ON THE ROAD TO REGULATORY ONTOLOGIES

EXPRESSING REGULATIONS IN STRUCTURED NATURAL LANGUAGE

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OUTLINE

1. **The team**

2. **The idea**

3. **Challenges in consuming regulation**

4. **Brief overview of the approach**

   - Expressing Regulations in Structured Natural Language

5. **Applications and benefits**

CREDITS

- **John Hall (Model Systems) & Donald Chapin (Business Semantics) for their continuous support**

- **Leona O'Brien, John Lombard, Patrick O'Sullivan, Peter O'Sullivan for their Legal subject matter expertise and their valuable contributions**

- **Tom Butler, GRCTC Principal Investigator for his valuable support**

GRCTC
THE TEAM

GRCTC, THE TEAM

- **Multidisciplinary research team**
  - Computer Science/ IS, Law, GRC, Finance
- **Academic Institutions and Industry Consortium**
  - Financial Institutions, Content Providers, Software Providers
- **Funded by Enterprise Ireland and the Irish Development Authority**
  - under the Technology Centres programme
- **Project started 20 months ago, centre established 8 months ago**

- **Note: current website is a placeholder, email for more info.**

THE IDEA

THE IDEA – FIBO & FIRO

- **Inspired by the EDM Council's Financial Industry Business Ontology, develop a Financial Industry Regulatory Ontology**

- **To capture/ axiomatize**

  - General regulatory knowledge

  - Domain-specific regulatory knowledge (AML, Capital Adequacy, etc.)

FIRO VIEW 1: A MODULARIZED ONTOLOGY

High-Level Module(s)

Regulatory "Meta-Concepts" (Entity, Action, Sanction, etc.) shared across regulations

Shared-Vocabulary describing a regulation (RegW, AML, etc.) – Terms, definition, structural relationships between terms, etc.

Obligations, prohibitions, reporting requirements, etc. from a regulation

Structural Modules

Guidance Modules

FIRO VIEW 2: A MULTILAYERED NETWORK OF ONTOLOGIES

General purpose

Reference a general purpose Ontology, when needed: CyC, SUMO, etc.

Foundation

Reuse a set of foundational ontologies: date/time, SKOS, W3C provenance ontology, etc.
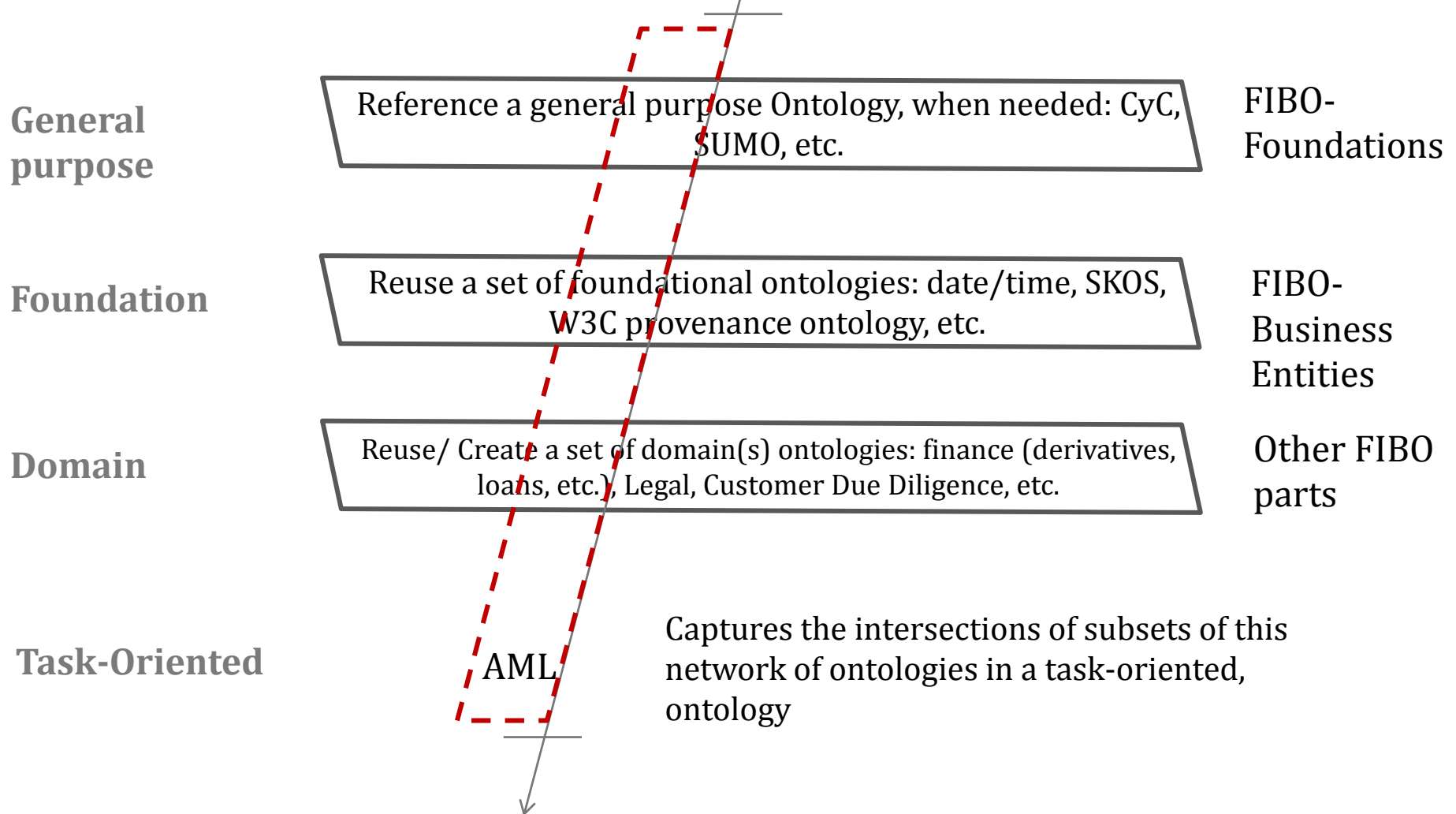
Domain

Reuse/ Create a set of domain(s) ontologies: finance (derivatives, loans, etc.), Legal, Customer Due Diligence, etc.

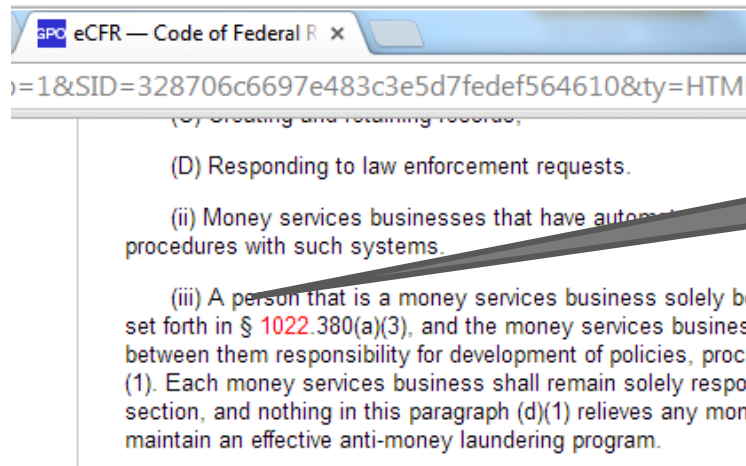# FIRO VIEW 2: A MULTILAYERED NETWORK OF ONTOLOGIES

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Reference a general purpose Ontology, when needed: CyC, SUMO, etc.

FIBO-Foundations

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Reuse a set of foundational ontologies: date/time, SKOS, W3C provenance ontology, etc.

FIBO-Business Entities

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Reuse/ Create a set of domain(s) ontologies: finance (derivatives, loans, etc.), Legal, Customer Due Diligence, etc.

Other FIBO parts

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Other FIBO parts

Task-Oriented

AML

Captures the intersections of subsets of this network of ontologies in a task-oriented, ontology
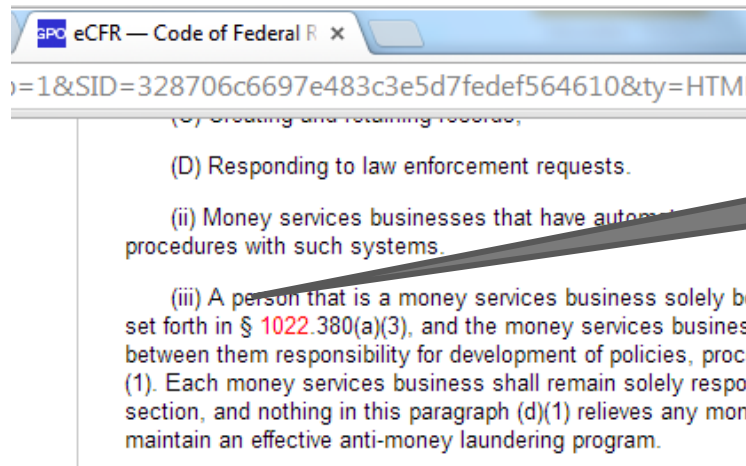
CHALLENGES IN CONSUMING REGULATIONS

REFERENCES TO FOLLOW AND FLESH OUT

[...] "A person that is a money services business solely because it is an agent for another money services business as set forth in § 1022.380(a)(3), and the money ..." [...]

(D) Responding to law enforcement requests.

(ii) Money services businesses that have autom... procedures with such systems.

(iii) A person that is a money services business solely beca... set forth in § 1022.380(a)(3), and the money services business fo... between them responsibility for development of policies, procedu... (1). Each money services business shall remain solely responsil... section, and nothing in this paragraph (d)(1) relieves any money ... maintain an effective anti-money laundering program.

DIFFERENT REFERENCES DESCRIBING THE SAME THING?

[…] "A person that is a money services business solely because it is an agent for another money services business as set forth in § 1022.380(a)(3), and the money …" […]
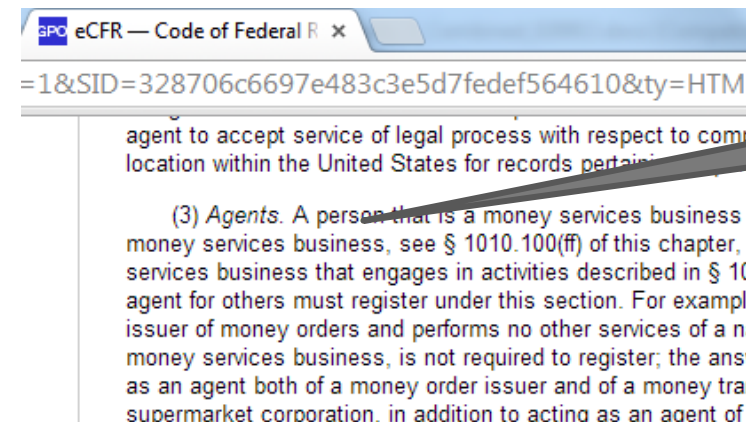
[…] "A person that is a money services business solely because that person serves as an agent of another money services business, see § 1010.100(ff) of this chapter…" […]

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DEFINITION CHANGES SCOPE

[...] "*Financial institution.* Each agent, agency, branch, or office within the United States of any person doing business, whether or not on a regular basis or as an organized business concern, in one or more of the capacities listed below: ...

(4) A telegraph company
" [...]

DEFINITION ELEMENTS NEED TO BE DEFINED

Code of Federal R ×   GPO eCFR — Code of Federal R ×

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(mm) *Person*. An individual, a corporation, a partnership, a trust or estate, a joint st ndicate, joint venture, or other unincorporated organization or group, an Indian Tribe (aming Regulatory Act), and all entities cognizable as legal personalities.

[...] "or other unincorporated organization or group, an Indian Tribe" [...]

[...] "money services business must, as part of its registration, maintain a list of its agents" [...]

— Code of Federal R ×   GPO eCFR — Code of Federal R ×

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§ 1022.380   **Registration of money services businesses.**

(a) *Registration requirement* —(1) *In general.* Except as provided in paragraph (a)(3) of this secti   ating to and except for sellers of prepaid access as defined in § 1010.100(ff)(7) of this chapter to the extent   they are n already agents, each money services business (whether or not licensed as a money services busi   s by any Sta must register with FinCEN. Each provider of prepaid access must identify each prepaid program fo which it is the of prepaid access. Each money services business must, as part of its registration, maintain a list of its agents as by 31 U.S.C. 5330 and this section. This section does not apply to the United States Postal Service, to agencies

COMPLEX SENTENCES

Excerpt from Money Services Businesses : Report of
suspicious transactions (31 CFR Chapter X)

AMBIGUOUS SENTENCES

Each foreign-located person doing business, whether or not on a regular basis or as an organized or licensed business concern, in the United States as a money services business shall designate the name and address of a person who resides in the United States and is authorized, and has agreed, to be an agent to accept service of legal process with respect to compliance with this chapter, and shall identify the address of the location within the United States for records pertaining to paragraph (b)(1)(iii) of this section.

what does location refer to?   the business of the agent, the agents home address or the location where the registration form has to be filed?

Excerpt from 31 CFR Chapter X - 1022.380(a)(2)

(DELIBERATE) AMBIGUOUS REGULATORY INTENT

[…] Matter of "Facts and Circumstances" […]

[…] unless the context otherwise requires

[…] or other similar items […]

31 CFR Chapter X subpart A § 1010.100 (ccc)

eCFR — Code of Federal R ×   GPO eCFR — Code of Federal R ×

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day in one or more transactions.

(ii) *Facts and circumstances; Limitations.* Whether a person is a check casher as described in this section is a matter of facts and circumstances. The term "check casher" shall not include:

(A) A person that sells prepaid access in exchange for a check (as defined in the Uniform Commercial Code), monetary instrument or other instrument;

Explained sometimes But not always

SOLUTIONS?

SOLUTIONS?

Need To

- Consolidate
- Disambiguate the meaning
    - Delimit the coverage of a definition
    - Identity demarcation issues while classifying things
    - Identify Obligations and Possibilities
- Interpret
    - The regulatory intent when not accurate
        - Based on previous experience? Jurisprudence?
    - Maybe prioritize the obligations

To do this properly SMEs have a major role to play

Difficult for SMEs to master formal logic (availability, overhead, etc.) – Need an alternative way to create these ontologies

WHY NOT USE NATURAL LANGUAGE...

in a more structured way

- To consolidate references in regulations
- To clarify ambiguity in definitions and obligations
- To interpret collaboratively the regulatory intent

Benefits:

- Overcome the consumption challenges
- And "seamlessly" represent the ontology building blocks in natural language (simple, no need to learn new technical languages)

How:

- Develop a shared vocabulary and shared guidance based on the regulatory text

SEMANTICS OF BUSINESS VOCABULARY AND BUSINESS RULES (SBVR)

- **OMG Specification**

- **Business Natural Language**

  - Used in a regulatory context

- **Grounded in ISO Common Logic**

- **While capturing the interpretation in SBVR, we identify**

  - General Noun Concepts

  - Individual Noun Concepts

  - *Verb concepts*

  - Keywords

  - Definitional Rules and Behavioral Rules

SBVR FEATURES

General Noun Concept

Verb Concept

credit union

Definition: **is** a union **chartered under** the Federal Credit Union Act or [...]

Concept Type: general noun concept
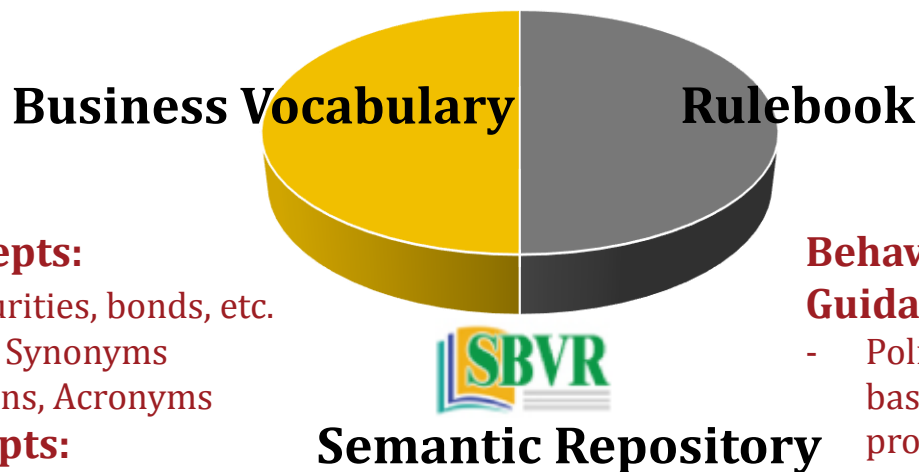
General Concept: union

Source: 12 CFR 700.2

[...]

Keyword

Individual Noun Concept

List of attributes (for every SBVR vocabulary entry)

SBVR FEATURES

Business Vocabulary

Rulebook

Semantic Repository

Noun concepts:

Car, dog, securities, bonds, etc.
- Definitions, Synonyms
- Abbreviations, Acronyms

Verb concepts:

Relationships among concepts
- General <-> Specific:
- Securities <->Bonds
- Composition, aggregation, etc.
- Characteristics:
Loan *has* issuingEntity

Individuals

Joseph, UCC, AIB, BoI, etc.

Structural Rules

It is necessary that each Loan
has **exactly one** issuingEntity

Behavioural Business Guidance

- Policies and rules expressed based on obligation, possibility, prohibition, etc.
- Composed from vocabulary elements

e.g.

Rule: **It is possible that a** Loan *has* **more that one** customer

Rule: **It is obligatory that a** customer *applying for* **a** loan *has* **a** valid ID

SBVR FEATURES

Conventional Dictionary

Term-based: each synonymous term has its own definition

| Black | Dark | Obscure | Indistinct | Faint | Pale | Light | White |
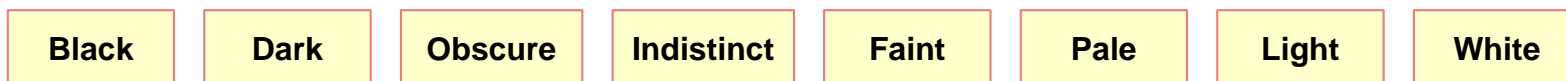
-   Chain of approximate synonyms   - →

Terminological Dictionary (SBVR Vocabulary)

Concepts-based: synonyms share the same definition
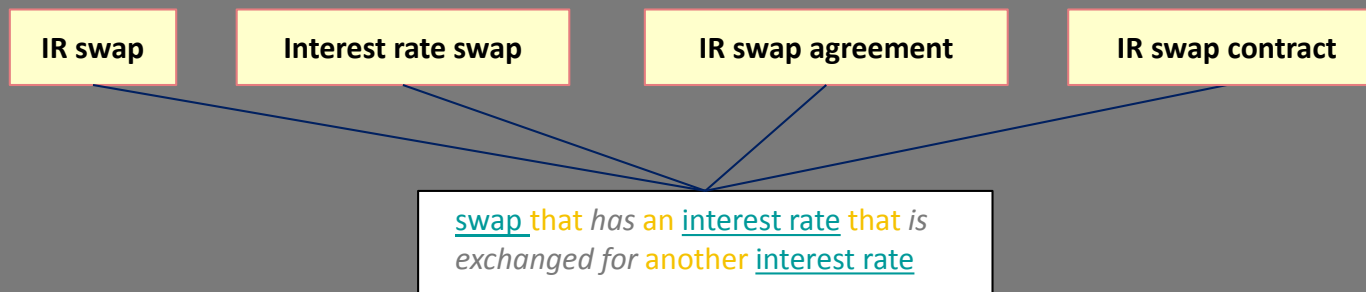
| IR swap | Interest rate swap | IR swap agreement | IR swap contract |

swap that *has* an interest rate that *is exchanged for* another interest rate

November 7, 2013

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:
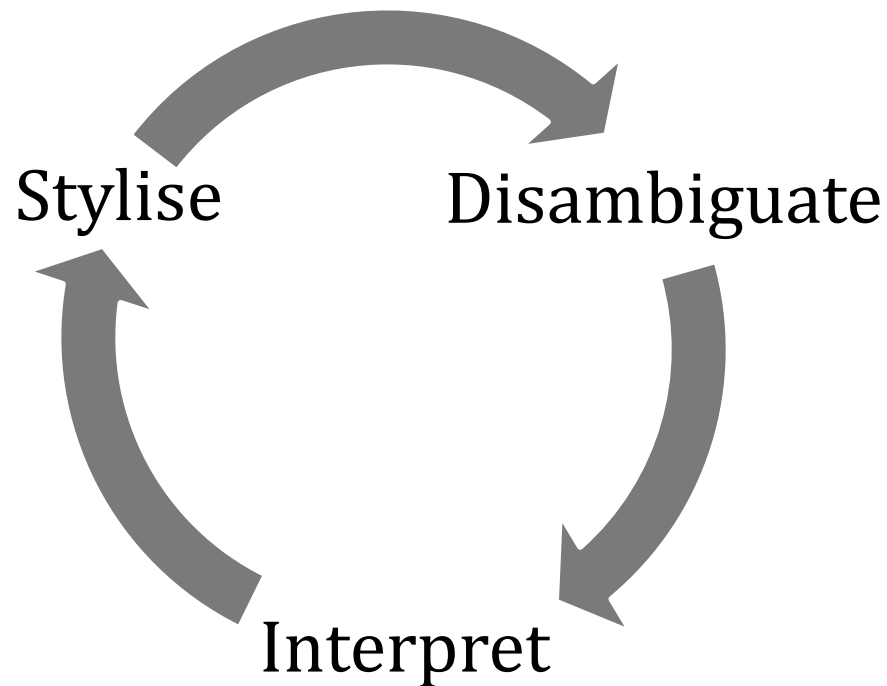
INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**
    - indicate what element in the SBVR metamodel this term (or set of terms) corresponds to

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General Concept: union

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[...]

INTERPRETING REGULATIONS WITH SBVR

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Verb Concept

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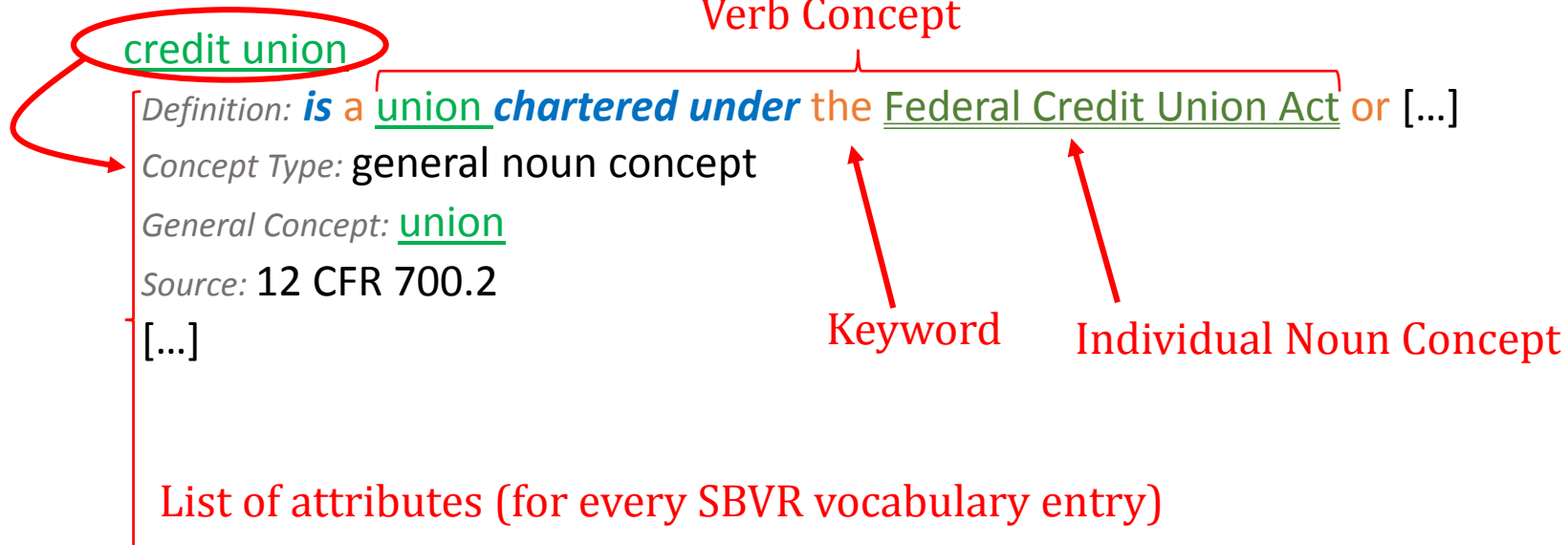
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The approach consists of 3 types of activities:

- **Stylise**
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- **Disambiguate**
  - Consolidate references

transaction account

Definition: transaction account ***includes*** accounts ***described*** in 12 U.S.C. 461(b)(1)(C) […]

INTERPRETING REGULATIONS WITH SBVR

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  - Consolidate references

transaction account

Definition: transaction account **includes** accounts **described** in 12 U.S.C. 461(b)(1)(C) […]

transaction account

Definition: transaction account **includes** deposit accounts or accounts **on which** the depositor or account holder **can make** withdrawals **by** negotiable or transferable instrument, payment orders of withdrawal, telephone transfers, or […]

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**

- **Disambiguate**

  - […]
  - Define terms from the text itself or find appropriate definitions

seller of prepaid access

Definition: […]

Obligation: It is obligatory that a seller of prepaid access *sells* prepaid access *offered under* a prepaid program *provided* that this prepaid access *can be used* before verification of customer identification *under* § 1022.210(d)(1)(iv). […]

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Verification of customer identification

Definition: *is* the collection *of* information *about* the customer *including* name, date of birth, address, and identification number

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**

- **Disambiguate**

  - [...]

  - Define unclear terms in the definitions themselves (levels of disambiguation)

e.g.: Definition of person uses Indian Tribe but it is not clear what can or cannot be considered as an Indian Tribe

Indian Tribe

Definition: any Indian tribe, band, nation, or other *organized* group or community of Indians that (A) *is recognized as eligible by* the Secretary *for* the special programs and services *provided by* the United States *to* Indians *because of* the status *of* these Indians, and (B) *is recognized as possessing* powers of self-government.

Concept Type: general noun concept

General Concept: person

Source: *25 USC Chapter 29 Indian Gaming Act Regulation* § 2703 (5)

http://www.law.cornell.edu/uscode/text/25/chapter-29

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

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- **Disambiguate**

    - […]
    - Define unclear terms in the definitions themselves (levels of disambiguation)

e.g.: Definition of Financial Institution uses Fund (but Fund not defined in the text)

fund

Definition: Distinct pool *of* financial instruments *managed by* a single investment policy.

Source: FIBO Overview of CIV (Funds) http://www.edmcouncil.org/semanticsrepository/index.html

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**

- **Disambiguate**

    - […]

    - Identify relationships between things represented by the terms

The List of Verb Concepts in the shared vocabulary

person *structures* transaction

person designate *is appointed by* money services business

supporting documentation *is maintained by* money services business

agreement *designates* [one] person *to register* money services business

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**

- **Disambiguate**

  - […]

  - Identify relationships between things represented by the terms

Carry on by repeating the previous tasks for the verb concepts

person *structures* transaction

person designate *is appointed by* money services business

supporting documentation *is maintained by* money services business

agreement *designates* [one] person *to register* money services business

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Stylise**

- **Disambiguate**

    - […]

    - Identify constraints on these relationships

agreement **designates** only one person **to register** money services business

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

- **Disambiguate**
    - […]
    - Identify the action(s) on which the modality(ies) lies and Identify these modalities

provider of prepaid access *maintains access to* transactional records

It is obligatory that each provider of prepaid access *maintains access to* transactional records *for* a period *of* five years.

INTERPRETING REGULATIONS WITH SBVR

The approach consists of 3 types of activities:

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provider of prepaid access *maintains access to* transactional records

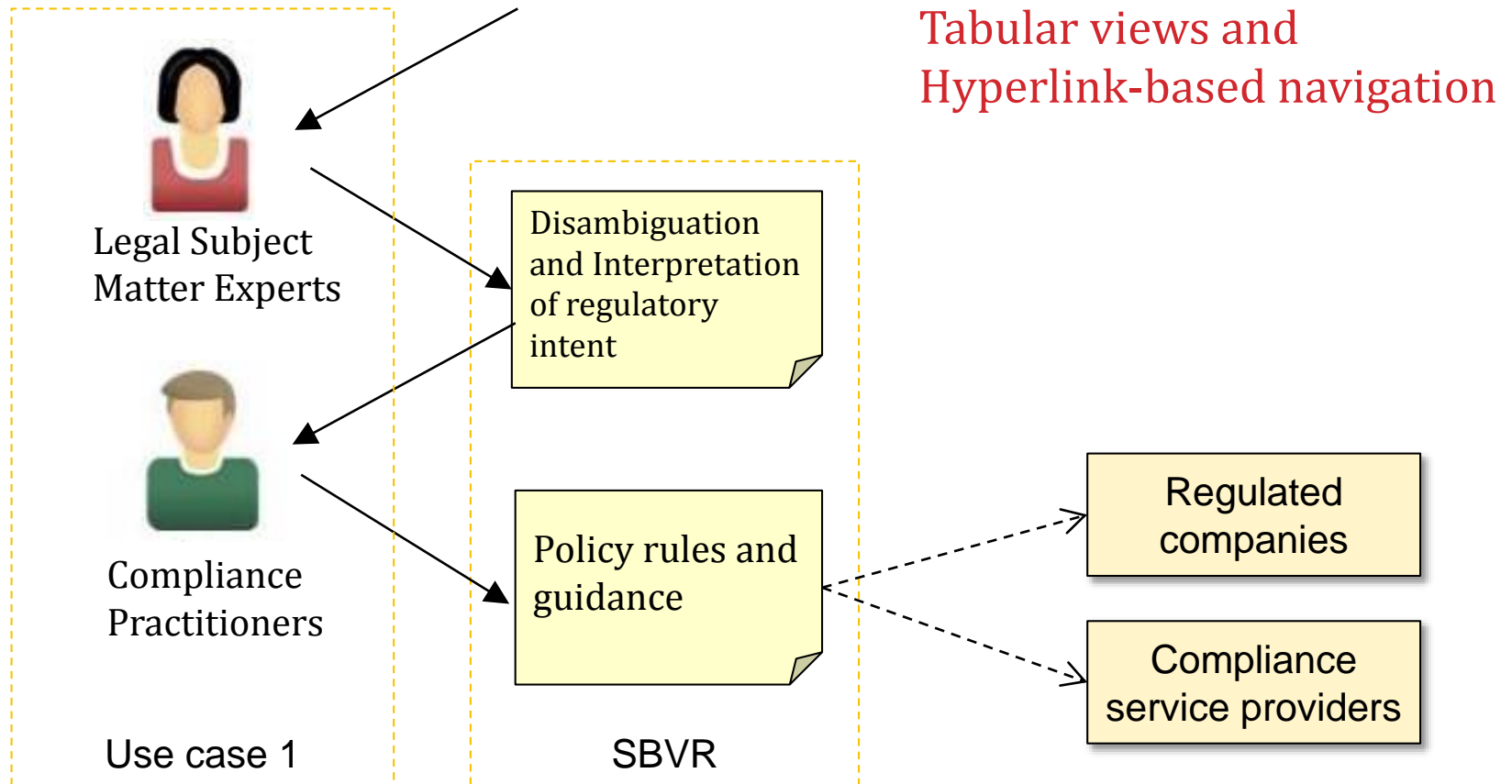Modality: Obligation   Modified Verb Concept

It is obligatory that each provider of prepaid access *maintains access to* transactional records *for* a period *of* five years.
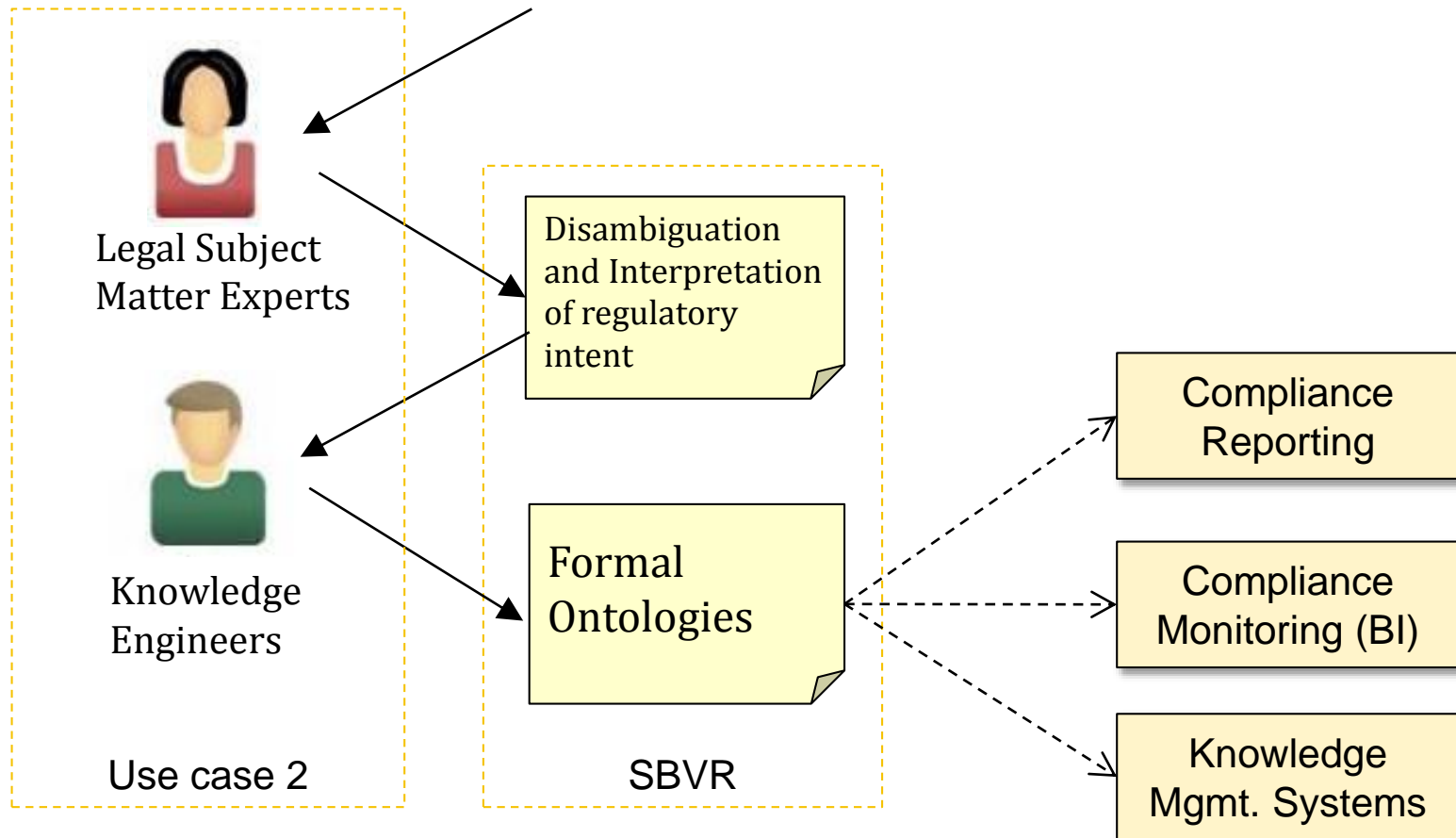
Constraint

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APPLICATIONS & BENEFITS

USING THE REPOSITORY TO CREATE POLICIES

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USING THE REPOSITORY TO CREATE FORMAL ONTOLOGIES

Legal Subject Matter Experts

Knowledge Engineers

Use case 2

Disambiguation and Interpretation of regulatory intent

Formal Ontologies

SBVR

Compliance Reporting

Compliance Monitoring (BI)

Knowledge Mgmt. Systems

USING THE REPOSITORY TO CREATE FORMAL ONTOLOGIES

<u>currency</u>

Definition: **is** the <u>coin</u> and <u>paper money</u> **of** a <u>country</u> that **is designated as** <u>legal tender</u> and that **circulates** and **is** customarily **used** and **accepted as** a <u>medium of exchange</u> **in** the <u>country of issuance</u>.

Concept Type: general noun concept

General Concept: legal tender

Source: 31 CFR Chapter X § 1010.100(m)

Example: the <u>coin</u> and <u>paper money</u> **of** the <u>United States</u>

OWL Class axioms:
- Currency
- LegalTender
- Coin
- PaperMoney
- Country
- MediumOfExchange

OWL SubClassOf axioms:
- LegalTender /Currency
- Country /CountryOfIssuance

OWL InstanceOf axioms:
- UnitedStates/ Country

OWL ObjectProperty axioms:
- HasCountryOfIssuance (coin, country)
- HasCountryOfIssuance (paperMoney, country)
- isDesignatedAsLegalTender(paperMoney, LegalTender)
- isDesignatedAsLegalTender(coin, legalTender)
- […]

SUMMARY & CONCLUSIONS

***Immediate* benefits**

- Remove complexity/ambiguity from regulations and resulting policies and rules
- Improve communication using a shared vocabulary
- Increase immediate understanding with underlying formal logic

***Intermediate* benefits**

- Build controls based on the guidance expressed in SBVR → auditability and backward traceability

Ultimate goal

- Reached when SBVR vocabularies and rules are transformed into fully machine understandable models
- On-going work
  - SBVR XMI Export Validation (against the OMG's Schema)
  - Increase the automation of SBVR XMI→ OWL

Interpreting Regulations is an Art

Our approach makes it a Science

THANK YOU

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QUESTIONS?