

Semantic Solutions for Financial Industry Systemic Risk Analysis

Next Generation Financial Cyberinfrastructure Workshop

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Mission

- Who we are:
 - Non-profit collaborative industry standards development team
 - From financial institutions, standards and trade groups, technology vendors
- Goal:
 - Create semantic financial data standards and operational solutions that will eliminate data quality gaps and will promote progress towards achieving data maturity and health in the financial system
- Our proposal/solution is:
 - A community-based, free and open source financial industry standard
 - Non-proprietary nor dependent on any individual vendor solutions
- Our collective challenge and journey:
 - We seek an open dialogue and the contribution of diverse perspectives to advance the potential of semantics and semantic processing

Poor Data Quality Impacted Early Identification of Risks During the 2008 Global Financial Crisis



While the global financial crisis had multiple causes a major *gap* was poor quality of financial data that led to:

- opaqueness, lack of transparency and thus inadequate awareness by regulators (and financial institutions) of mounting concentrations of financial risk. Examples:
- overleveraging in over-the-counter (OTC) derivatives (complex financial instruments used for hedging) were relatively opaque to regulators e.g. credit default swaps, resulting in insufficient liquid capital to cover drops in asset prices (ex. AIG, Lehman)
- inability to identify the risks inherent in mortgage backed securities
- impacted sensitivity of analytic risk models

Financial Contagion Influenced Regulators to Recommend Global Financial Data Standards



Regulators and financial institutions also were unable to gain visibility to complex financial interdependencies between counterparties to trades

- where default risks became magnified
- resulting in massive financial impacts across institutions and borders

Regulators have thus called for global financial data standards

- to ensure there is high data consistency, data linkage and data integration
- as a prerequisite for effective macroprudential risk analysis and reporting
- data standards are also desired by financial institutions for equal reasons

Regulatory Requirements for Financial Data Standards and Transparency



Financial data standards have been requested for:

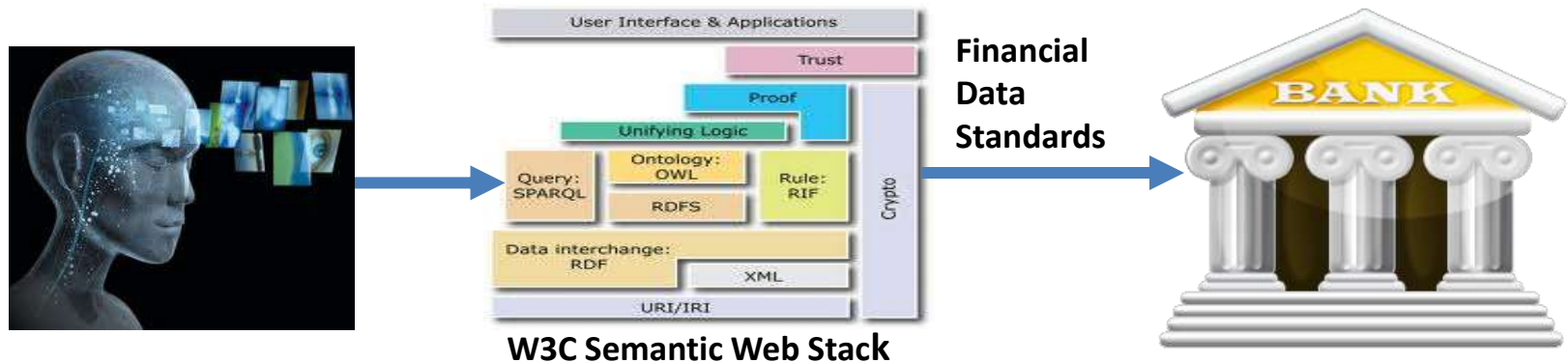
- identification of legal entities and their subsidiaries, ownership hierarchies
- identification of financial instruments e.g. derivatives
- precise and comparable language of financial contracts

So that regulators (and financial institutions) can

- classify undifferentiated swaps into asset classes and risk categories
- analyze linkages between counterparties to trades and identify aggregate positions and exposures across asset classes and ownership hierarchies
- understand exposures at institutional, national and cross-border levels
- aggregate the data and exchange information with other regulatory authorities
- also institutions can more easily filter out prospective trades that are classified outside of risk tolerances

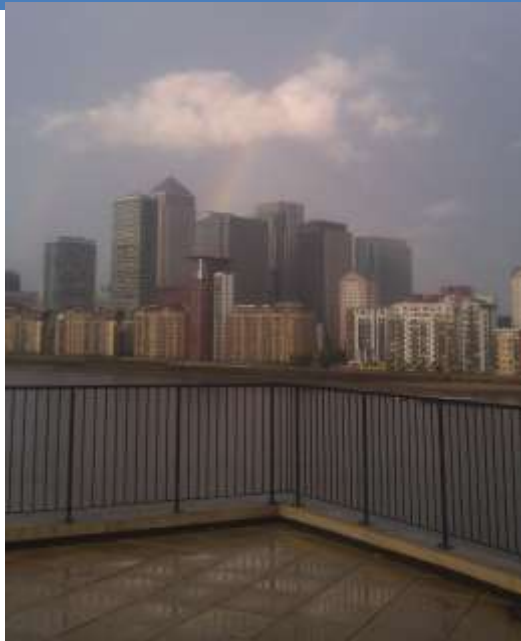
Semantic Technology Can be a Foundation for Financial Data Standards and Transparency

- The Enterprise Data Management Council and the Object Management Group believe that semantic technology
 - is the optimum way forward to define financial data standards in support of the objectives of the financial regulators and the financial industry
 - can supplement and map to existing financial data standards



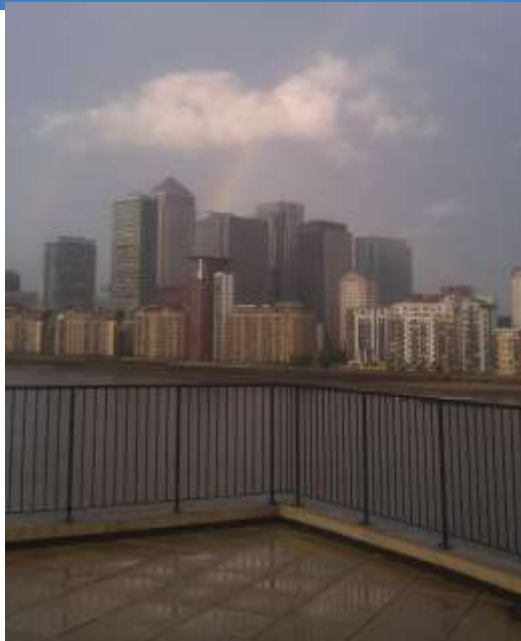
- Semantic technology uses machine intelligence to provide highly advanced data schemas (ontologies) and tools
 - that can help organizations better define, link, integrate and classify their data
 - and do this faster, cheaper, smarter

The View From Mike's Place



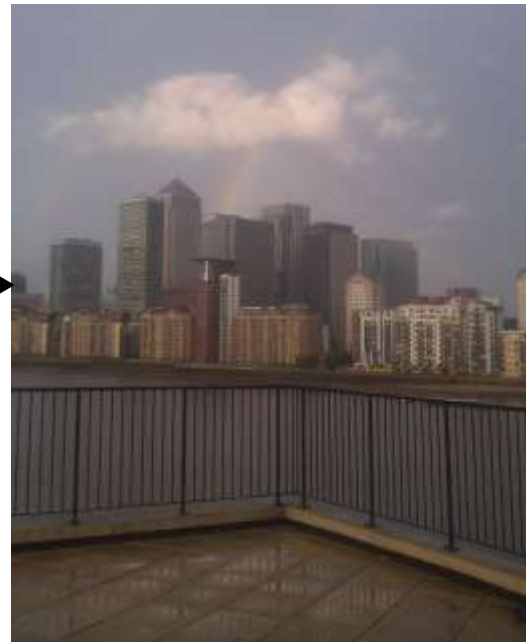
← **Some
banks**

The View From Mike's Place

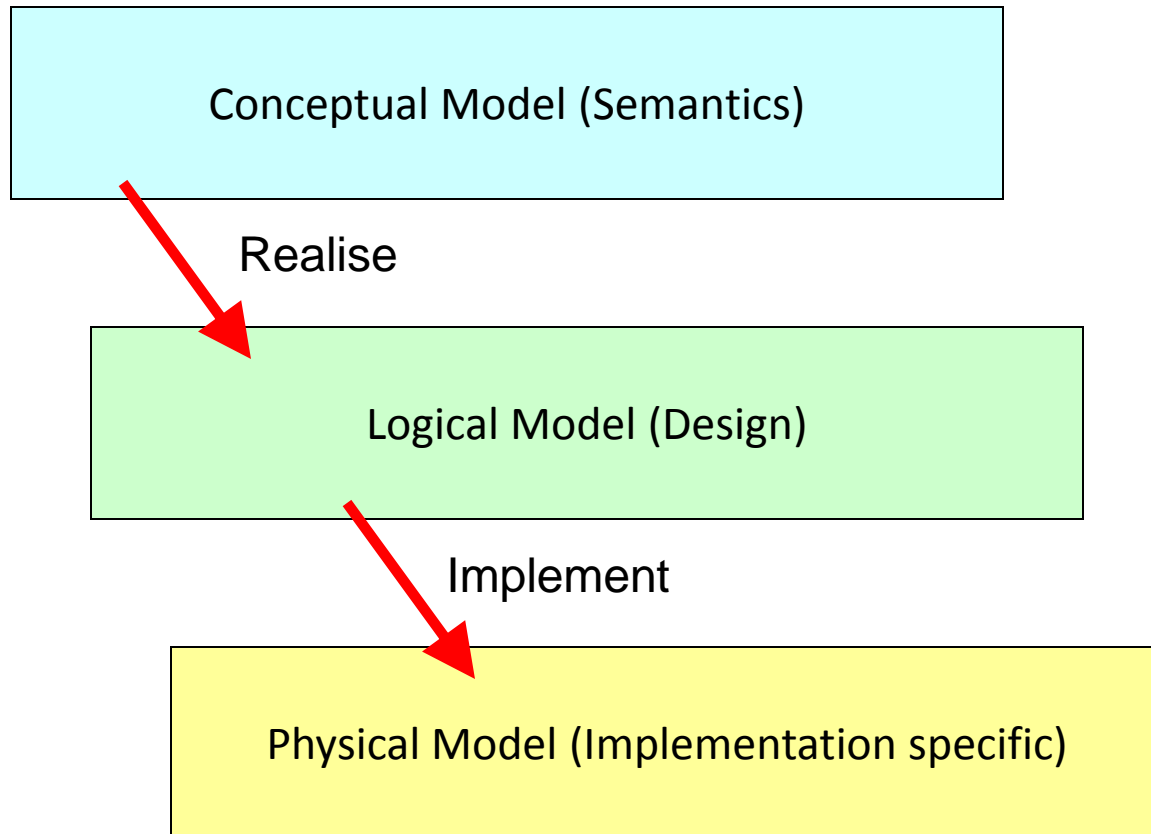


← **Some
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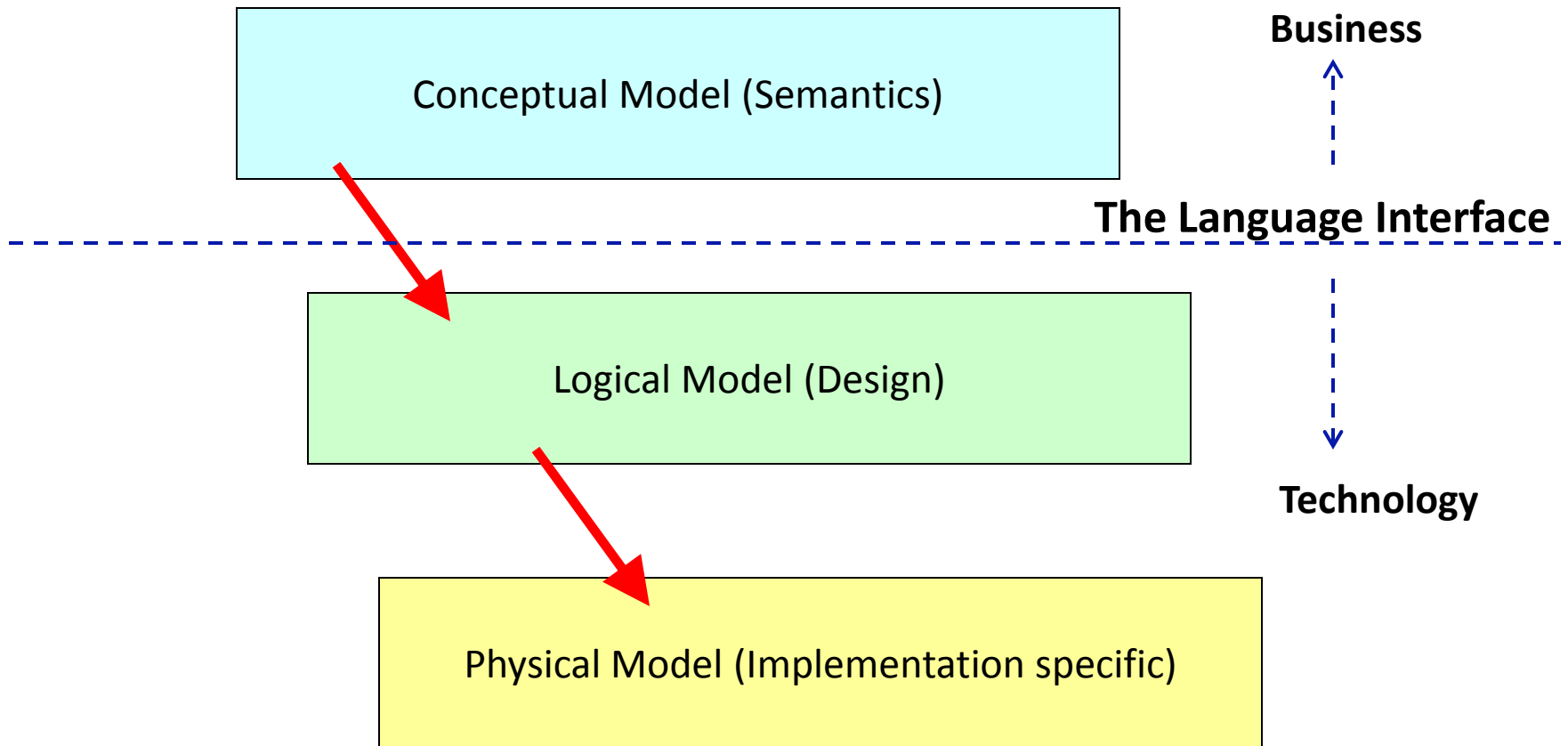
Some IT Firms →



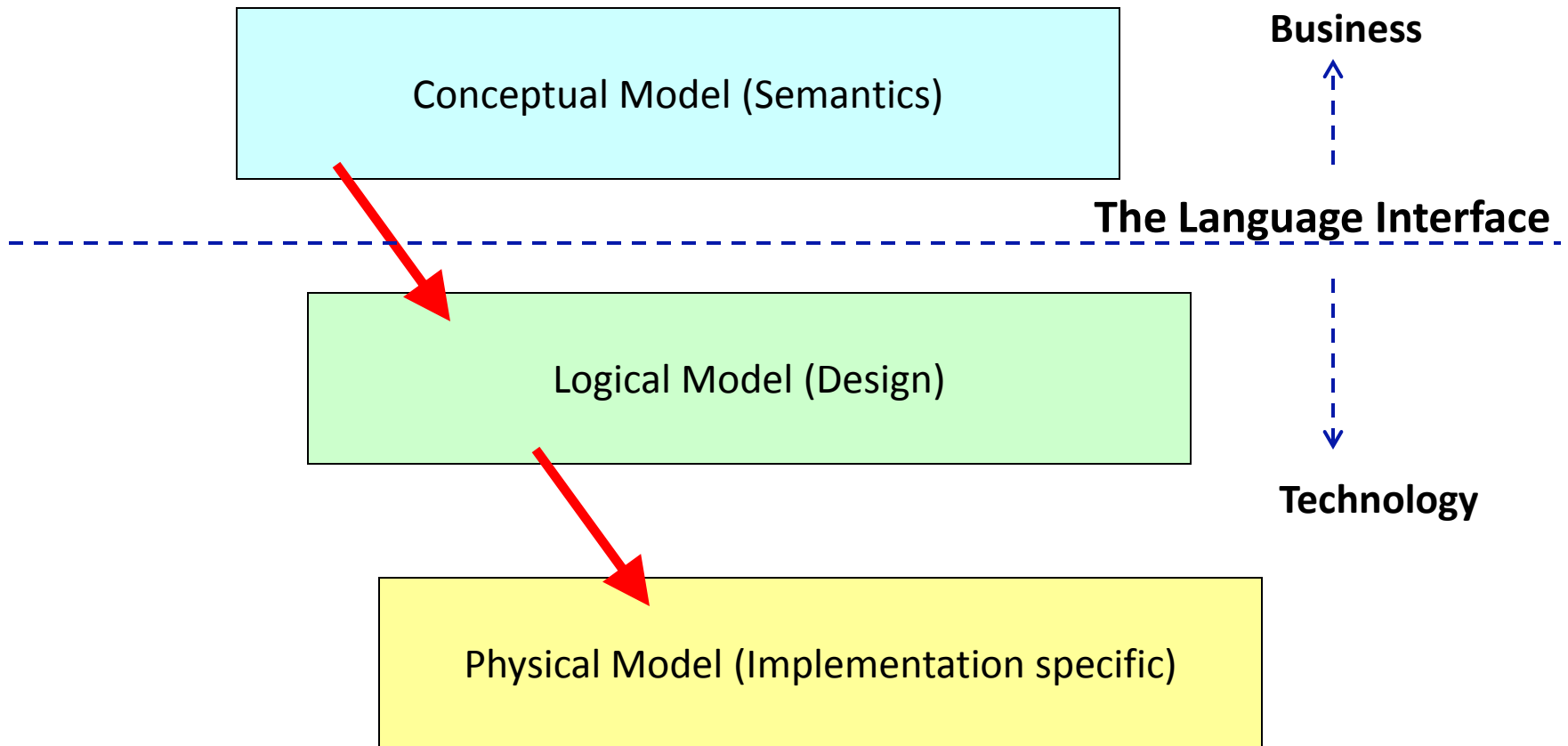
Conceptual Model for Data



Conceptual Model for Data



Conceptual Model for Data



FIBO bridges the “Language gap” between business and technology

FIBO Bridges the Language Gap...

- Technology governance
 - Not “business”
 - Not “Technology”
 - The business of technology development
- Mature process = predictable results
 - Change management
 - Transparency
 - Reuse of data
- Opportunity costs:
 - Cost over-runs
 - Poor delivery
 - Long and unmanageable discussions for every new change

How does Semantics Help?

- A single version of the truth
- Framed in formal logic
 - Complete and accurate
 - Extensible
- Implementable by technical staff
 - Does NOT require the technologists to understand everything in order to deliver it
 - BUT
 - Cultural shift: does not require the technologists to understand everything...
- New material is additive
 - Provided that the model is truly semantic

Towards Meaning

- The stated benefits for semantics only really apply if the model is actually meaningful
 - Full abstraction of concepts
 - What sort of “Thing” is this?
 - What distinguishes it from other things?
- For each concept, frame this in terms of a simpler, meaningful concept
- If you just implement the same old “data models” in a new syntax, there is no semantics and therefore no benefits from using semantics
- Syntax is not semantics!

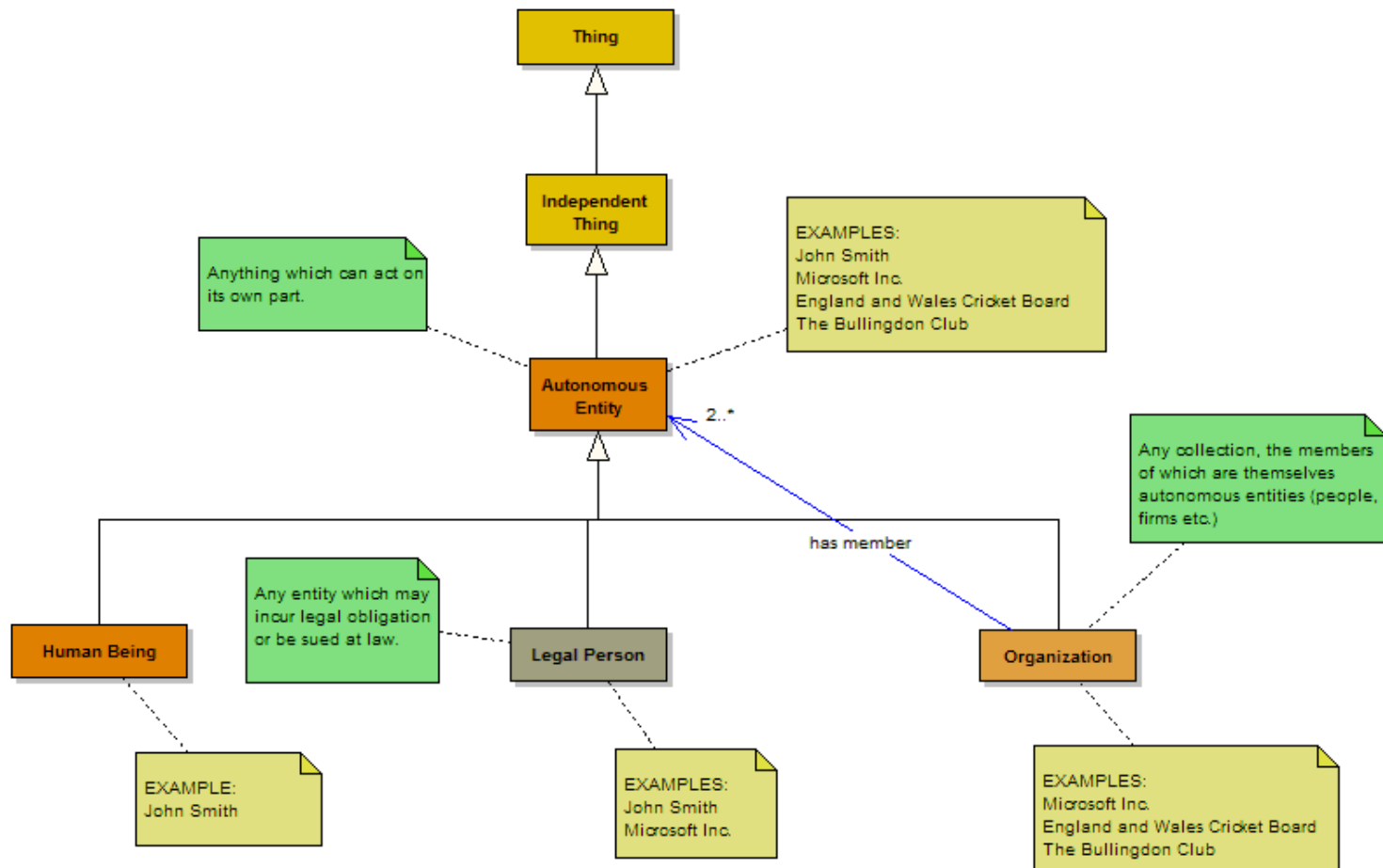
What we want

- Business meanings
- In business language
- For business people

What we want

- Business meanings
 - Not data dictionary
- In business language
 - Not a design
- For business people
 - No funny symbols and things
 - No language to learn
 - Just the facts
 - Boxes and lines – something like this...

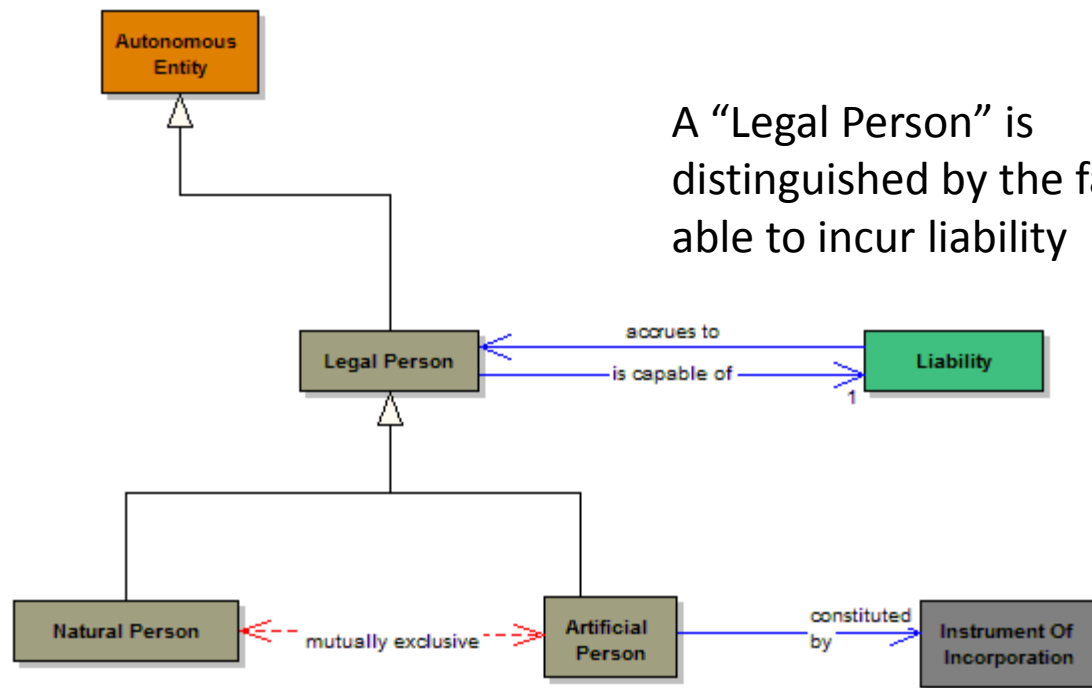
Types of Entity



Types of Entity

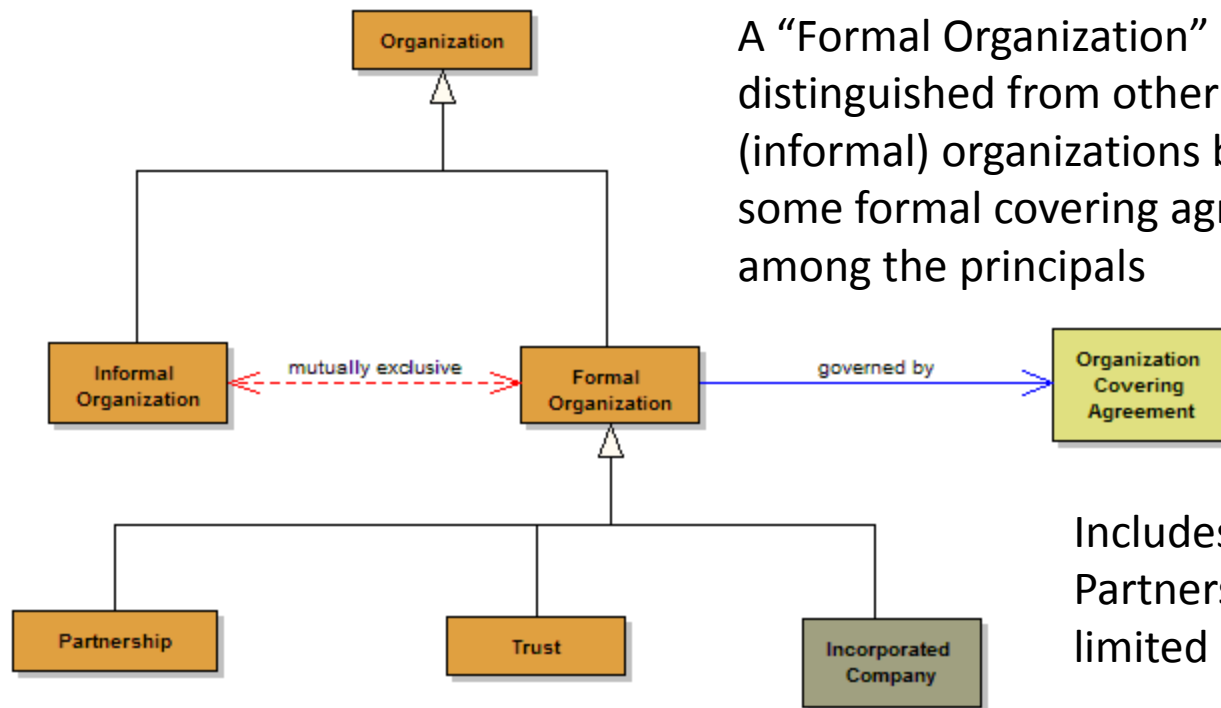
- Formal representation of the legal “facts of the matter”
 - What is a Legal Person?
 - What is an Organization
 - What kinds of entity may be both?
- This may be very different from any given data model
 - Forms a common key for a range of data models
 - Example: a model of data for loan borrowers will focus on Legal Person, since loan borrowers incur debt
 - Example: an identifier for participants in OTC Contracts is also limited to Legal Persons
 - Some identifiers need to identify Trusts – these are NOT legal persons
- Use as a common key to identify the things referred to in application data models

Legal Persons Fundamentals



An "Artificial Person" is a Legal Person with some formal instrument by which it is incorporated

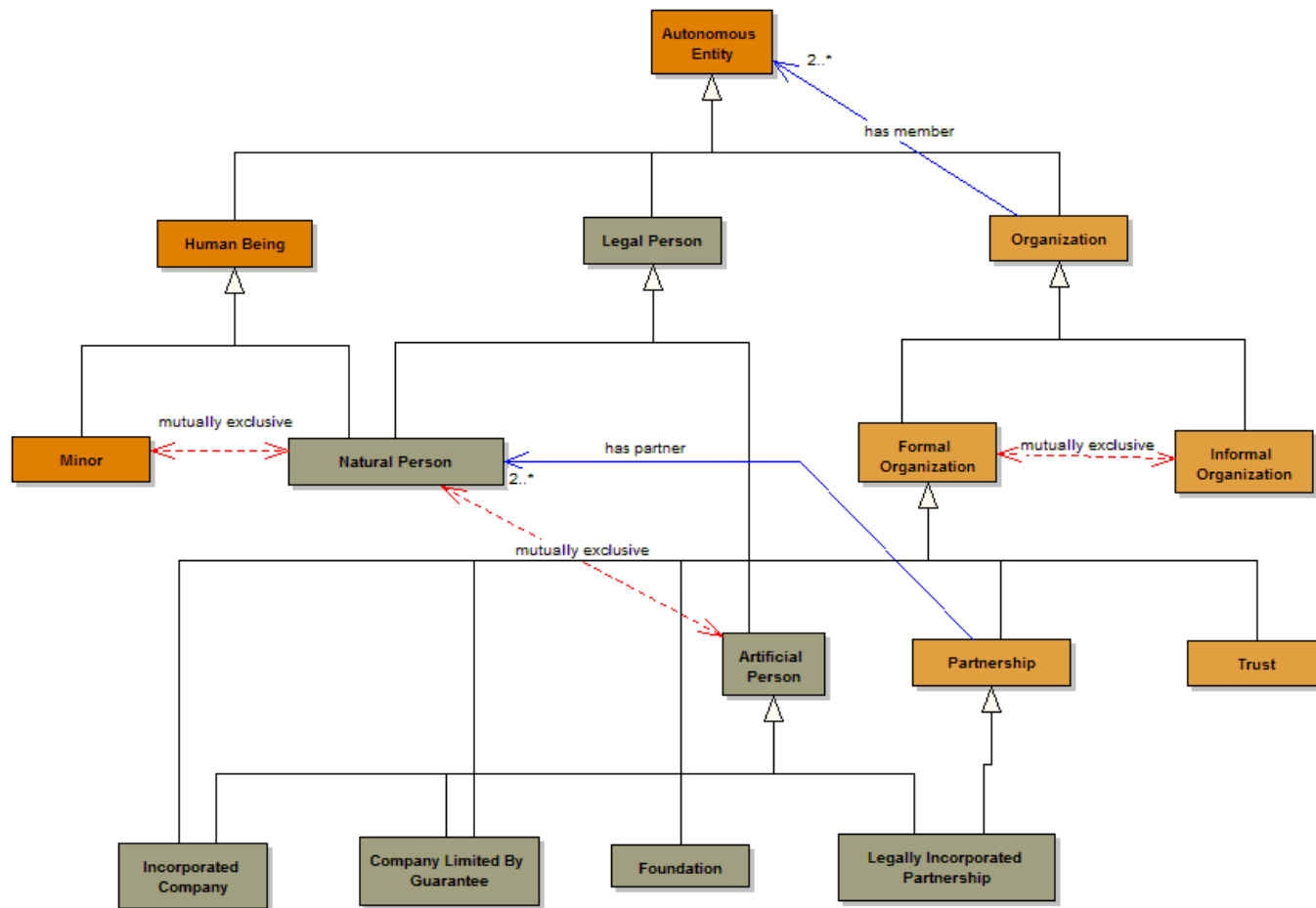
Formal Organization Fundamentals



A “Formal Organization” is distinguished from other (informal) organizations by having some formal covering agreement among the principals

Includes Trusts, Partnerships; also limited companies

Business Entities Taxonomy



Financial Industry Business Ontology (FIBO)

Requirement #1: Define Uniform and Expressive Financial Data Standards

ENTERPRISE DATA MANAGEMENT
EDM
COUNCIL



OWG
WE SET THE STANDARD™

Industry Standards

FpML

MISMO

FIX

ISO

MDDL

XBRL



Semantic Web

Financial Industry Business Ontology (FIBO)

Securities

Business Entities

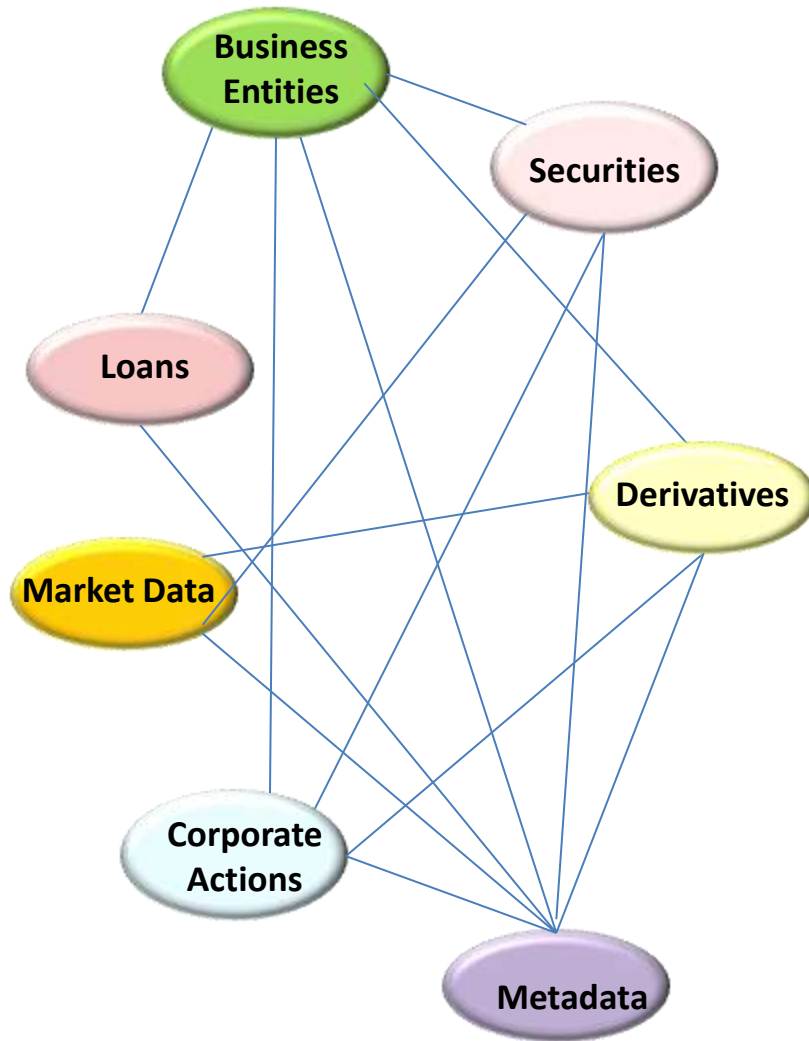
Derivatives

Metadata

Loans

Corporate Actions

Financial Industry Business Ontology (FIBO)



- **Business Entities**
 - Legal entities, ownership hierarchies, LEI,
- **Securities**
 - Tradable securities - equity, debt securities, reference data terms
- **Loans**
 - Retail lending, corporate, credit facilities
- **Derivatives**
 - Exchange traded and over the counter derivative trades, contracts and terms
- **Market Data**
 - Date and time dependent pricing, analytics
- **Corporate Actions**
 - Corporate event and action types, process
- **Annotation metadata**
 - Provenance. mapping, rulemaking

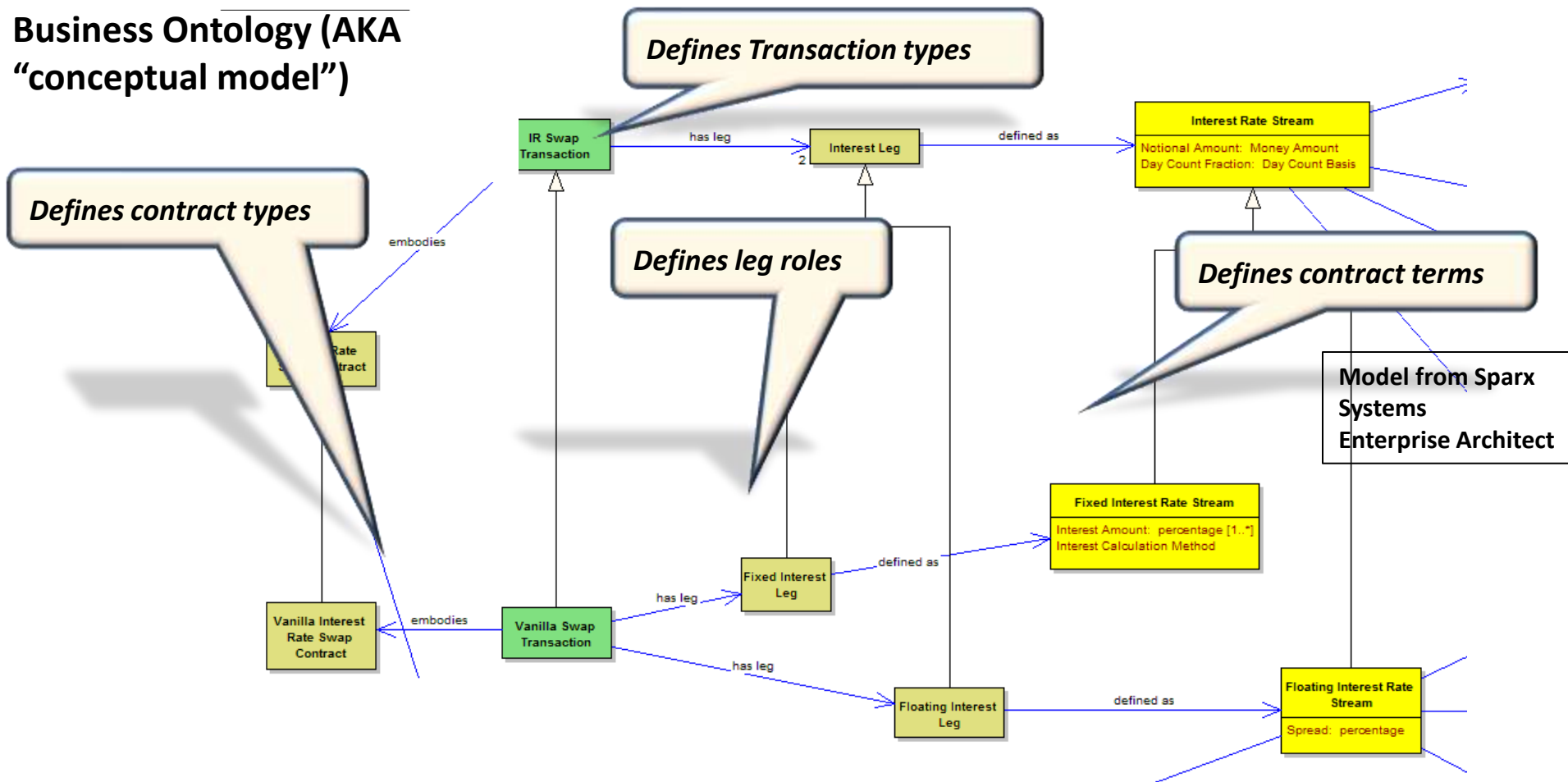
Some of the benefits of FIBO

- Open semantic standards for financial data that is exchangeable across financial institutions and regulatory authorities
- Provides data consistency and transparency
- Intended to support federal regulatory reporting rules
- Enables business validation and understanding
- Enables reuse and understanding of core industry data elements and concepts
- Reflects collaborative effort across institutions
- *Objective is to release modular ontologies that support business needs and priorities of the regulatory and financial community, e.g. Business Entities, IR Swaps*

Business Conceptual Ontologies

Requirement #1: Define Uniform and Expressive Financial Data Standards

Business Ontology (AKA
“conceptual model”)



Something.owl ≠ “an ontology”

Government Agencies Potentially Interested in FIBO per Dodd-Frank Requirements

The following regulatory agencies have expressed potential interest in semantic financial data standards via FIBO to enable greater data consistency, transparency and risk oversight to fulfill Dodd-Frank mandates



OFR



CFTC



SEC



FRB



OCC



ECB



Financial Institutions and Industry Organizations who have Expressed Interest in FIBO



STATE STREET



Northern Trust



Fidelity
INVESTMENTS



ISDA®

NIST



FIBO Business Conceptual and Operational Ontologies are Two Sides of the Same Coin

- **FIBO Business Ontologies**

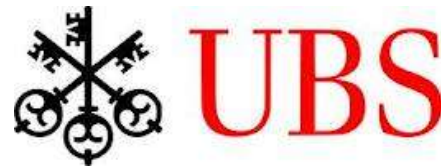
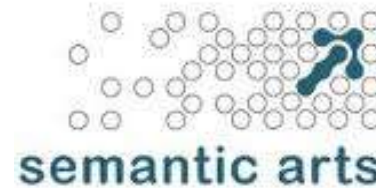
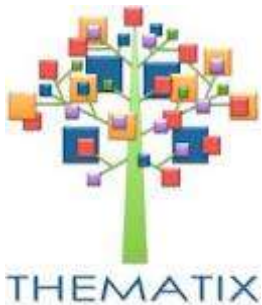
- Human facing
- Standard terms and definitions for business concepts
- Common reference for regulatory definitions, terms
- A resource for banks internally (integration, model driven development)



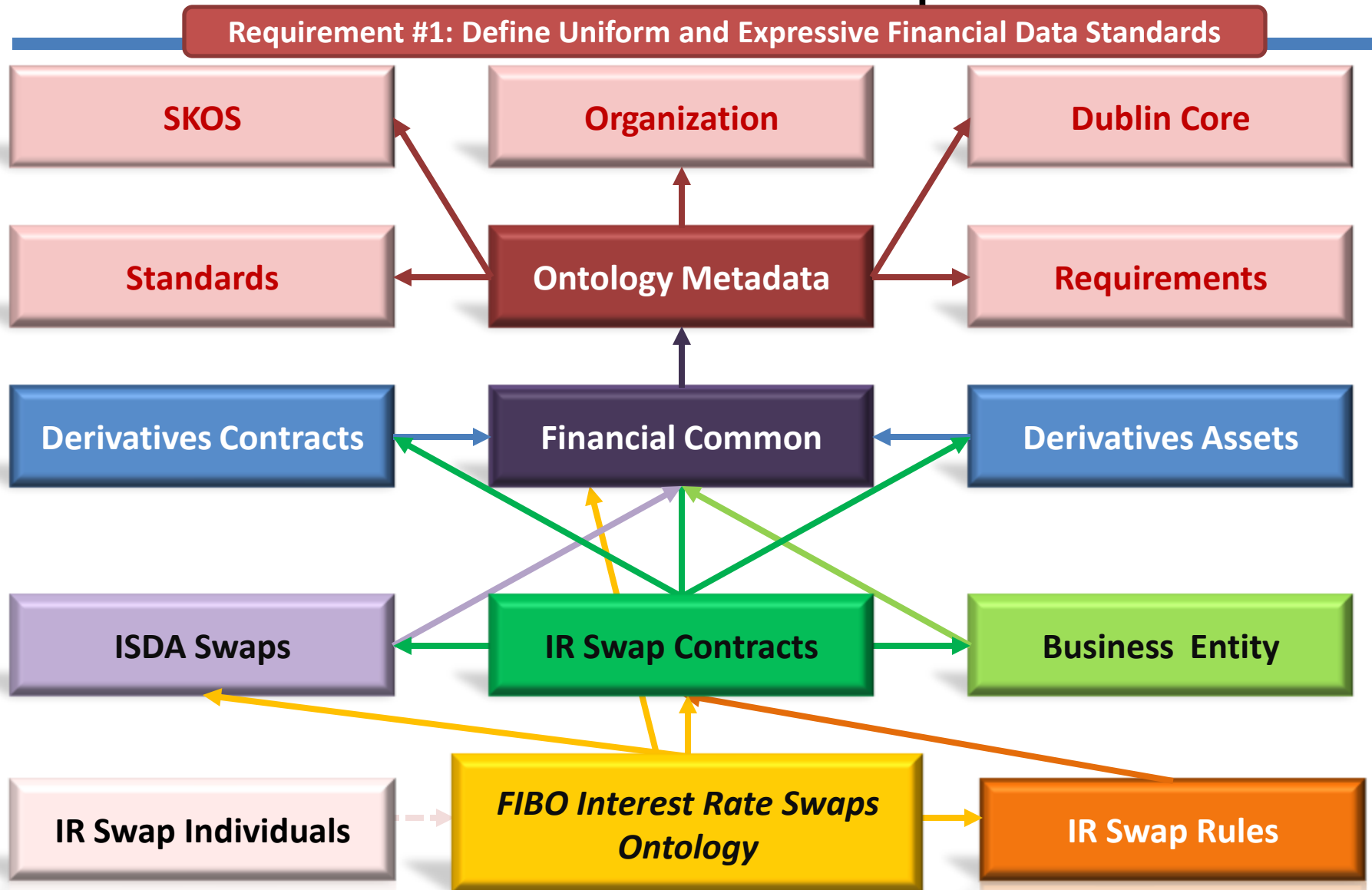
- **FIBO Operational Ontologies**

- Machine facing
- Derived from FIBO Business Ontologies
- Classification, inferencing, and semantic querying
- Deliver executable functionality to regulators and firms to enable data linkage, transparency and risk analytics

Contributors to FIBO OTC Derivatives Operational Ontologies



FIBO Modular Operational Ontologies for Interest Rate Swaps



Semantic Financial Metadata Annotations: *Setting the Standard for Standards*

Requirement #1: Define Uniform and Expressive Financial Data Standards

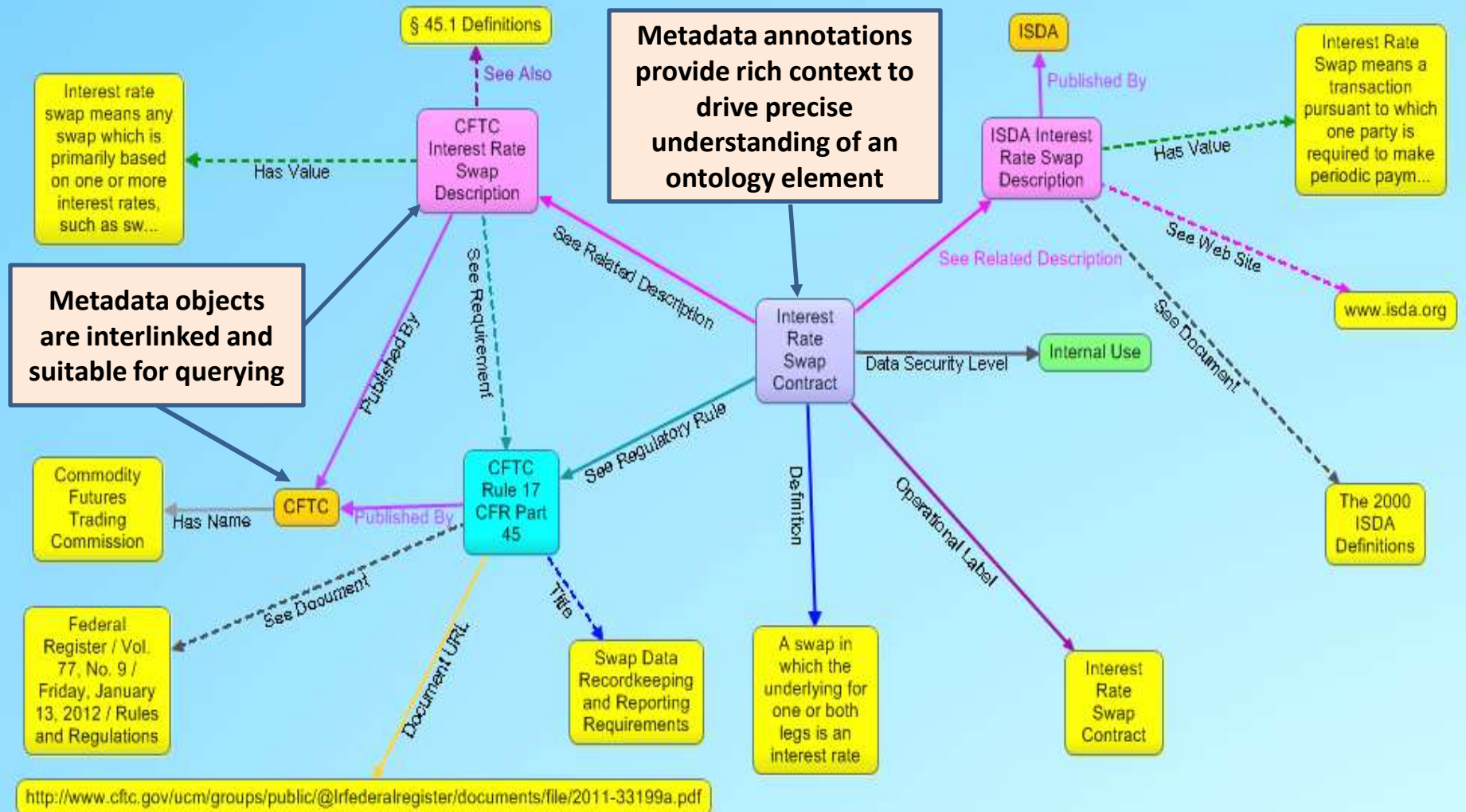
- ✓ In conventional data schemas limited explanatory information or metadata is available, resulting in:
 - the need to access independent metadata tools
 - confusion and data rationalization problems, which incurs errors, delays and cost
- ✓ Semantic metadata is directly *linked* to the elements in the ontology, including specific facts
 - One-stop integrated locus for related knowledge
- ✓ Metadata annotations provides:
 - Data Provenance, source and reference information
 - Cross-reference to data elements in related financial data standards, regulatory rules, business requirements and specifications e.g. FpML, CFTC rules, etc
- ✓ Metadata can be accessed as Linked Open Data



Linked Open Data

Semantic Metadata for Interest Rate Swap Contract

Requirement #1: Define Uniform and Expressive Financial Data Standards



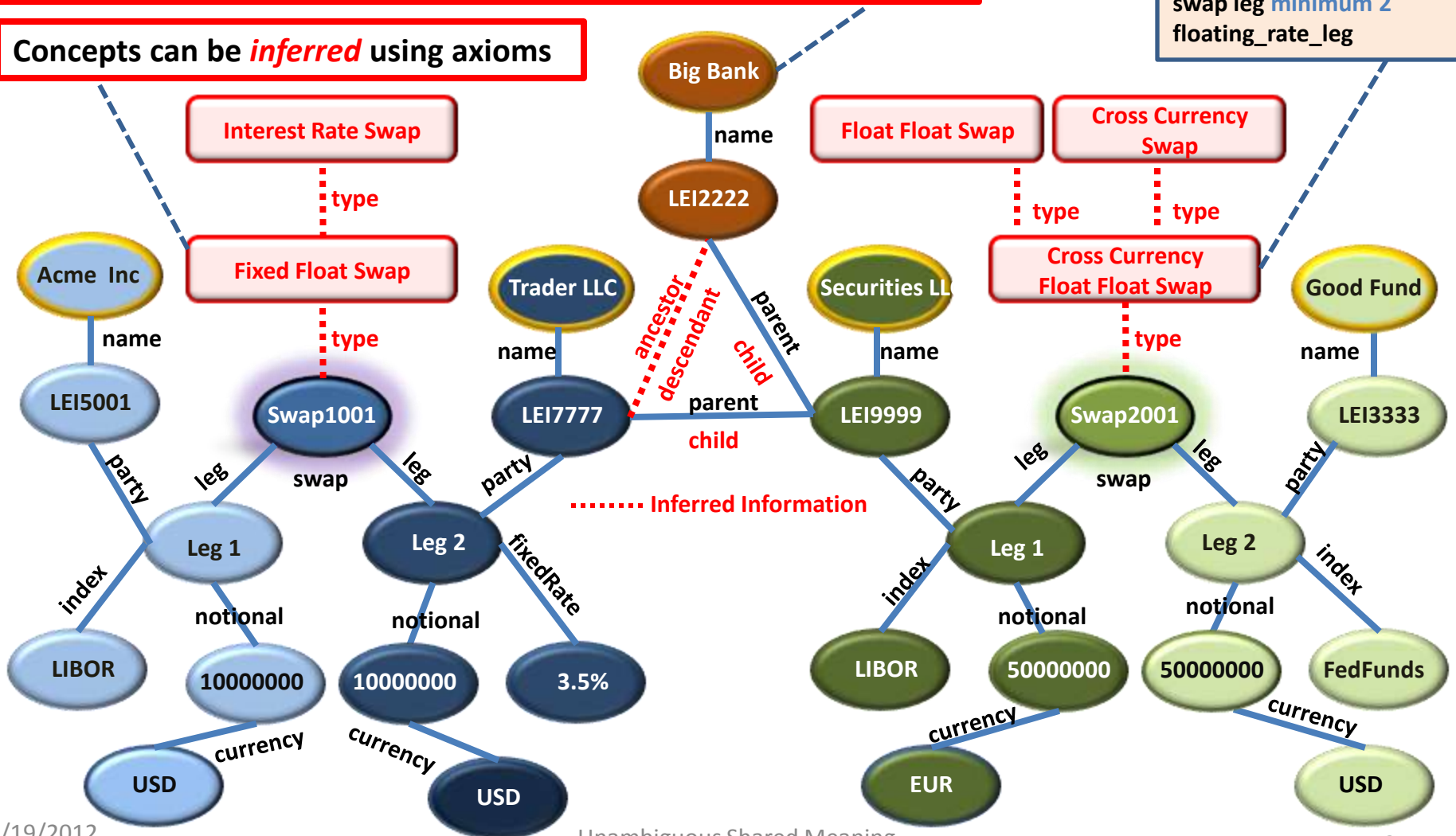
Semantic Reasoning Classifies and Links Data into a Networked Graph Pattern for Powerful Access

Requirement #2: Classify Financial Instruments into Asset Classes

Data in semantic graphs can be traversed, classified and aggregated

Concepts can be *inferred* using axioms

Float-Float Swap (Axiom)
swap leg **minimum 2**
floating_rate_leg

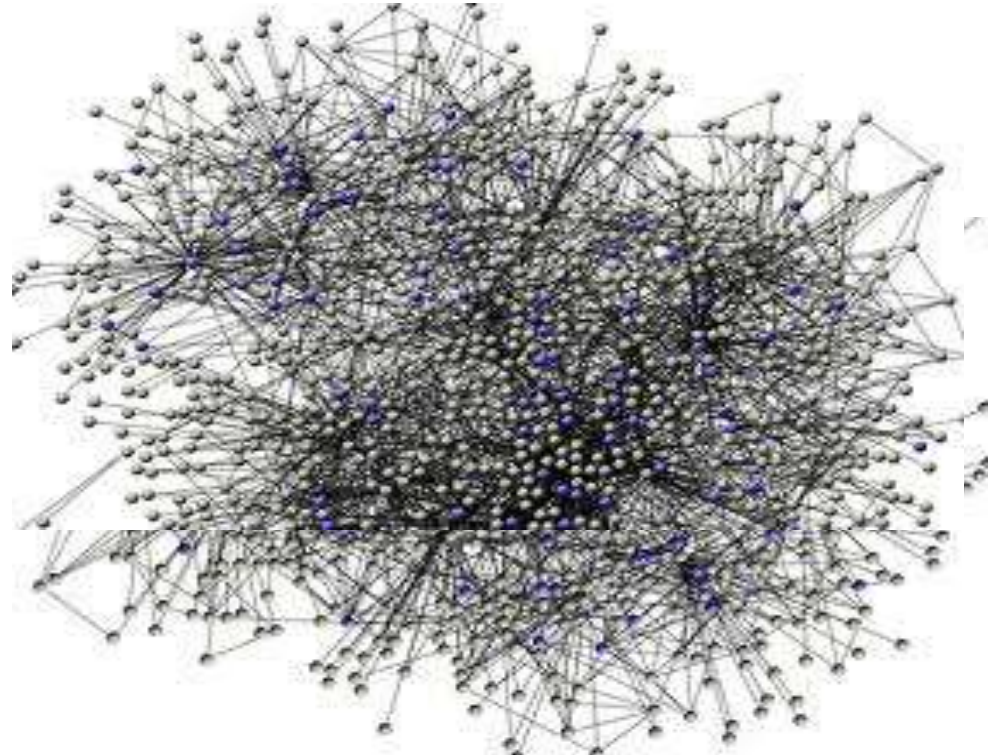


Semantically Defined Network Graph Structures Provide a Framework for Systemic Risk Analytics

Requirement #3: Link Disparate Information for Risk Analysis

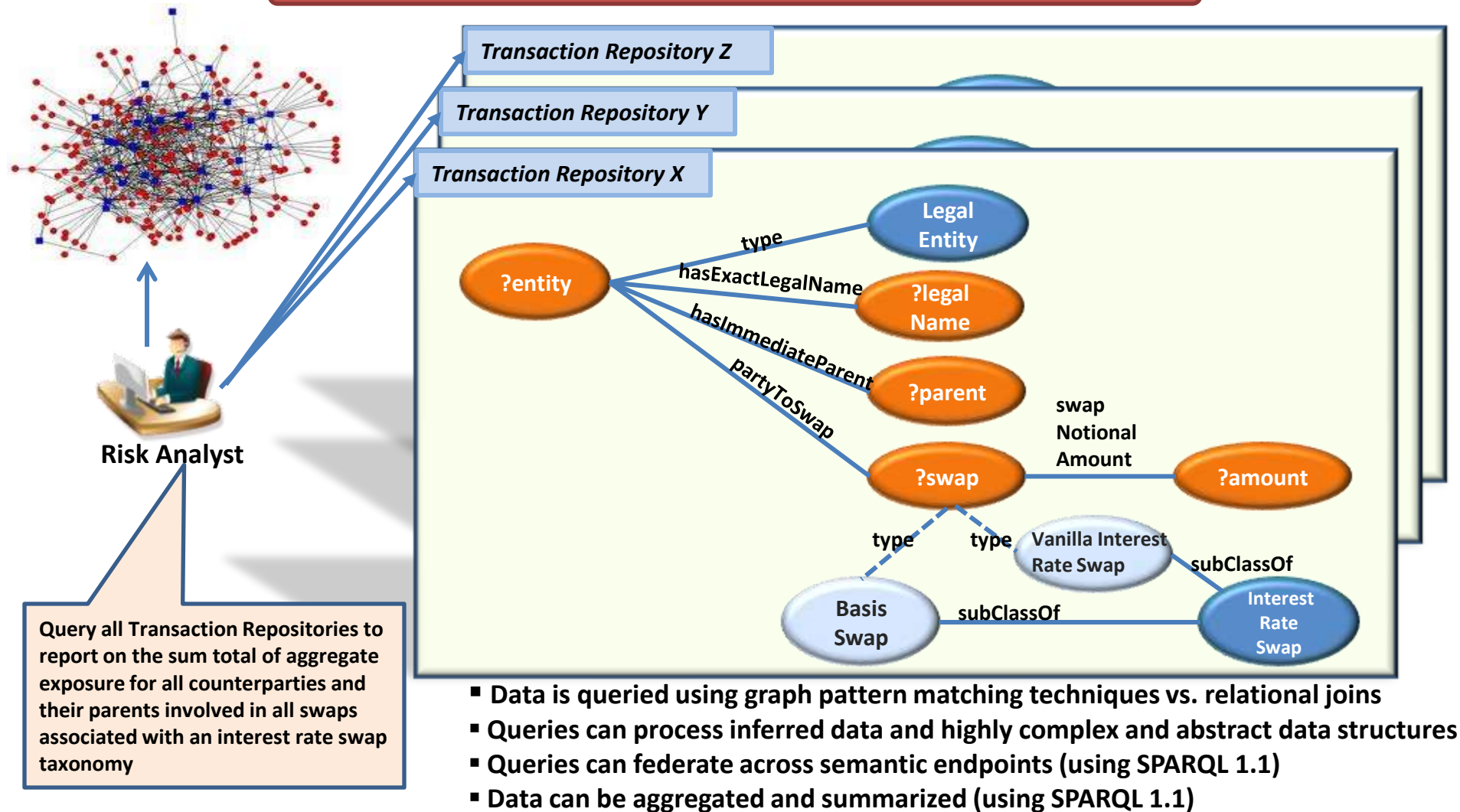
Conventional database technologies have limited ability to represent the complex entities and inter-relationships that span financial networks and that are necessary to traverse in order to perform highly effective risk analysis and simulations

- ✓ Network models based upon semantic financial data standards are flexible and easy to change
- ✓ Semantic network graphs can interconnect ownership entities, transactions, contracts, market data
- ✓ Reflect *transitive exposures* across counterparties, sovereigns
- ✓ Provide diverse aggregations that can rollup from atomic transactions to high level classifications for powerful analytics



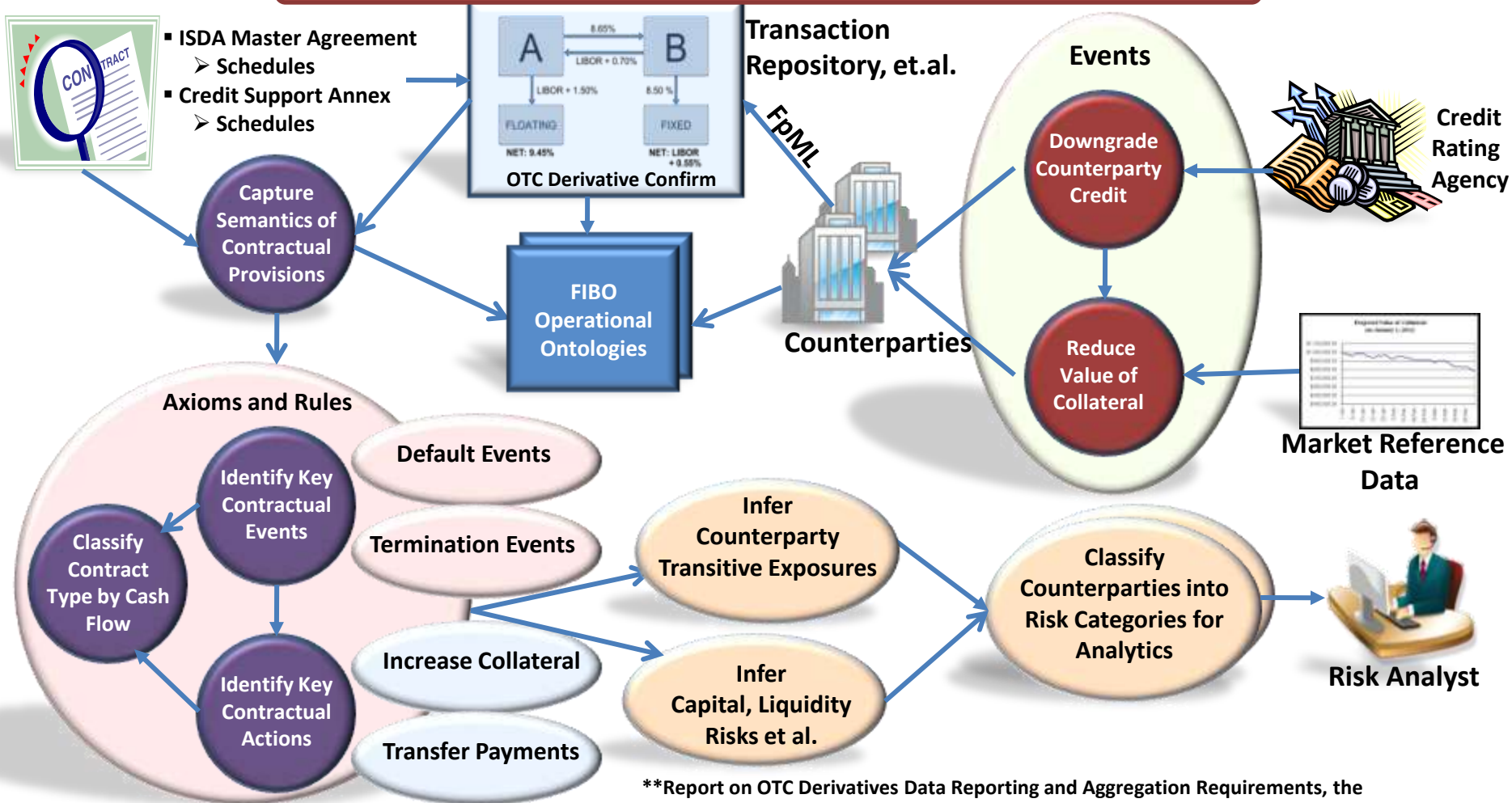
Semantics can Identify Positions of Legal Entities and Their Hierarchies Across Trades and Asset Classes

Requirement #3: Link Disparate Information for Risk Analysis



Semantics can Represent Contractual Provisions of Swap Agreements for Risk Analytics

Requirement #4: Electronically Express Contractual Provisions



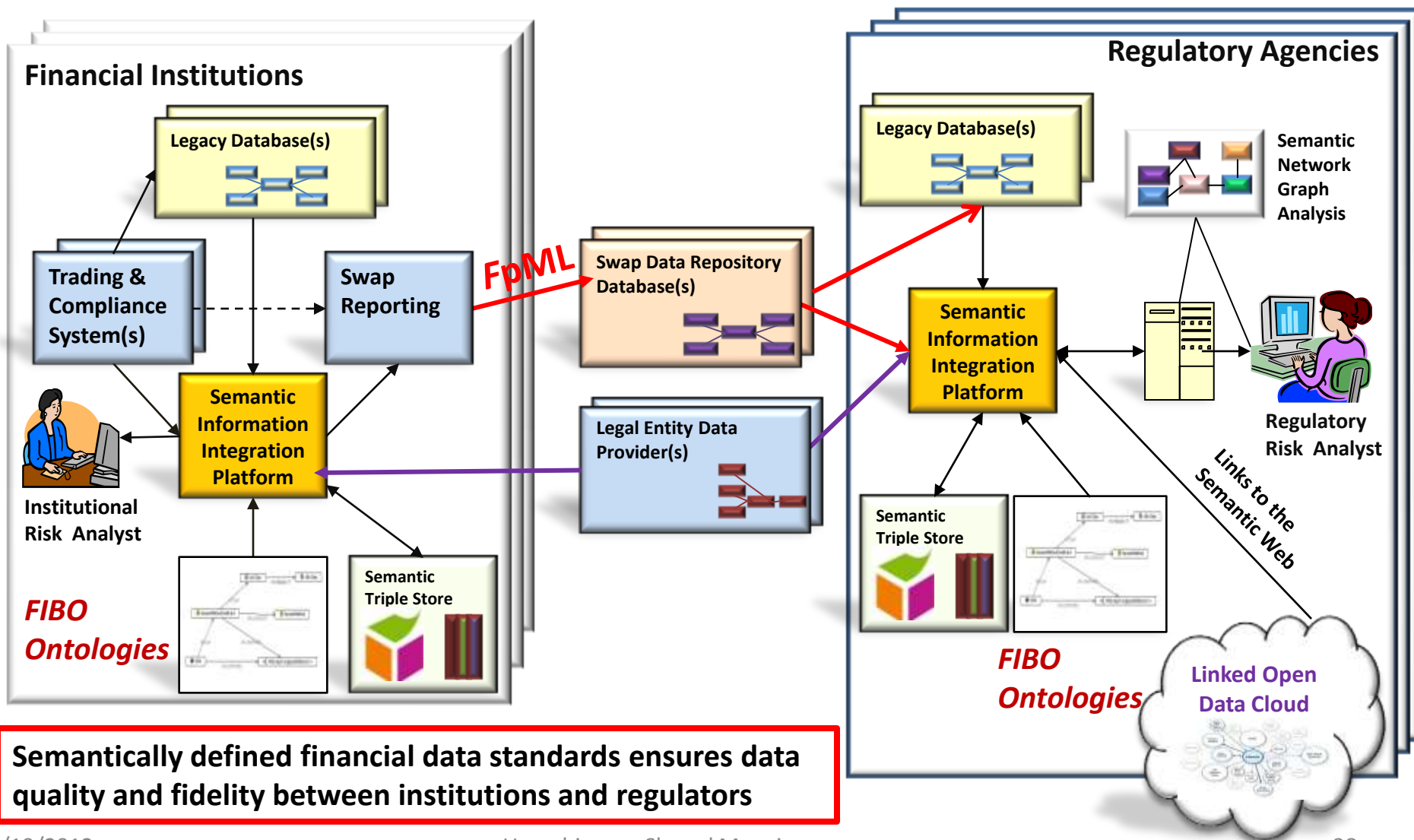
* W. Brammertz, "Unified Financial Analysis: The Missing Links of Finance", 2009

**Report on OTC Derivatives Data Reporting and Aggregation Requirements, the International Organization of Securities Commissioners (IOSCO), August 2011

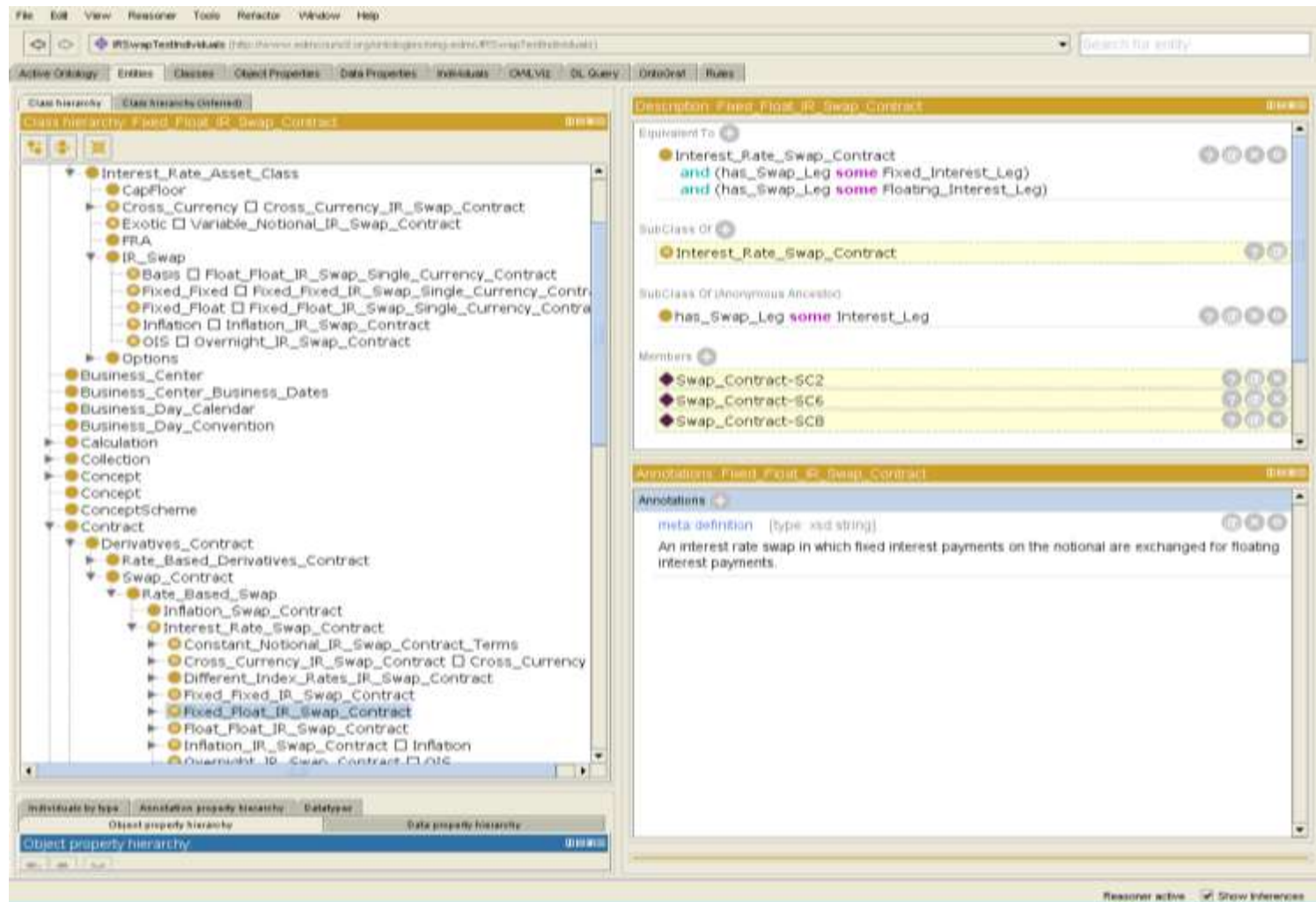
***Joint Study on the Feasibility of Mandating Algorithmic Descriptions for Derivatives, SEC/CFTC, April 2011

Unambiguous Shared Meaning

Proposed FIBO Architecture for Institutional and Macroprudential Oversight



FIBO OTC Derivatives Operational Ontology *Demonstration*



* Protégé Ontology Editor courtesy of Stanford University