

# Ontology Design Patterns in GeoLink



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**EarthCube:**

**NSF Program, multiple projects, long run-time**

**Goal: Developing a Community-Driven Data and Knowledge Environment for the Geosciences**

**“concepts and approaches to create integrated data management infrastructures across the Geosciences.”**

**“EarthCube aims to create a well-connected and facile environment to share data and knowledge in an open, transparent, and inclusive manner, thus accelerating our ability to understand and predict the Earth system.”**

**a.k.a.**

**modeling choices you may regret later**

**Whenever you decide on how to make your metadata**

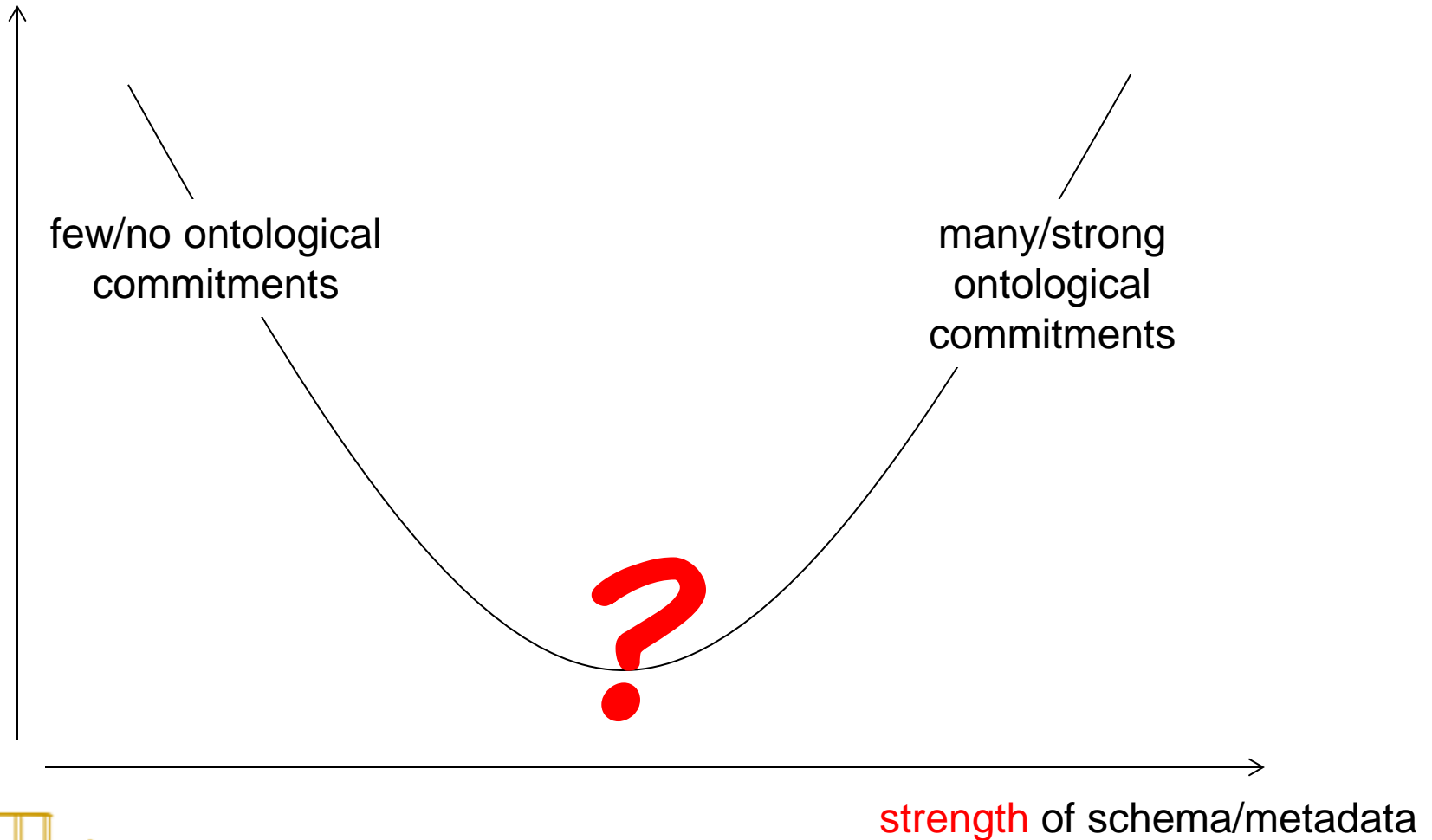
- **keyword annotation**
- **controlled vocabularies**
- **light-weight taxonomy**
- **full-blown ontology**

**You always have to make specific modeling decisions.**

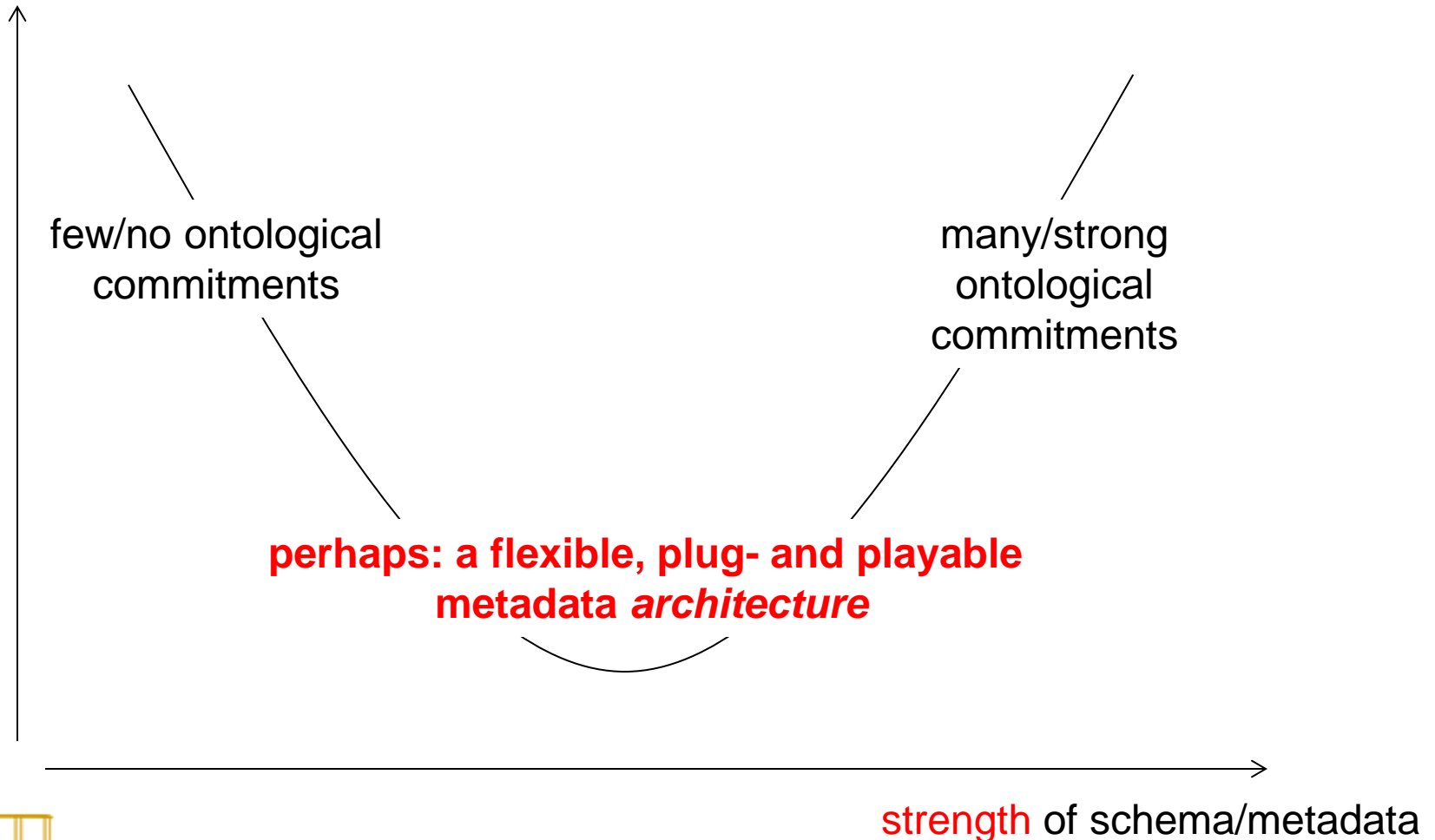
**You can either make detailed specifications (ontological commitments) which will often hinder reuse for new purposes.**

**Or you can avoid the commitments, resulting in ambiguity which cannot really be resolved later, thus also hindering reuse.**

cost of data integration and reuse



cost of data integration and reuse



**OceanLink:** NSF 2013-2014, \$300k

**GeoLink:** NSF 2014-2016, \$1.9M

**Building Blocks in the NSF EarthCube program**

**LDEO:** Robert Arko, Suzanne Carbotte, Kerstin Lehnert

**WHOI:** Cynthia Chandler, Peter Wiebe,  
Lisa Raymond, Adam Shepherd

**UCSB:** Krzysztof Janowicz, Yingjie Hu

**NCEAS:** Mark Schildhauer, Matt Jones

**Ocean Leadership:** Douglas Fils

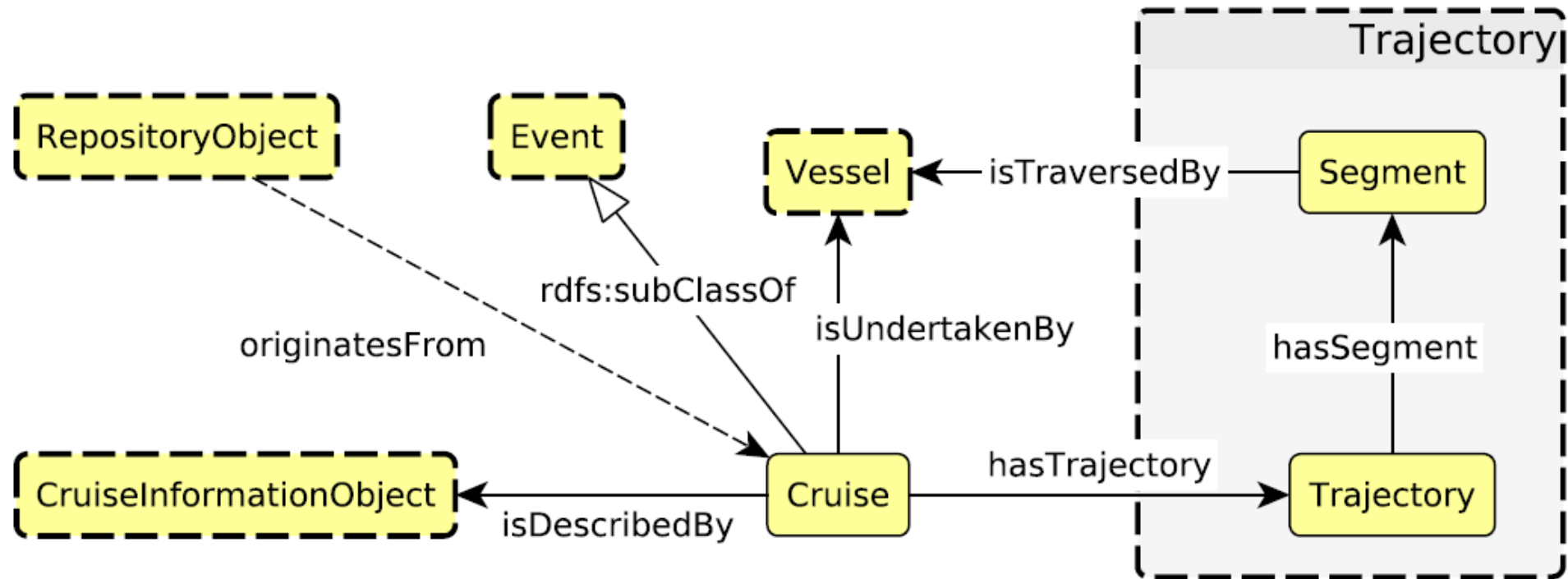
**Marymount Univ:** Thomas Narock

**WSU:** **Pascal Hitzler, Michelle Cheatham,**  
**Adila Krisnadhi, Nazifa Karima**

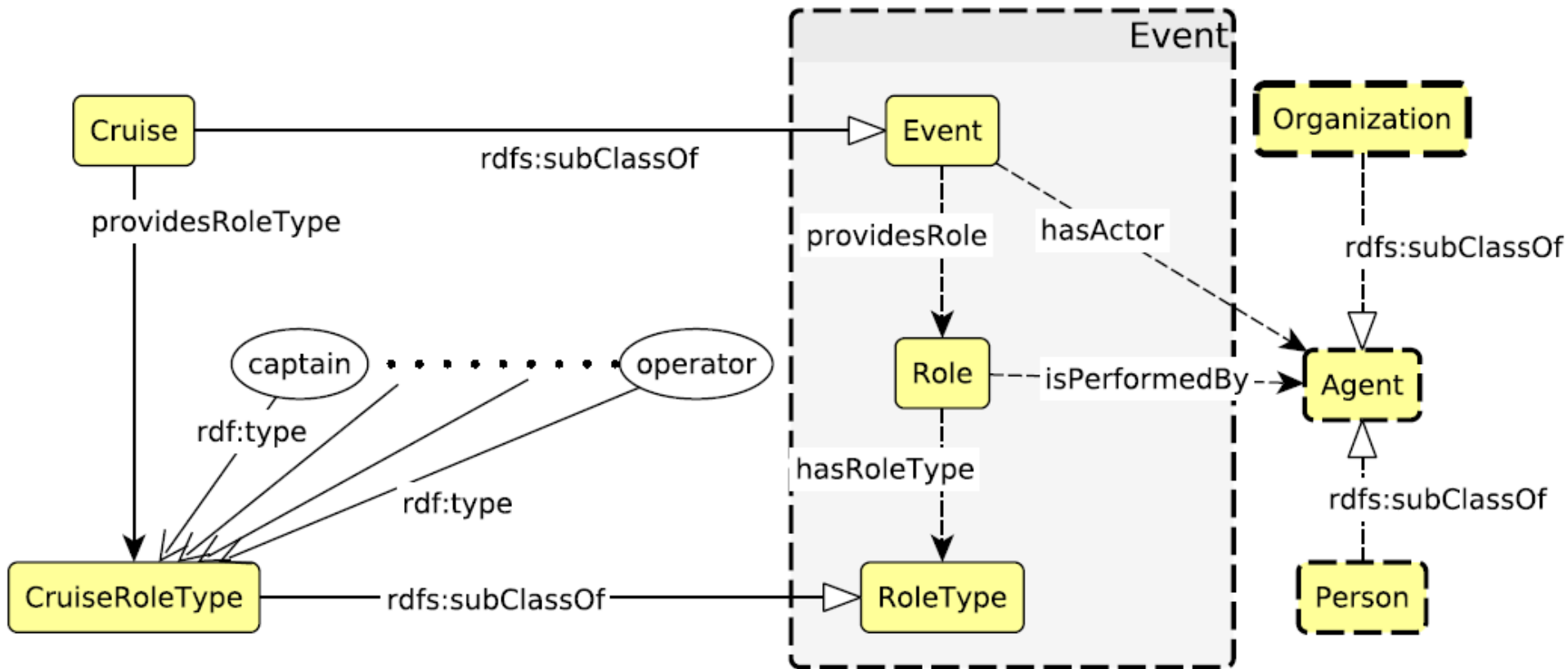
**UMBC:** Tim Finin

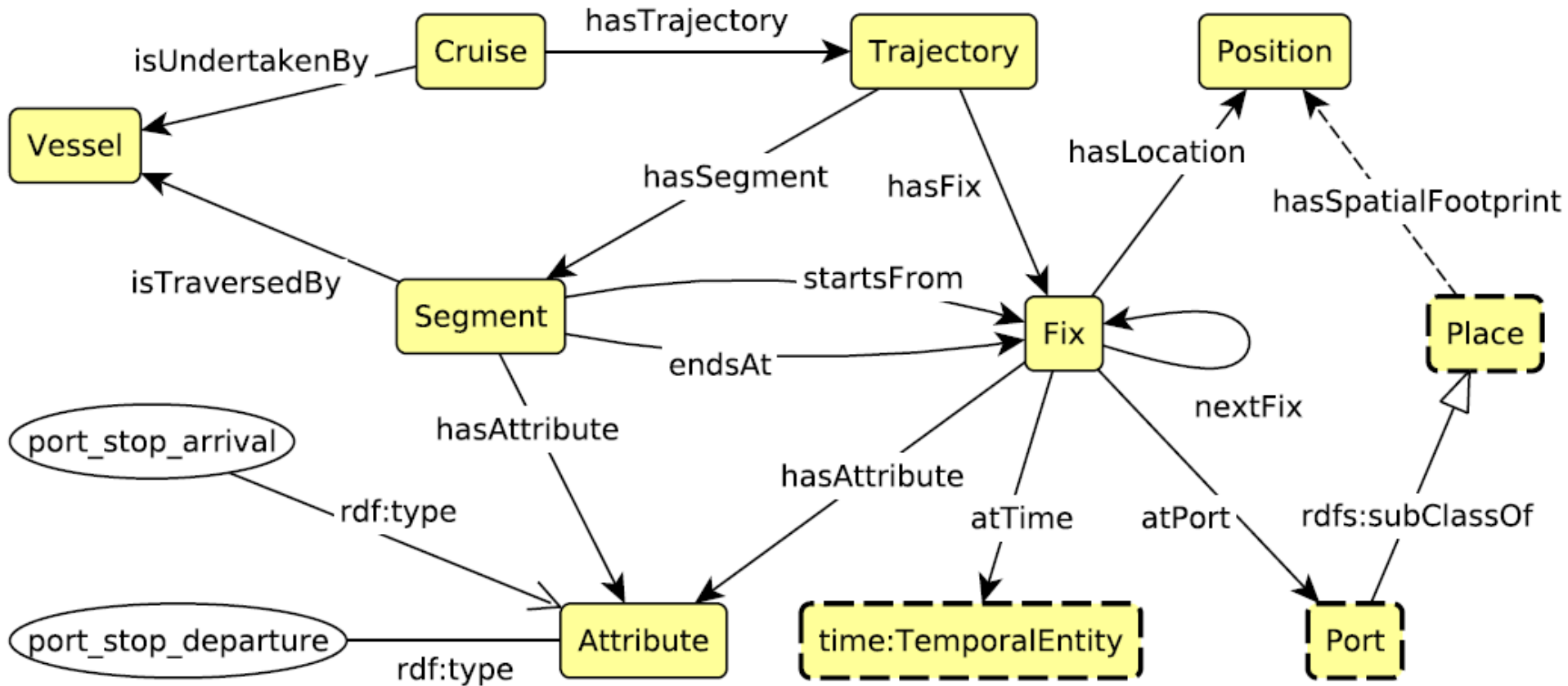
- **Strongly supportive of collaborative, inter-disciplinary modeling (focus on one central notion at a time)**
- **Keeping overview of a large continuously evolving ontology**
- **Open-ended use case: maximal flexibility of the modular approach for efficient adjustability**
- **Disruptive vision: plug- and playable ontology virtualization**

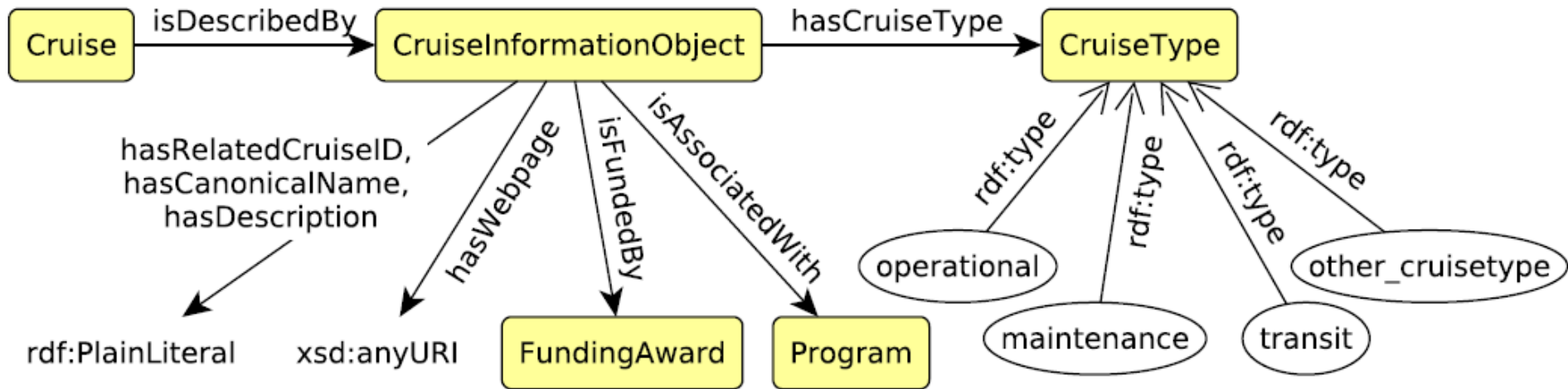




# Roles (Cruise as Event)







$$\text{Cruise} \sqsubseteq (=1 \text{ hasTrajectory.Trajectory}) \quad (13.1)$$

$$\text{Cruise} \sqsubseteq (=1 \text{ isUndertakenBy.Vessel}) \quad (13.2)$$

$$\text{Cruise} \sqsubseteq (=1 \text{ isDescribedBy.InformationObject}) \quad (13.3)$$

$$\text{InformationObject} \sqsubseteq (=1 \text{ isDescribedBy}^-.\text{Cruise}) \quad (13.4)$$

$$\text{hasTrajectory}^- \circ \text{isUndertakenBy} \sqsubseteq \text{isTraveledBy} \quad (13.5)$$

$$\exists \text{hasTrajectory.Trajectory} \sqsubseteq \text{Cruise} \quad (13.6)$$

$$\text{Cruise} \sqsubseteq \forall \text{hasTrajectory.Trajectory} \quad (13.7)$$

$$\exists \text{isUndertakenBy.Vessel} \sqsubseteq \text{Cruise} \quad (13.8)$$

$$\text{Cruise} \sqsubseteq \forall \text{isUndertakenBy.Vessel} \quad (13.9)$$

$$\exists \text{isDescribedBy.InformationObject} \sqsubseteq \text{Cruise} \quad (13.10)$$

$$\text{Cruise} \sqsubseteq \forall \text{isDescribedBy.InformationObject} \quad (13.11)$$

$$\exists \text{isTraveledBy.Vessel} \sqsubseteq \text{Trajectory} \quad (13.12)$$

$$\text{Trajectory} \sqsubseteq \forall \text{isTraveledBy.Vessel} \quad (13.13)$$

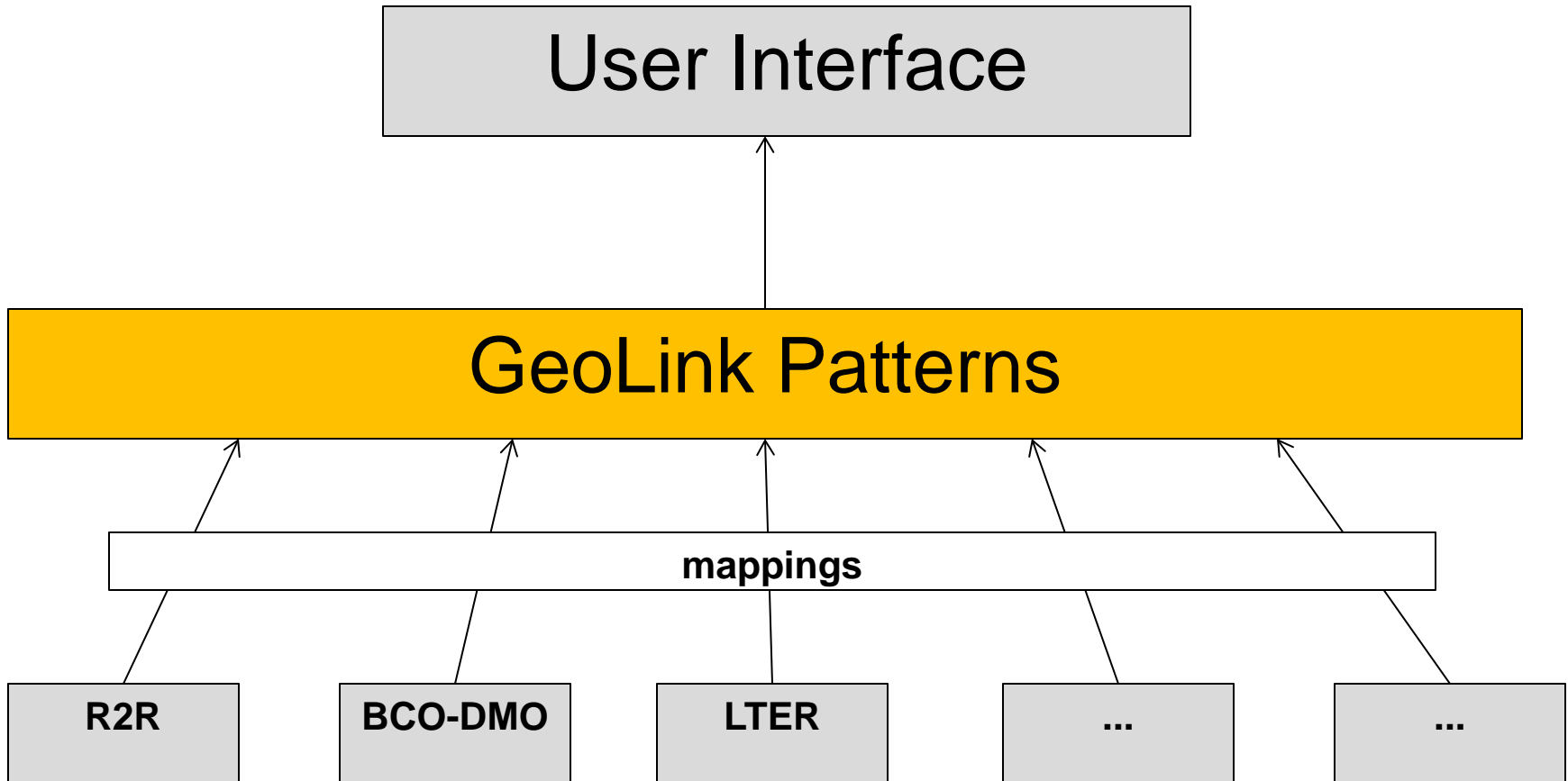
If a trajectory is traveled by a vessel, then every segment is traversed by that vessel.

$$\text{hasSegment}^- \circ \text{isTraveledBy} \sqsubseteq \text{isTraversedBy} \quad (13.28)$$

Also, a fix cannot be followed by more than one other fix, and cannot follow itself. This gives a linear structure in the ordering of the fixes.

$$\text{Fix} \sqsubseteq \exists \text{hasLocation.Position} \sqcap \exists \text{atTime.TimeEntity} \sqcap (=1 \text{ hasFix}^- . \text{Trajectory}) \quad (13.14)$$

$$\text{Fix} \sqsubseteq (\leq 1 \text{ nextFix.Fix}) \sqcap \neg \exists \text{nextFix.Self} \quad (13.15)$$



# Thanks!



[www.geolink.org](http://www.geolink.org)



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