

Interoperability 101

Introduction and Overview

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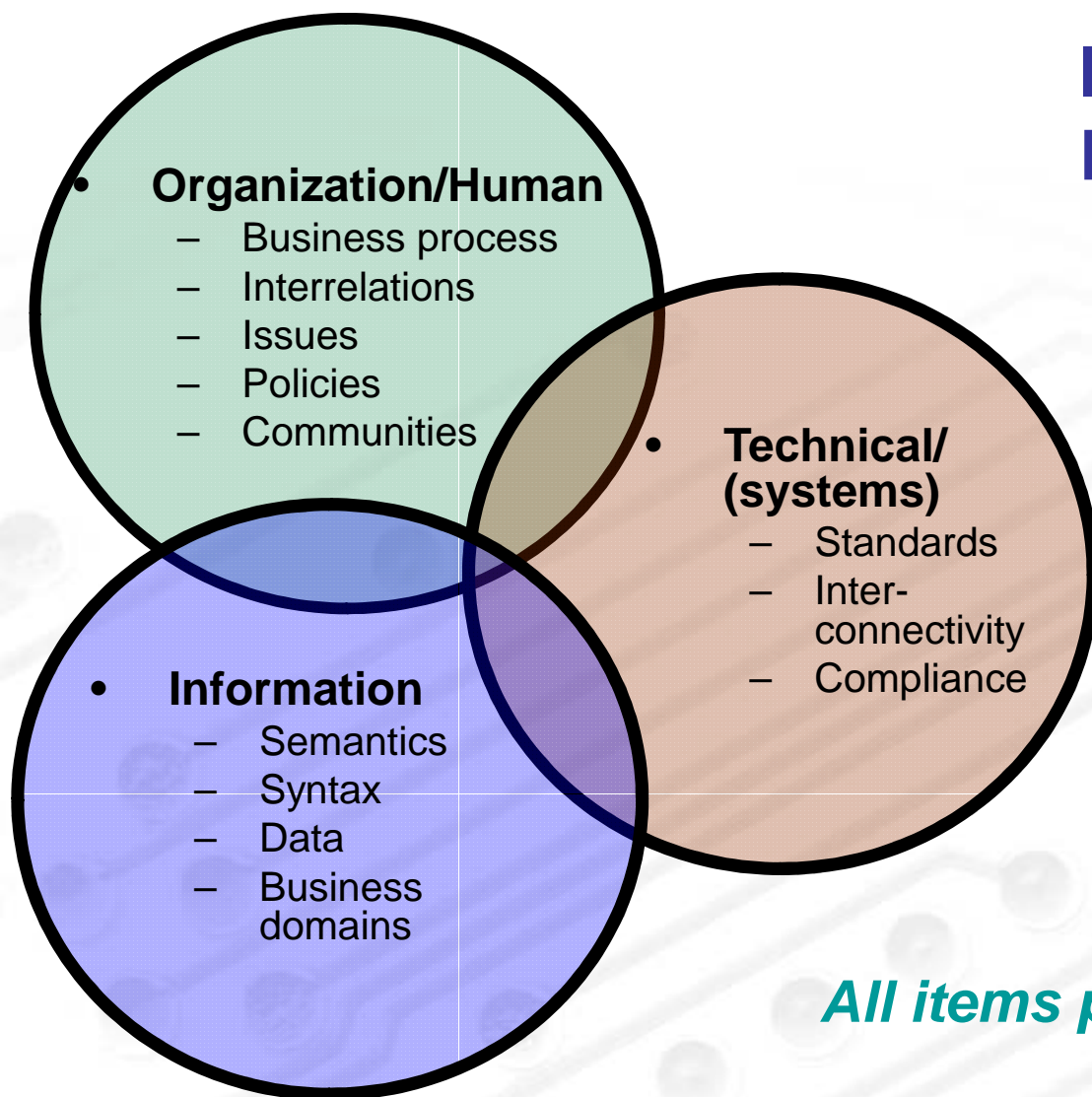
● A Simple Example



Reference Material

- Interoperability Context Setting Framework
- GridWise® Interoperability Constitution
- GWAC Interoperability Benefits Papers
 - Economic
 - Reliability
 - Environmental
- GWAC Smart Grid Interoperability Maturity Mode
- Available at:
www.gridwiseac.org/about/publications.aspx

GWAC Mission - Interoperability



Interoperable Software - Expected Impact:

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

All items provide compounding benefits

● *Inter*operability – Integration at Arm's Length

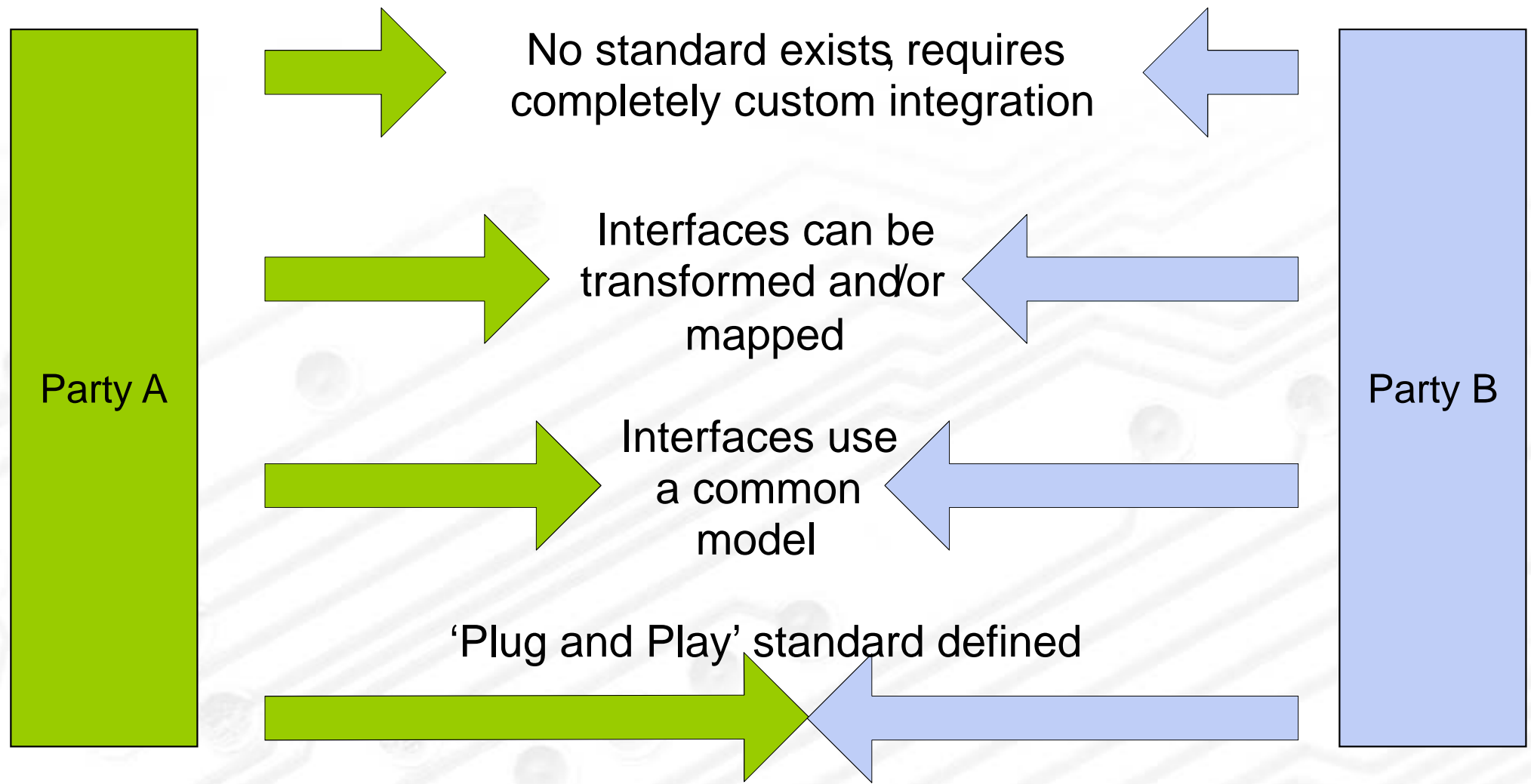
- Exchange of actionable information
 - between two or more systems
 - across organizational boundaries
- Shared meaning of the exchanged information
- Agreed expectation with consequences for the response to the information exchange
- Requisite quality of service in information exchange
 - reliability,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



○ Heterogeneity – Vive la Difference!

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

Distance to Integrate



Credit: Scott Neumann, UISol position paper

Where we started – The Constitution

What is GridWise? A vision...

- Information technology will revolutionize power grid modernization just as it has revolutionized business, education and entertainment.
- IT will form the “nervous system” of a new distributed technology-based system for energy response, distributed generation, and integration with traditional grid generation and distribution assets.
- Responsibility for managing the system will be shared by a collaborative network of utilities and entities.

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The Nutshell

- Objective
 - Principles and concepts to advance the electric system
- Challenges
 - Electric system is too vast for one organization
 - New players from other industries
 - Evolving heterogeneous, 24x7 system
- GridWise Architecture Council (GWAC)
 - Neutral, cross-sector, voluntary group
- Plan of Attack
 - Develop a common agenda and framework
 - Reference framework, levels for implementation
 - **Involve industry sectors and participants**
 - **Identify and address priorities!**
 - Standards, regulatory issues, market design

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The Emergence of the Constitution

- Focus is on developing broad-based buy-in and input on the interoperability statements of principle to support the GridWise architecture vision
- A set of fundamental, strategic statements that will facilitate the interoperation of electric system components and those parties involved in the production, transport, and use of electricity
- A vehicle to establish consensus surrounding fundamental principles
- Statements are relevant to all operations of the electric system, including end use, distribution, transmission, and generation.
- Striving for longevity (thirty years or more)

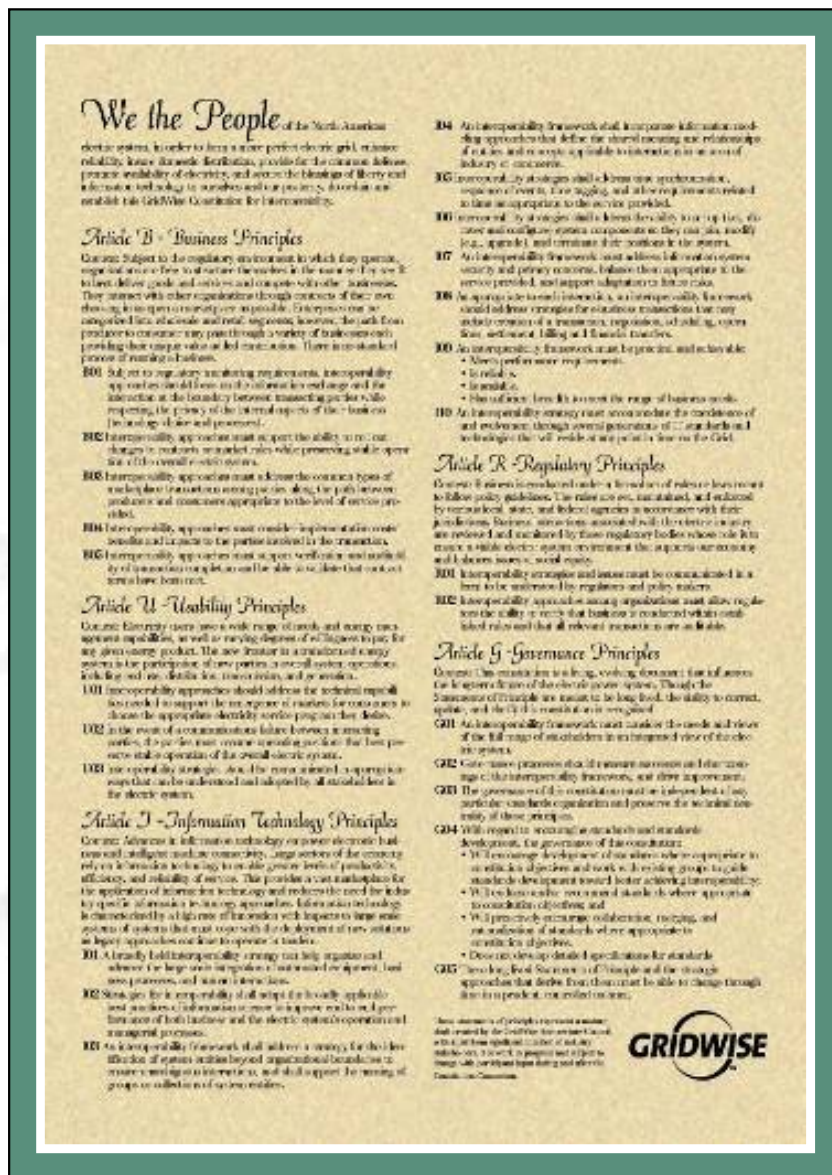
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GridWise Architecture Council

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Constitution:

Interoperability Statements of Principle



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



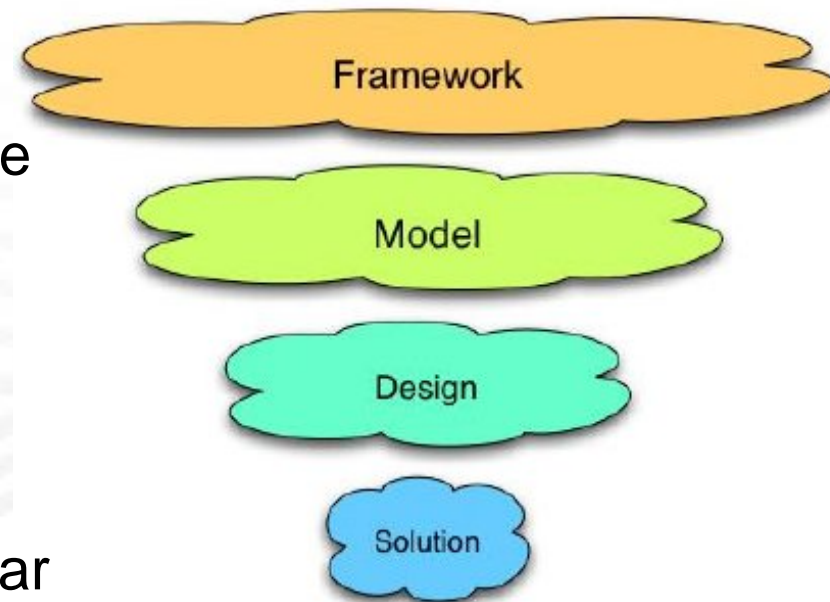
The Framework: Context for Interoperability Dialog

Interoperability Framework

- Organizing concepts
 - Taxonomy, definitions, levels, tenets
- Attempts to simplify the complex
 - **Warning – it's still complex**
- Aids communication between community members
 - **Careful – semantics remain a stumbling block**
- Provides perspective from selected viewpoints
- Reveals points where agreement simplifies integration
- **Focus plight of integrator, not component developer**

What do we mean by “Framework”?

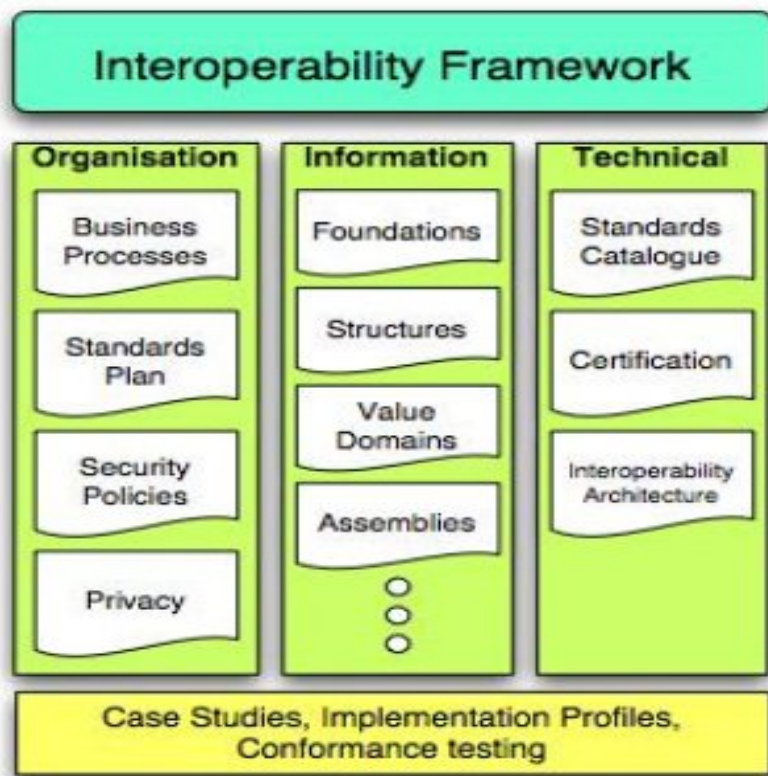
- **Framework** organizes concepts and provides context for discussion of detailed technical aspects of interoperability
- **Model** identifies a particular problem space and defines a technology independent analysis of requirements
- **Design** maps model requirements into a particular family of solutions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



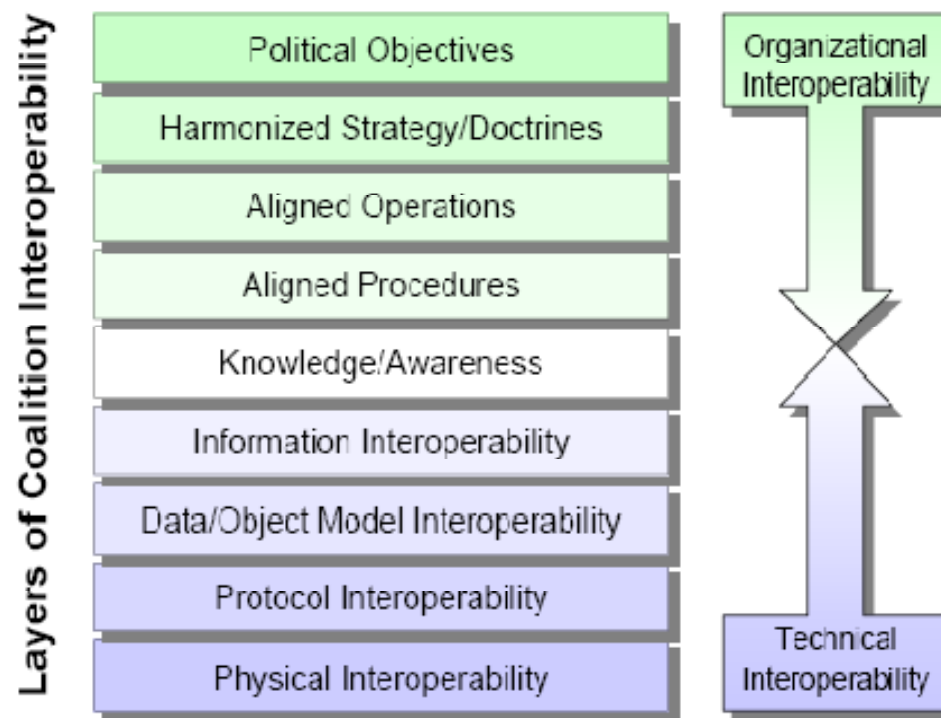
Borrowed from NEHTA:
Australian National E-
Health Transition Authority

Framework Inspirations

NEHTA Interop Framework



Layers of Coalition Interoperability



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A. Tolk, *Beyond Technical Interoperability*, 8th CCRTS, National Defense University, Jun 03

System Integration Philosophy

- Agreement at the interface
 - Create an interaction contract
 - Terms and conditions, consequences for failure to perform...
- Boundary of authority
 - Respect privacy of internal aspects on either side of the interface (technology choice and processes)
- Decision making in very large networks
 - Decentralized/autonomous decision-making
 - Multi-agent v. hierarchical approach
 - Addresses scalability, evolutionary change, eases integration
- Role of standards in the framework
 - Encourages standards for improving interoperation
 - Agnostic to specific standards and technologies

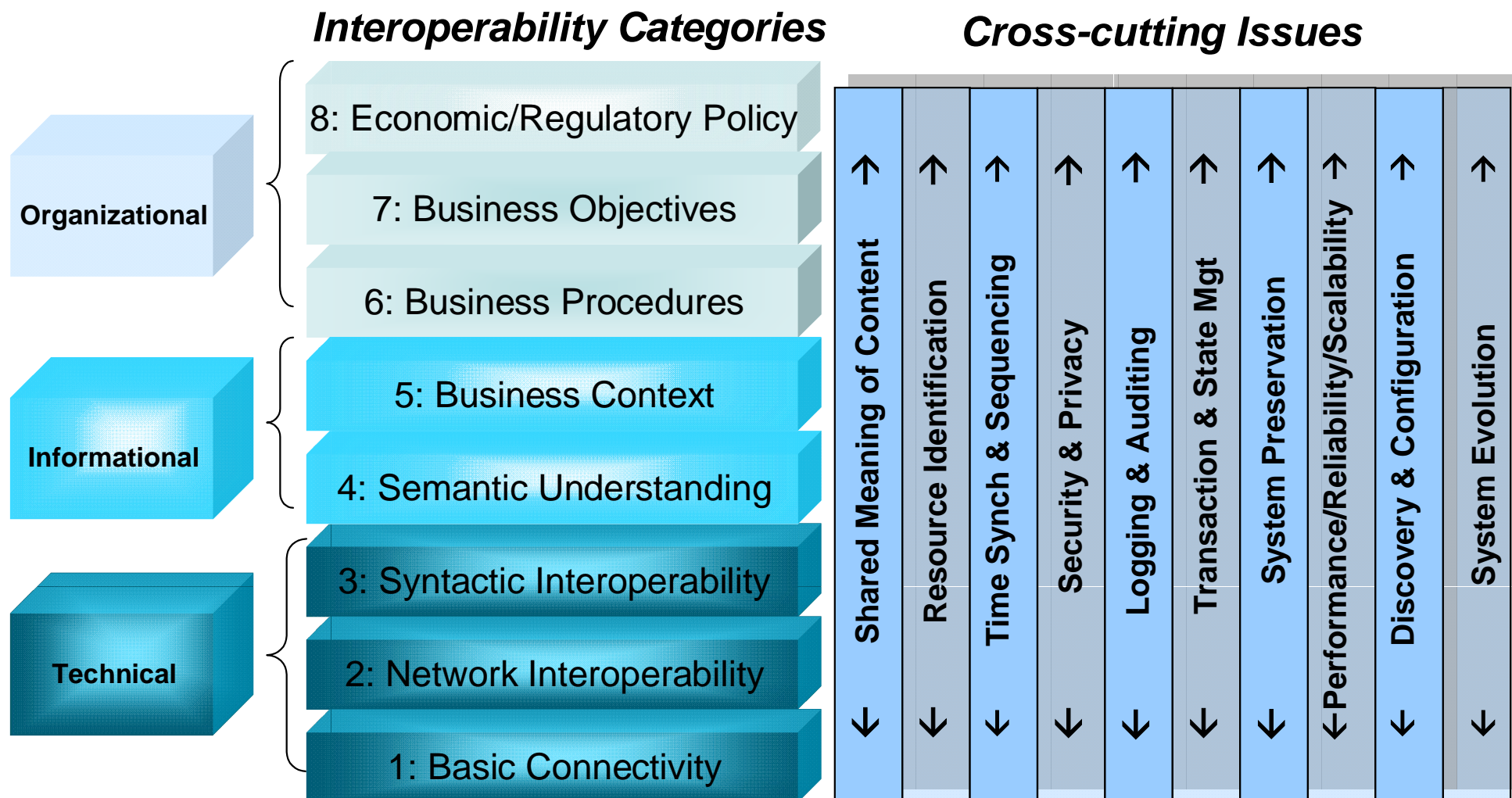
Interoperability Framework



Example: Demand Pricing Signal

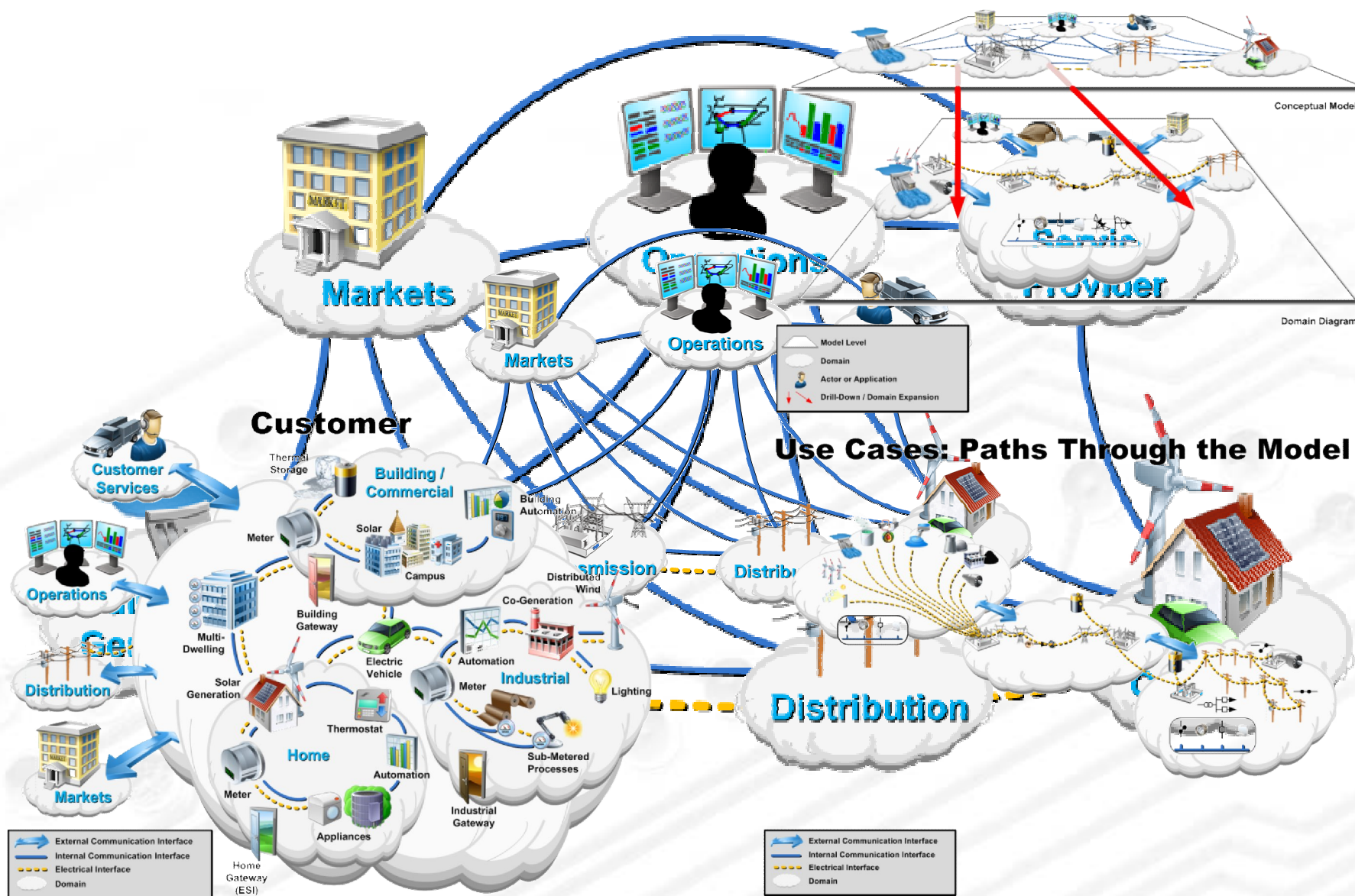
- Economic/Regulatory Policy
 - PUC issues retail real-time price signal policy
- Business Objectives
 - Electricity retailer objectives align with building services providers to aggregate demand
 - Building owners choose service provider with package that best meets their needs
- Business Procedures
 - Hour ahead price sent by electricity retailer to building service providers, acknowledgement returned with forecast next hour demand
- Business Context
 - Tailored portion of CIM, e.g., model building and energy price information
- Semantic Understanding
 - IEC 61968/61970 Common Information Model (CIM) in W3C OWL
- Syntactic Interoperability
 - SOAP messaging, UDDI registry and discovery, XML
- Network Interoperability
 - TCP/IPsec
- Basic Connectivity
 - IEEE 802.11 wireless mesh network to building controller

Cross-Cutting Issues



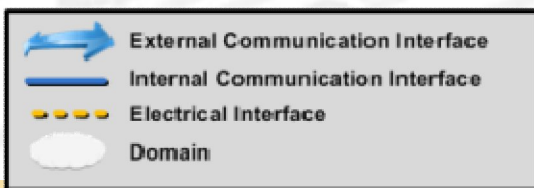
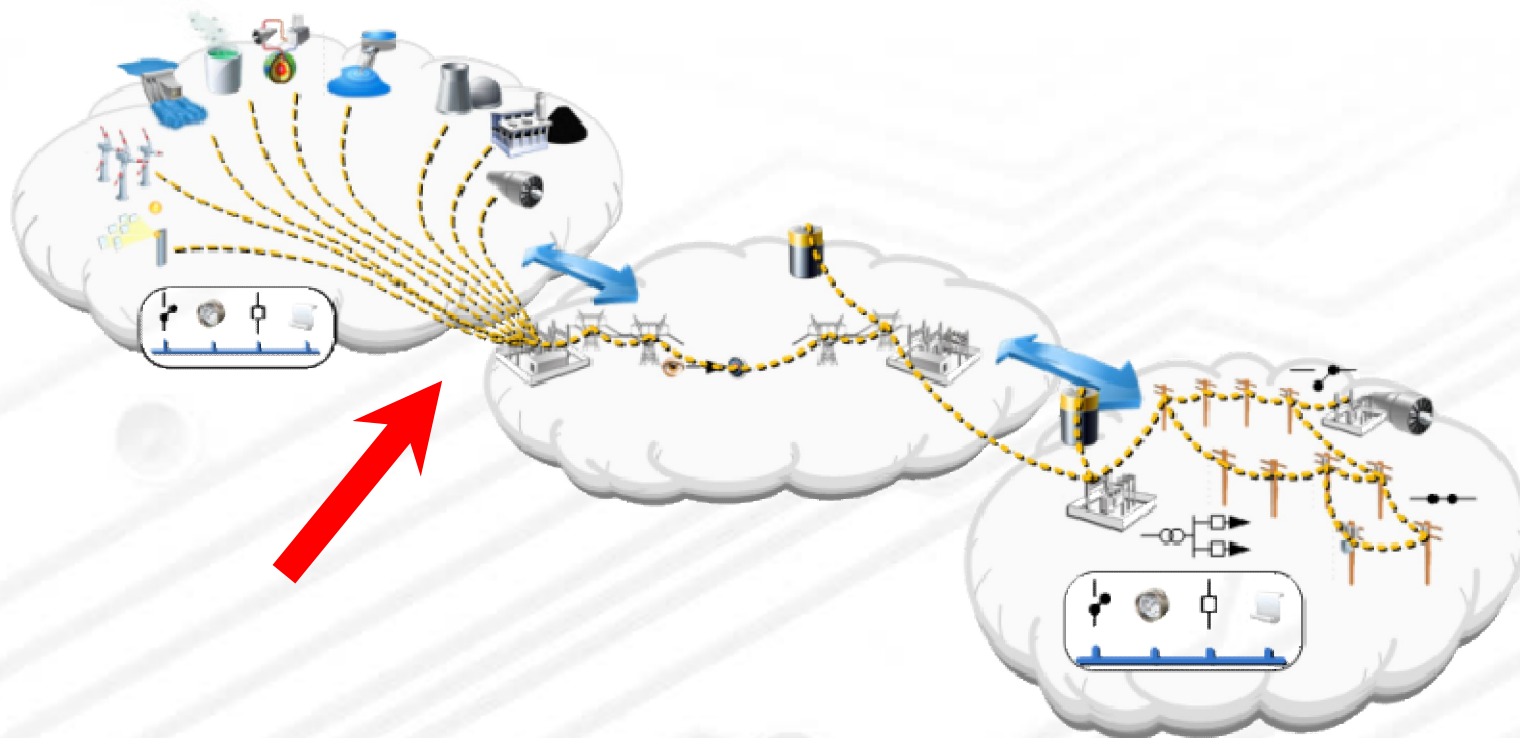
Using the Conceptual Model

Levels of the Conceptual Model

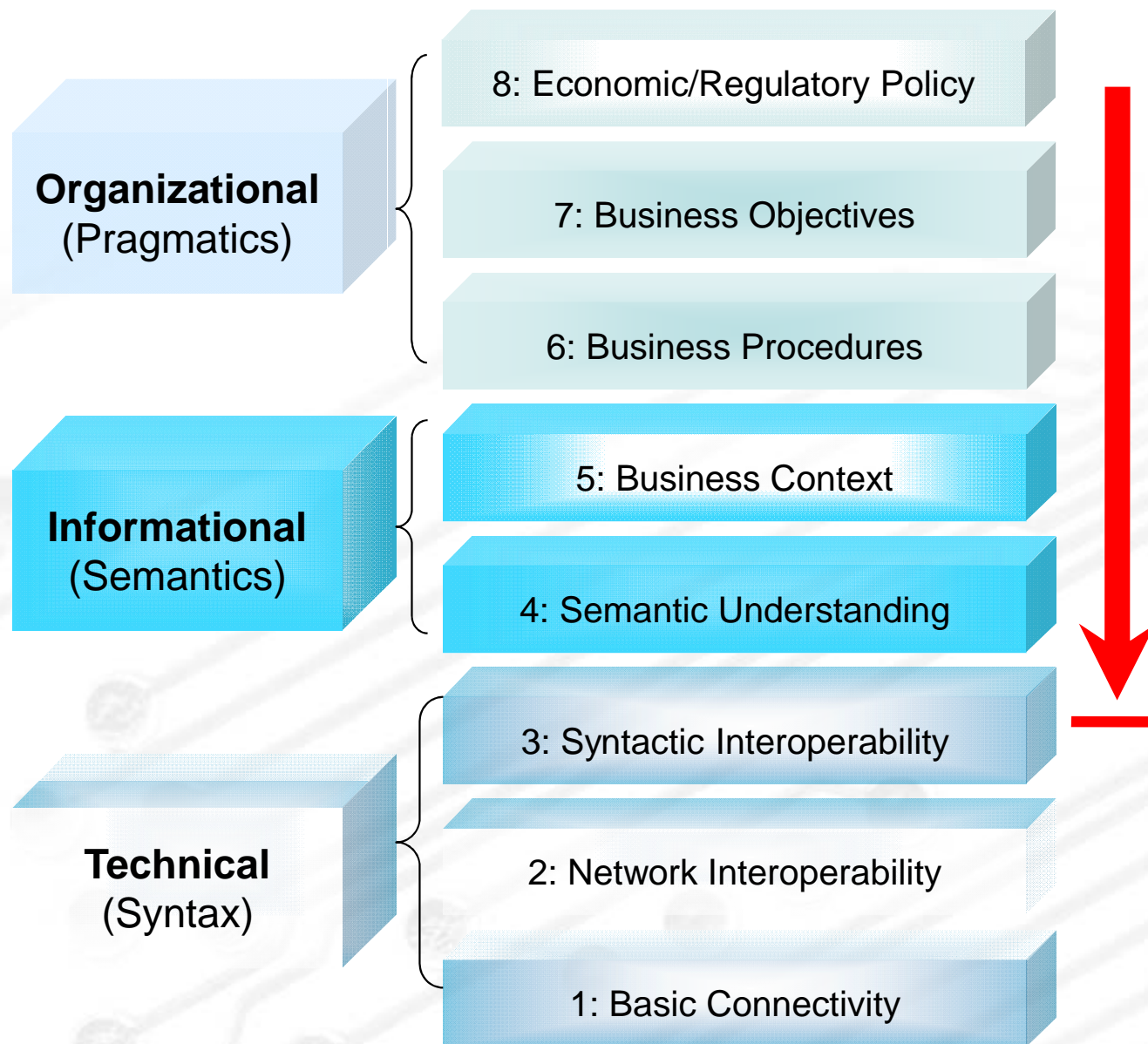


Inter- vs. Intra-System Interoperability

Use Cases: Paths Through the Model



The GWAC Stack and the Model



Analyze interoperability at key inter-system points in the use case paths through the Conceptual Model ...



... using the GWAC Stack top-down to define lowest layer that must be addressed