

The Semantics of Things that Happen an exploration

Mike Bennett

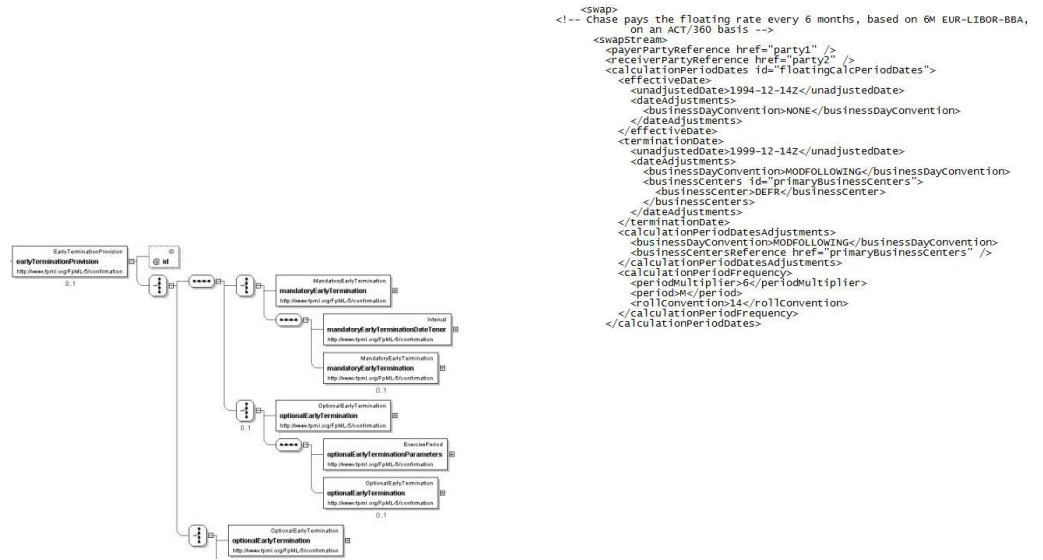
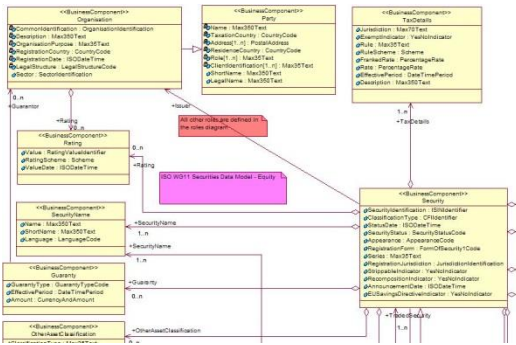
Ontolog Forum, 5 November 2015

Outline

- Brief introduction to FIBO
- The requirements for occurrent
- Issues with current placeholders
- A philosophical investigation
- Occurrent pairwise disjoint facets
- Conclusions and discussion starters

Introducing FIBO

Financial Industry Data Standards

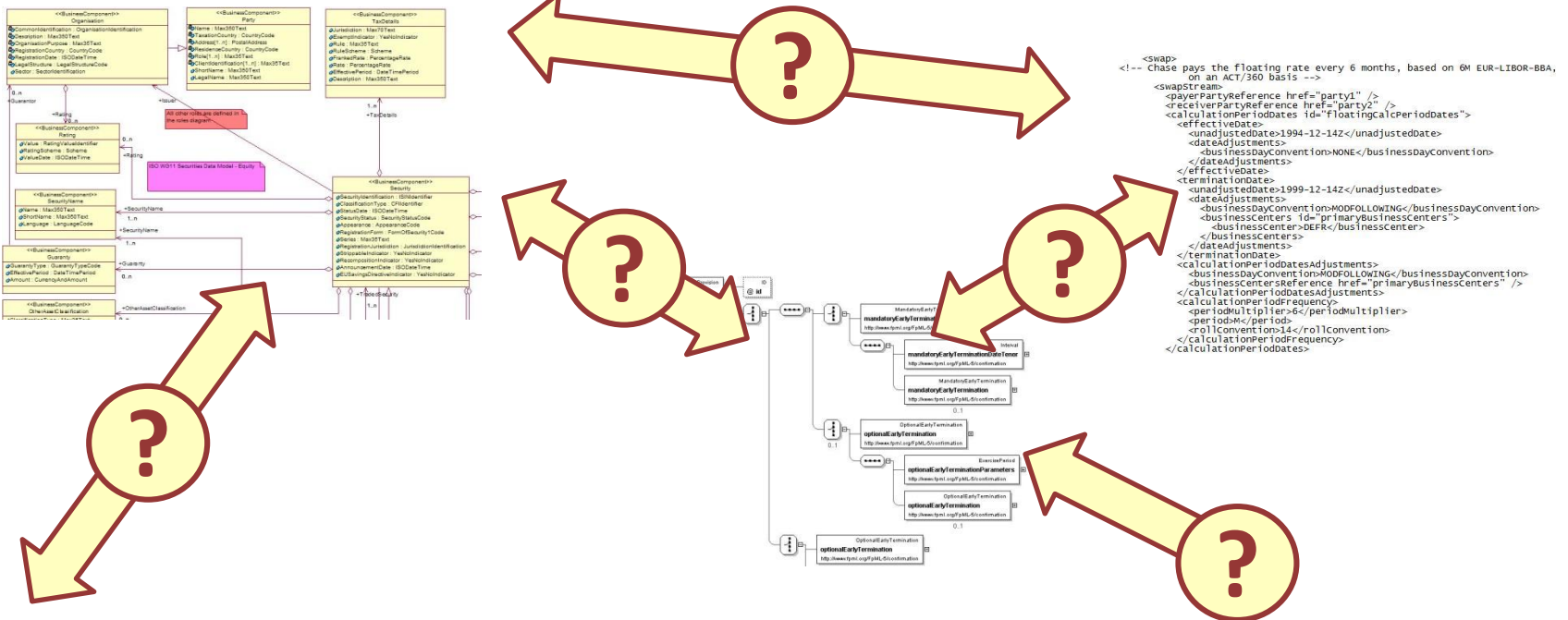


```

<!-- Chase pays the Floating rate every 6 months, based on 6M EUR-LIBOR-BBA,
on an ACT/360 basis -->
<SwapStream>
  <partyPartyReference href="party1" />
  <receiverPartyReference href="party2" />
  <calculationPeriodDates id="floatingCalcPeriodates">
    <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" />
        <businessCenters>DEFR</businessCenters>
      </dateAdjustments>
    </terminationDate>
    <calculationPeriodDatesAdjustments>
      <businessDayConvention>MODFOLLOWING</businessDayConvention>
      <businessCenters id="primaryBusinessCenters" />
    </calculationPeriodDatesAdjustments>
    <calculationPeriodFrequency>
      <periodMultiplier>6</periodMultiplier>
      <period>M</period>
      <rollConvention>14</rollConvention>
    </calculationPeriodFrequency>
  </calculationPeriodDates>

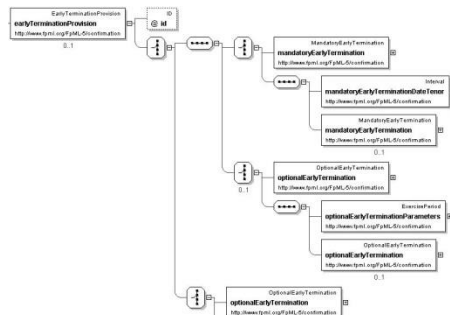
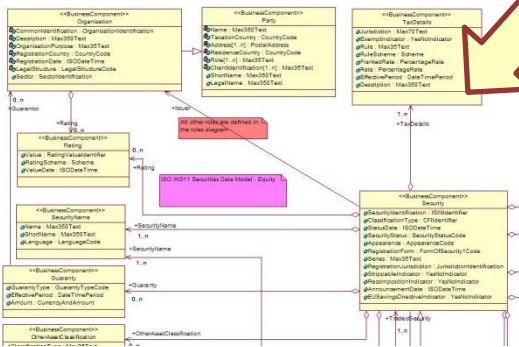
```

Disparate Data



Unified Semantics

Conceptual ontology
Shared business meanings



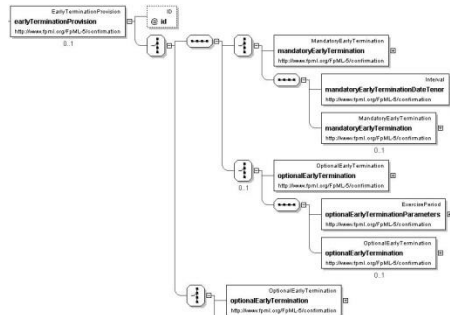
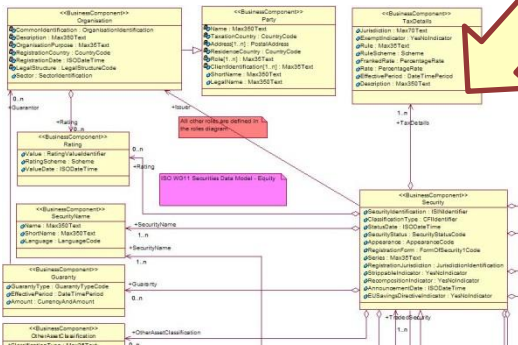
```
<SWAP>
  Chase pays the Floating rate every 6 months, based on 6M EUR-LIBOR-BBA,
  on an ACT/360 basis -->
</SWAP>
<swaptream>
  <partyPartyReference href="party1" />
  <receiverPartyReference href="party2" />
  <calculationPeriodDates id="floatingcalcperiodates">
    <effectiveDates>
      <unadjustedDate>1994-12-14Z</unadjustedDate>
    </effectiveDates>
    <businessDayConvention>NONE</businessDayConvention>
  </calculationPeriodDates>
  <dateAdjustments>
    <effectiveDates>
      <unadjustedDate>1999-12-14Z</unadjustedDate>
    </effectiveDates>
    <businessDayConvention>MODFOLLOWING</businessDayConvention>
    <businessCenters id="primarybusinesscenters">
      <businessCenter>DEFK</businessCenter>
    </businessCenters>
  </dateAdjustments>
  </terminationDate>
  <calculationPeriodDatesAdjustments>
    <businessDayConvention>MODFOLLOWING</businessDayConvention>
    <businessCentersReference href="primarybusinesscenters" />
  </calculationPeriodDatesAdjustments>
  <calculationPeriodFrequency>
    <periodMultiplier>6</periodMultiplier>
    <periodicPerIODs>
      <rollConvention>14</rollConvention>
    </periodicPerIODs>
  </calculationPeriodFrequency>
</calculationPeriodDates>
```

Business Validation



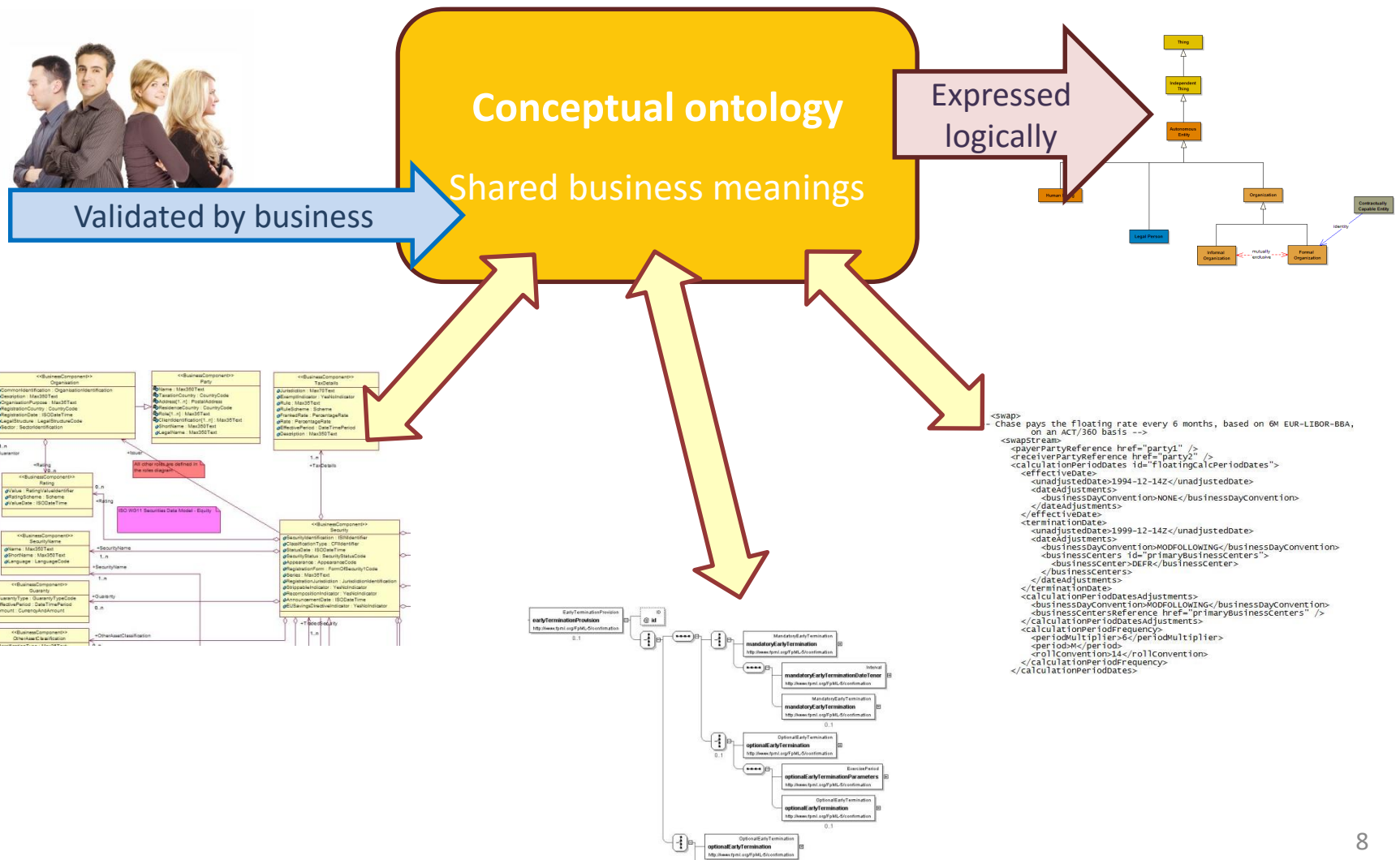
Validated by business

Conceptual ontology
Shared business meanings



```
<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" />
<<calculator>periodates id="FloatingCalculatorPeriodates">
<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>DEFK</businessCenter>
</businessCenters>
</dateAdjustments>
</terminationDate>
<calculator>periodatesAdjustments>
<businessDayConvention>MODFOLLOWING</businessDayConvention>
<businessCentersReference href="primaryBusinessCenters" />
<calculator>periodatesAdjustments>
<calculator>periodFrequency>
<periodMultiplier>6</periodMultiplier>
<period>6M</period>
<rollConventions>14</rollConventions>
</calculator>periodates>
</calculator>periodates>
```

Formal Logic Representation



Finance Industry Language

- Terminology / Vocabulary
 - Focus is on words
 - Different people use the same words for different concepts and different words for the same concepts
- Data Dictionary
 - Documents the meaning or meanings of individual data elements
 - Good design means one data element has many applications
- Ontology
 - Each element in the model represents on concept

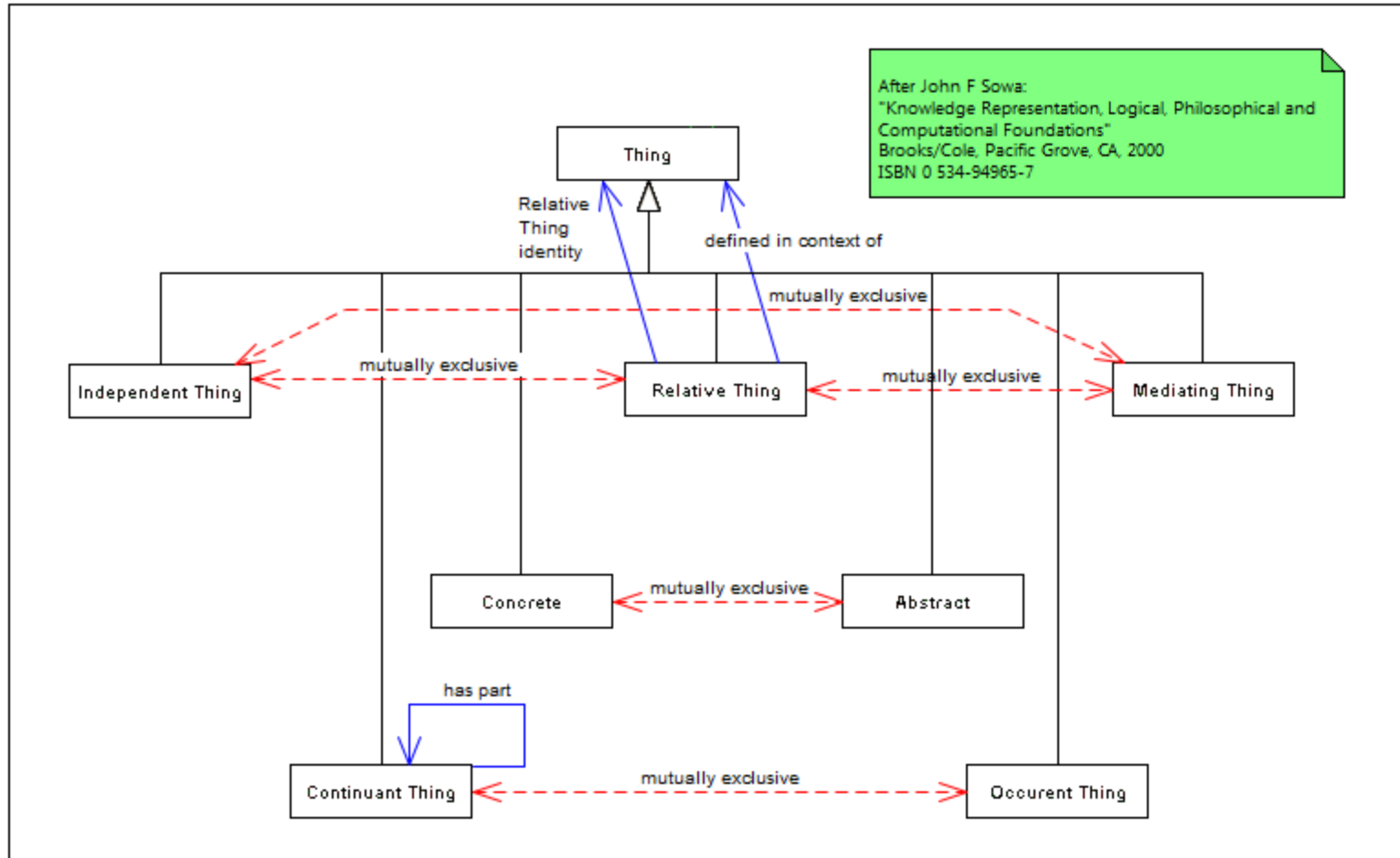
The FIBO Moment

- Previous standardization efforts at message and data levels
- Arguments over terms
- Atkin: “What if we considered the concepts without worrying about the words people use?”
 - Sudden outbreak of peace!

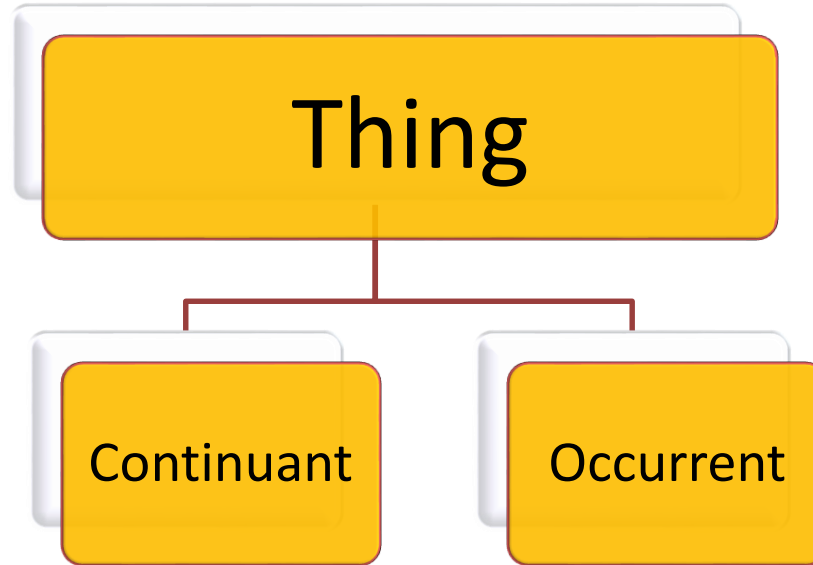
The FIBO Principles

- Concepts not Words
- Meanings are grounded in the terms of law, contract etc.
- Use of upper level abstractions

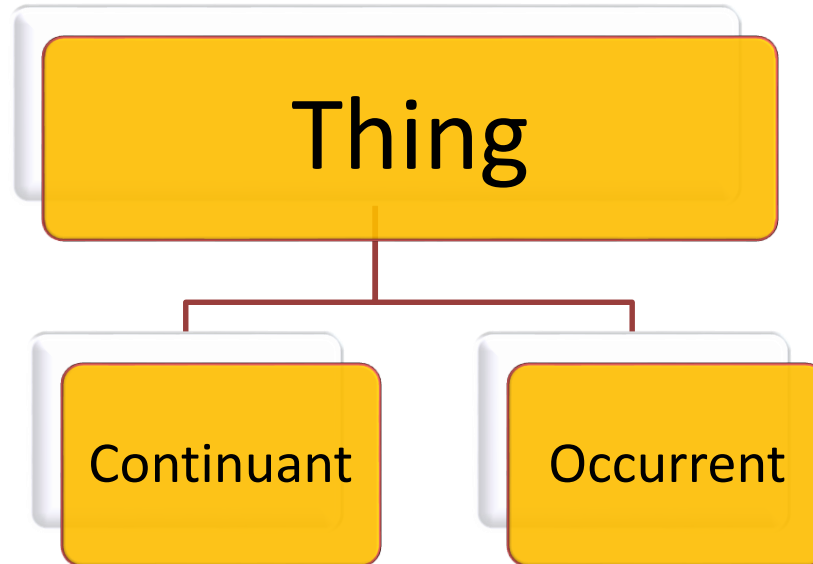
Upper Ontology Partitions



Continuants and Occurrents

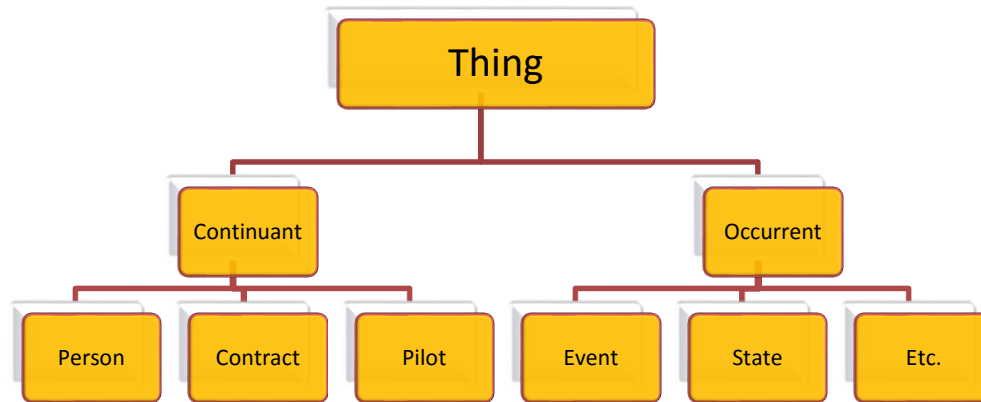


Continuants and Occurrents



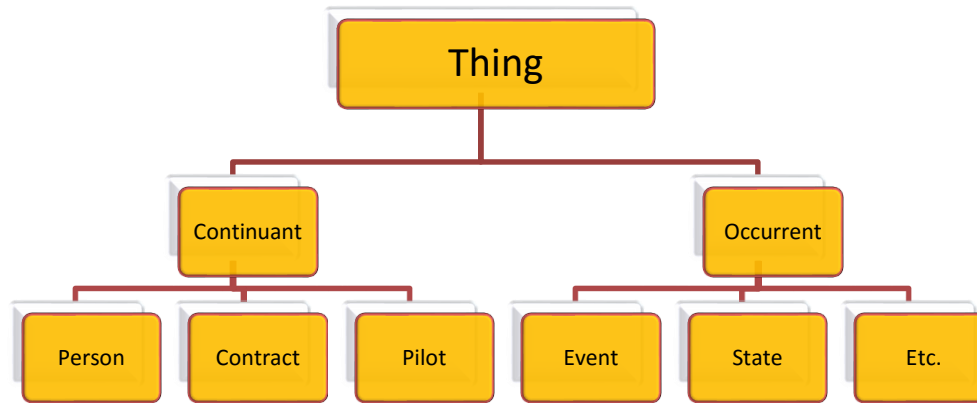
- Continuant:
where it exists, it exists in all its parts
 - Even if these change over time
- Occurrent: the concept is only meaningful with reference to time

Continuants and Occurrents



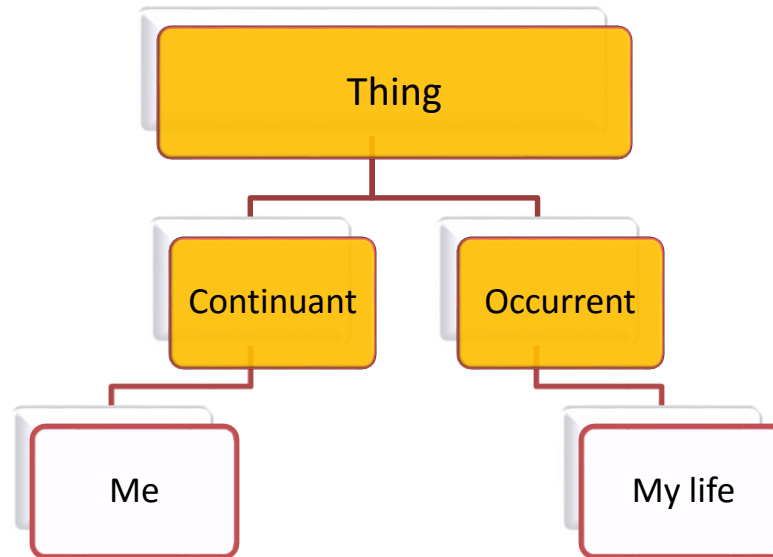
- Continuant:
where it exists, it exists in all its parts
 - Even if these change over time
- Occurrent: the concept is only meaningful with reference to time

Ontology Partitioning



- Things which are independent or relative are also either continuant or occurrent

Continuants and Occurrents Example



- Me: where I exist I exist in all my parts
 - Even if these change over time
- My life: happens over a period of time and cannot be defined without time

Why does this Matter?

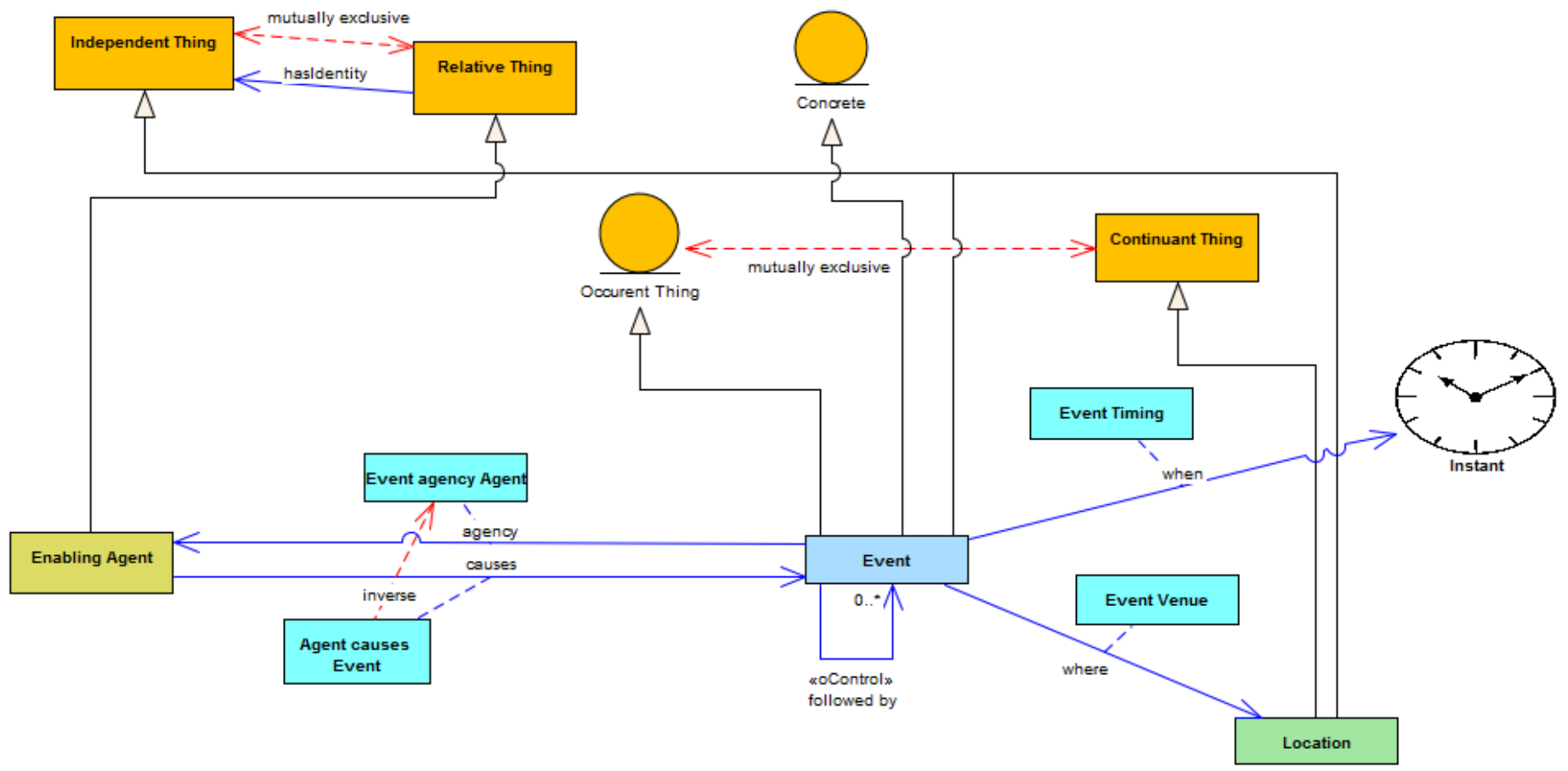
- Frame concepts which have a temporal component which are of interest to the business
 - Events, activities
 - States
 - Statuses, prices, other time-variant concepts
- Provide a basis for ontological modelling of business process
- This brings the two sides of development (structural and behavioural) into the same conceptual model

FIBO Occurrent Things Placeholders

- Event
- Activity
- Process (e.g. securities issuance)
- Corporate events
- Lifecycles
- Interest Accrual
- Conditions and triggers
- Transacton workflow / payments process

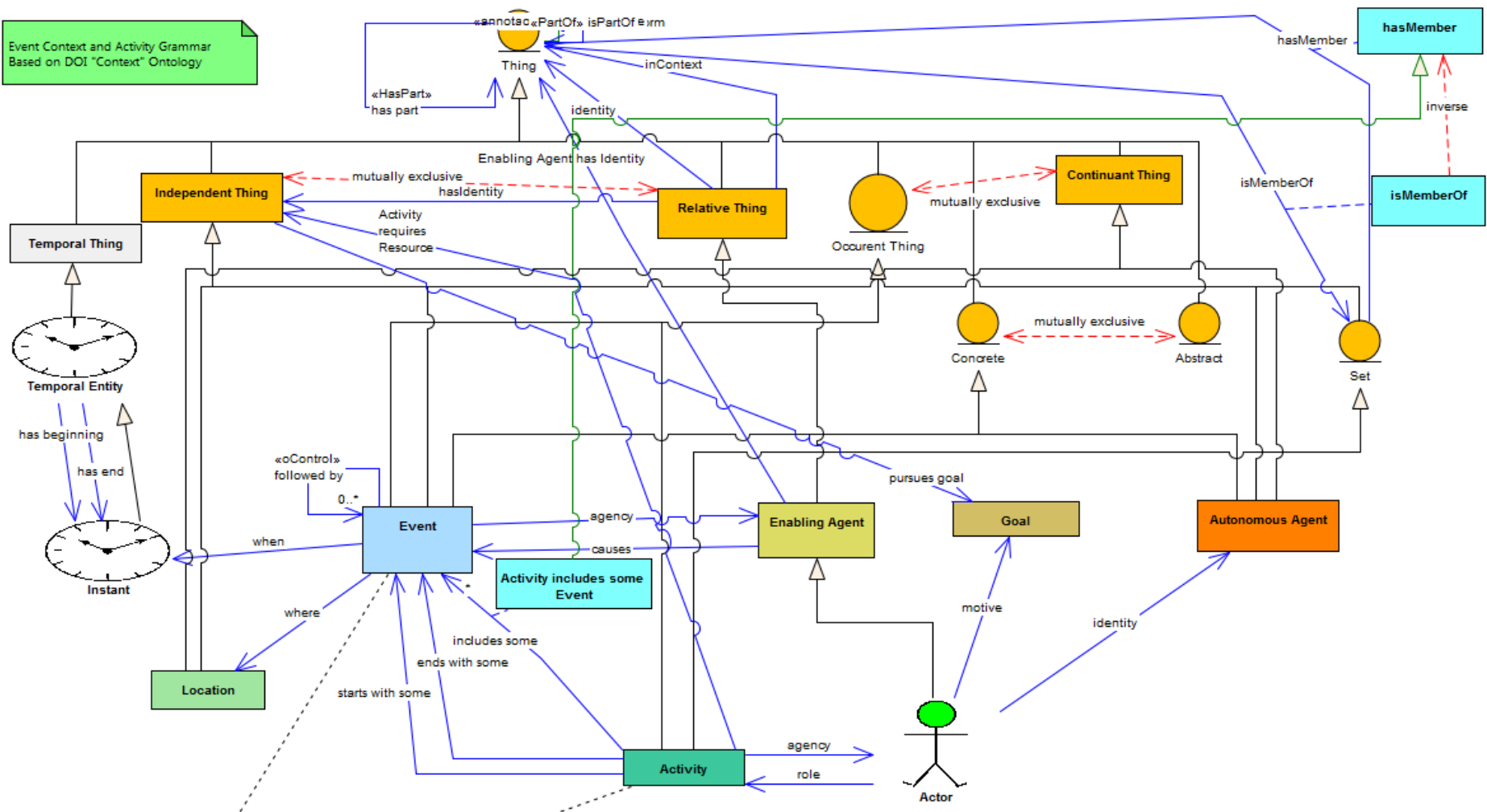
Event

class Event Grammar Detail



class Activity: Event Context

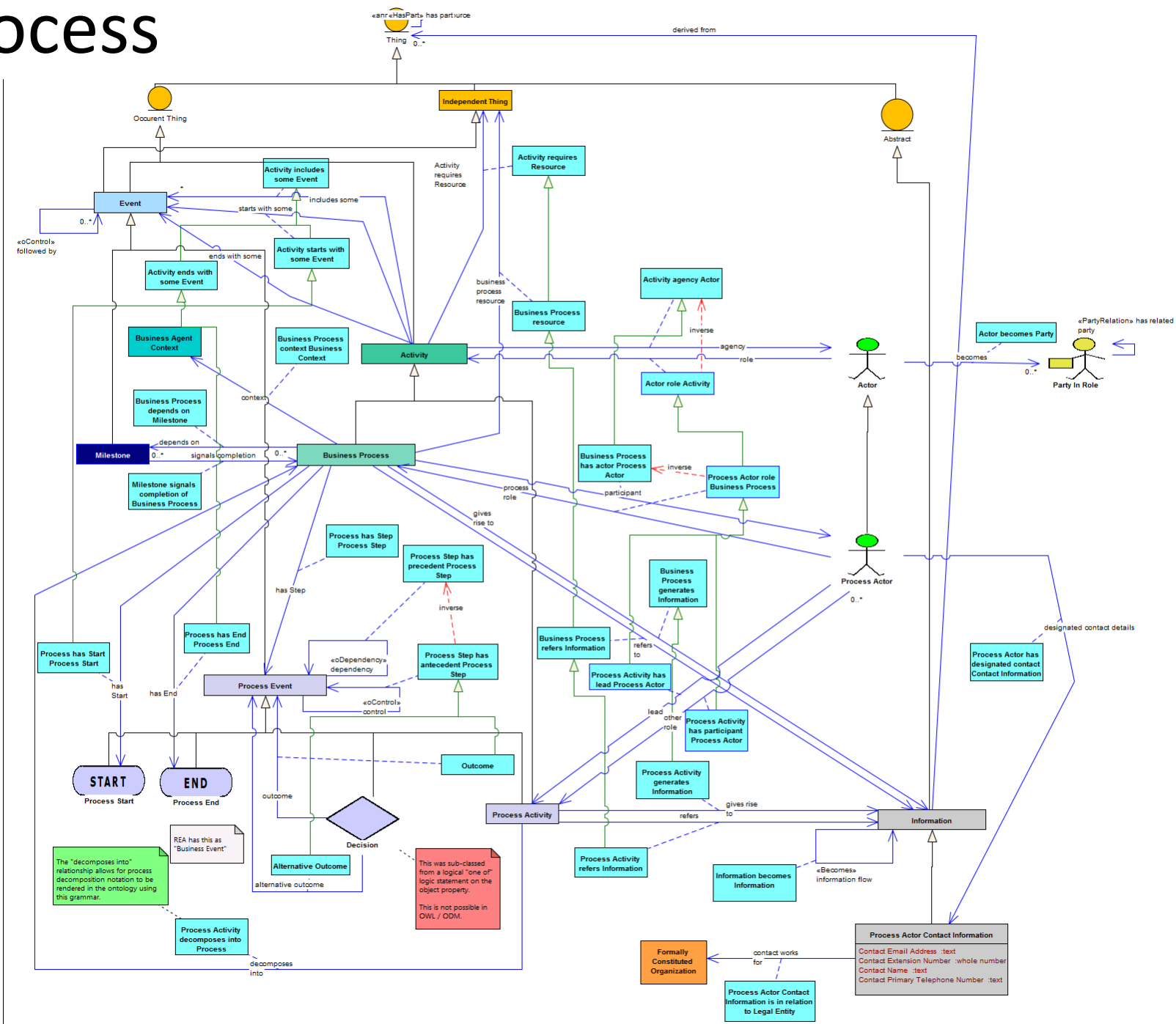
Event Context and Activity Grammar Based on DOI "Context" Ontology

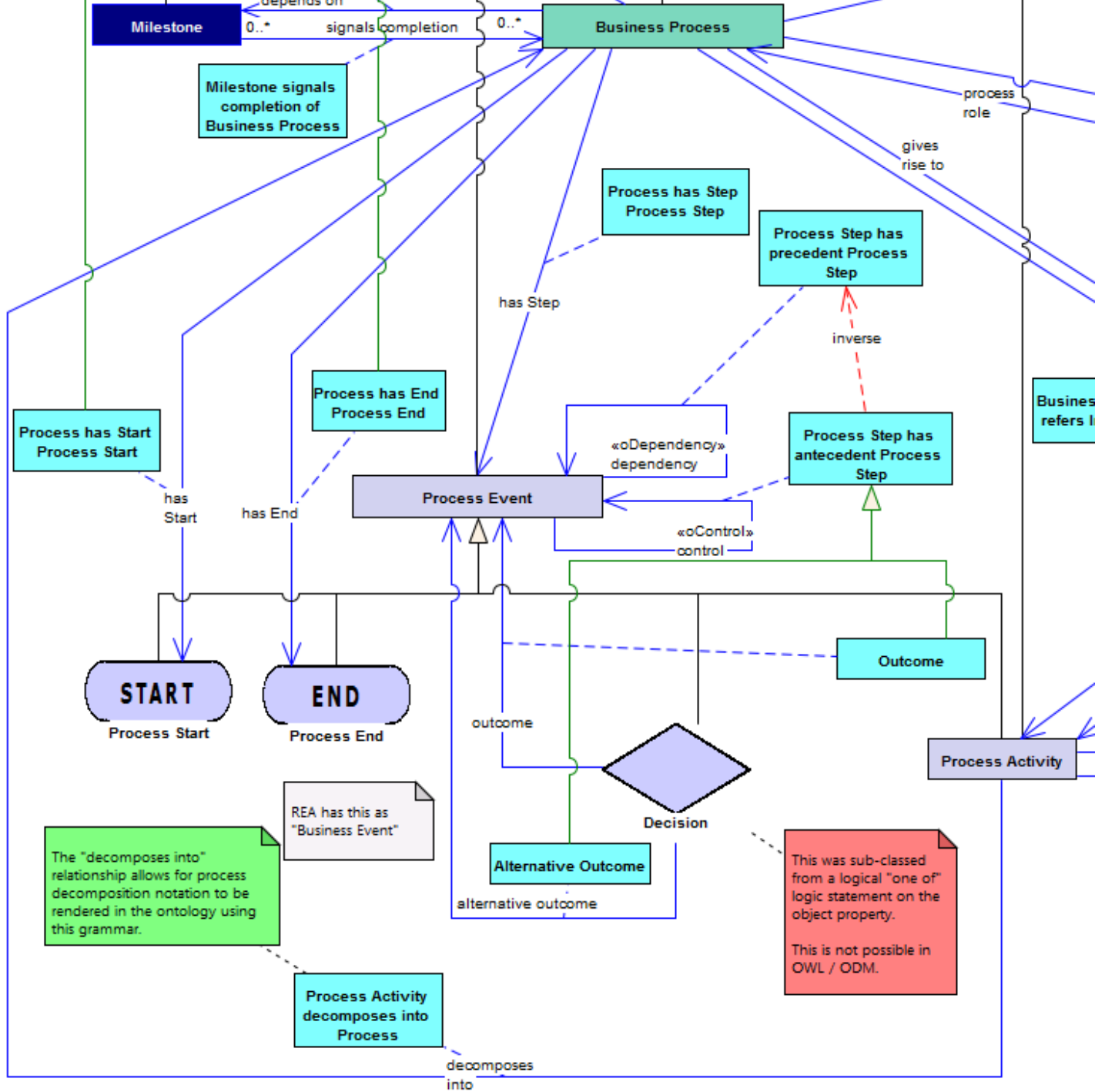


An event is instantaneous whereas an Activity occurs over a period of time (and is defined in relation to time).
 Activity decomposes into Events, i.e. there are instantaneous events which together make up that bundle of events which is described as an Activity.
 A Process is a kind of Activity (one which is pre-defined and repeatable).

An Event also causes some change of State (not yet shown).

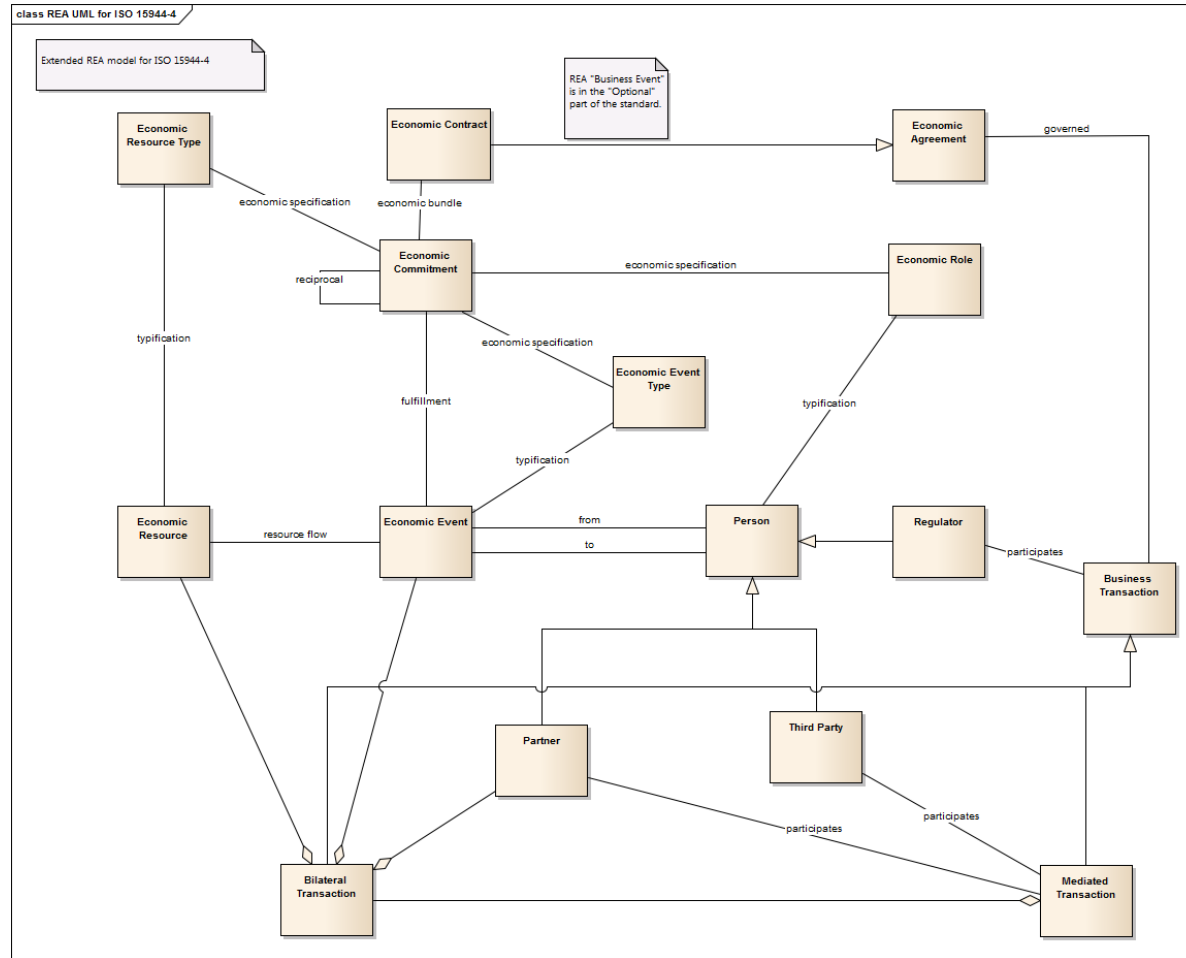
Process



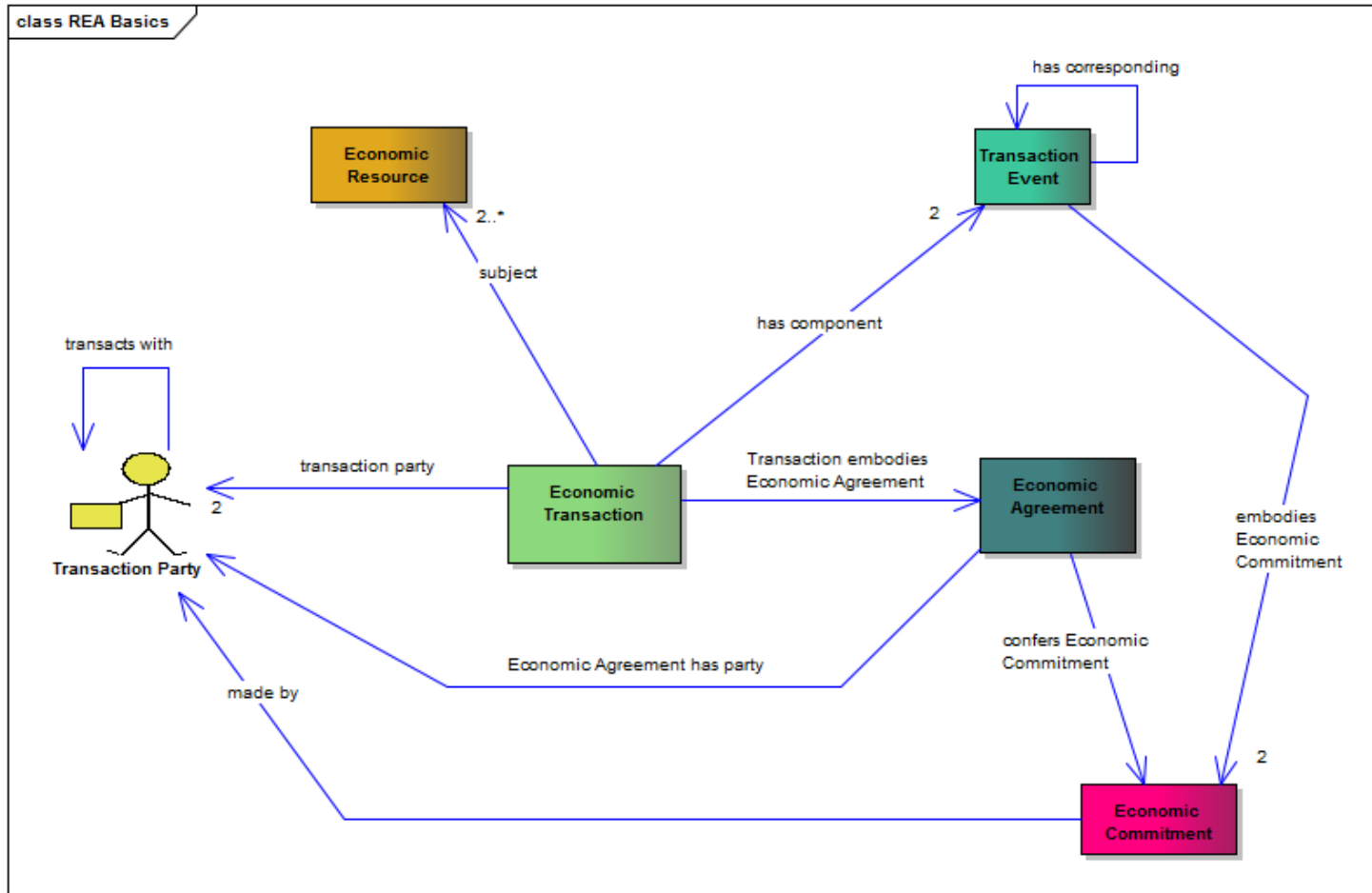


Terms Derived from REA Ontology

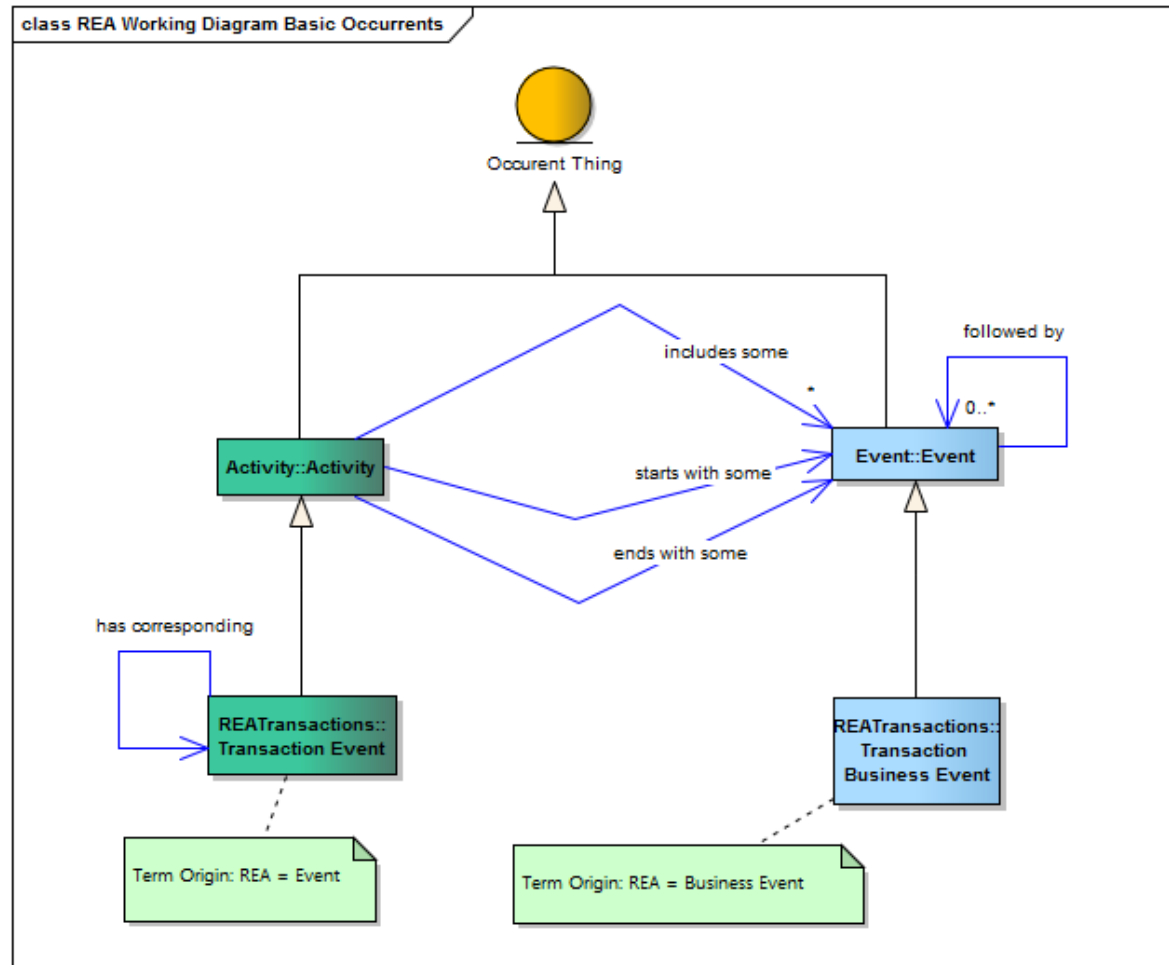
ISO 15944-4



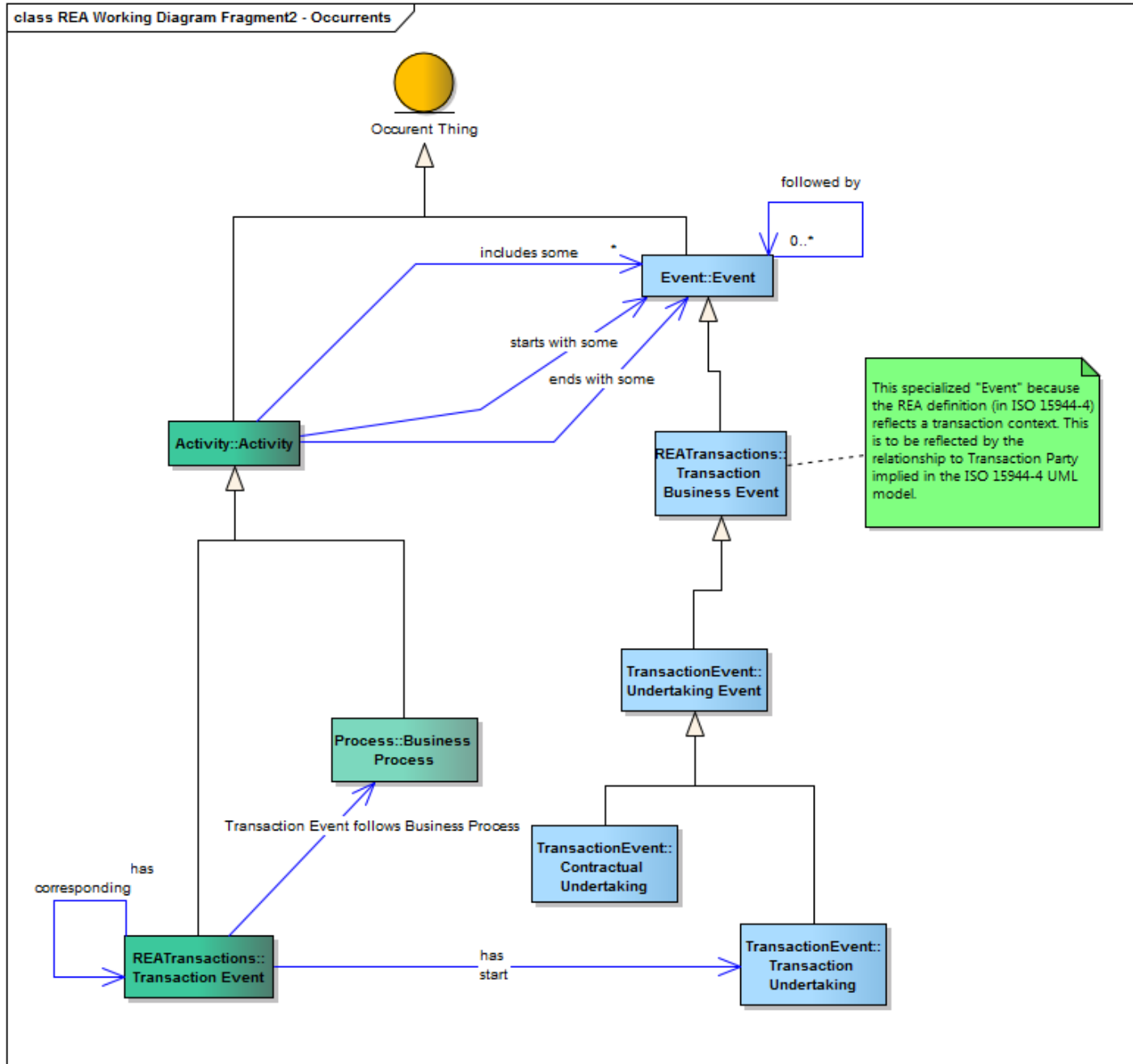
REA Basic Terms



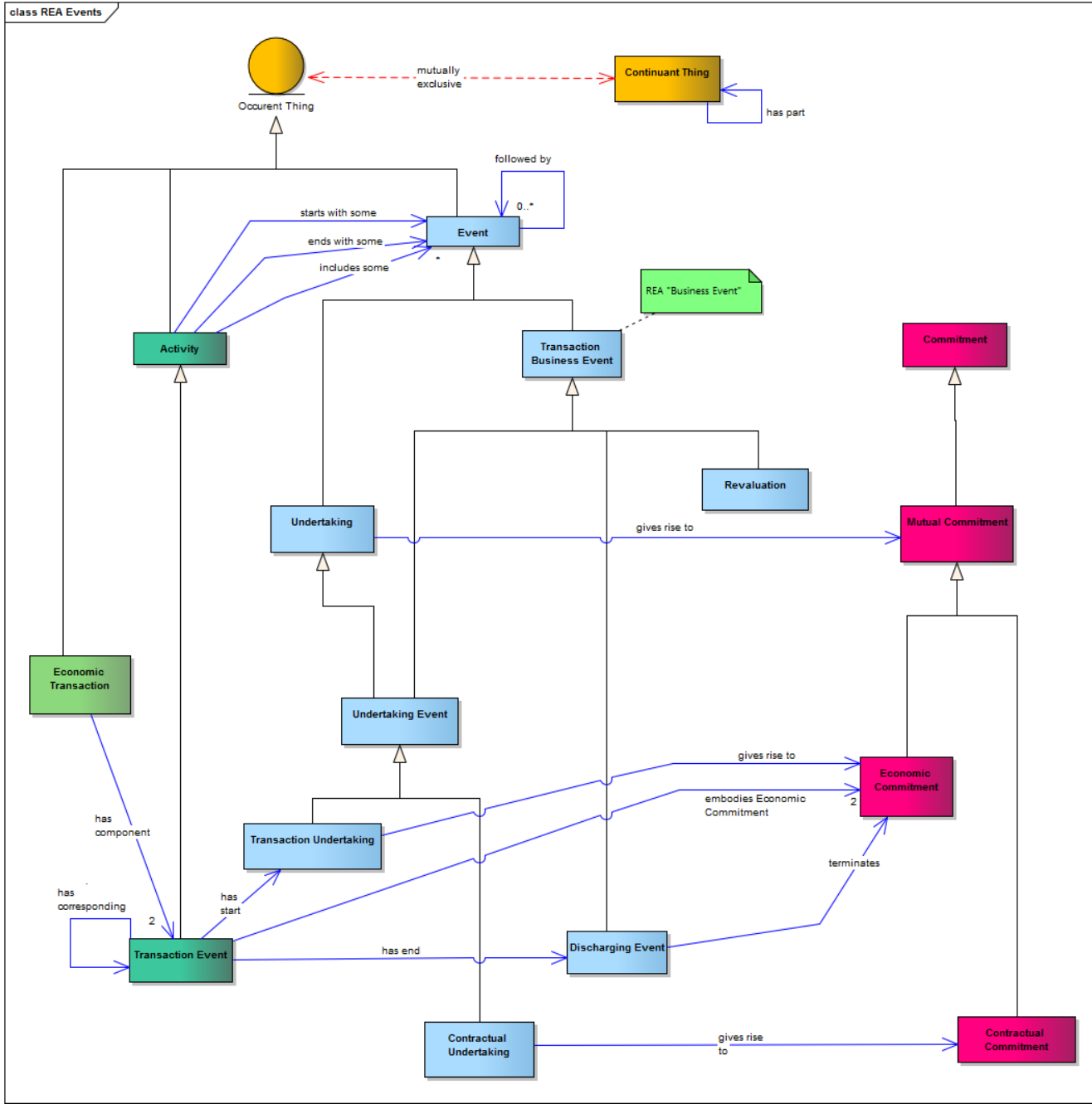
Occurrences



Txn Event

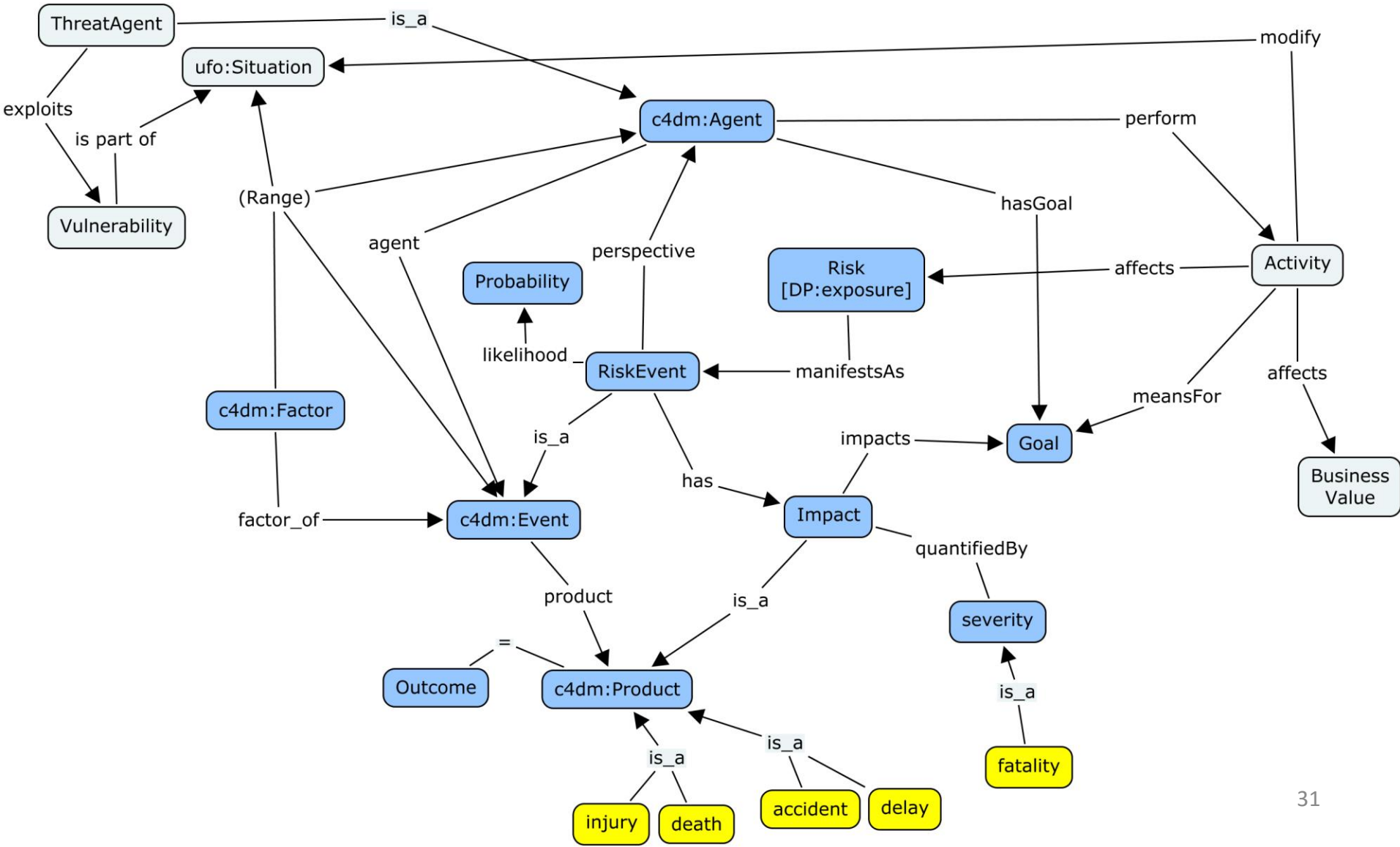


Txn Event Detail – Undertakings

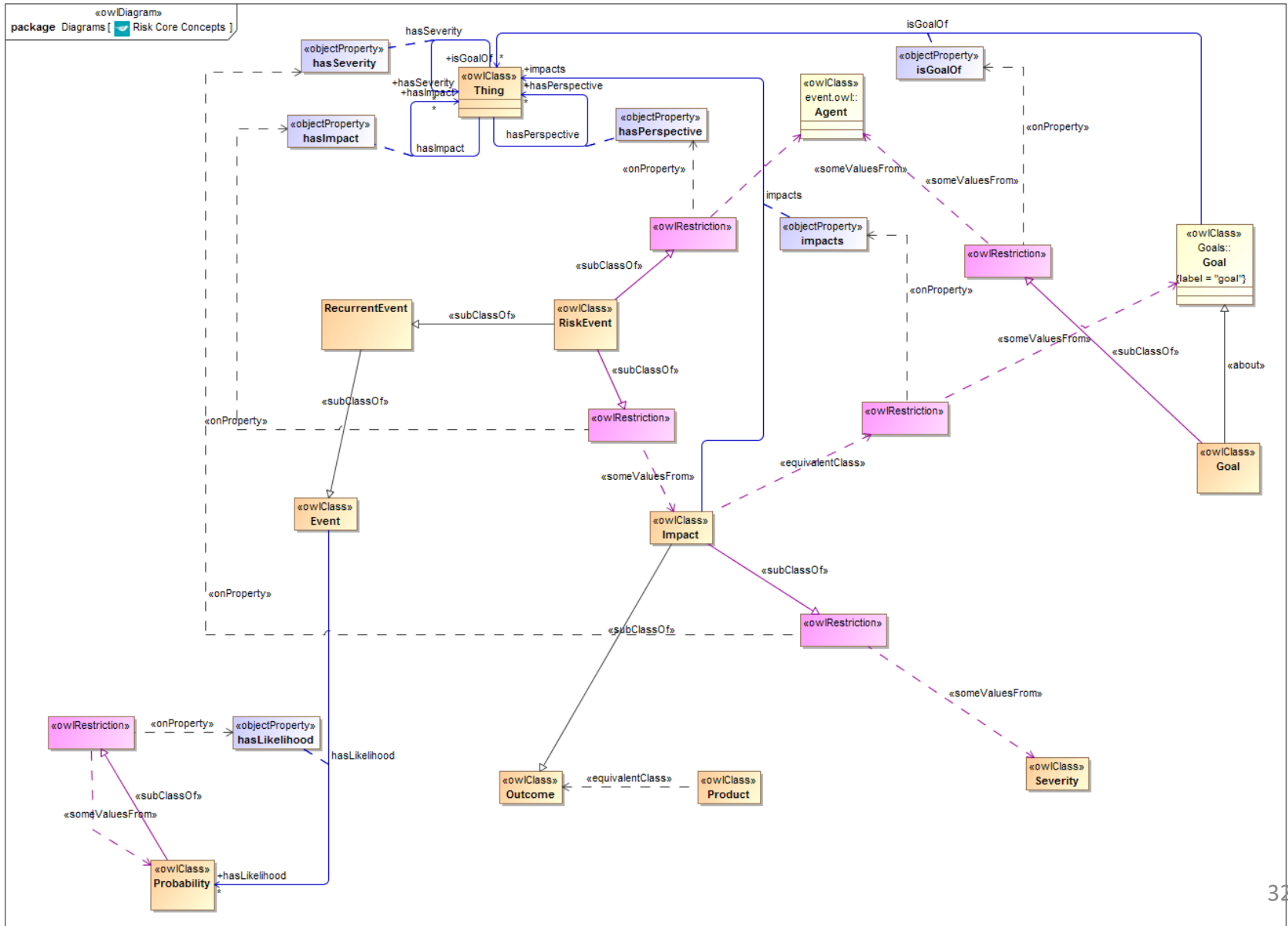


Ontology Summit 2014 Risk Hackathon

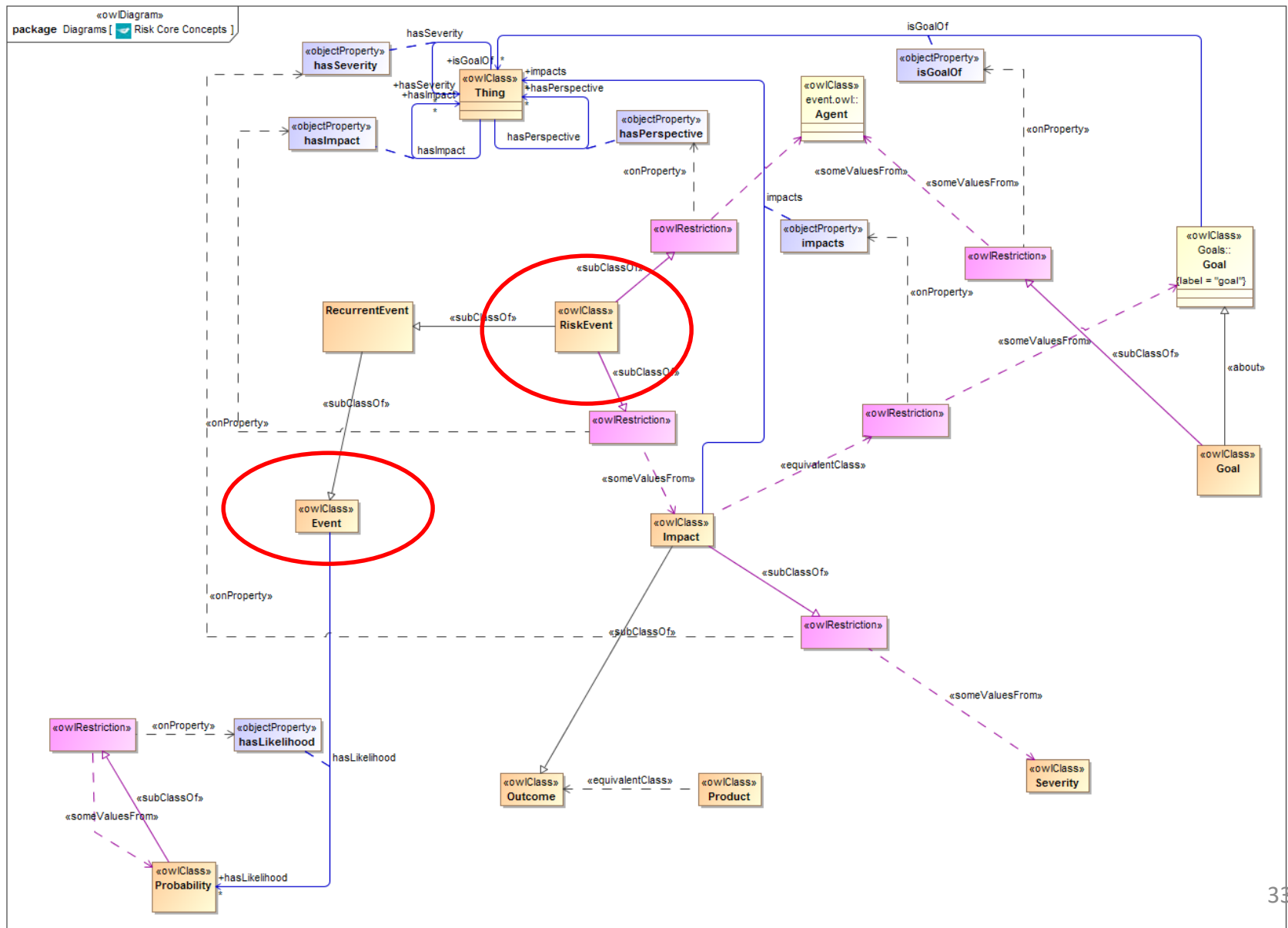
Initial Diagram for Risk Concepts



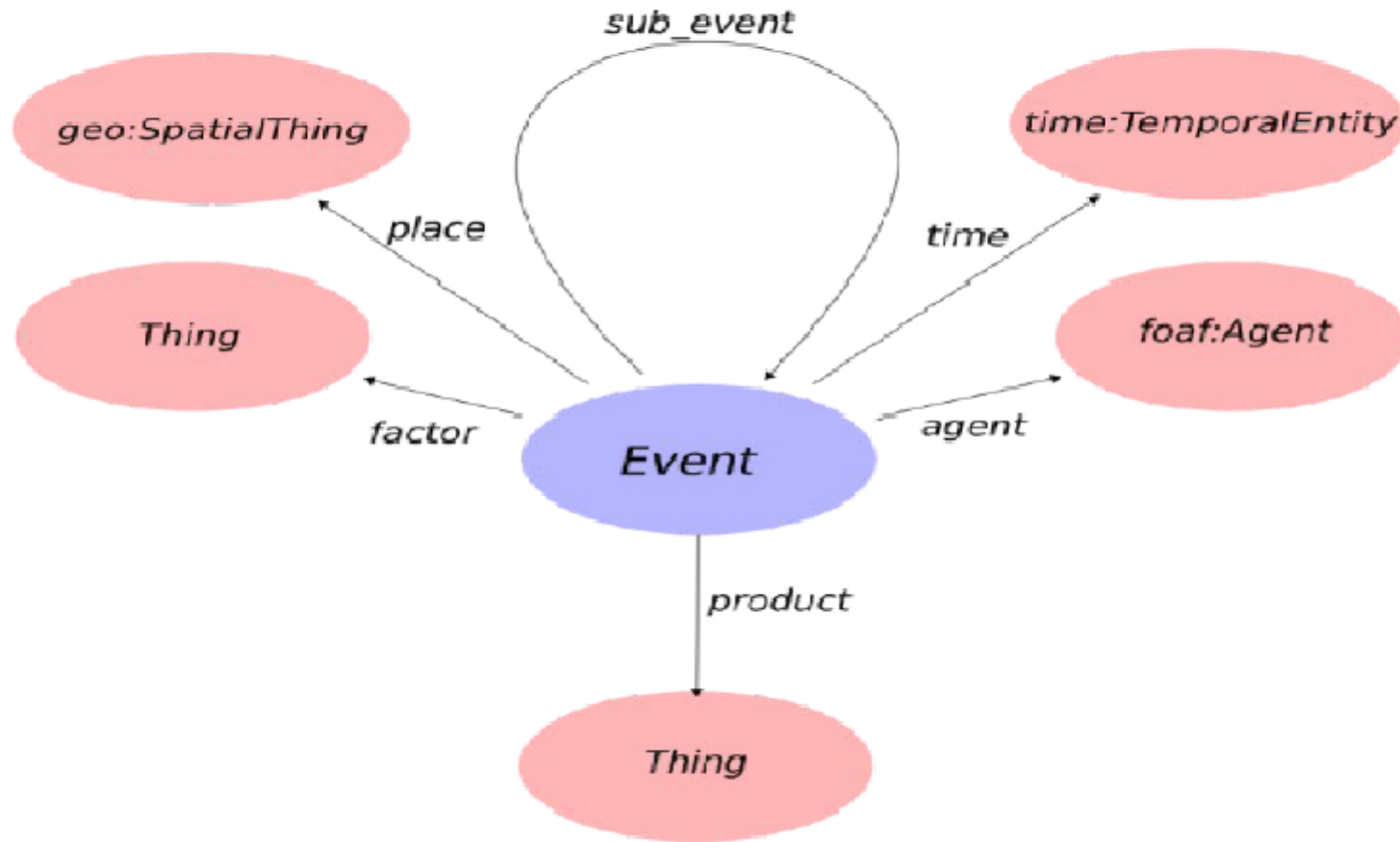
Risk Concepts Ontology



Risk Concepts Ontology



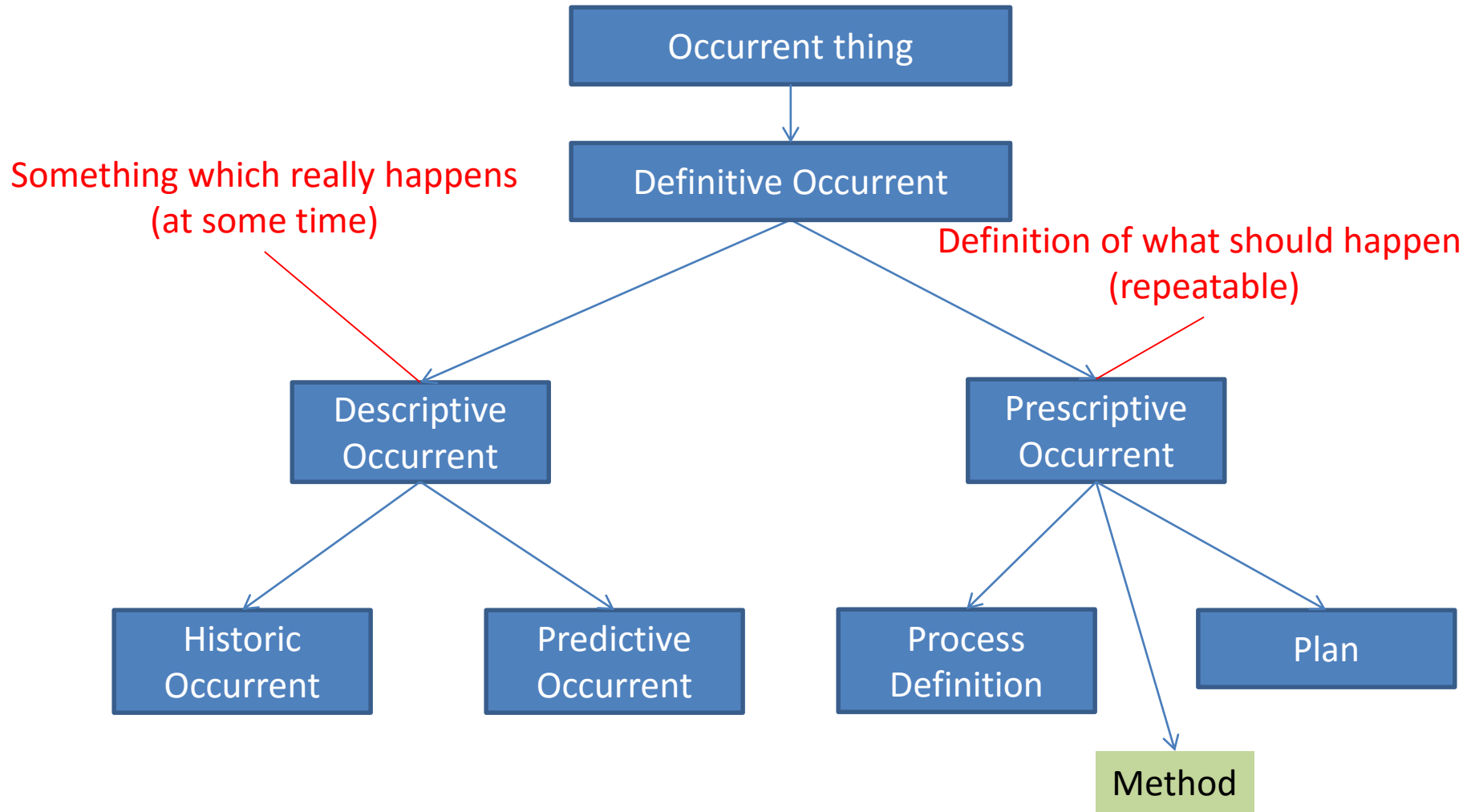
<http://purl.org/NET/c4dm/event.owl#>



What is Event?

- Event as something with a time and a place?
- Event as a relationship between 2 states?
- Event as every kind of “Occurrent Thing”?

Other Occurrent Requirements



Philosophical Investigation

Achievements and Attainments

- Stanford Encyclopedia
- DOLCE
- Some reactions and followups

Definitions

- From
 - [http://www.researchgate.net/post/Perdurant occurrences and perdurant continuants definitions and implications](http://www.researchgate.net/post/Perdurant_occurrences_and_perdurant_continuants_definitions_and_implications)

Continuants and occurrents.

- From the above link:
 - Continuants correspond largely to physical bodies, objects, and particular masses of matter, while occurrents correspond to events, processes, and - perhaps - momentary states. Here, I employ the following distinction:
 - a continuant is constructed as a spatial entity that has all its parts at an instant t , and no spatial parts at any other instant
 - an occurrent is constructed as a temporal entity that has only one part, or that has sequential temporal parts.

Continuants and occurrents.

- From the above link:
 - Continuants correspond largely to physical bodies, objects, and particular masses of matter, while occurrents correspond to events, processes, and - perhaps - momentary states. Here, I employ the following distinction:
 - States need not be momentary
 - a continuant is constructed as a spatial entity that has all its parts at an instant t , and no spatial parts at any other instant
 - Continuants need not be spatial
 - e.g. Commitment
 - an occurrent is constructed as a temporal entity that has only one part, or that has sequential temporal parts.
- We rejected aspects of this...

Endurants and perdurants

- In contemporary theories of persistence, a persisting entity either endures by having all its parts at any instant; or perdures by having parts at sequential instants. More generally,
 - an endurant has no temporal parts (or, at least, no conceptually distinguishable temporal parts) and thus exists in its entirety at each instant of its existence
 - a perdurant has temporal parts, and is at least temporally extended.

Discussion

- Continuant:
 - Leibniz's Law
 - Identity is based on having the same properties
 - However, parts and other properties change over time
 - The key is identity
 - This goes beyond simply having the same properties
 - But we are not sure exactly how – parked this problem for now
 - “A thing which continues in its identity”
 - Reject the explicitly “spatial” element of the definition
 - A commitment is a continuant

Discussion

- Occurrent
 - Some commentators suggest that time scale plays a part in the definition
 - We reject this
 - Use the perdurant definition
 - The concept is temporal in its definition
 - But it need not be instantaneous
 - A thing consisting entirely of temporal parts is itself an occurrent/perdurant

FIBO Working Definitions

- Continuant:
 - Definition: “something which exists and retains its identity across points in time”
 - Explanatory Note: These persist over time even when their constituents alter over time
- Occurrent:
 - Definition: “something which is defined wholly with reference to time or which consists of one or more things which are defined wholly with reference to time”
 - Explanatory Note: These are extended in time and so are only partly present at any time in which they exist

Extensions

- DOLCE has 4 extensions of perdurant
 - Achievement
 - Accomplishment
 - State
 - Process
- We need some clarity on achievement versus accomplishment, since the English words are synonymous – need to determine what are the assertions that distinguish these

DOLCE Light

- DOLCE Light left out a lot of the endurant v perdurant stuff, and simply said
 - there is an object, which is something that is rather than something that happens;
 - and then there is Event, which is something that happens.
- These are the same concepts with different labels

DOLCE Explanation

Top-Level Classes



Endurants and perdurants

- **Endurants (also referred to as continuants)**
 - Are wholly present at any time at which they exist
 - Can change in time
 - E.g. physical objects
- **Perdurants (or occurrents, occurrence)**
 - Are extended in time
 - Only partially present at any time at which they exist
 - E.g. events and processes
- **are related by participation:**
 - An endurant 'lives' by participating in a perdurant, e.g. a person participates in a discussion, a violinist performs in a concert

DOLCE Explanation

Top-Level Classes



- **Endurants (objects) and perdurants (events) may have constituent parts:**
 - Hairs on your head
 - Chorus of a song
- **Endurants (objects) may survive the loss and/or replacement of parts**
 - i.e. they retain their identity
- **Or, objects may just be ‘the sum of their parts’**
- **Parts cannot be removed from perdurants (events) once the event has happened**
 - Perdurants do not have temporal parts
- **Connectedness: once a whole object has been delimited, we can consider connections**
- **Mereology and topology => next lecture**

KMM Ontology Lecture 7



Source: <http://www.inf.ed.ac.uk/teaching/courses/kmm/PDF/L7-DOLCE.pdf>

Wikipedia Definitions

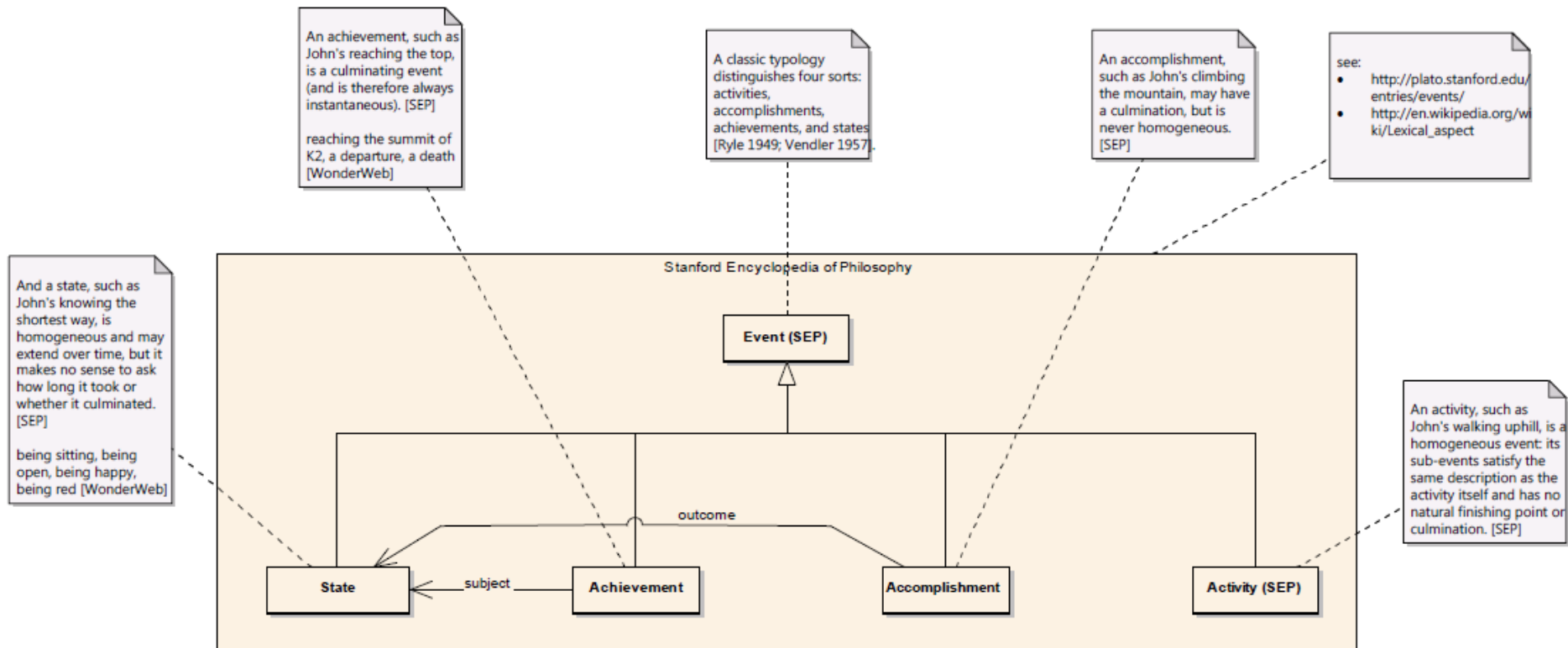
- **Endurant**

- Also known as continuants, or in some cases as "substance", endurants are those entities that can be observed-perceived as a complete concept, at no matter which given snapshot of time. Were we to freeze time we would still be able to perceive/conceive the entire endurant.
- Examples include material objects (such as an apple or a human), and abstract "fiat" objects (such as an organization, or the border of a country).

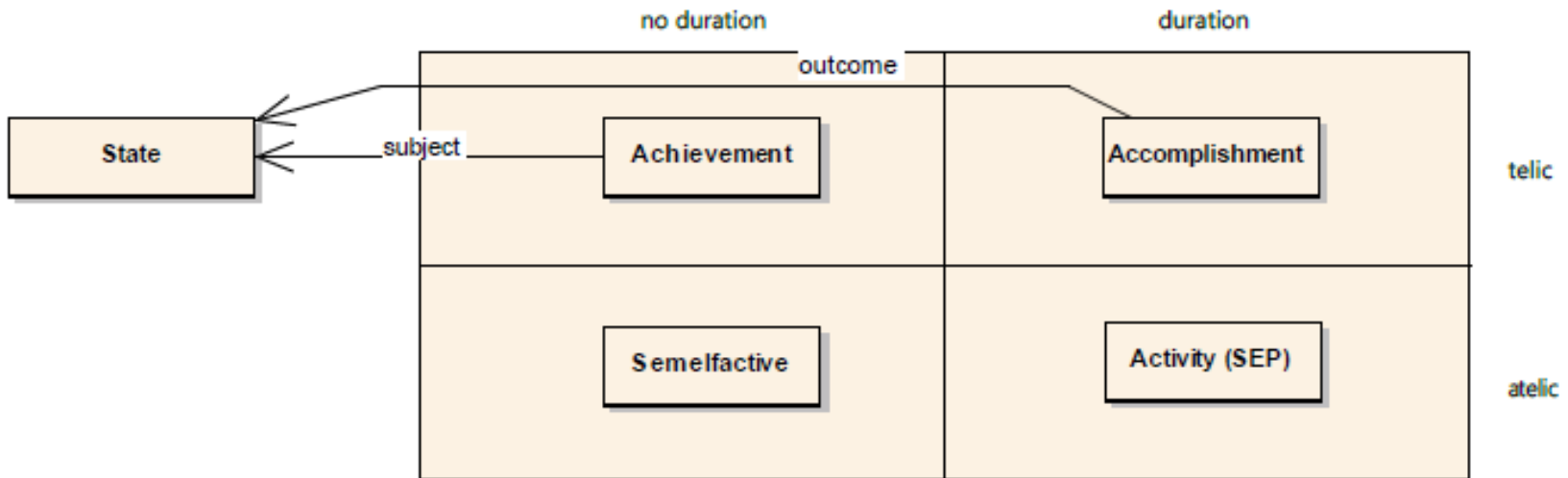
- **Perdurant**

- Also known as occurrents, accidents or happenings, perdurants are those entities for which only a part exists if we look at them at any given snapshot in time. When we freeze time we can only see a part of the perdurant.
- Perdurants are often what we know as processes, for example: "running". If we freeze time then we only see a part of the running, without any previous knowledge one might not even be able to determine the actual process as being a process of running. Other examples include an activation, a kiss, or a procedure.

Events (SEP)



Events (sorted)



- These are not the labels we will use
- Ontology is about the concepts

Comments

- Achievement and Accomplishment
 - As labels these were not helpful to business SMEs
 - Also not clear if we would use them in FIBO
 - Meanwhile, each represents a combination of concepts per the 2x2 table
- Conclusion
 - Separate out the distinct meanings
 - Pairwise disjoint facets
 - Also support earlier use cases for e.g. process as prescriptive occurrent

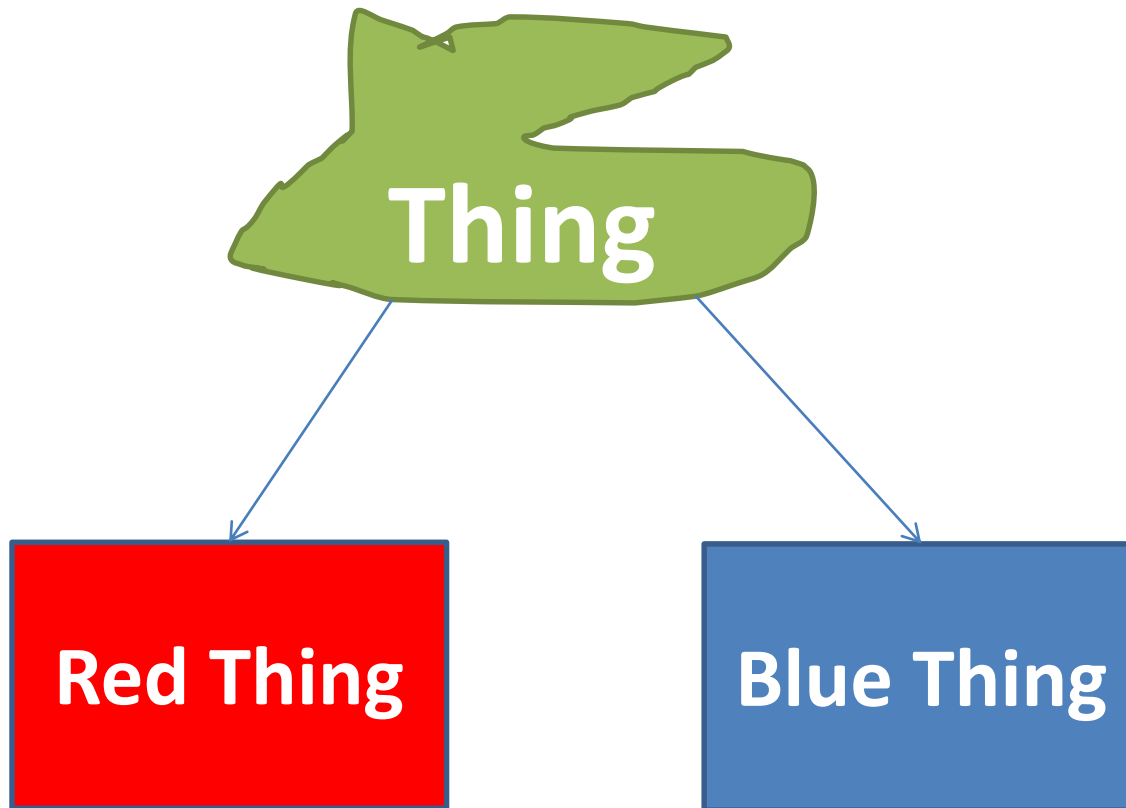
Proposals

- Faceted classification
- Some proposed facets
- Extending and using these

Faceted Classification

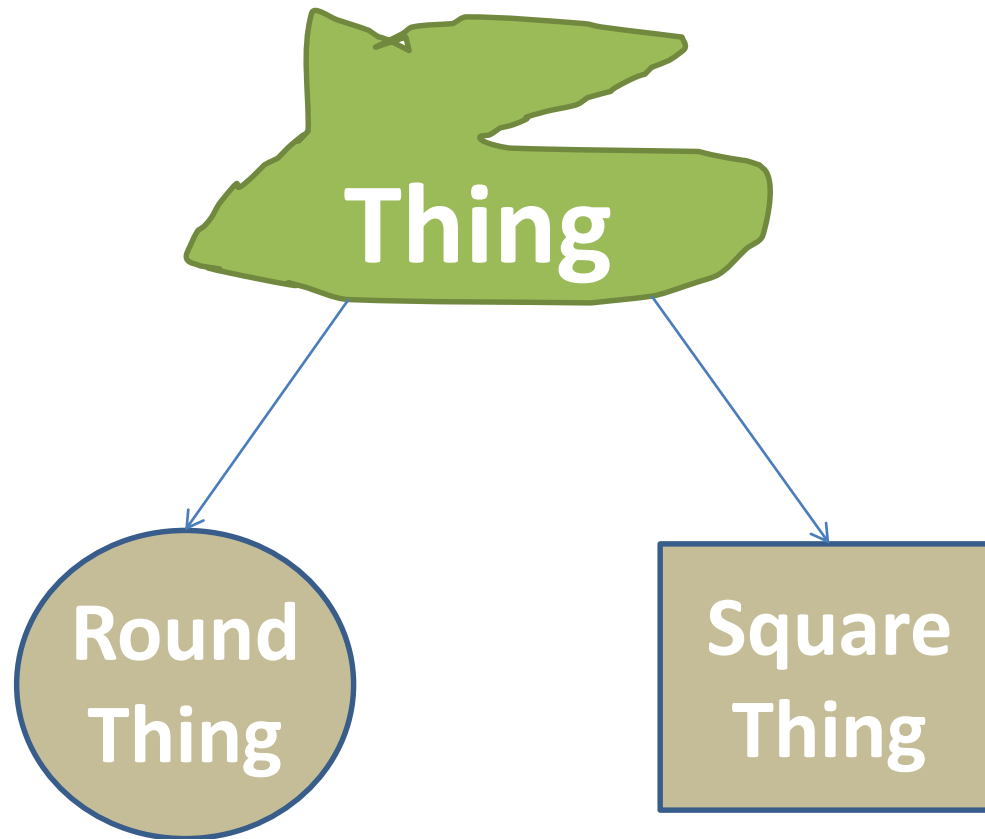


Faceted Classification



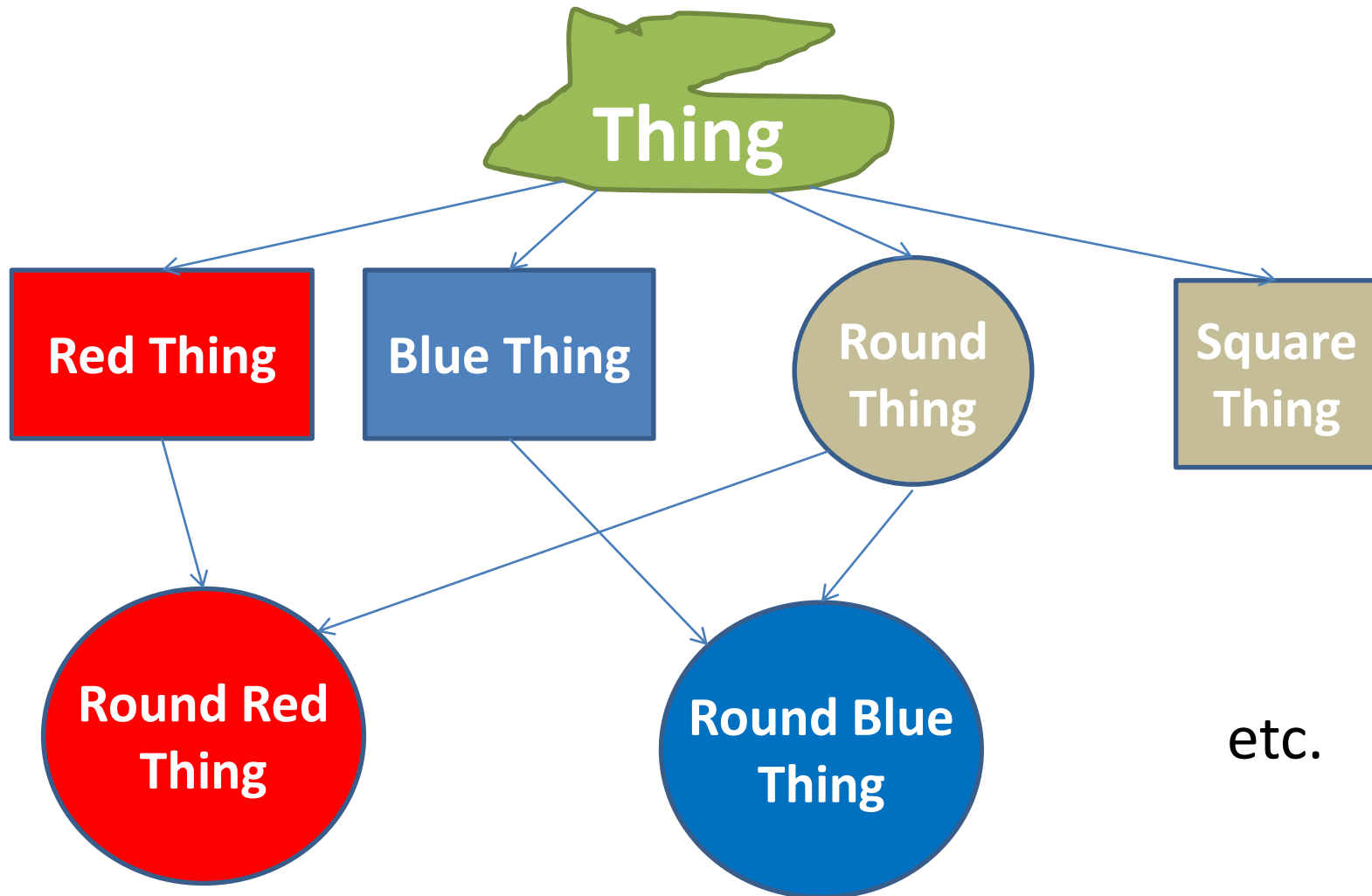
Differentiae: what distinguishes the sub types of the Thing

Faceted Classification



Differentiae: what distinguishes the sub types of the Thing

Faceted Classification



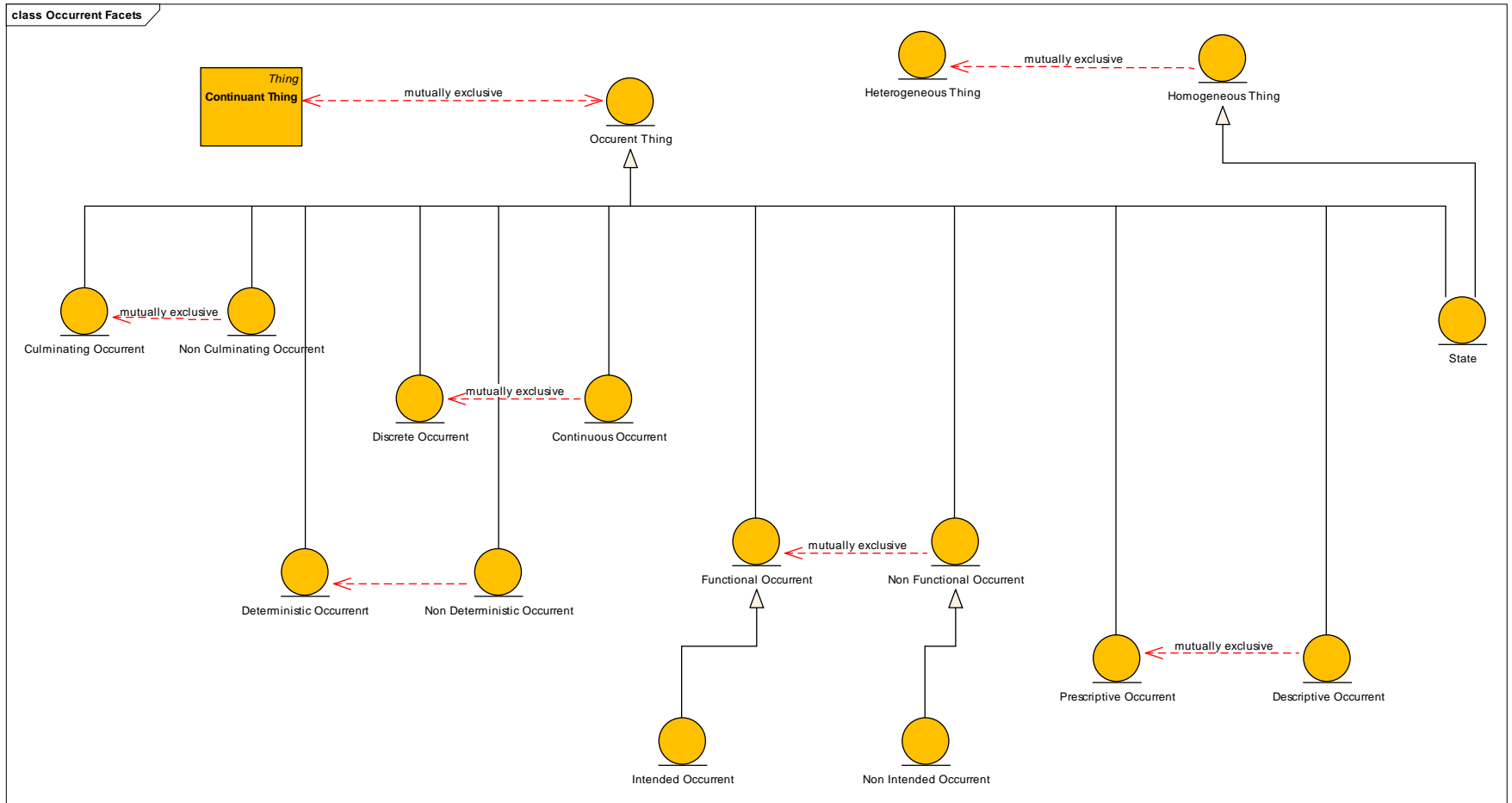
In initial prototyping environment

- (Sparx EA, with visual representation of OWL constructs but not RDF export)
- Facets:
 - Culminating
 - Prescriptive
 - Functional
 - Purposeful
 - Instantaneous
- Linking provisionally to FIBO placeholders

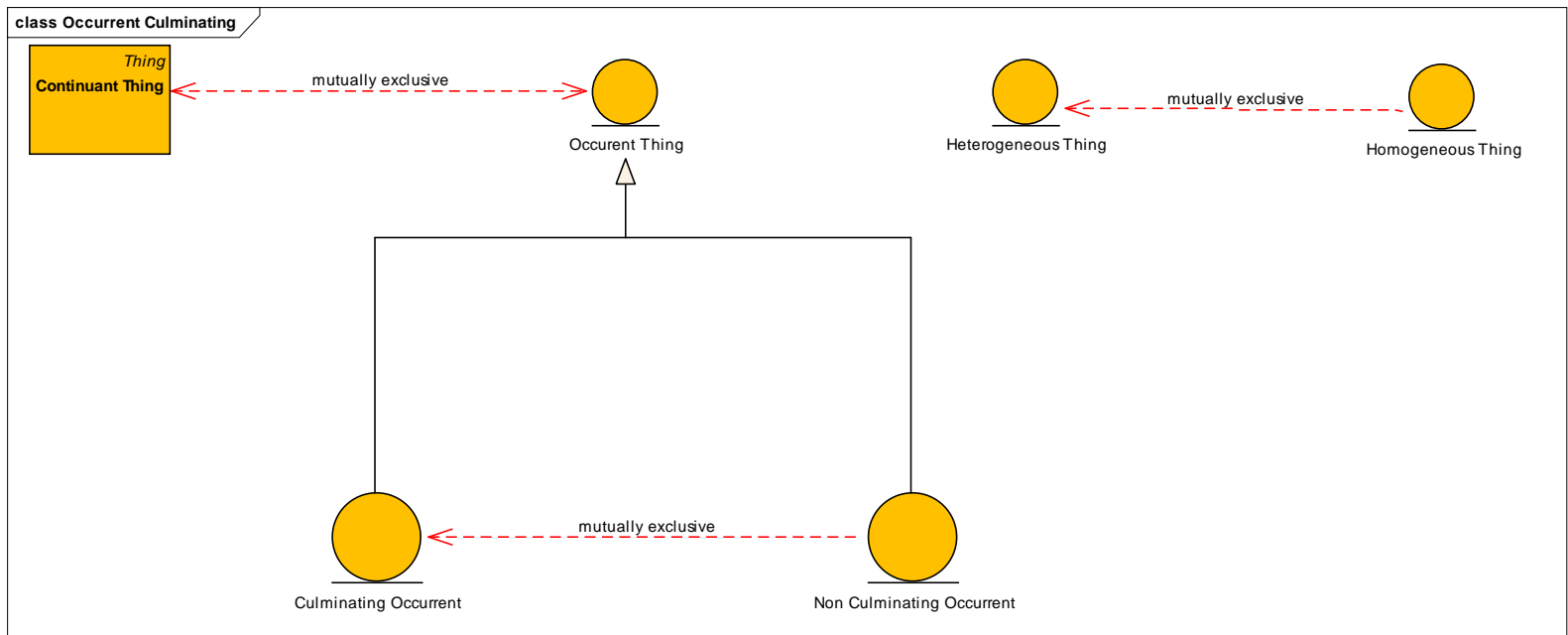
*geneous



Occurrent Facets



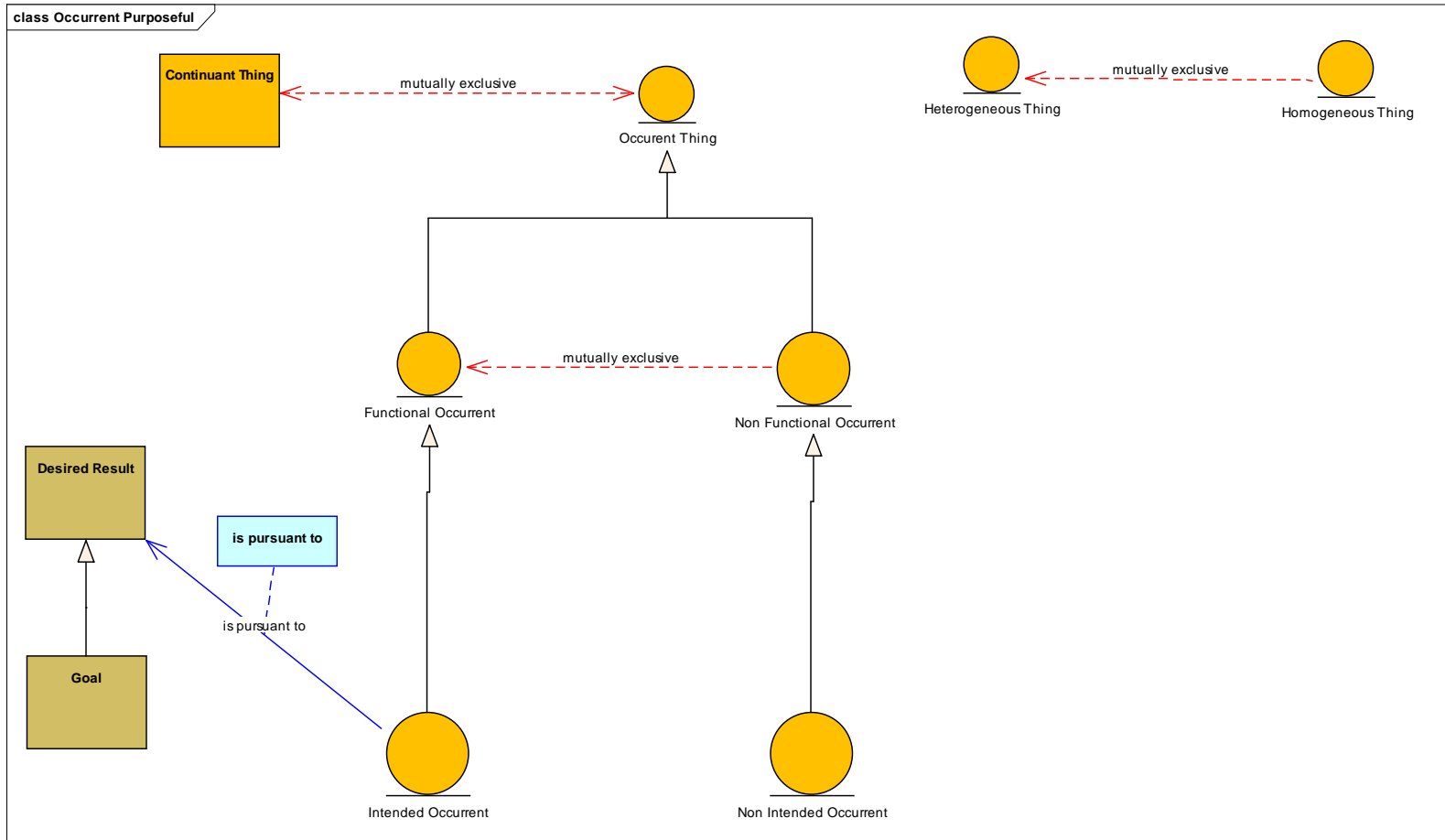
Culminating Facet



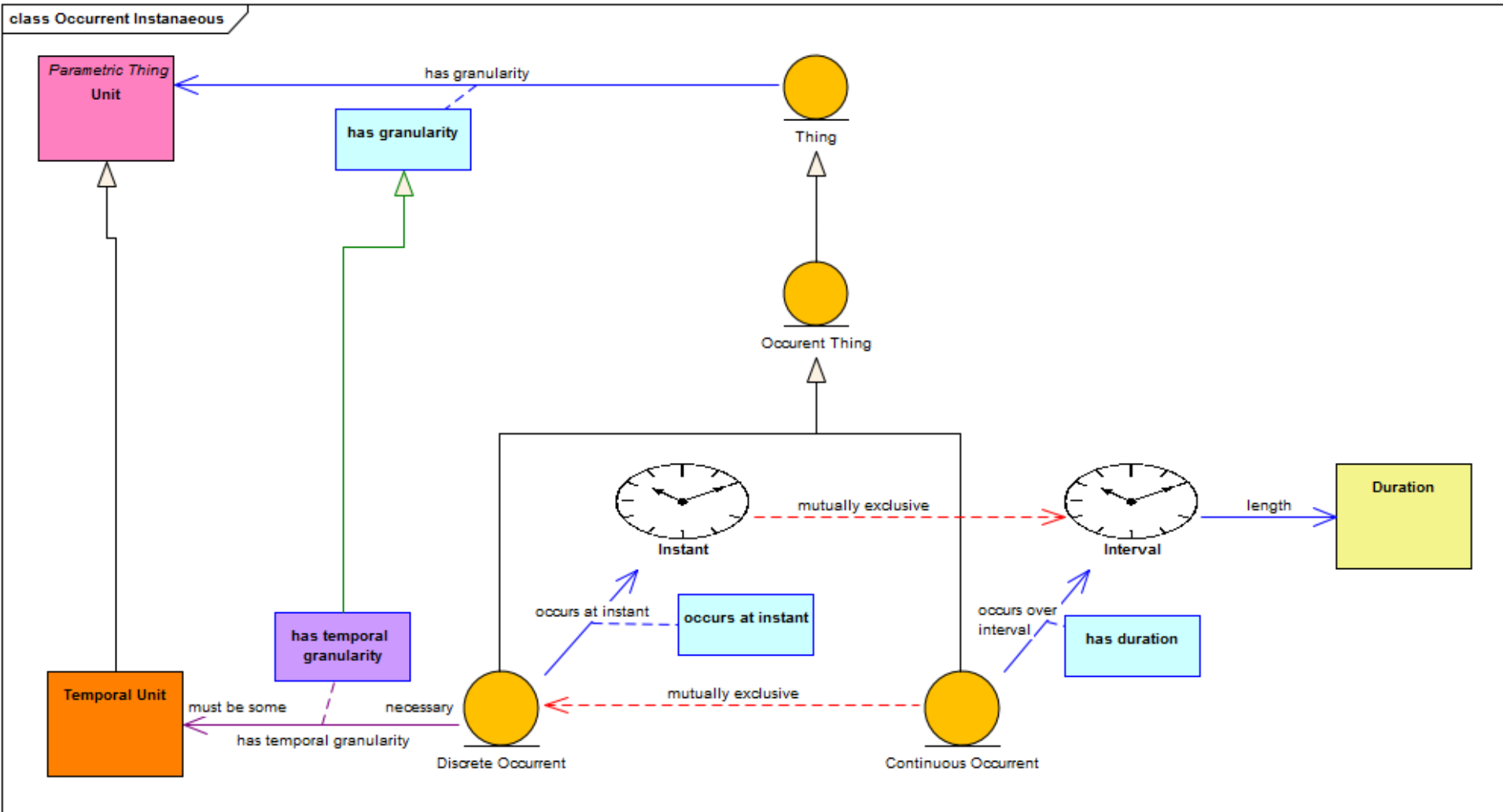
Telic: Function v Purpose

- Telic can be read as being something with a function
- Some interpretations attribute intent to the notion of function
 - We reject this – see e.g. Finke
 - <http://www.patheos.com/blogs/camelswithhammers/2011/10/natural-functions/>
 - A hand has a function but no designer intended that function
- Functional occurrent is superclass of purposeful occurrent
 - We would not use a word like telic anyway
 - Functional = Telic

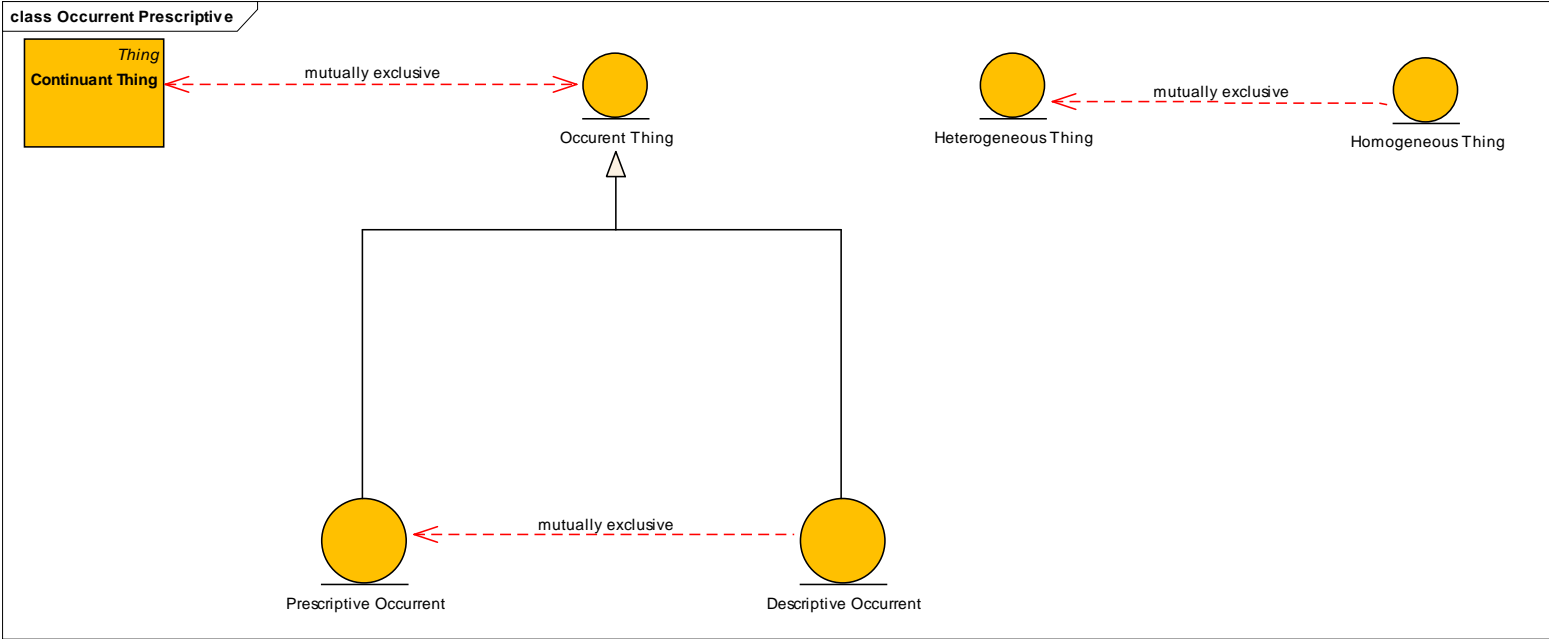
Functional and Purposeful



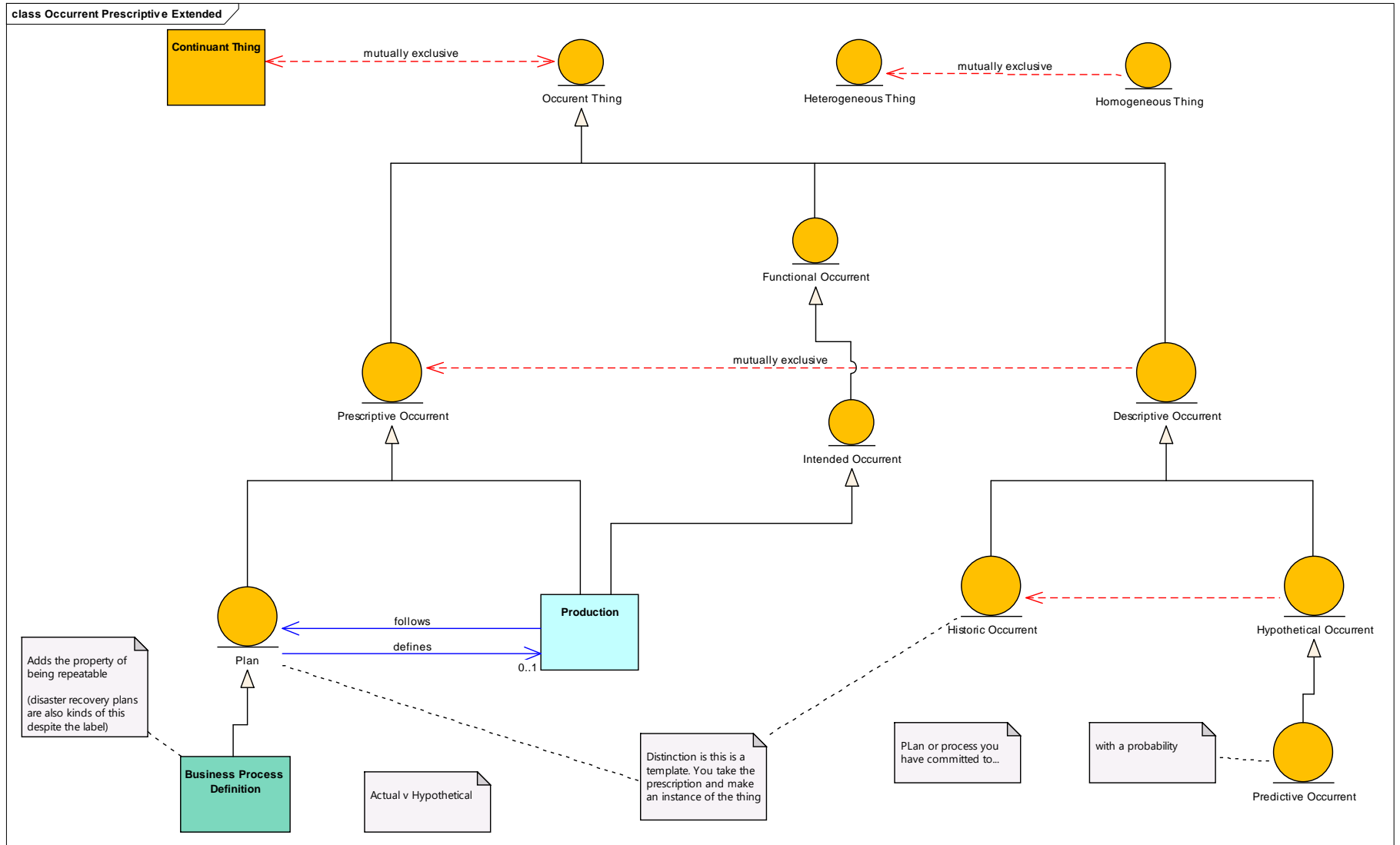
Instantaneous Facet



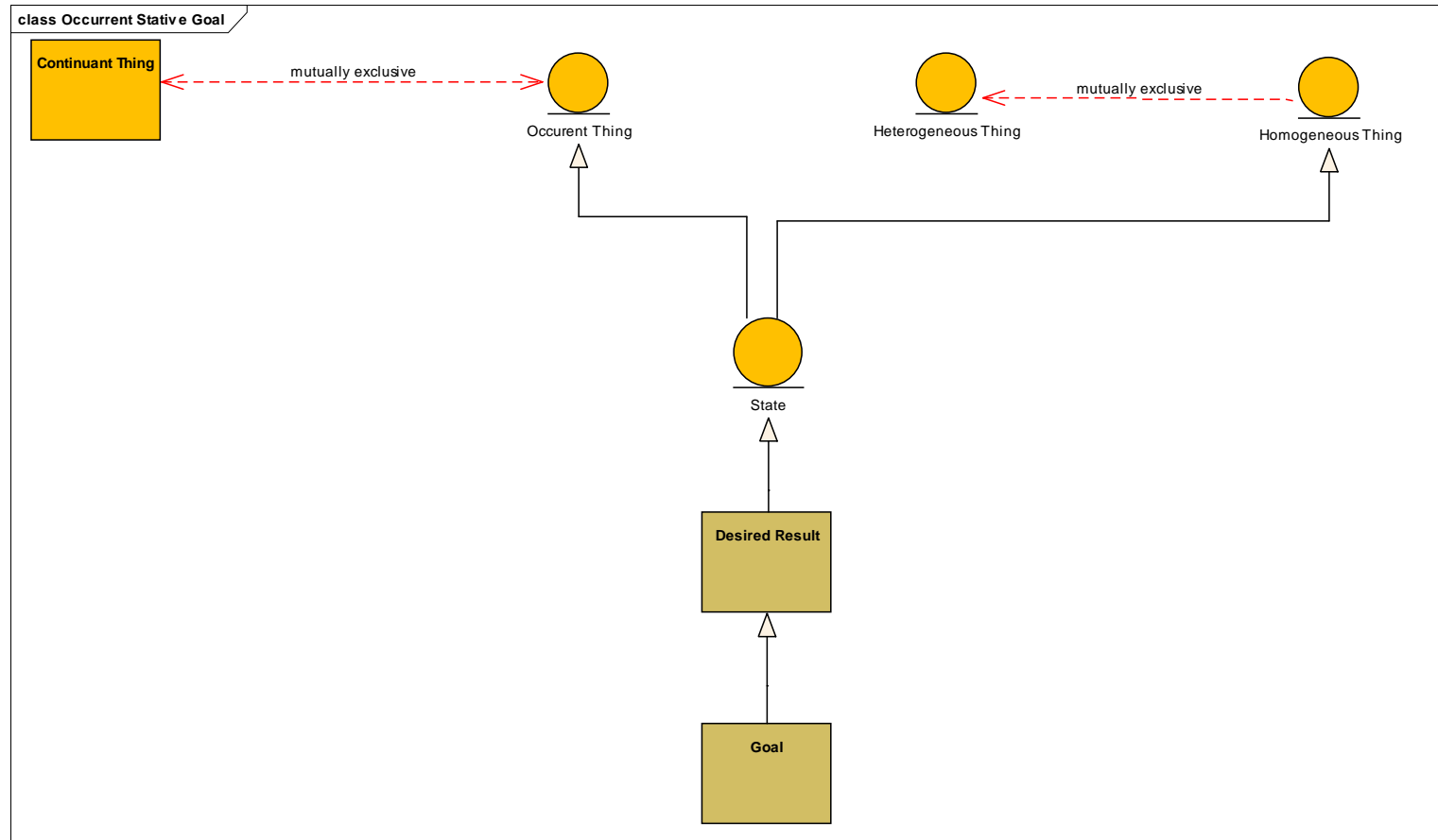
Prescriptive

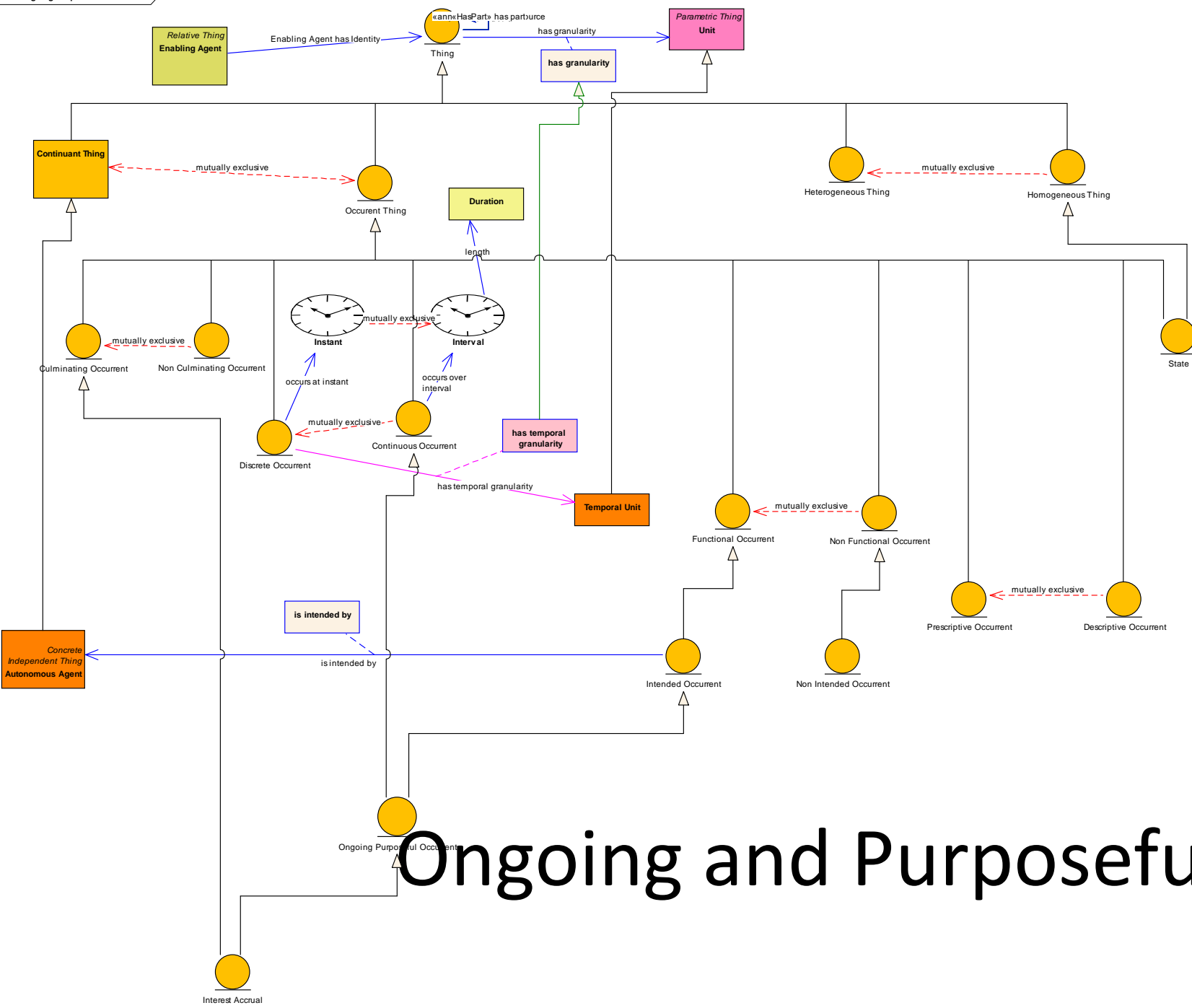


Prescriptive detail



Goal



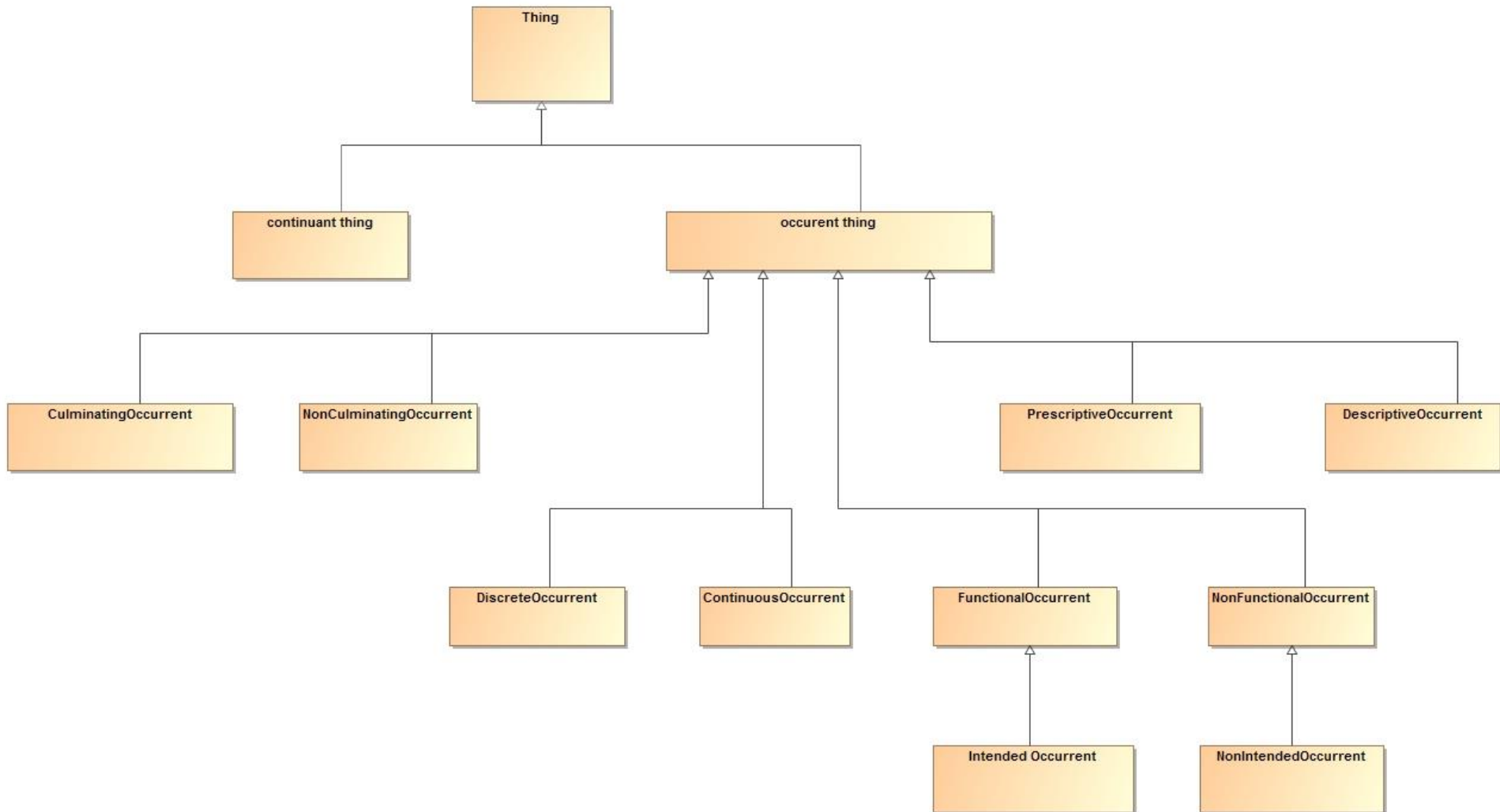


Ongoing and Purposeful

Implementation

- Move these into Cameo Conceptual Modeler for onward RDF/OWL generation
- Still needed to address the question of State

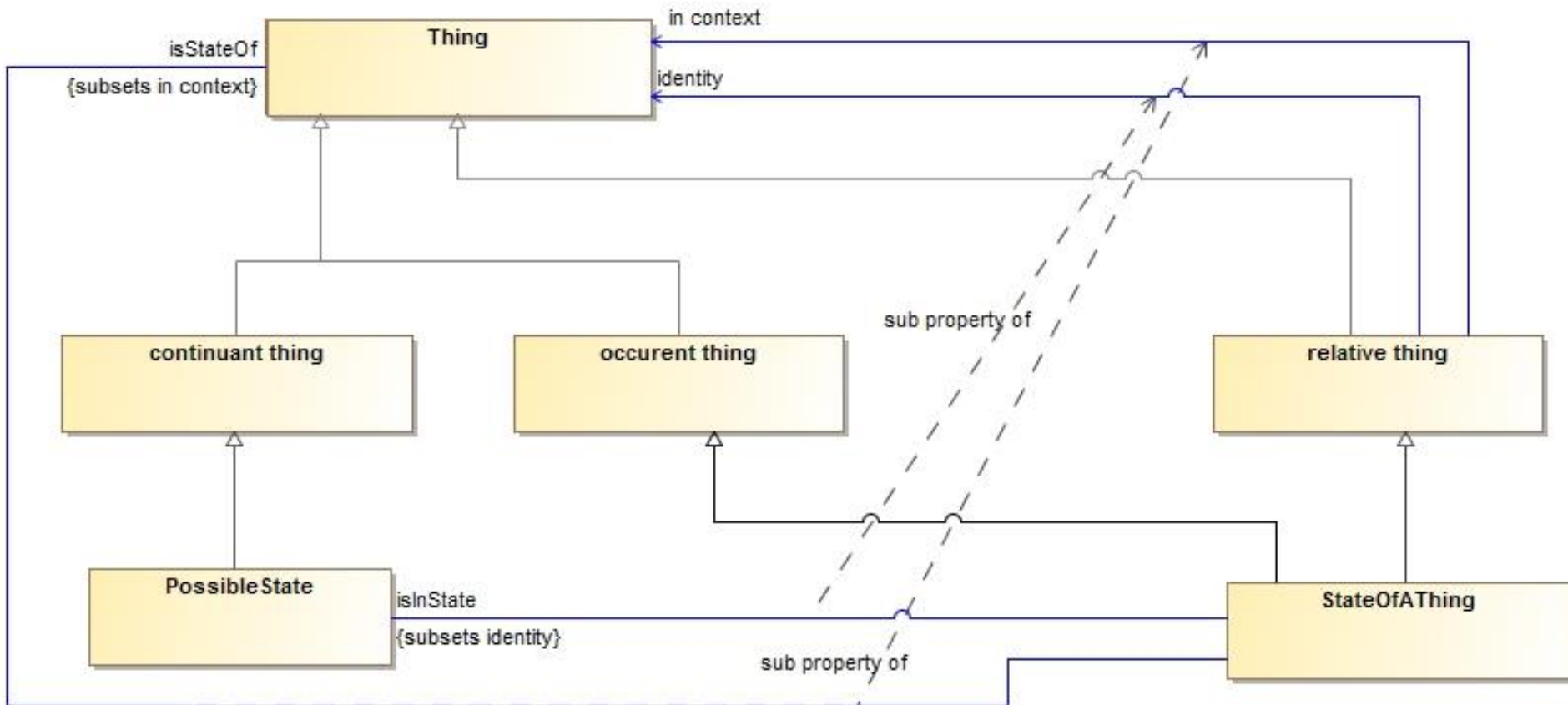
Occurrent Facets



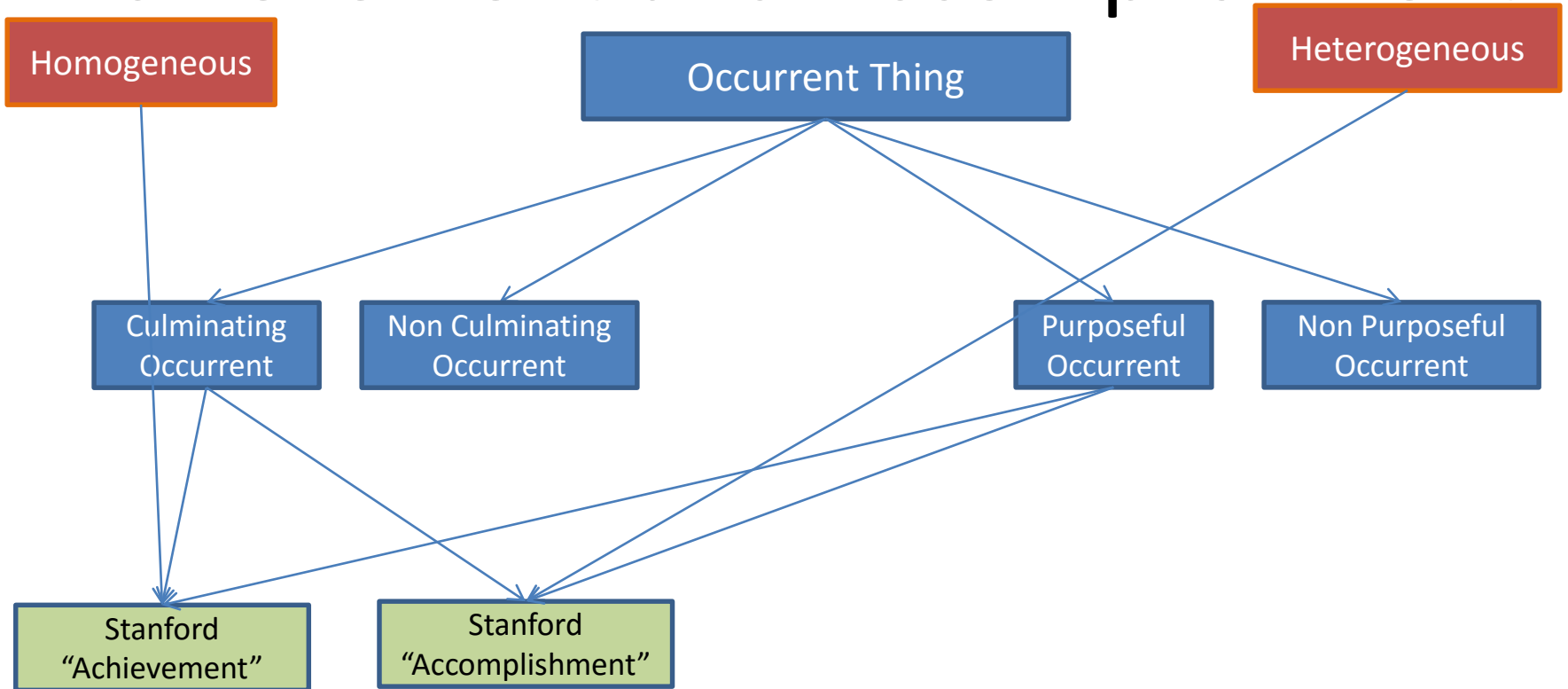
What is State

- There are two concepts often referenced by the word “State”
 - The state something is in
 - E.g. being red, being in default
 - Per State Transition Diagrams
 - This is occurrent
 - The state itself
 - The state of redness, the state of default
 - This is a continuant thing
 - It is also abstract (does not have concrete members in the world)

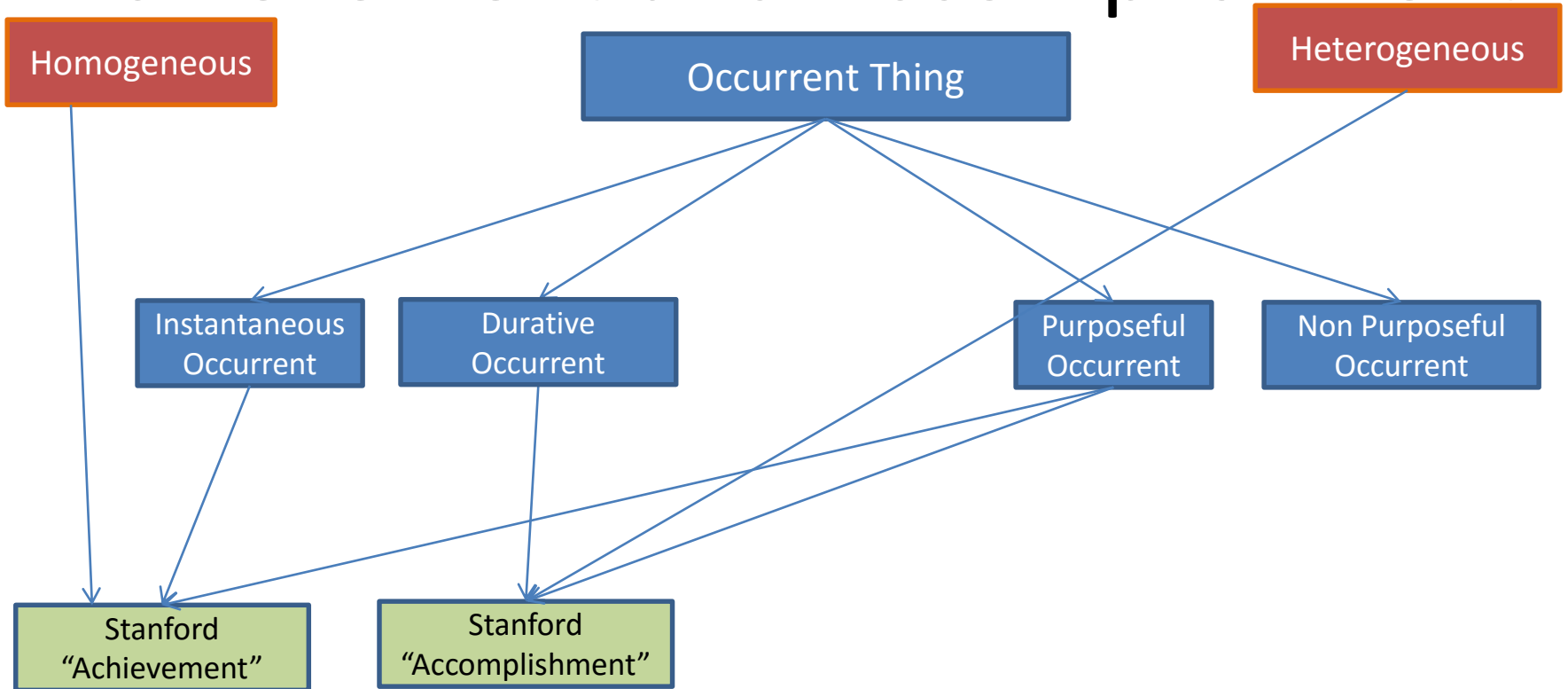
State Concepts



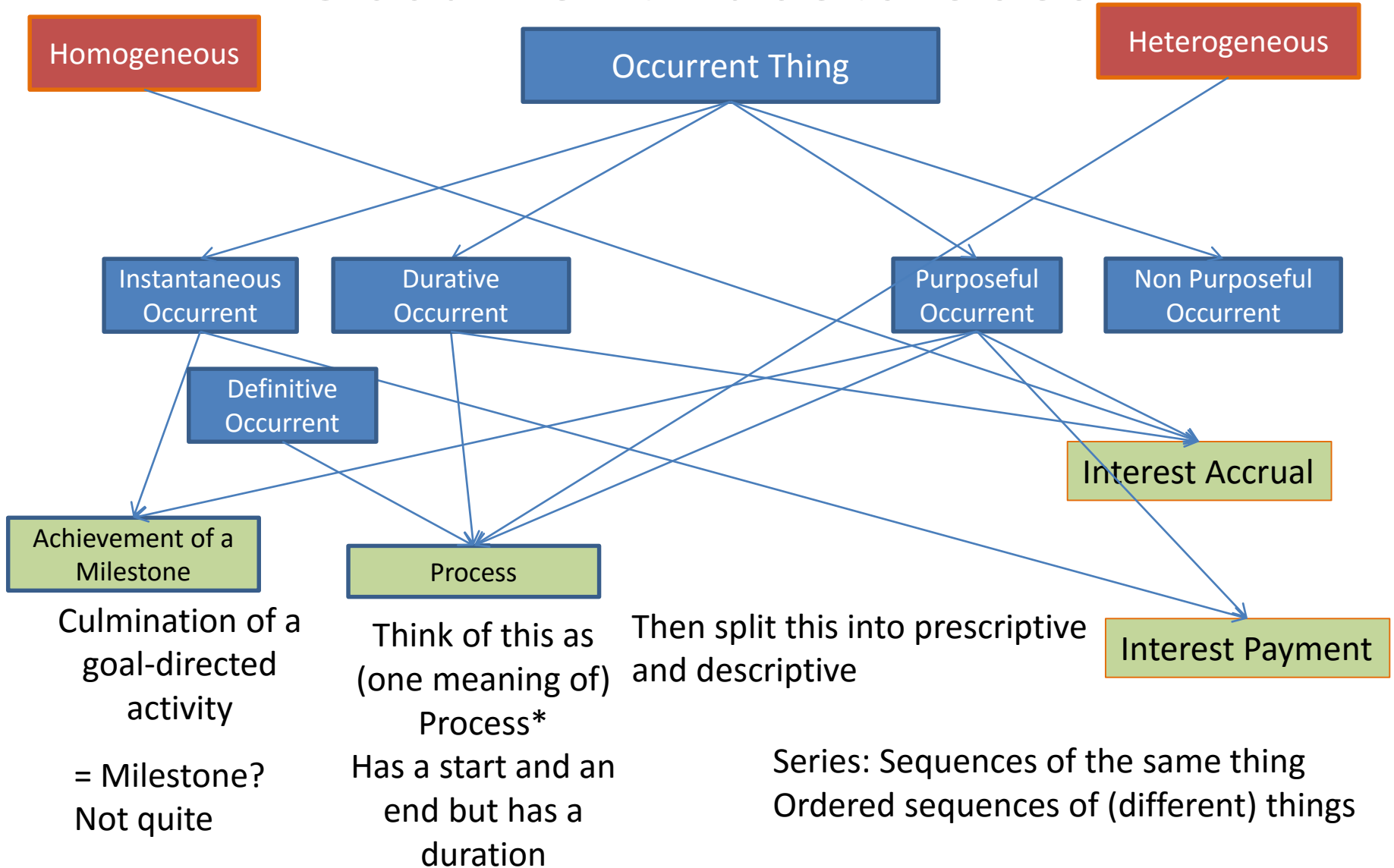
Achievement and Accomplishment



Achievement and Accomplishment



Occurrent Facets Uses



*Reserved word

Summary and Discussion Points

- We needed high level primitive concepts within which to frame various things which happen in finance
- These need not be highly axiomatized
 - rather, we want to ground out the meanings of a minimum set of primitive concepts so other concepts are derivable from these by use of axioms
- Analysis of existing concepts revealed multiple concepts
 - So we segregated these into pairwise disjoint facets
 - Have identified a possibly complete (?) set of facets
 - State was a challenge as it is two things only one of which is occurrent
- Have we defined a high level language from which to articulate things which happen?

Thank You!

- Mike Bennett

- mbennett@edmcouncil.org

- mbennett@hypercube.co.uk

- www.edmcouncil.org

- <http://www.edmcouncil.org/semanticsrepository/index.html>