# Interoperability 101
## Introduction and Overview

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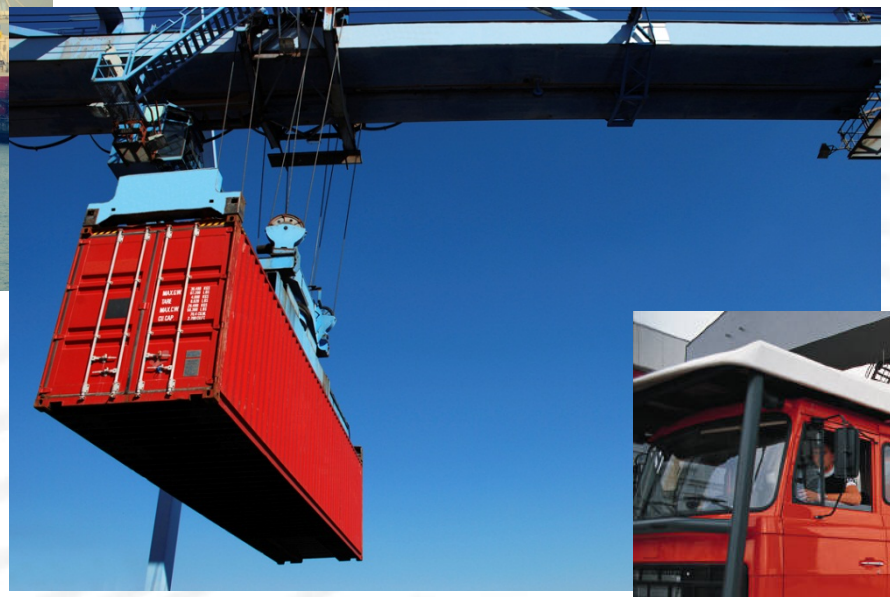
Ron Ambrosio, IBM Watson Labs

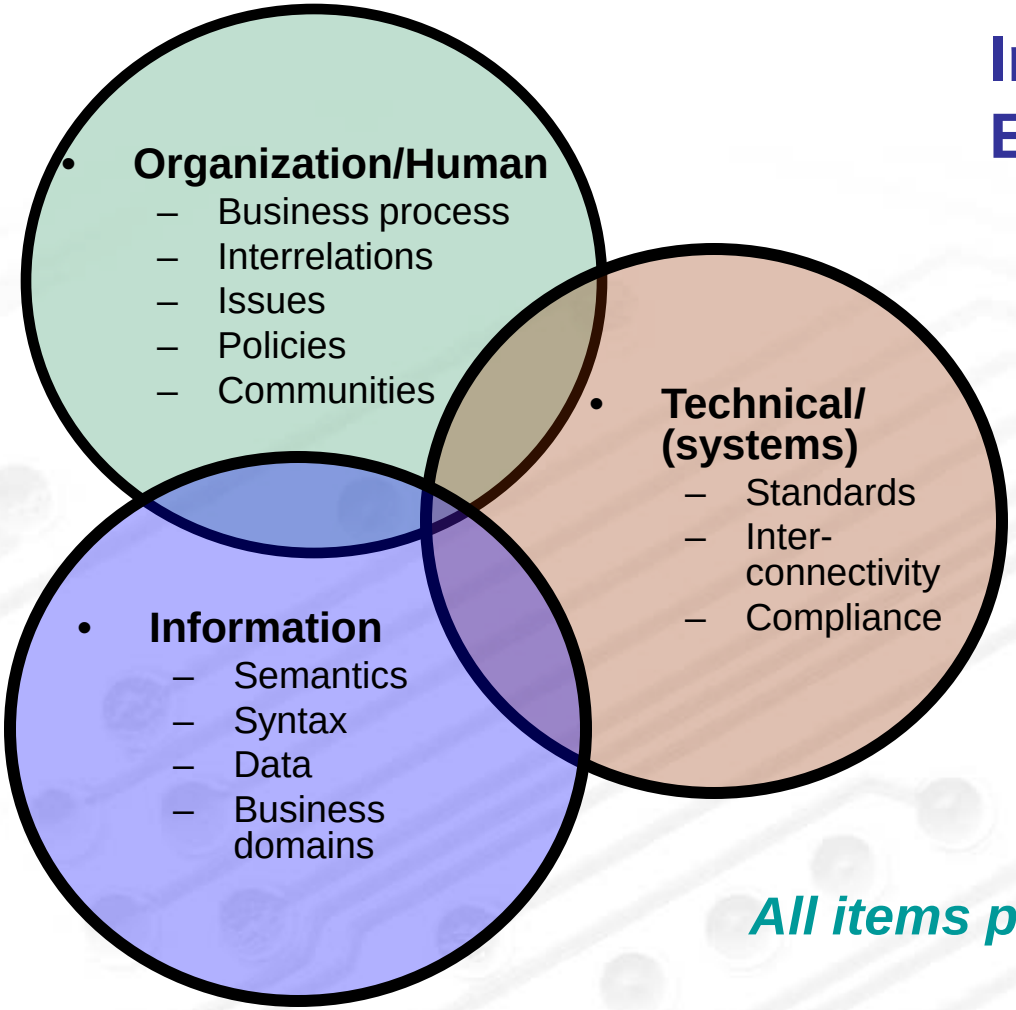
# A Simple Example



# 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***

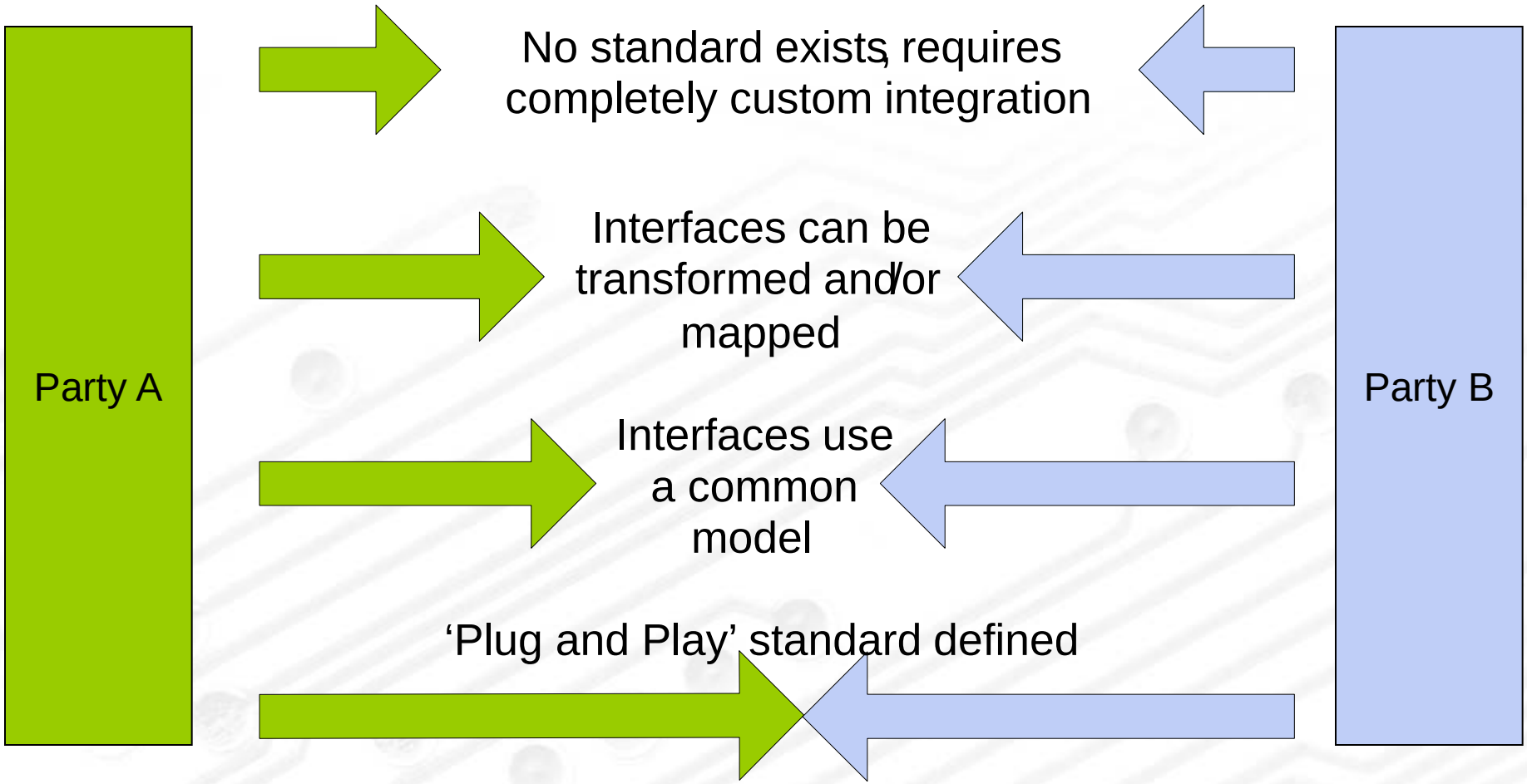
# ***Inter***operability – Integration at Arm's Length


- 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!

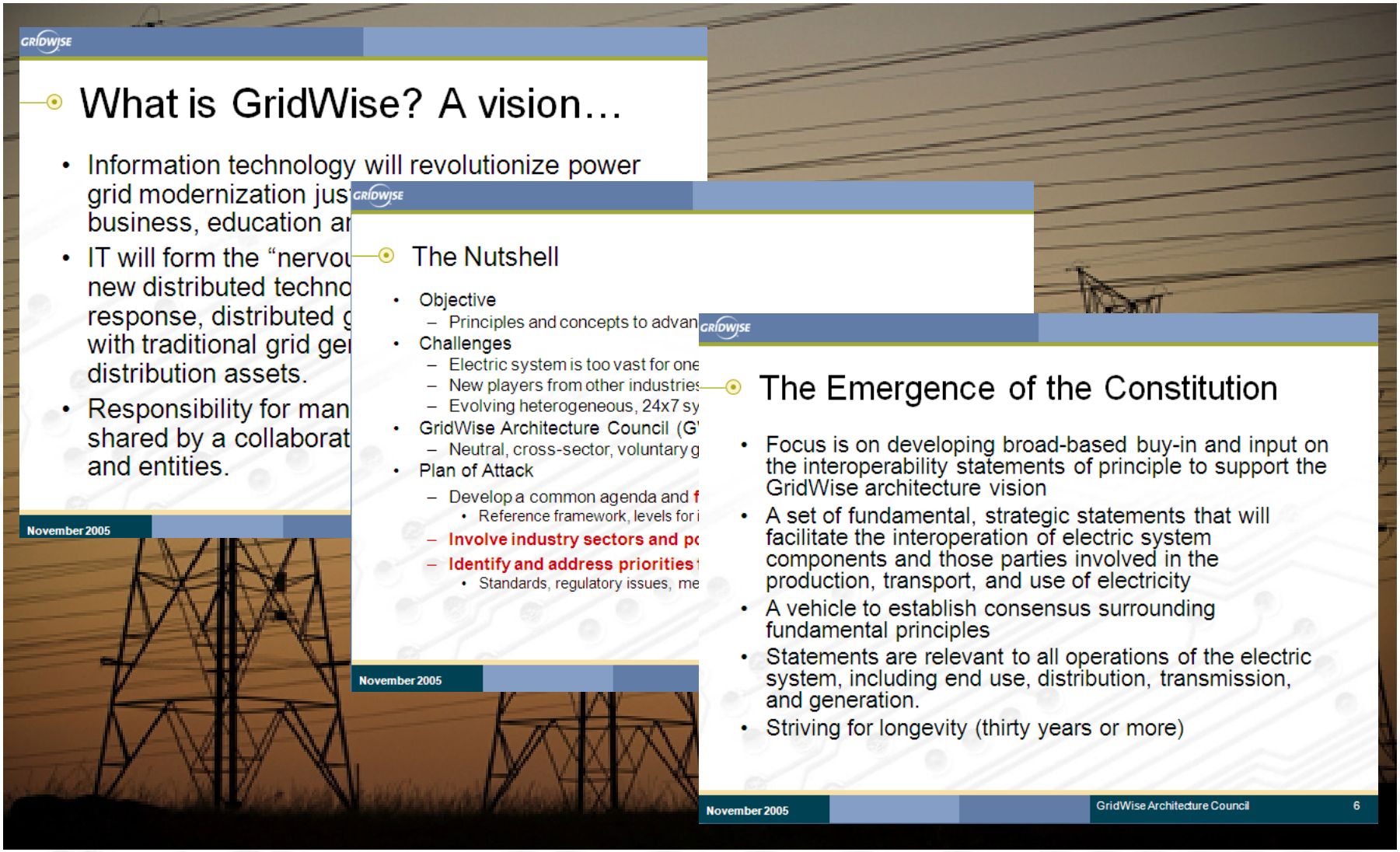
- Multiple versions and mixtures of technology
  - Including today's tech with *tomorrow's* innovations
- Multiple vendors with multiple products
- Multiple services needing integration
- Multiple organization structures
  - IOUs
  - Rural Co-ops
  - Munis

# Distance to Integrate



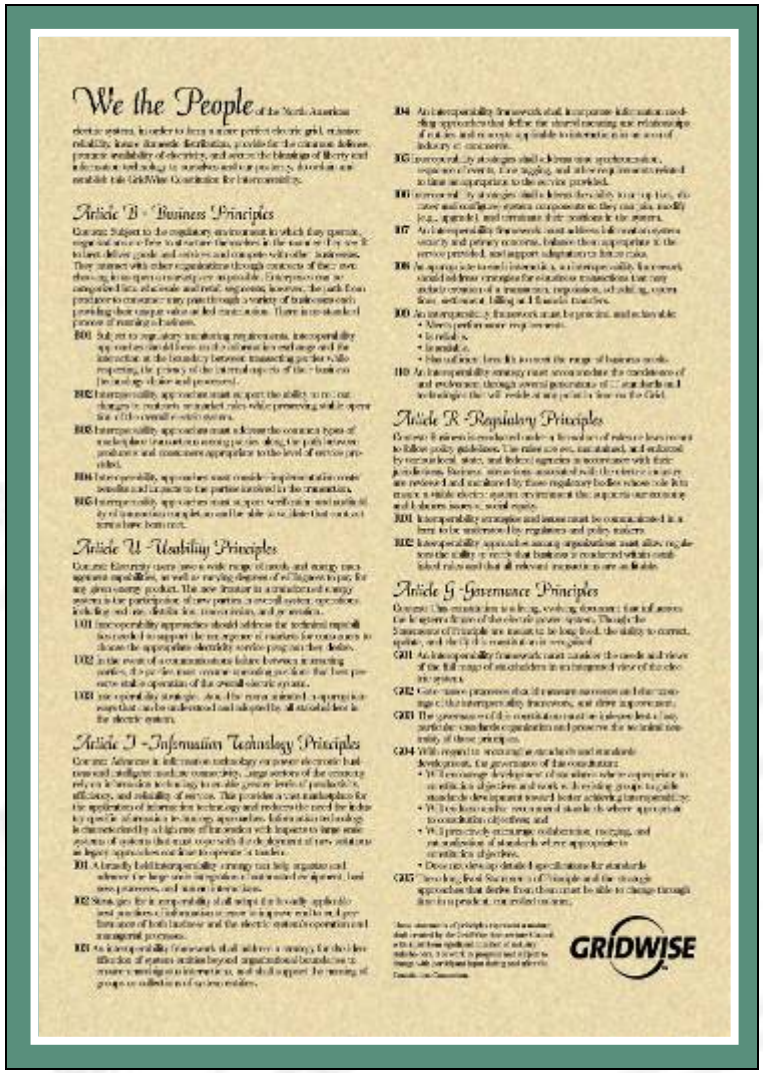

Credit: Scott Neumann, UISol position paper

# Where we started – The Constitution



# Constitution:

## Interoperability Statements of Principle



We the People of the North American electric system, in order to form a more perfect electric grid, ensure reliability, future domestic distribution, provide for the common defense, promote availability of electricity, and secure the blessings of liberty and democratic technology to ourselves and to our posterity, do ordain and establish this GridWise Constitution for interoperability.

Article B - Business Principles

Article U - Usability Principles

Article I - Information Technology Principles

Article R - Regulatory Principles

Article G - Governance Principles

GRIDWISE

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

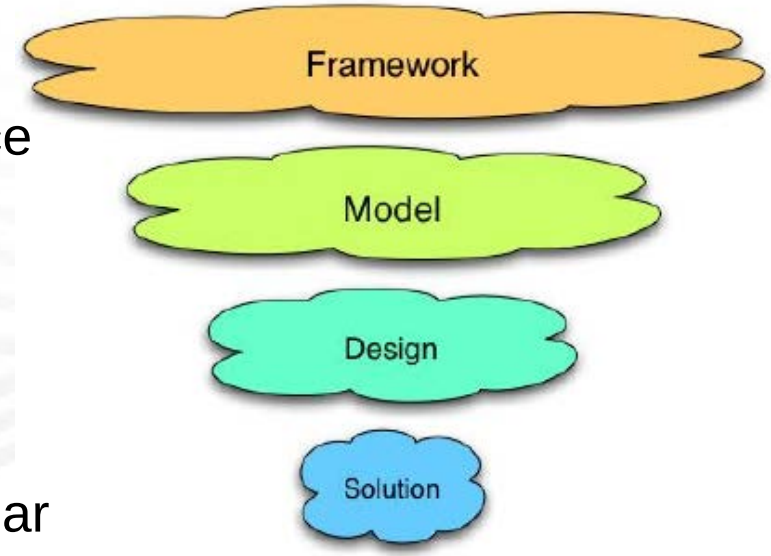
# The Framework: Context for Interoperability Dialog

# 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"?

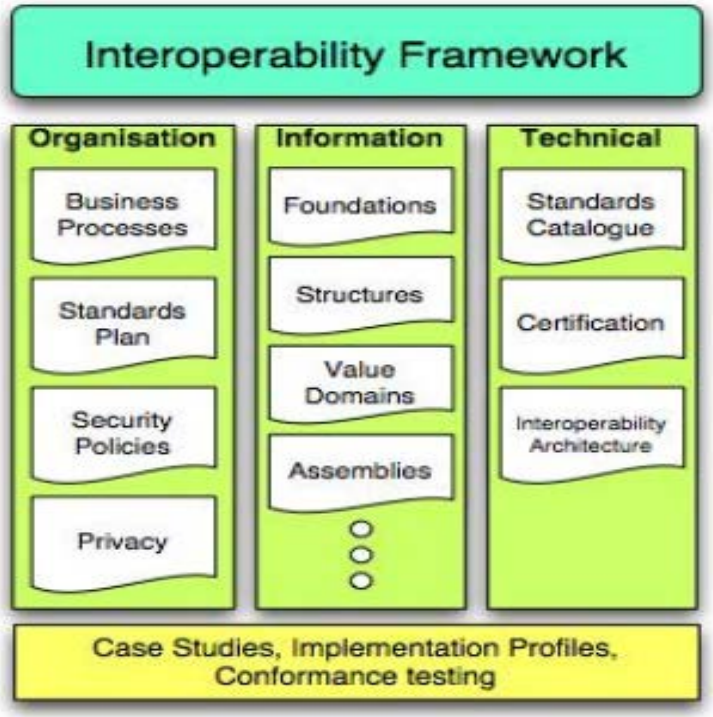
- *Framework* organizes concepts and provides context for discussion of detailed technical aspects of interoperability
- *Model* identifies a particular problem space and defines a technology independent analysis of requirements
- *Design* maps model requirements into a particular family of solutions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



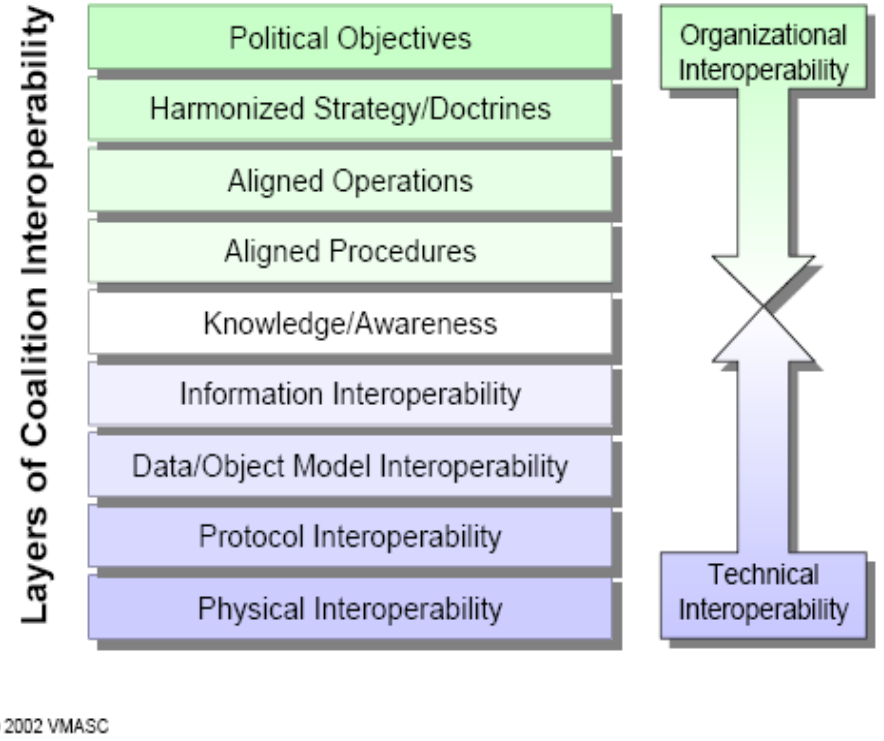

Borrowed from NEHTA: Australian National E-Health Transition Authority

# Framework Inspirations

NEHTA Interop Framework




Layers of Coalition Interoperability




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

# System Integration Philosophy

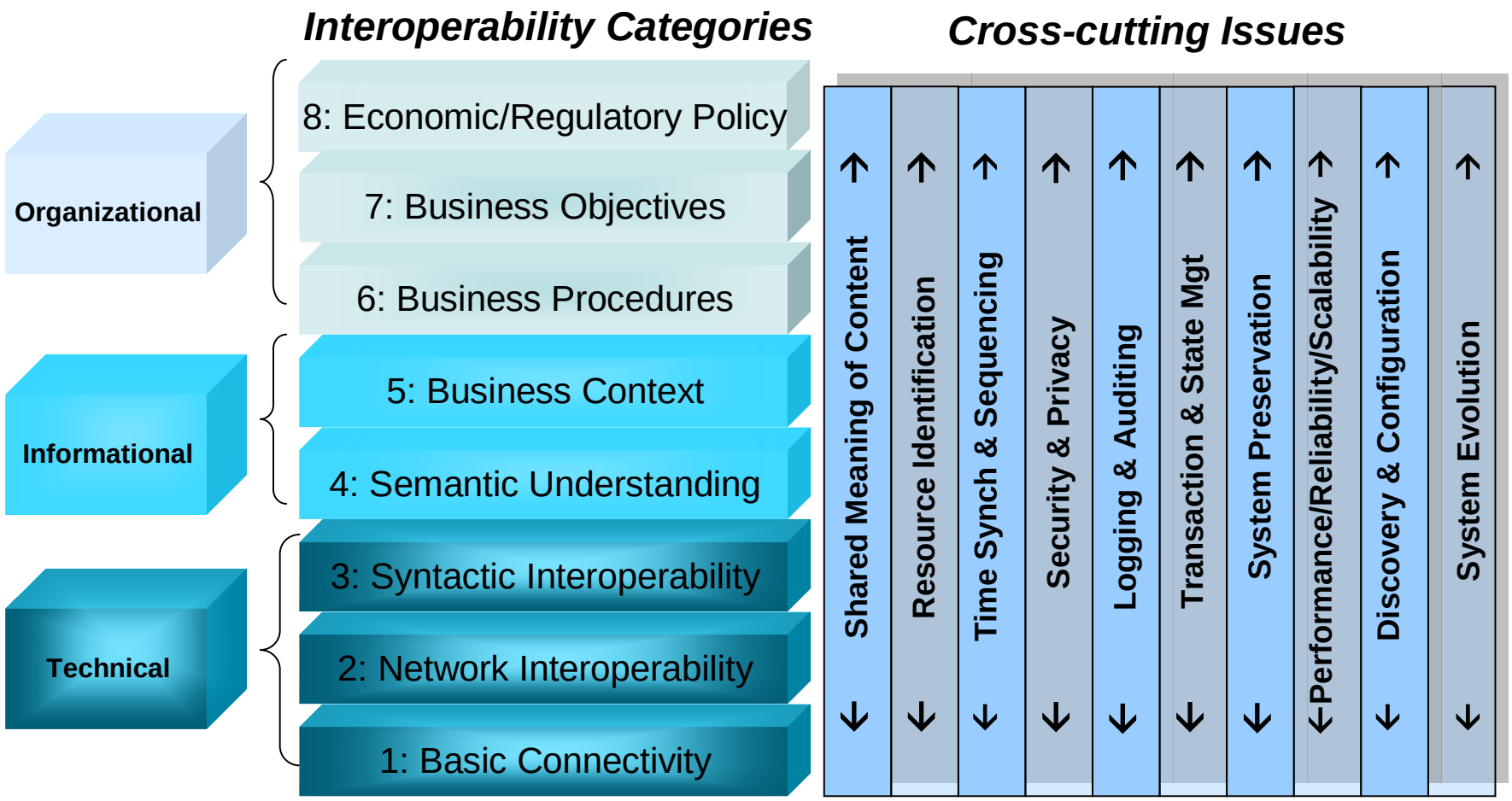
- Agreement at the interface
  - Create an interaction contract
  - Terms and conditions, consequences for failure to perform…
- Boundary of authority
  - Respect privacy of internal aspects on either side of the interface (technology choice and processes)
- Decision making in very large networks
  - 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

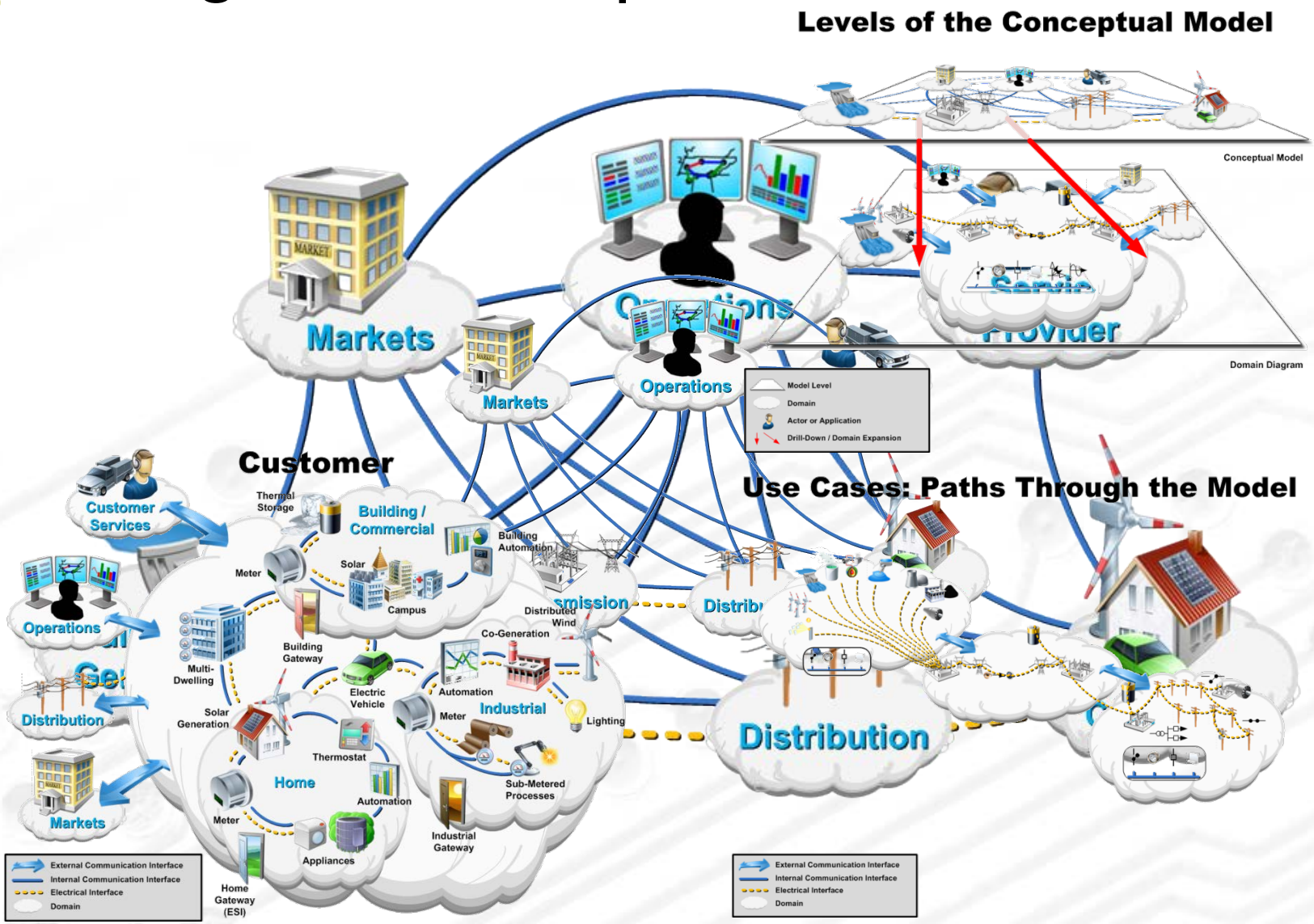
# Example: Demand Pricing Signal

- 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

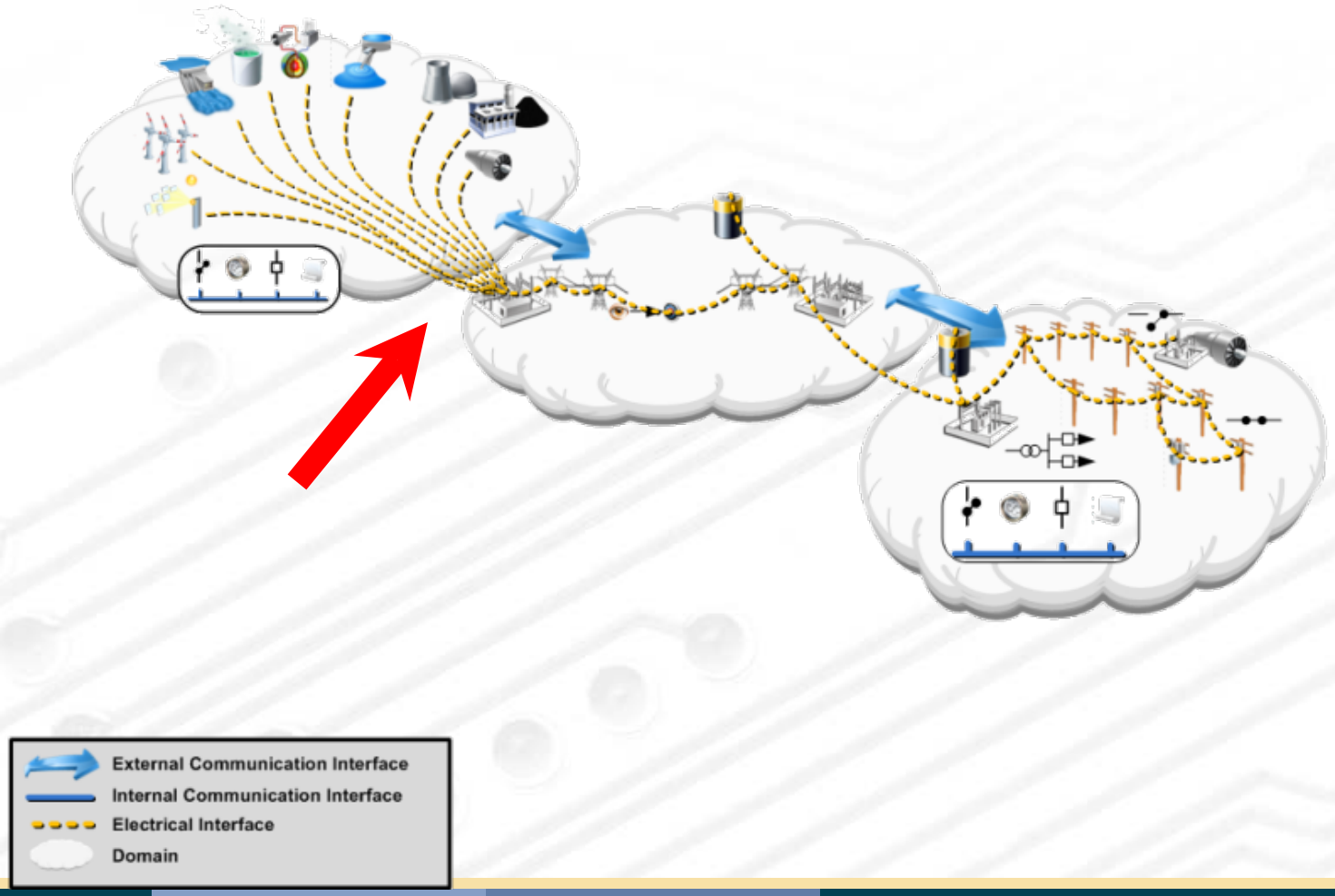


# Using the Conceptual Model

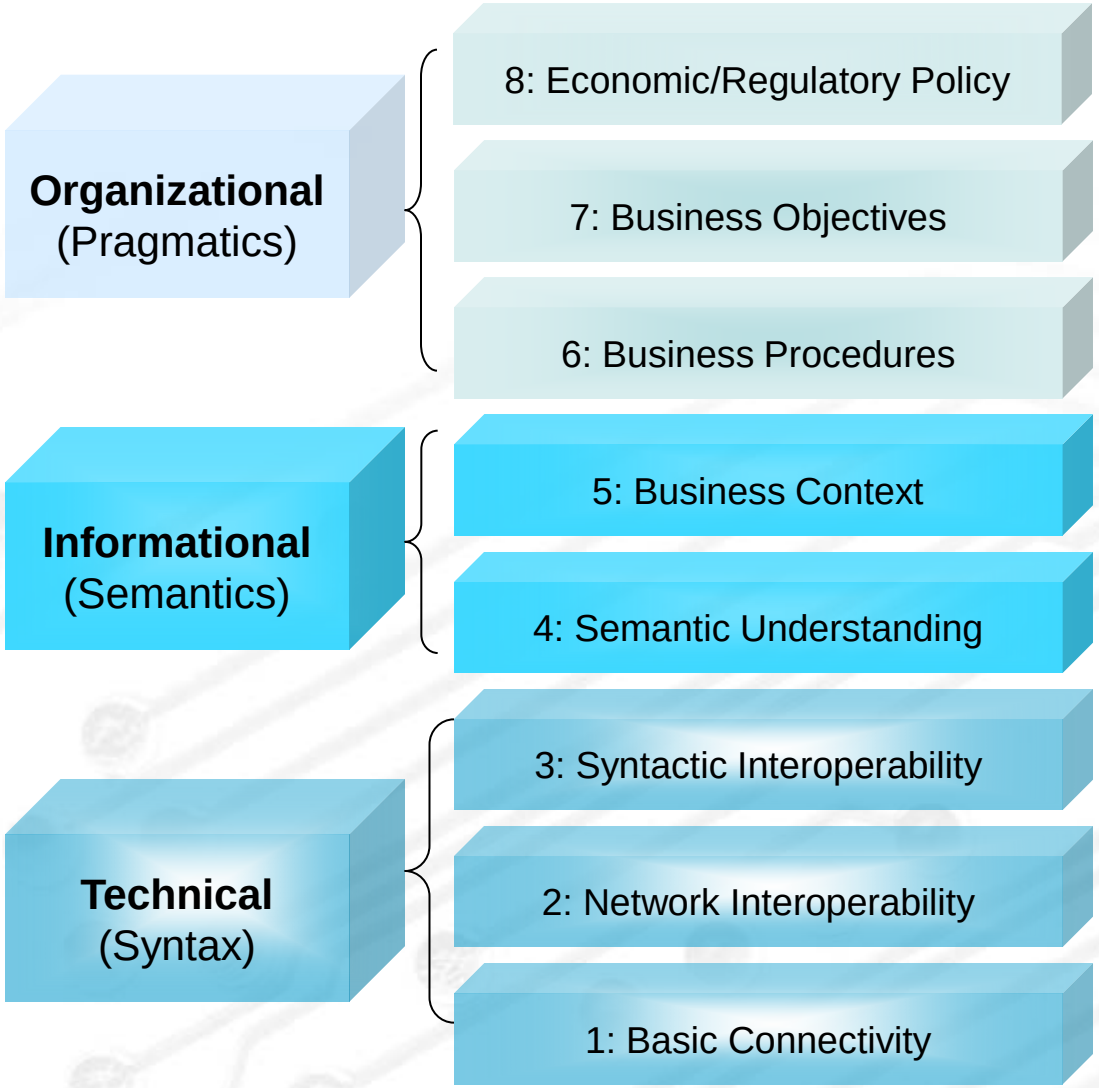


# Inter- vs. Intra-System Interoperability

## 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