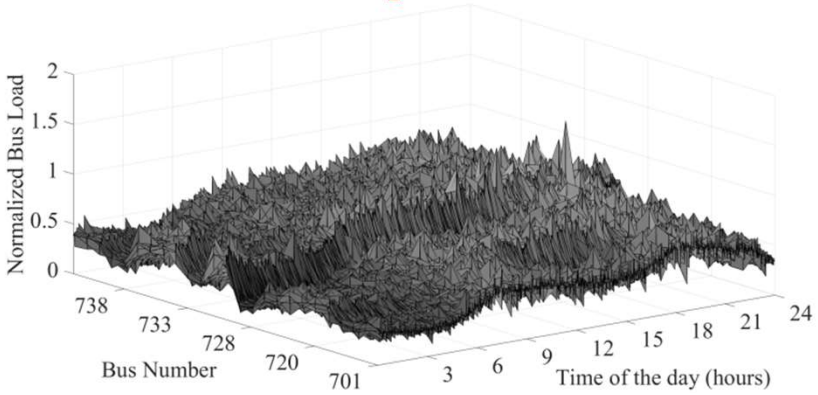
Smart Grid Technology

Principle and Application

Smart Grid Concept and Technology



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RMUTT

PSRC

GREMOTECH

Curriculum Vitae

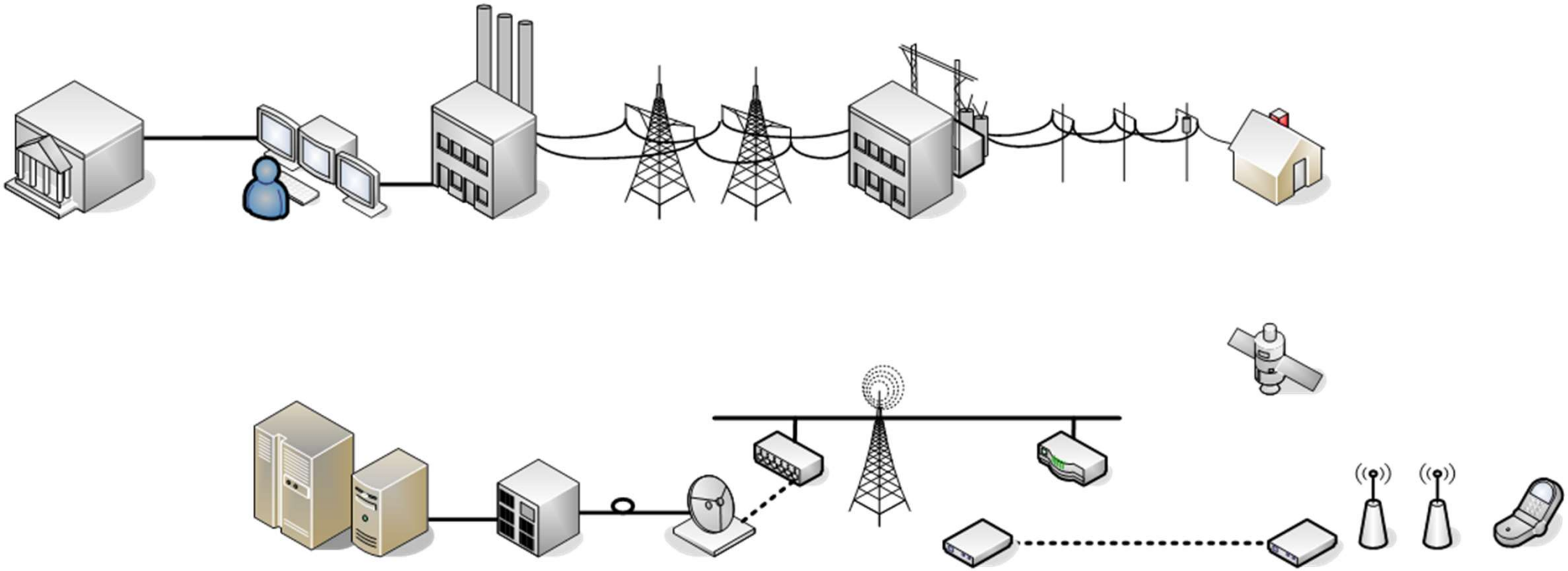
Krischonme Bhumkittipich, D.Eng.(Energy)

- Associate Professor in Electrical Engineering, RMUTT.
- Director of Graduate School, RMUTT.
- Research Associated at
  - Asian Institute of Technology
  - RWTH-Aachen University
- Publications: >100 papers (Both TH and EN)
- Research Interest:
  - Power System Dynamic and Stability
  - Power System Interconnection
  - Smart Grid Technology
- Teaching
  - Advanced Mathematics
  - Computer-Aided Power System Analysis
  - Optimization Technique & AI on Power System
  - Power System Dynamic and Stability
  - Smart Grid Technology

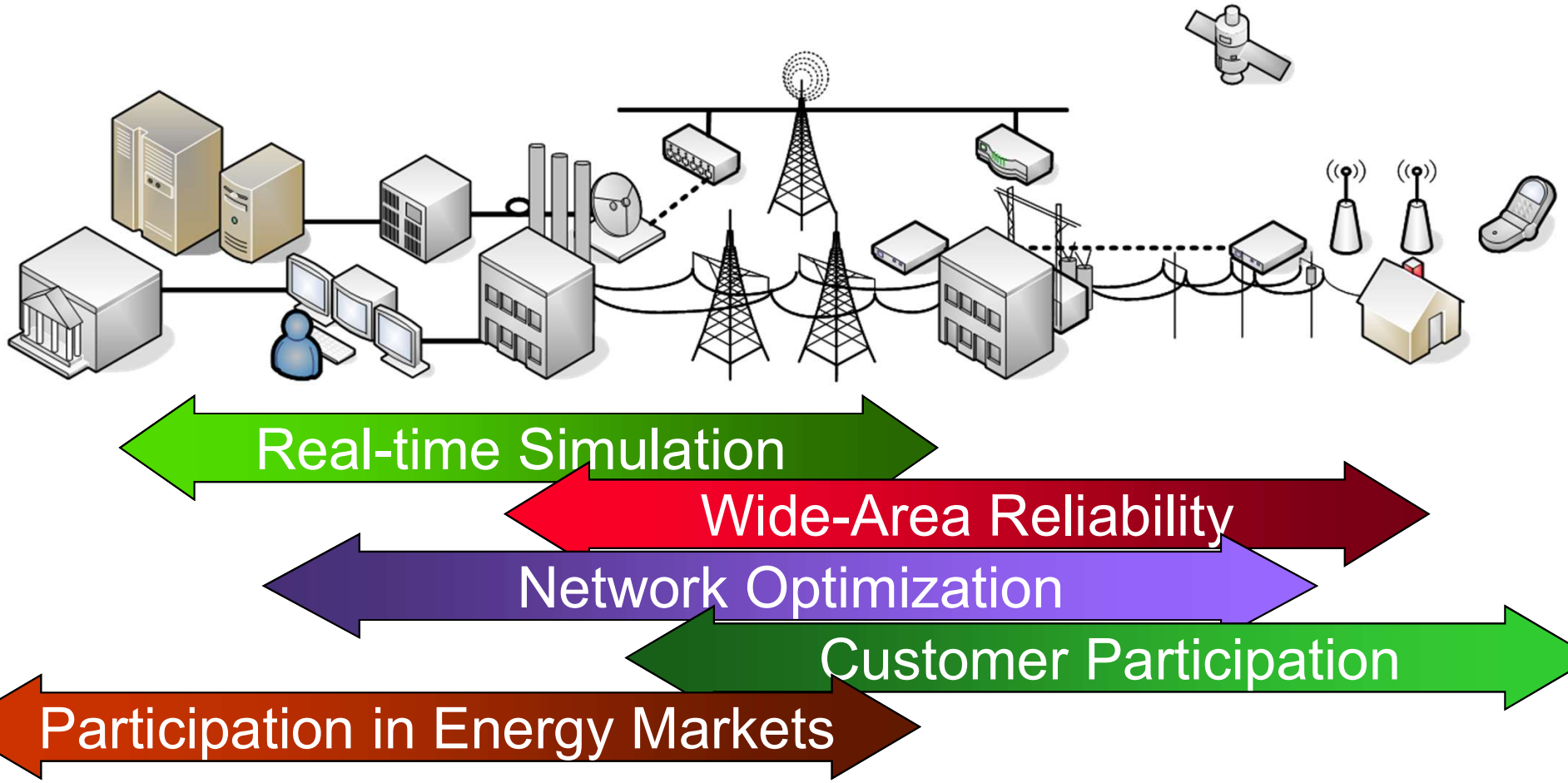
Outline

- **Background of Electrical Power System**
  - **presented by Dr. Krischonme Bhumkittipich (KB)**
- **Smart Grid Concept and Technology**
  - **presented by Dr. Krischonme Bhumkittipich (KB)**
- **Smart Grid Measurement and Control**
  - **presented by Dr. Krischonme Bhumkittipich (KB)**
- **Application of Smart Grid Technology**
  - **presented by Dr. Yuttana Kongjeen**

Goal: Merge Communication and Energy Networks



Changing the Face of the Grid



Source: EPRI IntelliGrid

Smart Grid "Elevator Speech" for Consumer

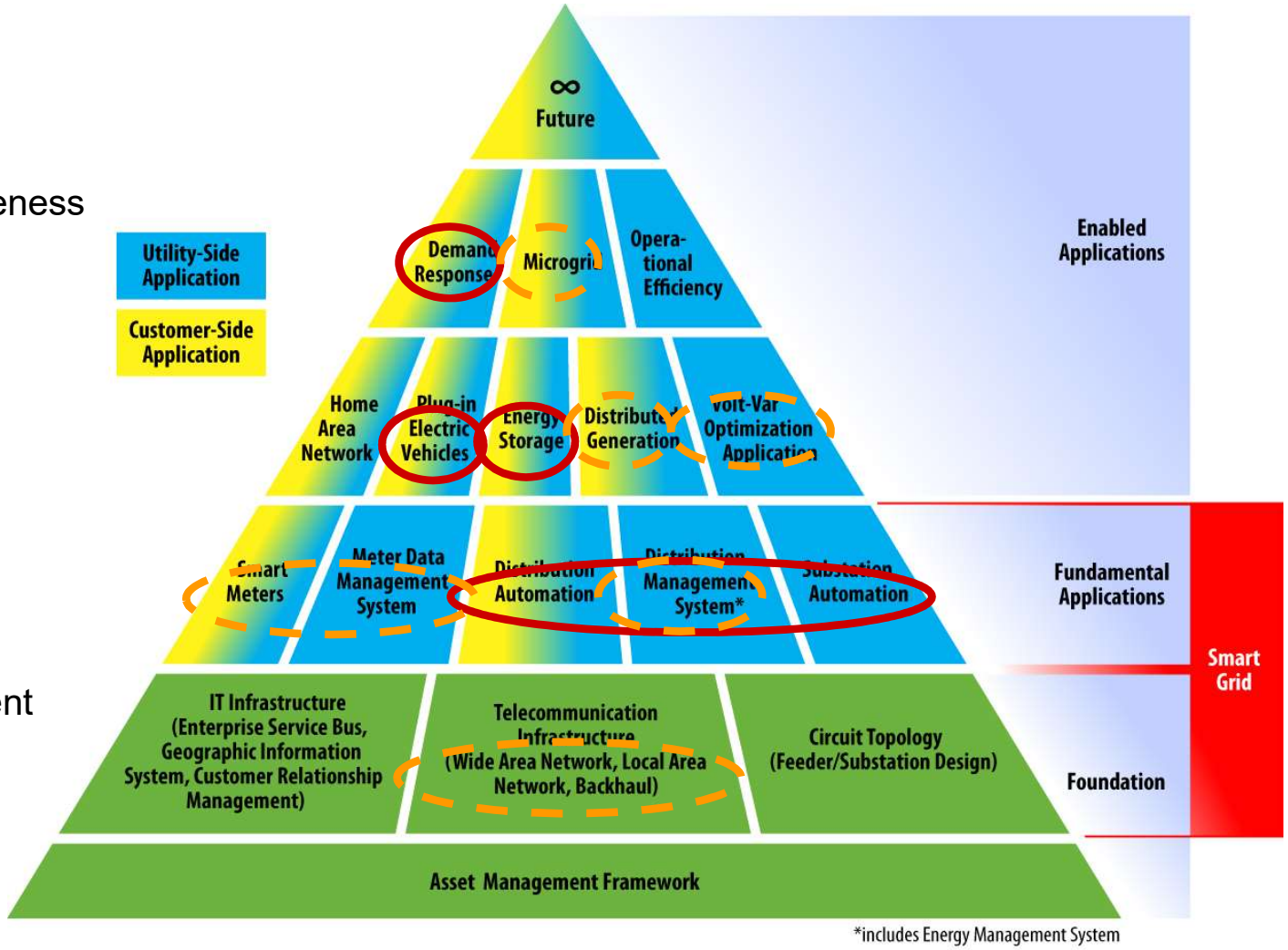
Right Now	With Smart Grid
Utility doesn't know when power is used	Utilities will offer you **lower rates** for using power in "off-peak" times
Utility often relies on *you* to tell *them* when your lights go out	Your **lights will go out less often** and outages won't last as long
We get large blackouts like the northeast in 2003	The grid will **automatically create "firebreaks"** fast enough to stop them
Utilities do green power and electric cars as "one-offs"	Consumers with **green power and electric cars** can be everyday items
Utilities are 10-30 years behind in cyber-security	Your electric power **will not be as vulnerable to attackers**
Energy prices will increase as aging infrastructure is replaced	**Prices won't rise as fast** because the system will be more efficient

Source: EnerNex

Everyone Has a Different Picture

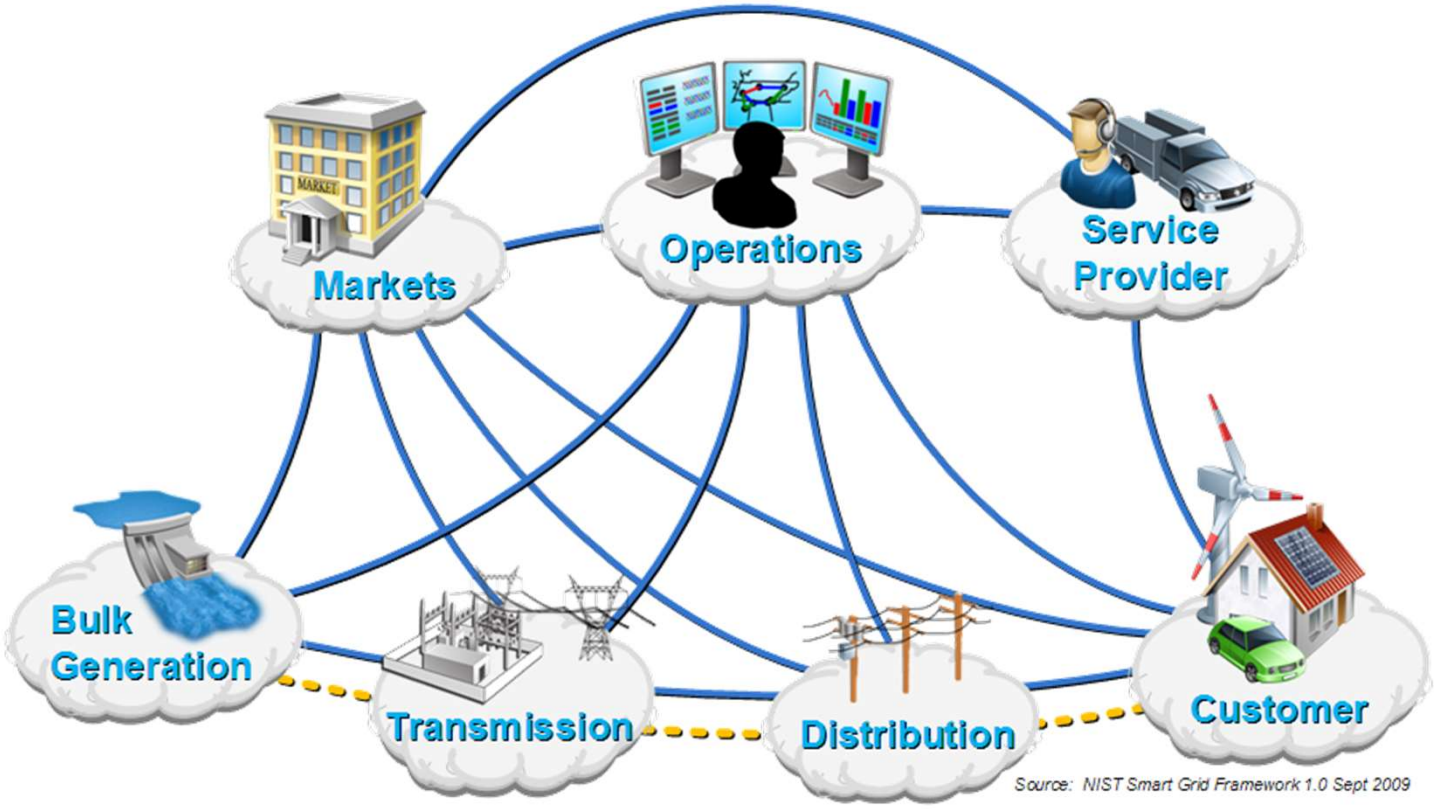
Smart Grid Policy:
- Wide Area Situational Awareness
- Demand Response
- Electric Storage
- Electric Transportation

Added:
- Advanced Metering
- Distribution Grid Management
- Cyber Security
- Network Communications

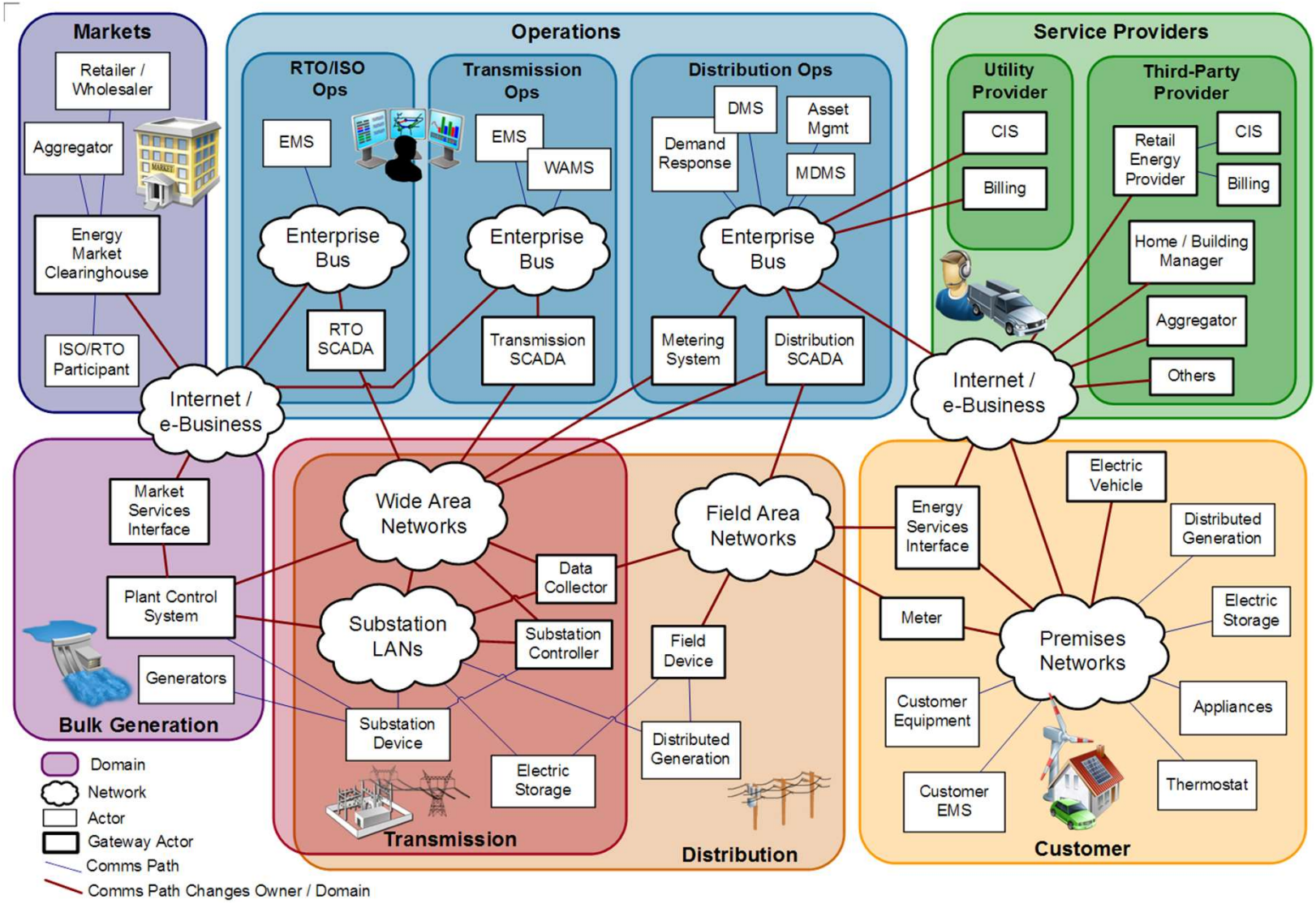


Source: BC Hydro

Conceptual Model High Level View

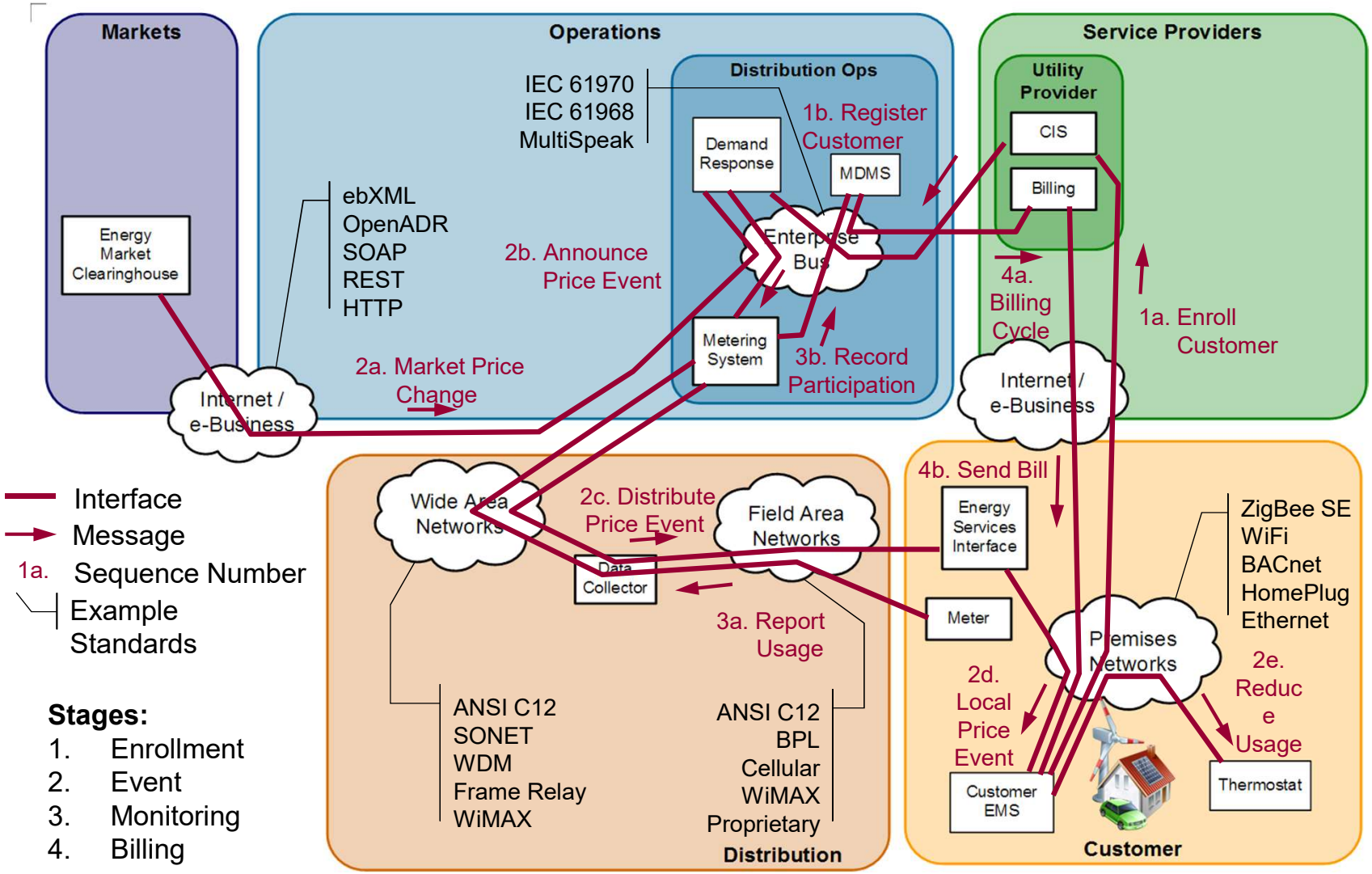


Conceptual Reference Model



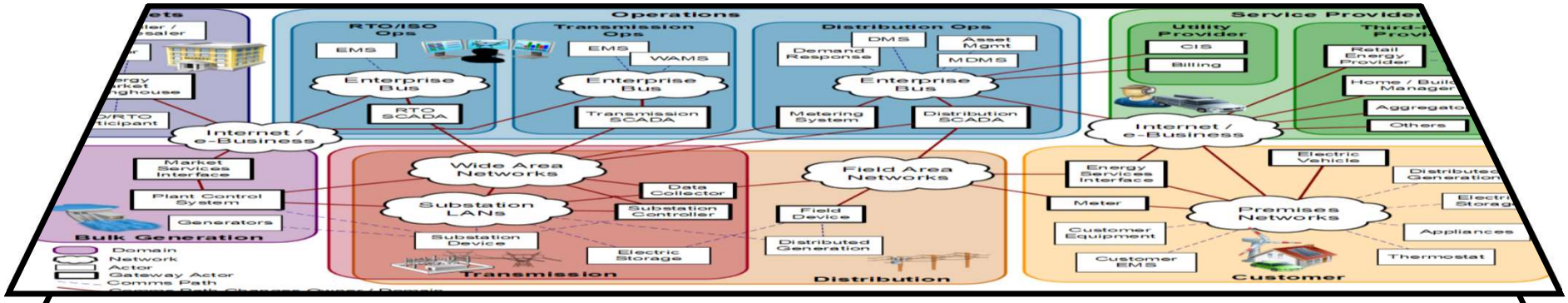
Source: NIST Smart Grid Framework

Demand Response – Example Only!



Source: EnerNex

The Stack Underneath



Organizational: Policy, Business Objectives, Business Procedures

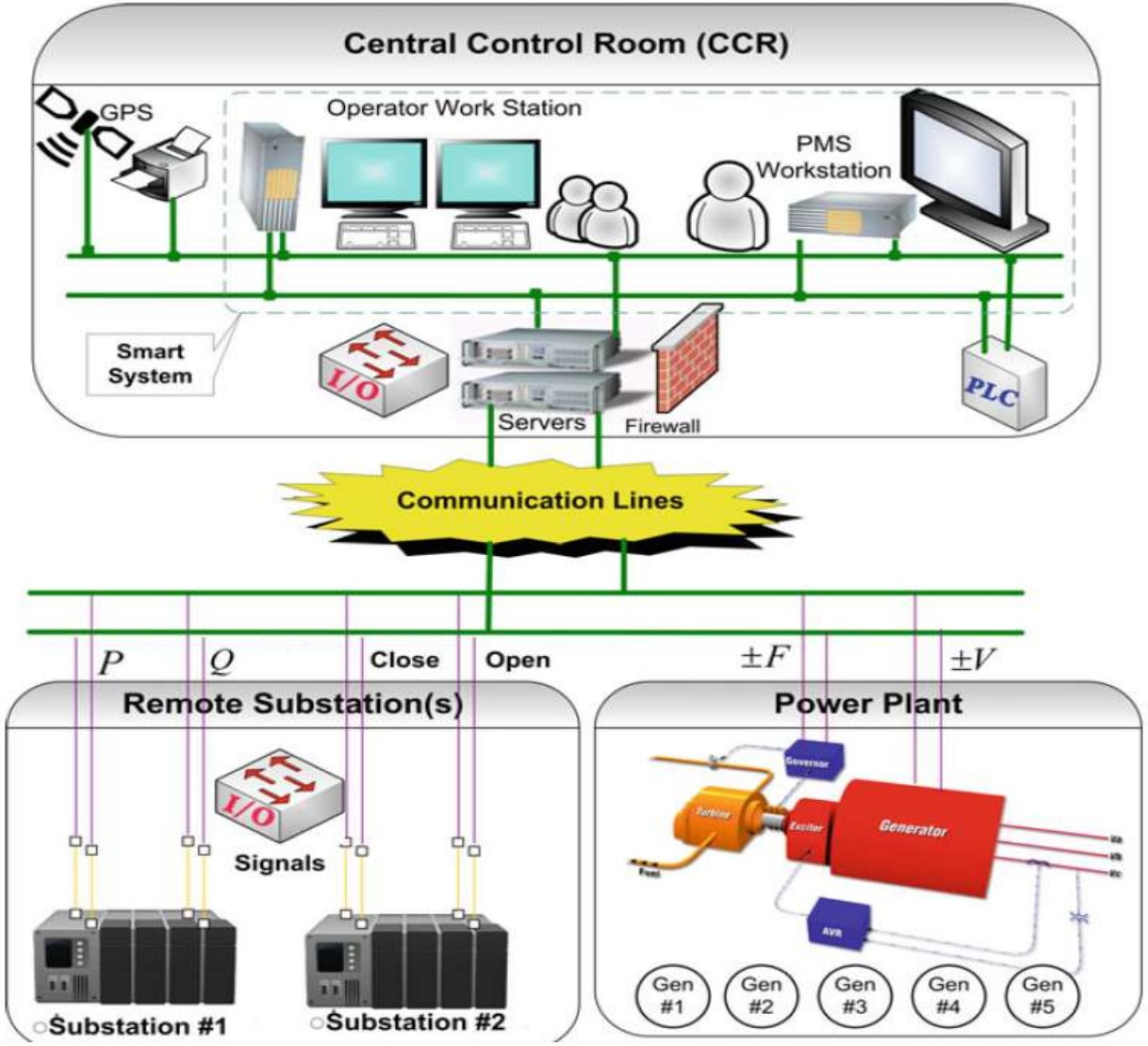
Informational: Business Context, Semantic Understanding

Technical: Syntactic Interoperability, Network Interoperability, Basic Connectivity

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

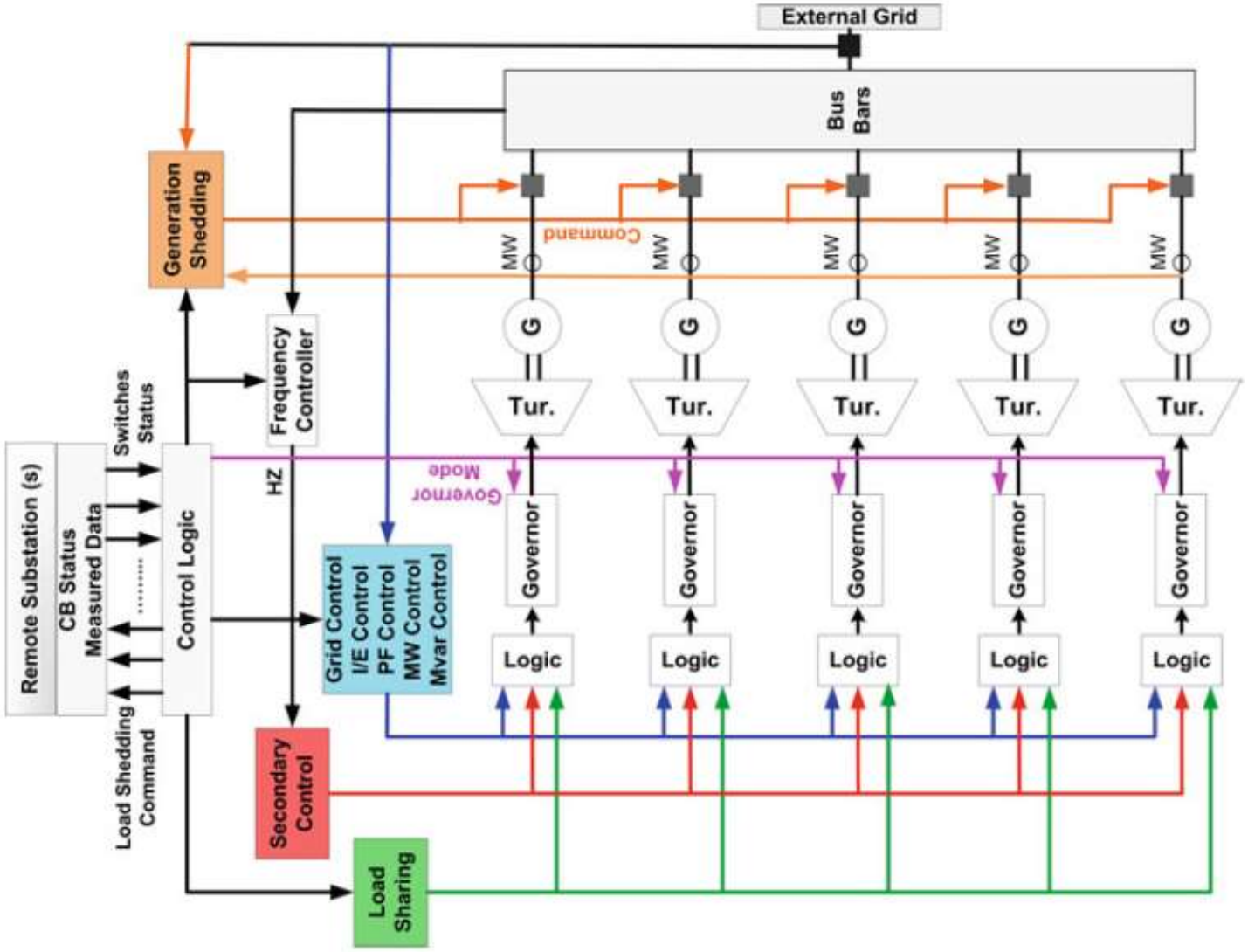
Source: EnerNex

Power System Management scheme



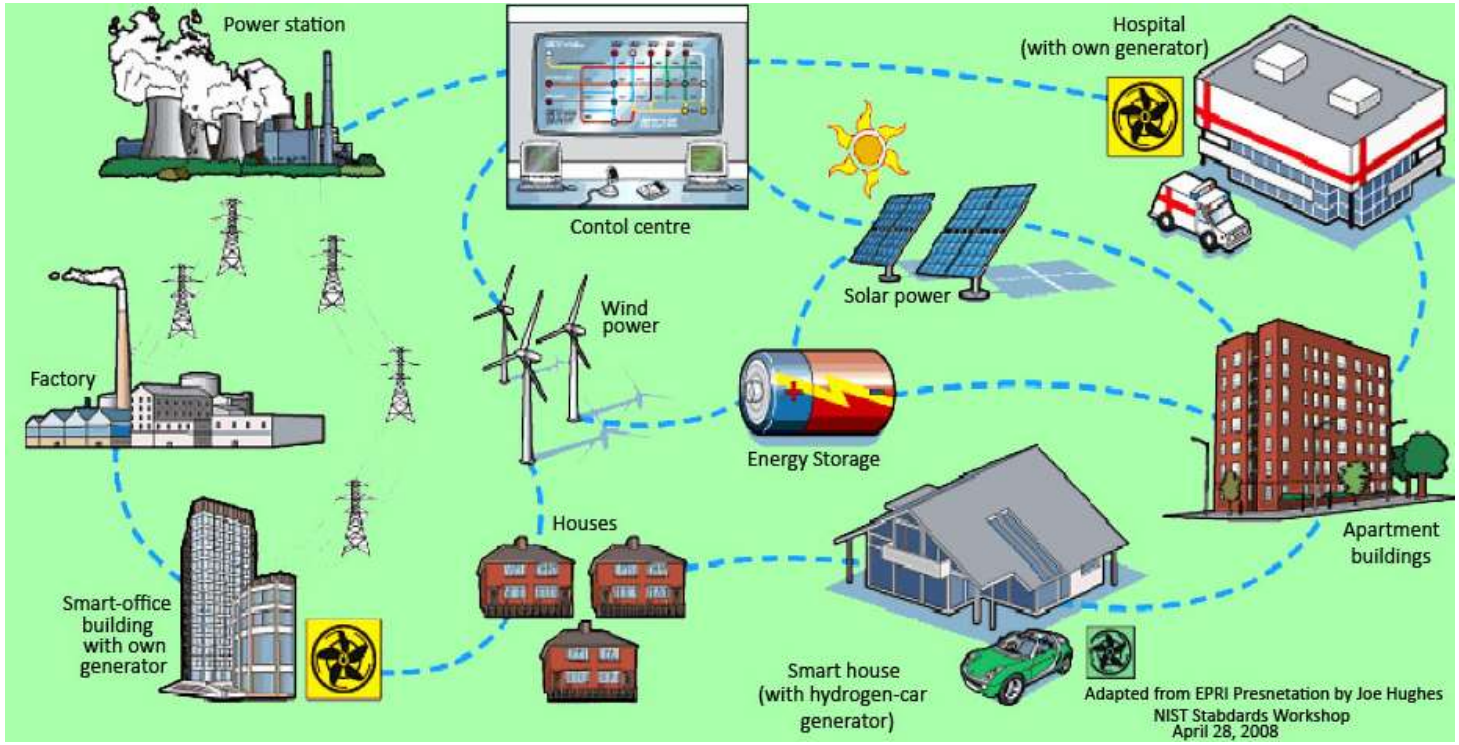
Example :Typical configuration of a power system management

Power System Management scheme



Example: Overall schematic of smart power management system controllers

Real time smart grid scheme

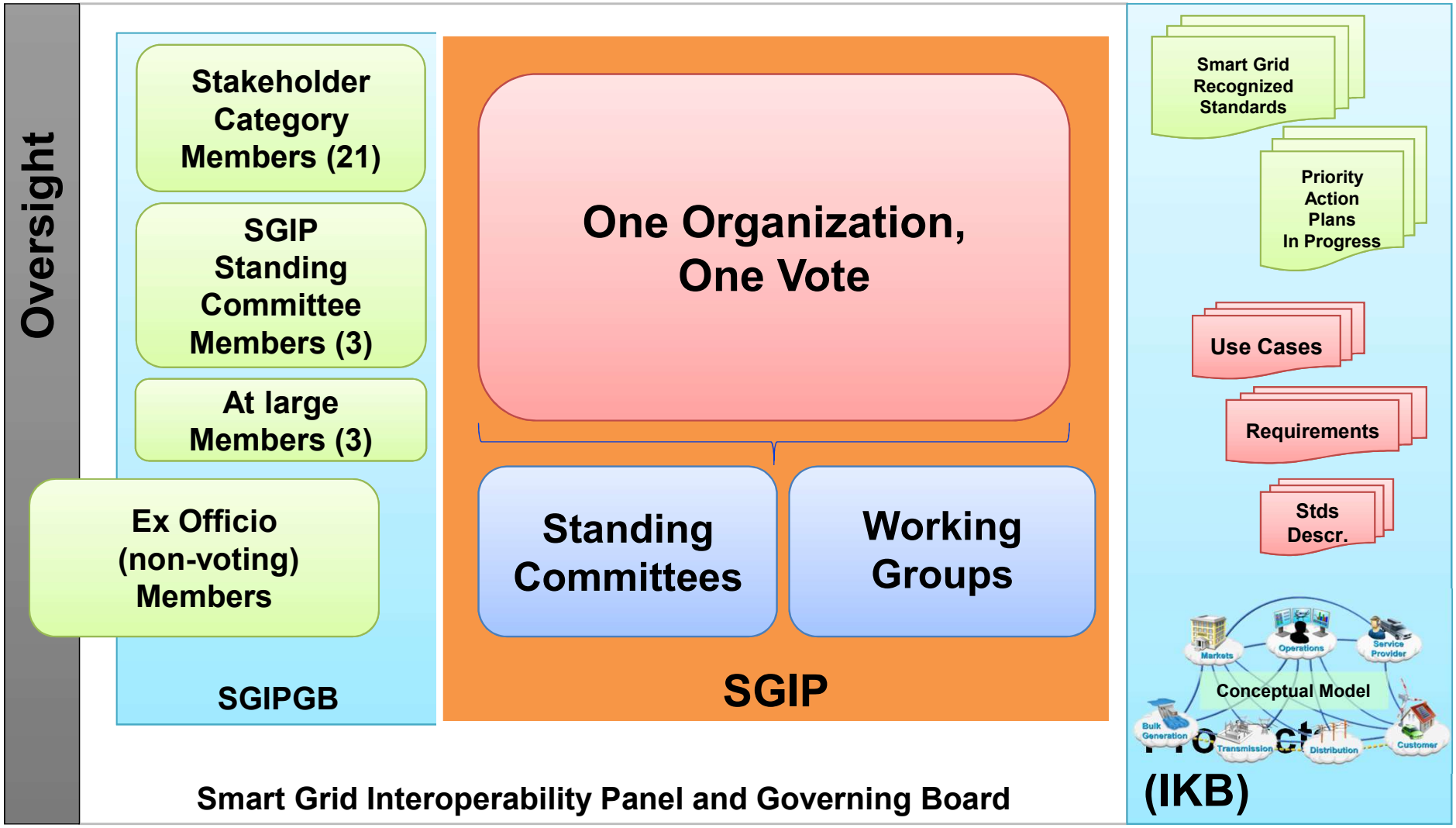


Real time demand from end users needed to manage in optimal condition and best benefits.

First 16 Framework Standards

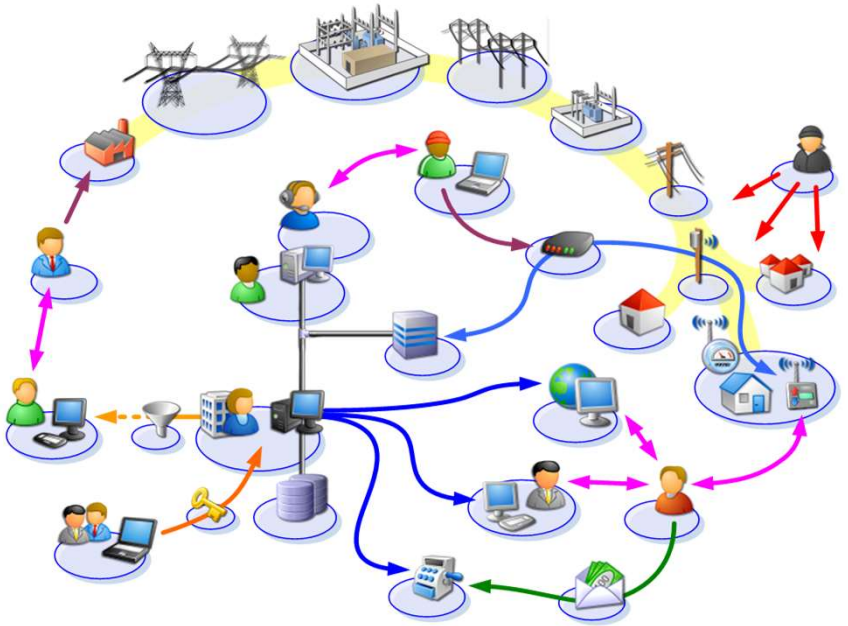
1	AMI-SEC System Security Requirements	✓	✓	✓			✓	✓
2	ANSI C12.19 End Device (Meter) Tables		✓	✓				✓
3	BACnet Building Automation & Control Net			✓	✓			✓
4	DNP3 – Distributed Network Protocol		✓		✓	✓	✓	
5	IEC 60870-6 – Inter-Control Center		✓					
6	IEC 61850 – Comms Nets in Substations		✓		✓	✓	✓	
7	IEC 61968/61970 – Common Info Model		✓	✓				
8	IEC 62351 – Data Comms Security		✓		✓	✓	✓	
9	IEEE C37.118 - Synchrophasors		✓			✓		
10	IEEE 1547 – Distributed Resources		✓		✓	✓	✓	
11	IEEE 1686 – IED Cyber Security				✓	✓	✓	
12	NERC Critical Infrastructure Protection	✓	✓	✓	✓	✓	✓	✓
13	NIST SP 800-53/82 Fed Info Sys Security	✓	✓	✓	✓	✓	✓	✓
14	Open Automated Demand Response	✓	✓	✓				✓
15	Open Home Area Network Requirements							✓
16	ZigBee/HomePlug Smart Energy Profile							✓

SGIP Structure



Stakeholder Categories - Draft

1.	Investor Owned Utilities
2.	Municipal Electric Utilities
3.	Rural Electric Utilities
4.	Independent Power Producers
5.	Renewable Power Producers
6.	Transmission Operators
7.	Retail Service Providers
8.	Commercial & Industrial Consumers
9.	Residential Consumers
10.	IT, Application Developers & Integrators
11.	ICT Infrastructure Providers
12.	Electric Transportation
13.	Power Equipment Mfg and Vendors
14.	Appliance Manufacturers
15.	Electricity & Financial Market Traders
16.	Venture Capital



17.	Standard Development Organizations
18.	Professional Societies, User Groups, Industry Consortia
19.	Academia, R&D Organizations
20.	State & Local Regulators
21.	Relevant Federal Agencies

Ways to Participate

- Contribute to IEC, IEEE and other standards orgs
  - The SGIP will not make standards
  - Only provides a forum and advisory to NIST
- Join in as part of the SGIP stakeholder categories
  - Web conferences Oct 9, Oct 28, Nov 12
  - First face-to-face meeting at Grid-Interop Conference
  - Call for candidates for the governing board
- Provide feedback on the charter
  - First act of SGIP will be to ratify its charter
  - Governance board could include international liaisons

Q&A

Thank you for your attentions