

Intelligrid Architecture

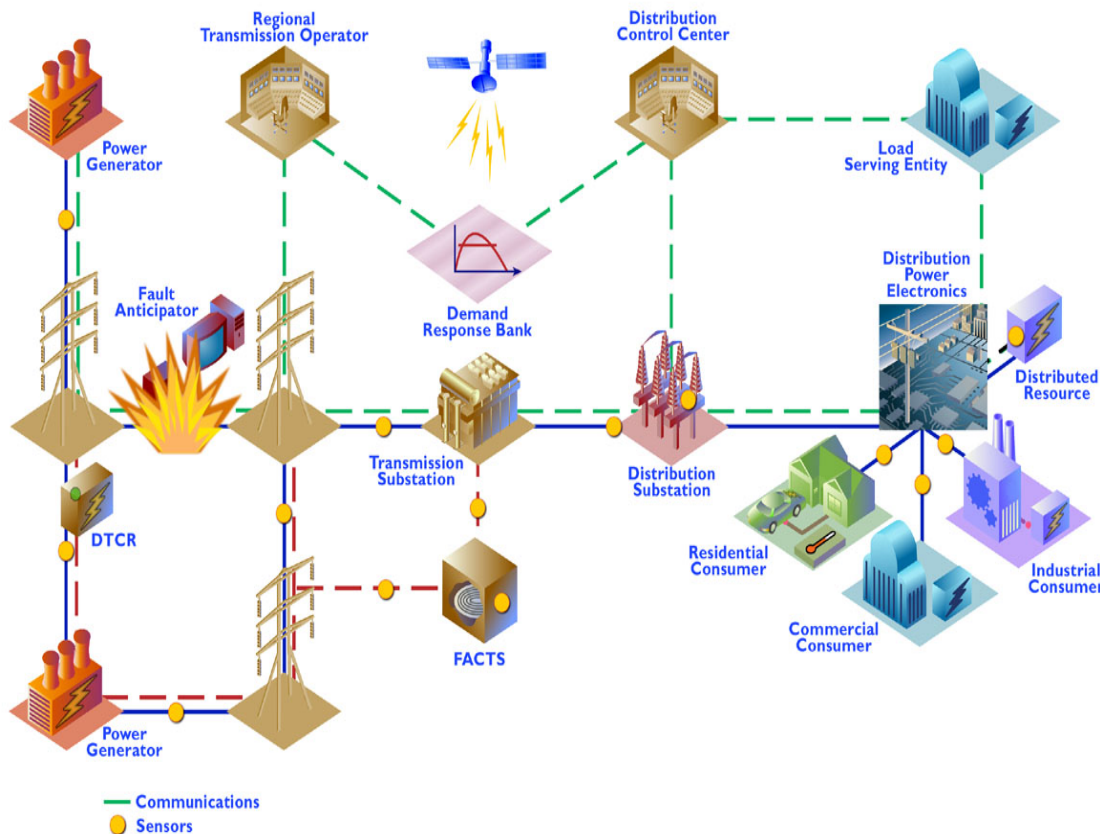
Architecture for the Intelligent Electricity Grid of the Future

(formerly known as the Integrated Energy and
Communications Systems Architecture (IECSA))

Don Von Dollen

CEIDS Technical Integration Manager

Vision of the Power System of the Future



OBJECTIVES:

Self-Healing and *Adaptive*
Interactive with consumers
and markets

Optimized to make best
use of resources and
equipment

Predictive rather than just
reacting to emergencies

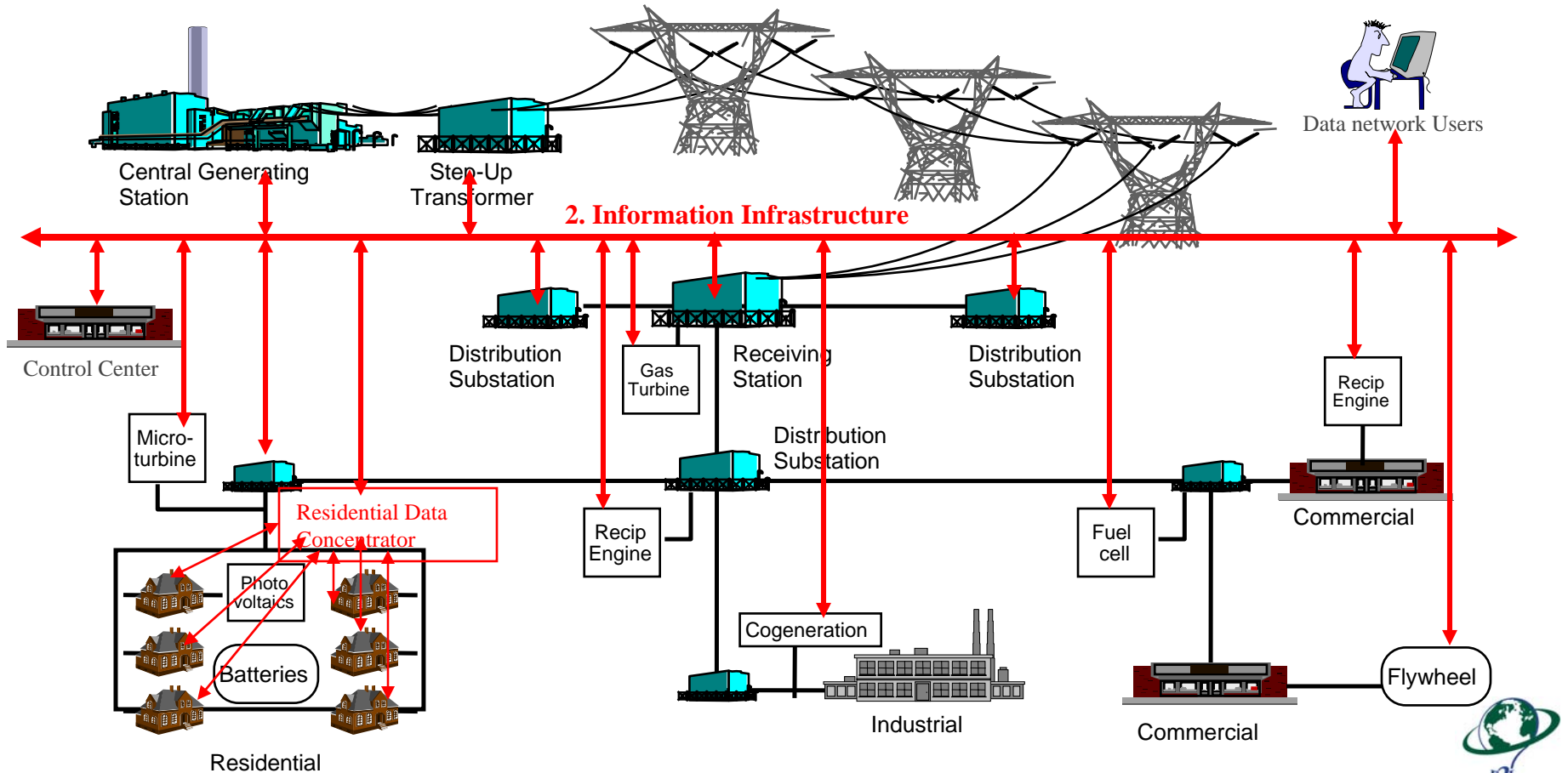
Distributed across
geographical and
organizational boundaries

Integrated, merging
monitoring, control,
protection, maintenance,
EMS, DMS, marketing, and
IT

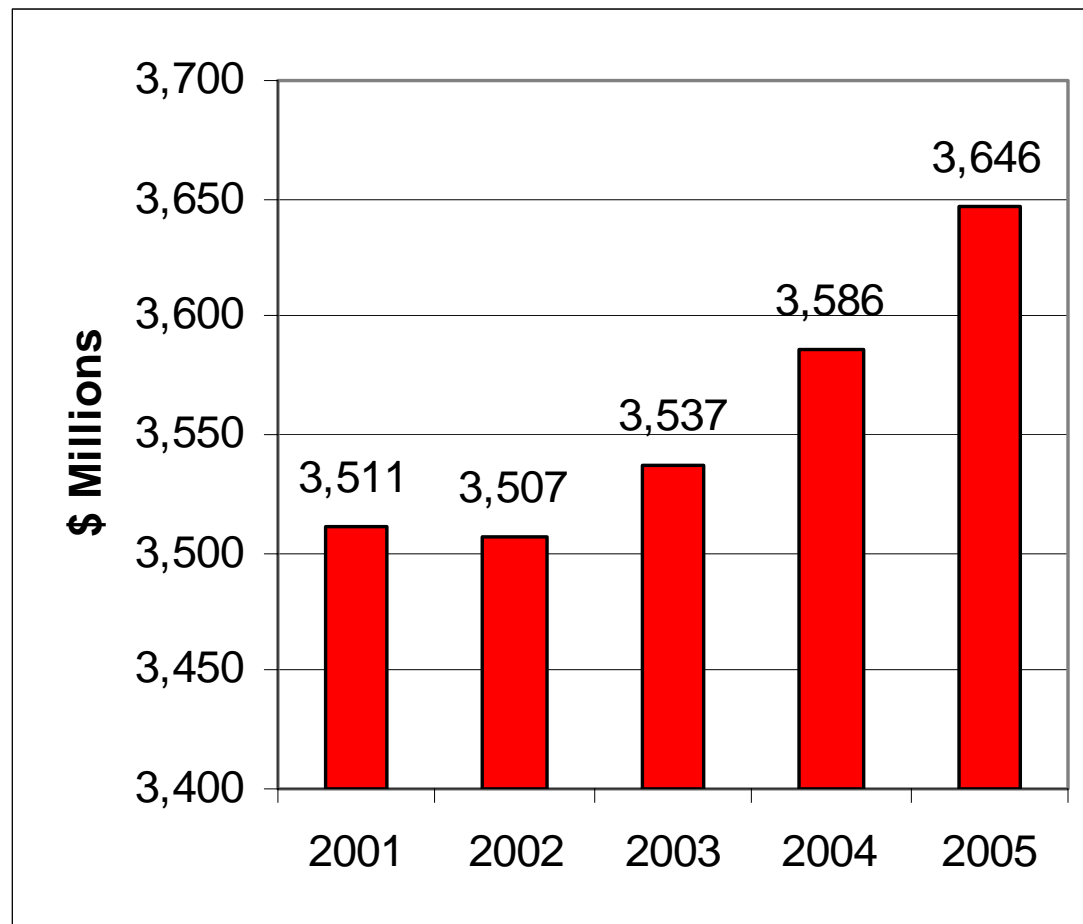
More Secure from attack

Merging Two Infrastructures

1. Power Infrastructure



Revenue from Telecom Equipment and Services Sold to Utilities in the U.S.



Source: UTC Research, 2002 WWW.RESEARCH.UTC.ORG/STATS&DATA

What is Impeding the Industry From Achieving the System of the Future?

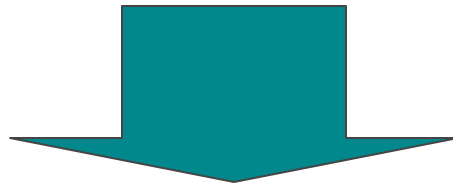
- Lack of interoperability
- Limited methods or tools for designing complex systems
- Incomplete, overlapping and conflicting standards
- Lack of a common “vision”



How Do We Overcome These Barriers?

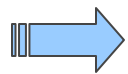
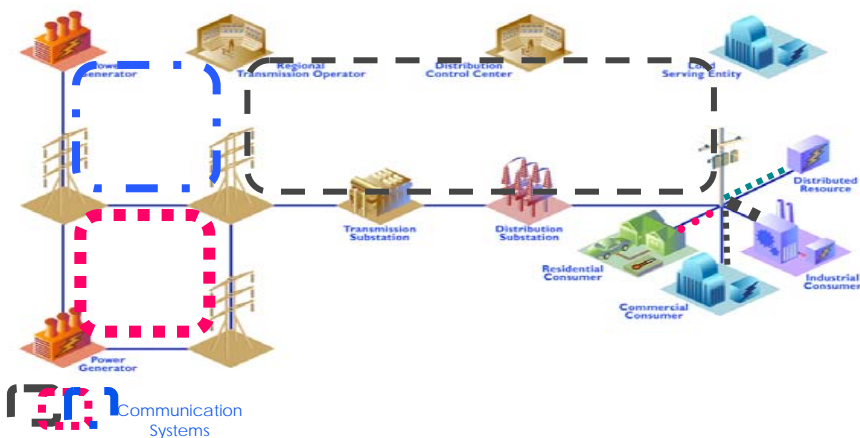
- Other industries have faced similar problems
 - Integration of disparate systems
 - Large complex systems
 - Need for interoperability, scalability, upgradeability and security

Aerospace, Software industry, Telecom

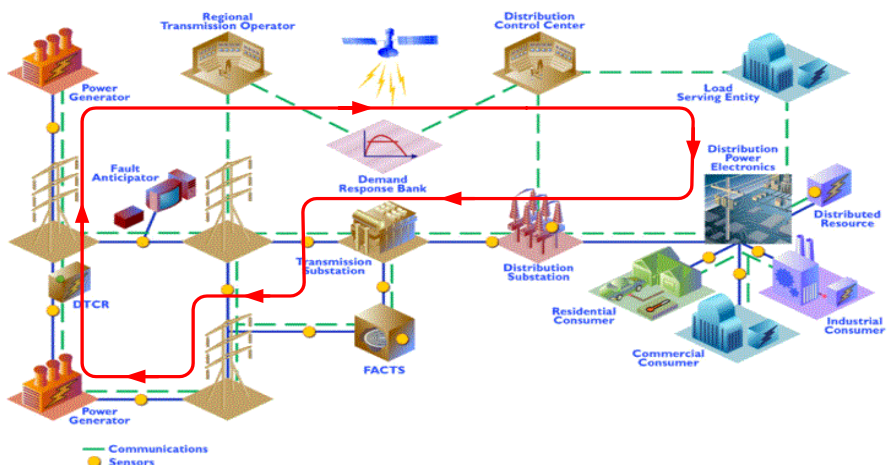
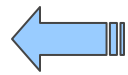


- Enterprise architecture
- Systems Engineering methods
- Modeling – Unified Modeling Language (UML)
- Open Standards

The Intelligrid Architecture Project



Intelligrid is an open, standards-based architecture for integrating the data communications networks and intelligent equipment needed to support the Power Delivery System of the Future



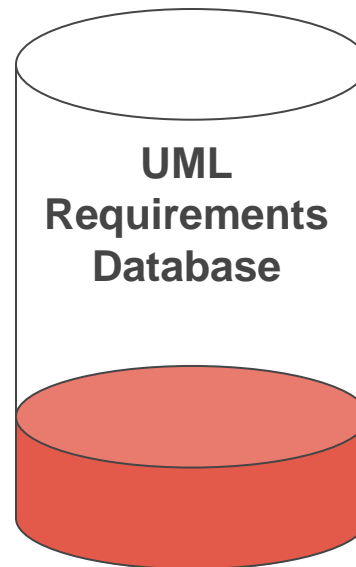
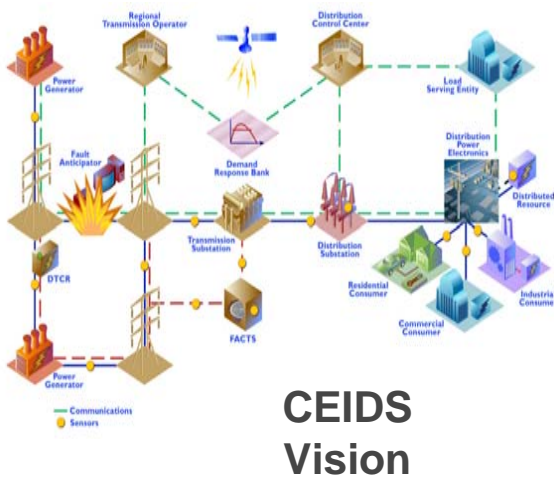
Future power system will support higher levels of integration and federated systems services to meet the needs of a "digital" society

Intelligrid Architecture Project Team

- General Electric
 - Global Research
 - Network Solutions
 - Multilin
 - SAS
 - PSE
- Lucent Technologies
- Utility Consulting International
- SISCO
- Electrotek



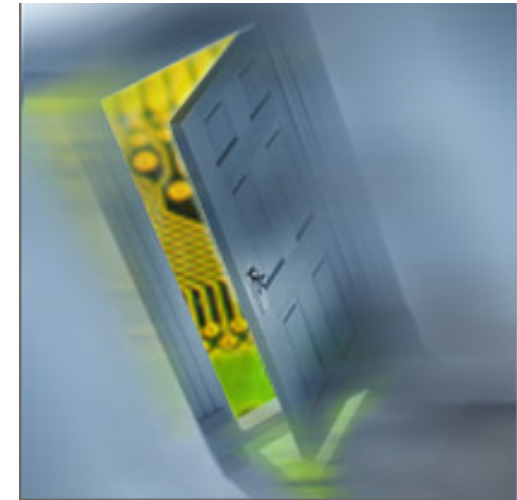
Intelligrid Architecture Project in a Nutshell



- **Tools & Methods**
- **Recommended technologies and best practices**

Deliverables

- **Methods and Tools** for designing advanced distributed computing systems
- **Functional Requirements** for the power system of the future
 - What do we need the system to do?
 - How will the system do it?
- **Requirements for the Communications Infrastructure** necessary to support the vision of the future
 - Technical/Performance – such as timing, availability, etc.
 - Management – configuration, congestion, etc.
 - Security – authentication, intrusion detection, etc.



Deliverables

- **Navigable Model** (UML) of the power system of the future
 - High level (focuses on applications that cut across the entire enterprise)
 - Actors (business and operational entities)
 - Applications (described step-by-step)
 - Points of integration
 - Types of information that need to be exchanged
 - Requirements
- **Recommendations** for using existing and emerging standards and associated technologies



Who Will Use The Intelligrid Architecture?

Executive & Regulator

- Provides a high-level vision of future power system functionality

Communications System Architect

- Provides recommendations and requirements that will be the basis for organization's policies and procedures

Procurement Personnel

- Provides insight for functional specifications of devices

Power System Planning

- Provides a vision of future power system functionality

System Designer/Engineer

- Provides tools, methods and information that will accelerate system design

Equipment Manufacturer

- Provides tools for planning new products

Standards Body

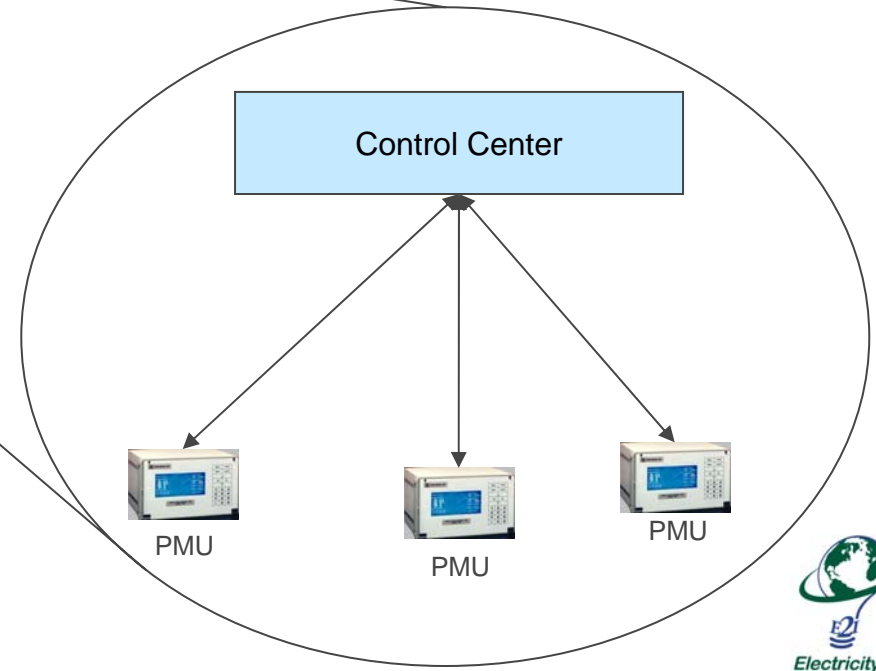
- Identifies gaps and overlaps in existing standards

Research Organization

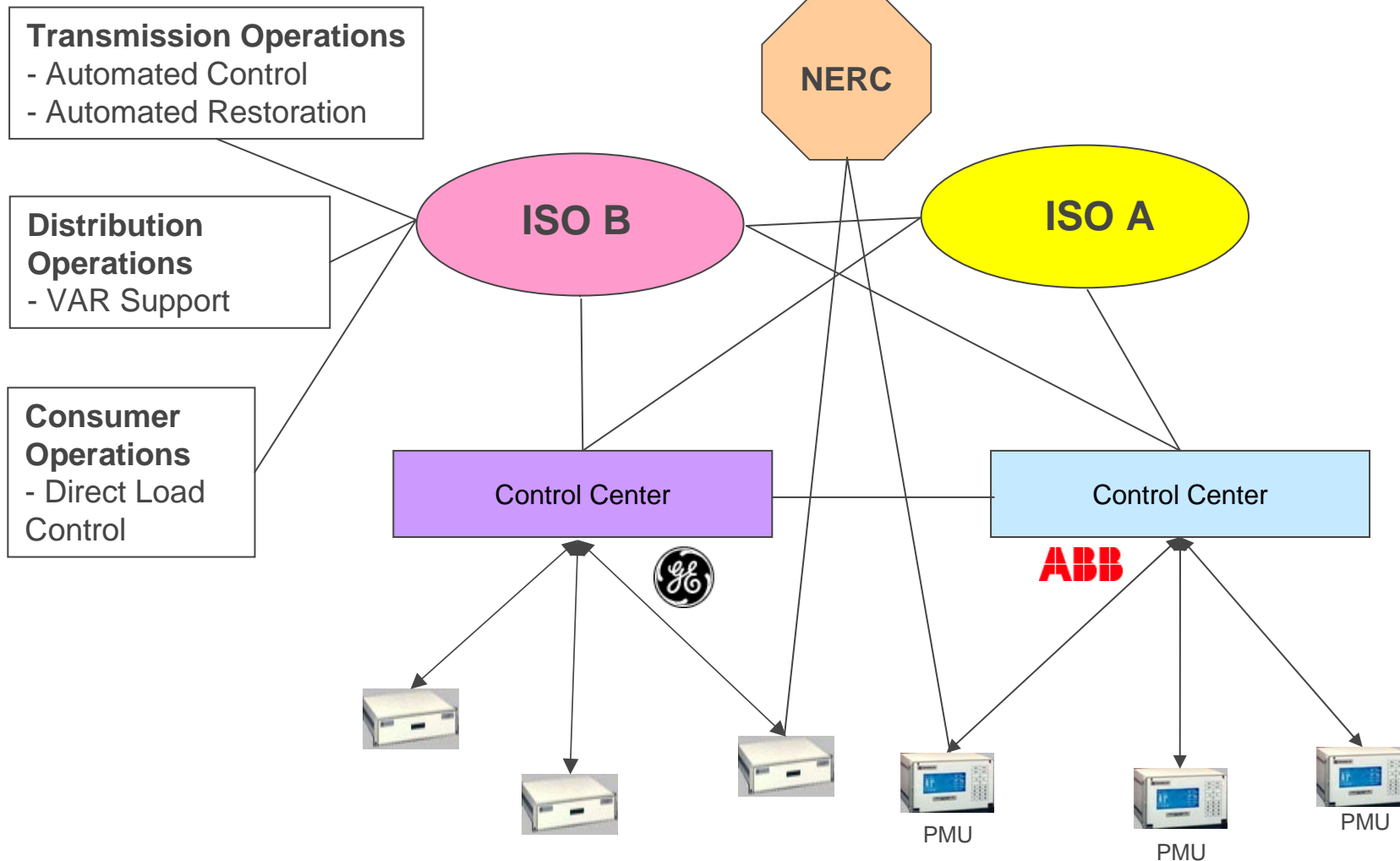
- Provides a vision for the future and identifies areas for future work

How Will The Intelligrid Architecture Be Used?

An Engineer is tasked with designing a Phasor Measurement System for his company



What Could Happen in the Future



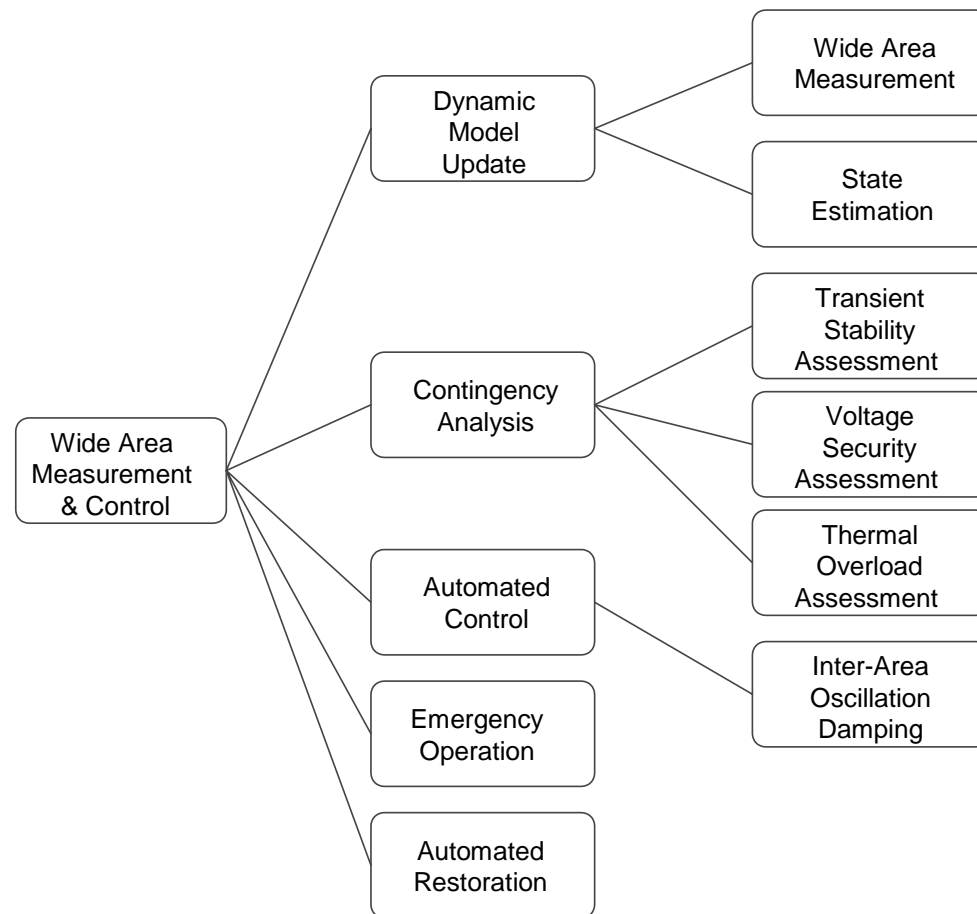
How Will The Intelligrid Architecture Help?



The Intelligrid **Methods and Tools** will provide him with an approach for solving the problem

How Will The Intelligrid Architecture Help?

The engineer will review the Intelligrid “Use Cases” that are related to his task



How Will The Intelligrid Architecture Help?



The Use Cases will provide him with an initial set of **Functional Requirements** for his application:

1. A description of the applications
 - An expert describes how the application is performed
2. The “actors” (devices, people or systems) that need to interact
3. The information that the actors need to exchange
4. A step-by-step description – what happens and in what order

How Will The Intelligrid Architecture Help?



The Use Cases will provide him with an initial set of **Requirements for the Communications Infrastructure** for his application:

- Configuration (*for example*)
 - Communications bandwidth - 100Mbps – 1 Gbps
- Quality of Service (*for example*)
 - Elapsed time response requirements for exchanging data: less than 4-10 milliseconds
- Security (*for example*)
 - Authentication, denial of service, ensuring unimpeded access to data is: critical
- Data Management (*for example*)
 - Data format requirements: Standardized data objects

How Will The Intelligrid Architecture Help?



The Intelligrid **Recommendations** will provide him with:

- Existing and emerging standards & technologies, for example:
 - IEC 61850 or DNP or ModBus
 - Global Interface Definitions (GID)
 - VPN or Open SSH
 - Physical layer technologies (Ethernet, SONET, ATM, etc.)
- Descriptions of relative advantages & disadvantages of each

Value of The Intelligrid Architecture

- Near-Term
 - Will provide Engineers with a head-start when specifying and designing automation systems
- Long-Term
 - Will allow for more efficient installation of systems
 - Eliminate “forklift upgrades”
 - Will reduce capital costs
 - Will reduce life cycle costs
 - Will improve asset utilization
 - Leverage infrastructure development
 - Enable bundled applications



Practical Examples of the Use of Intelligrid

Intelligrid Architecture In Use

- **California Energy Commission** - Dynamic Pricing Implementation
- **U.S. Department of Energy/
New York Power Authority** - Eastern Interconnection Phasor Measurement Project
- **Salt River Project** – Remedial Action Plan



Practical Examples of the Use of Intelligrid

Commitment to Use

- **Electricite de France** – has identified three applications
 - Re-designing its information system for the new Distribution System Operator created to un-bundle activities
 - Research project to increase automation in substation
 - Research activities with Con Edison in the CEIDS d-FSM project
- **Long Island Power Authority** – 3 possible areas:
 - Advanced distribution automation
 - Distributed resource control and management
 - Demand response / distributed resource aggregation (possibly with NYISO)



Intelligrid Architecture: Next Steps

- The Intelligrid Report was delivered this summer and is available at www.e2i.org
- Next Steps
 - Support with Implementation for Partners
 - Workshops with partners
 - Identification of an application
 - Technical support with application
 - Training & Support
 - Training Courses
 - General Support (web site, technical support, etc.)
 - Users' group