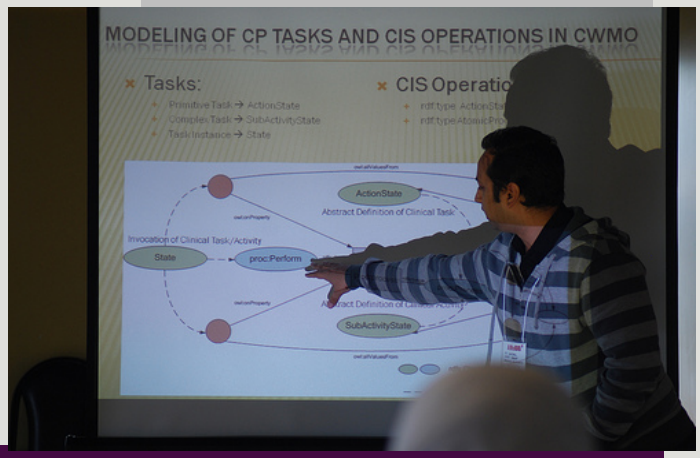
SOCoP Workshops & GeoSpatial Ontology Patterns



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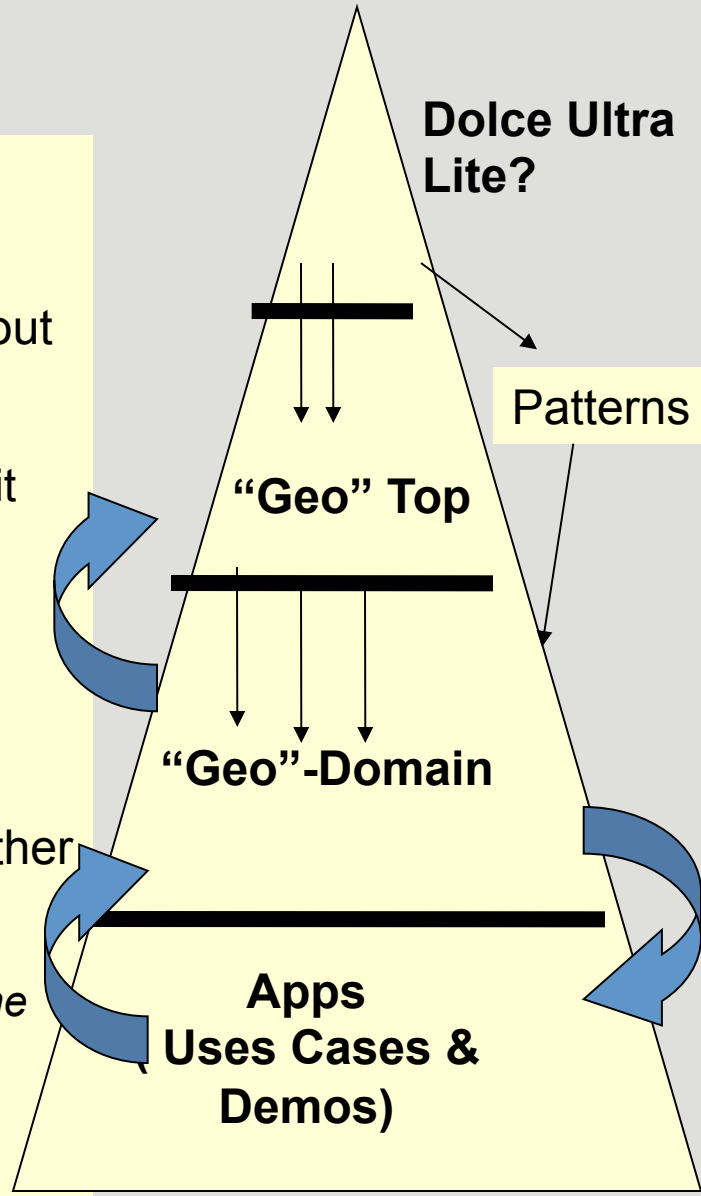
RDA IG GeoSpatial

Ontologies and Ontology Patterns

- Many levels & types of ontologies
- Something like DOLCE is quite complex and so are domain ontologies like SWEET
- One may pick some small repeating patterns (ODPs) out of large ontologies.
- ODPs, like OWL, are tools for ontologies
  - They are more easily understandable with good explicit documentation for design rationales
  - Robust
  - Can be used to build on modularly for reoccurring problems needing representation
  - Capture best practices
  - Should help bridging/integrating ontologies
- We focus on content ODPs using domain expertise rather than logical ODPs etc.
  - **owl:Class:_:x rdfs:subClassOf owl:Restric(on:_:y**
    - *Inflammation>on rdfs:subClassOf (localizedIn some BodyPart)*



ODP Rationale –Reuse, Minimal Constraints..

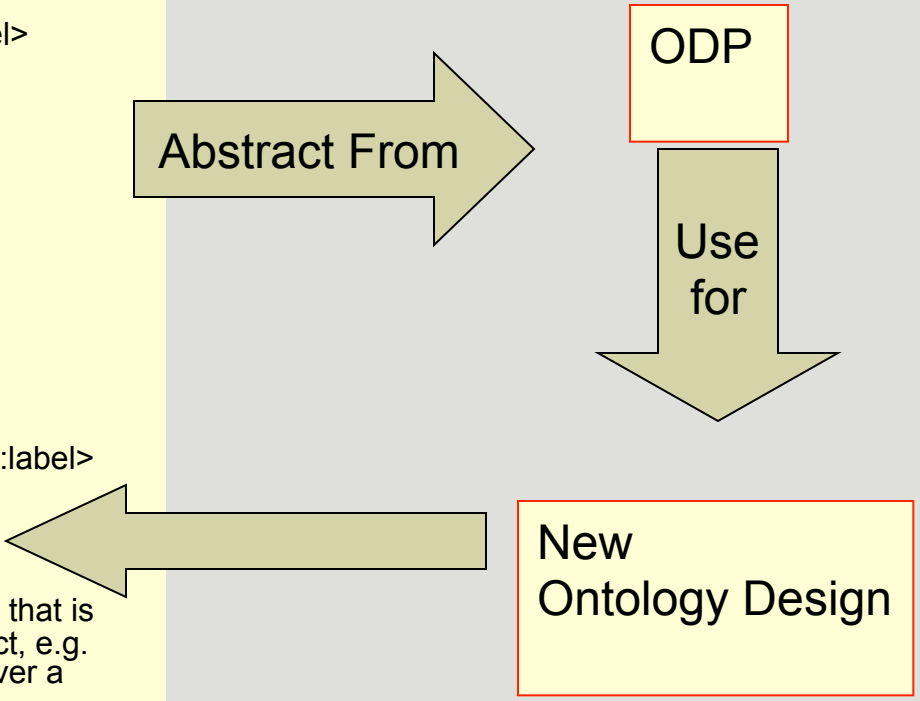
- **Problem**
- It is hard to reuse only the “useful pieces" of a comprehensive (foundational) ontology, and
  - the cost of reuse may be higher than developing a scoped ontology for particular purpose from scratch
  - “For solving semantic problems, it may be more productive to agree on minimal requirements imposed on .. Notion(s)
    - Werner Kuhn (**Semantic Engineering, 2009)**
- **Solution Approach**
  - Use small, well engineered, modular starter set ontologies with
    - explicit documentation of design rationales, and
    - best reengineering practices
  - These serve as an initial constraining network of “concepts” with vocabulary which people may build on/from for various purposes.

Ontology-ODP Relations – could be top down

Small DUL Portion

```
<owl:Class rdf:ID="SocialObjectAttribute">
  <rdfs:label xml:lang="en">Social attribute</rdfs:label>
  <rdfs:subClassOf>
    <owl:Restriction>
      <owl:onProperty>
        <owl:ObjectProperty rdf:ID="isRegionFor"/>
      </owl:onProperty>
      <owl:allValuesFrom>
        <owl:Class rdf:ID="SocialObject"/>
      </owl:allValuesFrom>
    </owl:Restriction>
  </rdfs:subClassOf>
  <rdfs:label xml:lang="it">Caratteristica sociale</rdfs:label>
  <rdfs:subClassOf>
    <owl:Class rdf:ID="Region"/>
  </rdfs:subClassOf>
  <rdfs:comment>Any Region in a dimensional space that is used to represent some characteristic of a SocialObject, e.g. judgment values, social scalars, statistical attributes over a collection of entities, etc.</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="WorkflowExecution">…
```

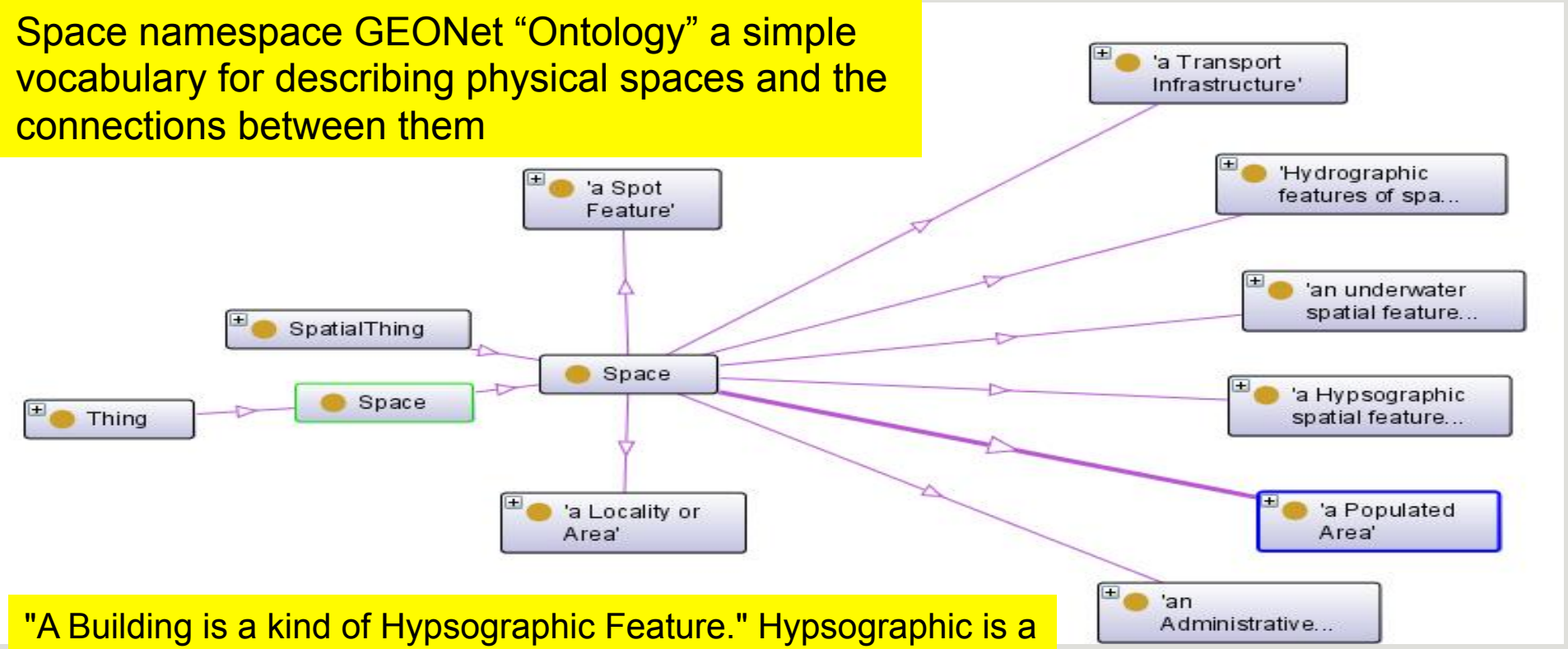
"Unfriendly logical structures, some large, hardly comprehensible Ontologies" (Aldo Gangemi)



In SOCoP we tend to leverage existing work, but build patterns from bottom up data views

We View Simple Ontologies Serve as Concept Model with Vocabularies

Space namespace GEONet “Ontology” a simple vocabulary for describing physical spaces and the connections between them



"A Building is a kind of Hypsographic Feature." Hypsographic is a top-level classification from GEONet and just means something that's found on land. It goes on: "A Public Building is a kind of Building, and a Recreational Venue is a kind of Public Building."

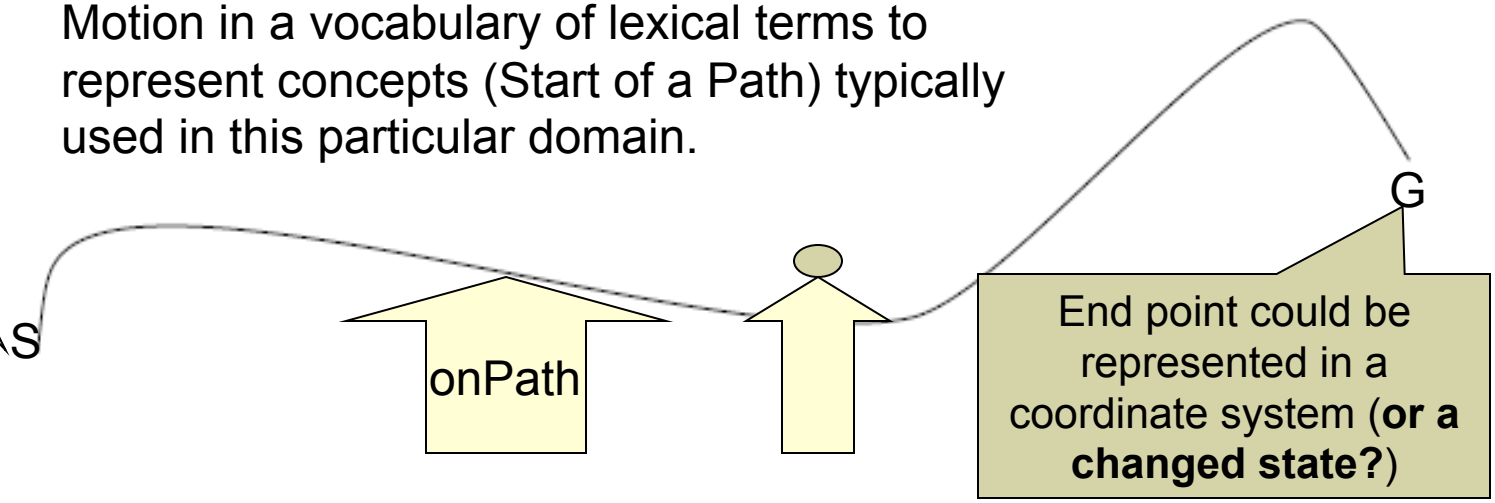
But this is not really a coherent, rationalized pattern

Old link http://frot.org/ontobot/ for work related to this ontology

Conceptual Pattern Example- A Schema for Motion (like Osmosis??)

All paths have a start point

We can **generally outline** what we mean by Motion in a vocabulary of lexical terms to represent concepts (Start of a Path) typically used in this particular domain.



- participants: path, moving object, start, goal

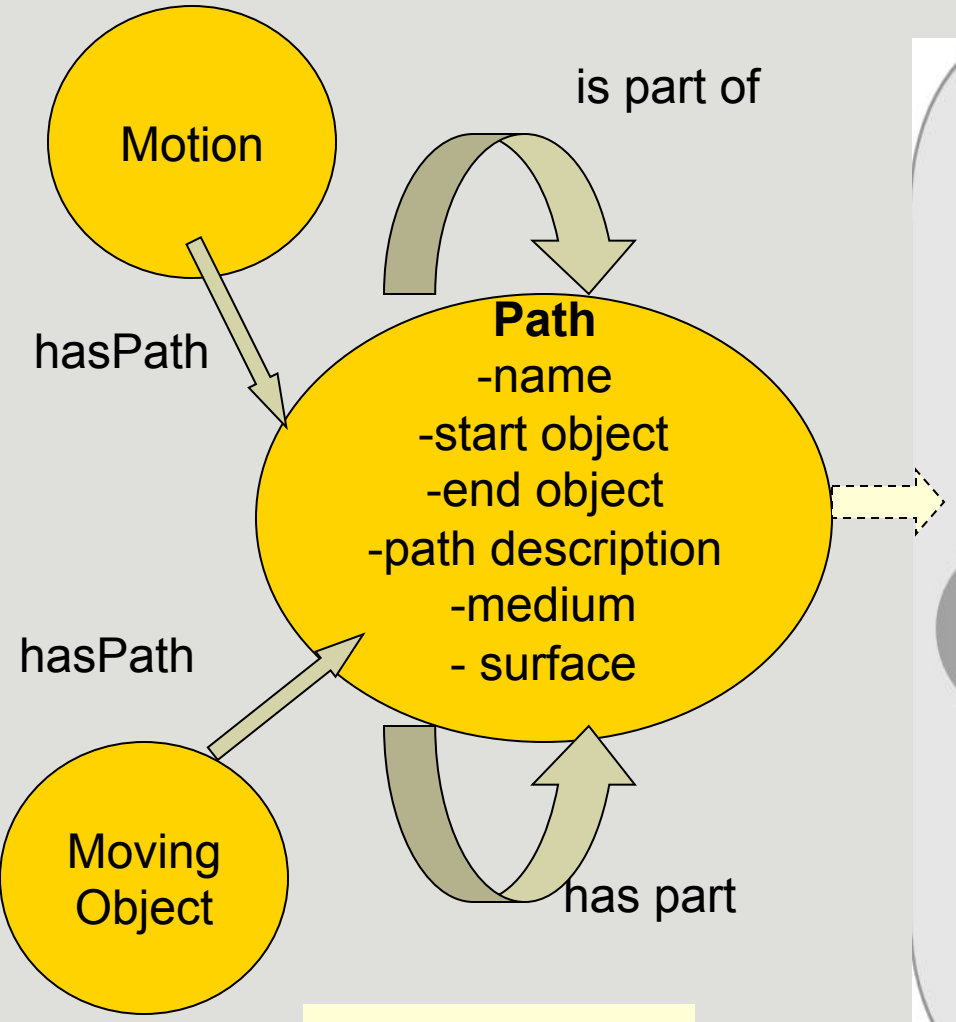
We remain general in the pattern since this is a cognitive activity & the concept has flexible semantics depending on human intentions and perspectives. The pattern can generate alternate descriptions conforming to alternate interpretations.

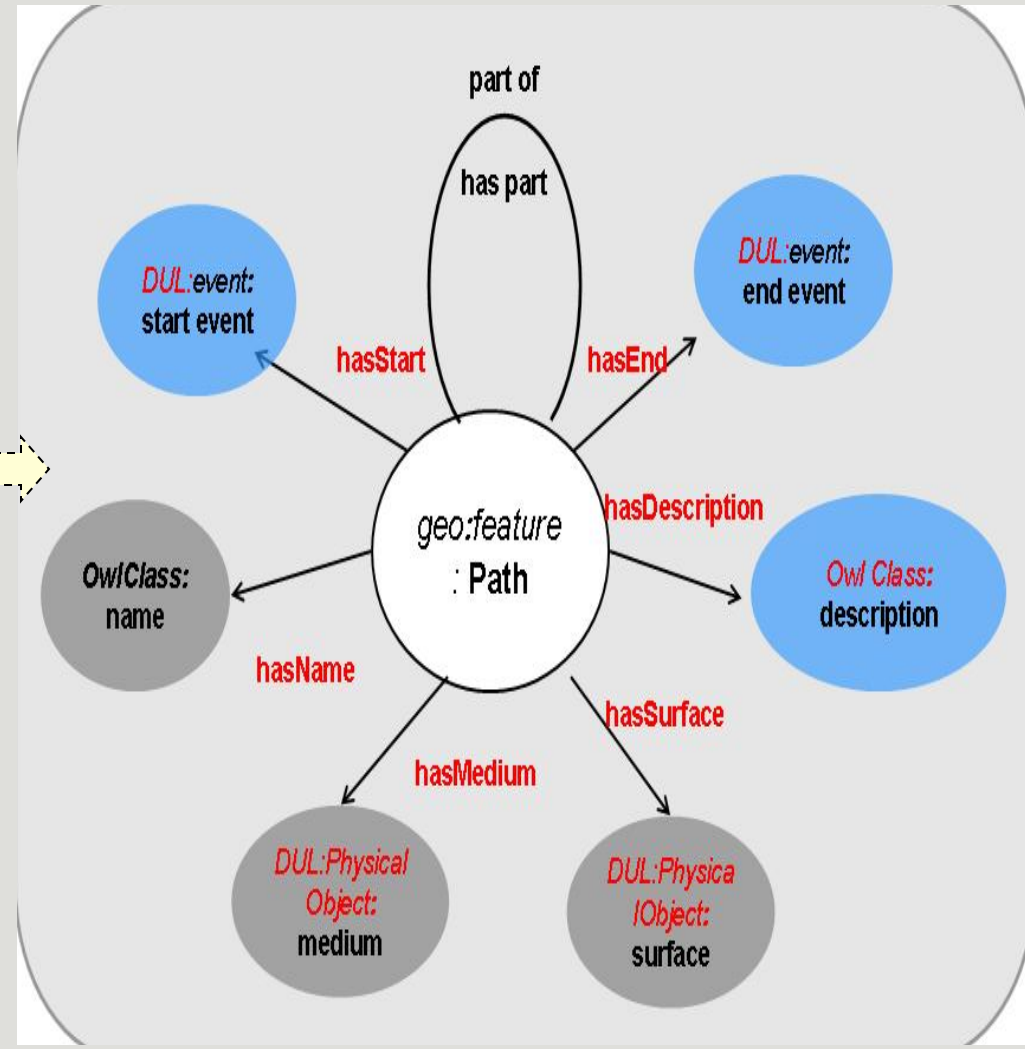
For details, see:

Kuhn, W., 2007. An Image-Schematic Account of Spatial Categories. *Spatial Information Theory, 8th International Conference, COSIT 2007*. Melbourne, Australia: Springer Lecture Notes in Computer Science 4736: 152-168

Just OWL Classes
Motion is an
OWL:Class

Geo-VoCamp Patterns – Path from an info perspective



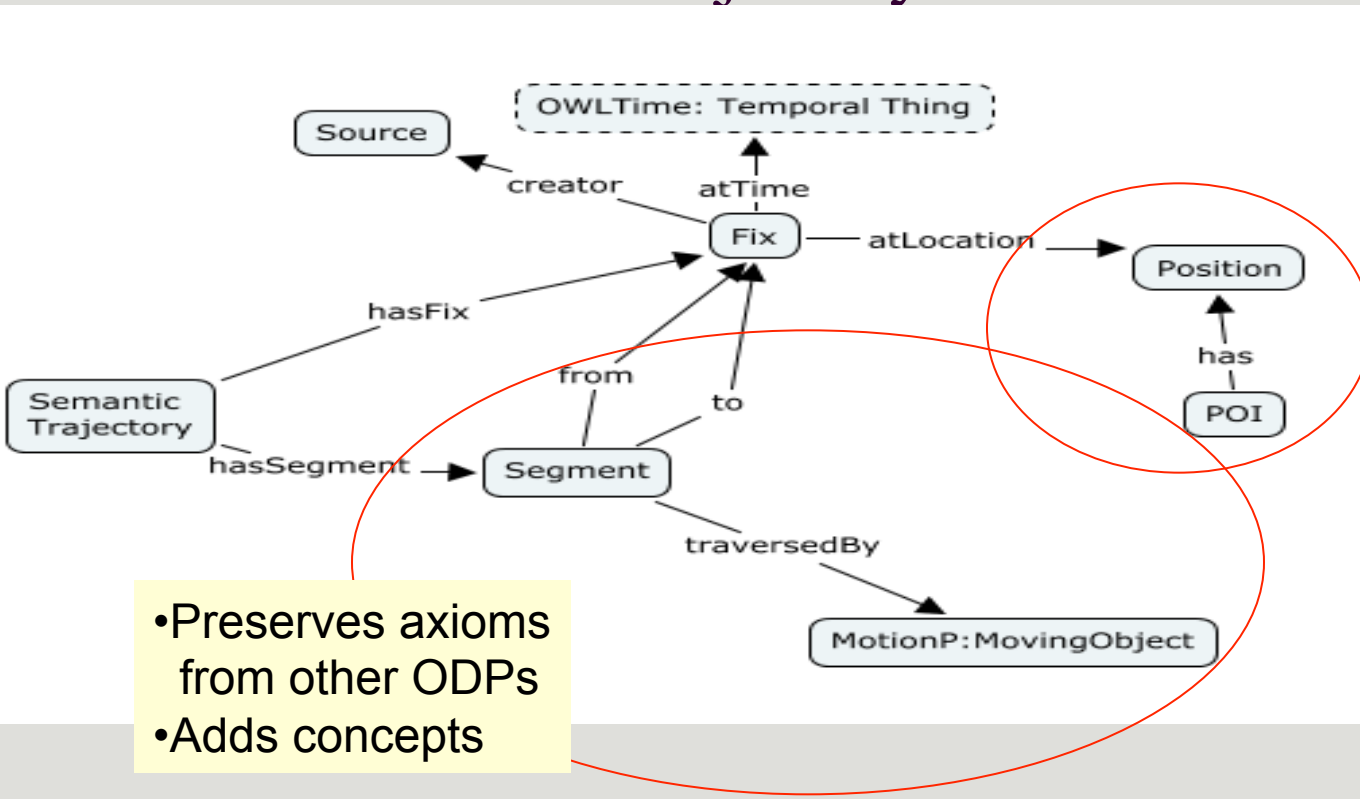


Light constraints

We Align & Compose New ODP from Old: New Pattern for Semantic Trajectory

ODPs are relatively autonomous but conceivably composable with other schemas.
E.g. compose a Semantic Trajectory Pattern from Trajectories/spatial paths/segments

Point Of Interest (POI)- observation area etc.

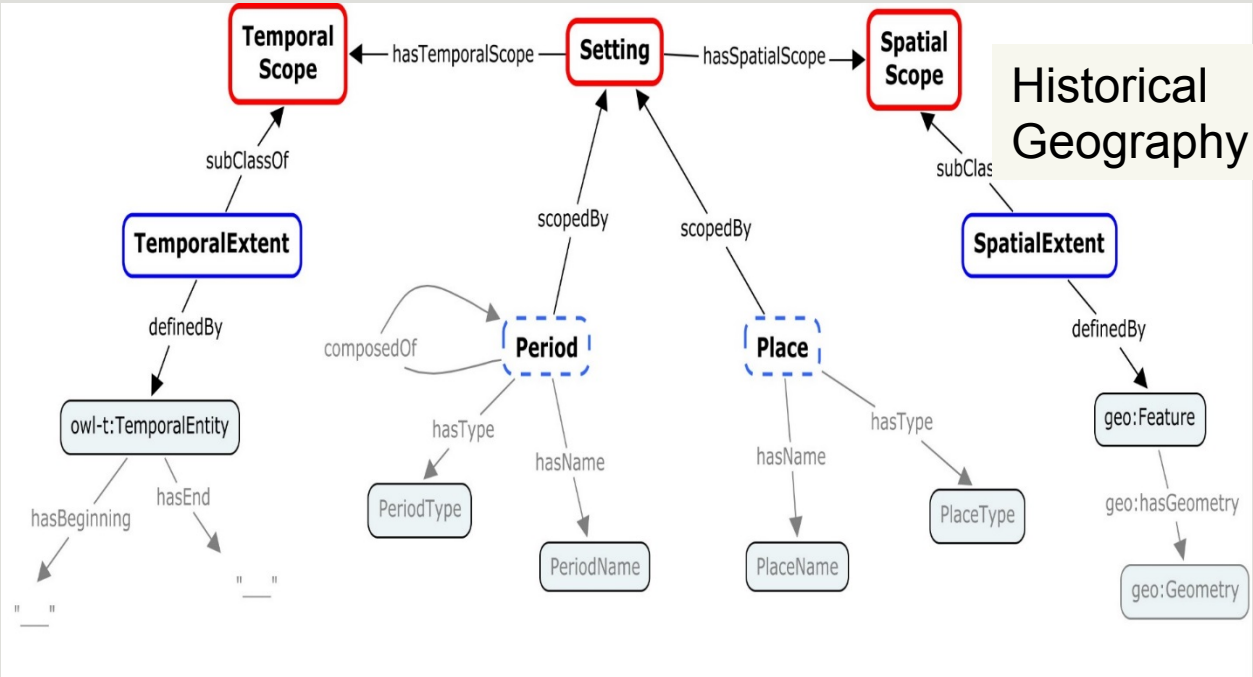


- Preserves axioms from other ODPs
- Adds concepts

Grounded Data for Model

:mikestrip a :SemanticTrajectory; :hasSegment [a :Segment; :from :fix1; // mikeshome:to :fix2;// rest stop :traversedBy :fordFocus], [a :Segment; :from :fix1; // rest stop :to :fix2],// WrightStateU :traversedBy :fordFocus], [a :Segment;:from :fix1; // WrightStateUniversity:to:fix2],//.. :fixn].:mike a foaf:Person:mikesFordFocus a motion:MovingObject.:garminEtrexVistaC a:Source.geo: Geometry rdfs:subClassOf :Position.:mikesFordFocus a motion:MovingObject]:motion1 a……

Another ODP Example & its Evolution – Setting: Something kind-of temporal (the sixties, the 19th century) or something kind-of spatial (France)

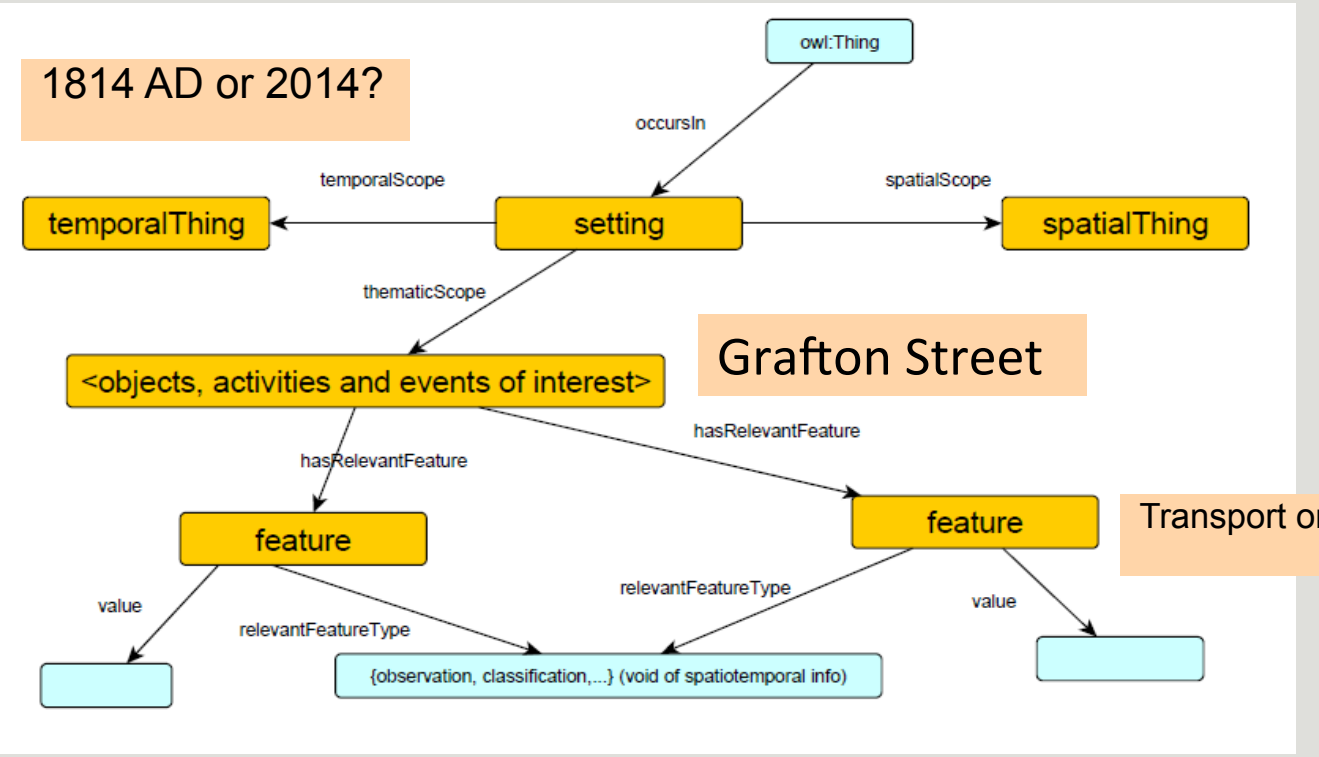


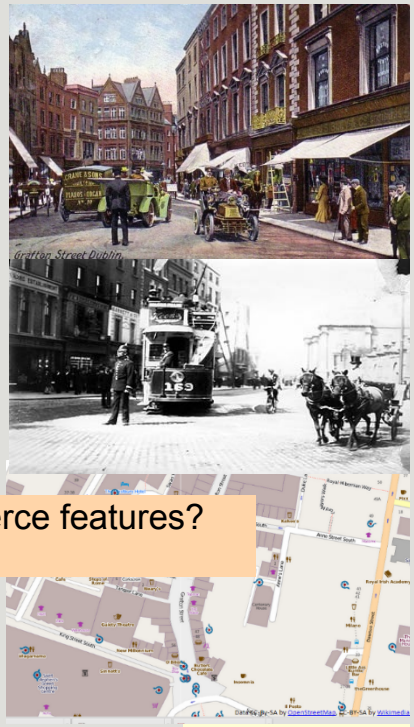
Historical Geography

Place, Period, and Setting for Linked Data Gazetteers
Karl Grossner, Krzysztof Janowicz, And Carsten Keßler

Definition of a setting.
A setting is a geospatial temporal region within which objects, activities and events occur. Our settings of interest are all the settings in which the objects, activities, and events of interest occur. Based on Worboys & Hornsby, (2004).”From objects to events: GEM, the Geospatial event model.”

Revised Setting ODP Example Evolution (from UCSB GeoVoCamp 2014)





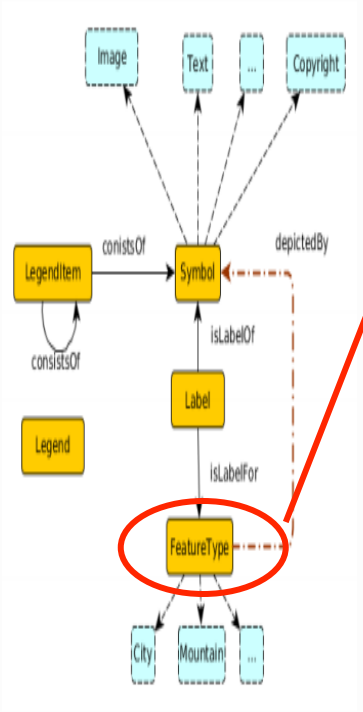
Transport or commerce features?

Mark Schildhauer, Gary Berg-Cross, Charles Vardeman, Pascal Hitzler, Helen Couclelis, Francis Harvey, George Planansky, Ben Adams, Andrea Ballatore, Krzysztof Janowicz, Dave Kolas

Terry de Valera, 1986, *Grafton Street: A Collage of Time and People*, *Dublin Historical Record,* 39(4), 122-131.

Making Commitments to an ODP : Maps - Legends Example

Fragment of a Map Legend Ontology Design Pattern



Ontological commitments

- Should Geographic Feature Types be **classes or instances**?
- Do we want to explicitly define the **depictedBy** relation
- Is stating that a **Legend** consists of LegendItems redundant?
- ...

Fragment of the Map Legend Ontology

$$\mathbb{N}_C = \{LegendItem, Symbol, Label, FeatureType\} \quad (1)$$

$$\mathbb{N}_R = \{consistsOf, isLabelFor, isLabelOf, depictedBy\} \quad (2)$$

$$\top \sqsubseteq \neg\exists N.\top \quad (3)$$

$$LegendItem \sqsubseteq \exists consistsOf.Symbol \sqcup \exists consistsOf.LegendItem \quad (4)$$

$$Label \sqsubseteq \exists SymbolizedBy.Symbol \sqcap \forall SymbolizedBy.Symbol \quad (5)$$

$$\top \sqsubseteq \leq 1\, isLabelFor.\top \quad (6)$$

$$\top \sqsubseteq \leq 1\, isLabelOf.\top \quad (7)$$

$$\top \sqsubseteq \leq 1\, SymbolizedBy.\top \quad (8)$$

$$Label \sqsubseteq \exists isLabelFor.FeatureType \quad (9)$$

$$Label \sqcap Symbol \sqsubseteq \bot \quad \text{(also for Symbol, Label, FeatureType, LegendItem)} \quad (10)$$

$$isLabelOf^- \circ isLabelFor \sqsubseteq depictedBy^- \quad (11)$$

$$\neg\exists consistsOf^- \sqsubseteq Legend \quad (12)$$

$$\ldots \quad (13)$$

Backup on Methods

ODP Work Takes Place at VoCamp Workshops

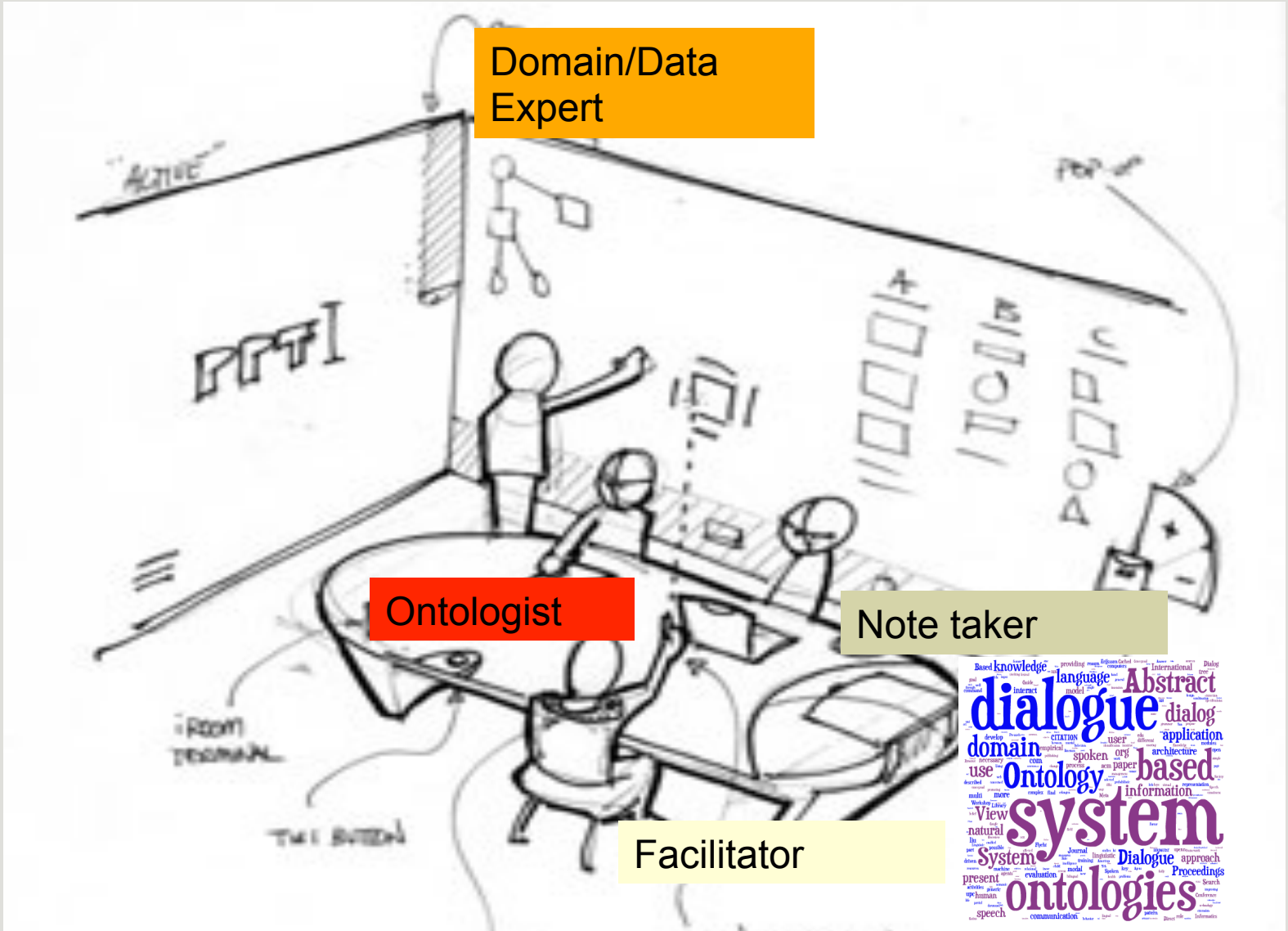
ODPs produced at 2-3 day GeoVoCamps

- We seek clarified agreement & reduced ambiguities/ conflicts on geospatial/earth science phenomena that can be formally represented in:
  1. Constrained, engineered models to support understanding, reasoning & data interoperability and/or
  2. Creation of general patterns that provide a common framework to generate ontologies that are consistent and can support interoperability.
- We like data-grounded work since:
  - *Much of the utility of geospatial ontologies will likely come from their ability to relate geospatial data to other kinds of information*.

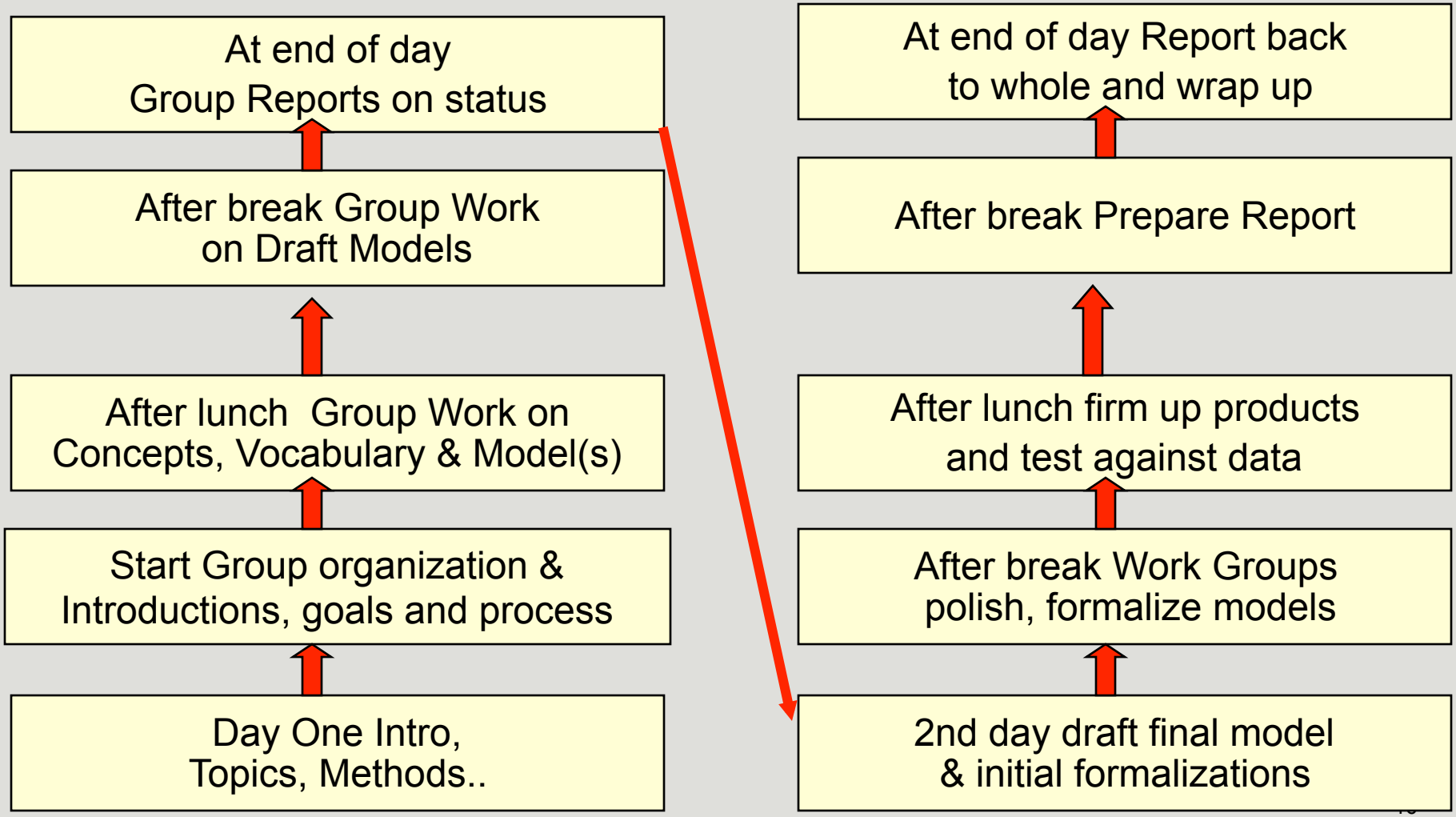
Workshop Ingredients

1. Goals of sessions set at start
2. 2-3 Workgroup Teams with a topic for ODP development
3. Use Phased Structure Sessions
    1. From Conceptualizations to Formalizations
    2. Lightweight Methods

Workgroups Include Multiple Roles:
Semantic Engineering is a Social Process



Logic of Work Sessions

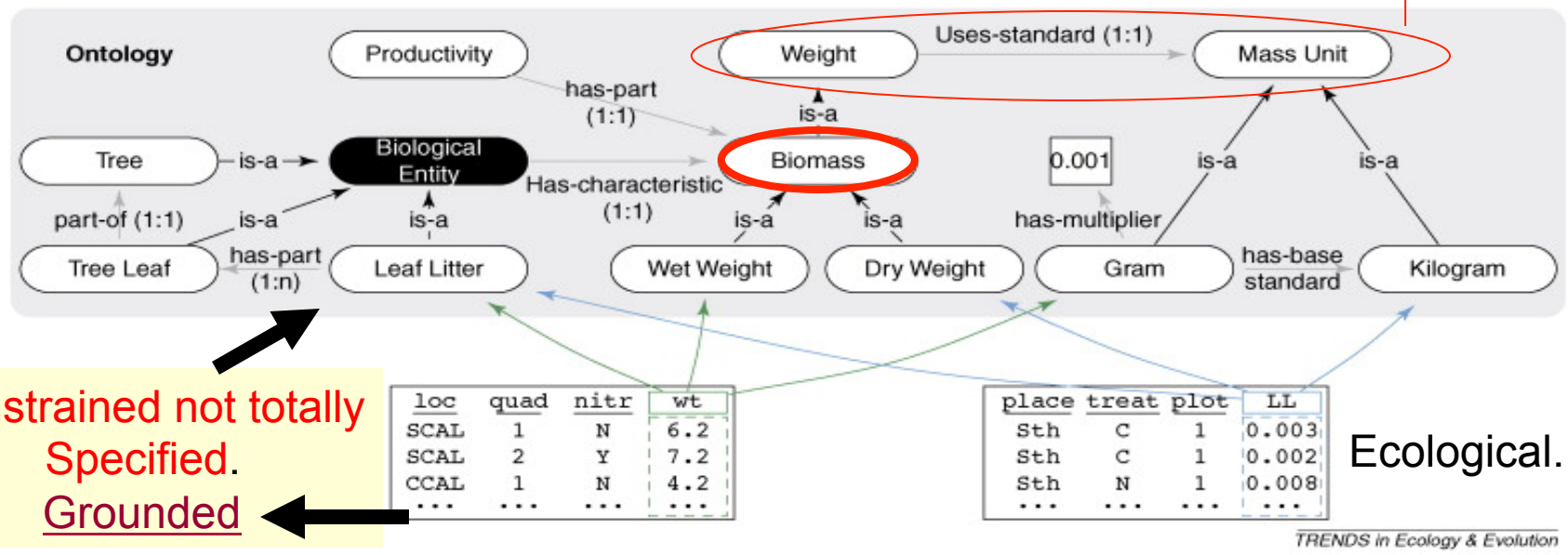


Lightweight Methods & Products

- Choose lightweight approaches grounded by scenarios and application needs.
  - Low hanging fruit **leverages initial vocabularies** and existing **conceptual models** to ensure that a semantics-driven infrastructure is available for use in **early stages of work**
  - Reduced entry barrier for domain scientists to contribute data

Simple parts/patterns & direct relations to data

Triple like parts



Constrained not totally Specified.
Grounded

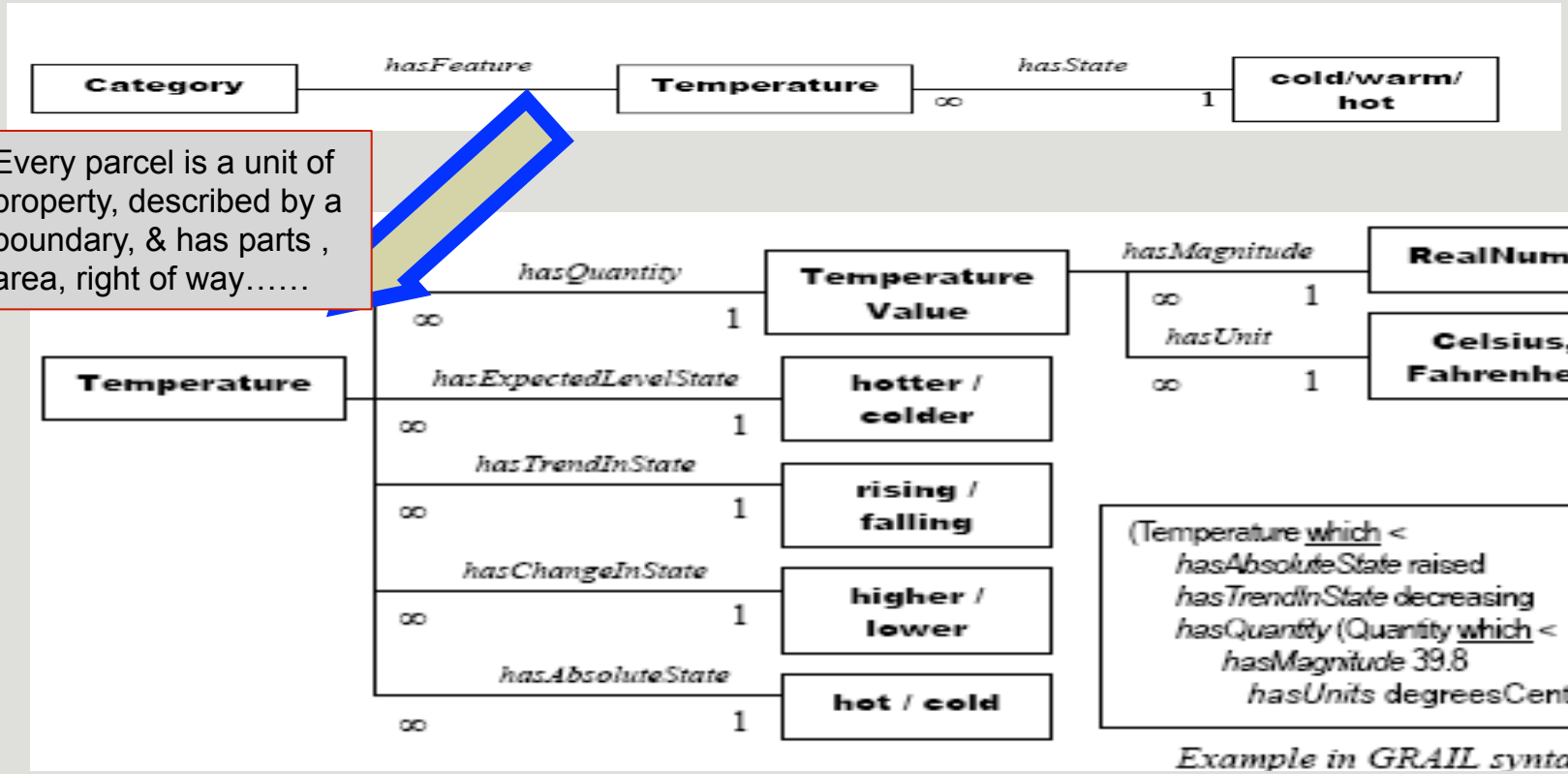
Ecological..

Combine Lightweight with incremental Approaches: Make Richer Schemata & Reusable Patterns from simple part – say a triple

Land Parcel, owner….

area, boundary, encumberance….

19 sq ‘, located at.



Simple Feature-State Model (from GRAIL) becomes a richer schema