NIST Smart Grid Interoperability Workshop Foundational Session

National Institute of Standards and Technology

Smart Grid Interoperability Workshop

GridInterop 2008

Foundational Session

November 11, 2008

Foundational Session Outline

- *2007 EISA Mandate*
- *Scope of the NIST role*
- *Smart Grid Goals*
- *GWAC Context-Setting Framework*
- *NIST Program*
- *Interoperability Framework Development Tools*
- *Interoperability Standards Workshop Objectives*
- *Interoperability Workshop Plan*
- *Go and do good work!*

The Mandate

Energy Independence and Security Act (EISA) of 2007

Title XIII, Section 1305.

Smart Grid Interoperability Framework

In cooperation with the DoE and other stakeholders, NIST will develop and maintain a framework comprising concepts, processes, and principles that promotes rapid progress toward a highly interoperable intelligent electric power infrastructure.

The Mandate

Energy Independence and Security Act (EISA) of 2007

Title XIII, Section 1305.

Smart Grid Interoperability Framework

The Framework:

- *implies a common architecture*
- *flexible, uniform, technology-neutral*
- *aligns policy, business, and technology approaches*
- *requires some design-level activities – it is to include protocols and standards for information management*

The Scope

- *accommodate traditional generation and transmission*
- *DG, renewables, energy storage, energy efficiency*
- *enabling devices and systems*
- *flexibility to accommodate:*
    - *regional and organizational differences*
    - *new technologies*

The Scope

Consider voluntary standards for electric appliances and equipment for homes and businesses that enable emergency response or DR for:

- *load reduction*
- *load adjustments to provide ancillary services*
- *load shedding in response to crisis*
- *load shedding to preserve grid reliability*

EISA Title XIII Smart Grid Goals

- *increase use of digital information and control technologies*
- *enable dynamic optimization of grid operations and resources with full cyber security*
- *integrate distributed resources including renewables*
- *incorporate demand response, demand-side resources, and energy efficiency*

EISA Title XIII Smart Grid Goals

- *deploy real-time, automated, interactive technologies for:*
  - *metering*
  - *communications*
  - *distribution automation*
- *integrate electricity storage and peak shaving technologies including:*
  - *plug-in electric vehicles*
  - *thermal storage air conditioning*

EISA Title XIII Smart Grid Goals

- *integrate smart appliances and consumer devices*
- *provide timely information and control options to consumers*
- *develop standards for interoperability*
- *lower barriers to interactions between smart grid technologies, practices, and services*

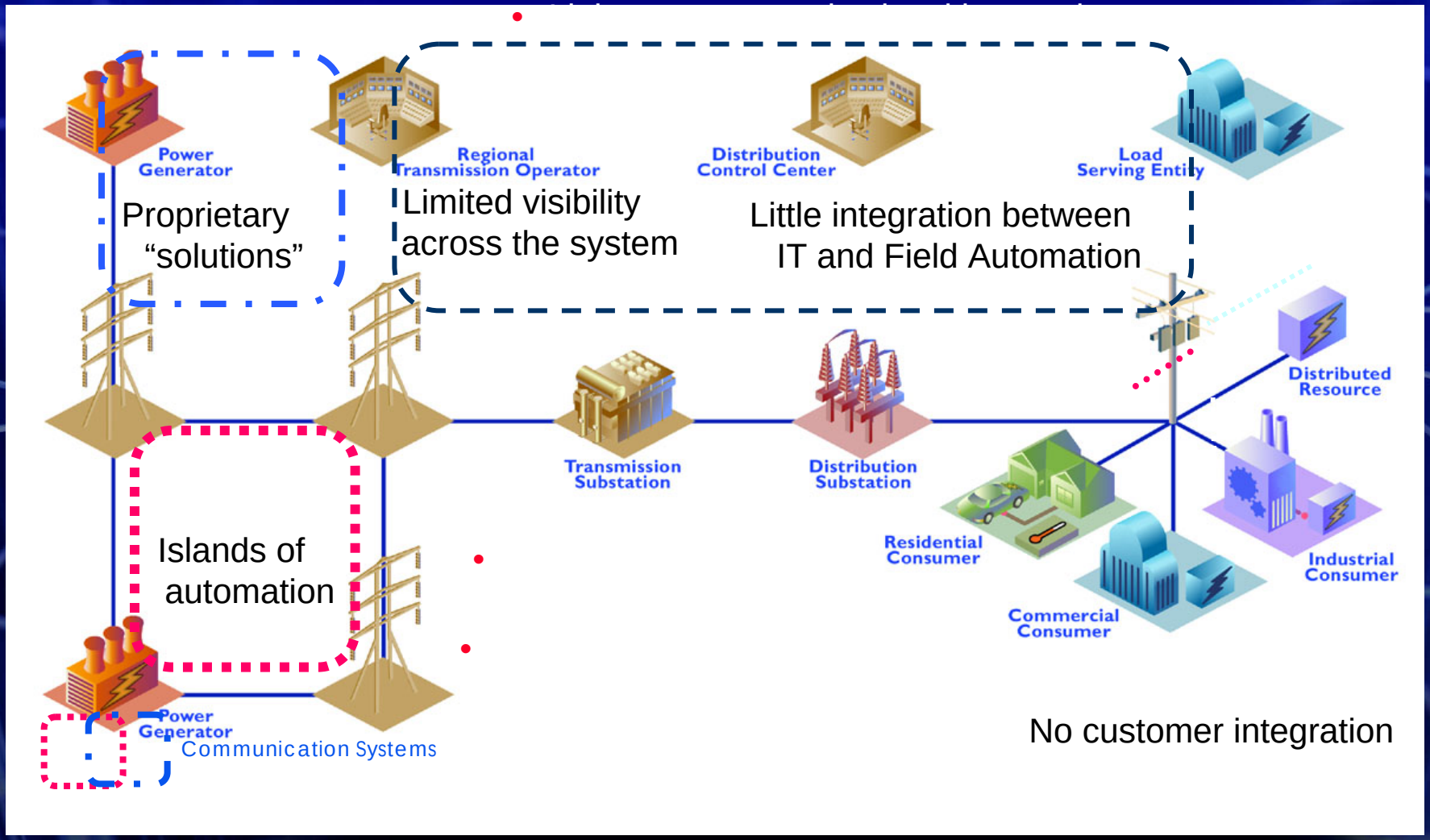
NIST Framework Goals

- *Develop and maintain an interoperability framework that identifies and characterizes the standards, protocols, policies, and models needed to enable the Smart Grid as outlined in the EISA mandate.*
- *December 2008 → Report to Congress on progress in developing the interoperability framework.*

NIST Framework Goals

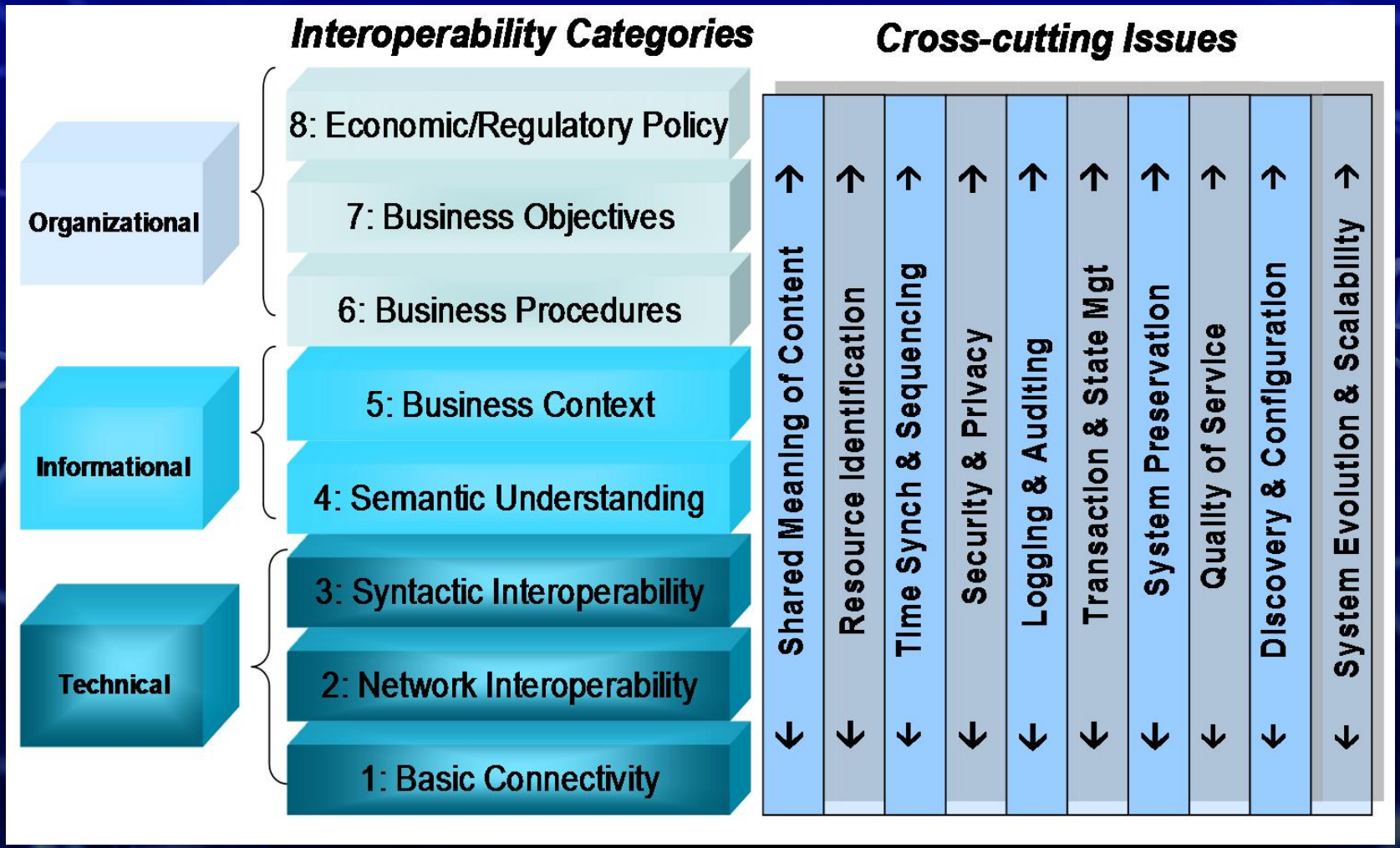
- *Collaborate with standards bodies, user groups, and other industry stakeholders to:*
  - *develop a shared vision interoperability*
  - *achieve consensus regarding the necessary standards, protocols, policies, and models*
  - *develop and/or promote interoperable standards, protocols, policies, and models*
- *Recommend FERC actions as NIST and stakeholders reach consensus on standards, policies, or practices.*

Today's "Smart Grid"



From "Standards and Architecture Development Issues for "Smart Grid" Infrastructure", Joe Hughes, EPRI

Framework Areas of Investigation

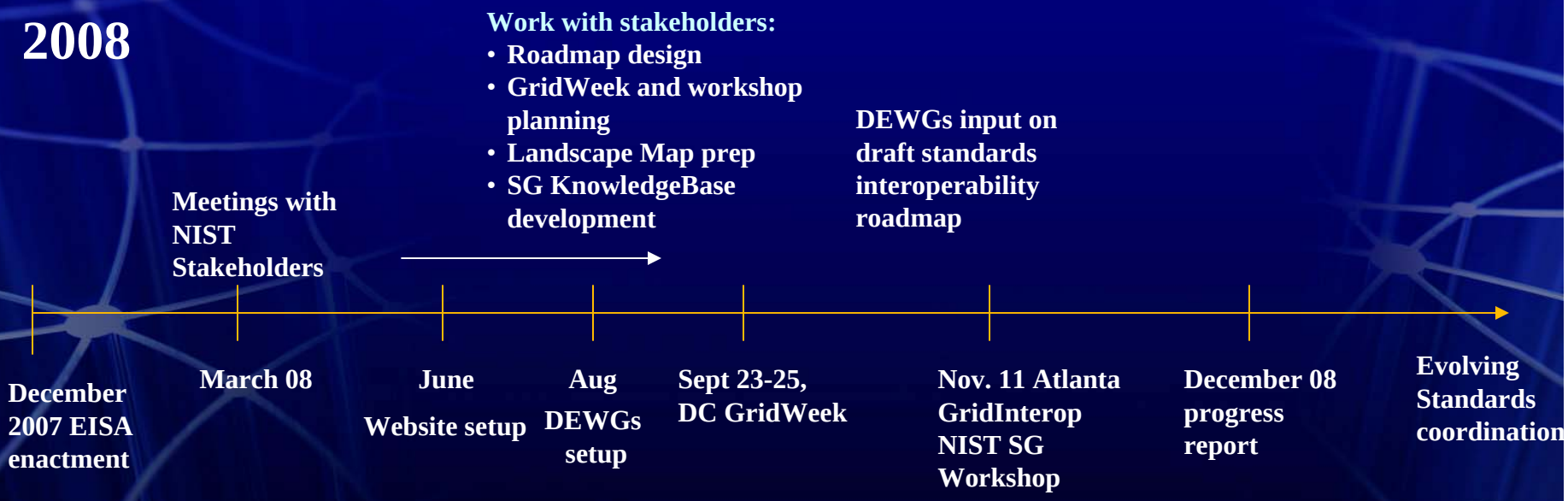


*From "*GWAC KnowledgeBase & Interop Context-Setting Framework*", Steve Widergren, GWAC/PNL*

The Timeline

NIST EISA Work Plan

2008



December 2008 progress report will include:

- Introduction with EISA directions and scope
- Summary of completed work efforts
- Overview of Interoperability Landscape Map and Interoperability Knowledge Base
- Smart Grid Standards Roadmap version 1.0
- Summary of stakeholder input
- Future year plans

http://www.nist.gov/smartgrid/

NIST Interoperability Framework

Four pillars supporting the NIST EISA mission

Concepts Processes Principles Construct

NIST Interoperability Framework

Pillar 1 — Concepts

Shared understanding and application of:

- *interoperability definitions*
- *interoperability taxonomy*
- *information models*

NIST Interoperability Framework

Pillar 2 — Process

Top-down analyses to identify and characterize interaction requirements that drive standards.

Business Objectives → *Use Cases* → *Interactions* → *Standards Protocols Policies…*

- *identify and characterize:*
  - *the important business processes/goals*
  - *use cases associated with the business processes/goals*
  - *actors, information objects, and interaction requirements*

NIST Interoperability Framework

Pillar 2 — Process (cont'd)

Top-down analyses to identify and characterize interaction requirements that drive standards.

Business Objectives → *Use Cases* → *Interactions* → *Standards Protocols Policies…*

- *assess the ability of standards, protocols, policies, practices and models to support interaction requirements*
- *design, build, and maintain an Interoperability Knowledge Base*

NIST Interoperability Framework

Pillar 3 — Principles

The requirements, goals, tenets, and best practices that define a highly interoperable grid.

- *consensus process*
- *communicate and connect*
- *adhere to the Interoperability Framework*
- *adopt broadly applicable (cross-sector) best practices*

NIST Interoperability Framework

Pillar 3 — Principles (cont'd)

The requirements, goals, tenets, and best practices that define a highly interoperable grid.

- *Aim for well defined interfaces and points of interoperability - focus on the semantics.*
- *Maximize use of open standards and proven, Internet-derived technologies.*

NIST Interoperability Framework

Pillar 3 — Principles (cont'd)

The requirements, goals, tenets, and best practices that define a highly interoperable grid.

- *Promote service-based architecture at the enterprise level.*
- *Consider transaction life-cycle:*
  - *scheduling*
  - *operations*
  - *settlement*

NIST Interoperability Framework

Pillar 3 — Principles (cont'd)

The requirements, goals, tenets, and best practices that define a highly interoperable grid.

For system/technology design:

- *manageable - permit the monitoring and control of performance, configuration, health, accounting, and security*
- *upgradeable - permit adding, changing or improving key features later without system disruption*
- *scalable - permit future expansion*

NIST Interoperability Framework

Pillar 3 — Principles (cont'd)

The requirements, goals, tenets, and best practices that define a highly interoperable grid.

- ***extensible*** *- make it easy to integrate new devices and applications*
- ***security and privacy*** *- protect critical information and manage who is authorized to access it*
- ***identification*** *- provide unambiguous reference to system entities*
- ***time and date*** *- address synchronization, sequencing, resolution, time tagging…*

NIST Interoperability Framework

Pillar 3 — Principles (cont'd)

The requirements, goals, tenets, and best practices that define a highly interoperable grid.

- *self-healing - design for automatic recovery from failure*
- *verification and audits - log important information*
- *discovery and configurability - provide for automatic discovery and configuration between components*

NIST Interoperability Framework

Pillar 4 - Construct

Build a framework that provides context-based guidance for solving interoperability problems.

This is the NIST Program - the sum total of what NIST is doing to coordinate forward progress on grid interoperability.

NIST Interoperability Framework

Pillar 4 - Construct

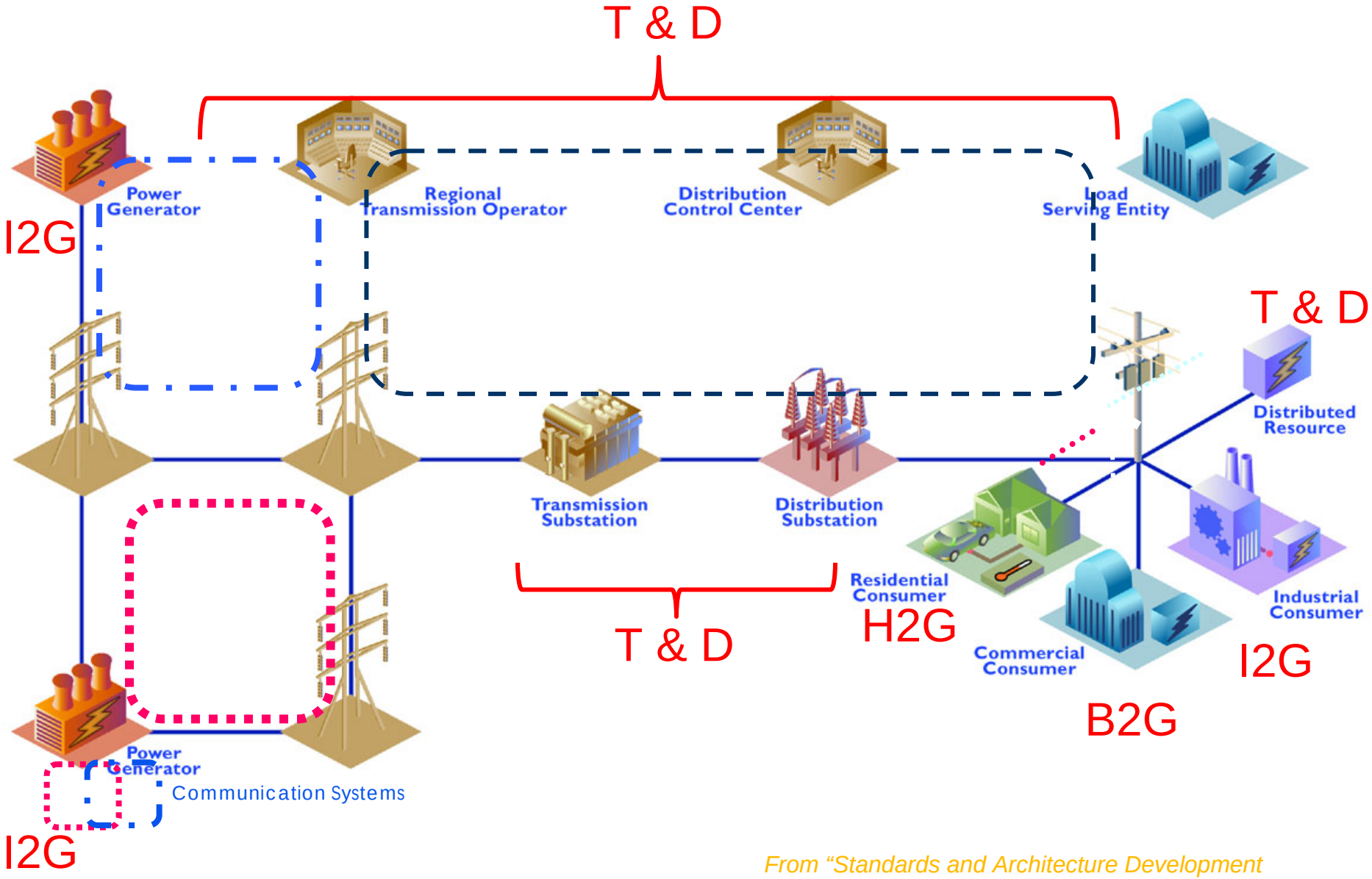
Build a framework that provides context-based guidance for solving interoperability problems.

- *Domain Expert Working Groups (DEWGs) and collaboration tools*
- *Interoperability Knowledge Base and associated tools*
- *Interoperability Assessment and Roadmap*
- *Rigorous communication with and among stakeholders*

Domain Expert Working Groups (DEWGs)

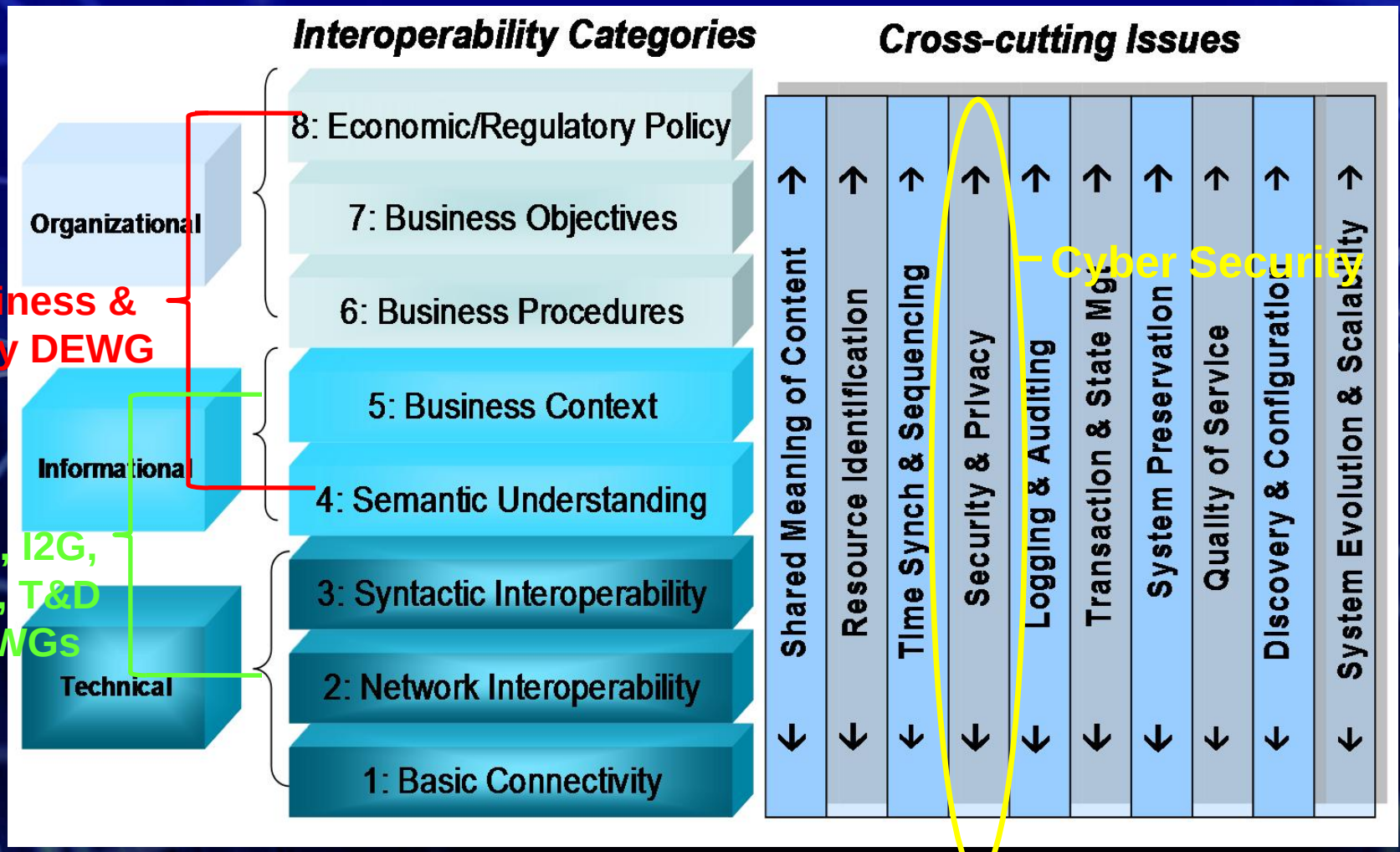
- *Transmission & Distribution (T&D)*
- *Building to Grid (B2G)*
- *Industry to Grid (I2G)*
- *Home to Grid (H2G)*
- *Business & Policy (B&P)*
- *Cyber Security*

The Domains



From "Standards and Architecture Development Issues for "Smart Grid" Infrastructure", Joe Hughes, EPRI

The Domains


Interoperability Categories
Cross-cutting Issues
Organizational
Informational
Technical
8: Economic/Regulatory Policy
7: Business Objectives
6: Business Procedures
5: Business Context
4: Semantic Understanding
3: Syntactic Interoperability
2: Network Interoperability
1: Basic Connectivity
Shared Meaning of Content
Resource Identification
Time Synch & Sequencing
Security & Privacy
Logging & Auditing
Transaction & State Mgt
System Preservation
Quality of Service
Discovery & Configuration
System Evolution & Scalability
Cyber Security
Business & Policy DEWG
B2G, I2G, H2G, T&D DEWGs

Domain Expert Working Groups (DEWGs)

DEWG members are subject matter experts and other stakeholders who understand the business, policy, and technical aspects of interactions within and between the different smart grid domains:

- *utilities, vendors, academia, industry and trade organizations, standards organizations, federal agencies, other industry experts*

Domain Expert Working Groups (DEWGs) Objectives

- *guide business objective and use case development*
- *develop interaction requirements*
- *point to relevant standards (that feed into the Interoperability Knowledge Base)*

Domain Expert Working Groups (DEWGs) Objectives

- *help develop the NIST interoperability roadmap*
- *lead coordination with standards development organizations (SDOs) on implementing the roadmap and harmonizing standards where needed*

DEWG Collaboration Tools

- *Interoperability Knowledge Base*
  - *built with the input of domain experts, and used as a resource for identifying standards gaps and overlaps*
- *DEWG SG TWiki site - a collaboration site for discussion, idea generation, work organization, intermediate repository for documents, URL, data files, … , etc.*
- *teleconferences, email, etc.*

Information modeling

- *SG Interoperability Definitions*
  - *setting a foundation of shared meaning and uniform usage*
- *SG Interoperability Taxonomy*
  - *organizing the information that identifies and characterizes SG entities, interactions, models, standards, protocols, policies, practices …*

Communications

- *DoE Smart Grid Task Force and guiding stakeholders: NEMA, EPRI, IEEE, etc.*
- *DEWG members*
- *GridWise Architectural Council*
- *Presentations to wider groups: stakeholder conferences, Gridweek, GridInterop*
- *Progress report to Congress next month*
- *NIST Smart Grid website: http://www.nist.gov/smartgrid/*

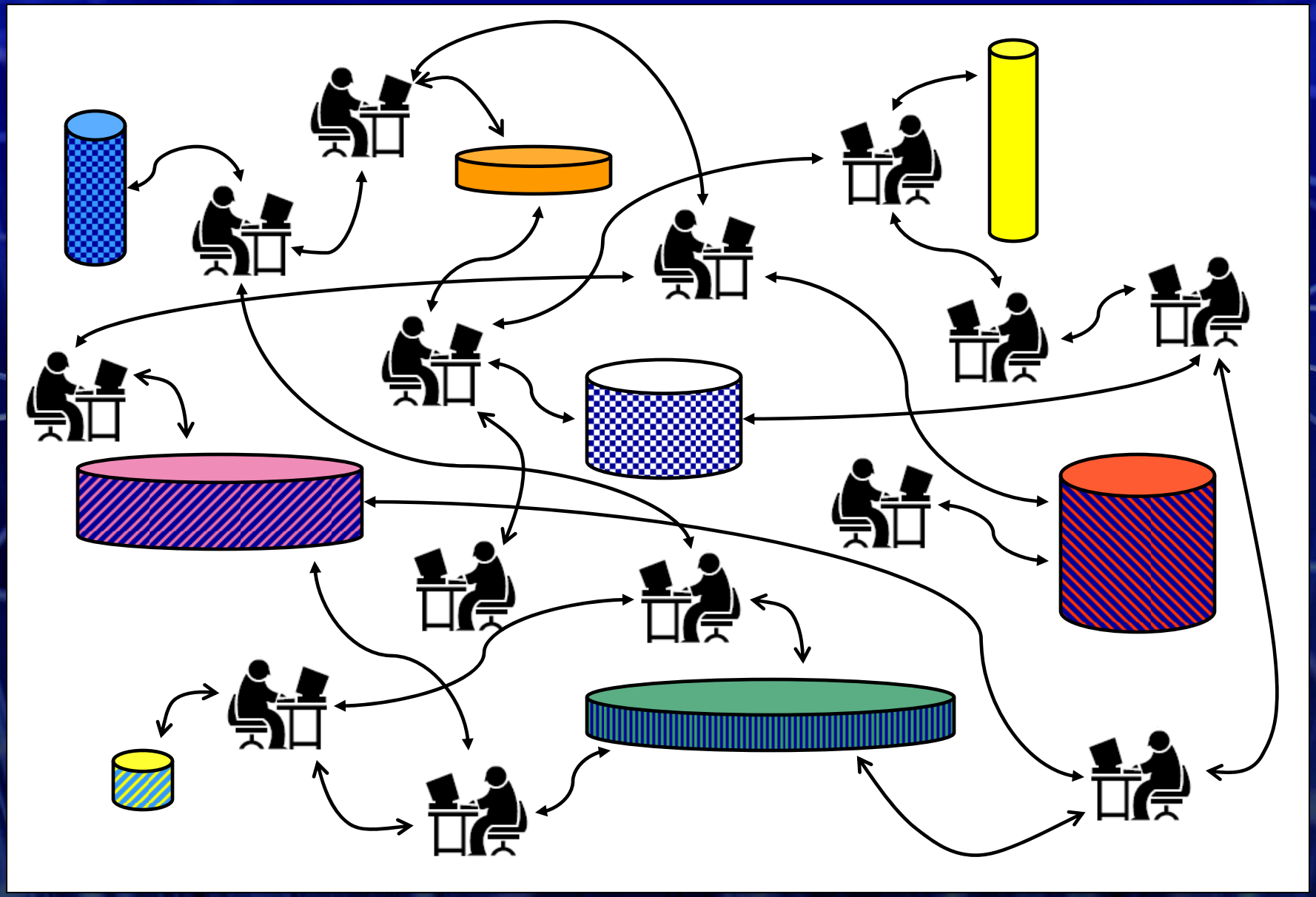
Topics Coming Up Next

Today's Collaboration Model

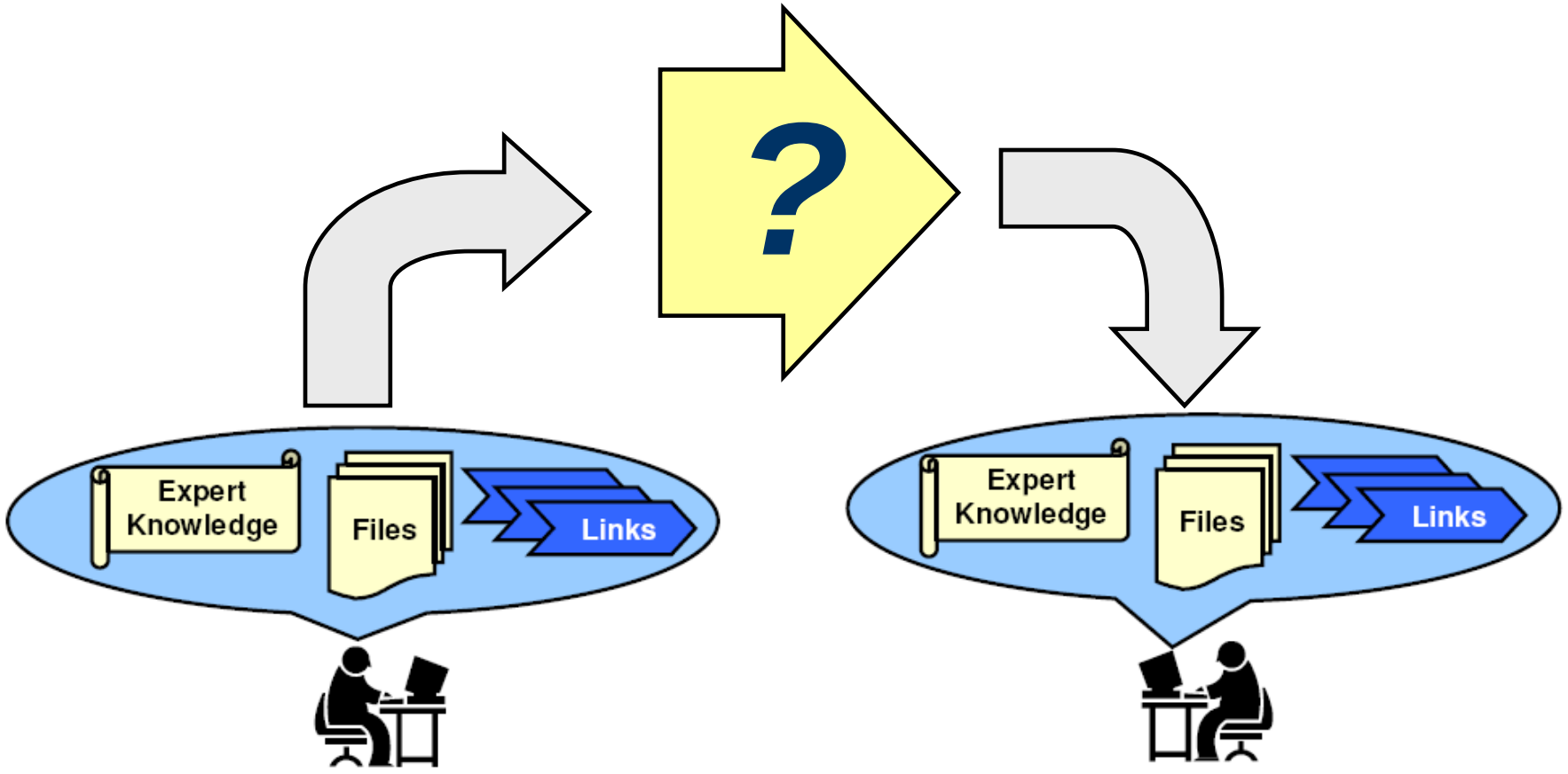
New Foundation For Collaboration

Workshop Overview

Today's Collaboration Model



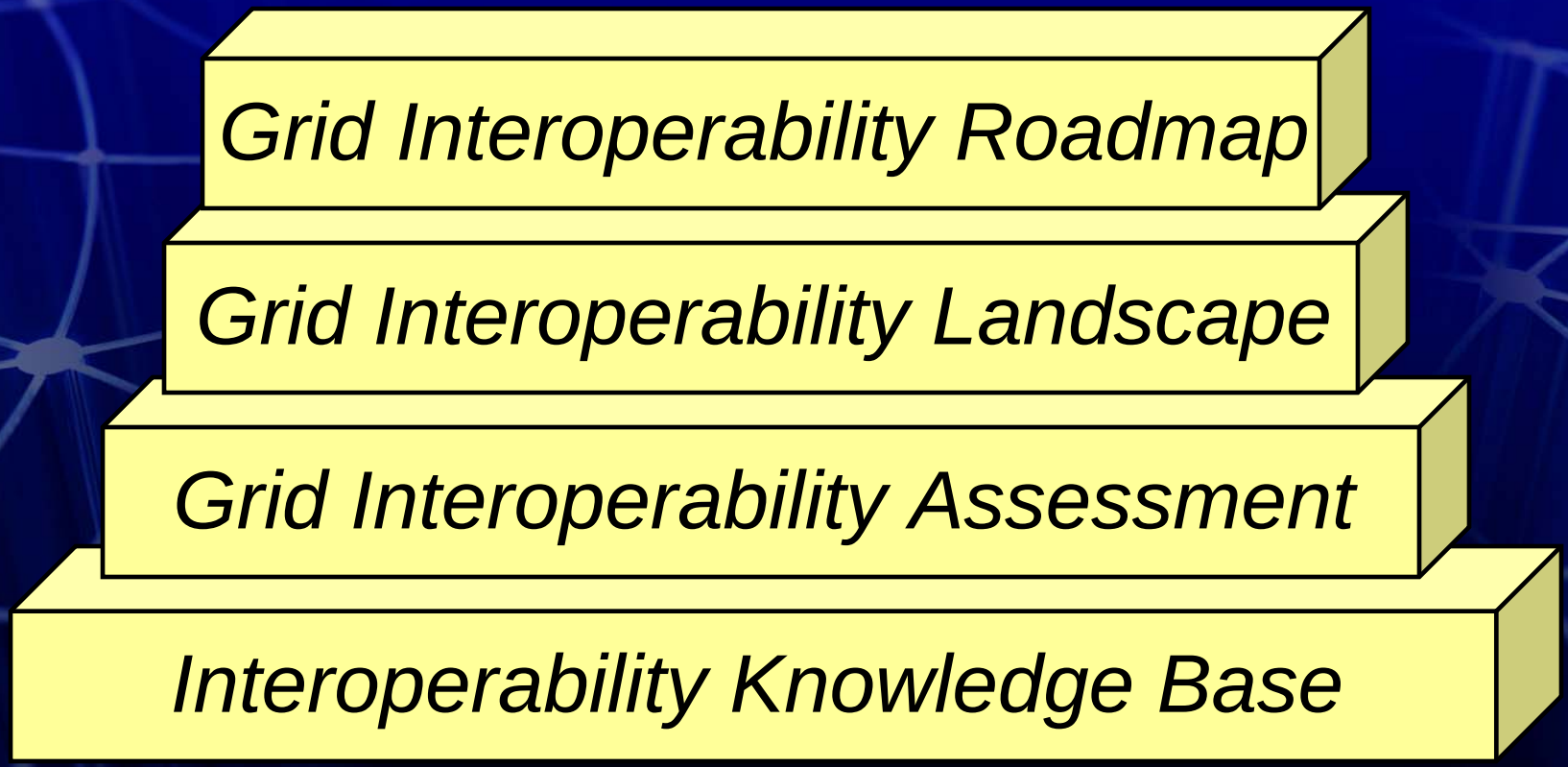
A New Foundation For Collaboration



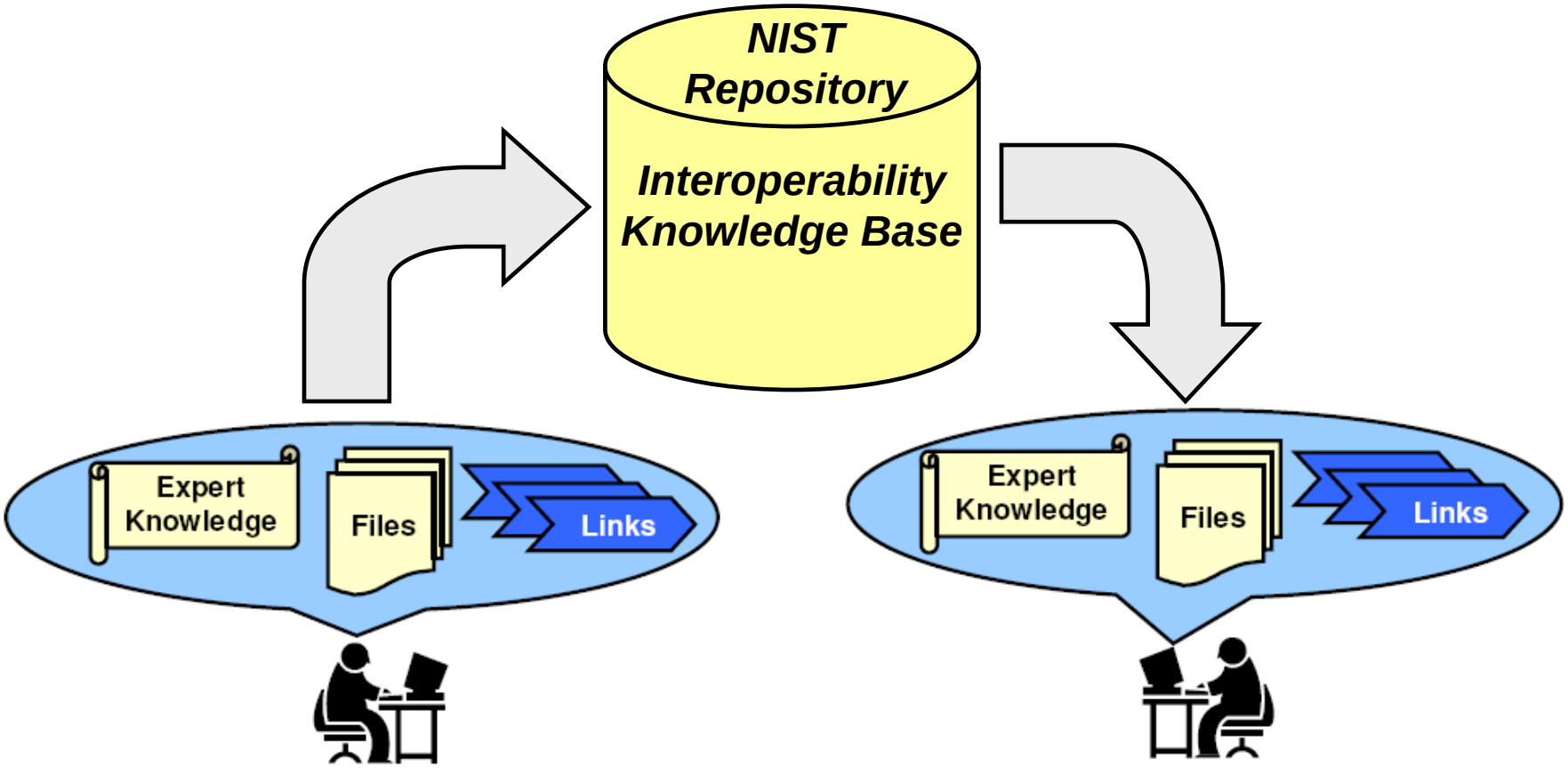
Contributors
Provide & Manage Information

Users
Explore & Acquire Information

A New Foundation For Collaboration



Interoperability Knowledge Base



Contributors

Provide & Manage Information

Users

Explore & Acquire Information

Interoperability Knowledge Base

The Interoperability Knowledge Base (IKB) will be a public information repository for information pertaining to, and supporting, development of a highly interoperable intelligent power grid (aka Smart Grid).

Interoperability Knowledge Base

Objective:

Implement and maintain a system architecture, information content, and knowledge base governance that enable highly effective communication and collaboration among all stakeholders.

Interoperability Knowledge Base

Objective:

Serve a large and diverse community of stakeholders.

utilities, consumers, ISOs, RTOs, regulators, policy-makers, standards organizations, system architects, service providers, hardware & software suppliers, industry groups, system integrators, industry & mass media, …..

Interoperability Knowledge Base

Objective:

Promote shared understanding and uniform use of semantics for information related to Smart Grid interoperability.

Interoperability Knowledge Base

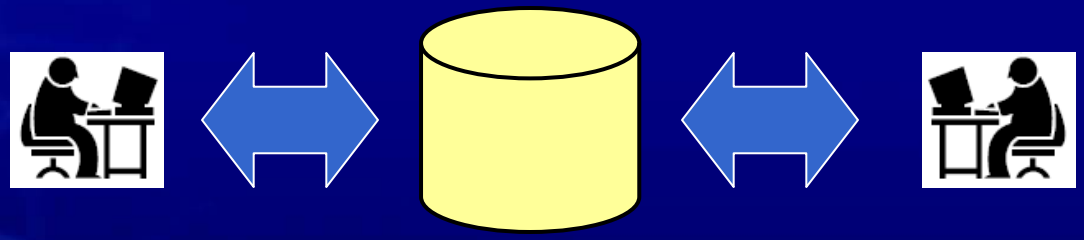
The Interoperability Knowledge Base will contain logically organized, accurate, comprehensive, and consistent content that identifies and characterizes all types of information relevant to grid interoperability.

Interoperability Knowledge Base

Types of information relevant to grid interoperability include:

- *entities*
- *technologies*
- *applications and their respective domains*
- *interactions and their respective requirements*
- *information objects*
- *policies & regulations*
- *Smart Grid interoperability development efforts*
- *the relationships among all of the above*

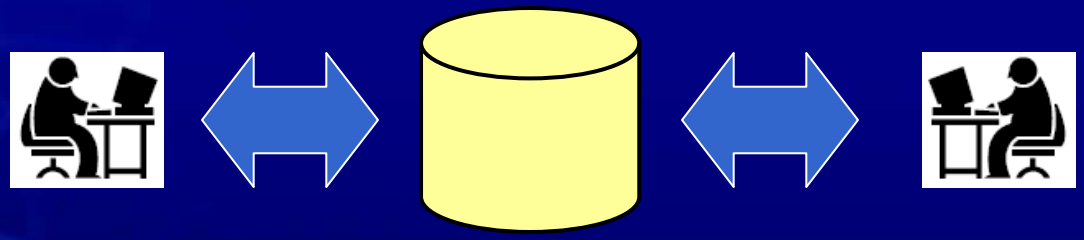
Interoperability Knowledge Base



System Implementation & Support Plan:

- *hosted and administered by NIST*
- *published data structure*
- *rigorous data management*

Interoperability Knowledge Base

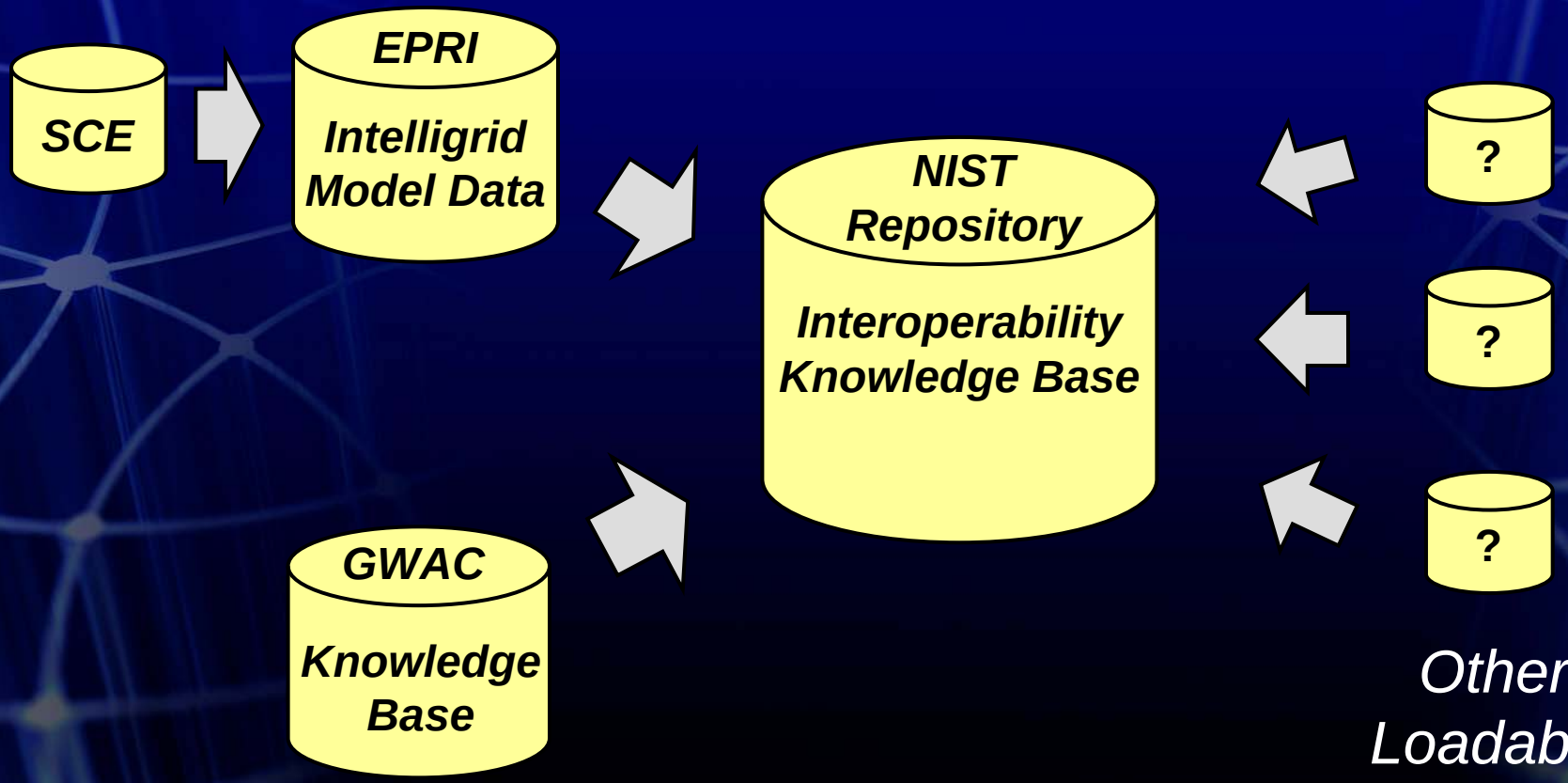


Content Development & Management Tasks:

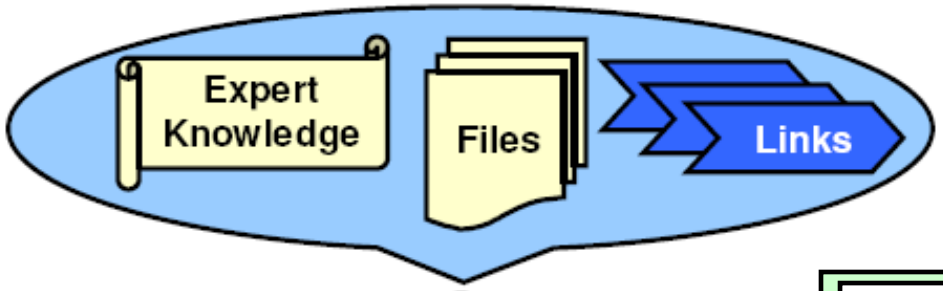
- *content goals*
- *nomenclature and organization (taxonomy)*
- *contributor outreach*
- *contributor portals*
- *access policies*
- *data import & export (XMI compliant)*

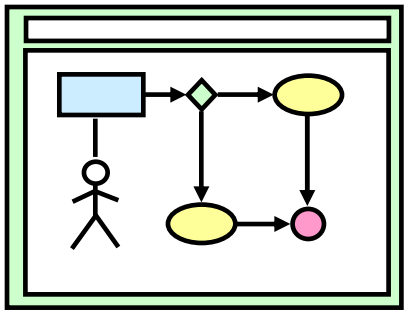
Interoperability Knowledge Base

Begin by importing & integrating content from existing knowledge bases.



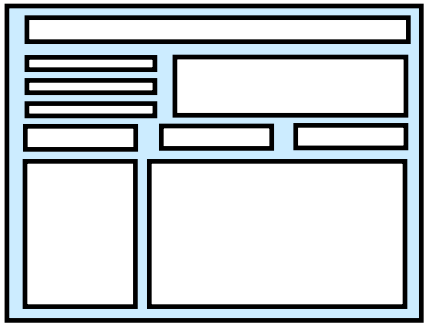
Contributors Provide and Manage Information

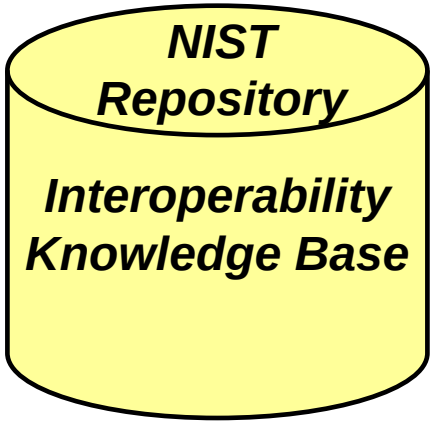




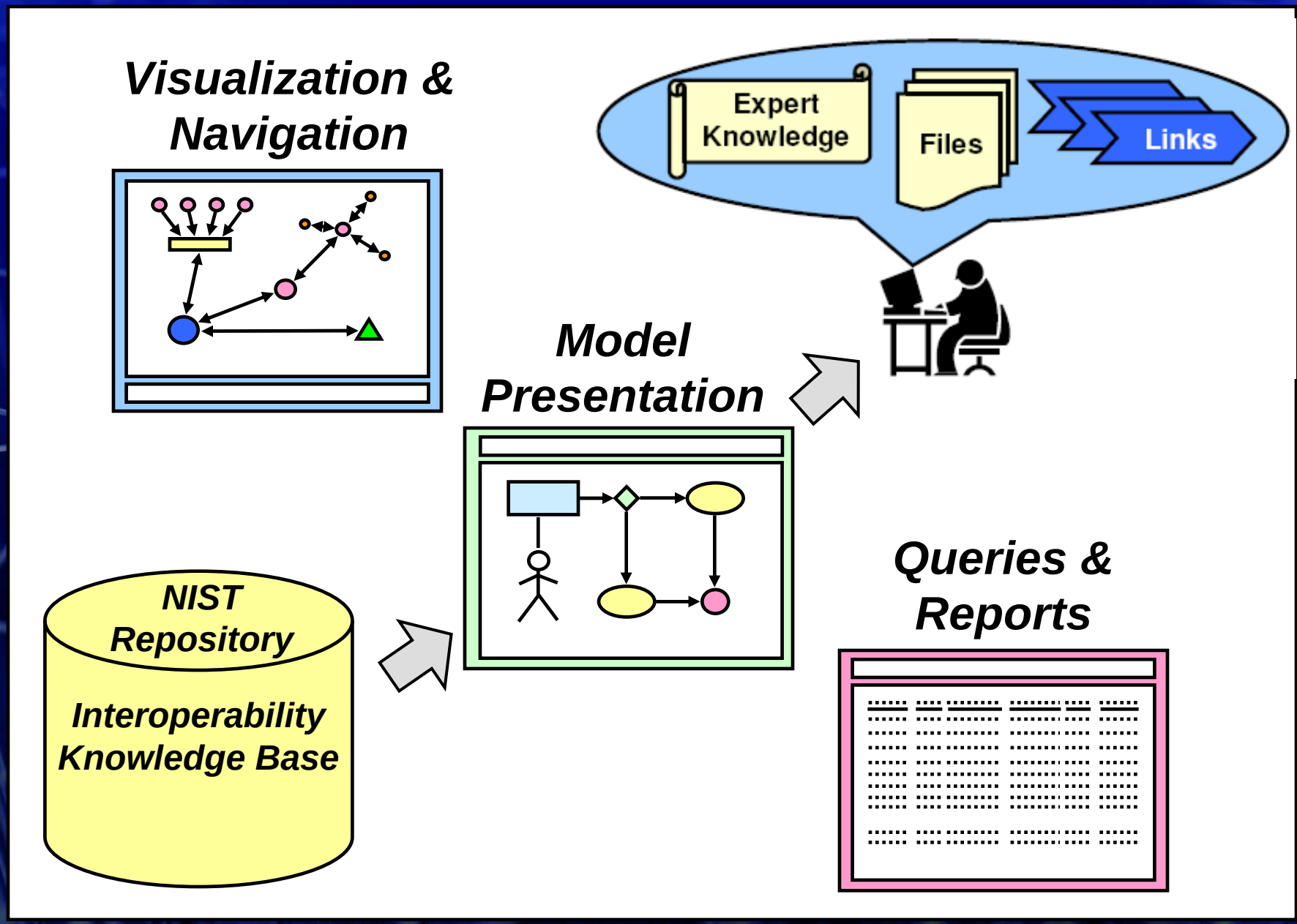
Model Creation & Mgmt. Tool(s)

Data Entry & Mgmt. Forms

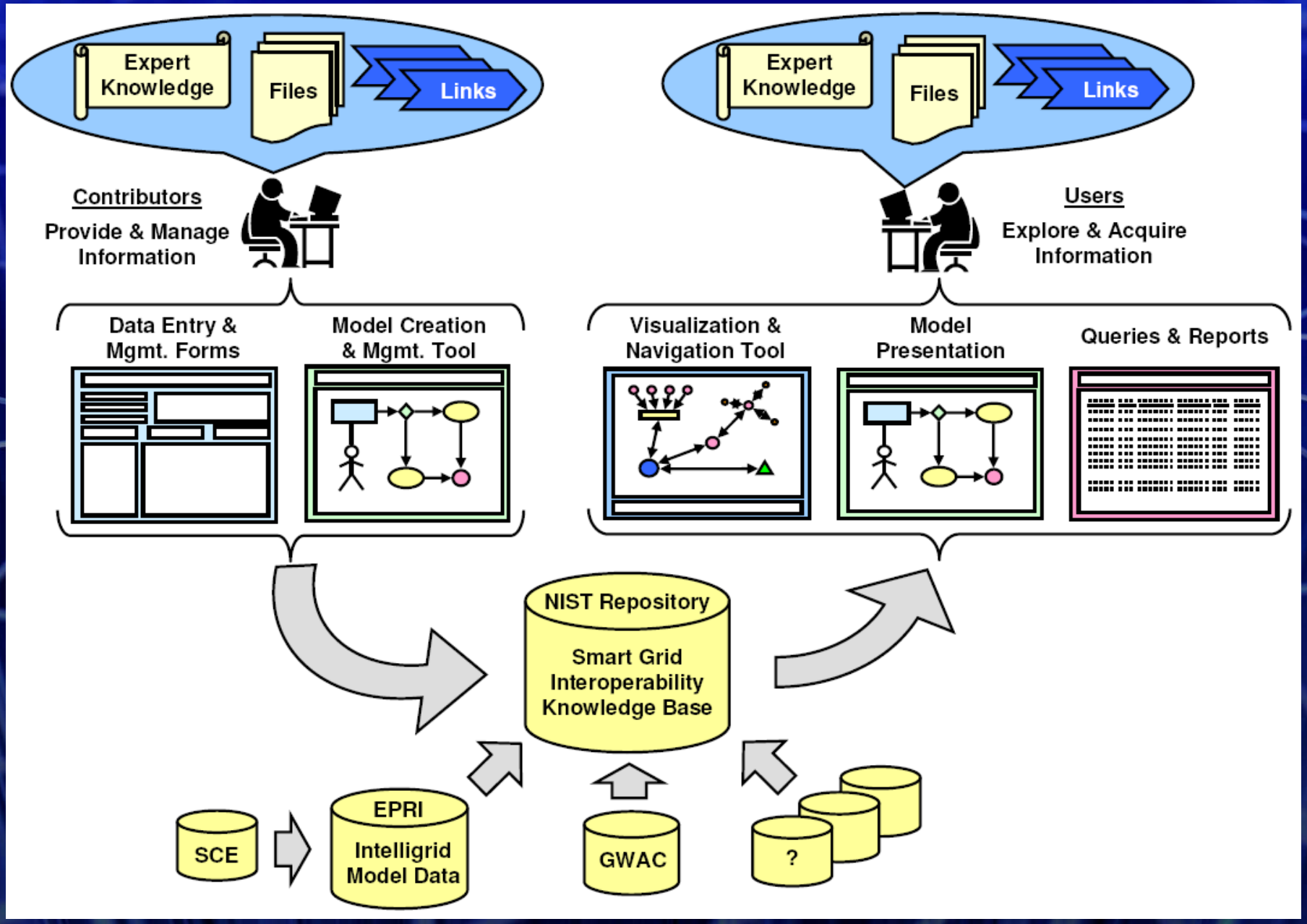




Users Explore and Acquire Information



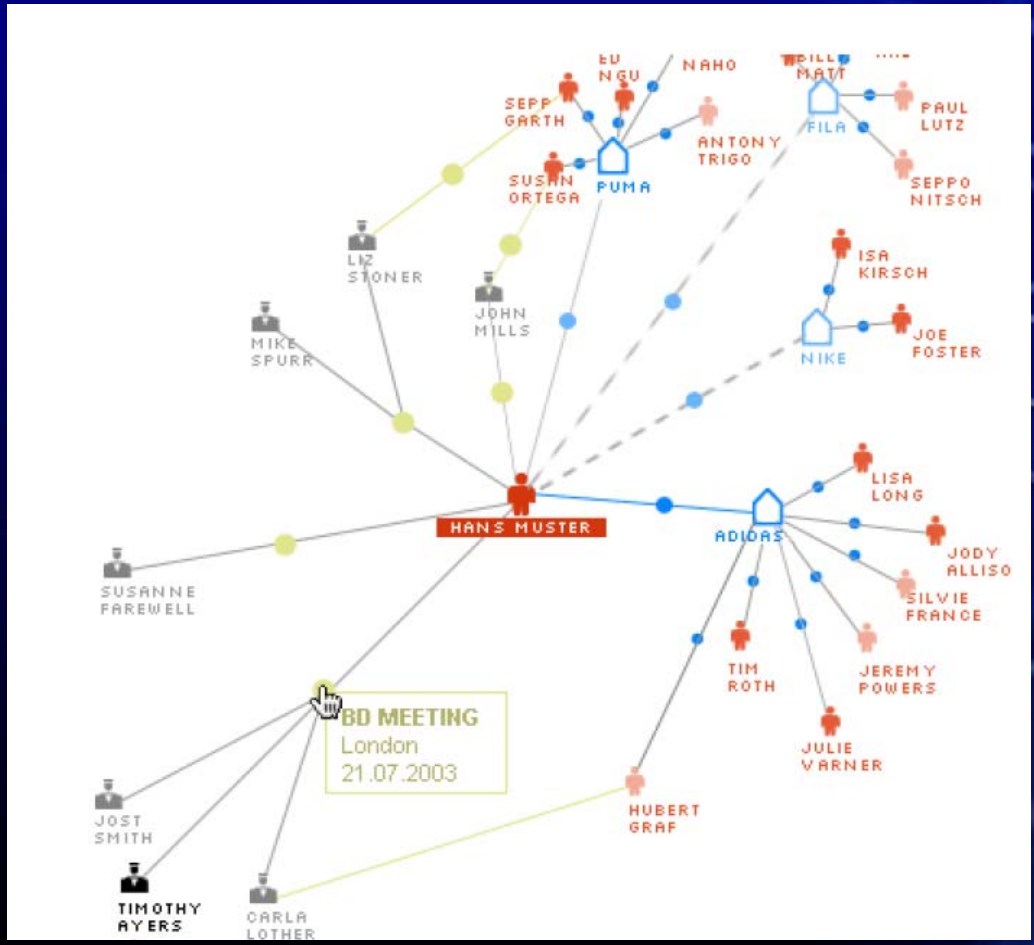
Interoperability Knowledge Base



Visualization & Navigation Tool

Example:

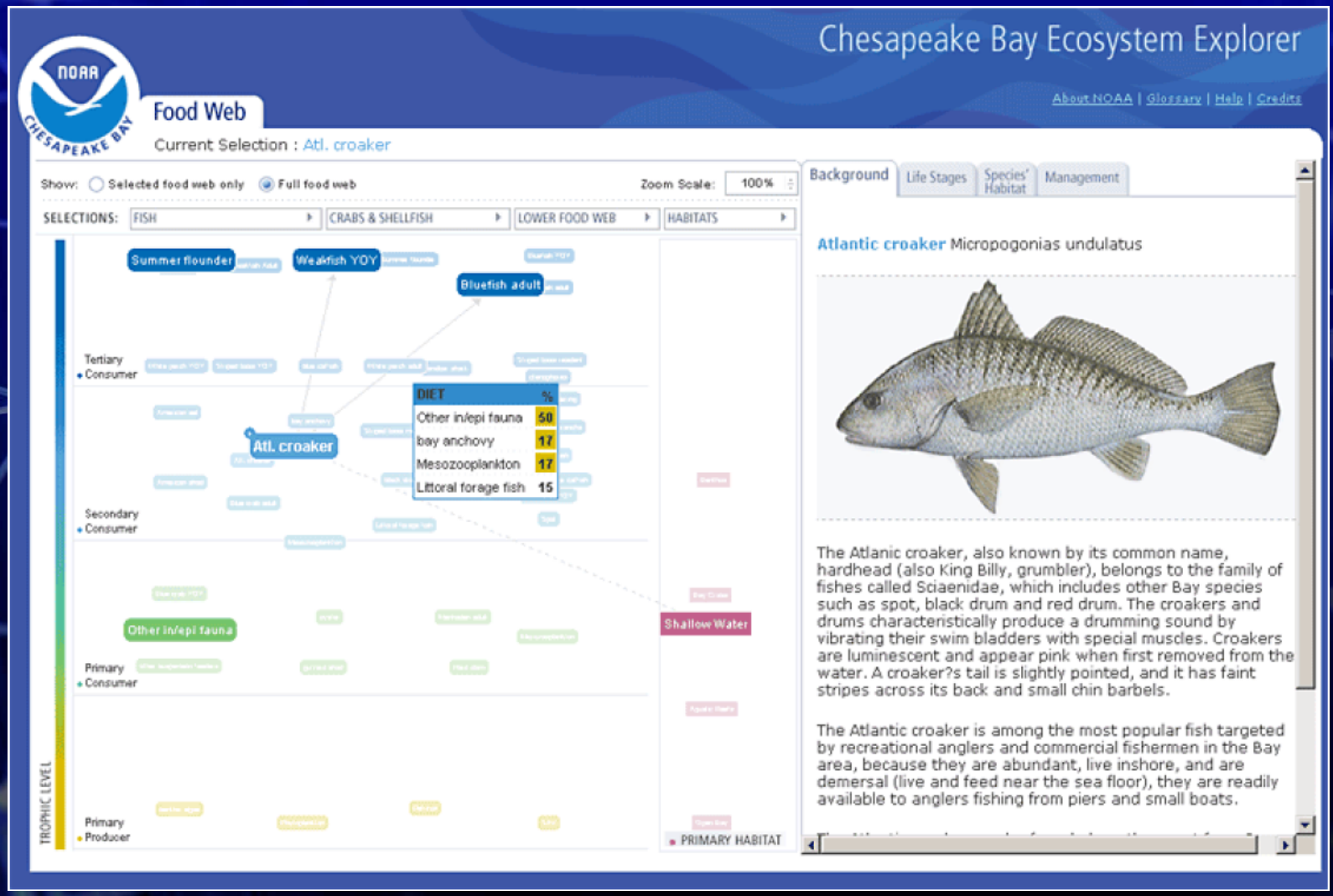
- *"Spider Diagram" shows links between objects*
- *symbols portray object types (people, events, and organizations in this example)*
- *colors portray object and link attributes*
- *"rolling over" objects and links exposes more data*
- *clicking on an object shifts the center of focus to the selected object*



Example diagram from ThinkMap.com

Visualization & Navigation Tool

This "Ecosystem Explorer" might be a good model for a "Smart Grid Explorer"



Example from ThinkMap.com

Grid Interoperability Assessment

The Grid Interoperability Assessment will be created and maintained through on-going collaboration within and between the NIST program working groups.

Grid Interoperability Assessment

The Assessment will be a continually evolving body of work residing in the Interoperability Knowledge Base.

Users will access and review the Assessment through multiple "views" of the information in the Interoperability Knowledge Base.

Grid Interoperability Assessment

The Assessment will identify, characterize, and assess the impact of:

- *the presence or absence of harmony and interoperability among Smart Grid components*
- *gaps and overlaps among existing and emerging technologies, standards, protocols, practices, policies…*
- *cross-cutting requirements that strongly influence grid interoperability*

Grid Interoperability Landscape

The Grid Interoperability Landscape will provide users with a visual representation of the information in the Interoperability Knowledge Base and the Grid Interoperability Assessment.

Grid Interoperability Landscape

The Landscape will be an adaptive resource that will always portray the current body of information in the Interoperability Knowledge Base and the Grid Interoperability Assessment.

Flexible presentment of Landscape views will respond to each individual user's needs and perspective(s).

Landscape views will be generated and presented by the Interoperability Knowledge Base visualization and navigation tool.

Grid Interoperability Roadmap

The Grid Interoperability Roadmap will help guide Smart Grid stakeholders as they plan their movement toward a highly interoperable grid.

Grid Interoperability Roadmap

- *identifies and promotes the technologies, practices, and policies that foster interoperability*
- *identifies barriers to interoperability and recommends an order of priority for eliminating those barriers*
- *recommends strategies for eliminating barriers to interoperability*

Workshop Overview

Six Working Groups:

- *Transmission & Distribution (T&D)*
- *Building-to-Grid (B2G)*
- *Industry-to-Grid (I2G)*
- *Home-to-Grid (H2G)*
- *Business & Policy (B&P)*
- *Cyber Security*

Workshop Overview

Five Breakout Sessions:

- *Tuesday*
  - *BO1 >> 1:30 pm – 3:00 pm*
  - *BO2 >> 3:30 pm – 5:00 pm*
- *Wednesday*
  - *BO3 >> 8:30 am – 10:00 am*
  - *BO4 >> 10:30 am – 12:00 pm*
- *Thursday*
  - *BO5 >> 8:30 am – 10:00 am*

Workshop Overview

Breakout Session 1

Tuesday >> 1:30 pm – 3:00 pm

Objective:

Develop information that will form the basis for portraying the current state of interoperability within the Working Group's domain.

Approach:

Break into teams of 6-8. Share and document information about interop experiences. Worksheets provided.

Workshop Overview

Breakout Session 2

Tuesday >> 3:30 pm – 5:00 pm

Objective:

Portray the current state of interoperability within the Working Group's domain.

Approach:

Break into same teams as in BO1. Consolidate and assess information developed in BO1. Worksheets provided.

Workshop Overview

Breakout Session 3

Wednesday >> 8:30 am – 10:00 am

Objective:

Recommend prioritization for the business and interoperability objectives that the Working Group identified in Breakout Sessions 1 and 2.

Approach:

Facilitated discussion and voting process.

Workshop Overview

Breakout Session 4

Wednesday >> 10:30 am – 12:00 pm

Objective:

Identify ways to improve the effectiveness and value of the NIST program.

Approach:

Working Group meets as a single group. Facilitated discussion and voting process.

Workshop Overview

Breakout Session 5

Thursday >> 8:30 am – 10:00 am

Objective:

Recommend next steps and timeline for the NIST program.

Approach:

Domain Expert Working Groups meet. Review and assess outcome of Breakout Sessions 1 - 4. Cyber Security group members join other groups for this breakout.

Gerald FitzPatrick, NIST Smart Grid Program

David Holmberg, NIST Smart Grid Program

Andrew Owens, Principal, Plexus Research