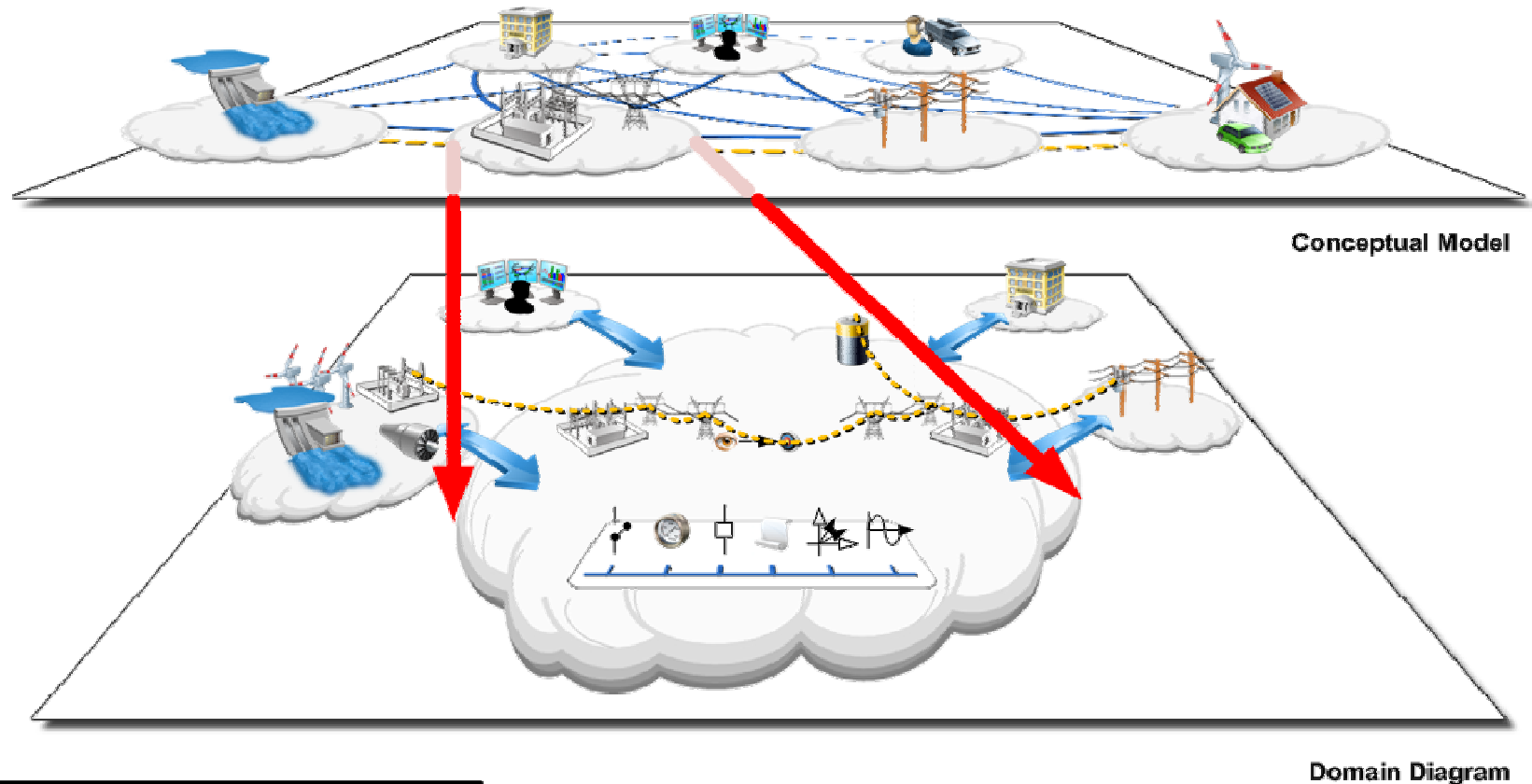
# *Conceptual Model – Views as a Tool*

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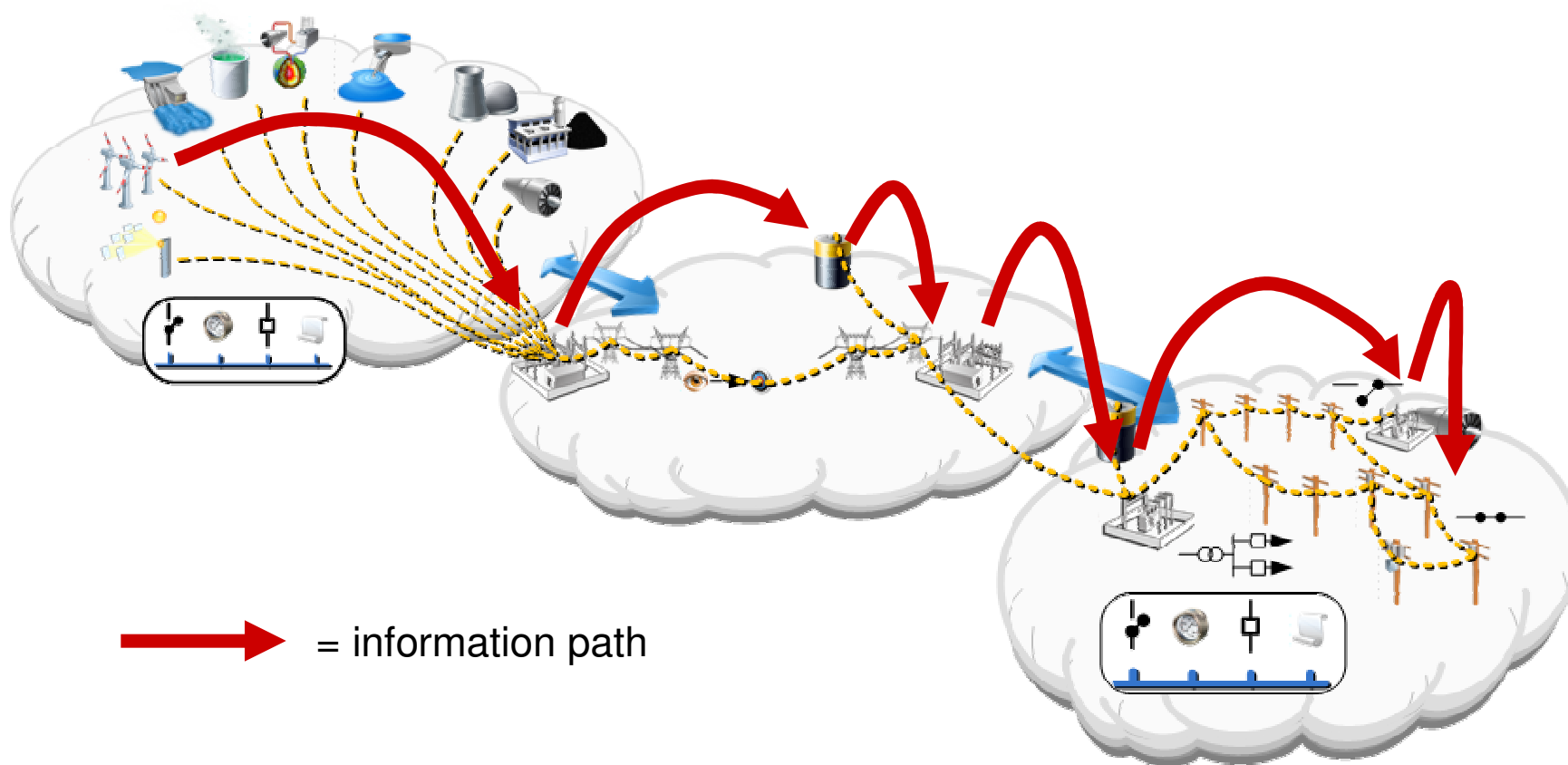




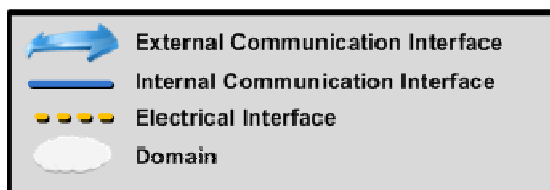
# Levels of the Conceptual Model



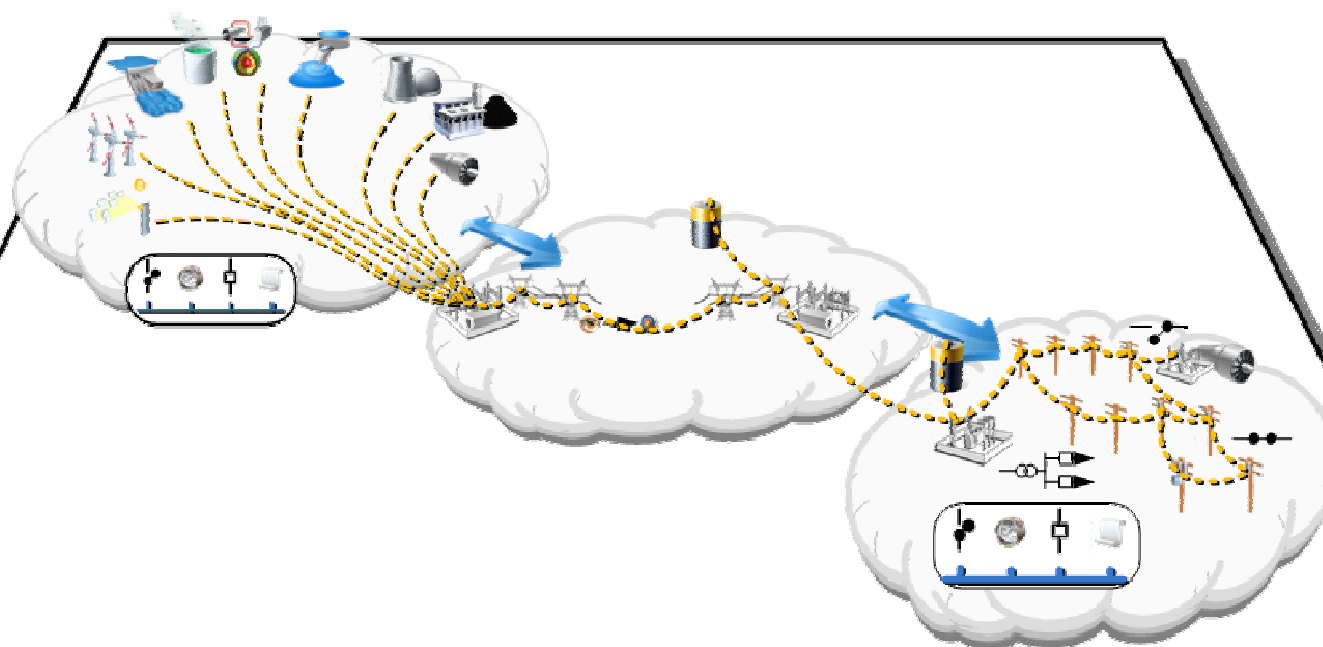
# ***Use Cases: Paths Through the Model***



→ = information path



# ***Interoperability Layers & the Model***



**Organizational:** Policy, Business Objectives, Business Procedures

**Informational:** Business Context, Semantic Understanding

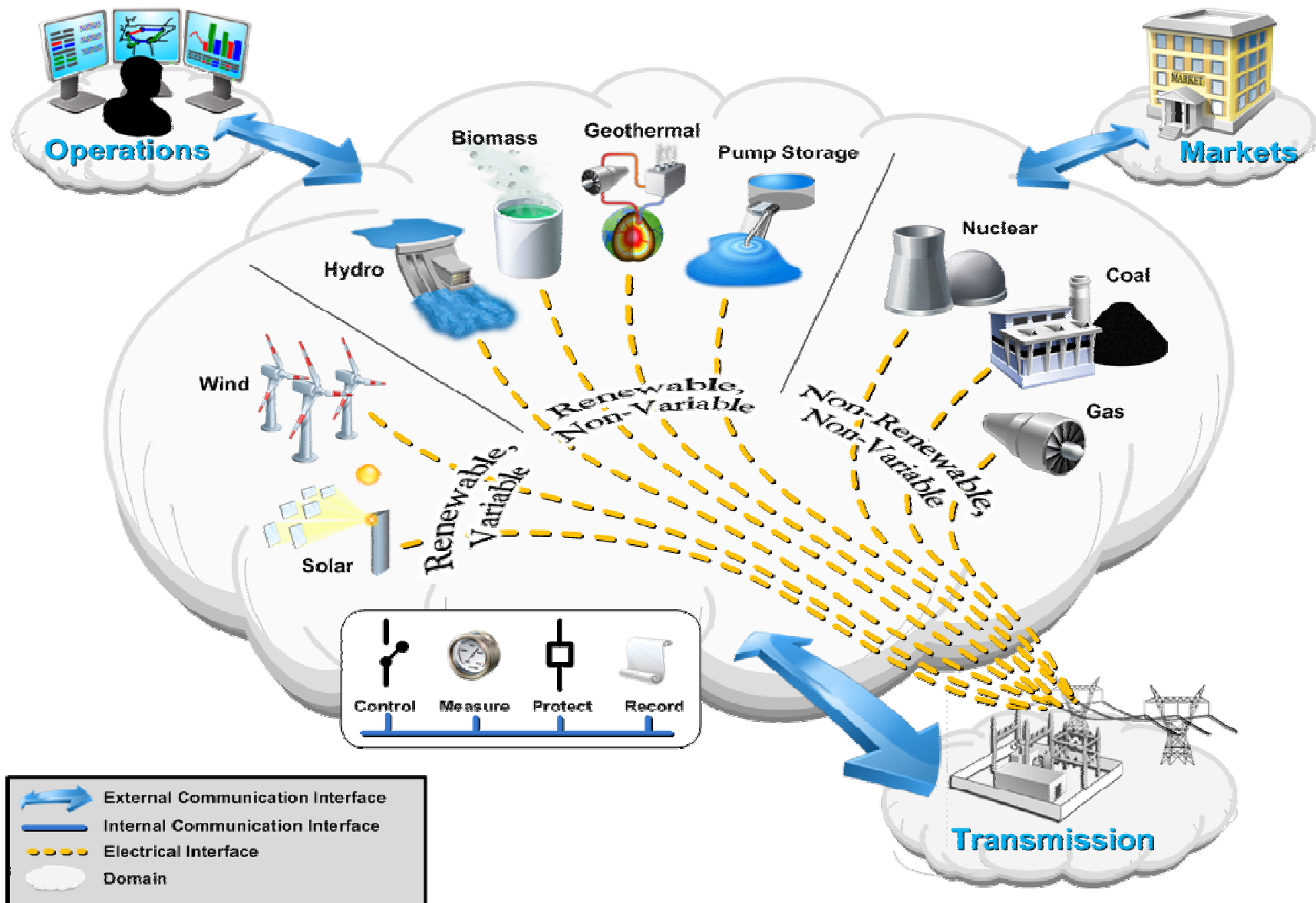
**Technical:** Syntactic Interoperability, Network Interoperability, Connectivity

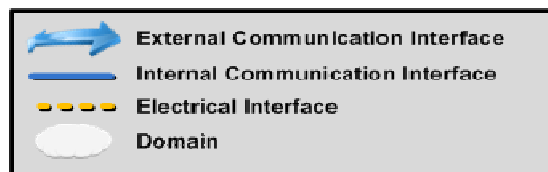
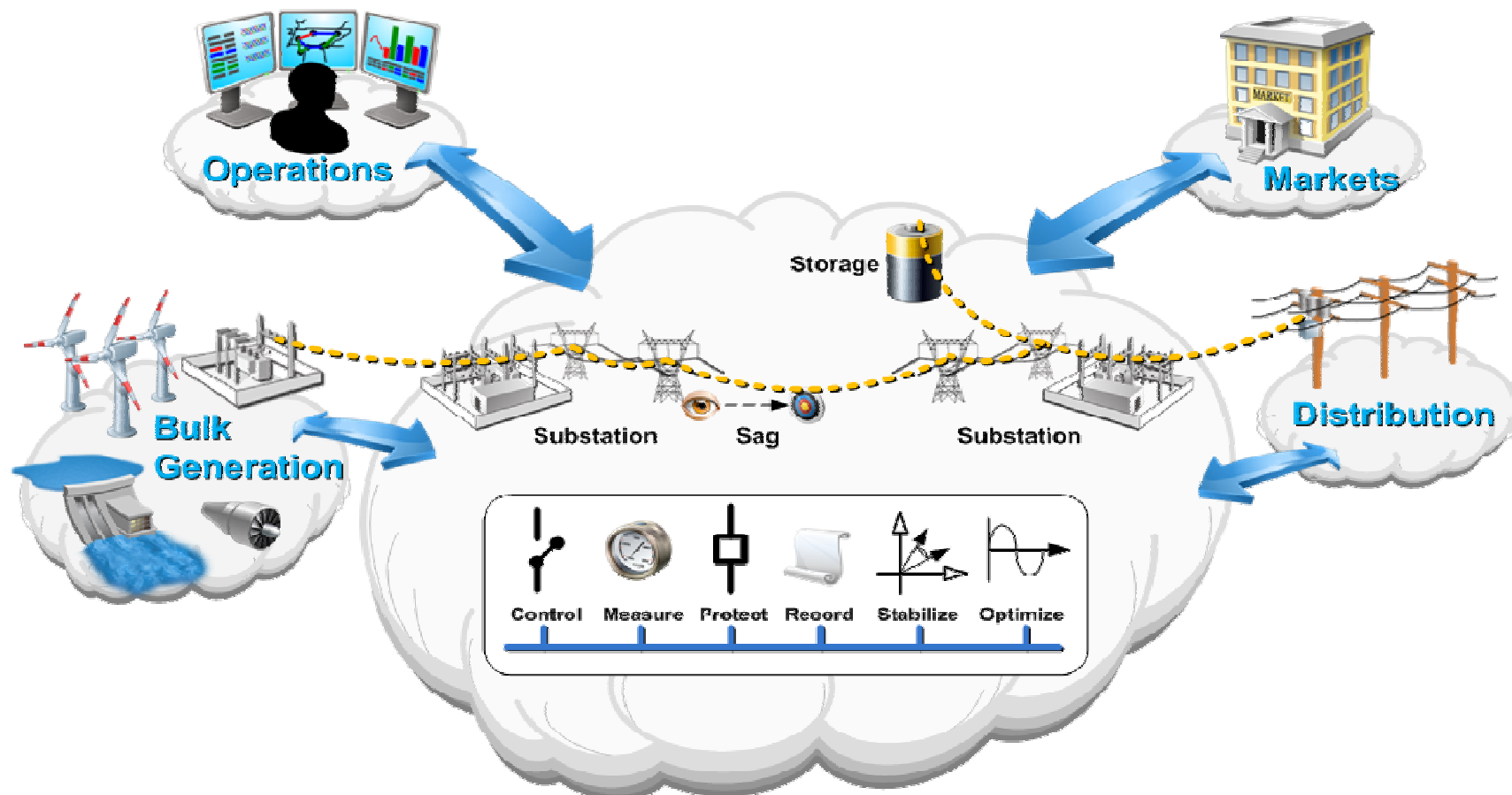
**Cross-Cutting Issues:** Security, Resource Identification, Time Synch, etc.



# Bulk Generation

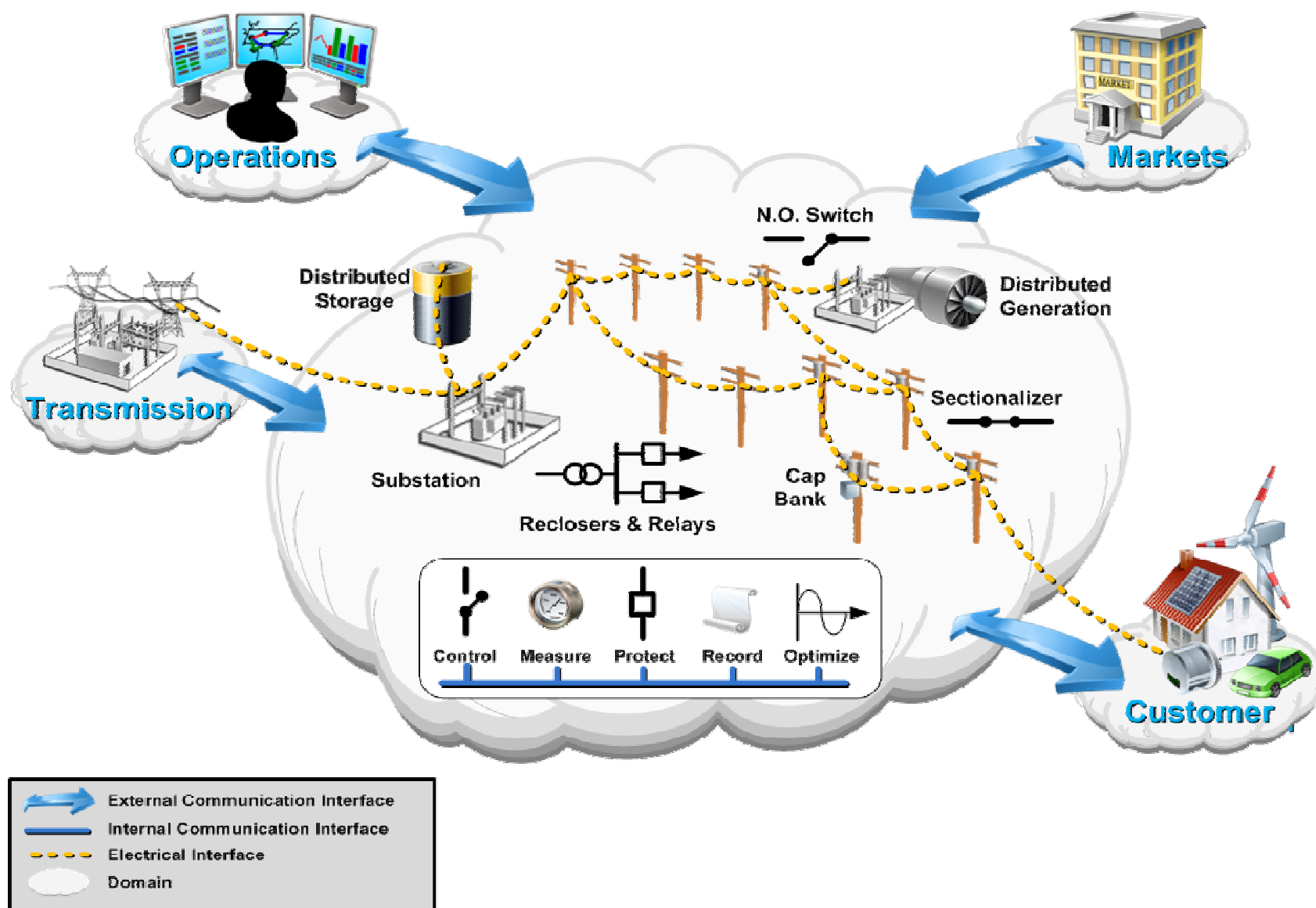
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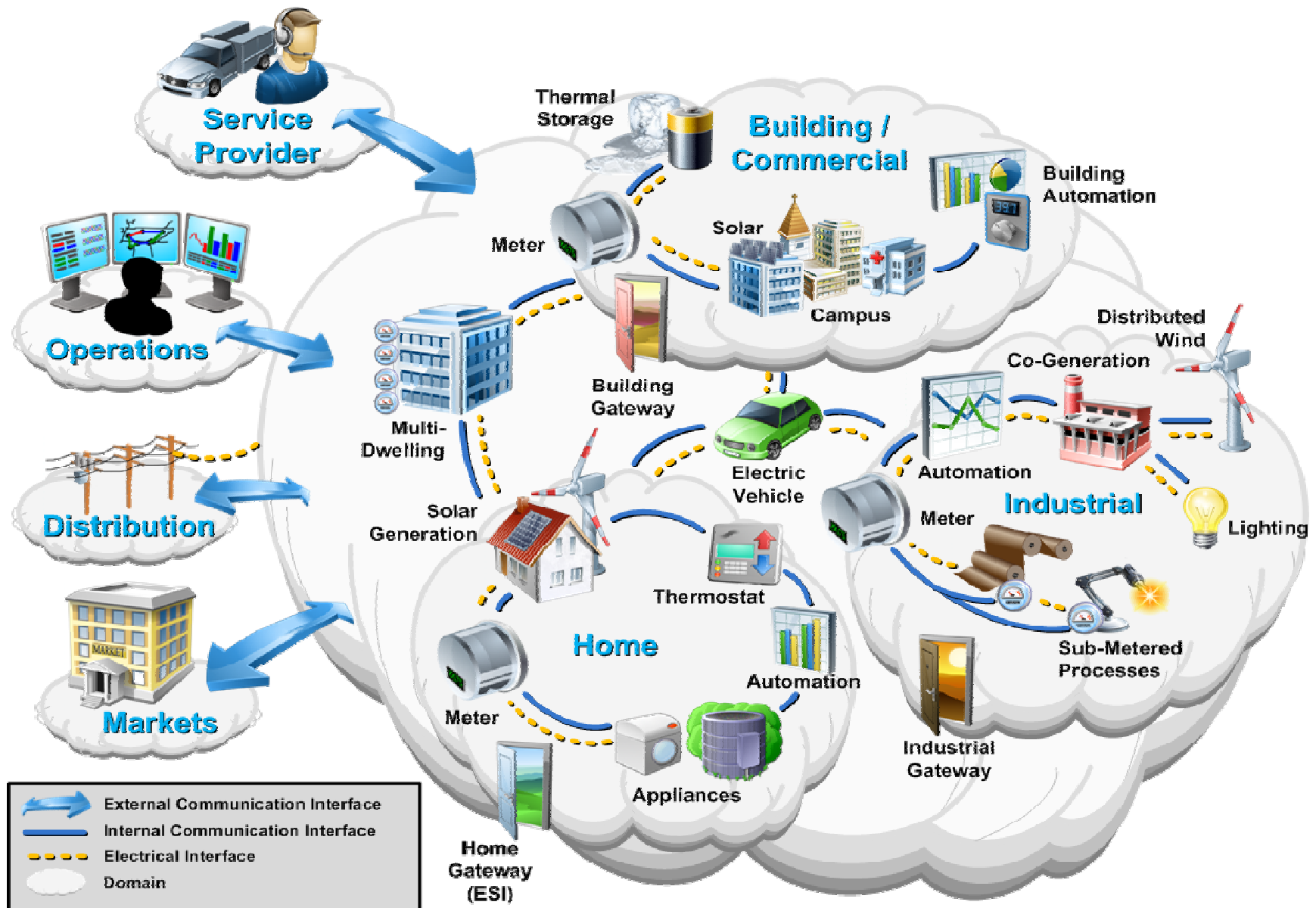


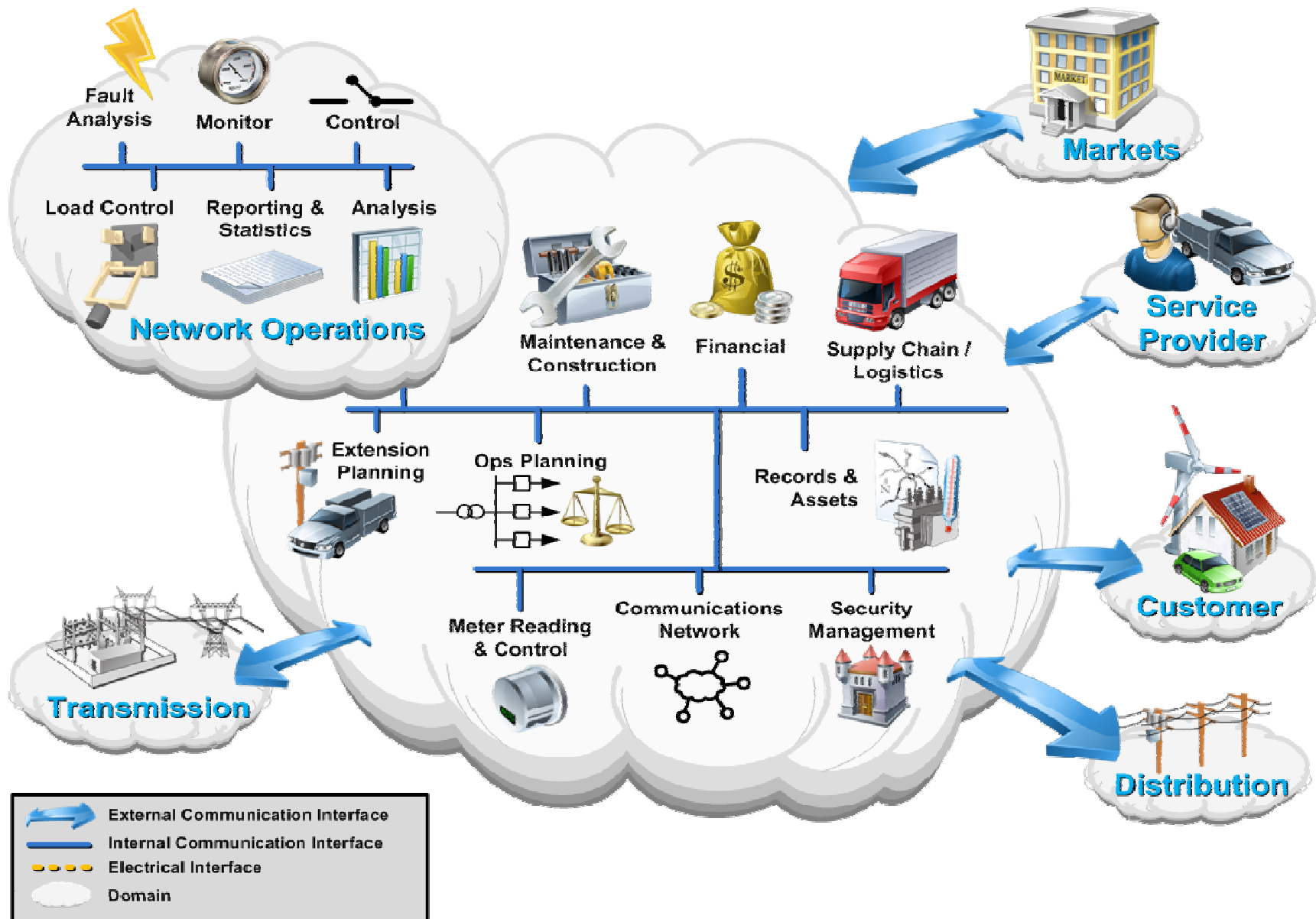


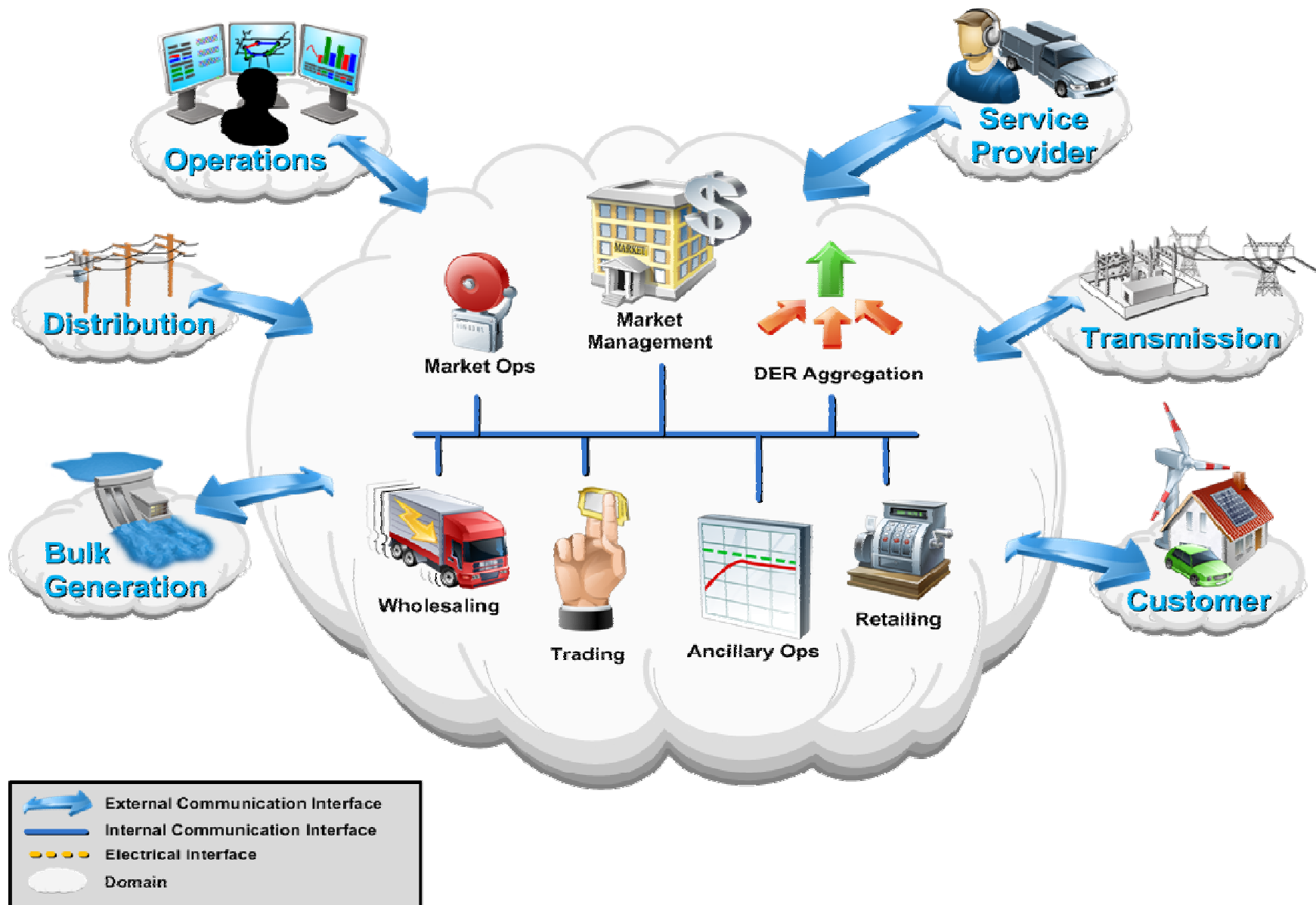
# Distribution

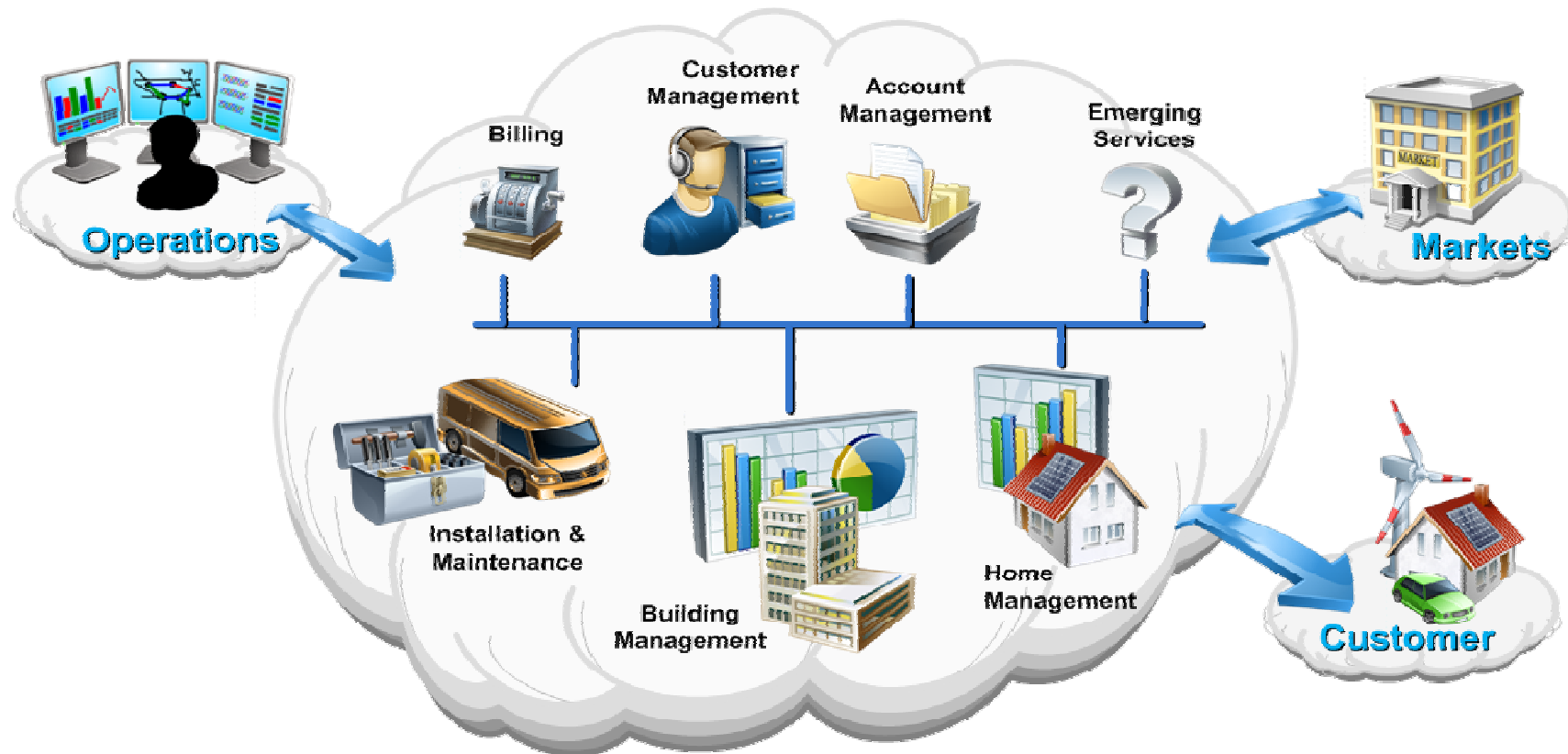
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# ***Will it Ever Work Together***

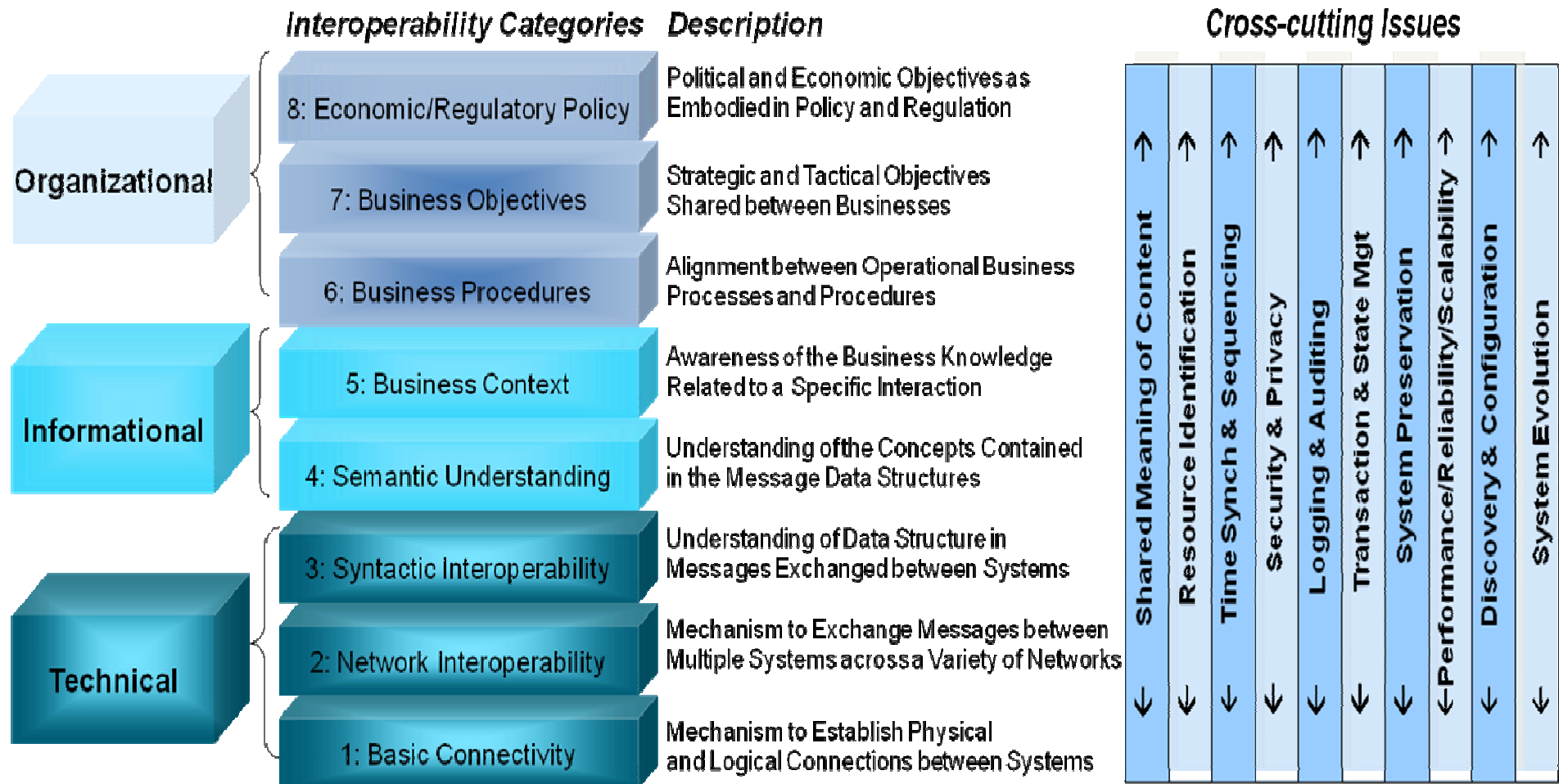
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- How does one validate a real world end to end integration?
- How does one validate integration with many vendors?
- How does one validate usability and simplicity overall?
- How does one validate real-world security?
- There are 3100+ utilities
- There are many regulatory, ISO and RTO models
- There is retail, wholesale, regulated and deregulated models
- There are commercial, industrial and residential models
- The need for standards and interoperability

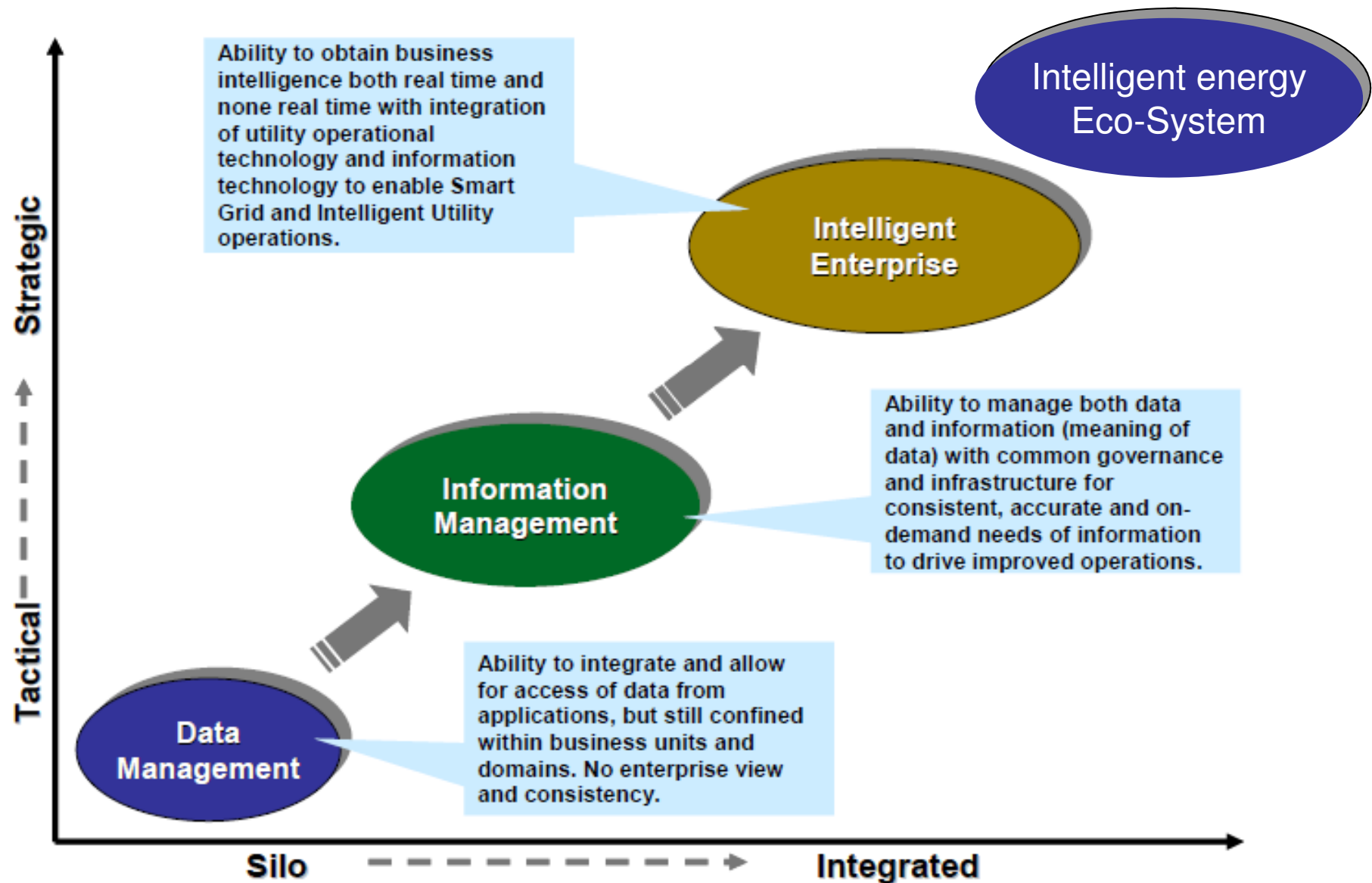


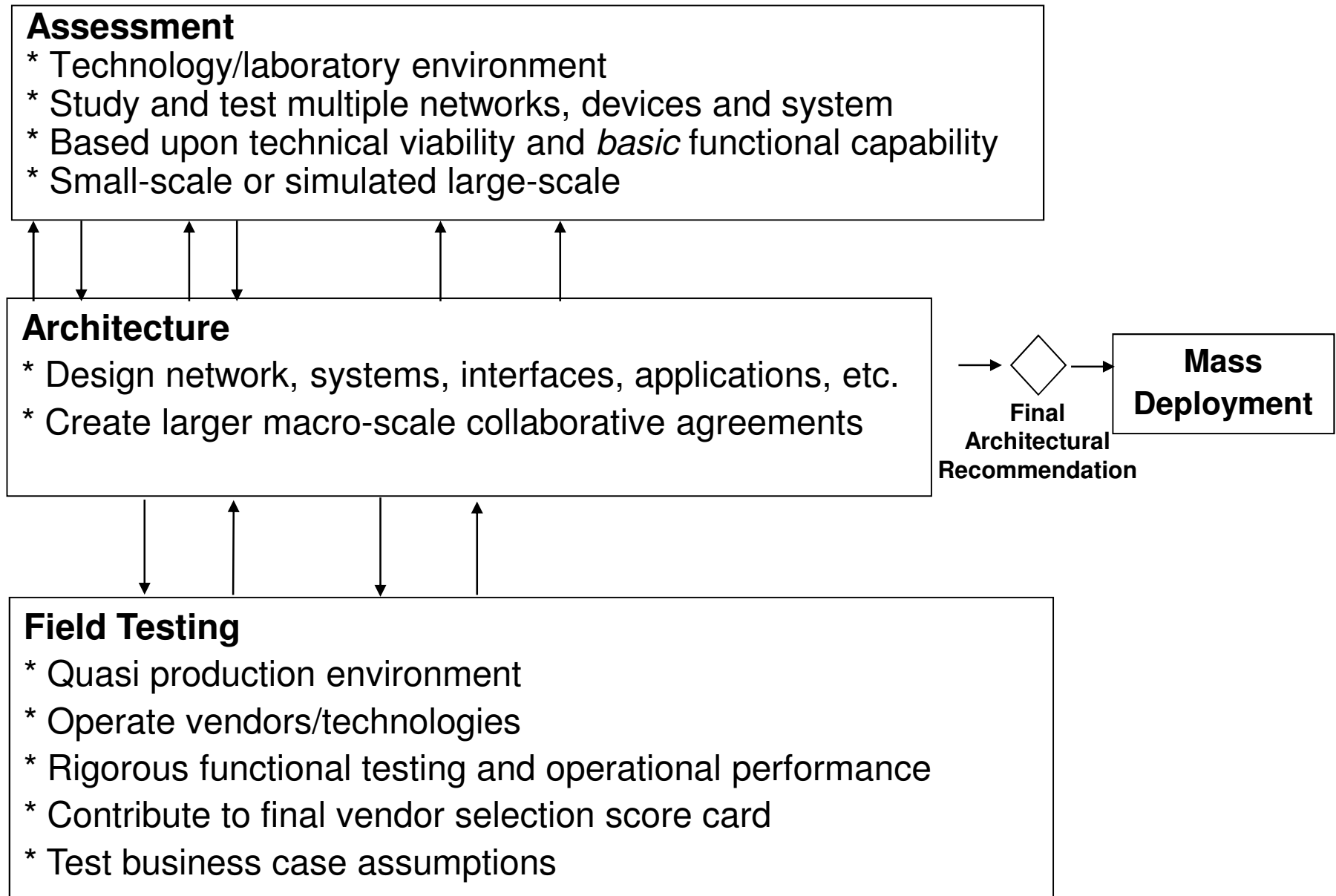
# Interoperability- GWAC Stack



# What about the Eco-System

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# *Smart Service Learning Center The Little Galapagos*



Less talking  
More doing

Agile Architecture



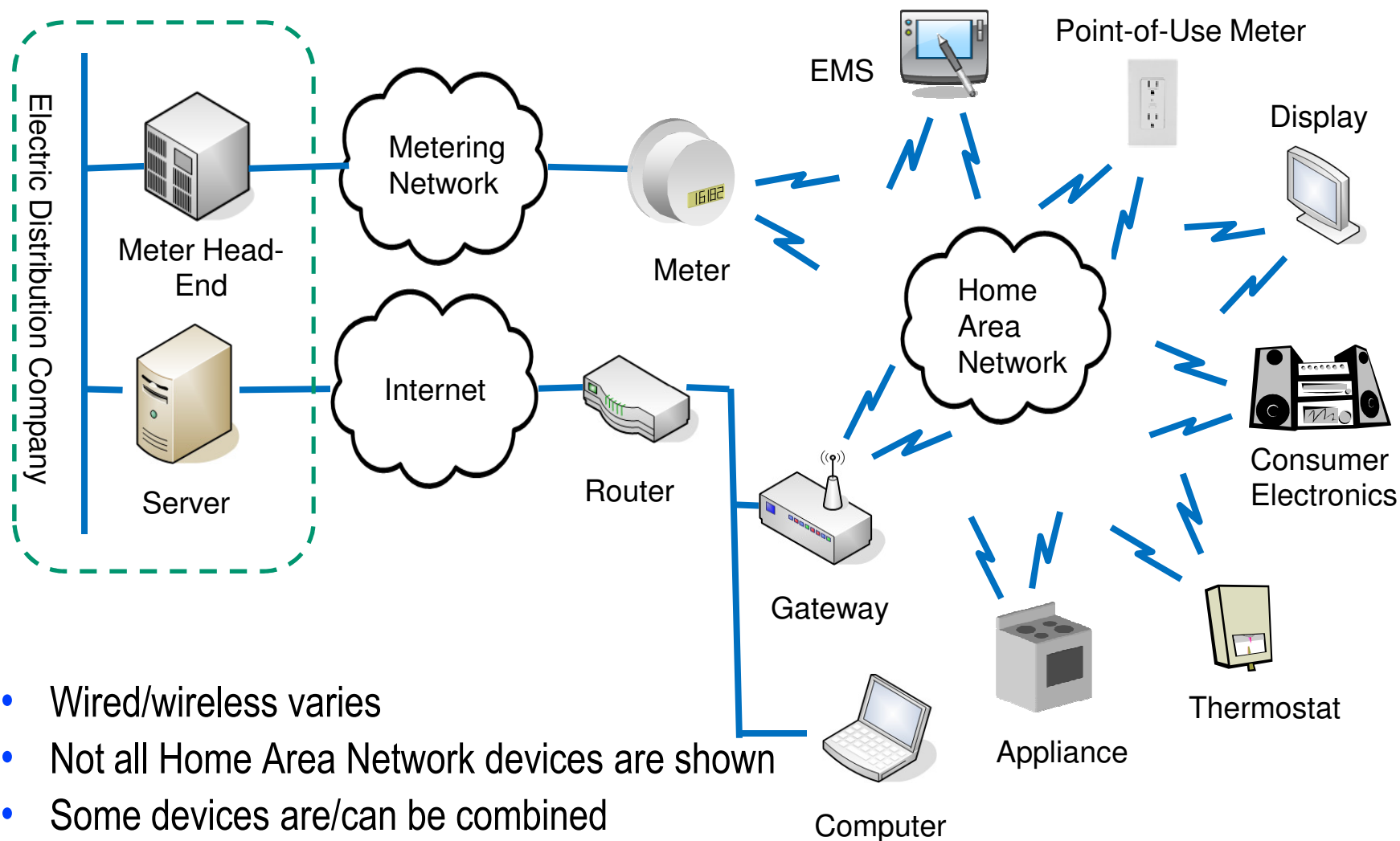
# ***Value to Many Stakeholders***

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- How does the grid impact the home? Lifestyle?
- Experience-oriented investigation
- Public access
- Home settings
  - Appliances
  - Environments
  - Varied lighting
  - Electronics
  - Automation
  - Smart Grid



# Allowed HAN Energy Communications Architecture



- Wired/wireless varies
- Not all Home Area Network devices are shown
- Some devices are/can be combined
- Point of interface varies





- **Stages**

- The Internet of things
- The sale of a commodity
- The delivery of information
- Thousands of standards used as a cohesive program
- Building a language for the energy eco-system
- The foundation for an unknown future

- **Robots**

- Who buy their food
- When their masters deem appropriate

- **The upsell of a commodity**

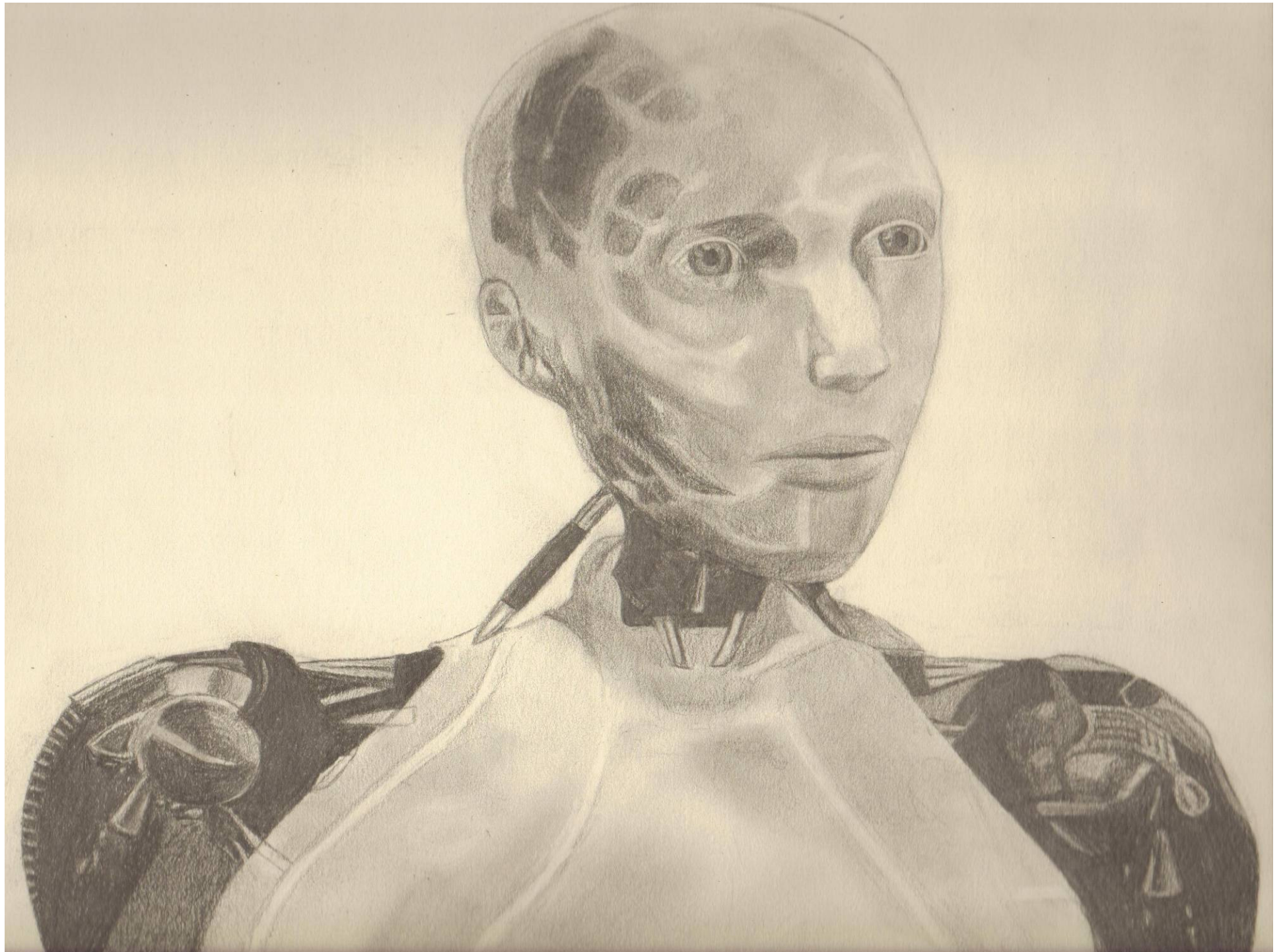
- The lowly coffee bean \$\$.01
- The ground coffee \$.02
- The endless perked coffee with breakfast \$.50
- The Starbucks experience \$2.60





- **What would English be if words were in the dictionary only when**
  - You paid for them
  - You lived in a certain village
- **The grid follows the laws of physics not just economics**
- **The laws of economics are being forgotten**
  - Markets where some must buy at retail and sell at wholesale
  - Markets where spoilage is not considered
  - Markets where road size and trucks are expected to be infinite
  - No mechanism for storage cost recovery
  - No mechanism for local market pricing / control
- **iRobot**
  - Aggregated devices under control can be a problem
  - People are using the wrong paradigms for ubiquitous devices
    - ◆ Firewalls versus firelanes, deterrence versus detection
  - Aggregated devices will happen whether there is a Smart Grid or not





# ***The Three Basic Laws***

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- **Moore's Law**

- 1: Circuits on a chip double approximately every 18 months
- 2: The cost of a fab plant doubles with every second generation

- **Metcalf's Law**

- Value of a telecommunications network is proportional to the square of the number of connected users of the system
  - ◆ A network of fifty-thousand nodes in a standard utility is worth 1/40,000 of a network of ten-million nodes in a smart grid utility
  - ◆ New development follows value

- **Longcore's Law**

- Firmware in new devices grows and firmware in new devices that have connectivity and security requirements grows exponentially
- Networks must be sized to deliver upgrades over their lifespan

- **Security is not itself a goal; rather it supports goals:**
  - **Reliable electric grid**
  - **Controllable electric grid**
  - **Safeguards**

- **100% Security is Mythical**
- **Primary Goals of CyberSecurity:**
  - **Deter/Delay Attacks**
    - ◆ Increase difficulty with firewalls and hardened configurations
    - ◆ Vendor relationships/security reviews
    - ◆ Update vulnerability management
  - **Monitoring/Alerting**
    - ◆ Field-deployed - using different platforms
    - ◆ Network and system monitoring
    - ◆ Sanity-checking Smart Grid application firewalls (future)
  - **Capability for Response**
    - ◆ Firelanes and rangers towers in ubiquitous environments
    - ◆ Firewalls in areas where you can have perimeters
    - ◆ Policy and procedures with communications plan

# ***Validate Everything***

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***Make the standards real!***

