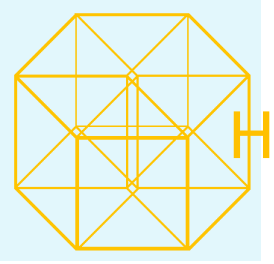


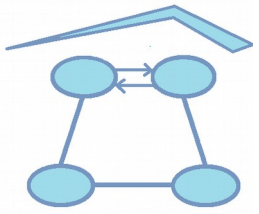
Hypercube Ltd.

Standards for Knowledge Graphs in the Financial Sector

Mike Bennett, Hypercube Ltd.

Ontology Summit 2020

13 May 2020



The Semantic Shed

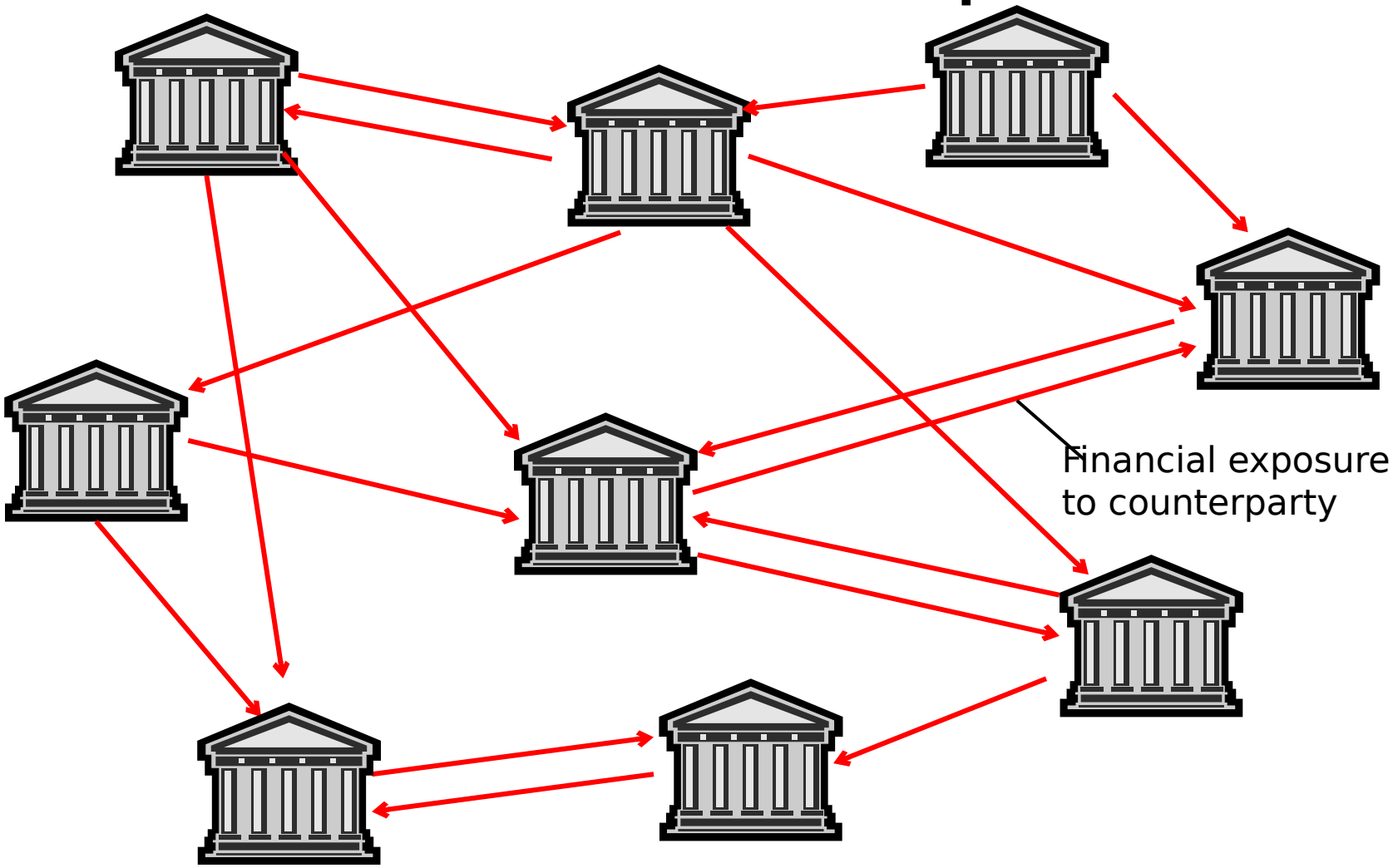
Understanding Business Meaning

Overview

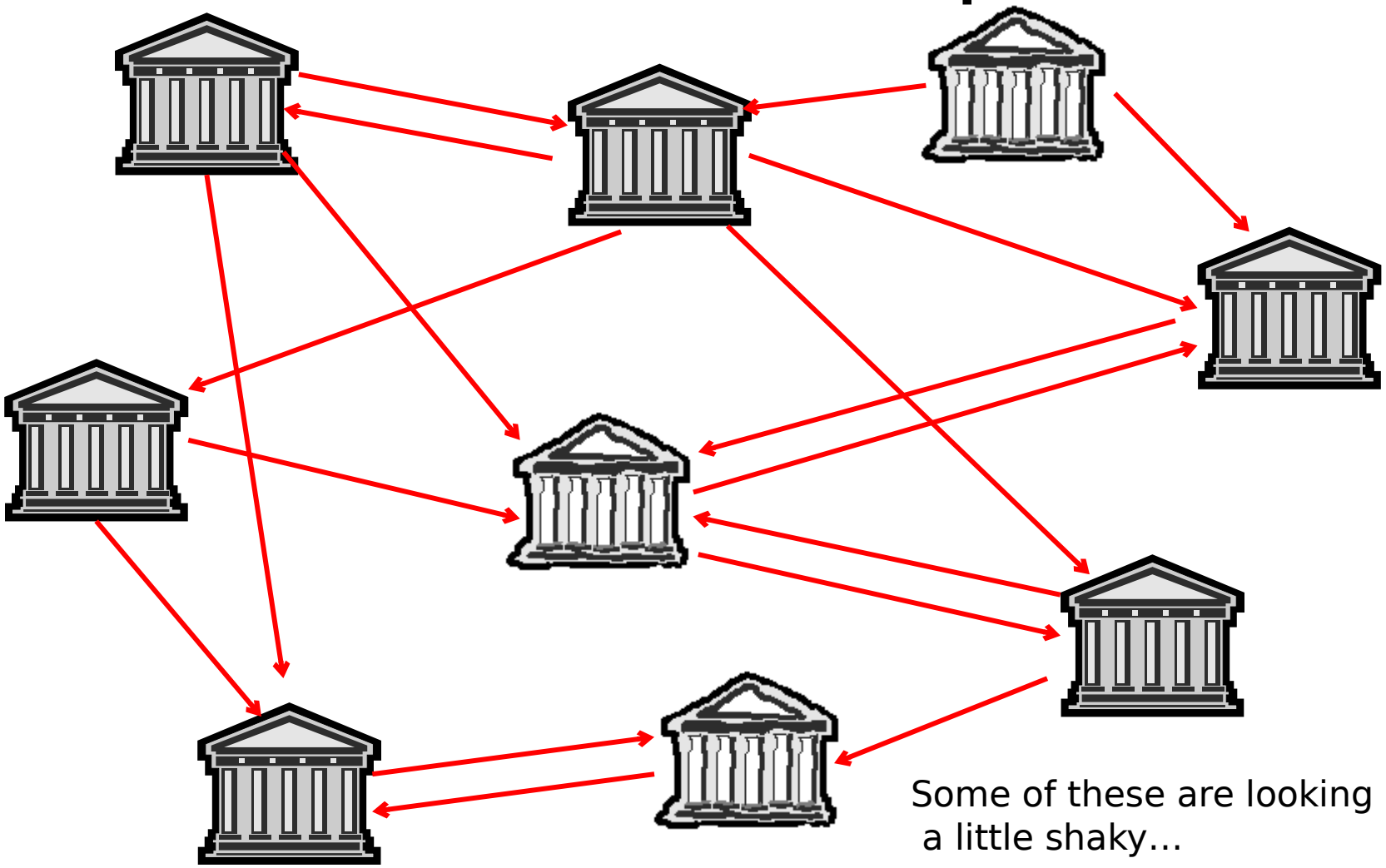
- Finance Industry Motivations
- Industry Use Cases
- FIBO
- Styles of ontology
- ISO 20022
- Ontology Standards Usage
- Summary and Conclusions

Finance Industry Motivations

Network of Financial Exposures

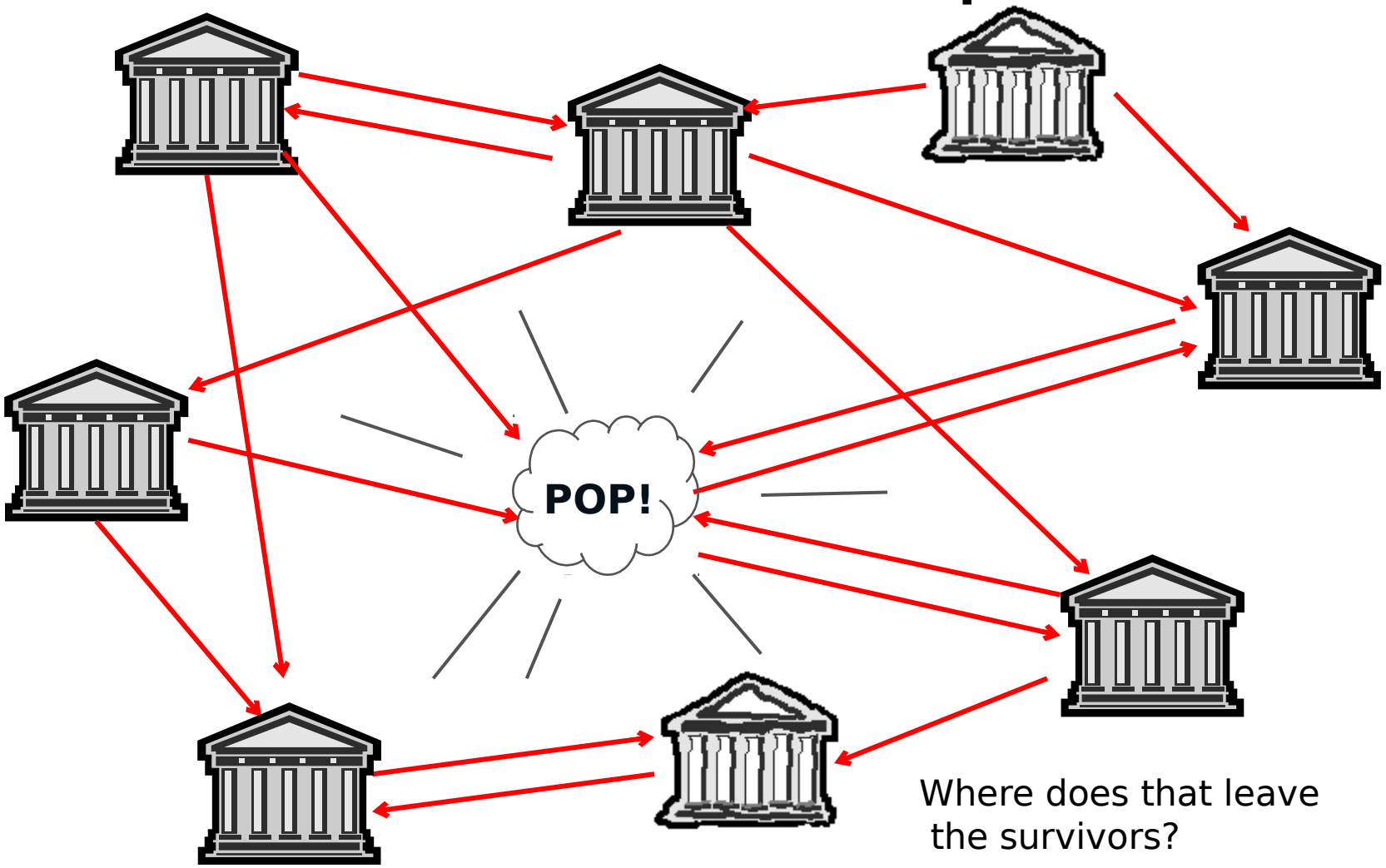


Network of Financial Exposures



Some of these are looking a little shaky…

Network of Financial Exposures



Where does that leave the survivors?

Systemic Risk: What Happened?

- Firms took a long time to establish their exposures to endangered banks
- Data wasn’t the problem
- Knowledge was

FIBO

STANDARDS-BASED INFRASTRUCTURE

Legal Entity Identifier

Bloomberg OPEN SYMBOLOGY

LEI GLOBAL LEGAL ENTITY IDENTIFIER FOUNDATION

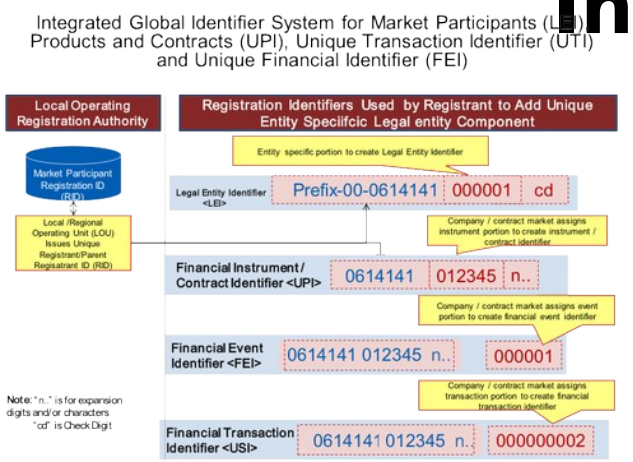
Loan Attended Routing ID

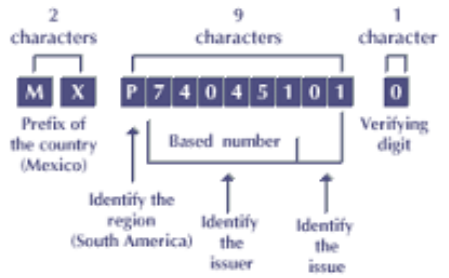
Institution	PSUNV	PeopleSoft University
Aid Year	2012	Financial Aid Year 2011 - 2012
Reporting School Routing ID	36363636	UNIVERSITY OF CALIFORNIA-RIVER

*Attended School Routing ID	
36363636	UNIVERSITY OF CALIFORNIA-RIVER
47474747	UNIVERSITY OF CALIFORNIA-SAN D
59595959	UNIVERSITY OF CALIFORNIA-SFRAN

CUSIP GLOBAL SERVICES

Pathway to all Objectives Starts with Implementation of the Standar[illegible] Infrastructure

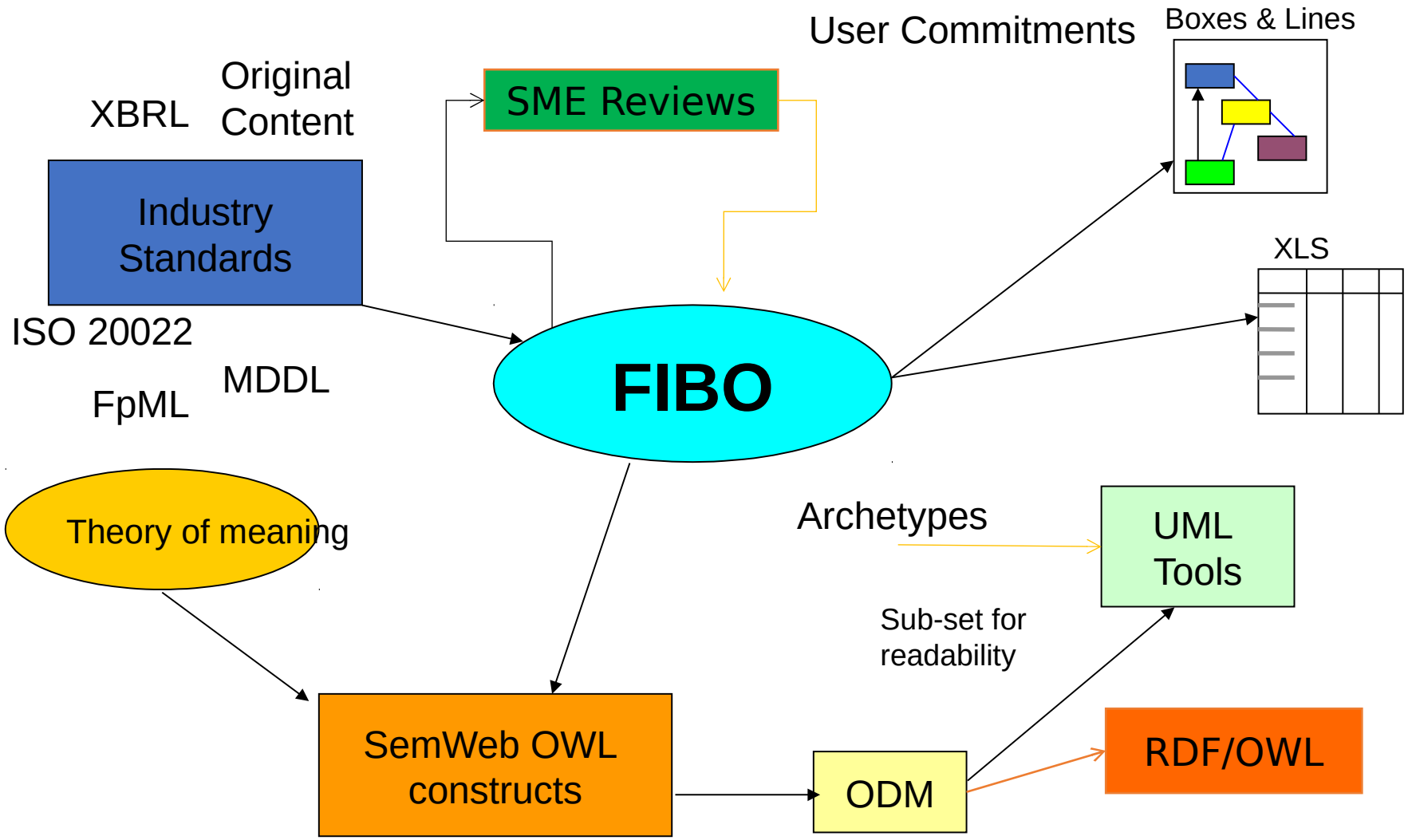




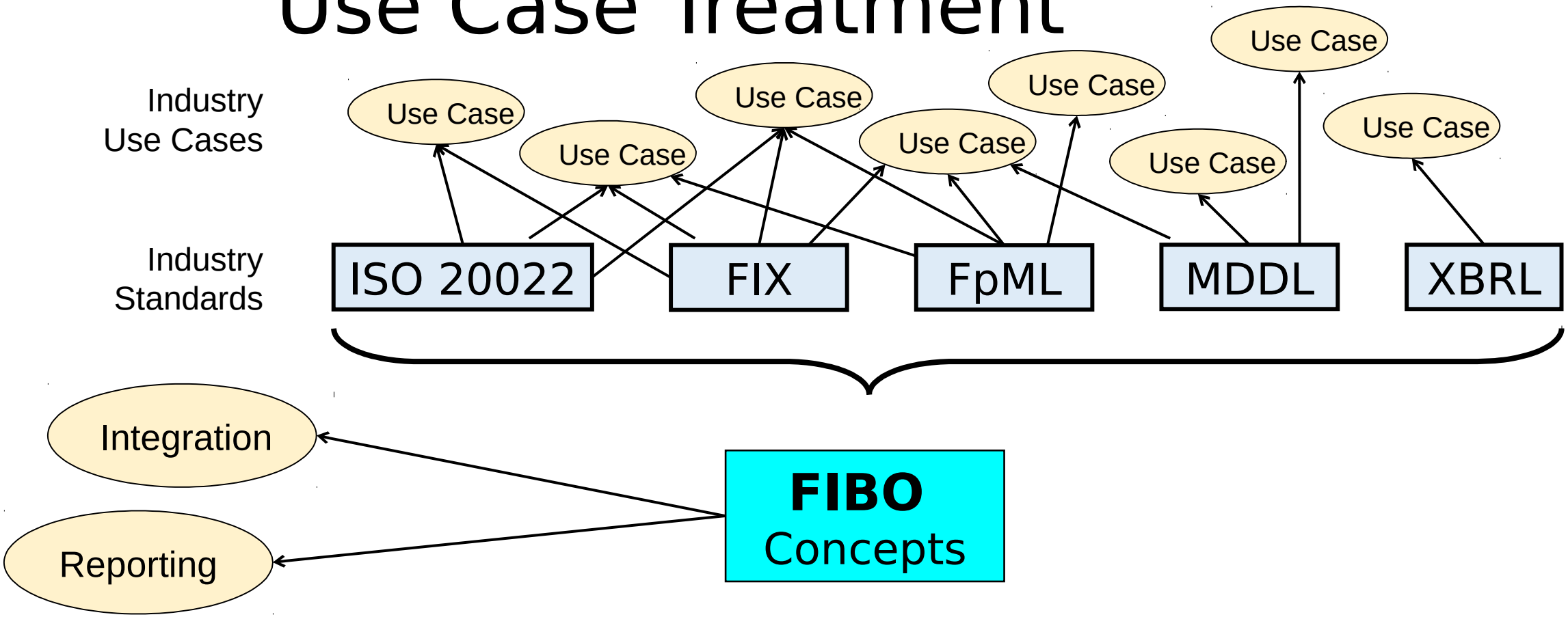
FIBO

Financial Industry Business Ontology

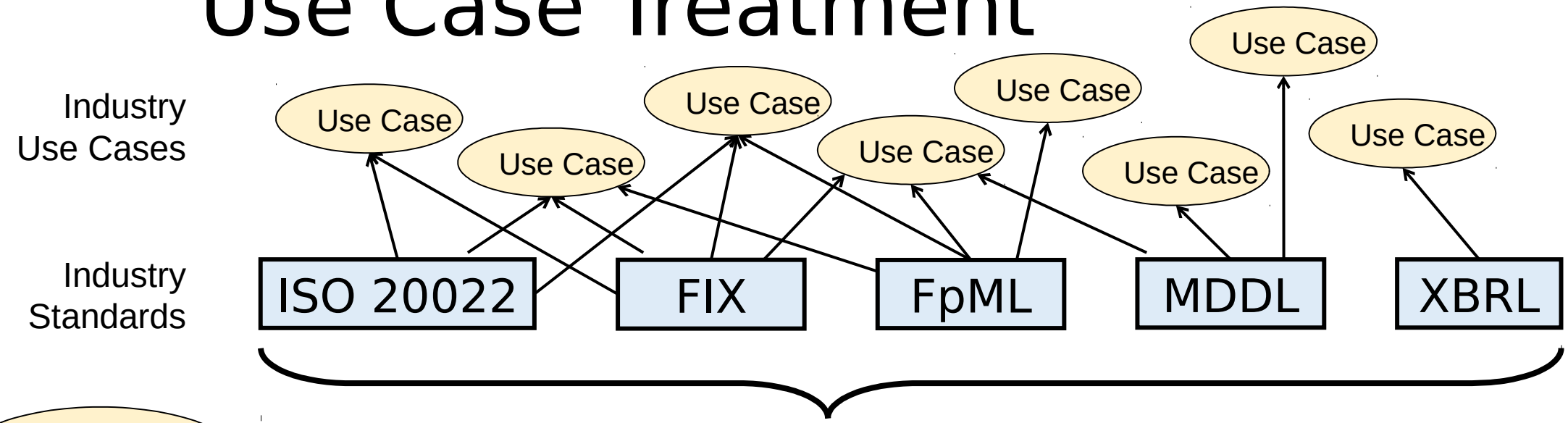
FIBO Early Development

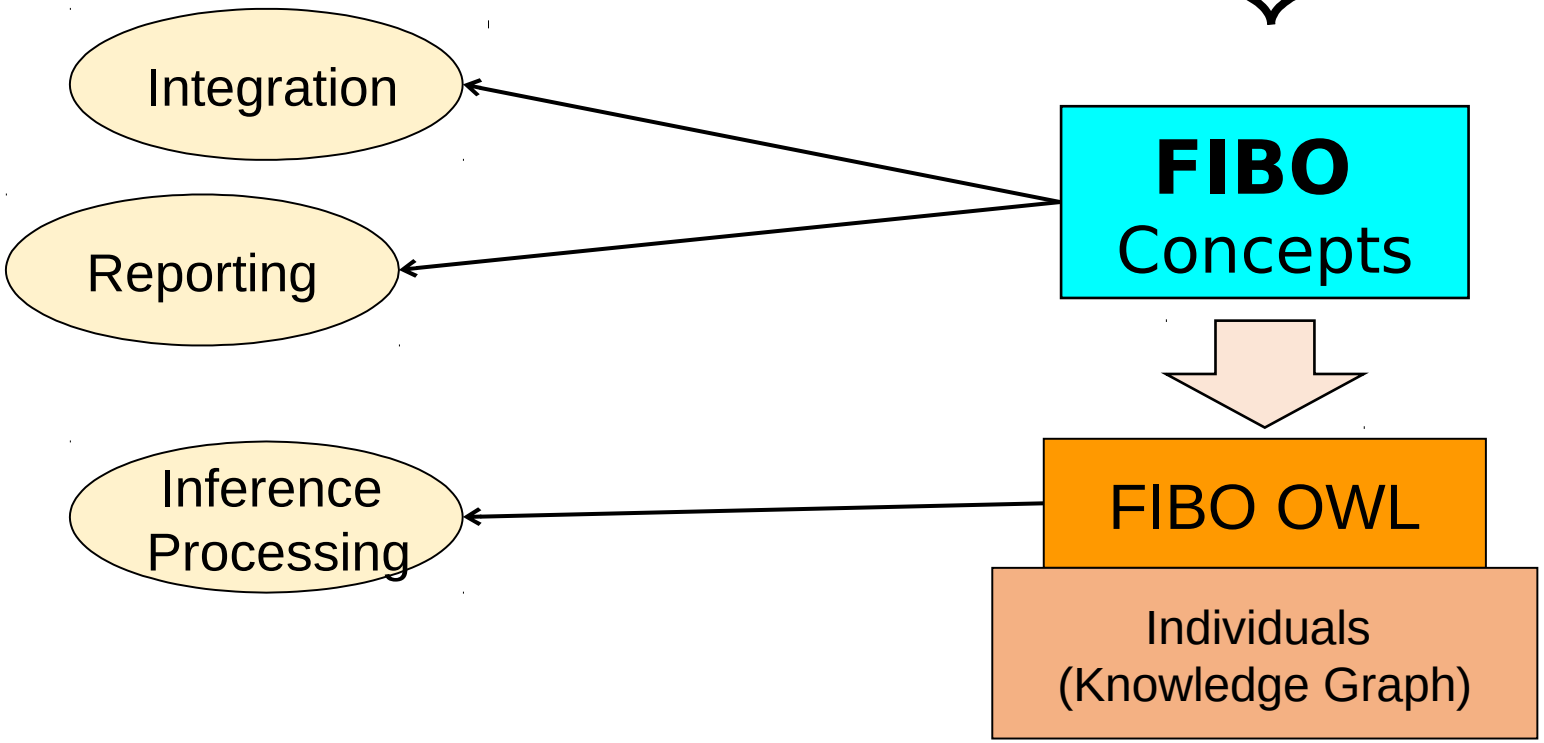


Use Case Treatment

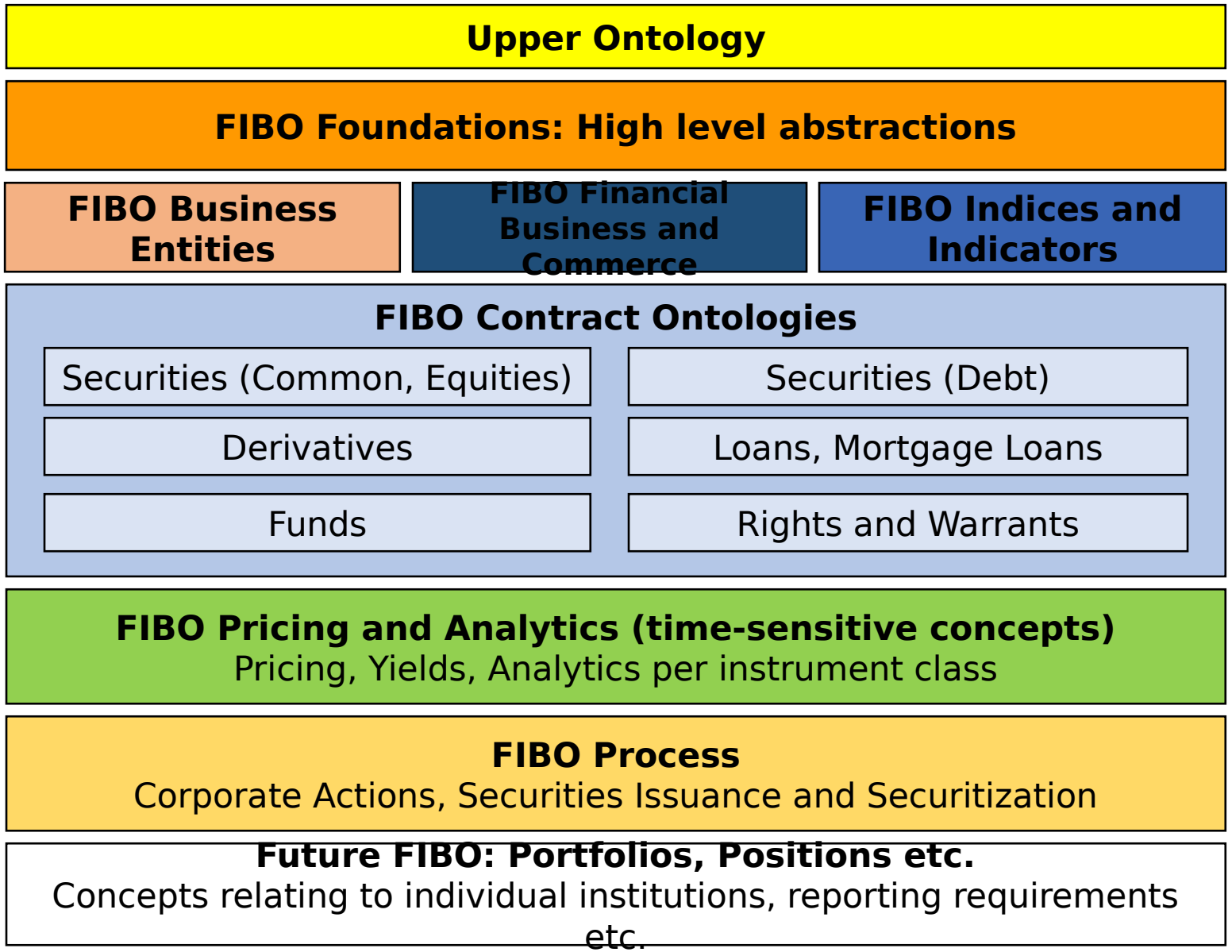


Use Case Treatment





FIBO: Scope and Content



FIBO Ecosystem

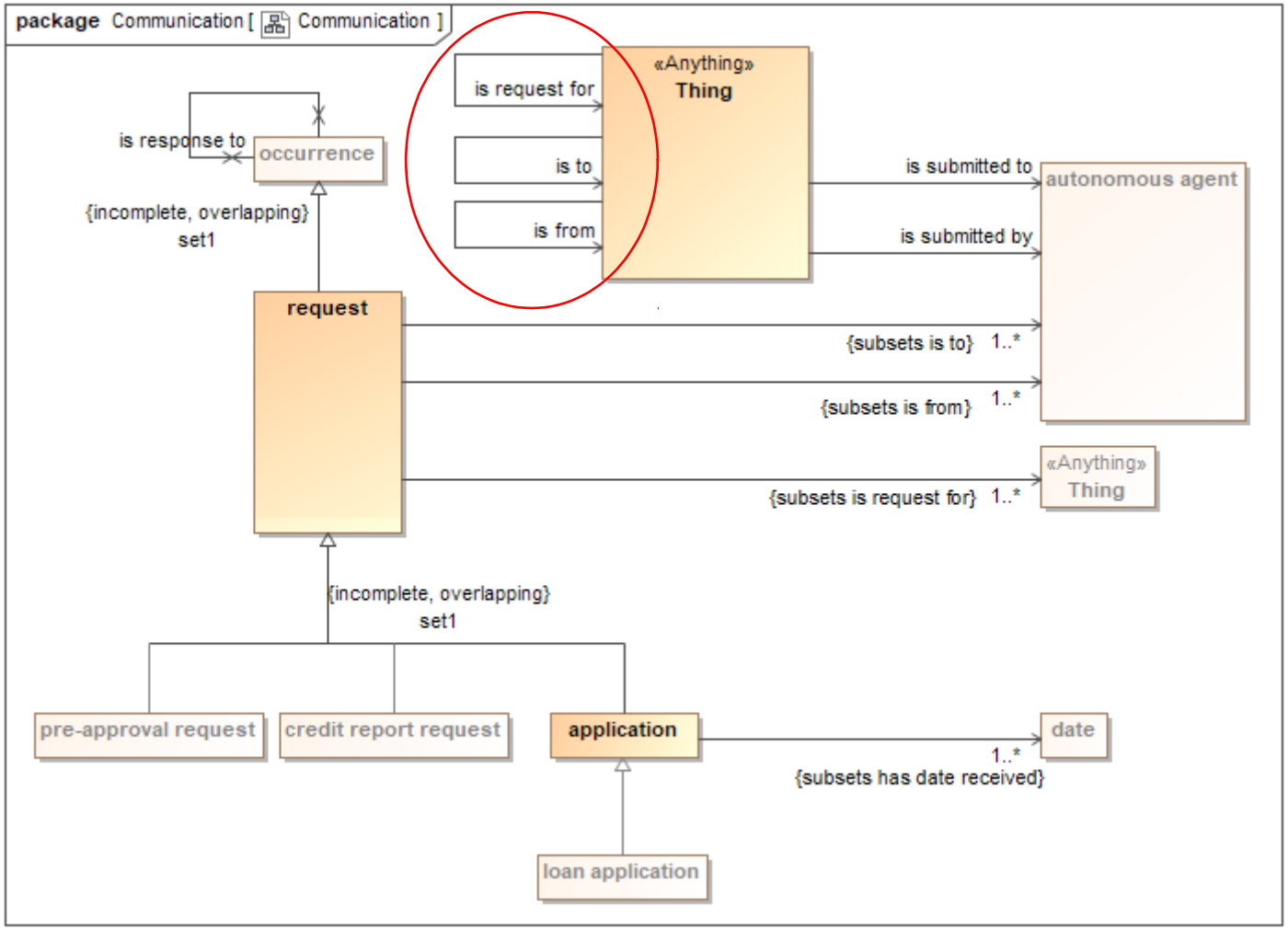
- **Industry Collaboration** (Ecosystem)
  - GitHub for collaborative coding
  - JIRA for issue management
  - Jenkins for automated testing
  - Confluence (wiki) for audit trail

State-of-the-Art

- **BTDM Methodology** (Tested)
  - Built Test Deploy Maintain methodology for governance
  - Full end-to-end ontology (visible and navigable)
  - Fully extendable for proprietary applications
  - Expressed in both OWL and UML (auto-generated)
  - Automated testing of machine executable FIBO

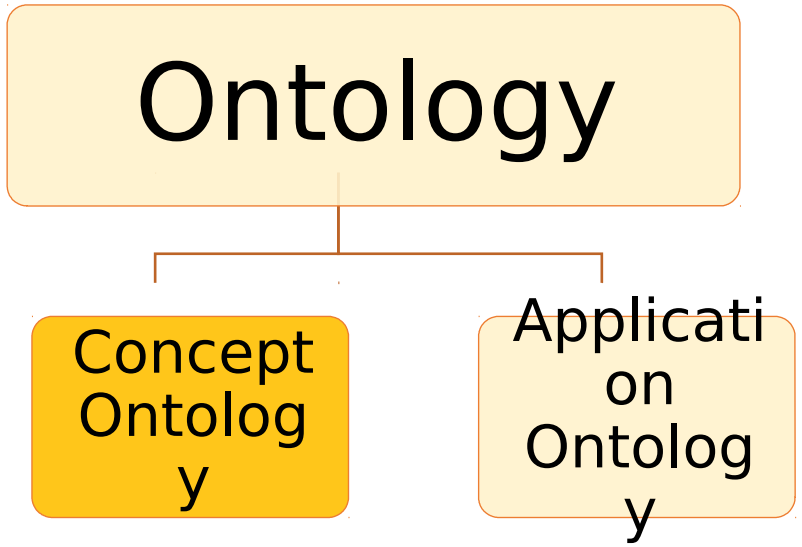
Documented and Tested

Properties with No Domain or Range

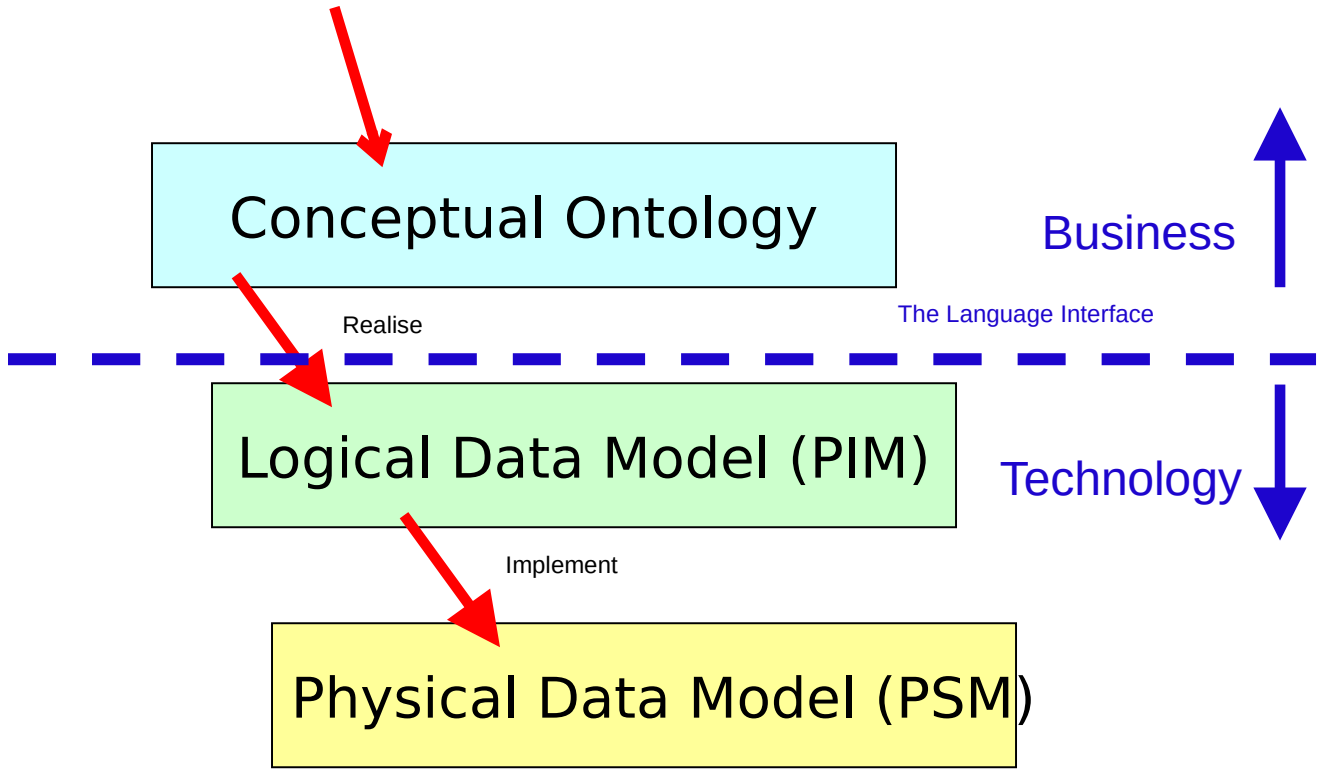


Styles of ontology

Concept Ontology

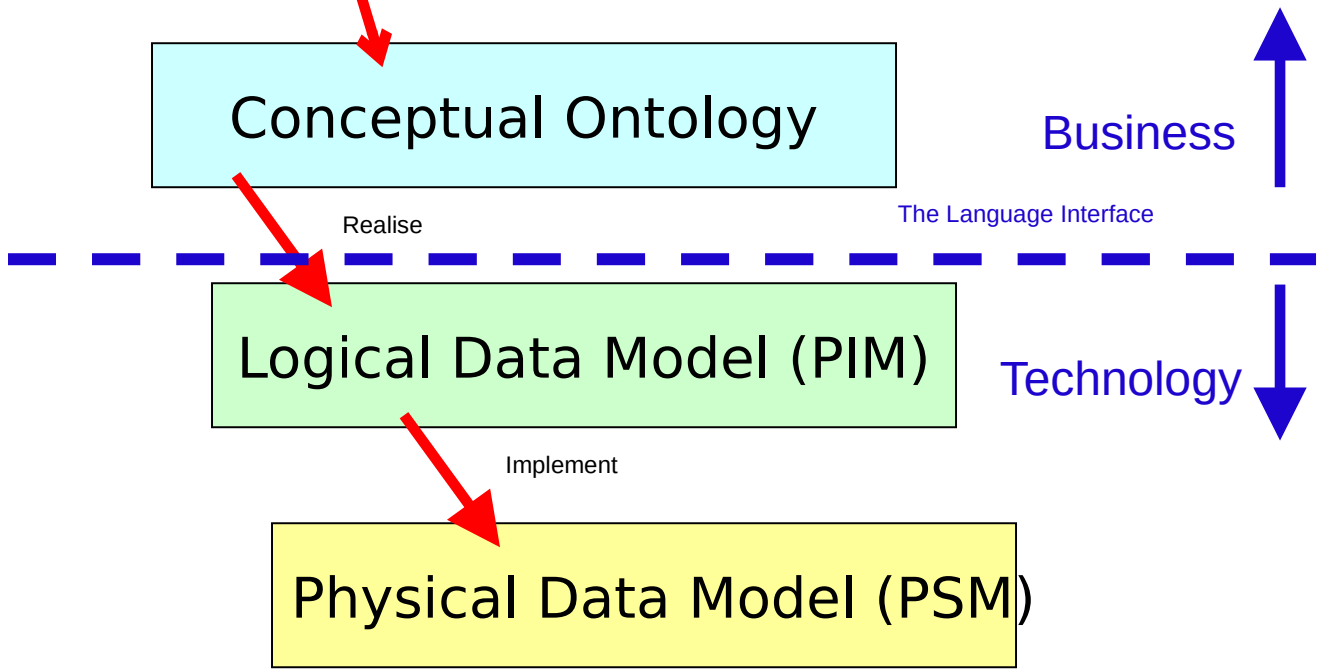


This is not a more abstract model of the solution...

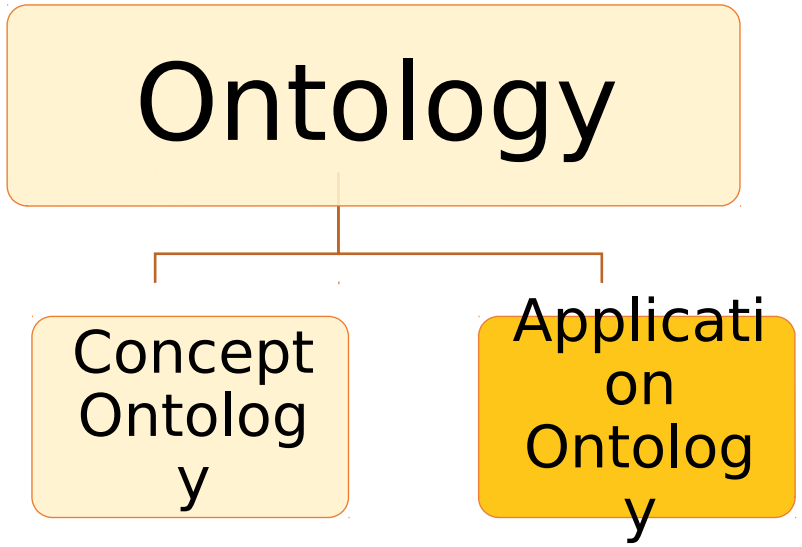


This is not a more abstract model of the solution...

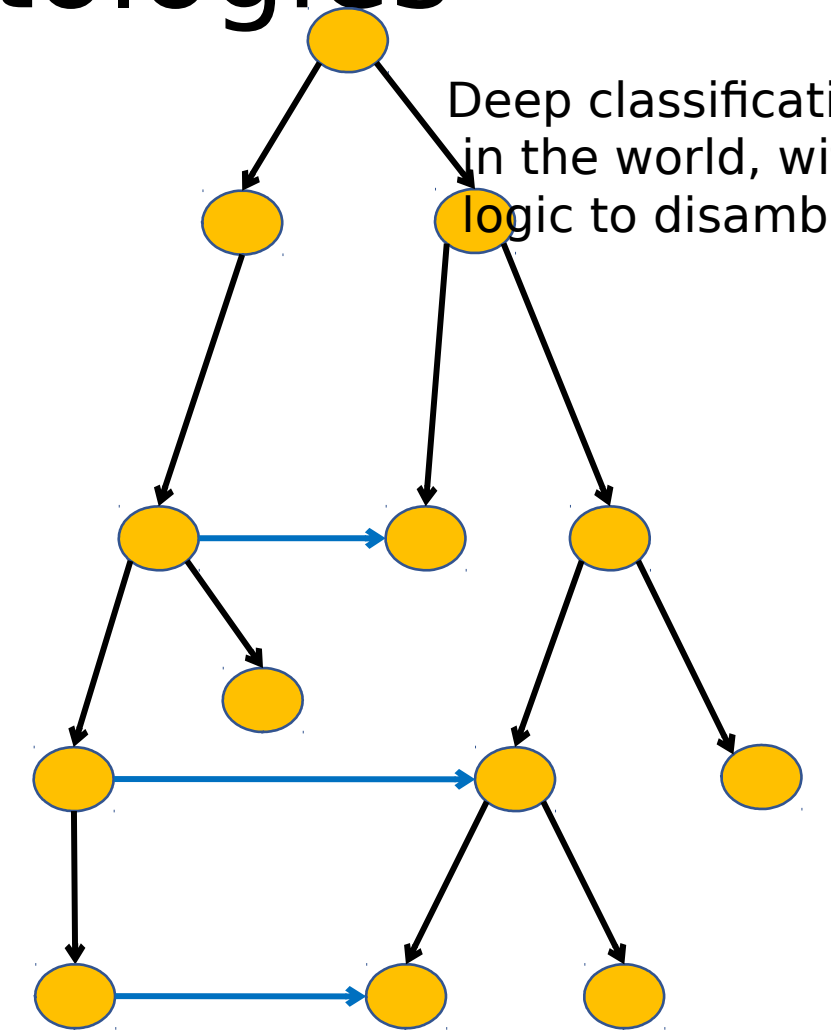
It's a concrete model of the problem!



Application Ontology

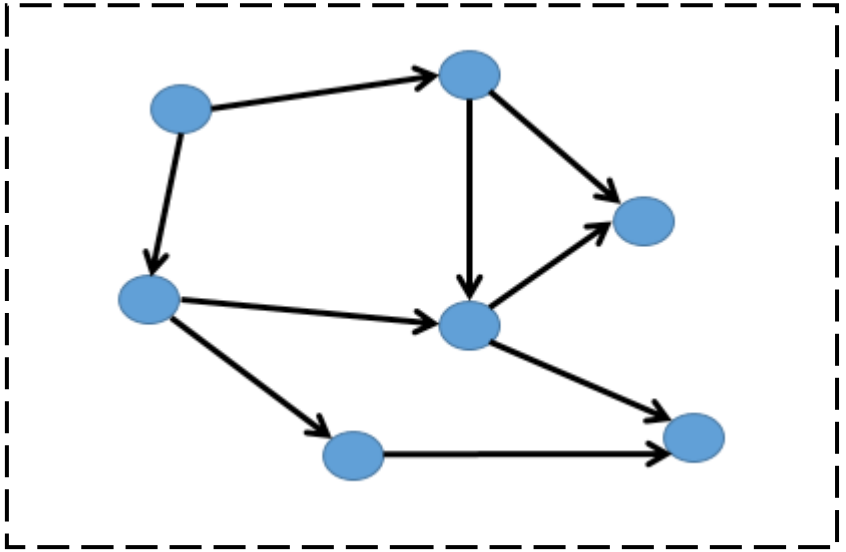


Foundational v Correspondence Ontologies

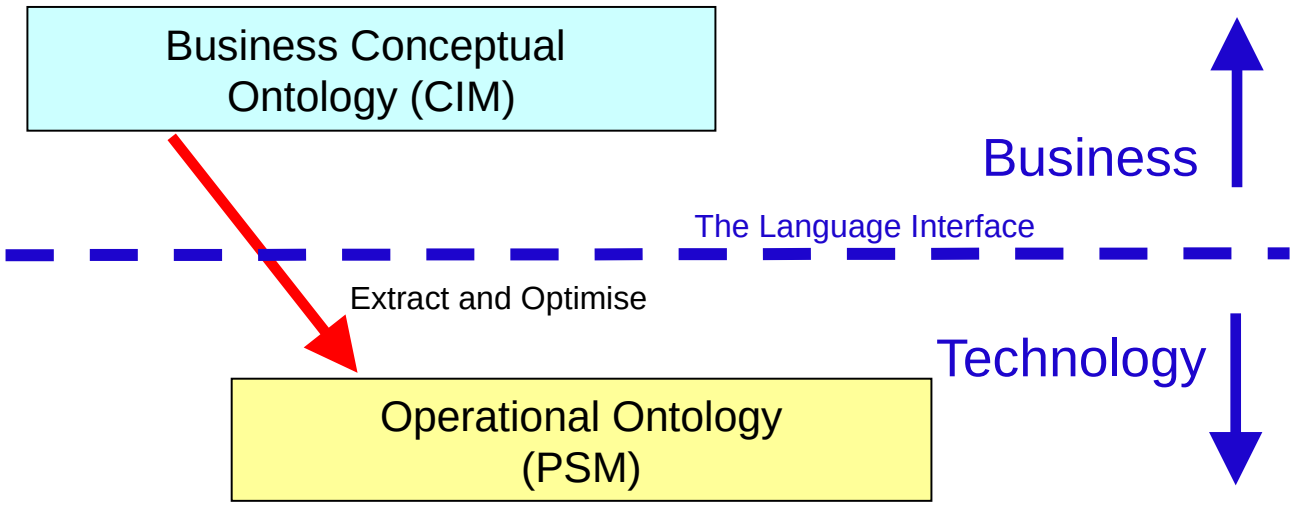


Deep classification hierarchy of types of thing in the world, with relationships and sufficient logic to disambiguate

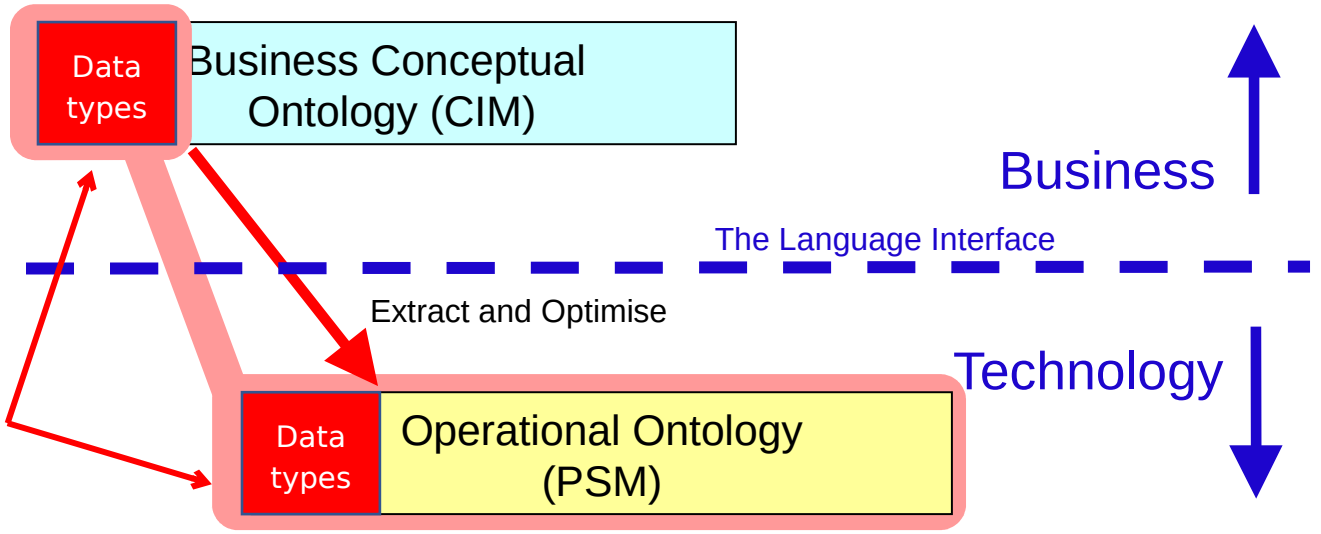
Self-contained classes, properties and logical statements corresponding to some set of things in the world



Conceptual and Operational Ontology



Conceptual and Operational Ontology



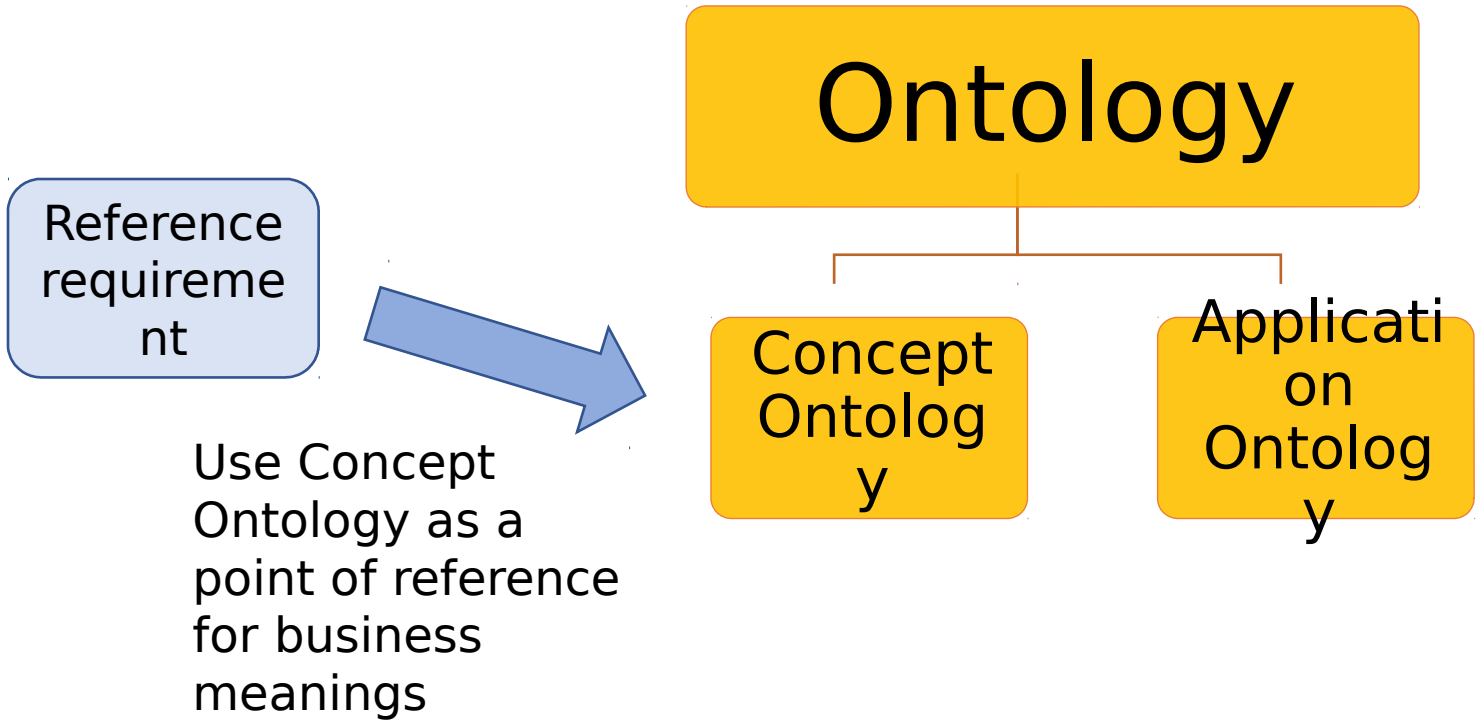
- OWL is an application language!
- OWL plus data (Knowledge Graph) is a physical artifact
- There are real things, the definitions of which are not based on data
  - There are also (some) real things that *are* natively data (e.g. Identifiers)

Data Surrogates versus Real Things

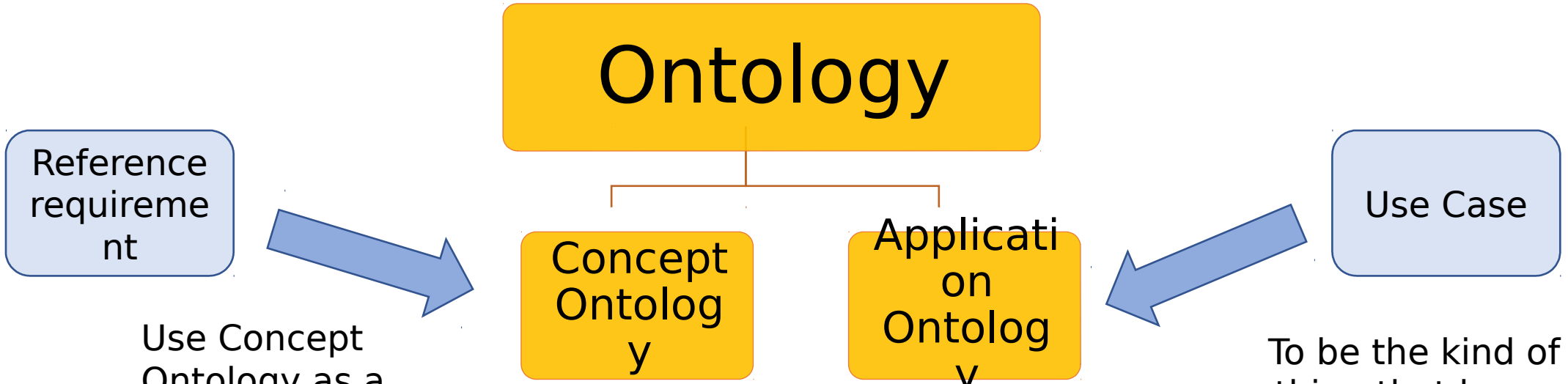
- Look for signatures in data that imply the presence of real world, identifying matter
- Frame the necessary conditions for membership of a class (in a logical ontology) in terms of what would be found (true) in data when the class of thing is there
- Inference as distinct from meaning in the original sense
- From the data you can infer that a thing exists in reality

- Real meaning – by definition mostly does not rely on data!

Reference v Application Ontologies

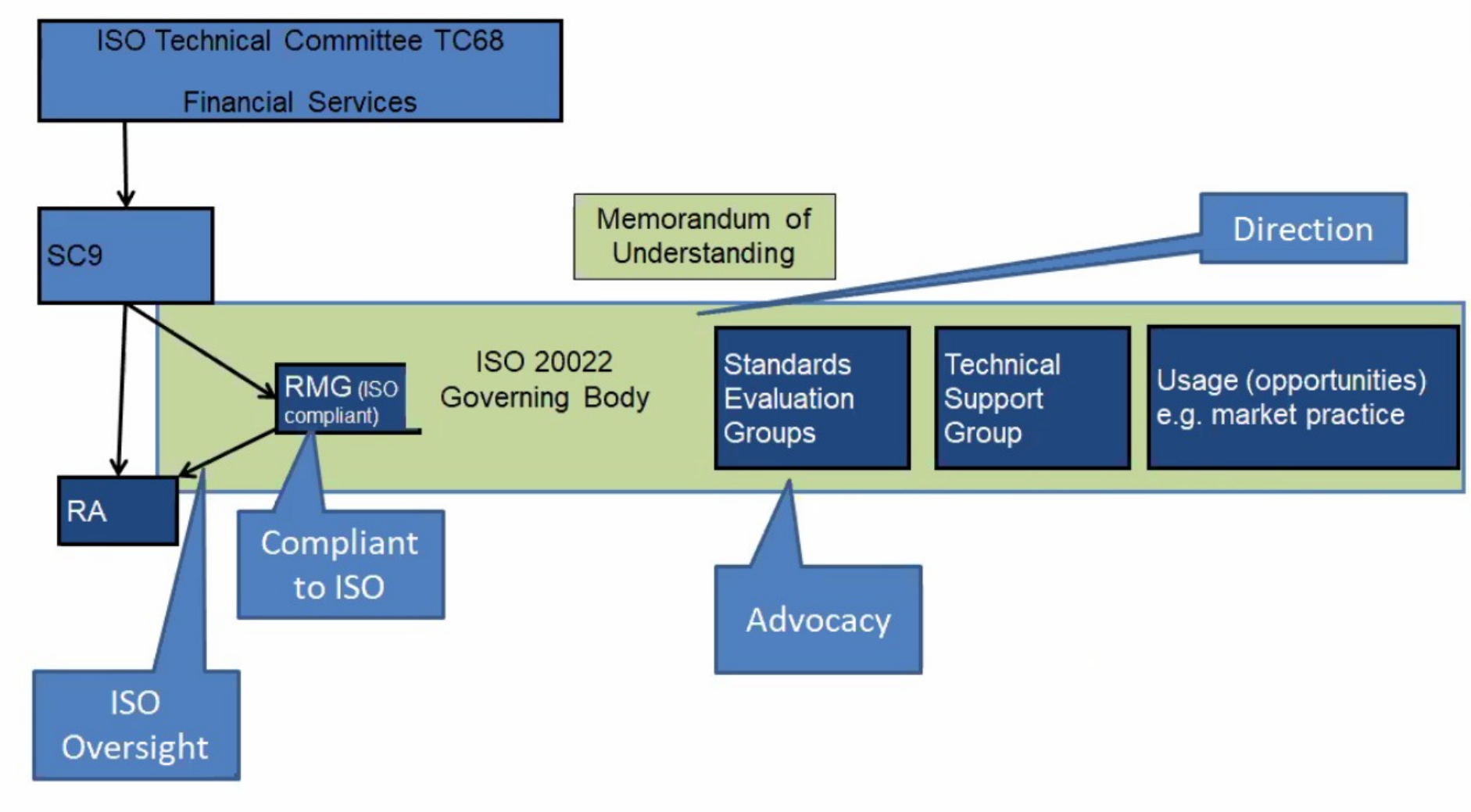


Reference v Application Ontologies

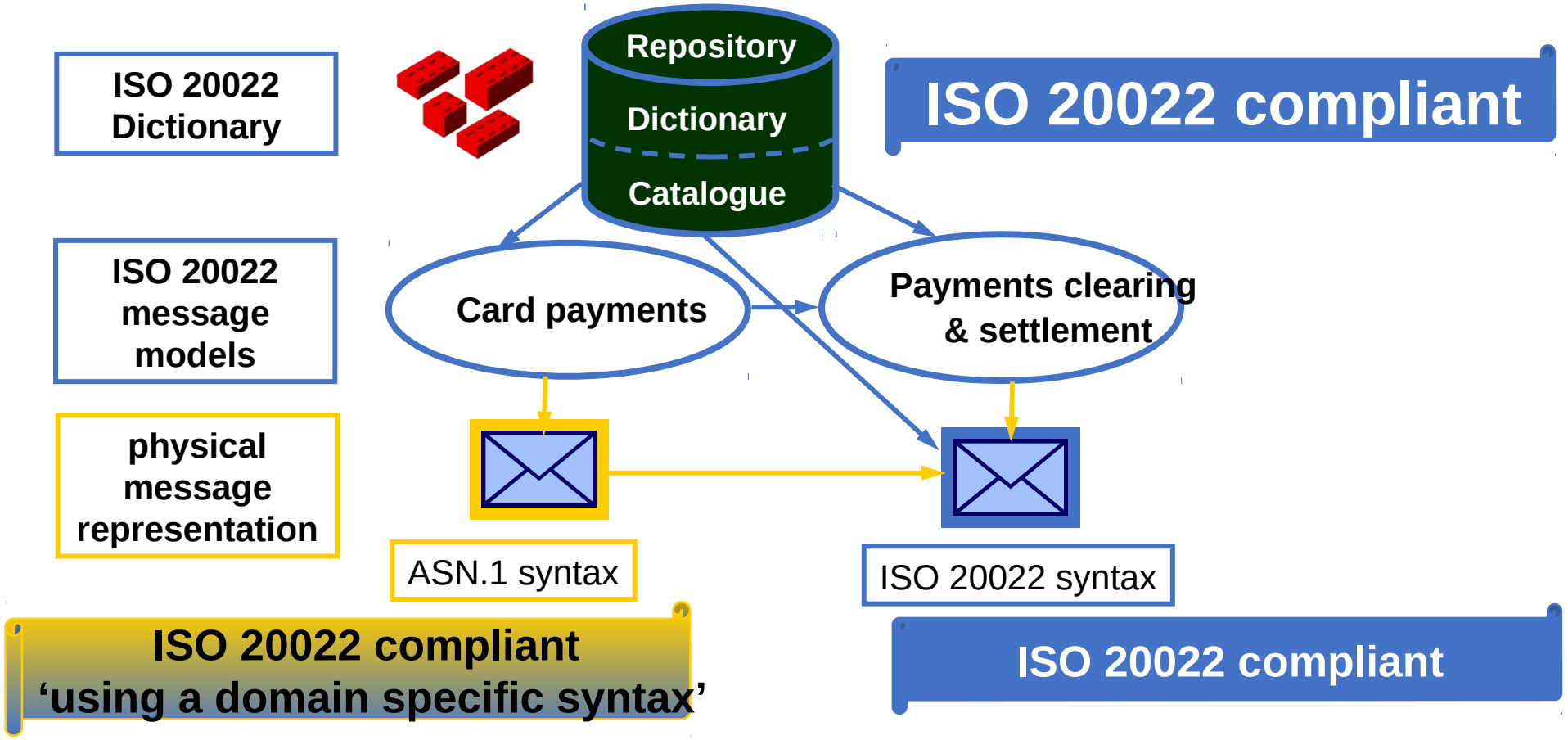


ISO 20022

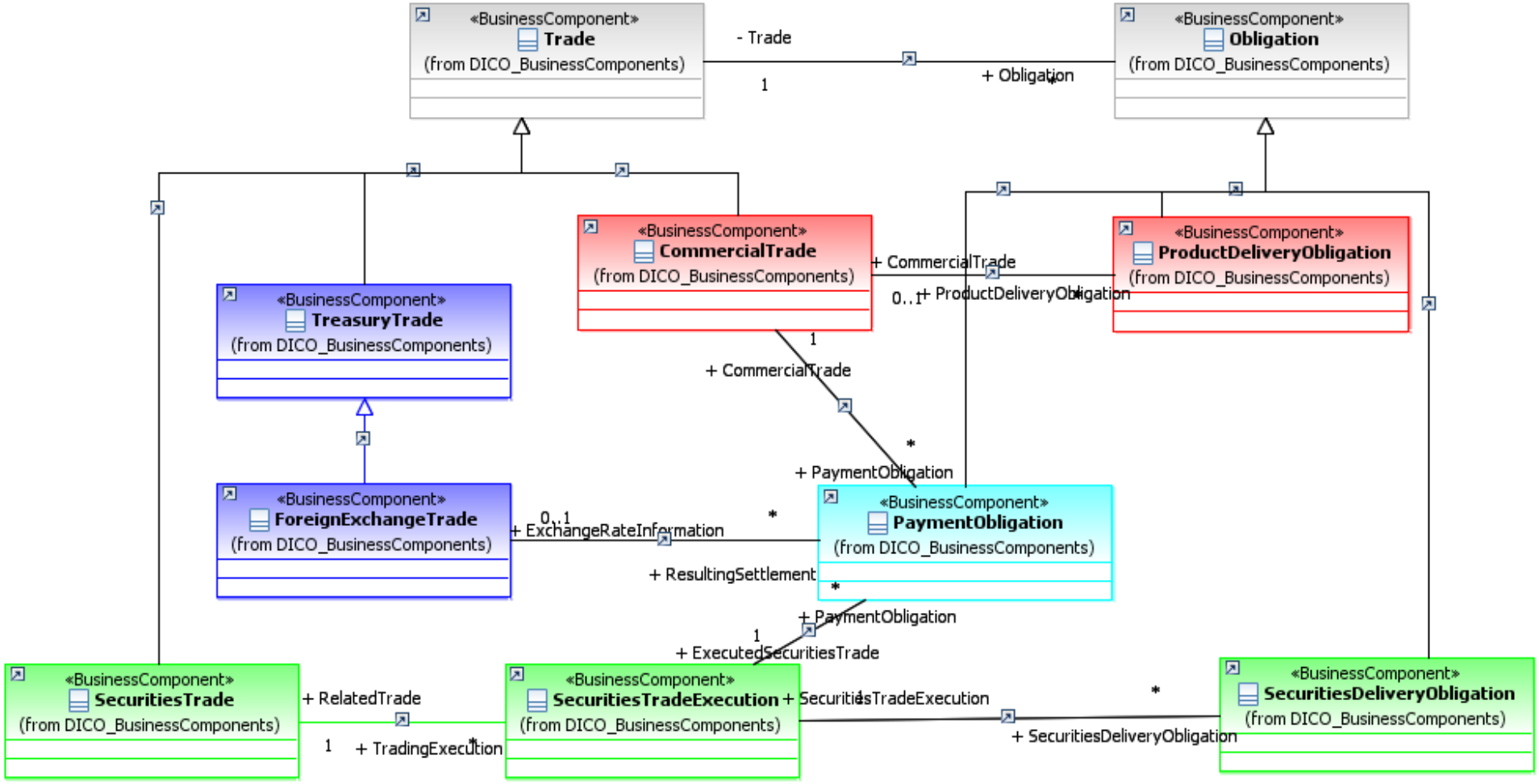
ISO 20022 Standard Organs



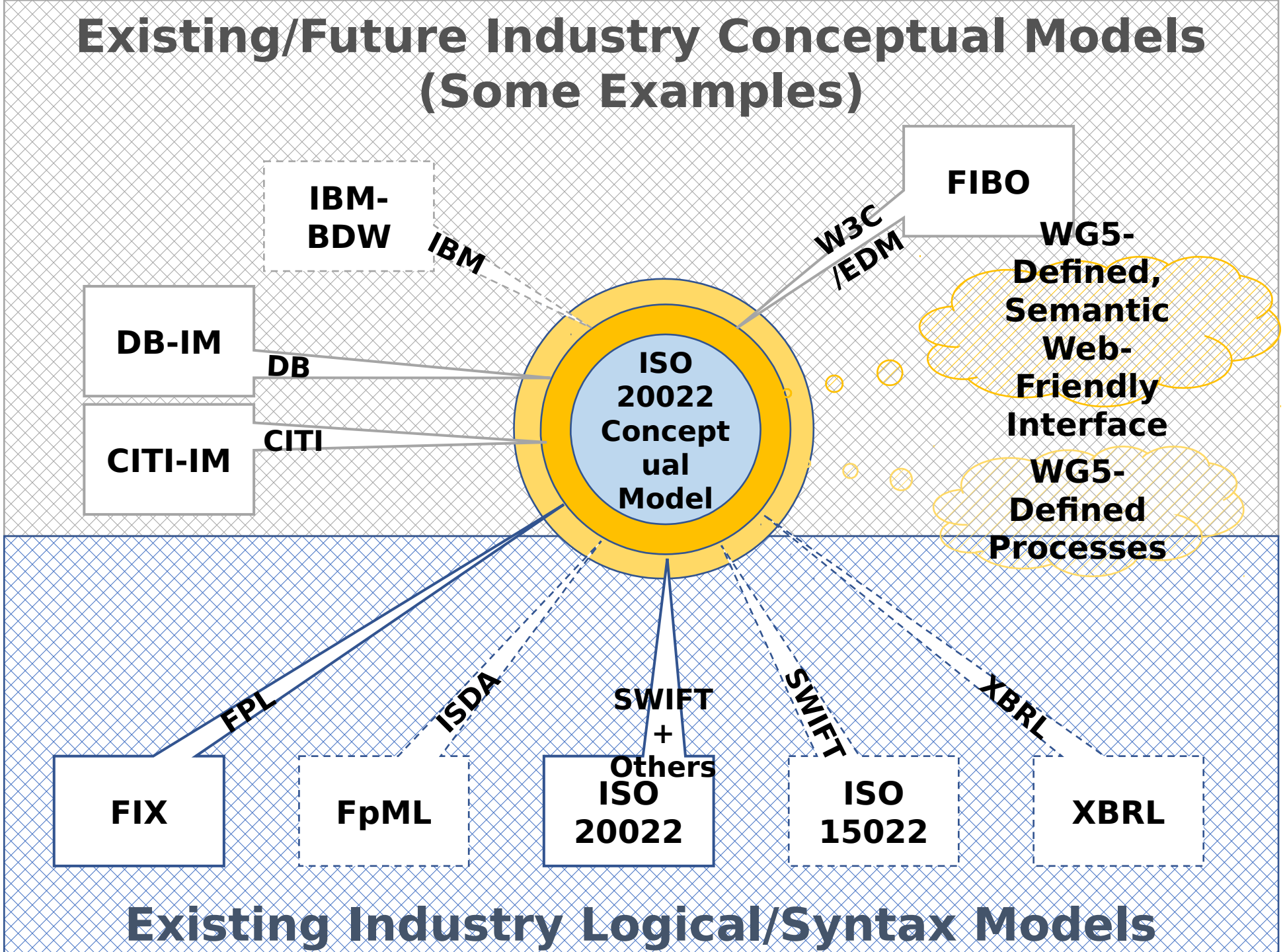
ISO 20022 compliance at model level



ISO 20022 Semantics: Trade



- A trade normally leads to an obligation.
- Different types of trade create different types of obligations.


Existing/Future Industry Conceptual Models
(Some Examples)
IBM-
BDW
IBM
FIBO
W3C
/EDM
WG5-
Defined,
Semantic
Web-
Friendly
Interface
DB-IM
DB
CITI-IM
CITI
ISO
20022
Concept
ual
Model
WG5-
Defined
Processes
FPL
ISDA
SWIFT
+
Others
SWIFT
XBRL
FIX
FpML
ISO
20022
ISO
15022
XBRL
Existing Industry Logical/Syntax Models

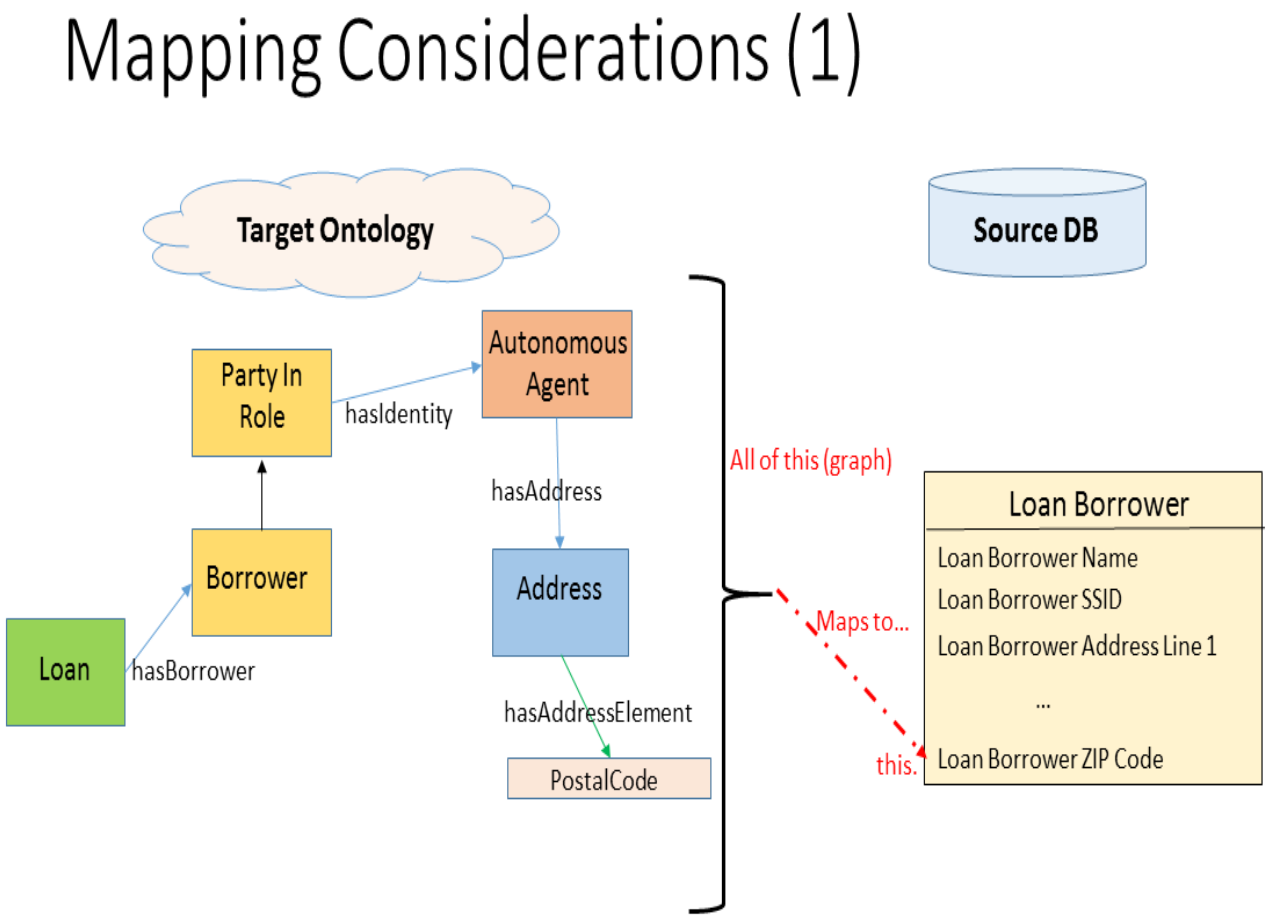
Details

- Map ISO 20022 metamodel to OWL/SKOS/RDF to be documented within a Technical Report
- Create an OWL/SKOS/RDF metamodel for code lists to be documented within a Technical Report
- SWIFT Standards should be able to create the transform from the ISO 20022 e-repository to the semantic version.
- The RA could then run the transform for each update to the e-repository.
- The working group and possibly a follow on study group or working group would be responsible for the evolution and functionality of the transform and the semantic version of the e-repository. The RA will not be responsible for maintenance of the transform or the artifacts generated.

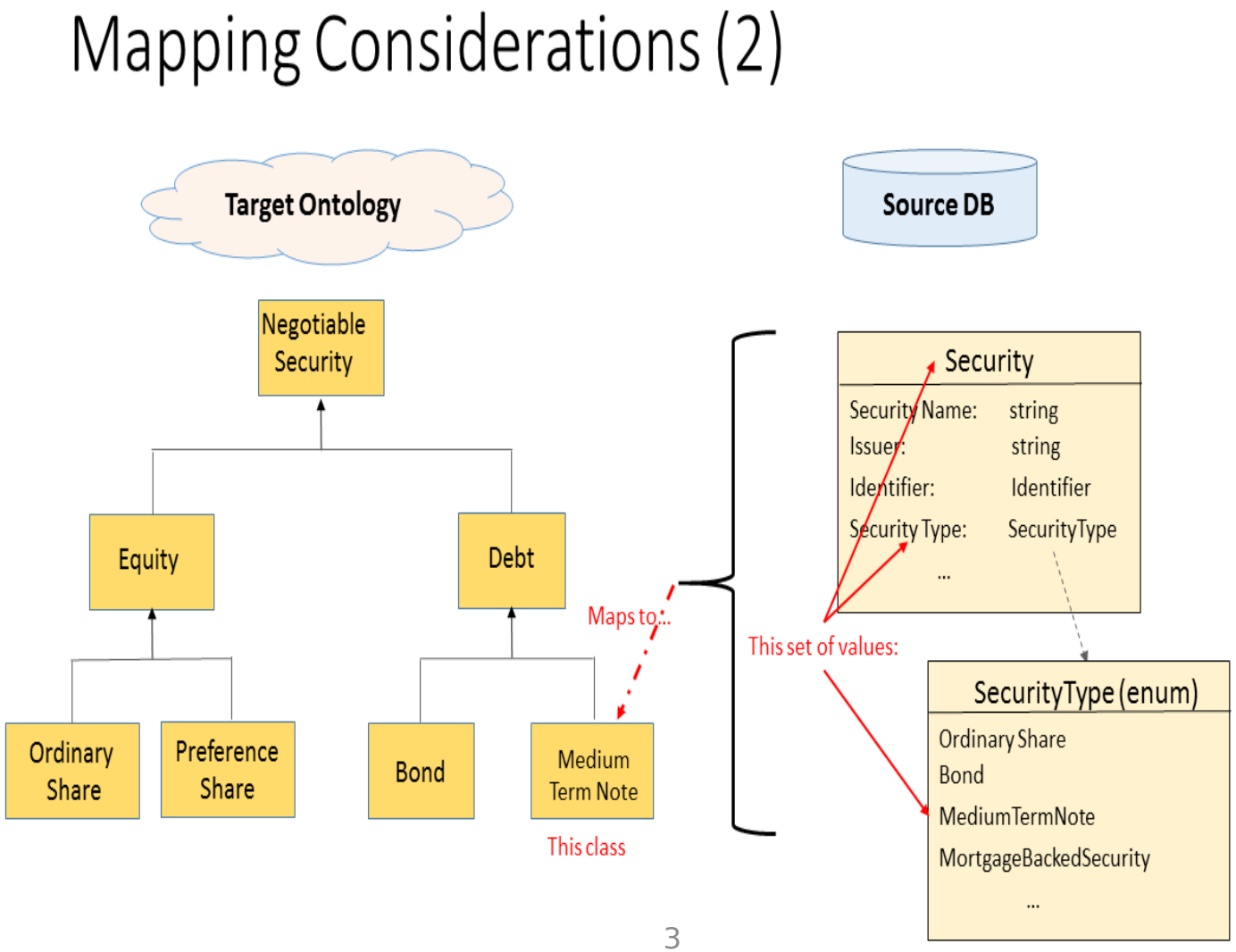
ISO 20022 Semantics

- Phase 1: OWL representation of ISO 20022 Metamodel
  - i.e. <<BusinessComponent>>, <<MessageComponent>> etc. stereotypes
- OWL Usage
  - Single format (OWL) for all meta-levels (M2 and M1)
  - Single namespace?
- Enables querying etc. across the whole space
  - Ontology of metamodel elements for ISO 20022, FIX etc. to map native message content
  - Representation of business concepts (securities, transactions etc.) for concept mapping
  - Potentially, representation of mapping relations as OWL properties
- The conceptual ontology will be a later phase of work
- Some mapping proofs of concept…

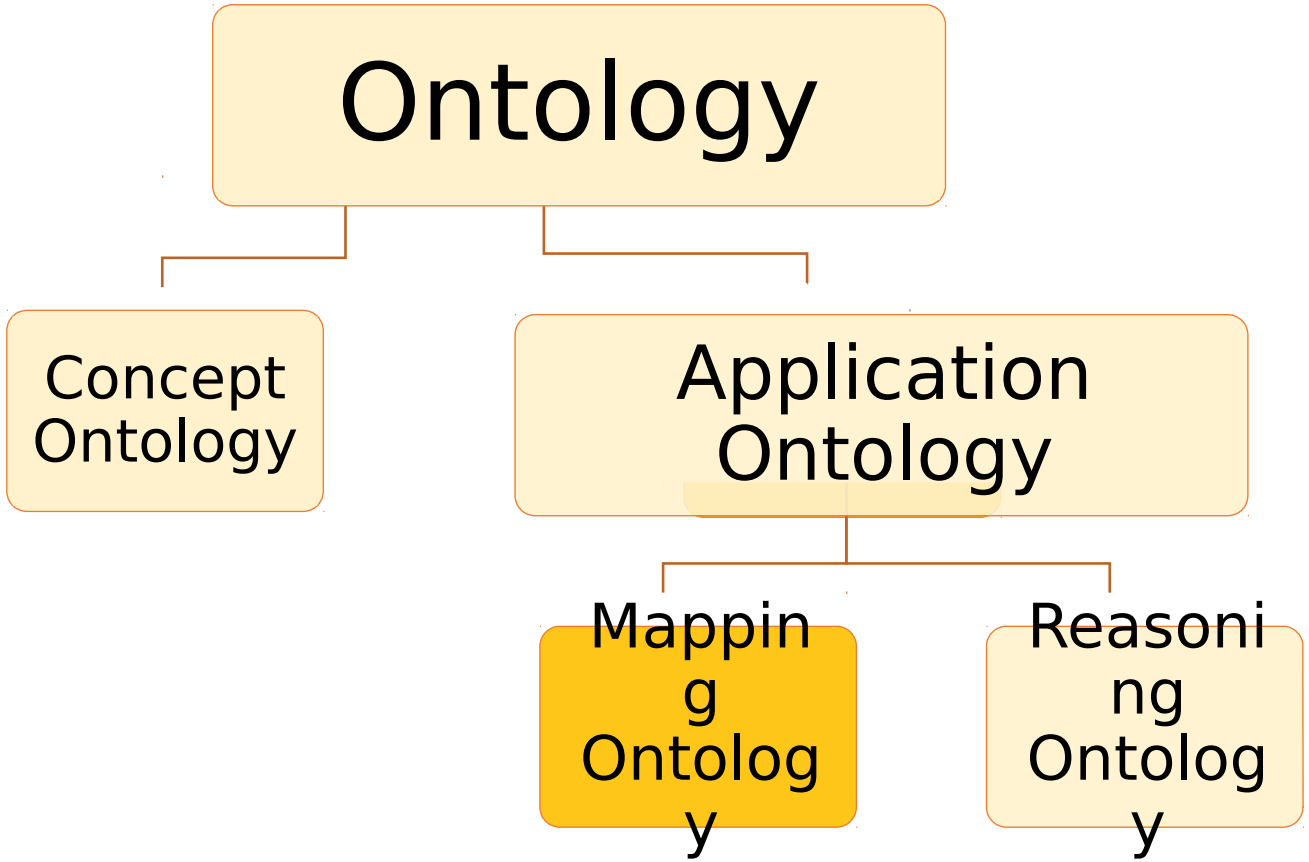
Ontology to Data Model



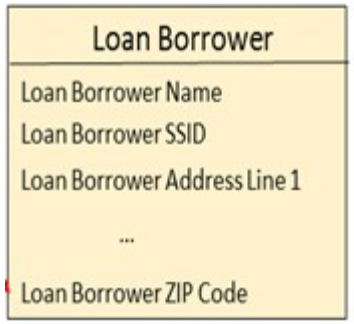
Data Model to Ontology



Mapping Ontology

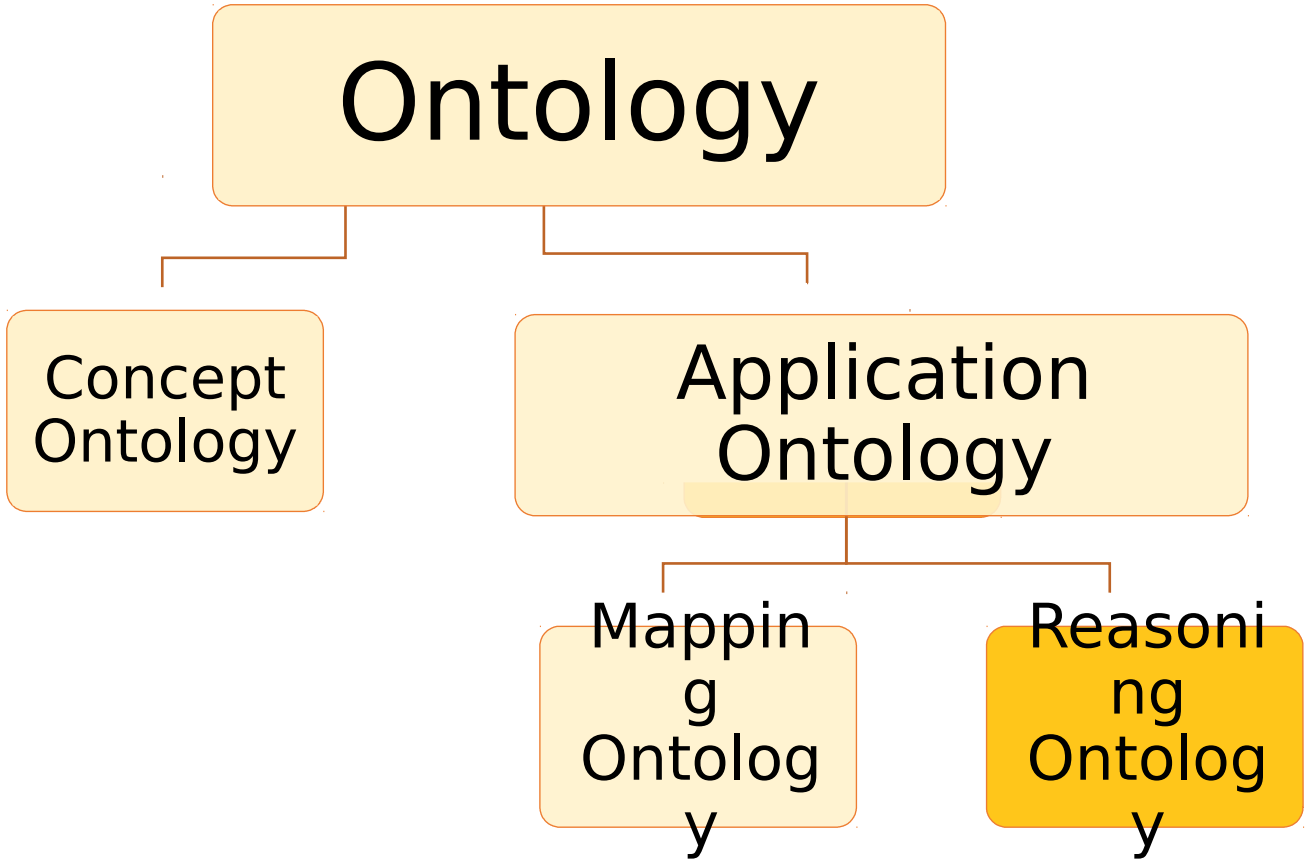


Mapping Ontology



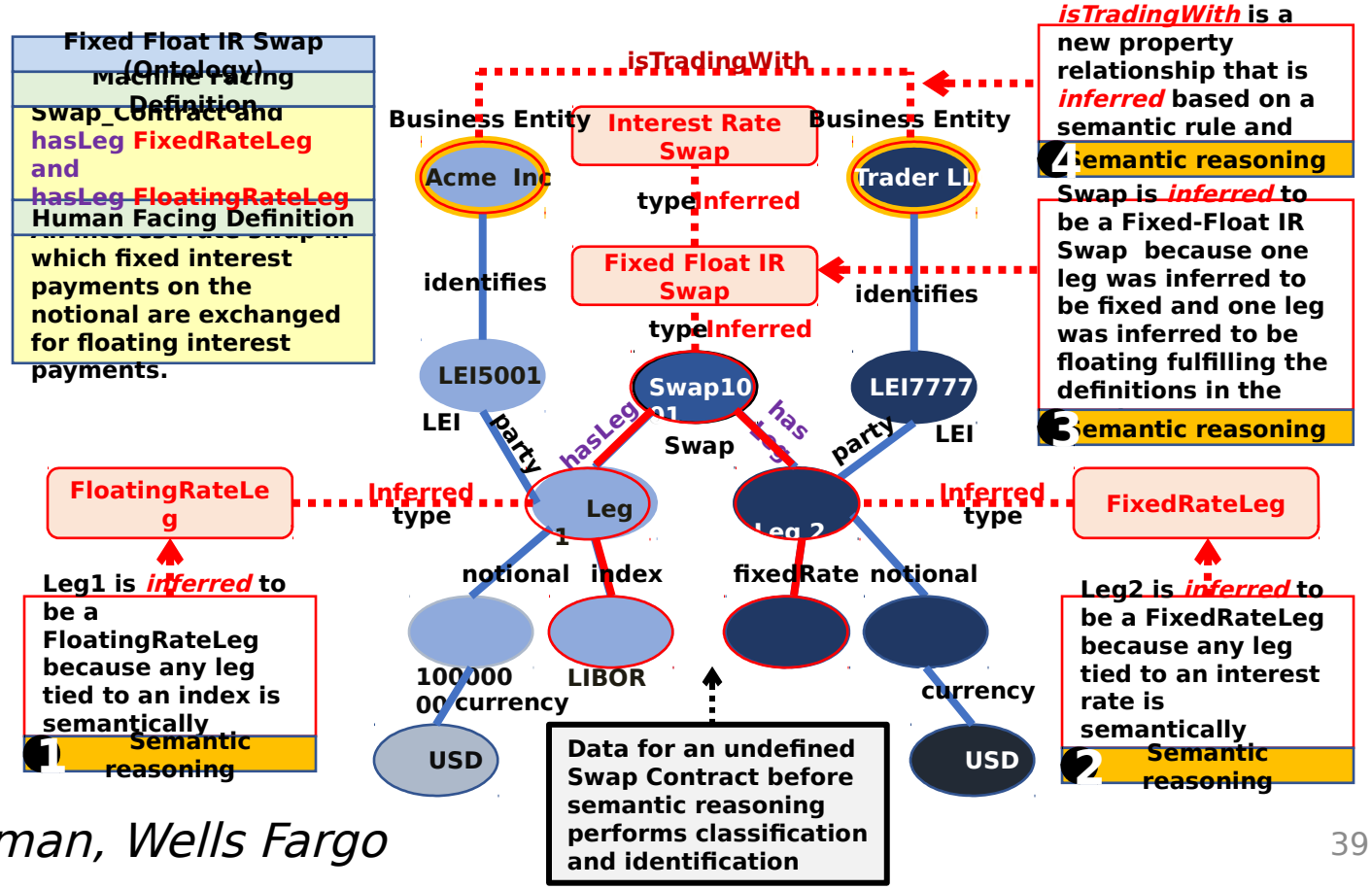
- Consider a data model with multiple prope
  - These are usually optional
  - There are a lot of them
- Ontology (of any sort) should get rid of optionality
  - Sub-classes, each with properties or restrictions saying what makes that class (of thing) what it is
- Ontology treats properties as first class citizen (they are not attached to a class)
- These properties all have narrow meanings, specific to the presence of that property on that class

Reasoning / Inference Processing Ontology



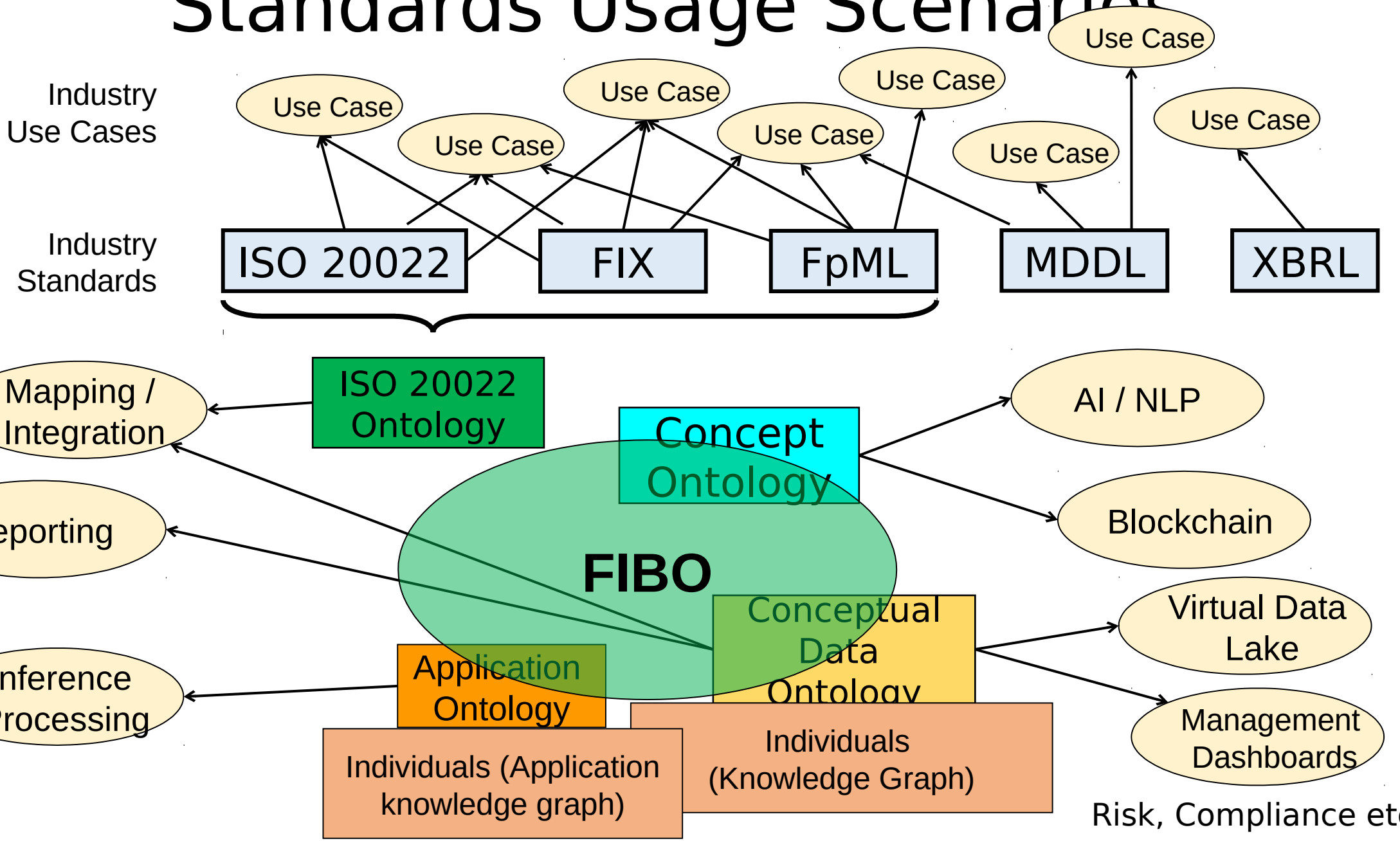
Semantic Web Applications

- Semantic Operational Processing *Reasons* over Data to Infer Classifications and Relationships



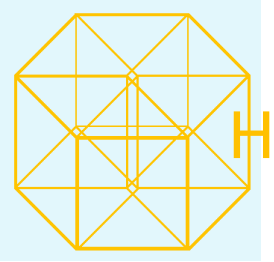
Ontology Standards Usage

Standards Usage Scenarios



Conclusions

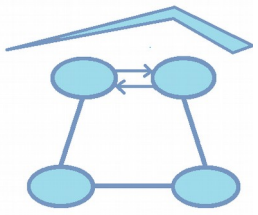
- There is no ‘one size fits all’ style of ontology
- Different usages indicate different ontology styles
  - Data or Things
  - Deep foundational hierarchies or correspondence graphs
  - Deep property hierarchy for mapping, restrictions for reasoning
- Novel applications like AI and NLP may require further distinctions



Hypercube Ltd.

Thank You!

Mike Bennett
Hypercube Ltd – a member of the Semantic Shed
www.hypercube.co.uk



The Semantic Shed
Understanding Business Meaning

Takeaways: Financial Ontology Standards Applications

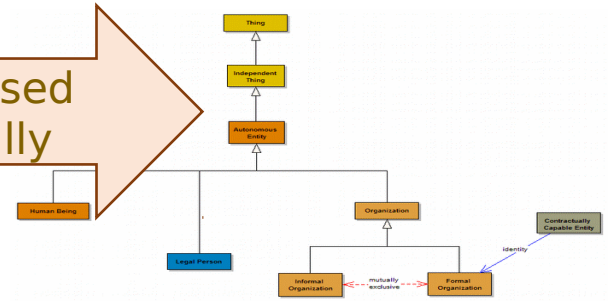
Integration

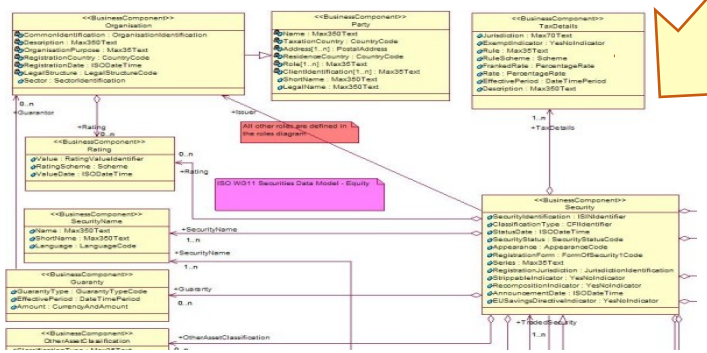
Validated by business

Reference Ontology

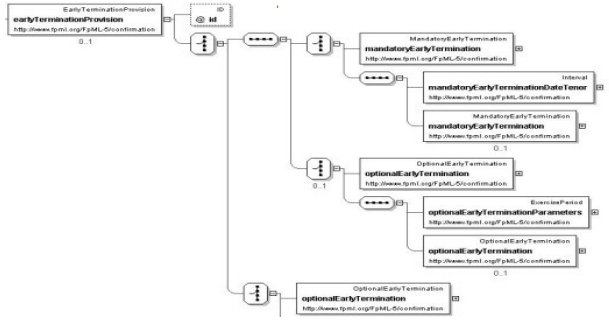
Shared business meanings

Expressed logically





Single reference for mapping across data and message models using common semantics



```
<swap>
<!-- Chase pays the floating rate every 6 months, based on 6M EUR-LIBOR-BBA,
        on an ACT/360 basis -->
  <swapStream>
    <payerPartyReference href="party1" />
    <receiverPartyReference href="party2" />
    <calculationPeriodDates id="floatingCalcPeriodDates">
      <effectiveDate>
        <unadjustedDate>1994-12-14Z</unadjustedDate>
        <dateAdjustments>
          <businessDayConvention>NONE</businessDayConvention>
        </dateAdjustments>
      </effectiveDate>
      <terminationDate>
        <unadjustedDate>1999-12-14Z</unadjustedDate>
        <dateAdjustments>
          <businessDayConvention>MODFOLLOWING</businessDayConvention>
          <businessCenters id="primaryBusinessCenters">
            <businessCenter>DEFR</businessCenter>
          </businessCenters>
        </dateAdjustments>
      </terminationDate>
      <calculationPeriodDatesAdjustments>
        <businessDayConvention>MODFOLLOWING</businessDayConvention>
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      </calculationPeriodFrequency>
    </calculationPeriodDates>
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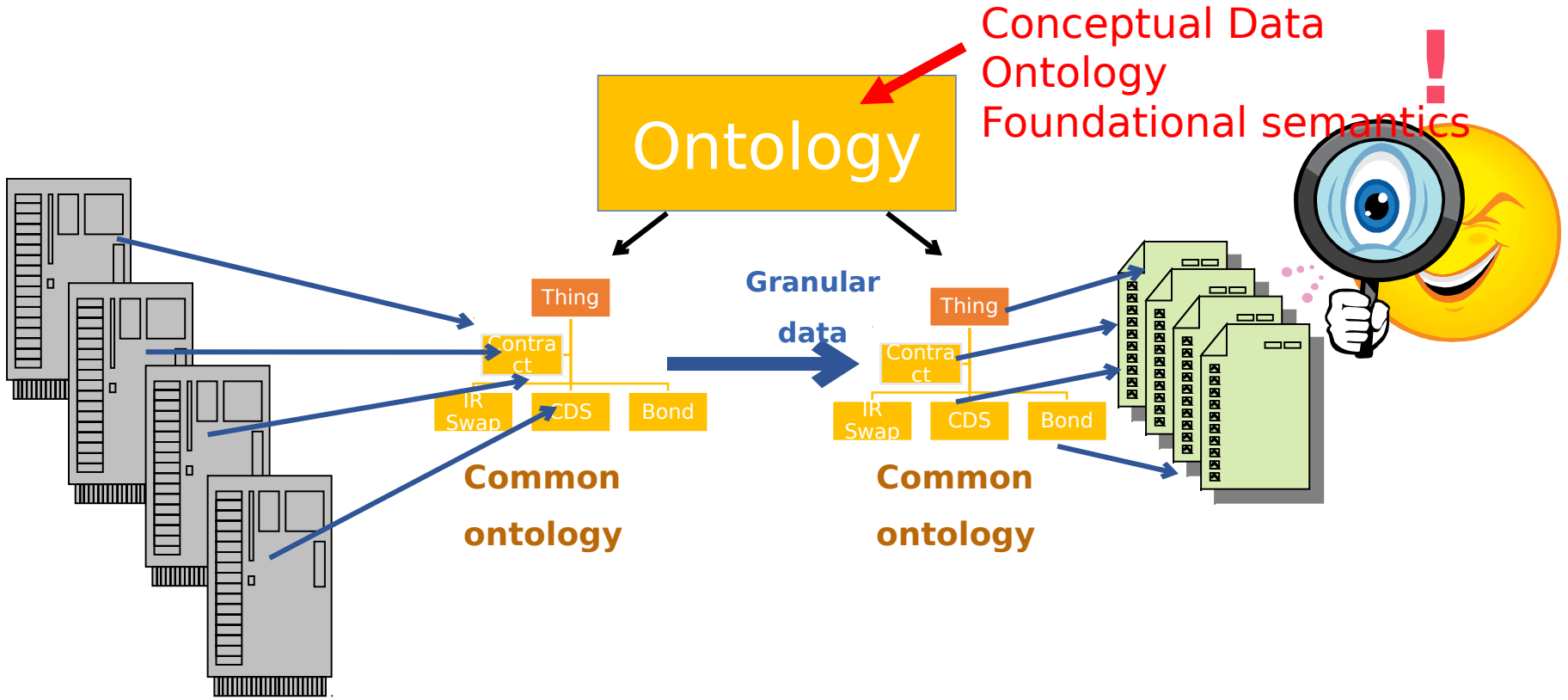
Regulatory Reporting with Semantics



REPORTING ENTITY

Data is mapped from each system of record into a common ontology

Reported as standardized, granular data

Agnostic to changes in forms

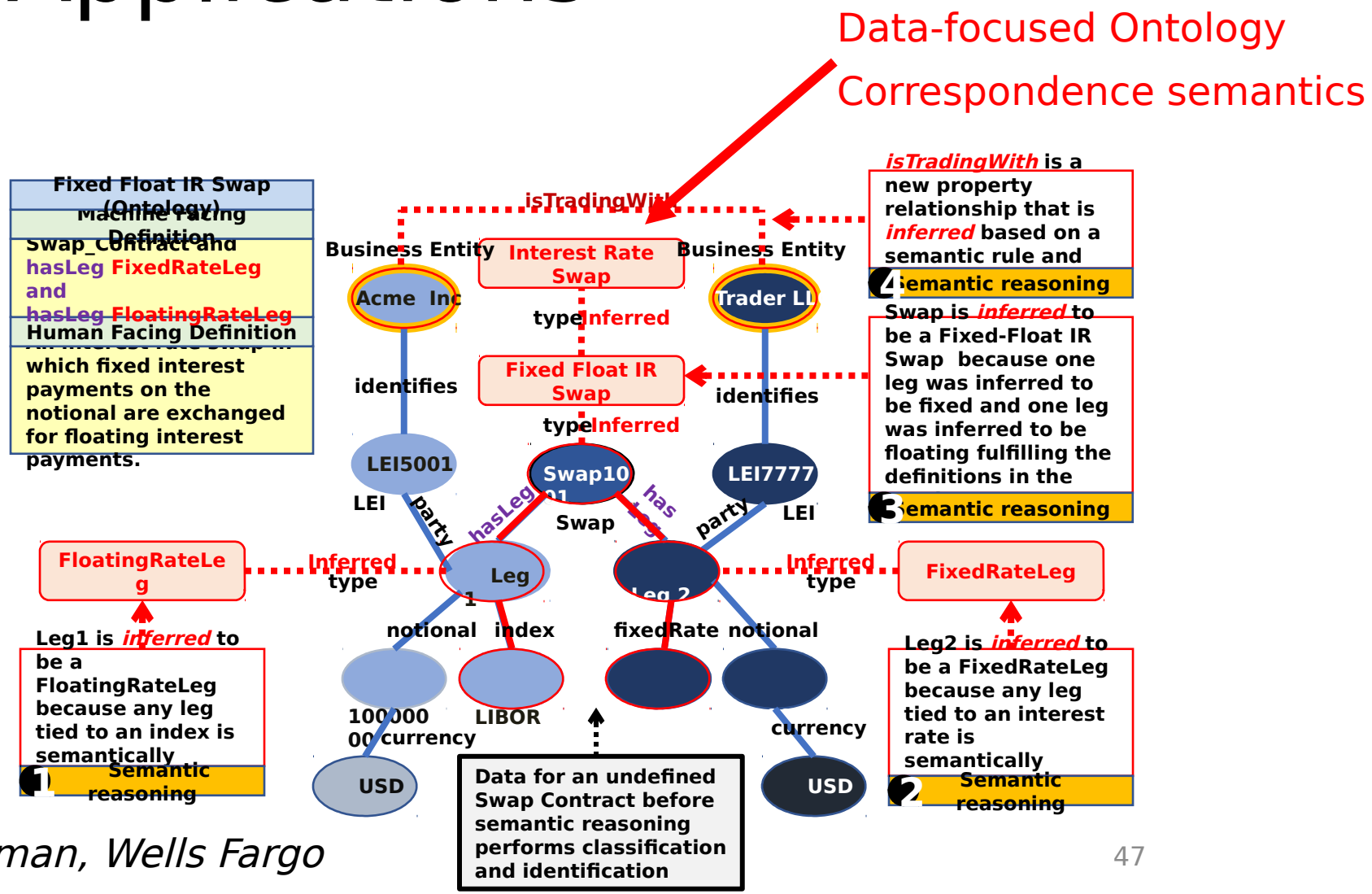
REGULATORY AUTHORITY

Receives standardized, granular data aligned with standard ontology (FIBO)

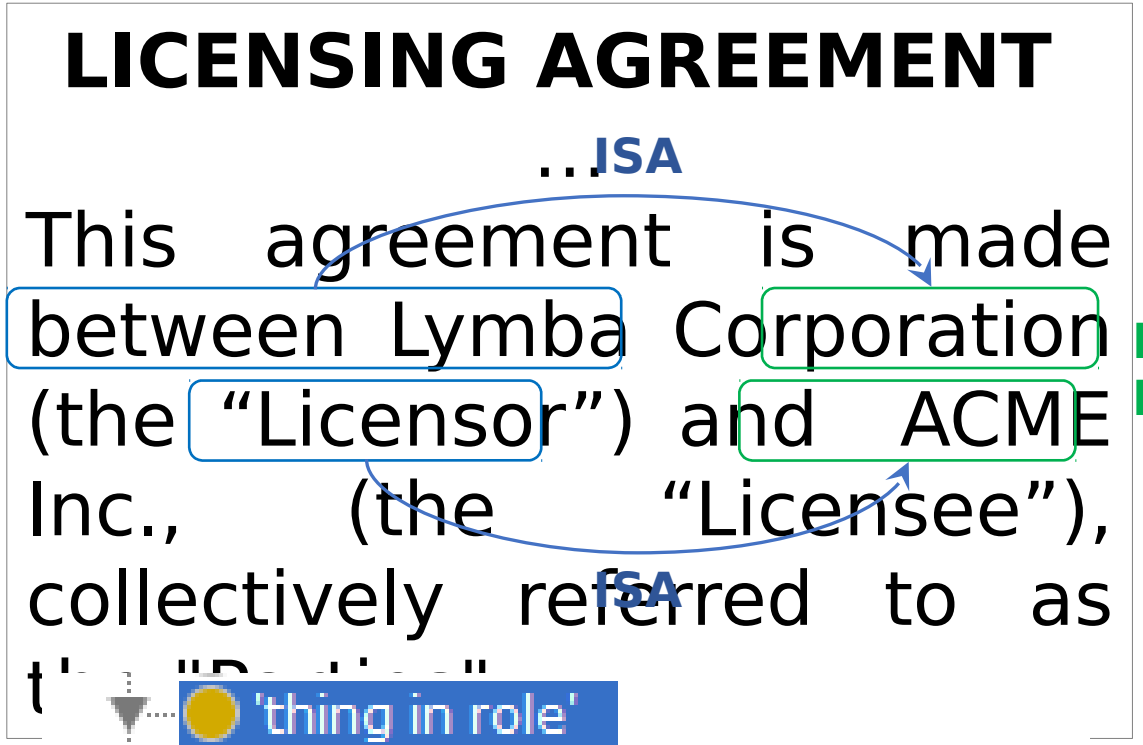
Uses semantic queries (SPARQL) to assemble information

Changes to forms need not require re-engineering by reporting entities

Semantic Web Applications



AI and Natural Language Processing



Source: Lymba presentation, Ontology Summit 2017

Virtual Data Lakes: ET and NoETL