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EnerNex CORPORATION

The Smart Grid

NIST Interim Smart Grid Roadmap Overview and Conceptual Model

Smart Grid Super Session
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The NIST Role

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**…"

The Need for Standards is Urgent

Example: Smart Meters

- $40 - $50 billion dollar deployment nationwide
- Underway now
- ARRA will accelerate
- Rapid technology evolution
- Absence of firm standards

Source: Congressional Research Service Report

Comparison of Smart Grid with Next Generation Telecom Network

	Telecom Next Generation Network	Smart Grid
Real-world examples	Verizon FiOS, AT&T Uverse	Xcel Boulder, Colorado
First trials	2004	2008
Standards coordination started	2003	2008
# key standards bodies	3	15
Release 1 standards issued	2005	2009
Release 2 issued	2008	Will be issued on rolling basis
# standards documents	~600 so far	Will be hundreds
Nature of standards	Mostly mix & match of existing standards	Mix & match of existing standards and many new

White House Meeting May 18

- Chaired by Secretaries Locke and Chu
- 66 CEOs and senior executives, federal and state regulators

- We 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 for innovation
- Open standards are essential
- Today's regulatory assumptions may have to evolve

We Need A Standards Roadmap

- Capabilities
- Priorities
- Reference Model
- Standards
- Release Plan
- Responsibilities
- Governance
- Testing and Certification

NIST Three Phase Plan

PHASE 1
Identify an initial set of existing consensus standards and develop a roadmap to fill gaps

PHASE 2
Establish public/private Standards Panel to provide ongoing recommendations for new/revised standards

PHASE 3
Testing and Certification Framework

Roadmap Focus Areas

- FERC-identified priority applications:
  - Demand Response
  - Wide-Area Situational Awareness
  - Electric Storage
  - Electric Transportation
- Additional priority applications:
  - Advanced Metering Infrastructure
  - Distribution Grid, including Distributed Energy Resource Integration
- Cross-cutting priorities
  - Cyber Security
  - Data networking

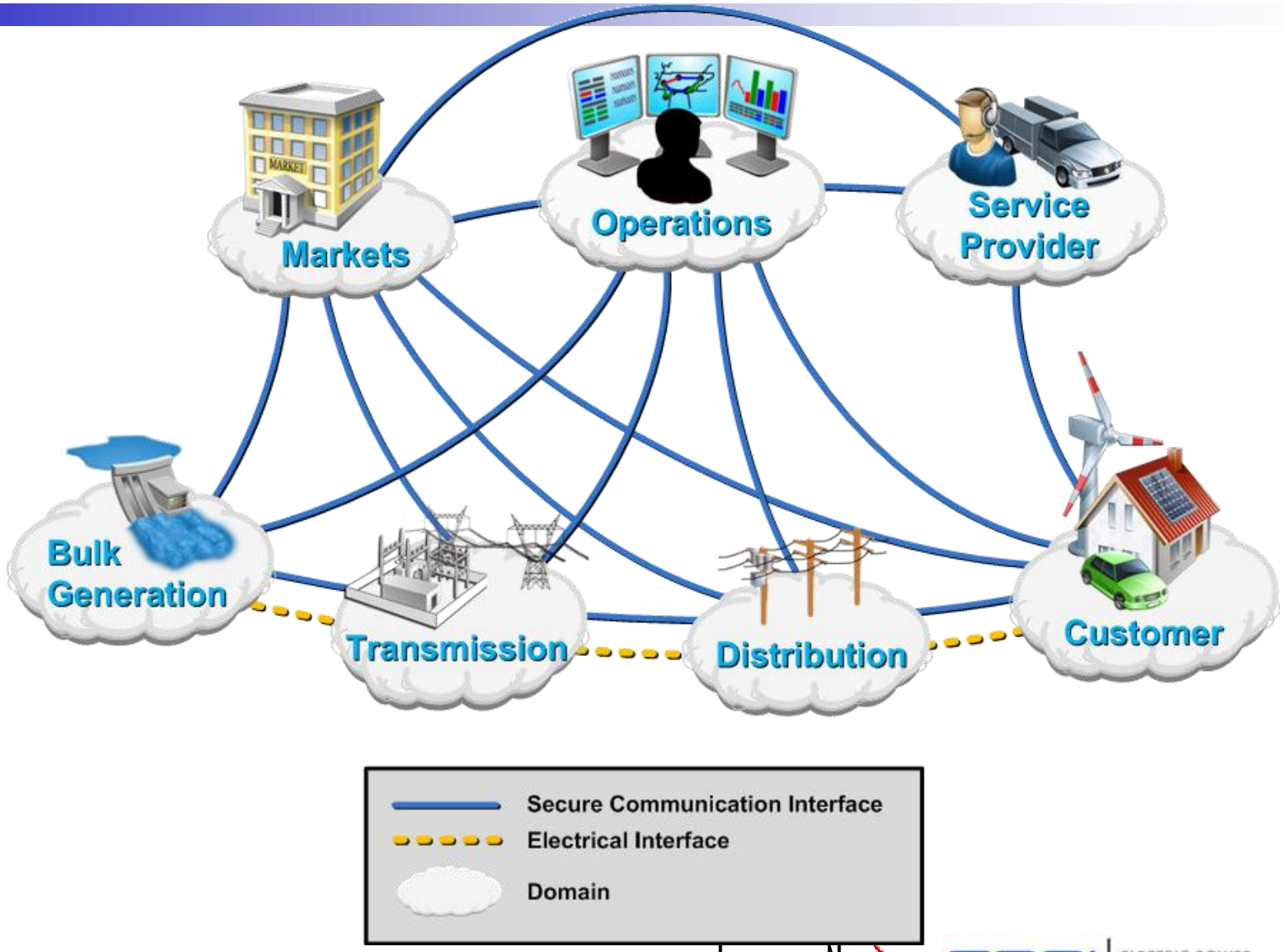
NIST Draft Interim Roadmap - Outline

Executive Summary
Chapter 1: Purpose and Scope
Chapter 2: Smart Grid Vision
Chapter 3: Smart Grid Conceptual Model
Chapter 4: Smart Grid Applications and Requirements
Chapter 5: Cyber Security Considerations for the Smart Grid
Chapter 6: Prioritized Actions
Chapter 7: Definitions
Chapter 8: References
Appendix A: Standards Profiles by Domain
Appendix B: Alphabetical Standards List
Appendix C: Requirements, Standards Gaps, and Issues
Appendix D: Key Use Cases for Cyber Security Considerations
Appendix E: Vulnerability Classes
Appendix F: Crosswalk of Cyber Security Standards

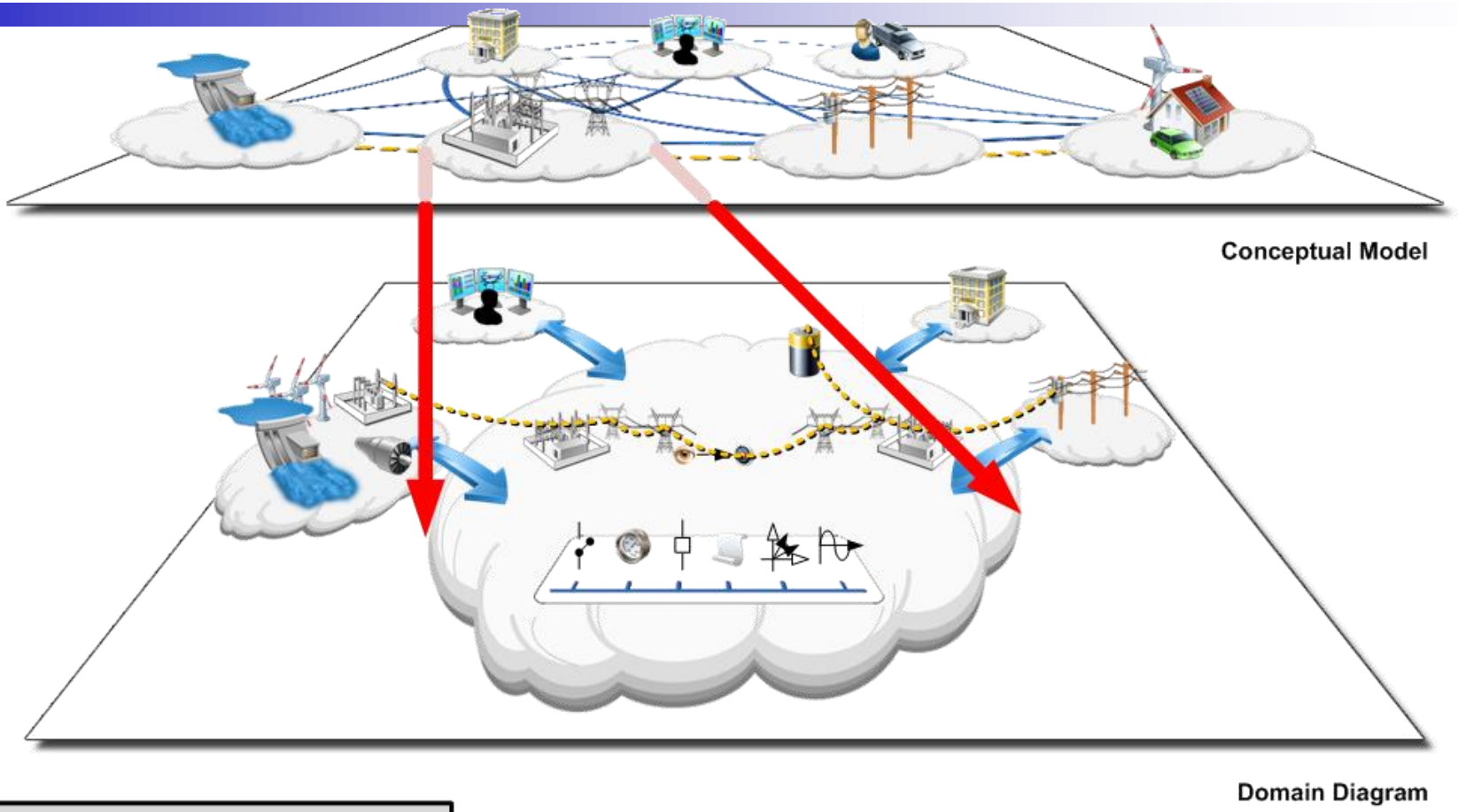
Conceptual Model: Core Principles

- System of Systems – multiple architectures
- General
  - Loose Coupling
  - Layered Systems
  - Shallow Integration
- Interface Related
  - Symmetry
  - Transparency
  - Composition
  - Security

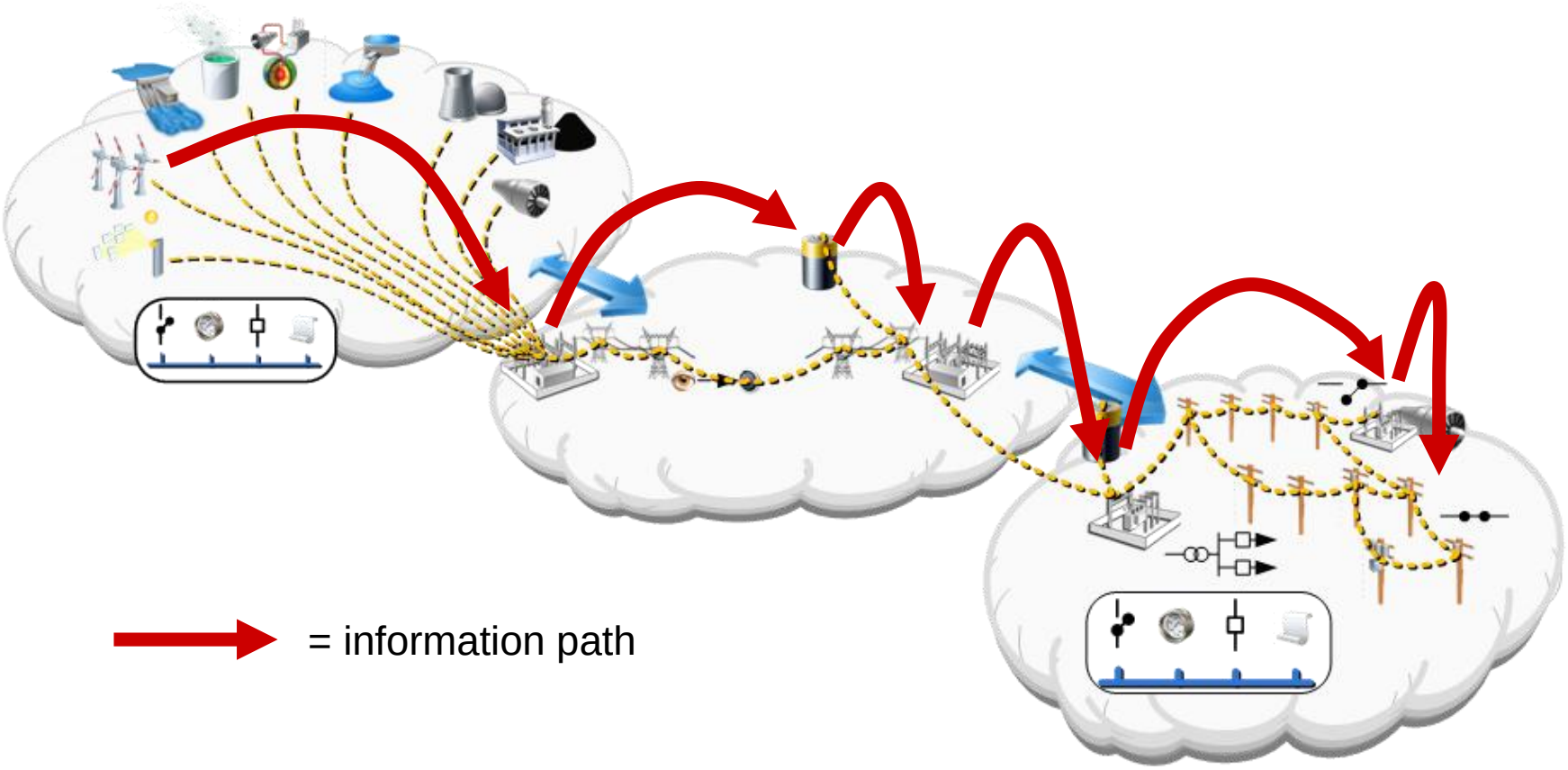
Conceptual Model – Views as a Tool



Levels of the Conceptual Model

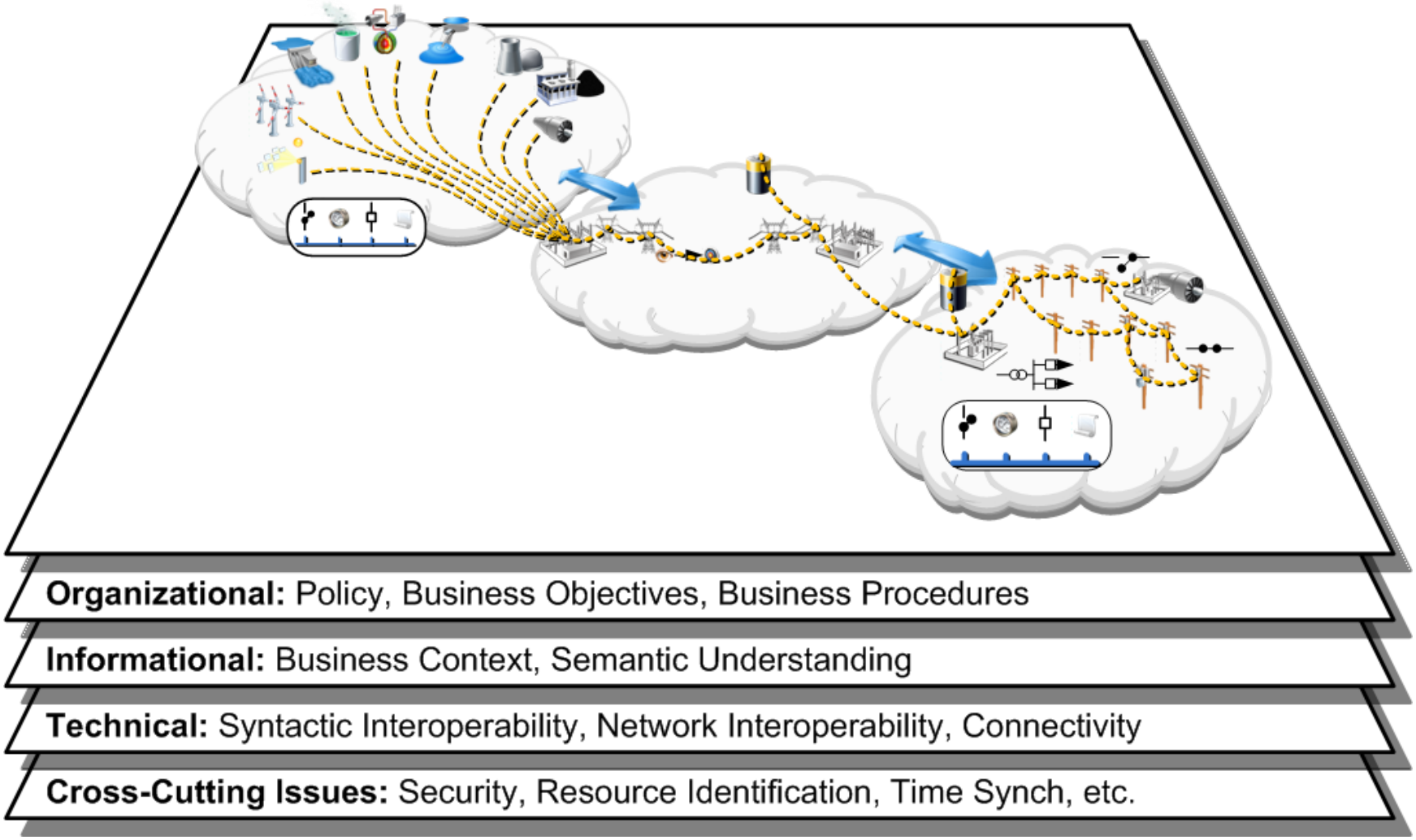


Use Cases: Paths Through the Model

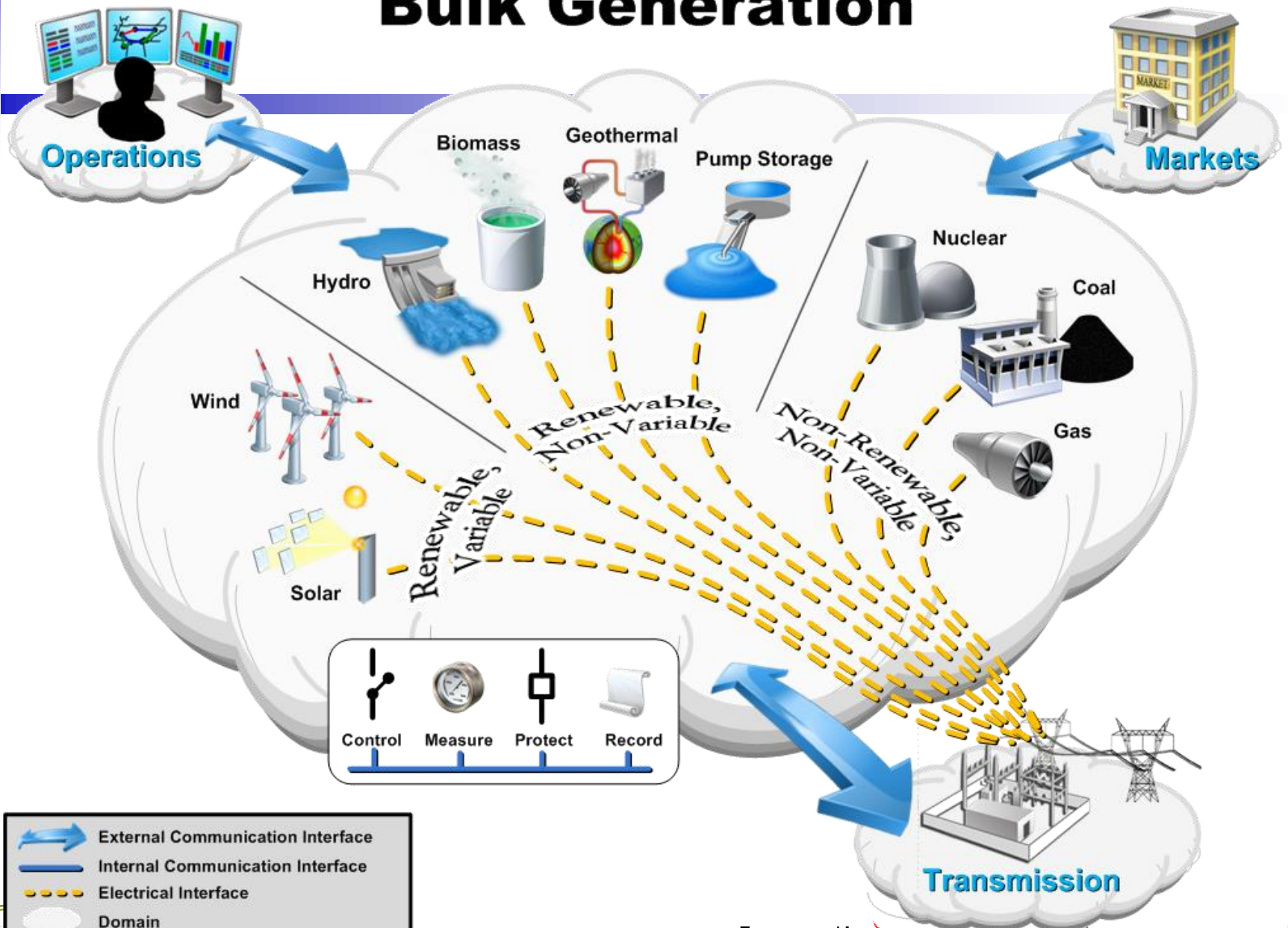


External Communication Interface
Internal Communication Interface
Electrical Interface
Domain

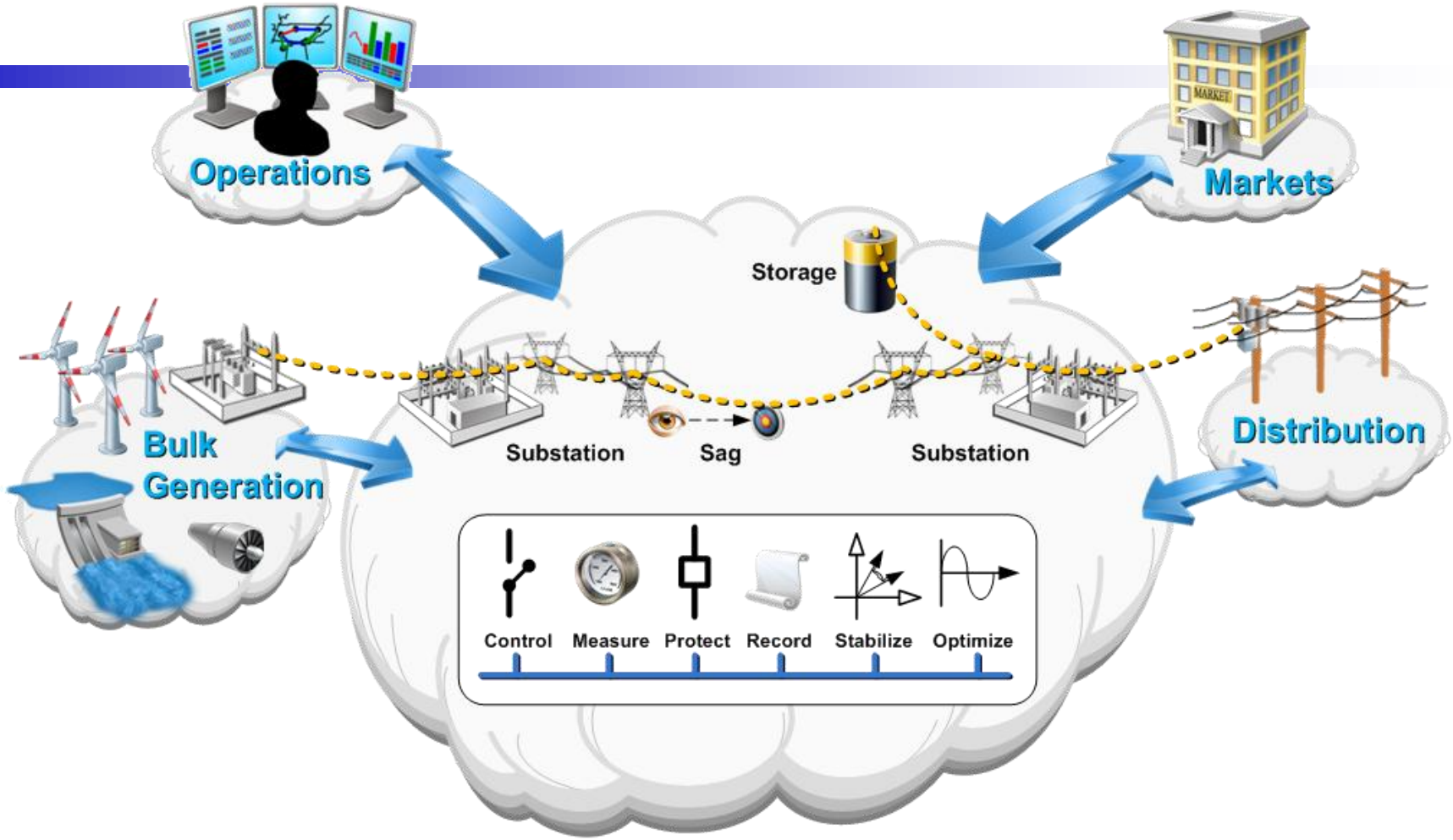
Interoperability Layers and the Model



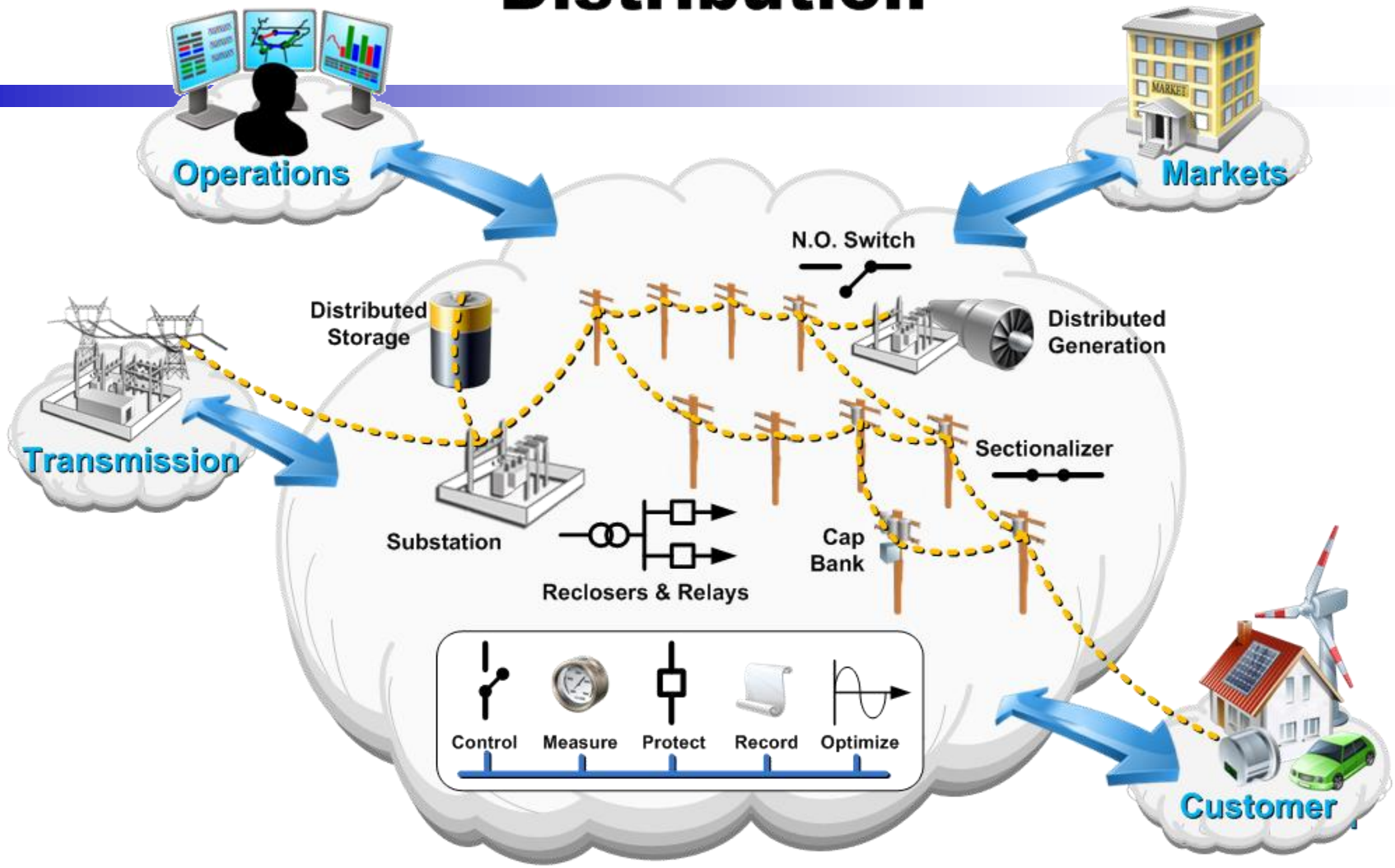
Bulk Generation



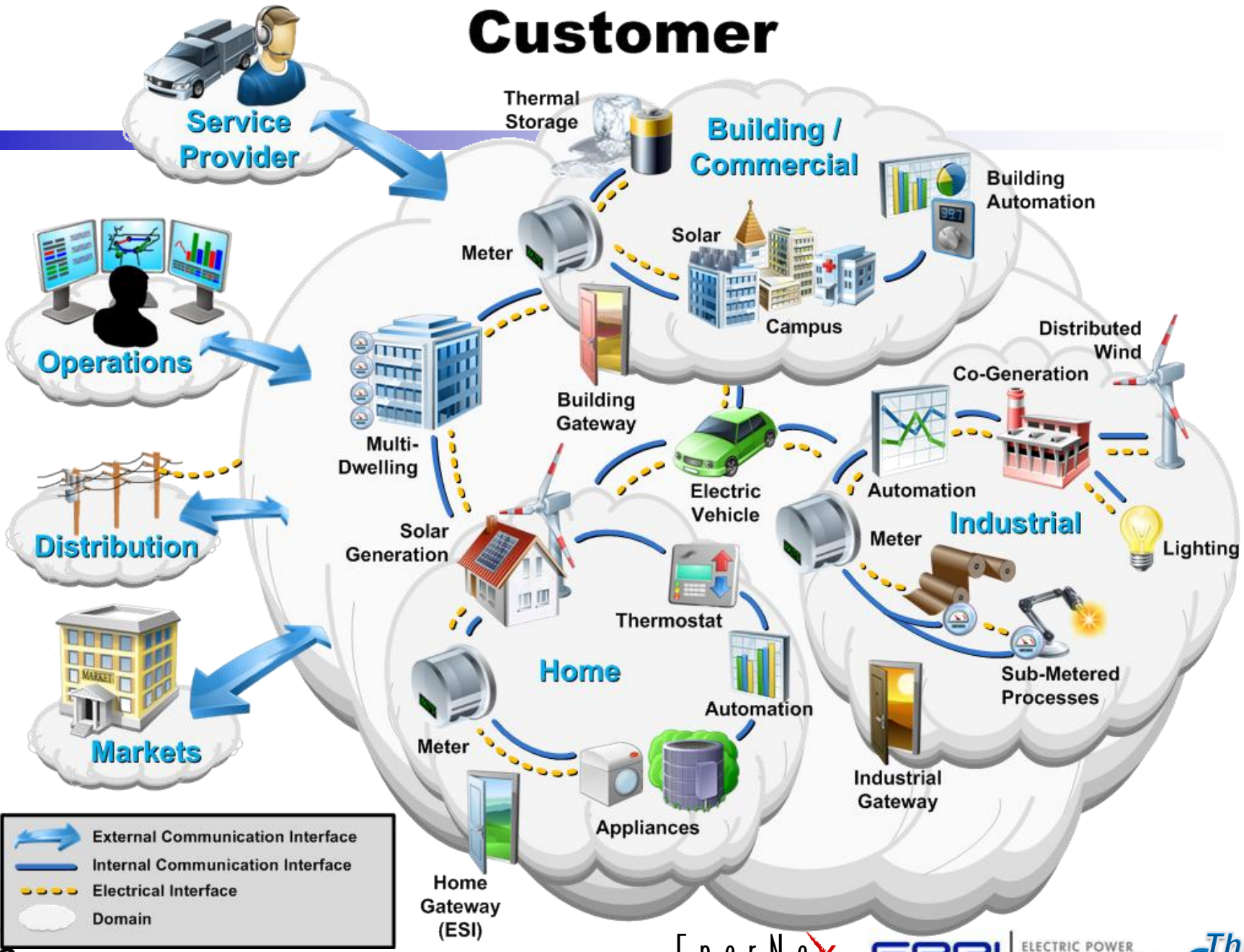
Transmission



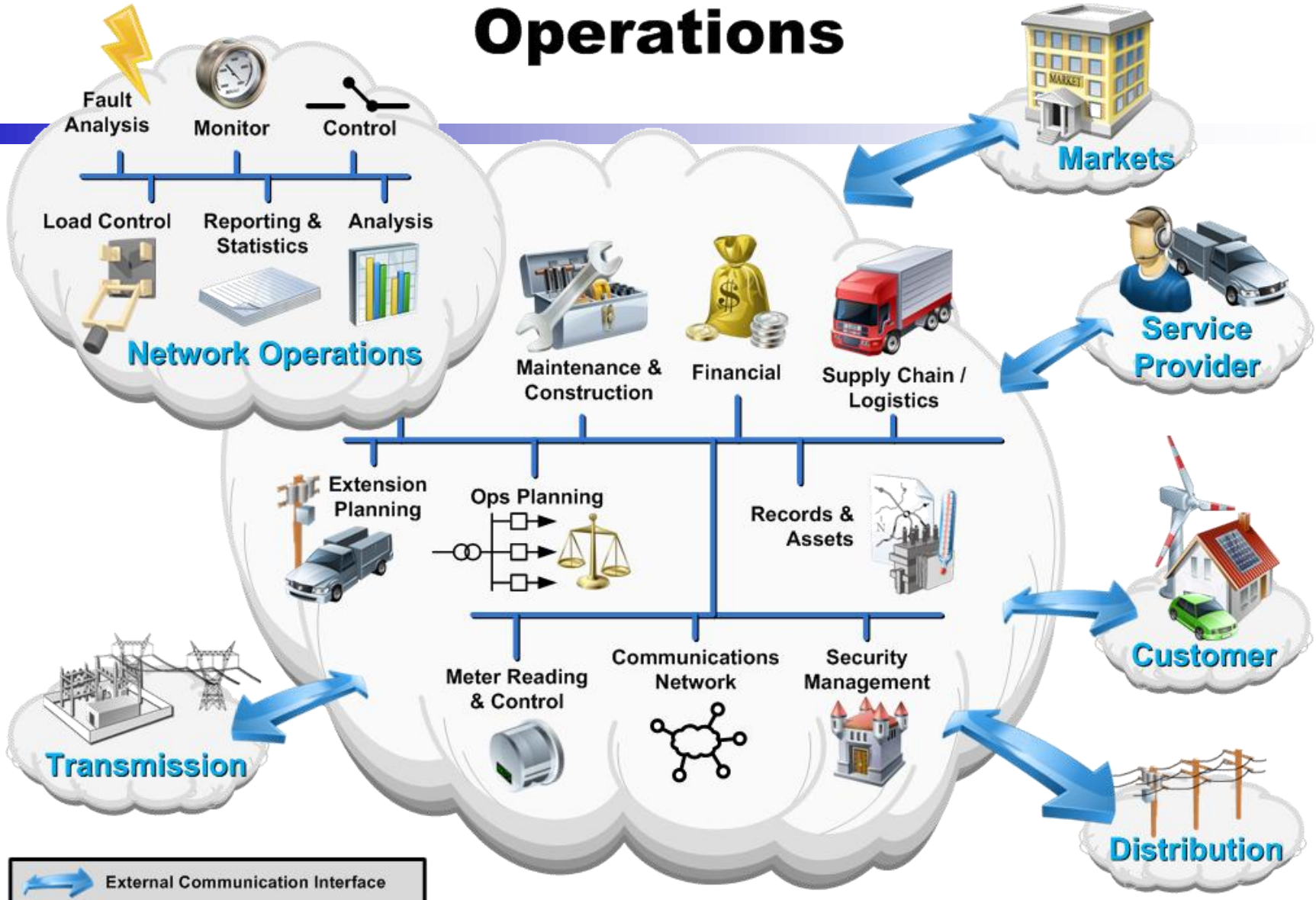
Distribution



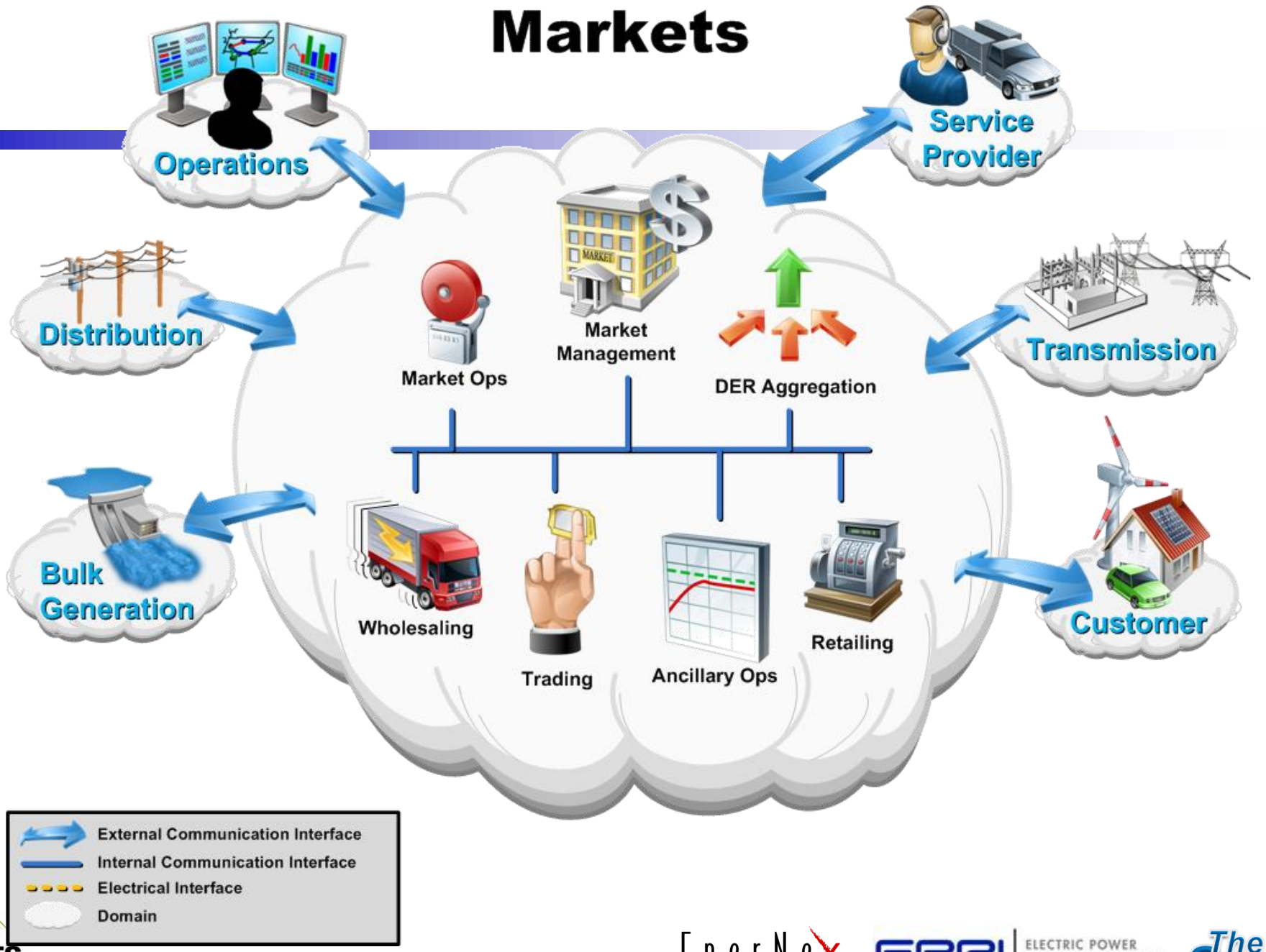
Customer


Service Provider
Operations
Distribution
Markets
Thermal Storage
Building / Commercial
Building Automation
Meter
Solar
Campus
Building Gateway
Multi-Dwelling
Distributed Wind
Co-Generation
Electric Vehicle
Automation
Industrial
Solar Generation
Meter
Lighting
Thermostat
Sub-Metered Processes
Home
Automation
Meter
Industrial Gateway
Appliances
Home Gateway (ESI)
External Communication Interface
Internal Communication Interface
Electrical Interface
Domain

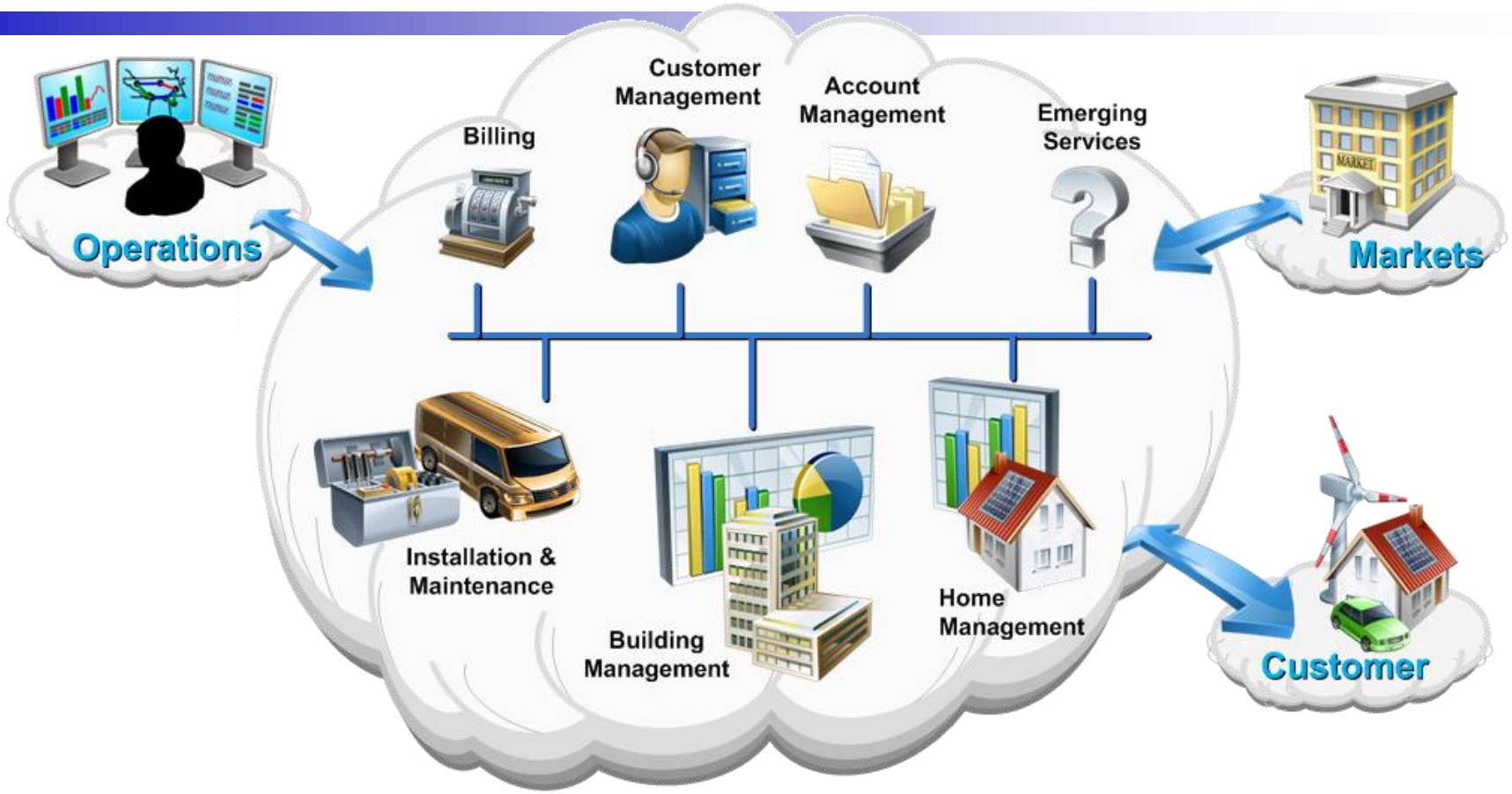
Operations


Fault Analysis
Monitor
Control
Load Control
Reporting & Statistics
Analysis
Network Operations
Markets
Service Provider
Maintenance & Construction
Financial
Supply Chain / Logistics
Extension Planning
Ops Planning
Records & Assets
Meter Reading & Control
Communications Network
Security Management
Transmission
Customer
Distribution
External Communication Interface
Internal Communication Interface
Electrical Interface
Domain

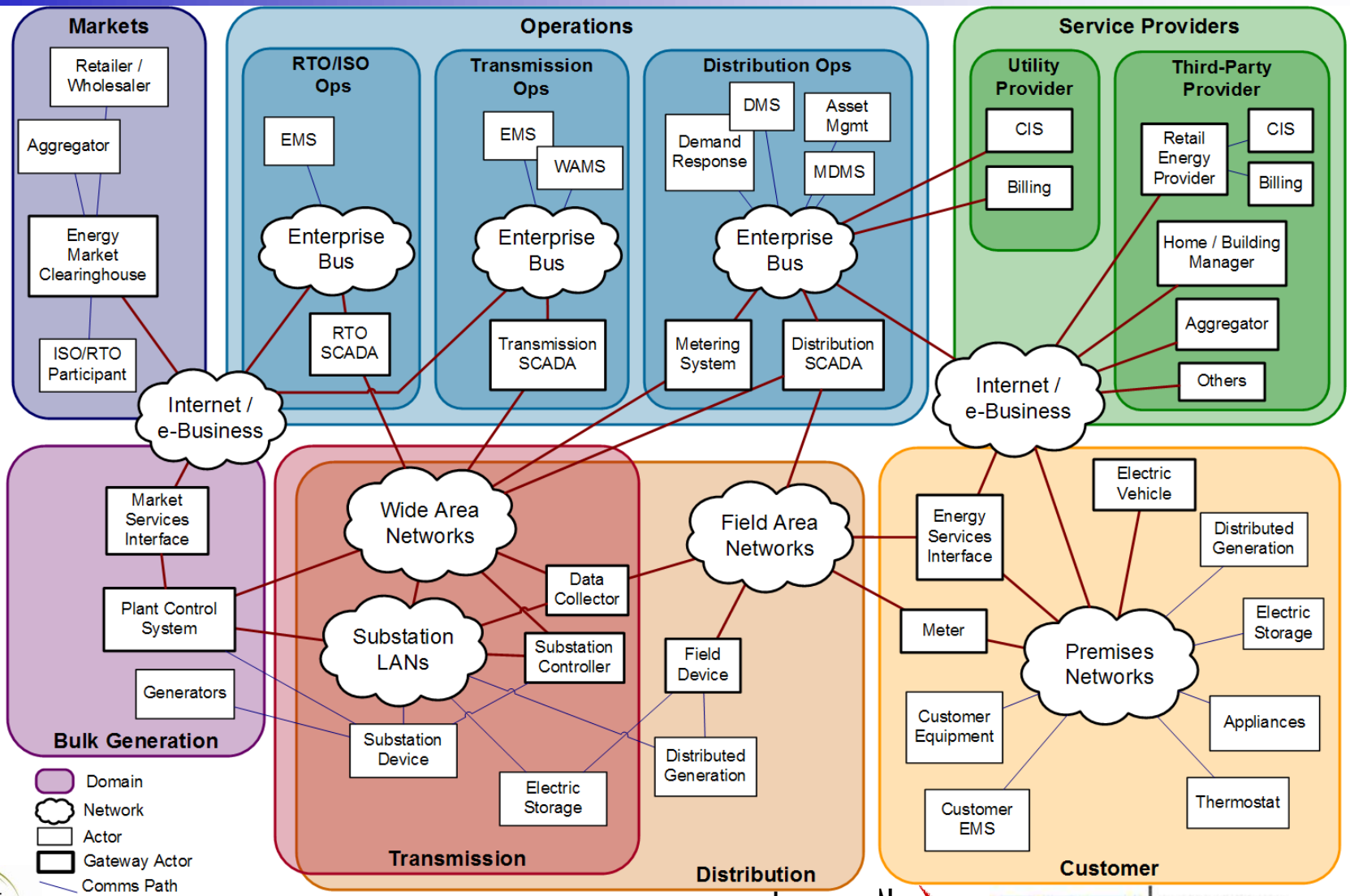
Markets


Operations
Service Provider
Distribution
Transmission
Market Ops
Market Management
DER Aggregation
Bulk Generation
Wholesaling
Trading
Ancillary Ops
Retailing
Customer
External Communication Interface
Internal Communication Interface
Electrical Interface
Domain

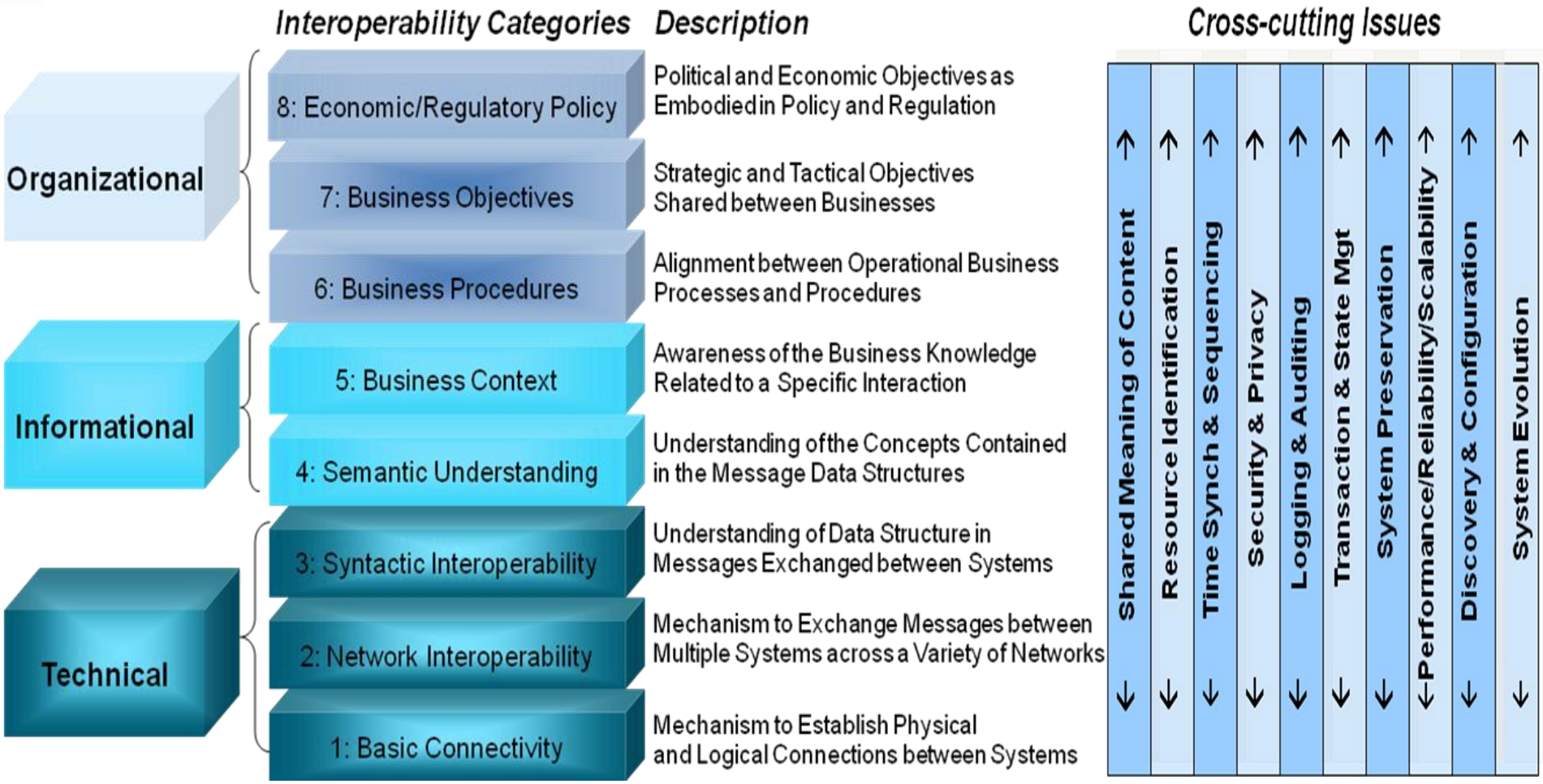
Service Provider



Example Architecture Compatible with Model



GWAC Stack – Levels of Interoperability



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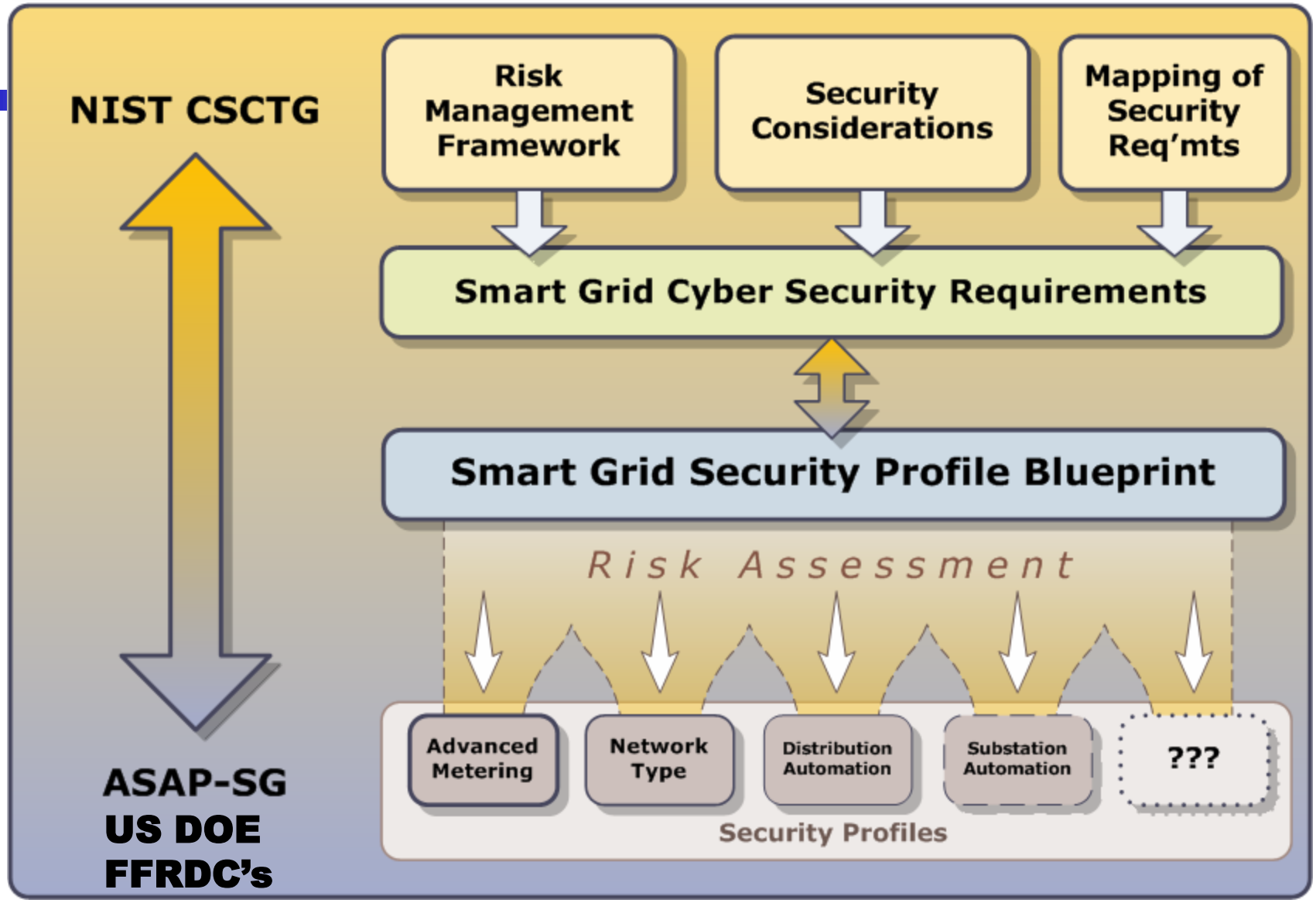
DOE / NIST / UCAIug / ASAP-SG Effort



Key Findings

- Developing a common semantic model - NIST should work with the appropriate standards development organizations to form a common representation of information models for the smart grid
- Developing a common pricing model standard - NIST should work with the relevant standards development organizations to develop an approach for developing a common pricing model to traverse the entire value chain.
- Developing a common semantic model for advanced metering, demand response and electric transportation – NIST should coordinate the various industry activities to accelerate the development and adoption of a unified semantic model for these high-priority applications.
- Conducting an analysis to select Internet Protocol Suite profiles for smart grid applications - NIST should commission a group to perform a comprehensive mapping of smart grid application requirements to the capabilities of protocols and technologies in the Internet Protocol Suite to identify Internet protocol Suite subsets as important for various applications in the various smart grid domains.

Key Findings, Continued

- Investigating Communications Interference in Unlicensed Radio Spectrums - NIST should commission a group of experts to study the issue of communications interference in unlicensed radio spectrums for smart grid applications.
- Developing common time synchronization and management - NIST should work with the appropriate standards development organizations to develop or adopt application or role based time synchronization guidelines
- Coordinating efforts across Standards Development Organizations – NIST should coordinate cross-SDO efforts for harmonizing and extending their standards and addressing new standards requirements.

Priority Action Plans (PAP)

1. Use of IP
2. Wireless Guidelines
3. Pricing Model
4. Scheduling
5. Meter Profiles & Upgrade Std
6. ANSI C12 to Common Info Model (CIM)
7. Storage Interconnect
8. CIM Distribution Models and Harmonization
9. Standard DR Signals
10. Energy Usage to Customer
11. Models for Electric Transportation
12. IEC 61850 to DNP3
13. Time Synch
14. Integrate Transmission & Distribution Models and Relay Settings
15. Cyber Security

Smart Grid Standards Acceleration Workshop
August 3-4 Workshop Objectives

- Review PAPs
  - Each PAP will be reviewed, modified, and completed to the best of the ability of the members of the breakout sessions.
  - Outcome: Revised PAP
- Develop and refine PAP tasks
  - For each of the PAPs, the breakout teams will develop tasks to meet the PAP objectives.
  - Outcome : List of Task Owner / Description / Task team
- Assign tasks and develop timelines
  - Once the tasks have been developed, assignments and timelines for each task will be discussed. We are looking for commitments from SDOs to agree to these tasks. More than likely, this will not be something people are willing to do. However, we should expect commitments from SDO representatives to help move the ball forward – at least presenting to their organizations and getting decisions on what they are willing to take on.
  - Outcome : Task timelines
- Overall: Produce list of Action Items to be addressed and a timeline for addressing them
  - Outcome : Action list of owner/due date/details

Questions?

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Co-chair, IEEE PES Intelligent Grid Coordinating Committee

Member, DOE GridWise Architecture Council

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