GridWise® Architecture Council (GWAC) 101

David Elve

Questions I often get….

- What is GWAC? What does it do?
- What organizations comprise the GWAC?
- What value do stakeholders obtain from GWAC?
- If there is value, are there some real utility case studies?
- Are we really already members? Who represents us?
- Which stakeholder group does GWAC target?
- How does GWAC interact other industry groups?
  - I see many of the same people at SGiP and UCAIug

The question I rarely get…
Wow, cool, how do I get involved so I can help with all the work?!

Key Discussion Points

- >3,000 electric utilities (NAM); most with access to the Grid
- Both IOUs and small utilities have resource issues
- Utility key interests: Cost control, risk mitigation
- Educate and enlarge the pool of talent for the industry
- Become a “Go To” resource for utilities
  - Smart Grid *Knowledge and Networking*

No need for failures of any sort – security is just one issue..

Agenda

- Update and overview on the Gridwise Architecture Council (GWAC)
  - What is does, how it is relevant…
  - How it supports and provides tremendous value to the smart grid industry.
- Update on SGiP
- Update on the UCAIug
- Q&A

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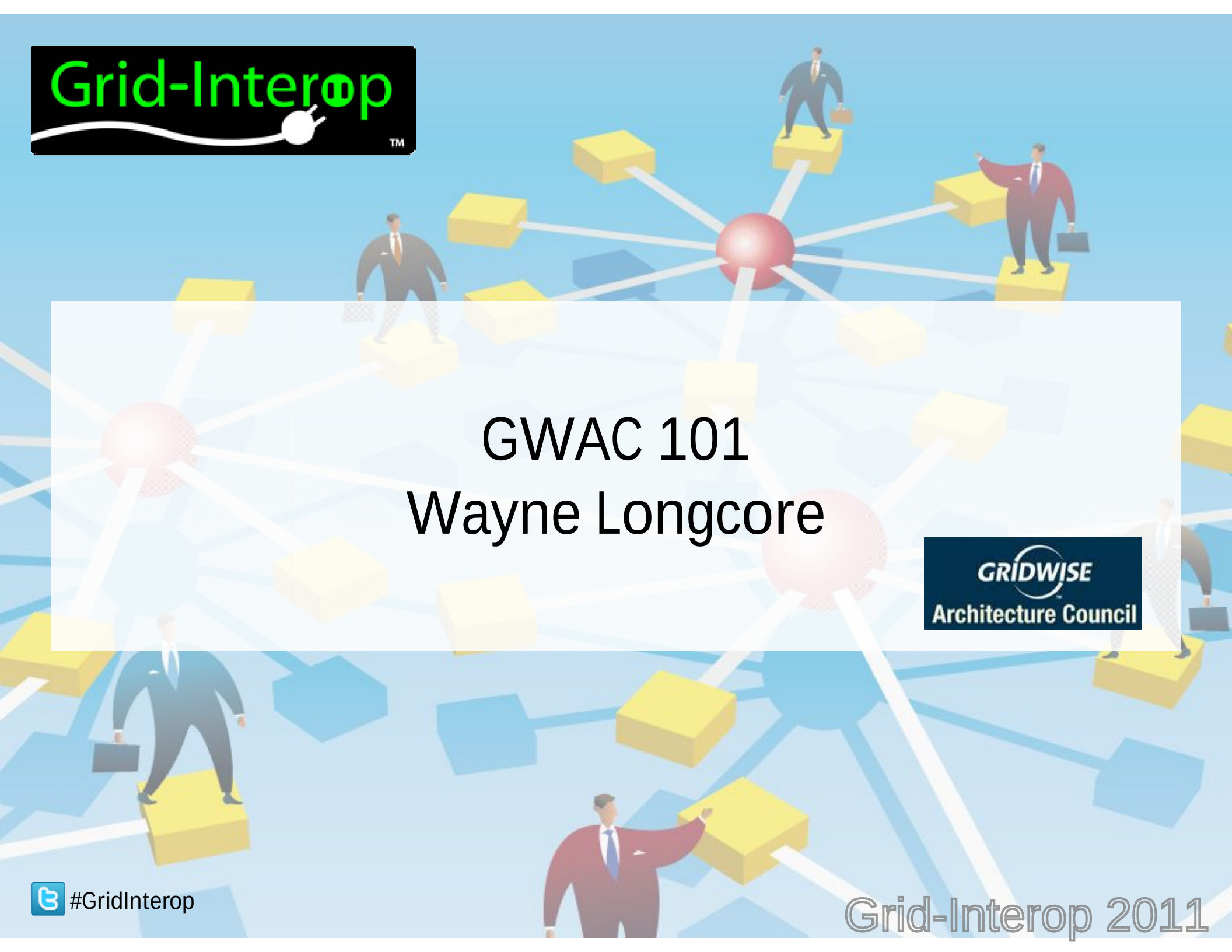
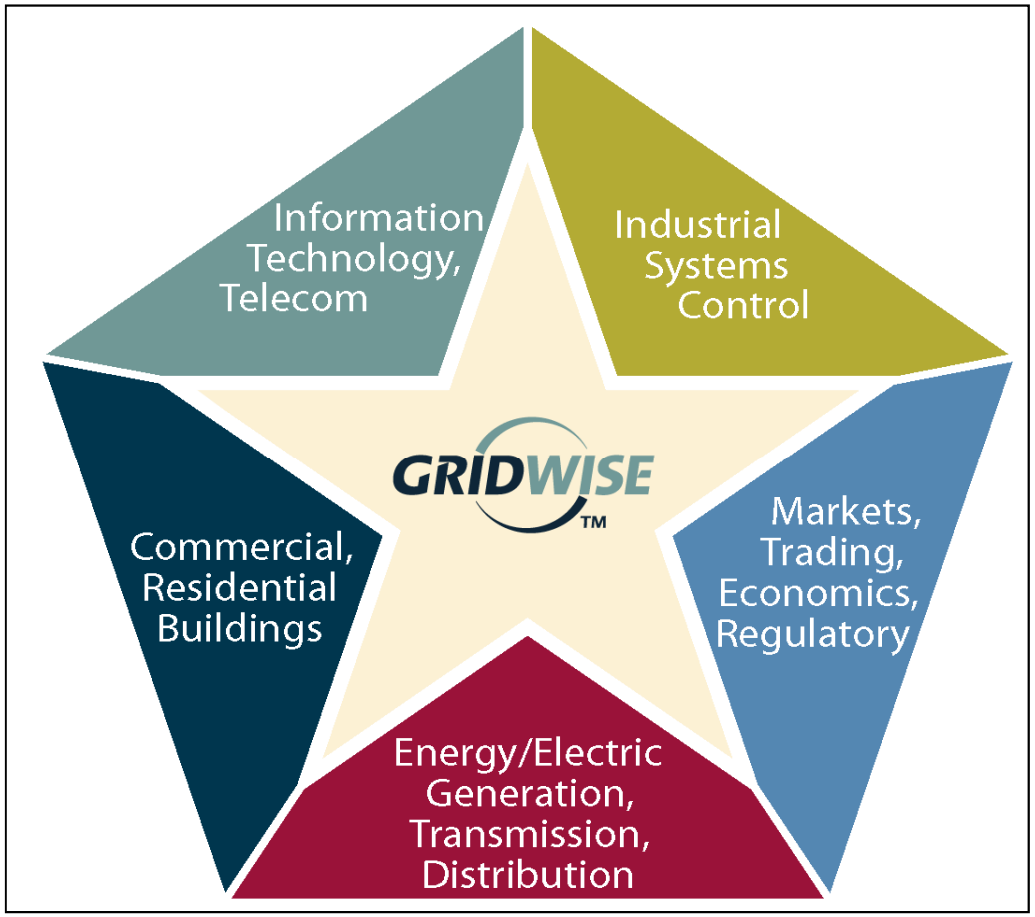

Grid-Interop
GWAC 101
Wayne Longcore
GRIDWISE
Architecture Council
#GridInterop
Grid-Interop 2011

GridWise Architecture Council

- Who



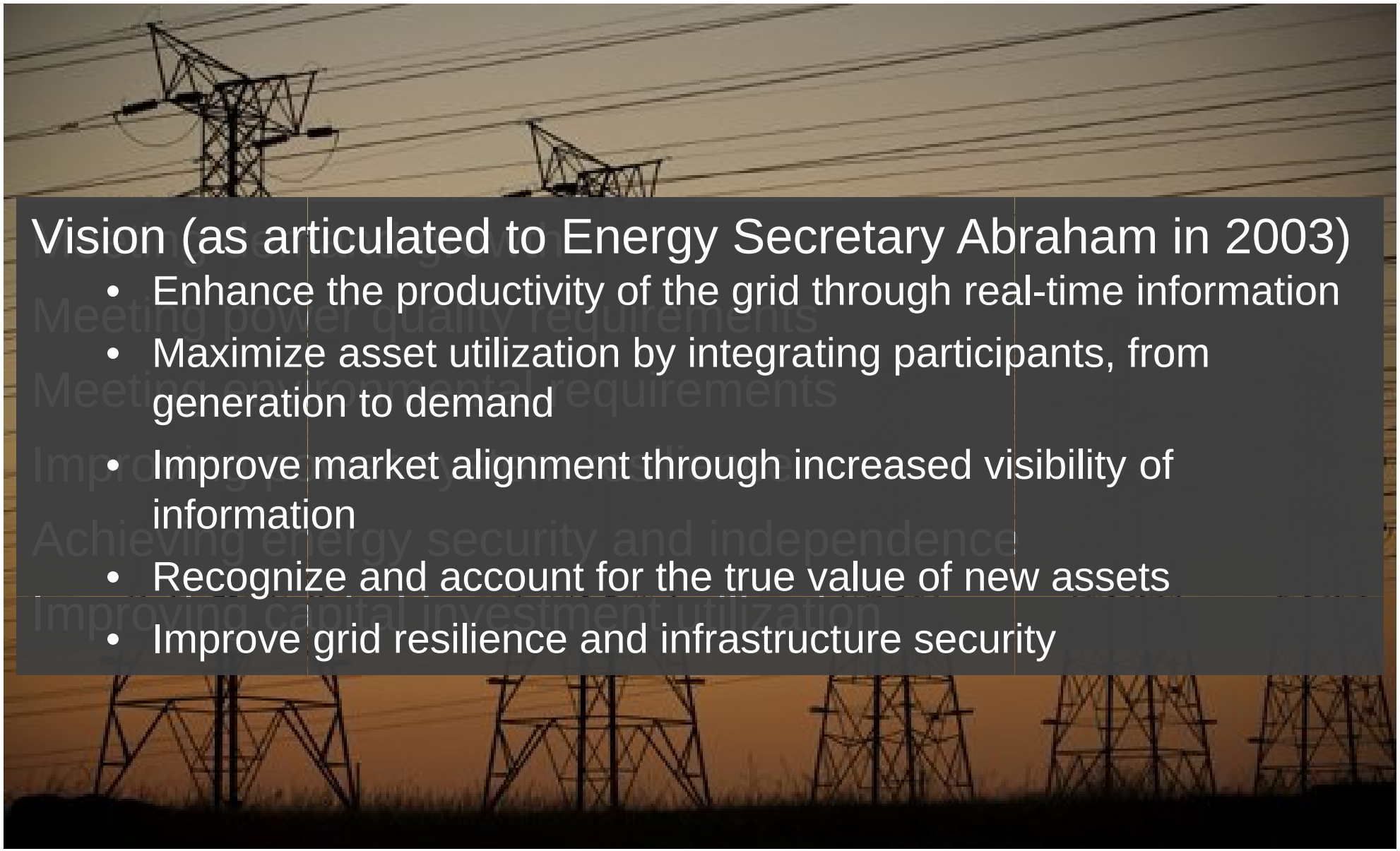
- What
  - Principles of interaction
  - Interoperability

Advocating
Facilitating
Eye on the Future

The Electricity Community

→ The future is in the linkage of sectors across the electricity chain.

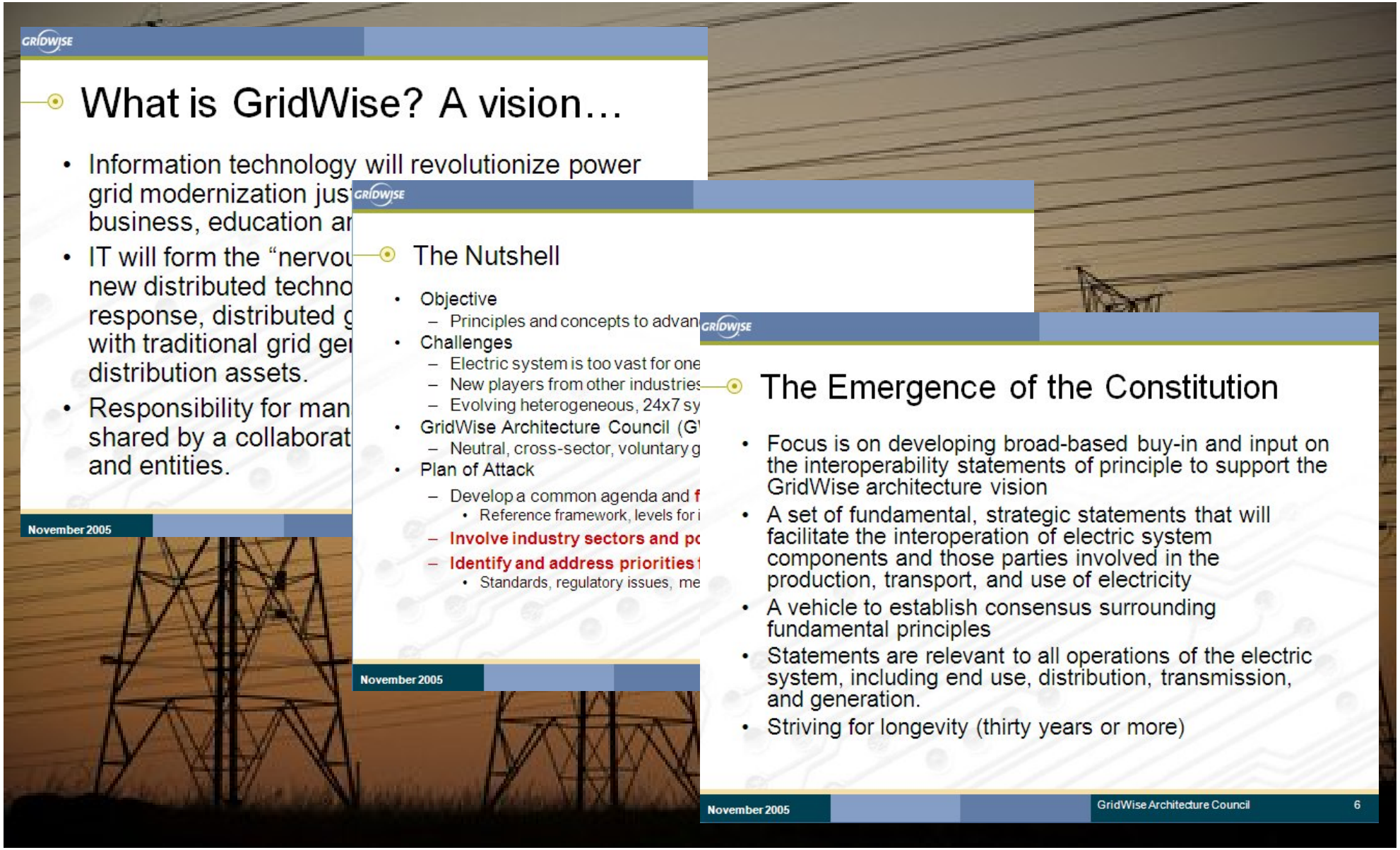
Why We're Here – The "End-Game"



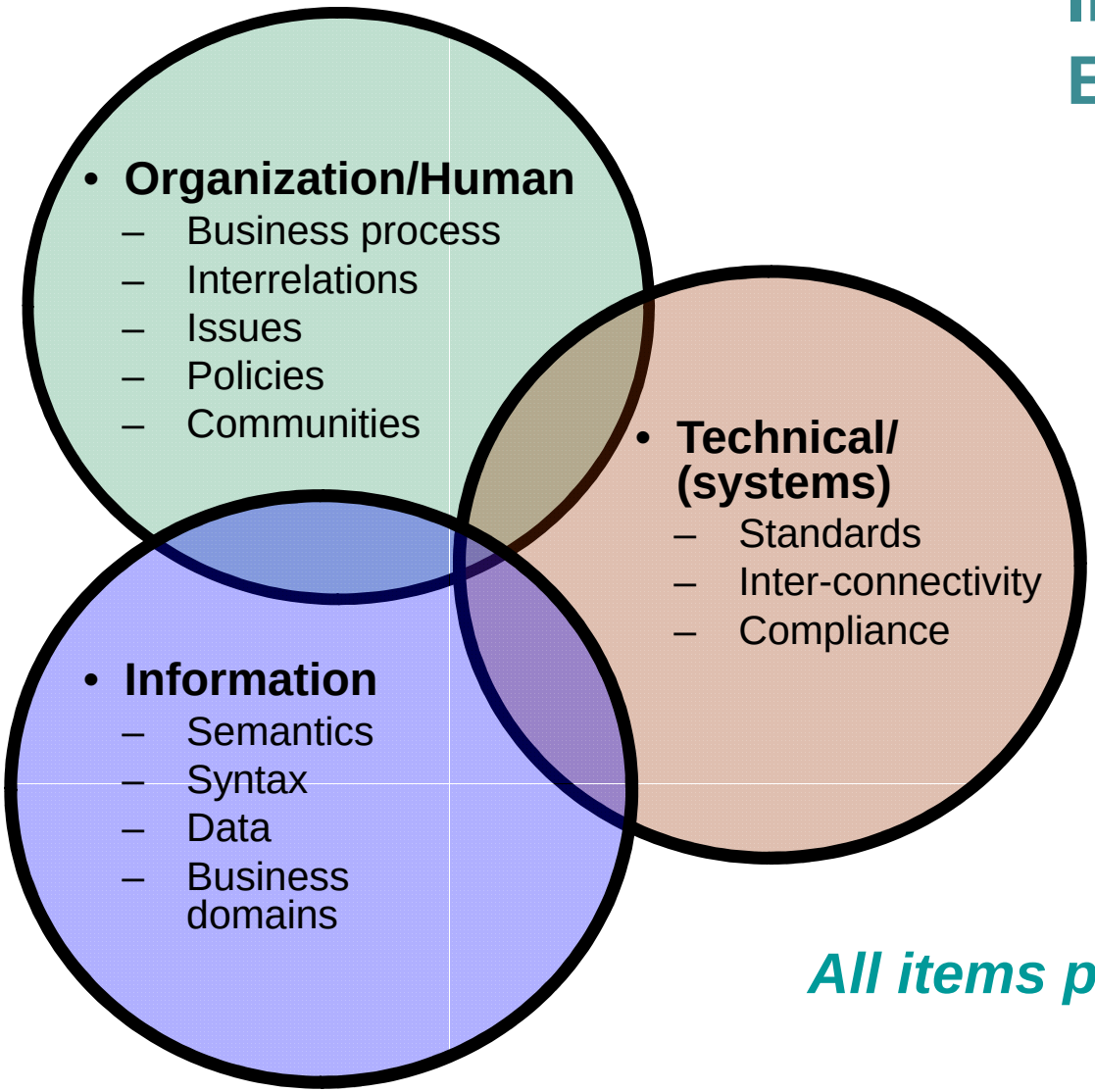
Vision (as articulated to Energy Secretary Abraham in 2003)

- Enhance the productivity of the grid through real-time information
- Maximize asset utilization by integrating participants, from generation to demand
- Improve market alignment through increased visibility of information
- Recognize and account for the true value of new assets
- Improve grid resilience and infrastructure security

Where we started – The Constitution



GWAC Mission - Interoperability



Interoperable Systems- Expected Impact:

- **Reduced integration cost**
- **Reduced cost to operate**
- **Reduced capital IT cost**
- **Reduced installation cost**
- **Reduced upgrade cost**
- **Better security management**
- **More choice in products**
- **More price points & features**

All items provide compounding benefits

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GWAC's Strategic Grid Sector Focus

Interoperability Strategic Focus:

Step 1: Common Vision across the North American Power Grid

Step 2: Grid Ownership of Common Vision

Step 3: Grid Ownership of Vision Management Processes

Interop Technical Focus:

Step 1: Identify issues:

a - Within the Sectors

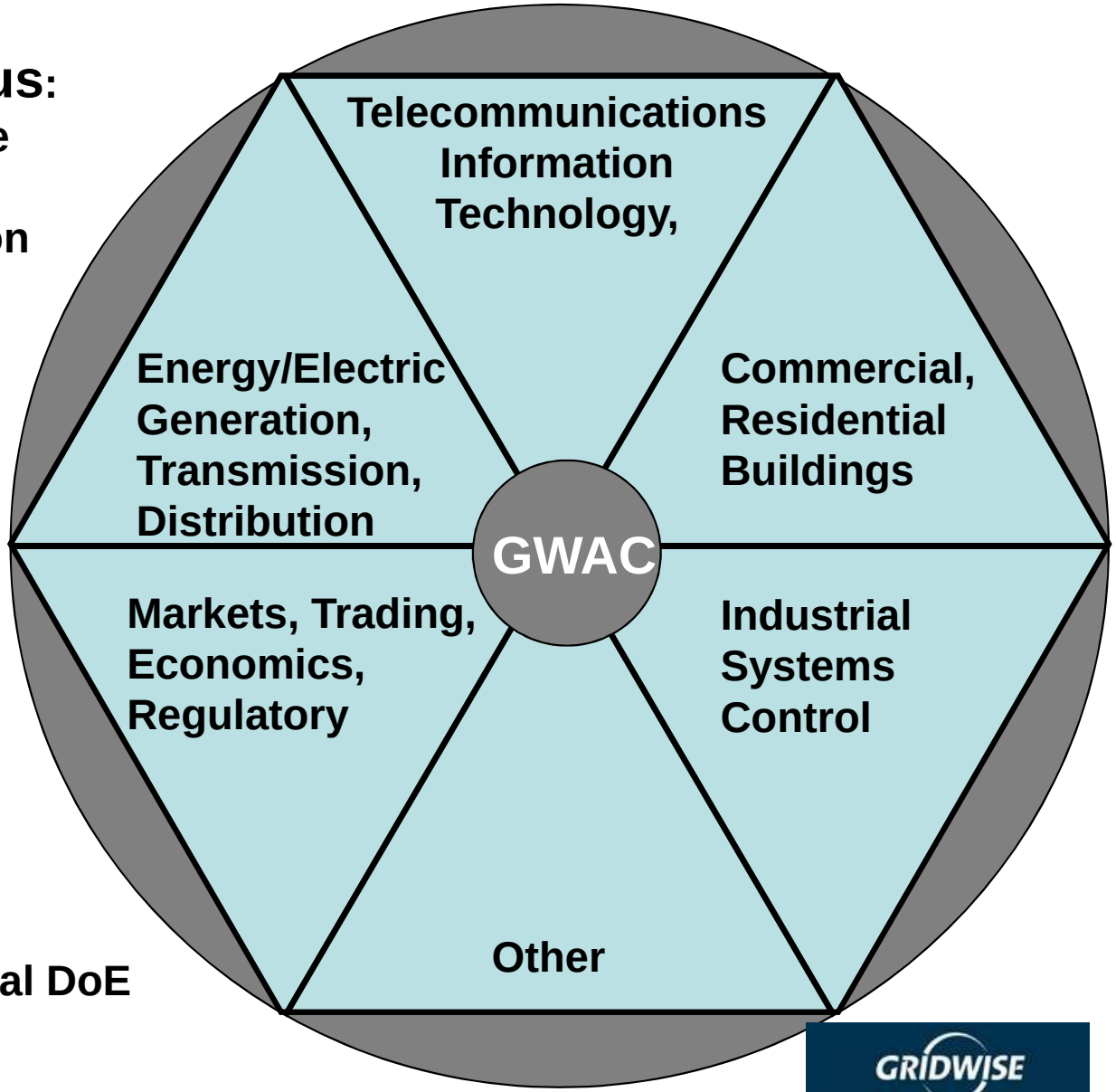
b - Between the Sectors

c - Across entire System

Step 2: Educate – Conceptual Understanding

Expected Results:

Industry picks up the cost after initial DoE investment



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Interoperability

- Exchange of actionable information
  - between two or more systems
  - across organizational boundaries
- Shared meaning of the exchanged information
- Agreed upon expectation of the response to the information exchange
- Requisite quality of service of information exchange
  - reliability, fidelity, security

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Heterogeneity – Vive la Difference!

- Multiple versions and mixtures of technology
  - Including today tech with *tomorrow's* innovations
- Multiple vendors with multiple products
- Multiple services needing integration
- Multiple organization structures
  - IOUs
  - Rural Coops
  - Munis

The Council's Approach

Strategic Vision

- GWAC provides an independent strategic vision to the community

Methods and Tools

- GWAC has developed and continues to update and develop interoperability tools and guidance for the benefit of the community
- Best known of these is the "Interoperability Context Setting Framework" which contains the well known *GWAC Stack*
- These tools and methods give the community a common language, a way to talk about the challenges – especially important in the policy and regulatory groups

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The Council's Approach

GWAC Engagement with the Industry

- GWAC Meetings
  - Held a minimum of quarterly, open to all interested parties
  - Outside speakers covering national and international topics of interest
- GWAC Member Liaisons
  - Individual GWAC members engaged in their respective industry activities
- Grid-Interop Forum
  - Annual technical meeting focused on smart grid interoperability
- NIST SGIP Activities
  - Congress directed NIST to engage GWAC in the 2007 EISA Legislation
  - GWAC members serve on Governing Board and lead the Architecture Committee and Testing & Certification Committee
  - GWAC members are actively involved in DEWG and PAP activities, often in leadership positions

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The Council's Tools

2006 – Interoperability Constitution

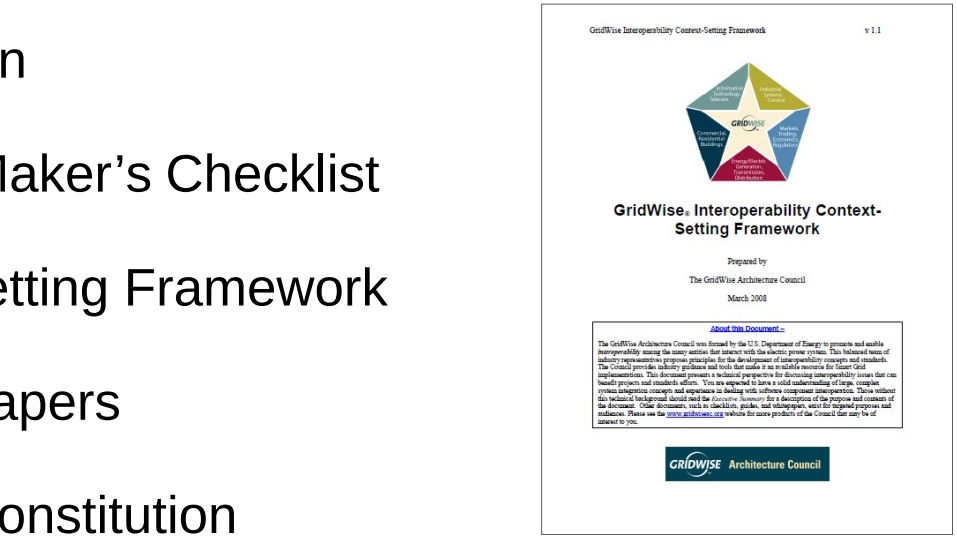
2007 – Interoperability Decision Maker's Checklist

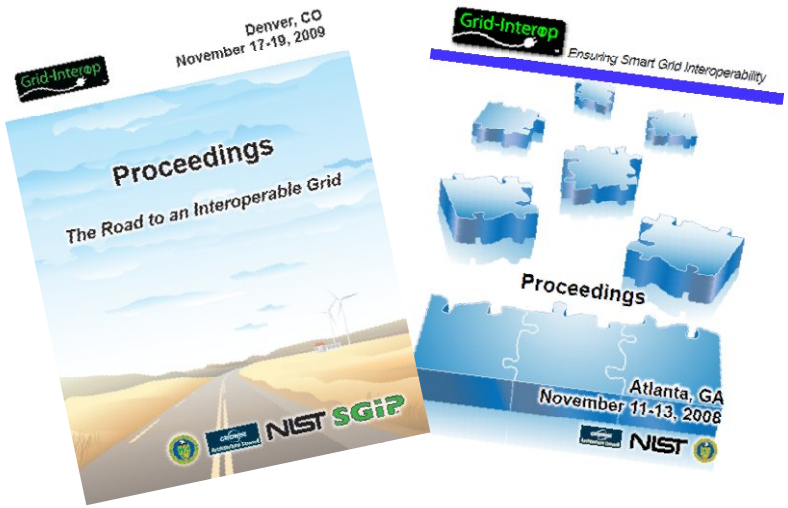
2008 – Interoperability Context Setting Framework

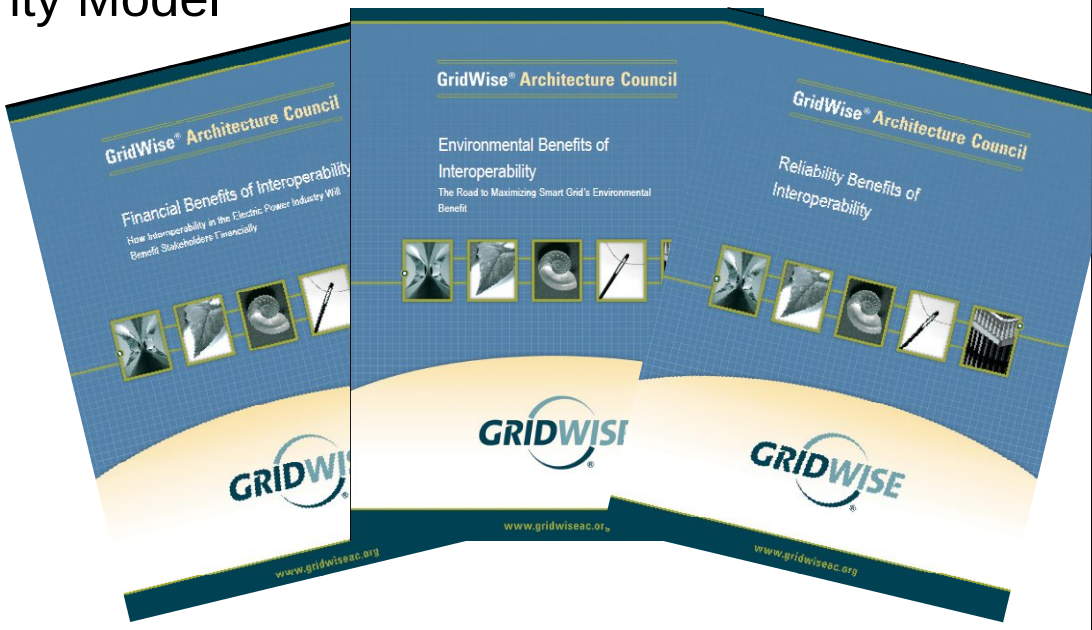
2009 – Interoperability Benefits Papers

2011 – Updated Interoperability Constitution

2011 – Smart Grid Interoperability Maturity Model







Interoperability Statements of Principle

The Constitution

"B04- (v2.0) Interoperability approaches must consider implementation costs/benefits and impacts to the parties involved in the transaction."

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Constitution Principles: Business

- B01- (v2.0) Subject to regulatory monitoring requirements, interoperability approaches should focus on the information exchange and the interaction at the boundary between transacting parties while respecting the privacy of the internal aspects of their business (technology choice and processes).
- B02- (v2.0) Interoperability approaches must support the ability to roll out changes to contracts or market rules while preserving stable operation of the overall electric system.
- B03- (v2.0) Interoperability approaches must address the common types of marketplace transactions among parties along the path between producers and consumers appropriate to the level of service provided.
- B04- (v2.0) Interoperability approaches must consider implementation costs/benefits and impacts to the parties involved in the transaction.
- B05- (v2.0) Interoperability approaches must support verification and auditability of transaction completion and be able to validate that contract terms have been met.

Subject to the regulatory environment in which they operate, organizations are free to structure themselves in the manner they see fit to best deliver goods and services and compete with other businesses. They interact with other organizations through contracts of their own choosing in as open a marketplace as possible. Enterprises can be categorized into wholesale and retail segments; however, the path from producer to consumer may pass through a variety of businesses each providing their unique value added contribution. There is no standard process of running a business.

Constitution Principles: Usability

- U01- (v2.0): Interoperability approaches should address the technical capabilities needed to support the emergence of markets for consumers to choose the appropriate electricity service program they desire.
- U02- (v2.0): In the event of a communications failure between interacting parties, the parties must assume operating positions that best preserve stable operation of the overall electric system.
- U03- (v2.0): Interoperability strategies should be communicated in appropriate ways that can be understood and adopted by all stakeholders in the electric system.

Electricity users have a wide range of needs and energy management capabilities, as well as varying degrees of willingness to pay for any given energy product. The new frontier in a transformed energy system is the participation of new parties in overall system operations, including end use, distribution, transmission, and generation.

Constitution Principles: Technology

- I01- (v2.0) A broadly held interoperability strategy can help organize and advance the large scale integration of automated equipment, business processes, and human interactions.
- I02- (v2.0) Strategies for interoperability shall adopt the broadly applicable best practices of information science to improve end to end performance of both business and the electric system's operation and managerial processes.
- I03- (v2.0) An interoperability framework shall address a strategy for the identification of system entities beyond organizational boundaries to ensure unambiguous interactions, and shall support the naming of groups or collections of system entities.
- I04- (v2.0) An interoperability framework shall incorporate information modeling approaches that define the shared meaning and relationships of entities and concepts applicable to interactions in an area of industry or commerce.
- I05- (v2.0) Interoperability strategies shall address time synchronization, sequence of events, time tagging, and other requirements related to time as appropriate to the service provided.

Advances in information technology empower electronic business and intelligent machine connectivity. Large sectors of the economy rely on information technology to enable greater levels of productivity, efficiency, and reliability of service. This provides a vast marketplace for the application of information technology and reduces the need for industry specific information technology approaches. Information technology is characterized by a high rate of innovation with impacts to large scale systems of systems that must cope with the deployment of new solutions as legacy approaches continue to operate in tandem.

Constitution Principles: Technology

- I06- (v2.0) Interoperability strategies shall address the ability to set up (i.e., discover and configure) system components so they can join, modify (e.g., upgrade), and terminate their positions in the system.
- I07- (v2.0) An interoperability framework must address information system security and privacy concerns, balance them appropriate to the service provided, and support adaptation to future risks.
- I08- (v2.0) As appropriate to each interaction, an interoperability framework should address strategies for e-business transactions that may include creation of a transaction, negotiation, scheduling, operations, settlement, billing and financial transfers.
- I09- (v2.0) An interoperability framework must be practical and achievable:
  - Meets performance requirements.
  - Is reliable.
  - Is scalable.
  - Has sufficient breadth to meet the range of business needs.
- I10- (v2.0) An interoperability strategy must accommodate the coexistence of and evolvement through several generations of IT standards and technologies that will reside at any point in time on the Grid.

Advances in information technology empower electronic business and intelligent machine connectivity. Large sectors of the economy rely on information technology to enable greater levels of productivity, efficiency, and reliability of service. This provides a vast marketplace for the application of information technology and reduces the need for industry specific information technology approaches. Information technology is characterized by a high rate of innovation with impacts to large scale systems of systems that must cope with the deployment of new solutions as legacy approaches continue to operate in tandem.

Constitution Principles: Regulatory

- R01- (v2.0) Interoperability strategies and issues must be communicated in a form to be understood by regulators and policy makers.
- R02- (v2.0) Interoperability approaches among organizations must allow regulators the ability to verify that business is conducted within established rules and that all relevant transactions are auditable.
- R03- (v2.1) Interoperability approaches must allow regulators to verify the cost-effectiveness of the relevant business transactions where required.
- R04- (v2.1) Interoperability must enable consumers to have understandable choices of energy services and simple methods for using these services.
- R05- (v2.1) Interoperability approaches must provide tools for regulators to ensure that electric systems continue offering consumers reliable service in a manner that protects consumers[1] safety and privacy.
- R06- (v2.1) Implementers of interoperability methods must inform regulators of any ancillary support needed for consumers to use energy services successfully. Ancillary support means information, education and skills that consumers need in order participate in the relevant energy transaction.

Business is conducted under a formal set of rules or laws meant to follow policy guidelines. The rules are set, maintained, and enforced by various local, state, and federal agencies in accordance with their jurisdictions. Business interactions associated with the electric industry are reviewed and monitored by those regulatory bodies whose role is to ensure a viable electric system environment that supports our economy and balances issues of social equity.

Constitution Principles: Policy

- P01- (v2.1) Interoperability solutions should provide maximum flexibility for consumers, subject to regulatory constraints, while respecting their access, usage, disclosure and privacy rights for these data.
- P02- (V2.1) Development of model interoperability policies will facilitate consideration and adoption of specific policies by legislators and regulators with adaption to the needs of specific jurisdictions.
- P03- (v2.1) Interoperability policies should support information flows among utilities, customers and third-party suppliers of energy services along a variety of communication pathways subject to security and privacy protections.

Policies may be developed by regulators, legislators or energy service providers and are established to provide protection for customers while allowing for maximum customer flexibility and choice. Policies should be designed for ransparent transactions and processes in the electric power industry so that products and services develop and flourish while serving the needs of the conomy and the nation.

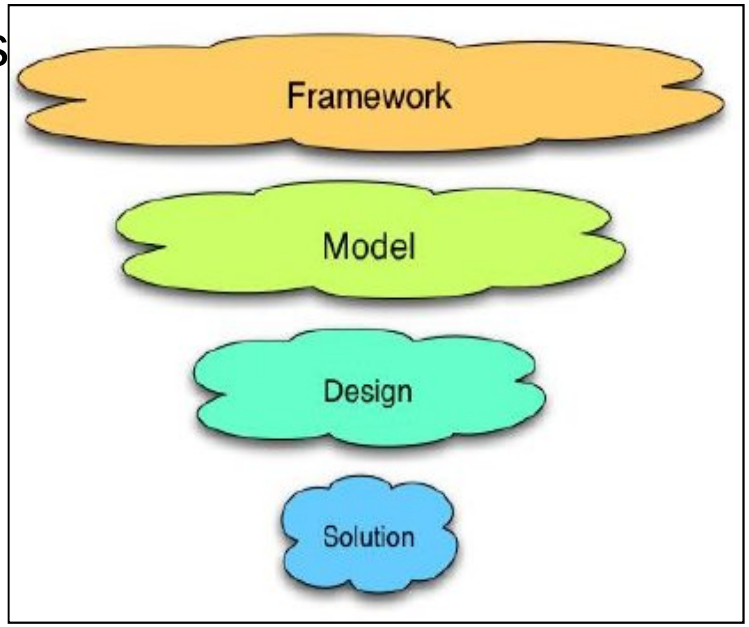
Constitution Principles: Governance

- G01- (v2.0) An interoperability framework must consider the needs and views of the full range of stakeholders in an integrated view of the electric system.
- G02- (v2.0) Governance processes should measure successes and shortcomings of the interoperability framework, and drive improvement.
- G03- (v2.0) The governance of this constitution must be independent of any particular standards organization and preserve the technical neutrality of these principles.
- G04- (v2.0) With regard to encouraging standards and standards development, the governance of this constitution:
  - Will encourage development of standards where appropriate to constitution objectives and work with existing groups to guide standards development toward better achieving interoperability;
  - Will endorse and/or recommend standards where appropriate to constitution objectives; and
  - Will proactively encourage collaboration, merging, and rationalization of standards where appropriate to constitution objectives.
  - Does not develop detailed specifications for standards.
- G05- (v2.0) These long lived Statements of Principle and the strategic approaches that derive from them must be able to change through time in a prudent, controlled manner.

This constitution is a living, evolving document that influences the long-term future of the electric power system. Though the Statements of Principle are meant to be long lived, the ability to correct, update, and clarify this constitution is recognized.

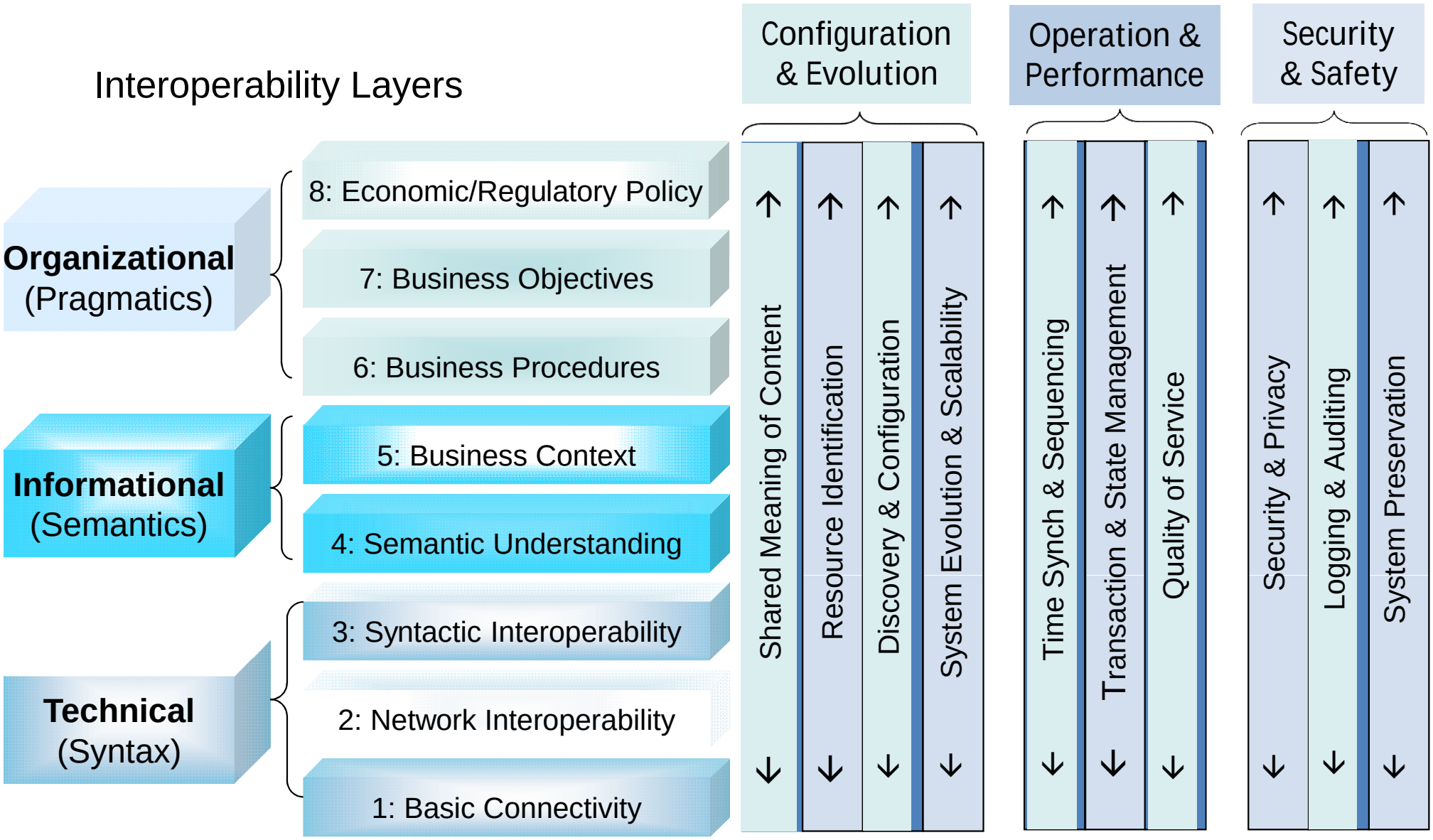
What do we mean by “Framework”?

- *Framework* organizes concepts and provides context for discussion of detailed technical aspects of interoperability
- *Model* identifies a particular problem space and defines a technology independent analysis of requirements
- *Design* maps model requirements into a particular family of solutions
  - Uses standards and technical approaches
- *Solution* manifests a design into a particular developer software technology
  - Ensures adherence to designs, models, and frameworks.

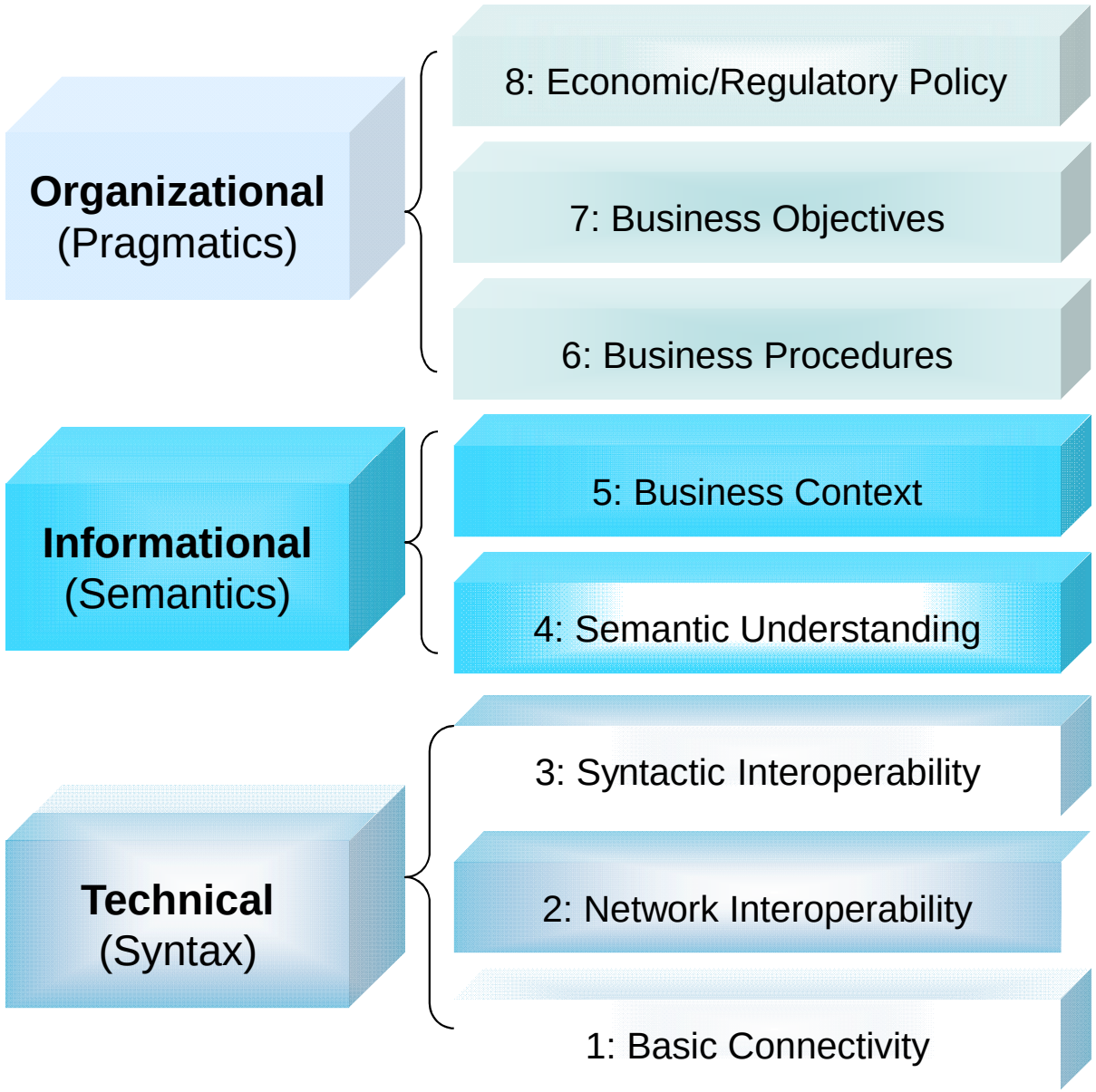


Borrowed from NEHTA: Australian National E-Health Transition Authority

Interoperability Framework



GWAC Stack applied: DR example



We defined assumptions about the real-time market model that we wished to test

Defer capital investment; improve response to unplanned outages

Real-time market and buy/sell bids as the primary optimization mechanism

Real-time Pricing accounts with customers

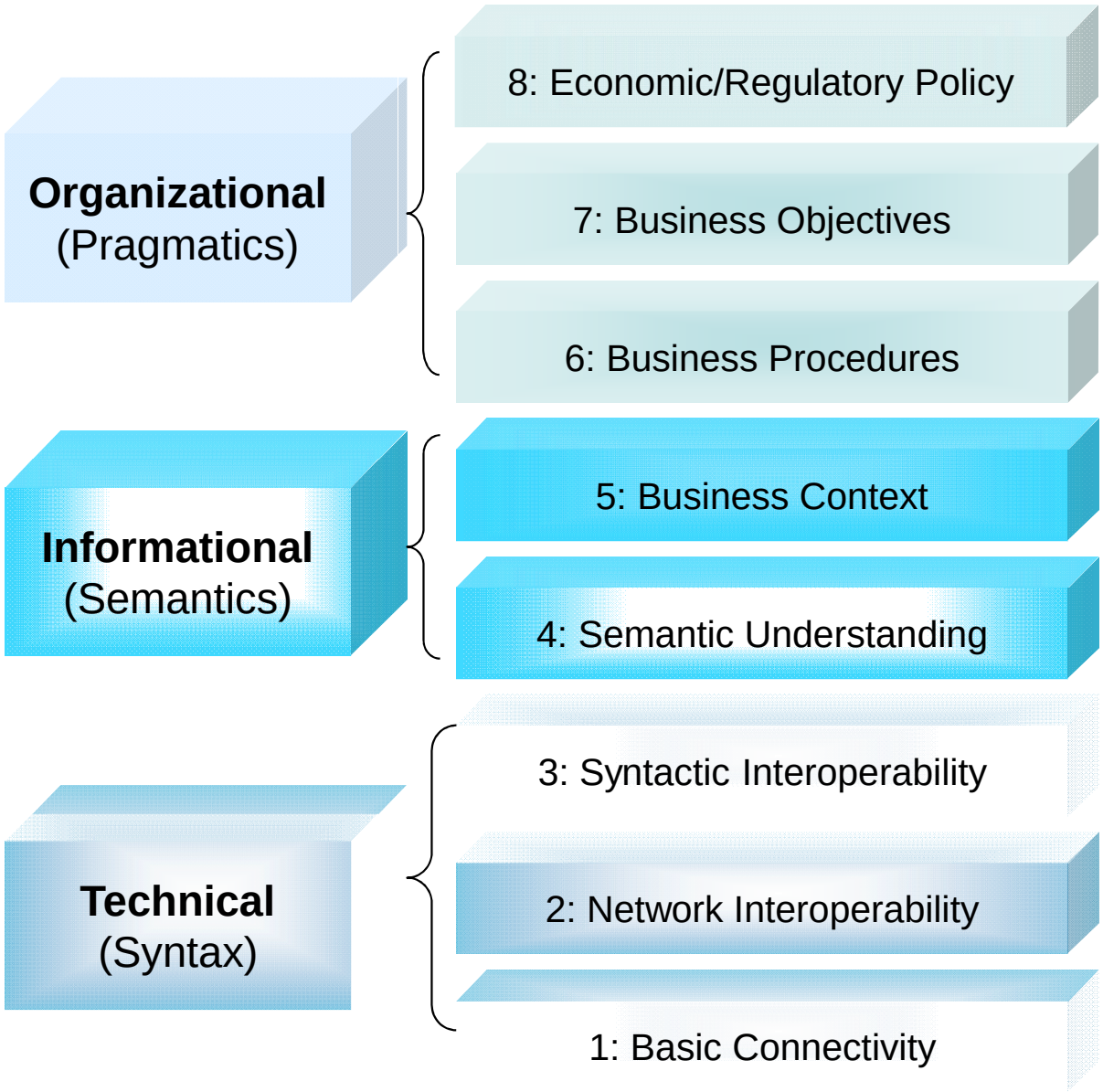
Defined virtual devices that combined the physical device functions with addl business process information flow & functions

Used an implementation of ISO/IEC 18012-2 to establish heterogeneous interoperability and enable semantic model above

IP and non-IP bridged by a gateway – little or no application function in the gateway

Heterogeneous mix of wired and wireless technologies

Addressing the Upper Stack Layers



Fully engaging the regulatory and policy communities

Defining new business models and understanding the value propositions

Striving for uniformity in the upper layers, to enable scale-up to large markets

Decisions Makers Checklist

- Architecture and Design
- Interconnectivity and Security
- Evolutionary capability and Service Life
- Collaborator independence
- Supplemental Decision-Makers Interoperability Checklist
  - Supplemental *questions for utilities*
  - Supplemental questions for *vendors*

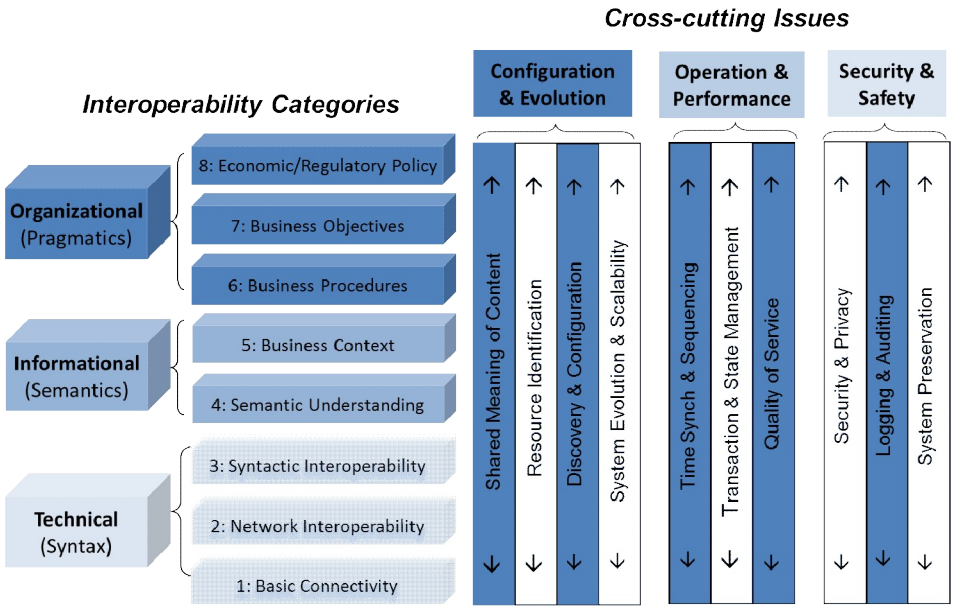
A Maturity Model: Interoperability

- Interoperability questions for a community/ecosystem
  - How well does stuff integrate?
  - Which interfaces need the most improvement?
  - What areas of the interface deserve the most attention?
- What should an interoperability maturity model (IMM) accomplish?
  - Gap identification and guidance for improvement
  - Measure interoperability progress in a community
  - Be both descriptive and prescriptive

Encourage a standards-based, interoperability-aware, culture with individual and shared roadmaps for improvement

SG IMM* Inspirations

GWAC Context-setting Framework



NEHTA Interoperability Maturity Model

http://www.nehta.gov.au/connecting-australia/ehealth-interoperability

SEI Capability Maturity Model for Integration (CMMI)

http://www.sei.cmu.edu/cmmi/general/index.html

Level	Title
5	***Optimizing***
4	***Quantitatively Managed***
3	***Defined***
2	***Managed***
1	***Initial***

* Smart Grid Interoperability Maturity Model

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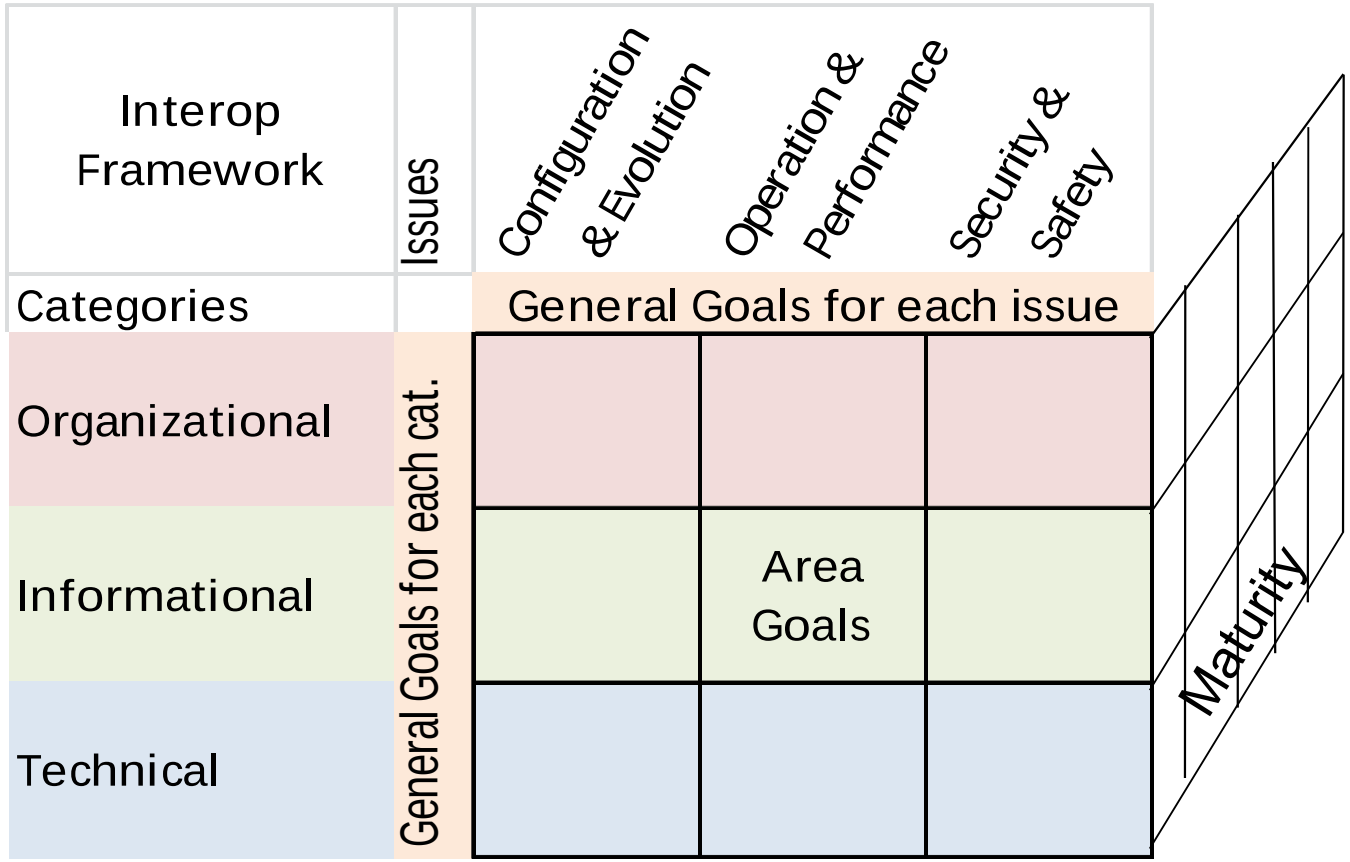
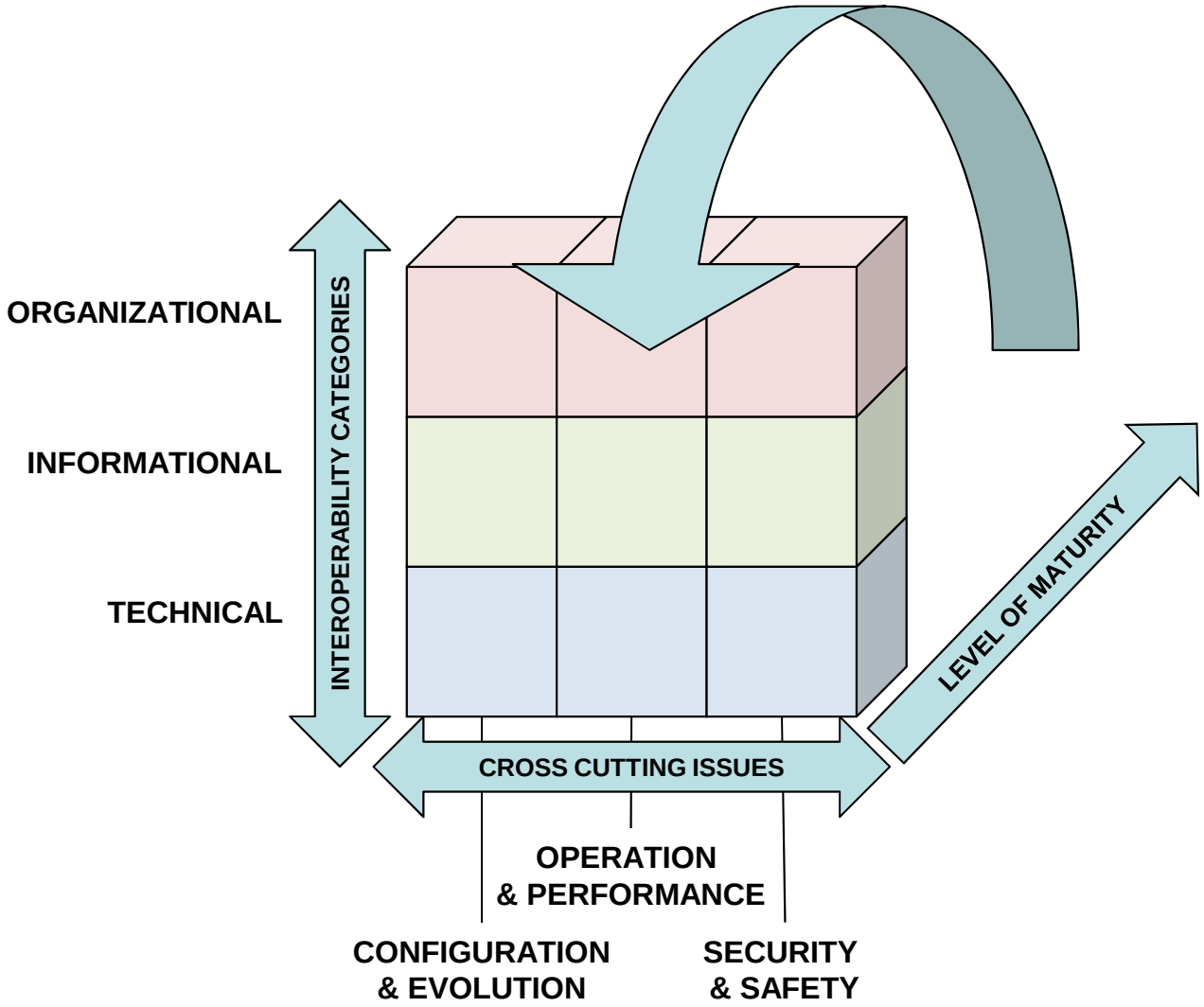
GWAC Stack with Maturity Dimension

XYZ Interface Specification



Rotate the Interop Framework



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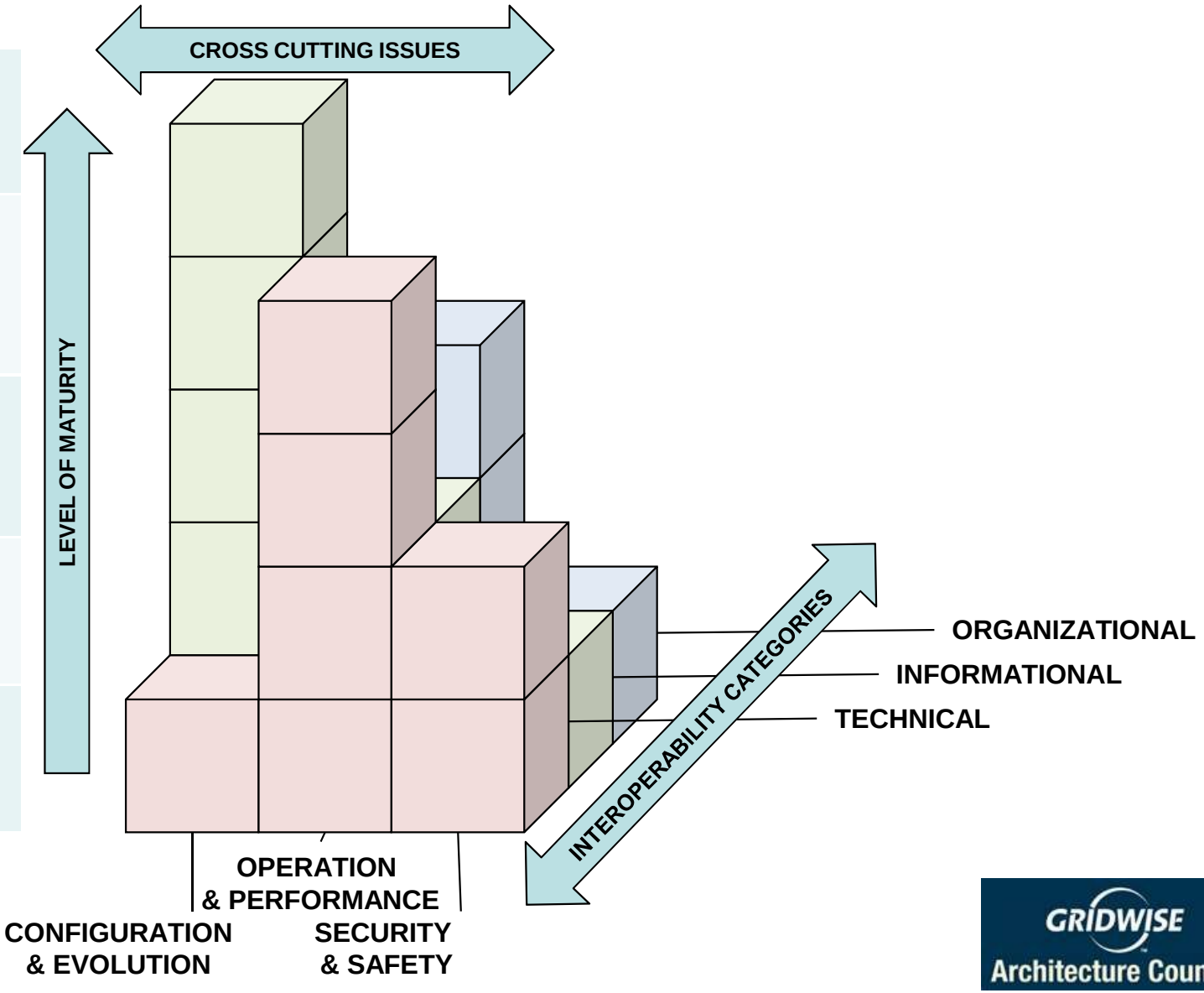
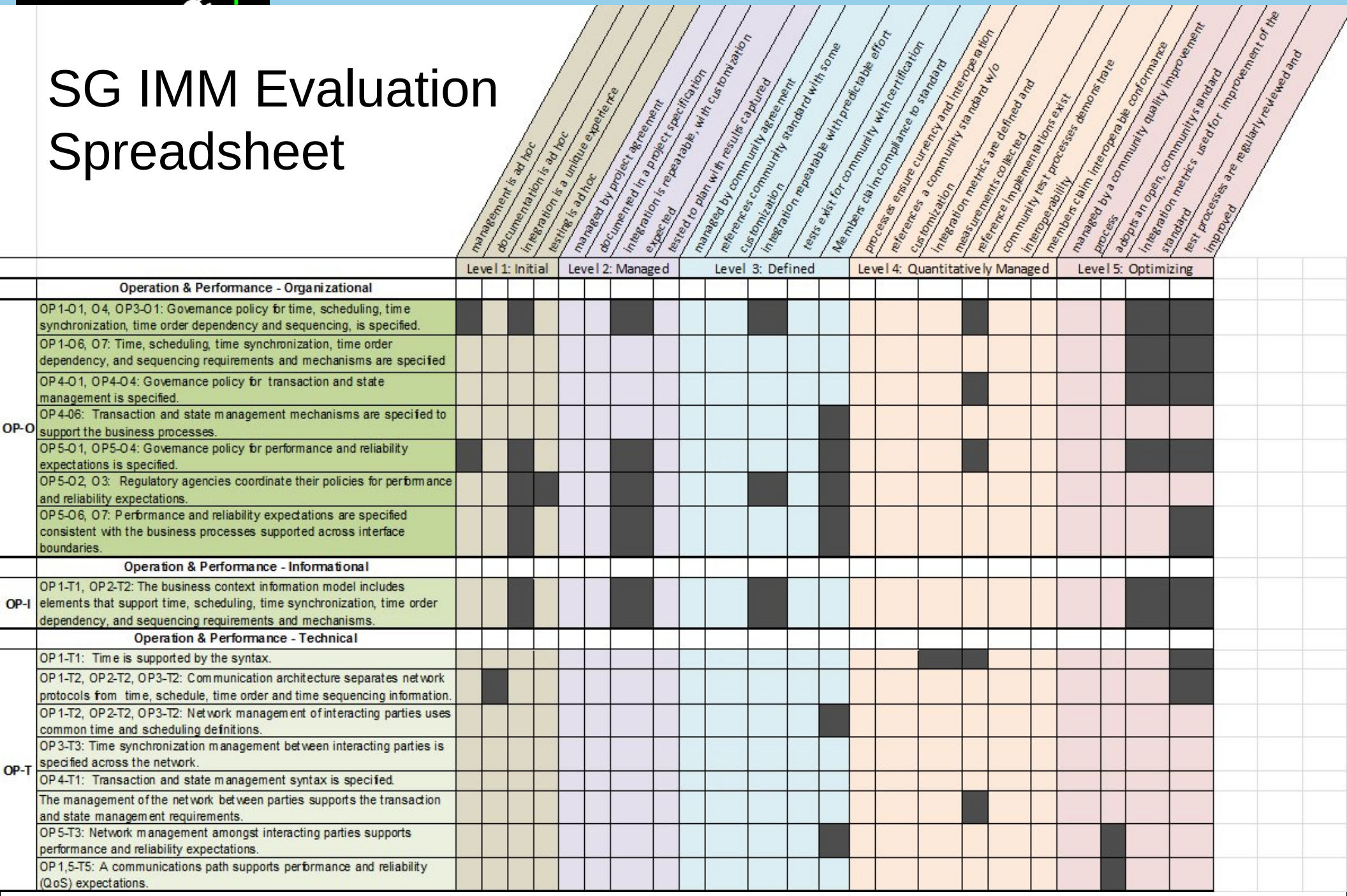
Maturity Evaluation Is Multi-dimensional

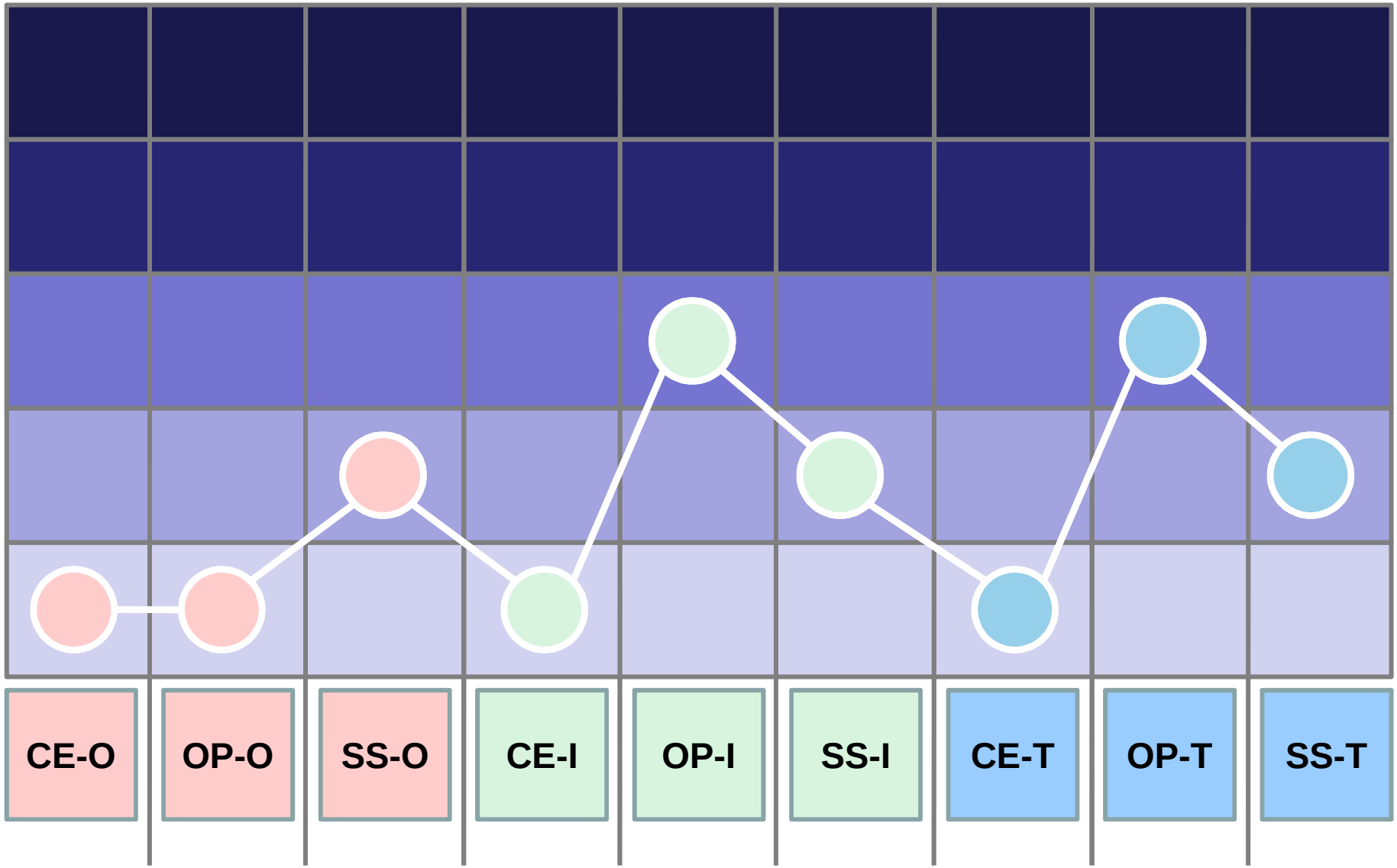
5	*Optimizing*
4	*Quantitatively Managed*
3	*Defined*
2	*Managed*
1	*Initial*



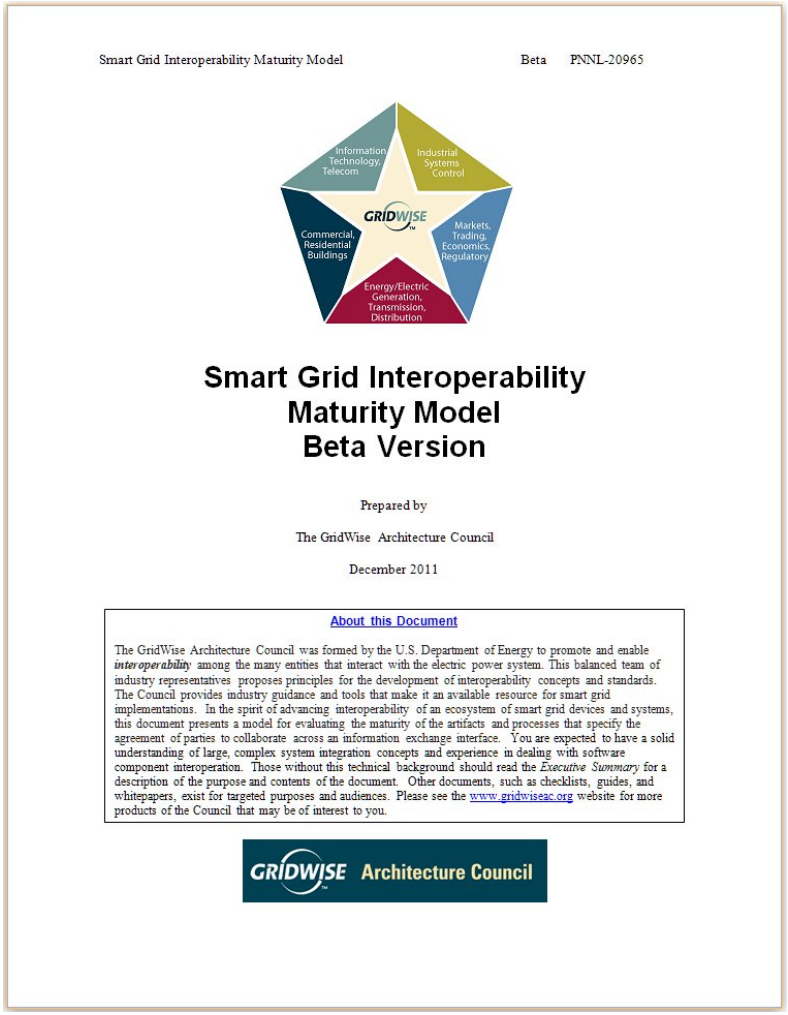
SG IMM Evaluation Spreadsheet



What Does SGIMM Maturity look like?



SG IMM Beta Document


Smart Grid Interoperability Maturity Model Beta PNNL-20965

Smart Grid Interoperability Maturity Model Beta Version

Prepared by

The GridWise Architecture Council

December 2011

About this Document

The GridWise Architecture Council was formed by the U.S. Department of Energy to promote and enable ***interoperability*** among the many entities that interact with the electric power system. This balanced team of industry representatives proposes principles for the development of interoperability concepts and standards. The Council provides industry guidance and tools that make it an available resource for smart grid implementations. In the spirit of advancing interoperability of an ecosystem of smart grid devices and systems, this document presents a model for evaluating the maturity of the artifacts and processes that specify the agreement of parties to collaborate across an information exchange interface. You are expected to have a solid understanding of large, complex system integration concepts and experience in dealing with software component interoperation. Those without this technical background should read the *Executive Summary* for a description of the purpose and contents of the document. Other documents, such as checklists, guides, and whitepapers, exist for targeted purposes and audiences. Please see the www.gridwiseac.org website for more products of the Council that may be of interest to you.

GRIDWISE Architecture Council

Please see the www.gridwiseac.org website for more information.

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Interoperability Benefits Papers

- Environmental benefits of interoperability
  - Resource optimization, greener energy, carbon productivity, plugin electric vehicles
- Financial benefits of interoperability
  - Parallels in other industries
- Reliability benefits of interoperability
  - Situational Awareness & System-Wide Information Flow
  - Interoperability and Information Availability
  - Interoperability and Information Accuracy

Smart Grid Vision

- Incontrovertible truths
  - The physical grid has constraints
  - Continued growth of device intelligence
  - Variable Renewable Generation will continue to increase at bulk and as distributed resources for the foreseeable future.
- Scenarios
  - Interoperability Implications
    - Of constraints in scenarios
    - Of intelligence in scenarios
    - Of variable and distributed generation

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Where do we go next?

- How do we get it all to work together?
  - Standards are important, but not sufficient
    - Testing and validation are critical (NIST Phase 3)
  - Best practices must be defined, shared and adopted
    - GWAC Interoperability Maturity Model
      - New work in progress
    - Smart Grid Information Clearinghouse (SGIC)
      - http://www.smartgridinformation.org
    - Lessons learned from other domains
      - e-Commerce
      - Defense Systems

Closing Comments

- Always keep the end-game vision in mind
- Use all the tools that have been created already
- The Council is a valuable resource for the Federal Smart Grid Task Force
  - Consider how to leverage us
- Start thinking about the higher layers of the GWAC Stack today, not later

SGiP Overview and Update

Ward Pyles
Southern Company

Past to Present

- NIST established the SGIP in 2009 to help fulfill its EISA obligations
  - Does not write standards. Instead…
  - Provides guidance and oversees group activities in development of use cases, requirements, and action plans
  - Specifies the necessary testing and certification requirements to assess the achievement of interoperability
- Membership is open to anyone
  - 22 Stakeholder Categories
  - Currently, over 1,800 individuals from 715 organizations involved in SGIP efforts
  - Consensus – general agreement of the members
  - Harmonization – work proceeds with the participation of multiple standards setting organizations

SGIP Catalog of Standards (CoS)

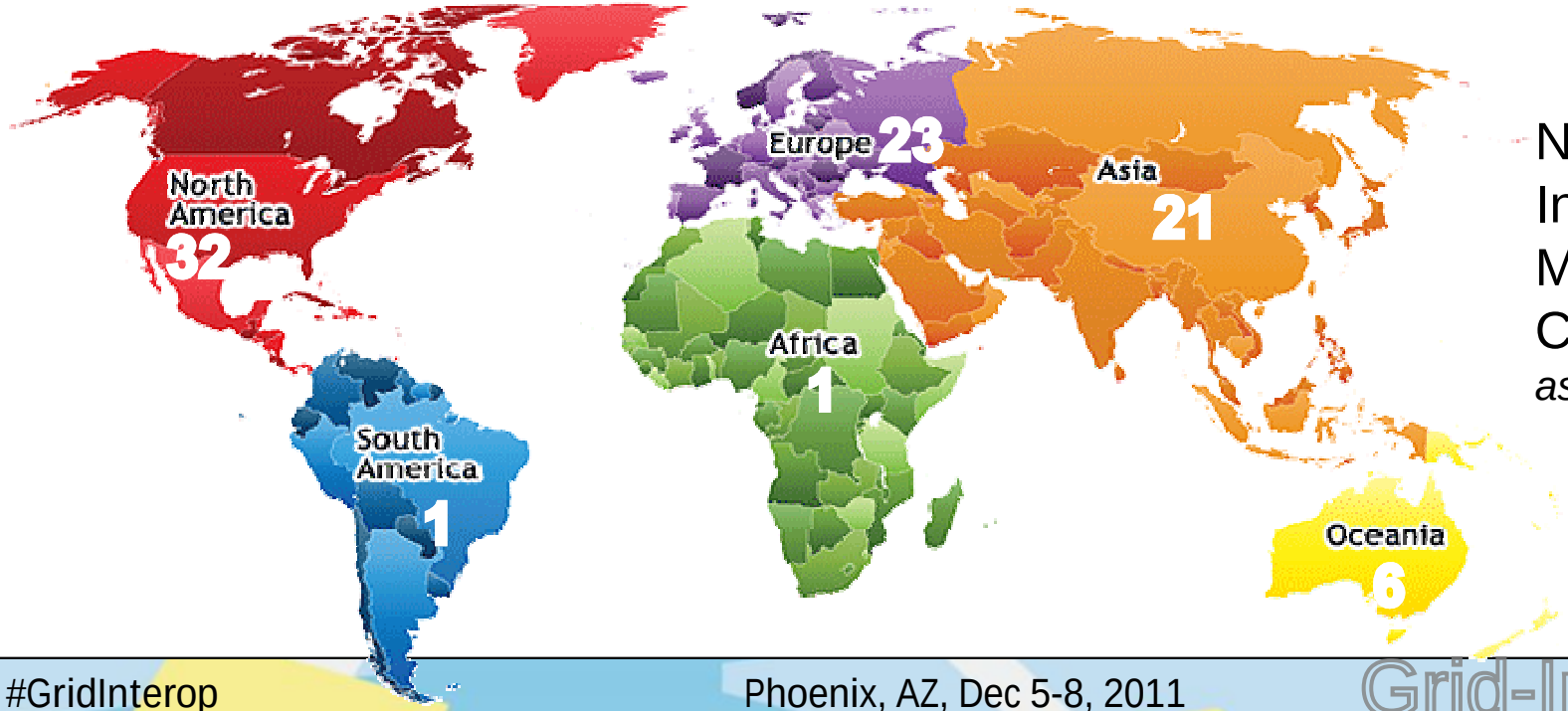
- SGIP maintains a “catalog of standards”
  - A compendium of standards and practices considered to be relevant for the development and deployment of a robust and interoperable Smart Grid.
  - Must be passed by supermajority of the SGIP Plenary
- To view, type “SGIP catalog of standards” into Google or search engine of choice

NIST Framework

- NIST Interoperability Framework and Roadmap is the starting point for SGIP efforts and vision
  - Release 1.0 was officially released in January 2010
  - Release 2.0 in development and includes
    - Adds 22 standards, specifications and guidelines to the 75 previously recommended as immediately applicable
    - New cyber security guidance and product testing proposals
    - Expanded view of the architecture of the Smart Grid
    - New framework for testing conformity – the Interoperability Process Reference Manual

Global Collaboration

- Many countries have identified the Smart Grid as a priority — the SGIP hopes to be an ideal forum for international standards collaboration.
- SGIP recent international efforts:
  - Letter of Intent with Korea Smart Grid Standardization Forum (KSGSF)
  - White paper with Europe's Smart Grid Co-ordination Group (SG-CG
  - Cooperation with Asia-Pacific Economic Cooperation (APEC)



Number of SGIP International Members by Country
as of Oct. 2011

Getting Involved

- Participation in SGIP is open to all individuals associated with SGIP member organizations
  - Participation Options
    - Face to Face Meetings
    - Webinars & Phone Conferences
    - Email Lists
    - Standards Setting Organizations (SSOs)
    - SGIP TWiki
  - Find membership details and more at http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/WebHome
    - Or type “SGIP” into Google or search engine of choice.

UCAIug Overview and Update

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Founder & Managing Partner
UtiliSec

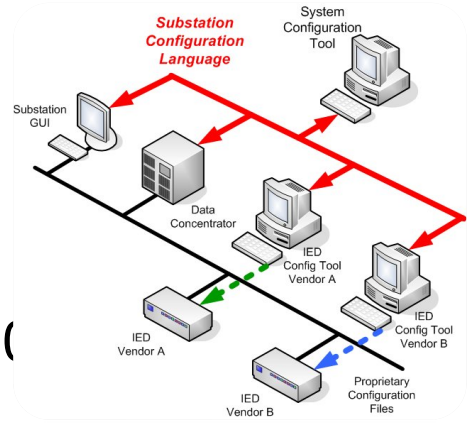
#GridInterop

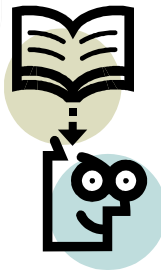
UCAIug Mission (from Charter)

- ***Enable utility integration*** through the deployment of **open standards**
- ***Provide a forum*** for the various stakeholders in the utility industry to ***work cooperatively together*** as members of a **common organization** to:
  - **Influence, select, and/or endorse open and public standards** appropriate to the utility market based upon the needs of the membership
  - Specify, develop, and/or accredit product/system testing programs that **facilitate the field interoperability** of **products and systems** based upon these standards
  - Implement educational and promotional activities that **increase awareness and deployment** of these **standards** in the utility industry

UCAIUG – Technical Focus

- Communications
  - IEC 61850 – Substation Automation
  - IEC 61850 based extensions for wind, hydro, distributed generation, etc.
- Application Integration
  - Common Information Model (CIM) 61970 and IEC 61968
  - Generic Interface Definition (GID) IEC 6197(
- Smart Grid
  - Systems (AMI, HAN, Demand-Response…)
  - Communications (Networking, Interoperability…)
  - Cyber Security
  - Conformity





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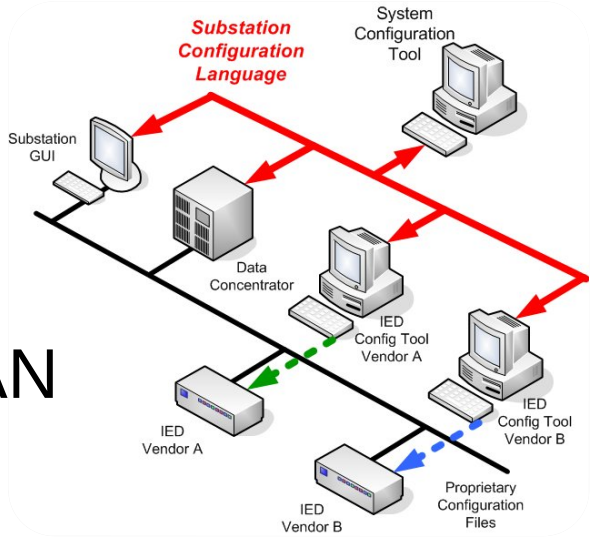
IEC 61850 – Substation Automation

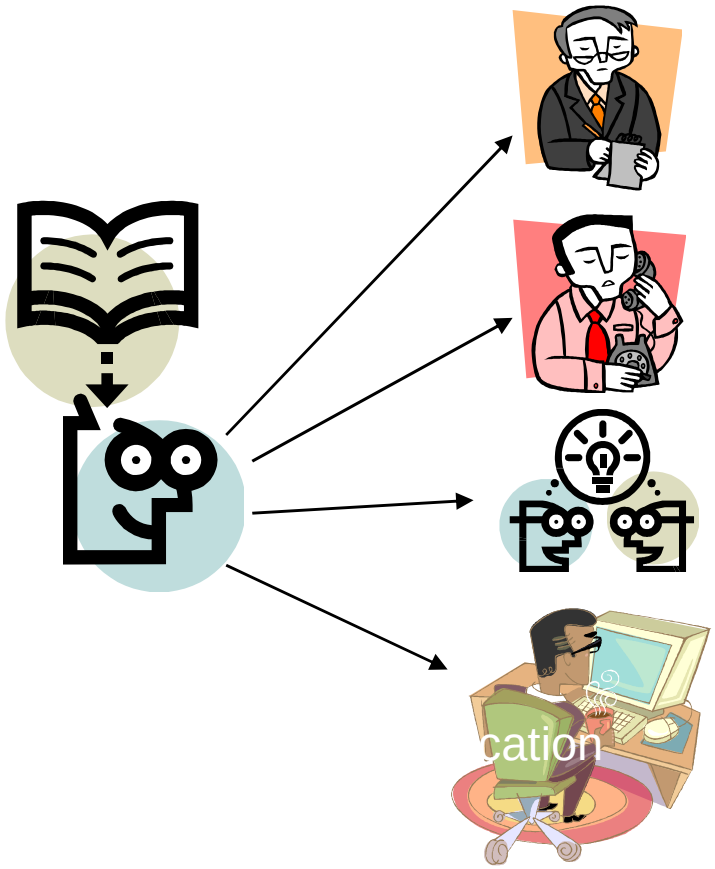
Features no other SCADA protocol has had before...

- Self-Description and Browsers
- Structured Data
- Device Models, not Data Points
- Fast Interlocking and Tripping over the LAN
- Substation Configuration Language
- Transmitting Waveform Samples in Real-Time
- LAN-Based Time Synchronization



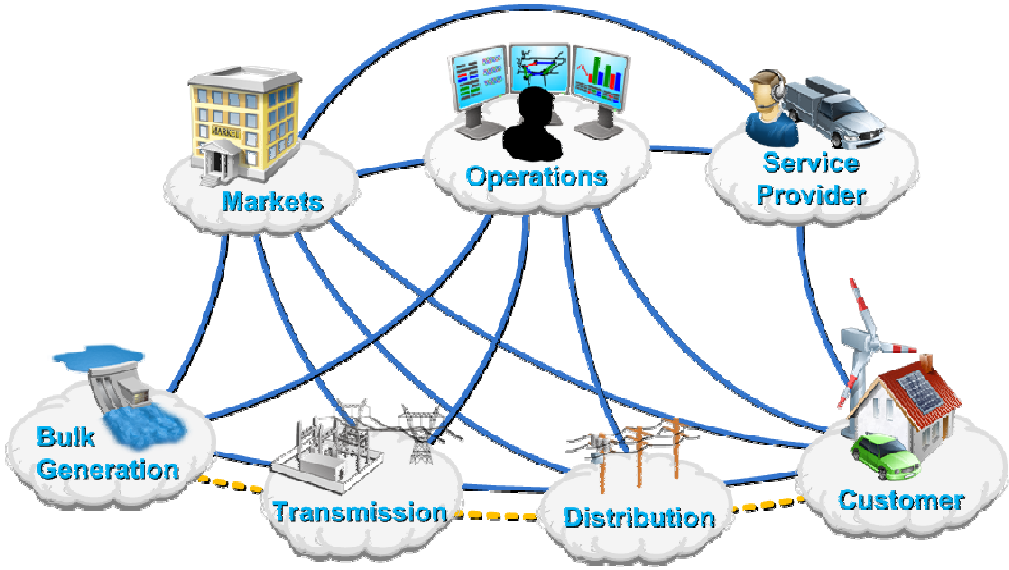
CIM – Basis for a Common Systems Language for Utilities

- The same dictionary is used for multiple forms of human communication:
  - Letters
  - Phone calls
  - Conversations
  - Emails
  - Etc
- In similar manner, the same CIM is used for multiple forms of computer communication:
  - XML
  - RDF
  - OWL
  - DDL
  - Etc.



Open Smart Grid

- Development of an open standards-based information/data model, reference design & interoperability guidelines
- Development of system requirements from the asset owner perspective
- Vehicle for system designers, implementers, and owners to come together to discuss technical issues not addressed in standards



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Benefits of Membership

- Shorten learning curve with access to educational materials and experts
- Gain timely access to information on standards activities
- Gain valuable insight from peers and benefit from sharing/accessing common solutions
- Support and participate in a community effort to establish useful standards for our industry
- Make your company's leadership visible in the industry

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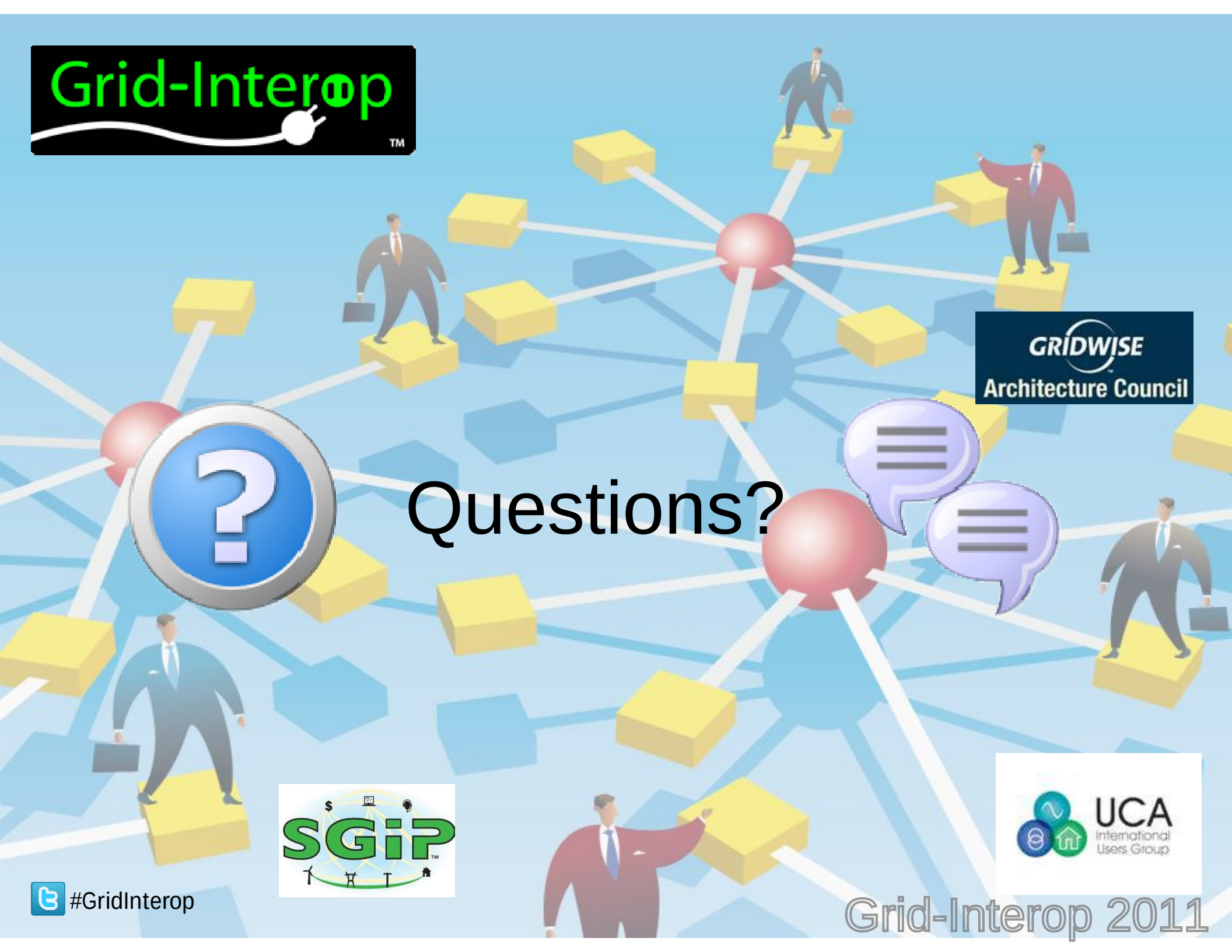
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