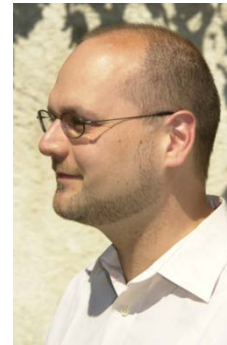


Data Repository Integration with Ontology Design Patterns

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EarthCube:

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.”

Targeting data sharing and discovery in the Earth Sciences.

LDEO: Robert Arko, Suzanne Carbotte, Kerstin Lehnert

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

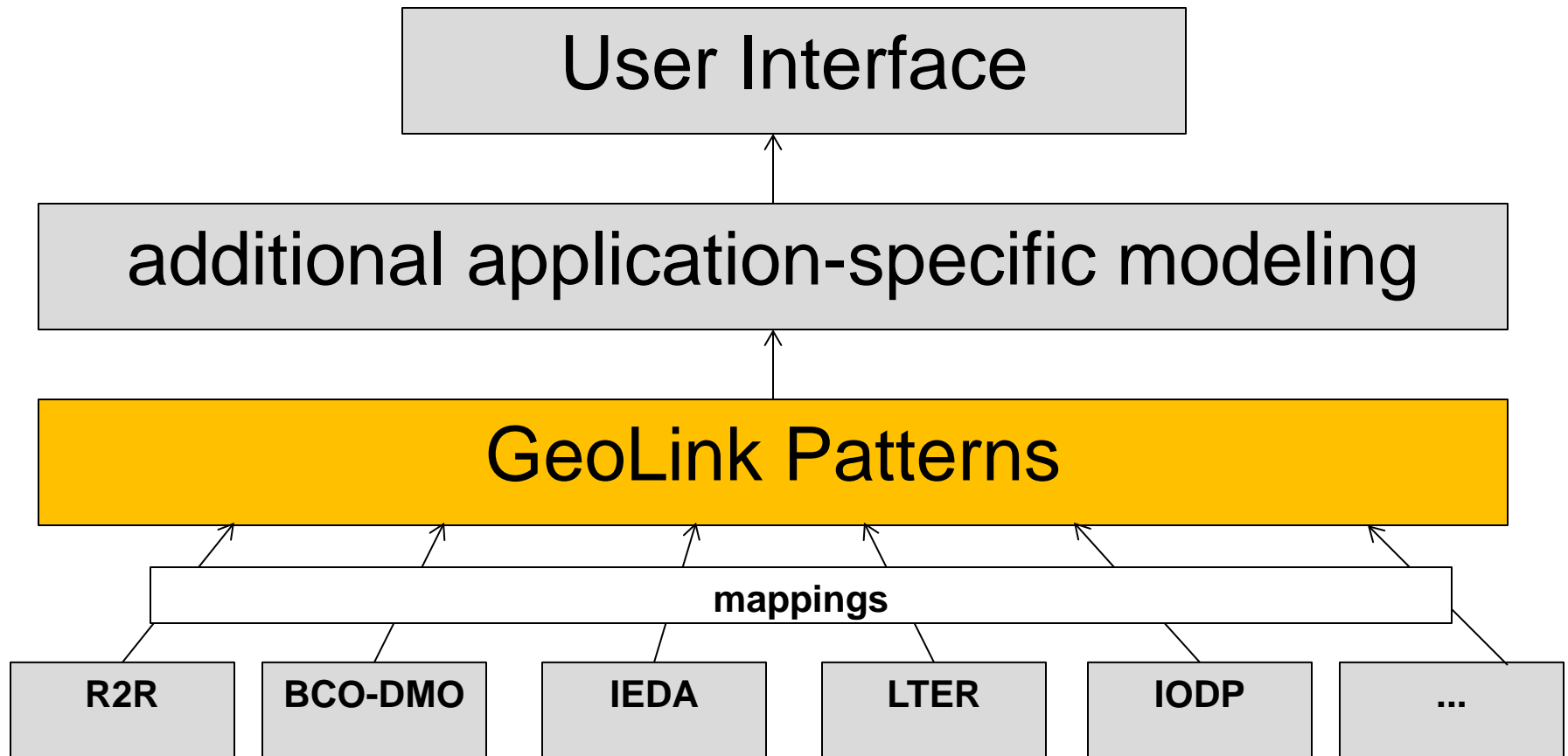
**UCSB: Mark Schildhauer, Krzysztof Janowicz, Matt Jones,
Yingjie Hu**

Ocean Leadership: Douglas Fils

Marymount Univ: Thomas Narock

WSU: Pascal Hitzler, Michelle Cheatham, Adila Krisnadhi

UMBC: Tim Finin



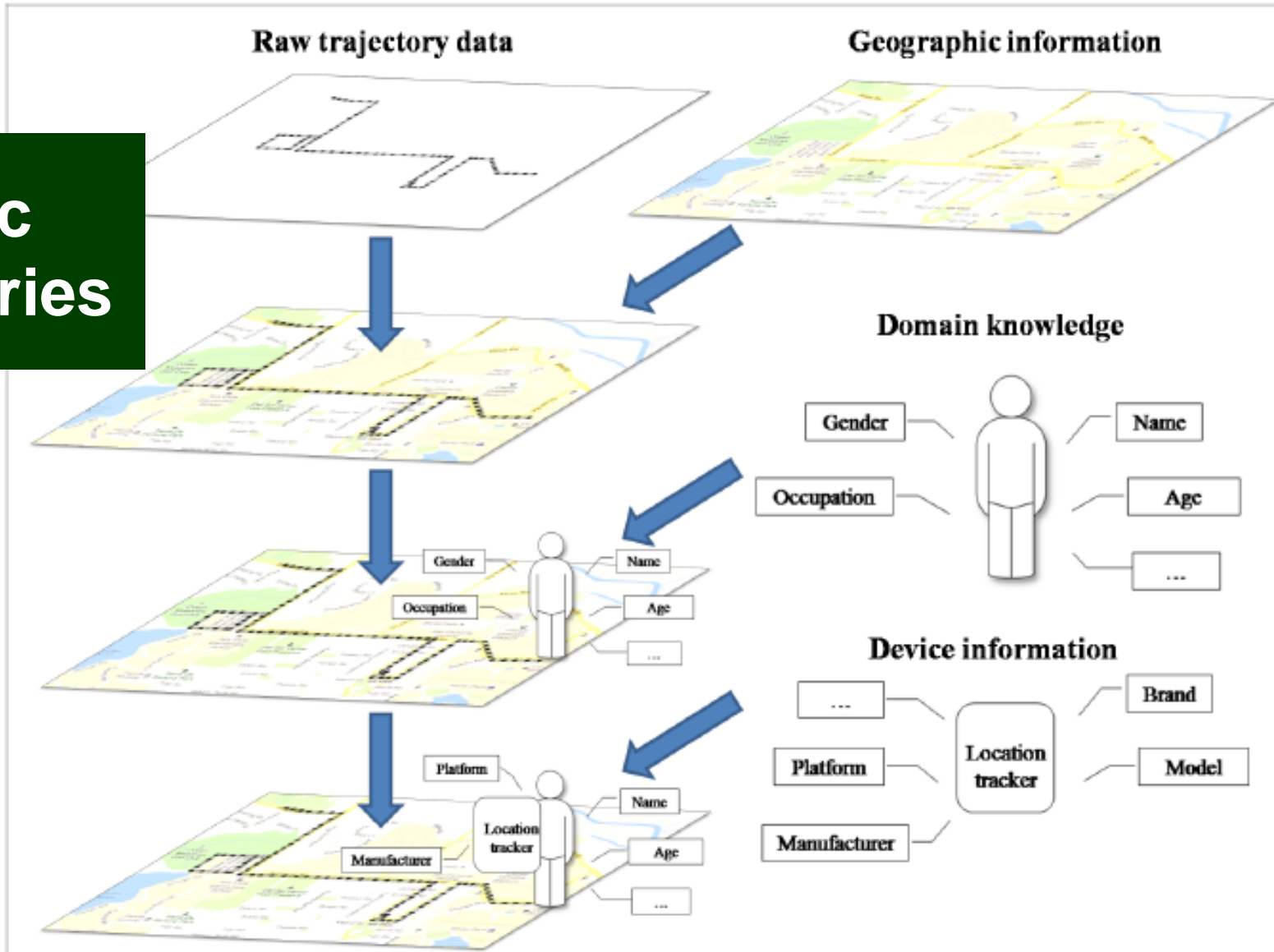
“An ontology design pattern is a reusable successful solution to a recurrent modeling problem.”

So-called *content patterns* usually encode specific abstract notions, such as process, event, agent, etc.

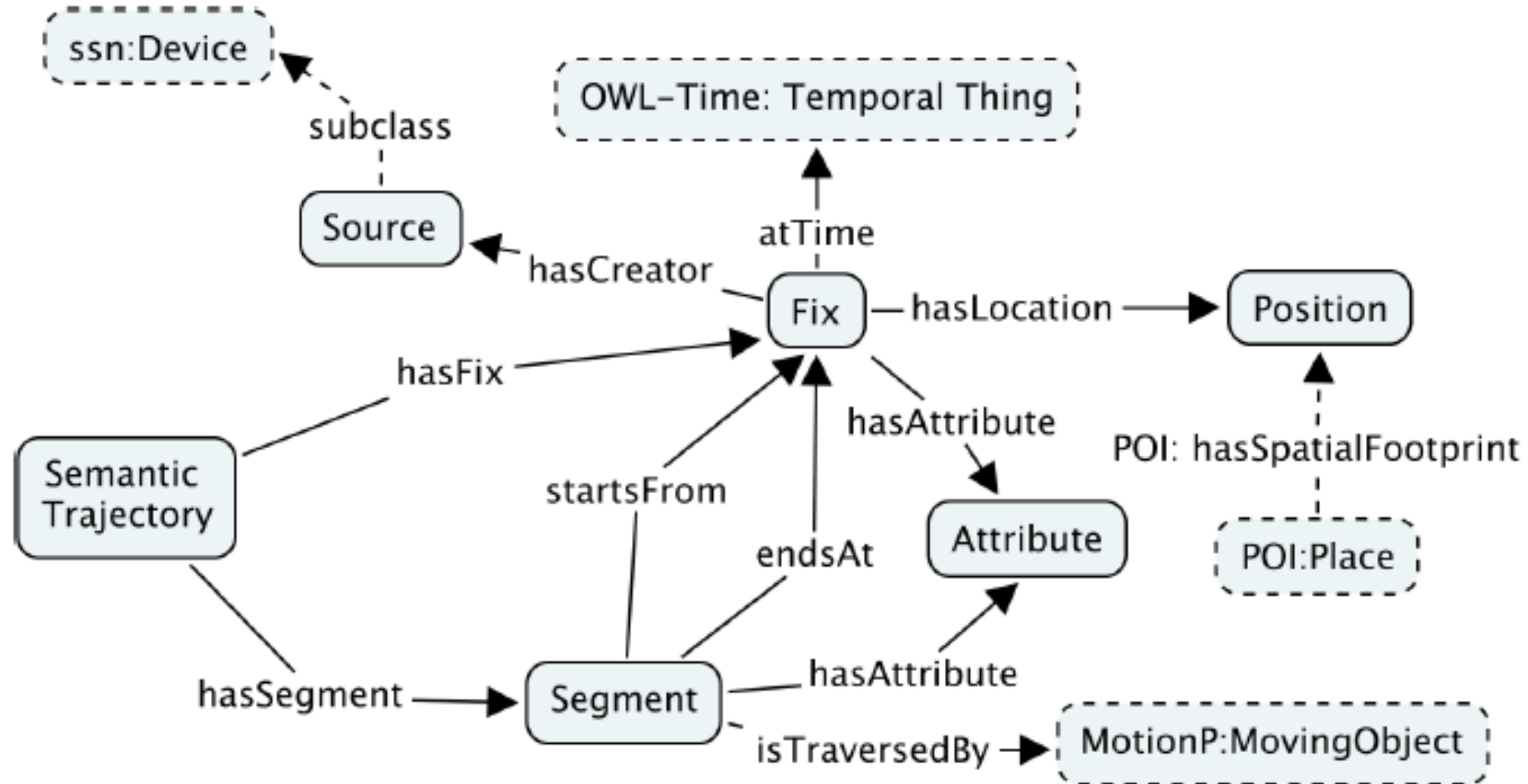
Patterns provide modular, reusable, replaceable, pieces.

By agreeing on **reuse of generic patterns** (but **leaving the relationships** between the patterns to a specific assembly **for a special purpose**), we can have **reuse while preserving heterogeneity**.

Semantic Trajectories



[Hu, Janowicz, Carral, Scheider, Kuhn, Berg-Cross, Hitzler, Dean, COSIT2013]



$$\begin{aligned} \text{Fix} \sqsubseteq & \exists \text{atTime.OWL-Time:Temporal Thing} \sqcap \exists \text{hasLocation.Position} \\ & \sqcap \exists \text{hasFix}^- .\text{SemanticTrajectory} \end{aligned} \quad (1)$$

$$\text{Segment} \sqsubseteq \exists \text{startsFrom.Fix} \sqcap \exists \text{endsAt.Fix} \quad (2)$$

$$\top \sqsubseteq \leq 1 \text{startsFrom.}\top \quad (3)$$

$$\top \sqsubseteq \leq 1 \text{endsAt.}\top \quad (4)$$

$$\text{Segment} \sqsubseteq \exists \text{hasSegment}^- .\text{SemanticTrajectory} \quad (5)$$

$$\text{startsFrom}^- \circ \text{endsAt} \sqsubseteq \text{hasNext} \quad (6)$$

$$\text{hasNext} \sqsubseteq \text{hasSuccessor} \quad (7)$$

$$\text{hasSuccessor} \circ \text{hasSuccessor} \sqsubseteq \text{hasSuccessor} \quad (8)$$

$$\text{hasNext}^- \sqsubseteq \text{hasPrevious} \quad (9)$$

$$\text{hasSuccessor}^- \sqsubseteq \text{hasPredecessor} \quad (10)$$

$$Fix \sqcap \neg \exists endsAt.Segment \sqsubseteq StartingFix \quad (11)$$

$$Fix \sqcap \neg \exists startsFrom.Segment \sqsubseteq EndingFix \quad (12)$$

$$Segment \sqcap \exists startsFrom.StartingFix \sqsubseteq StartingSegment \quad (13)$$

$$Segment \sqcap \exists endsAt.EndingFix \sqsubseteq EndingSegment \quad (14)$$

$$SemanticTrajectory \sqsubseteq \exists hasSegment.Segment \quad (15)$$

$$hasSegment \circ startsFrom \sqsubseteq hasFix \quad (16)$$

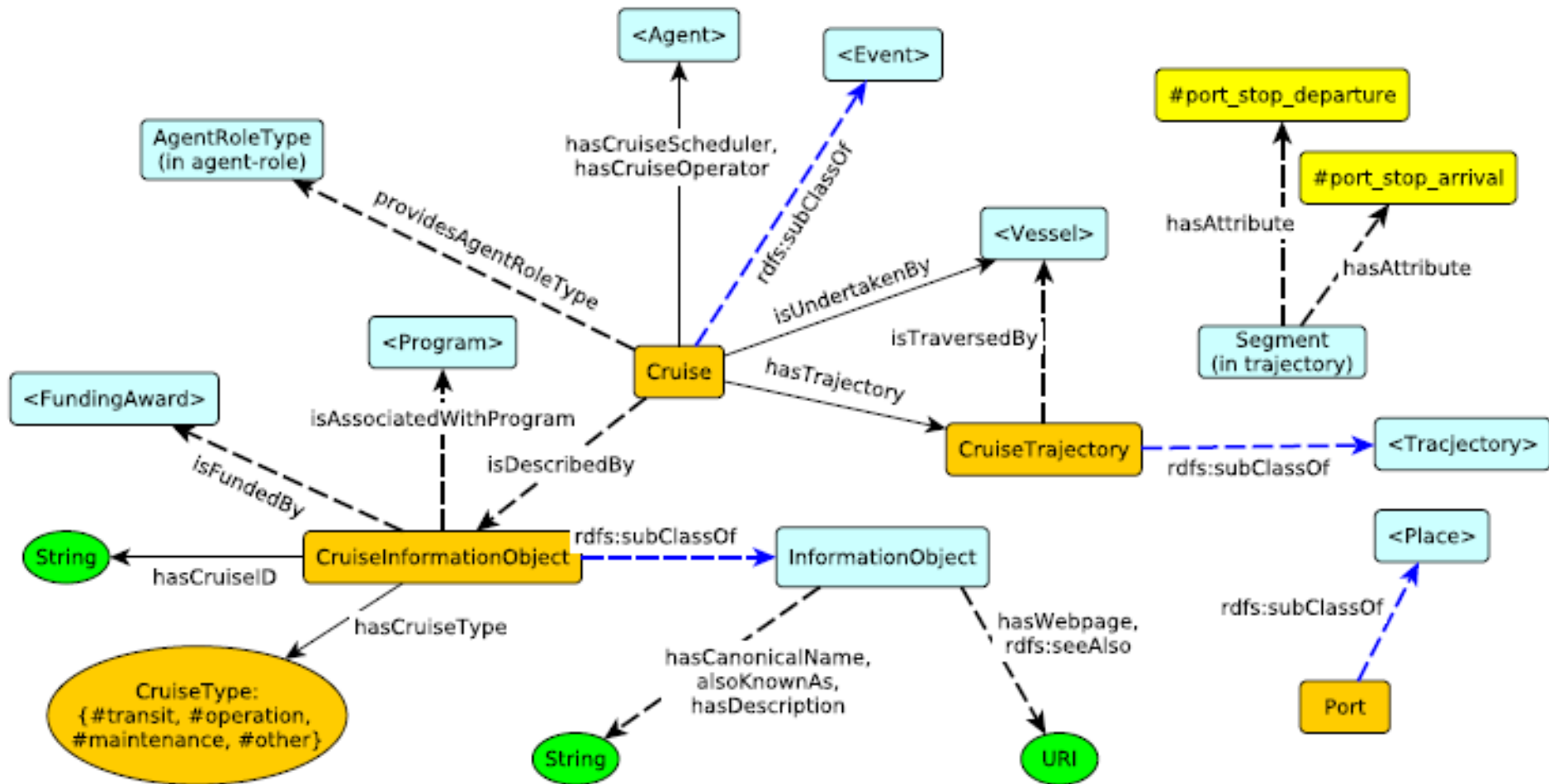
$$hasSegment \circ endsAt \sqsubseteq hasFix \quad (17)$$

$$\exists hasSegment.Segment \sqsubseteq SemanticTrajectory \quad (18)$$

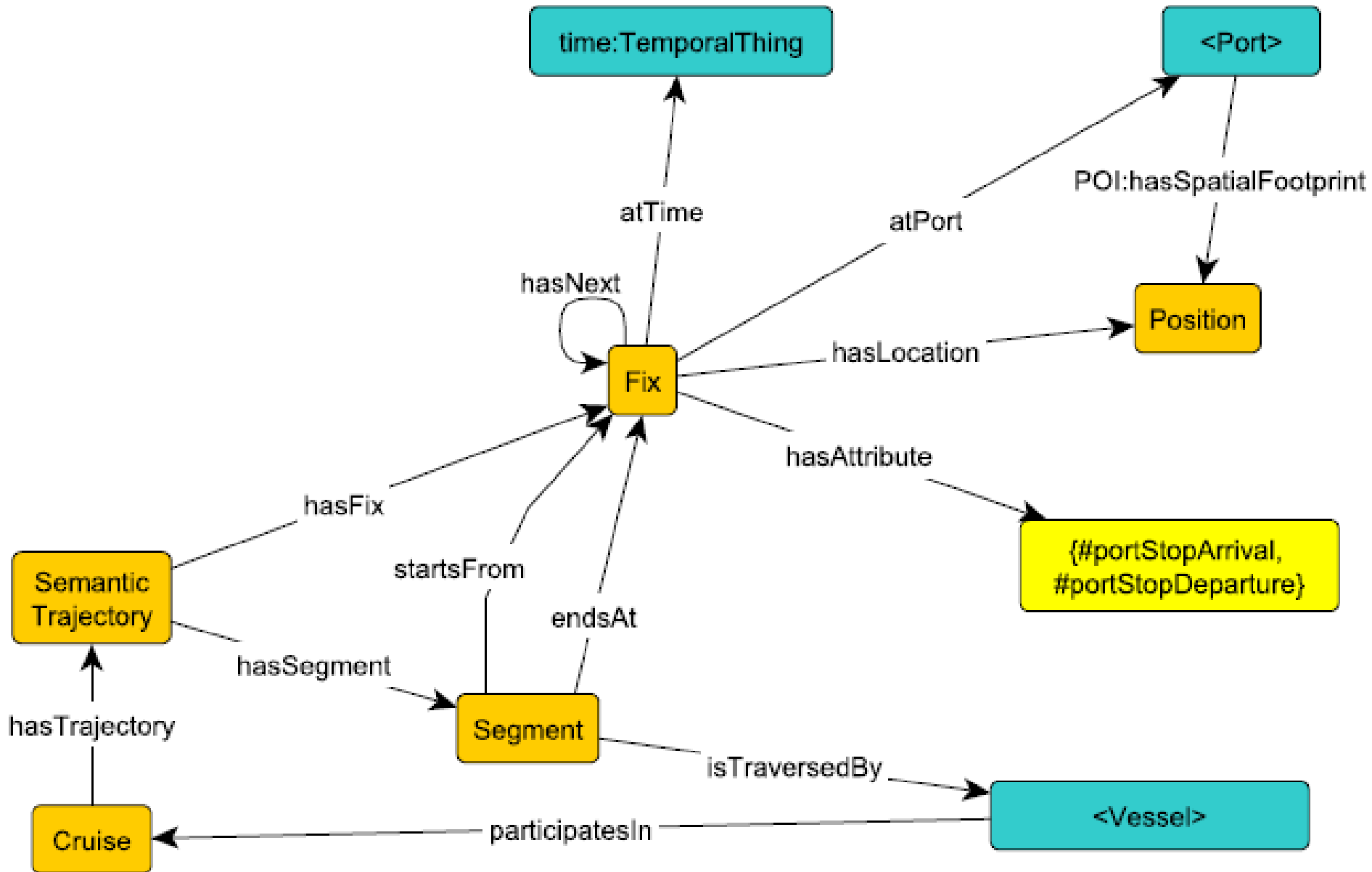
$$\exists hasSegment^- .SemanticTrajectory \sqsubseteq Segment \quad (19)$$

$$\exists hasFix.Segment \sqsubseteq SemanticTrajectory \quad (20)$$

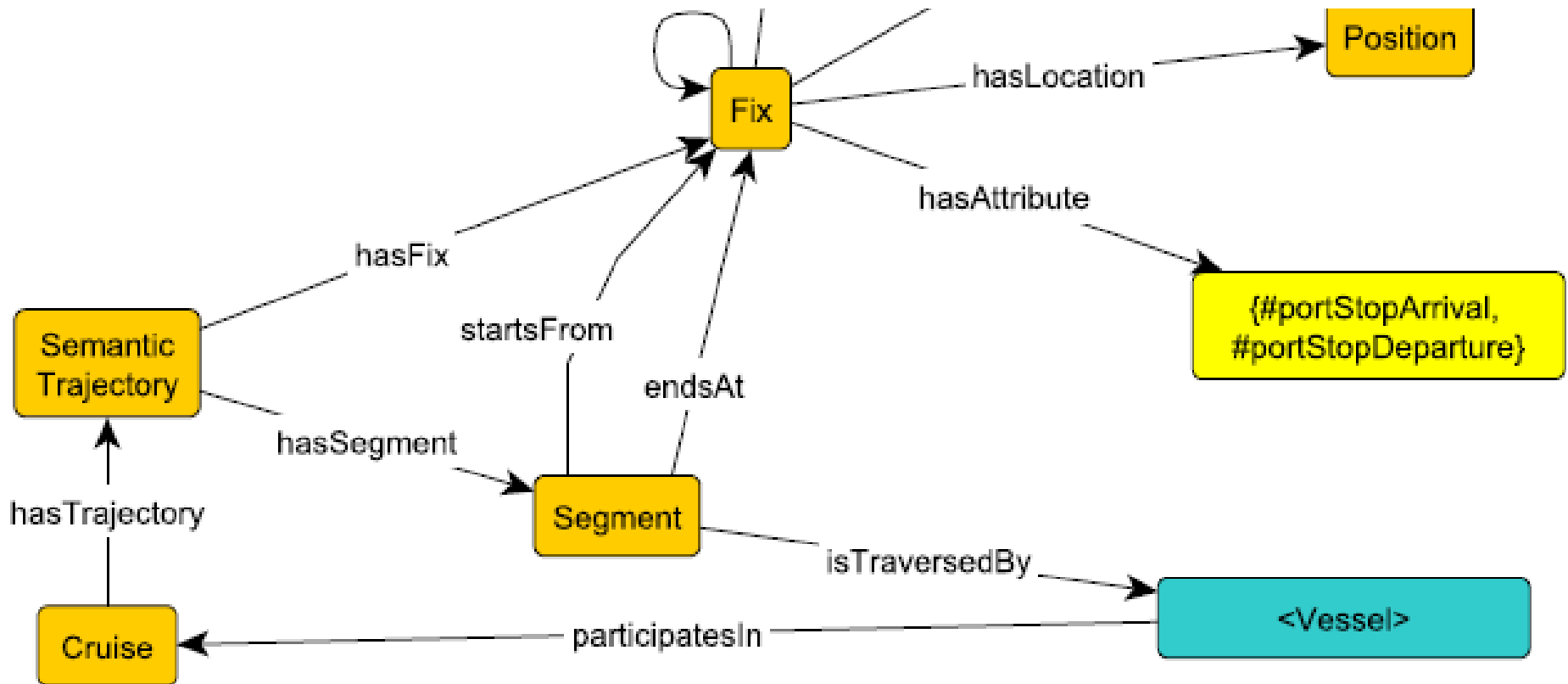
$$\exists hasFix^- .SemanticTrajectory \sqsubseteq Fix \quad (21)$$



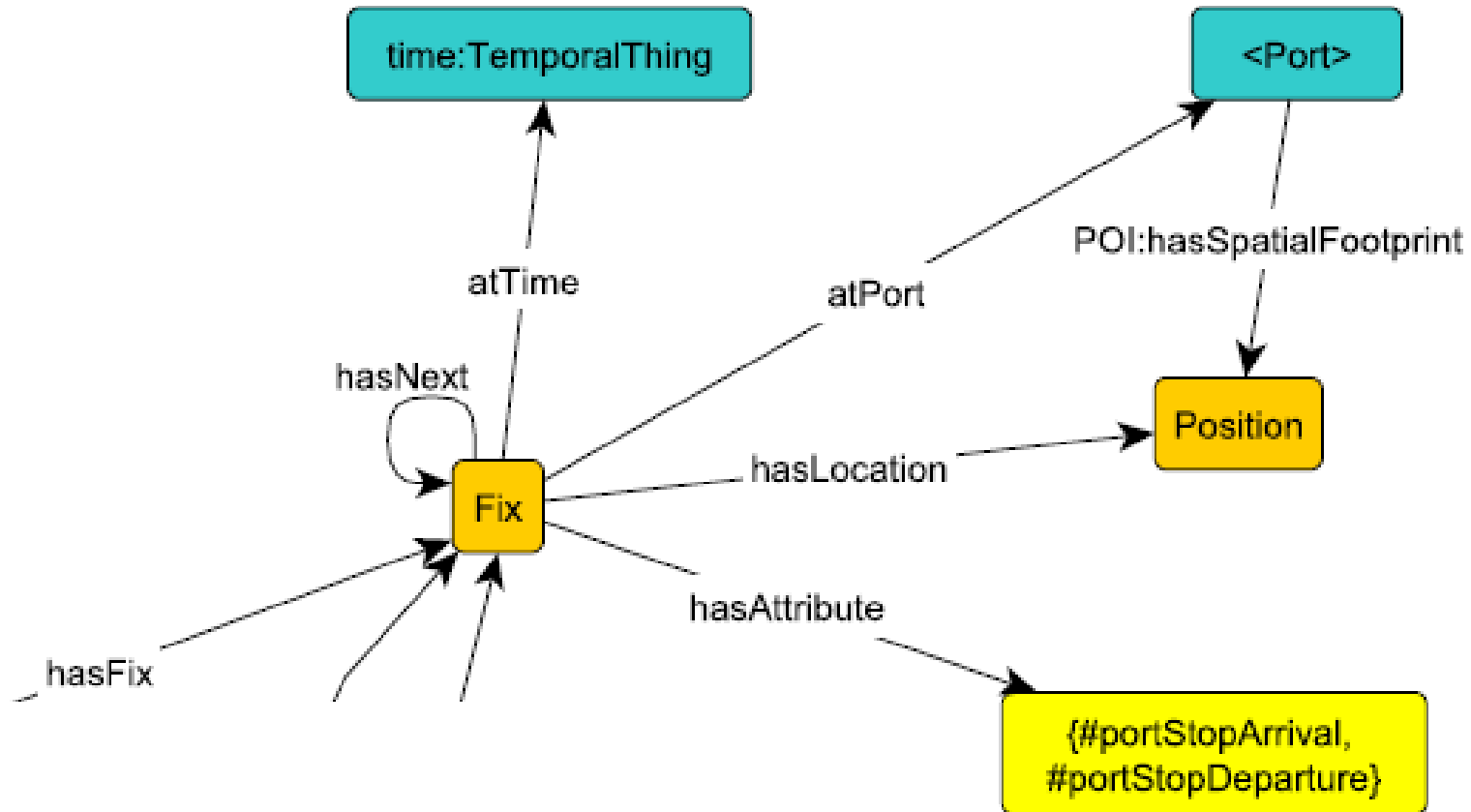
Cruise trajectory (draft)



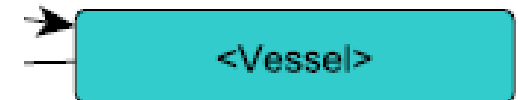
Cruise trajectory

$$\begin{aligned} & \text{Cruise}(x) \wedge \text{hasTrajectory}(x, y) \\ & \quad \wedge \text{hasSegment}(y, z) \wedge \text{isTraversedBy}(z, v) \\ & \quad \rightarrow \text{participatesIn}(v, z) \end{aligned}$$


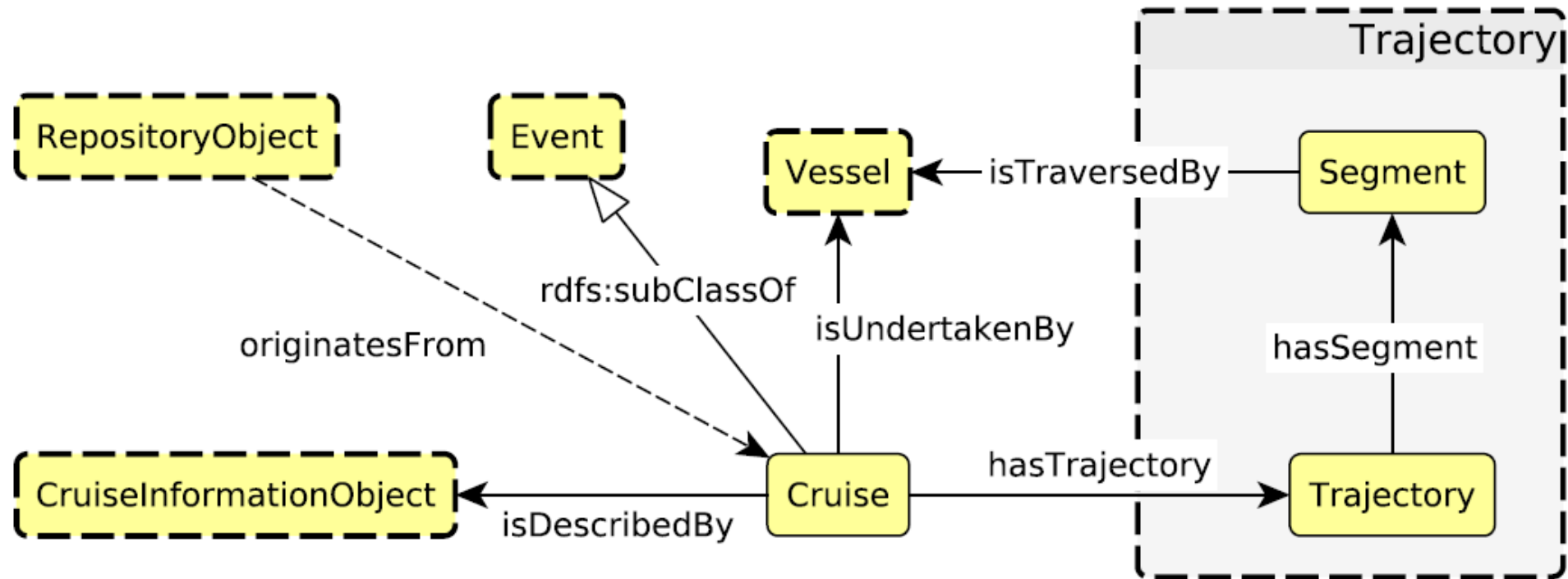
$$\begin{aligned} & \text{Cruise}(x) \wedge \text{hasTrajectory}(x, y) \\ & \quad \wedge \text{hasSegment}(y, z) \wedge \text{isTraversedBy}(z, v) \\ & \quad \rightarrow \text{participatesIn}(v, z) \end{aligned}$$
$$\text{Cruise} \equiv \exists \text{cruise}.\text{Self}$$
$$\begin{aligned} & \text{cruise} \circ \text{hasTrajectory} \circ \text{hasSegment} \circ \text{isTraversedBy} \\ & \quad \sqsubseteq \text{hasParticipant} \end{aligned}$$
$$\text{hasParticipant} \equiv \text{participatesIn}^-$$



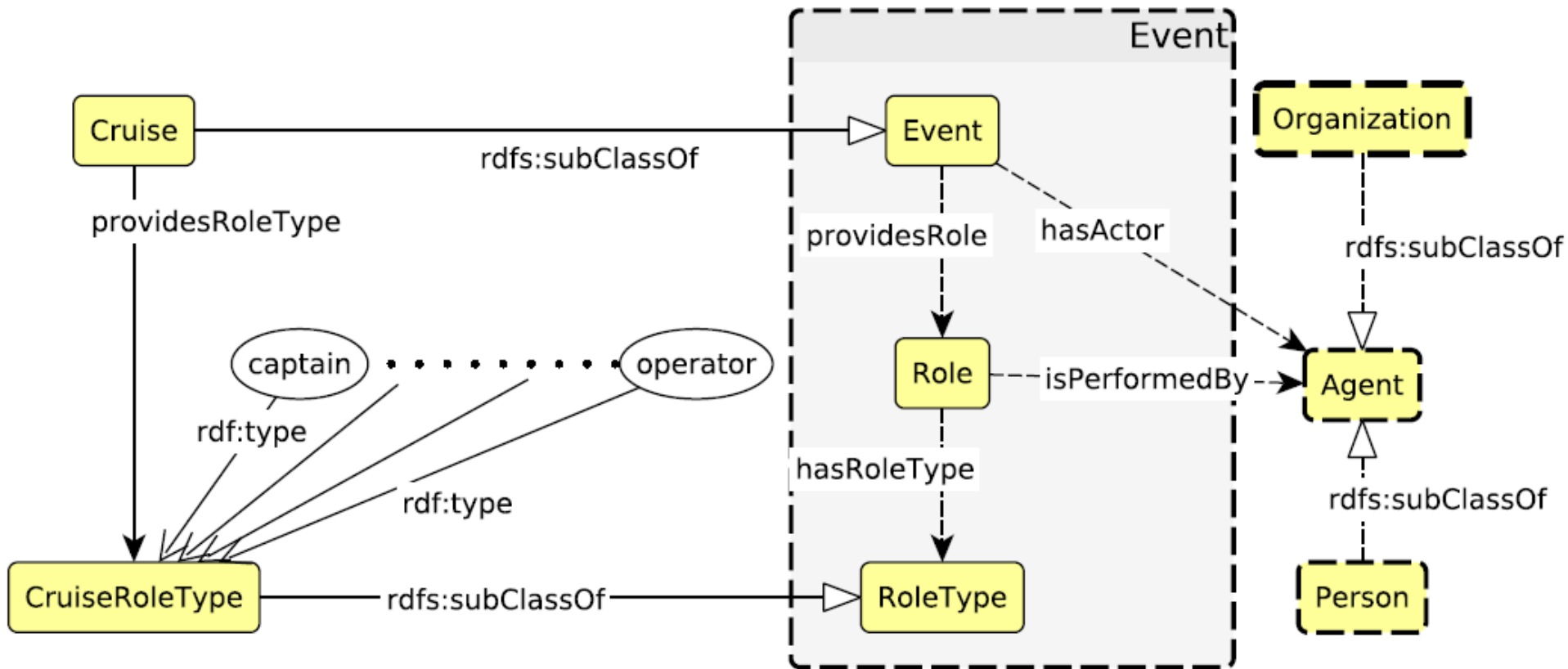
$\text{Fix}(x) \wedge \text{hasAttribute}(x, \#portStopArrival)$
 $\wedge \text{atPort}(x, y) \wedge \text{hasSpatialFootprint}(y, z)$
 $\wedge \text{hasLocation}(x, w) \rightarrow \text{locatedIn}(w, z)$

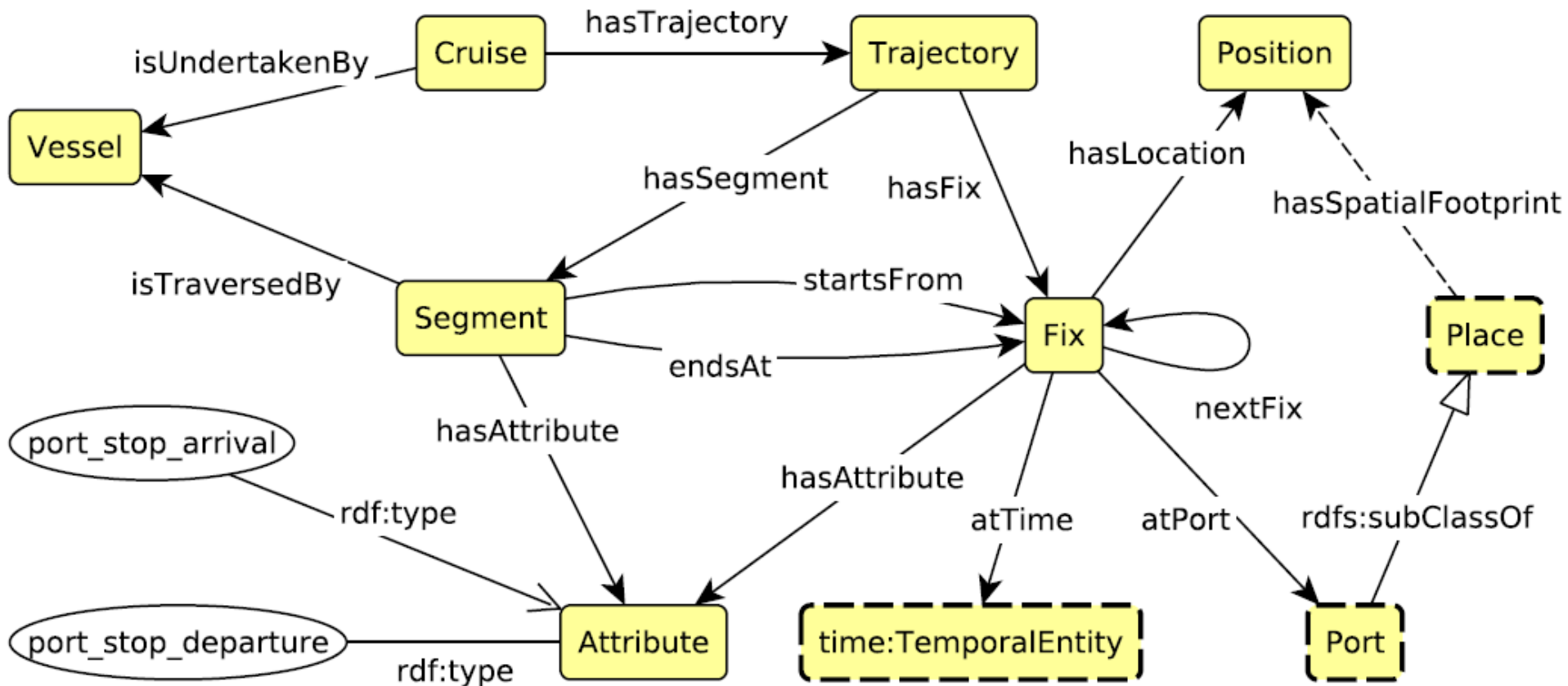


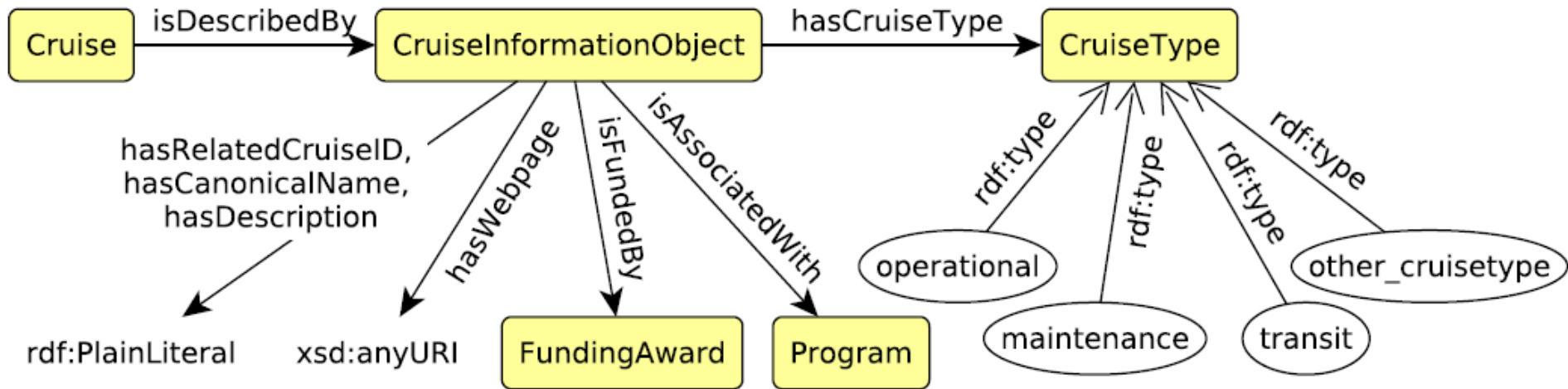
$$\begin{aligned} & \text{Fix}(x) \wedge \text{hasAttribute}(x, \#\text{portStopArrival}) \\ & \wedge \text{atPort}(x, y) \wedge \text{hasSpatialFootprint}(y, z) \\ & \wedge \text{hasLocation}(x, w) \rightarrow \text{locatedIn}(w, z) \end{aligned}$$
$$\begin{aligned} \text{Fix} \wedge \exists \text{hasTrajectory}.\{\#\text{portStopArrival}\} & \equiv \exists \text{fixps}.\text{Self} \\ & \text{hasLocation}^- \circ \text{fixps} \circ \text{atPort} \circ \text{hasSpatialFootprint} \\ & \sqsubseteq \text{locatedIn} \end{aligned}$$



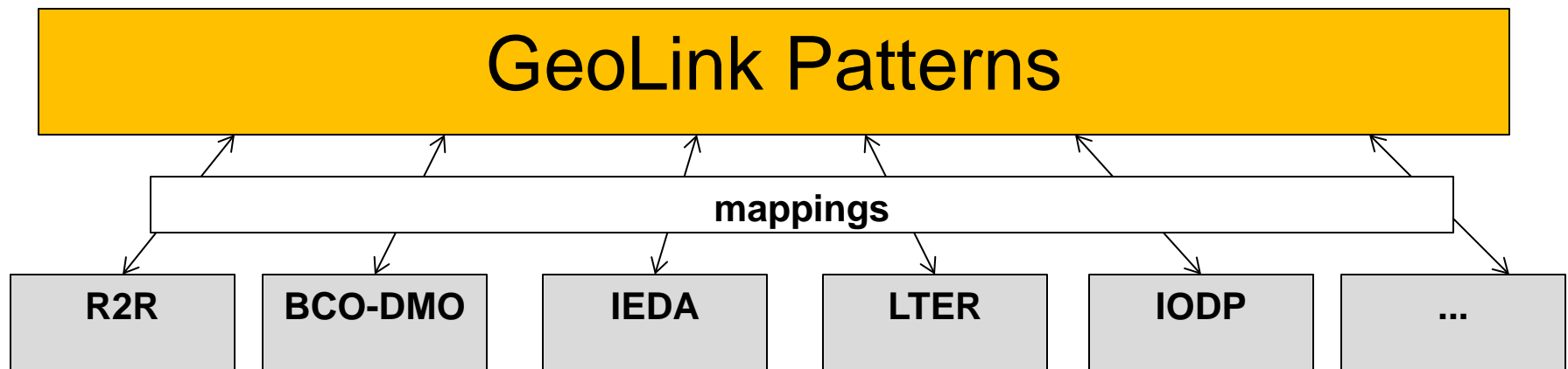
Roles (Cruise as Event)







- Aggregated data can be “pulled back” along the same mappings, if desired.
- Since the patterns are very generic, there is no loss of information by using them as interchange format.



Thanks!

www.oceanlink.org
www.geo-link.org

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