

A Semantic Infosphere

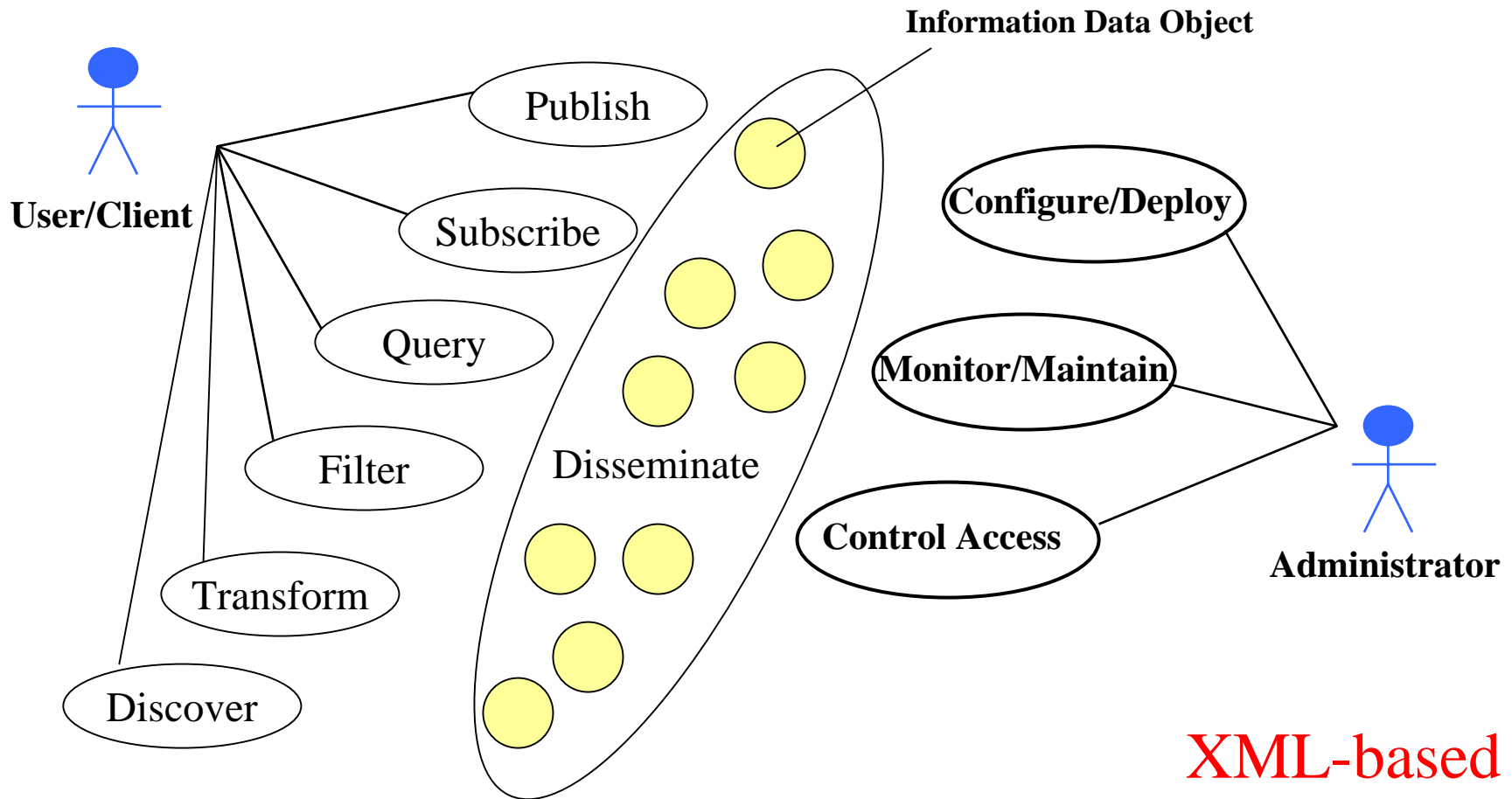
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Existing Infrastructure



Reference: Adapted from USAF Scientific Advisory Board Study (SAB-TR-99-02)

Why Semantic Filtering?

For both *subscriptions* and *queries*

- Filtering based on *CONCEPTS*, not keywords;
- Does not require knowledge of report structure (unlike XPath);
- Very expressive (e.g. based on description logic);
- Automatic classification of different subscriptions/queries;
 - Rich hierarchy of IDOs being subscribed to;
 - Check set of filters for internal consistency.

Approach

- **Ontologies:** Use DAML+OIL, to represent an ontology in the required domain.
- **Semantic Metadata:** Augment the IDOs with semantic metadata using ontology terms. Metadata is published along with the IDO.
- **Semantic Filtering**
 - Create semantic filters for queries or subscriptions
 - Use FaCT inference engine to match document metadata to subscriptions
- **Integration:** Integrate into existing Xinfosphere architecture.

Domain: Battlefield Spot Reports

Spot Report 1

1. **220555Z Jun 92**
2. **46 53' 25" N, 122 41' 40" W**
3. **Scout platoon completed recon of Rainier.
No enemy contact.**

Sct platoon moving to battalion left flank.

4. **2-48 Inf**

Spot Reports

Two things being reported on:

- A reconnaissance **event** by a particular unit.
- A **movement** by that same unit.

In general, there could be many things.

Metadata (informal)

sp-001

- 1. Template Type: EVENT
- 2. Message Nr: SP-001
- 3. Time of Event: 220555Z JUN 92
- 4. Force Initiating: FRIENDLY
- 5. Event Activity: RECON
- 6. Agent Location: 046 53 25 N 122 41 40 W
- 7. Object Location: 046 53 25 N 122 41 40 W
- 8. *etc.*

The Ontology

- **Four kinds of information:**
 - *Move*: for movement activities
 - *Event*: for other activities
 - *Situation Report*: to describe friendly force readiness.
 - *Enemy Order of Battle*: to describe enemy status and activities.
- **A template for each**
- **A report has one or more of each of these four templates.**
- **Key template attributes...**

Some Key Attributes

- **All templates:**

- *Agent Unit*: Location, Function, ID, Size and Vehicles

- **Move and Event Activities:**

- *Agent* (i.e. acting): ForceType, Purpose of, Response of, Instrument of

- *Object*: Result for & Response of

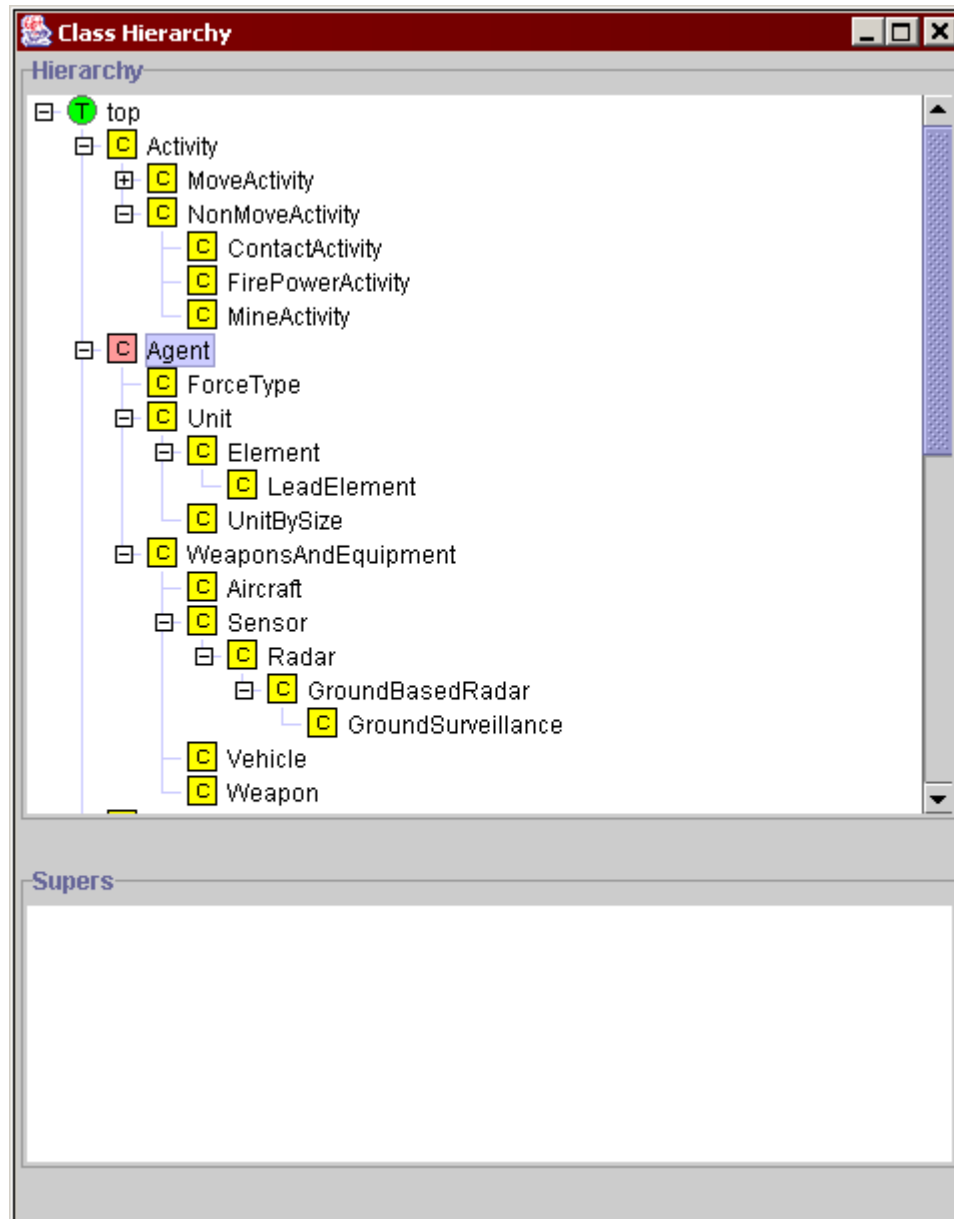
- *Other*: Time of event & General result

- **Event Templates only:**

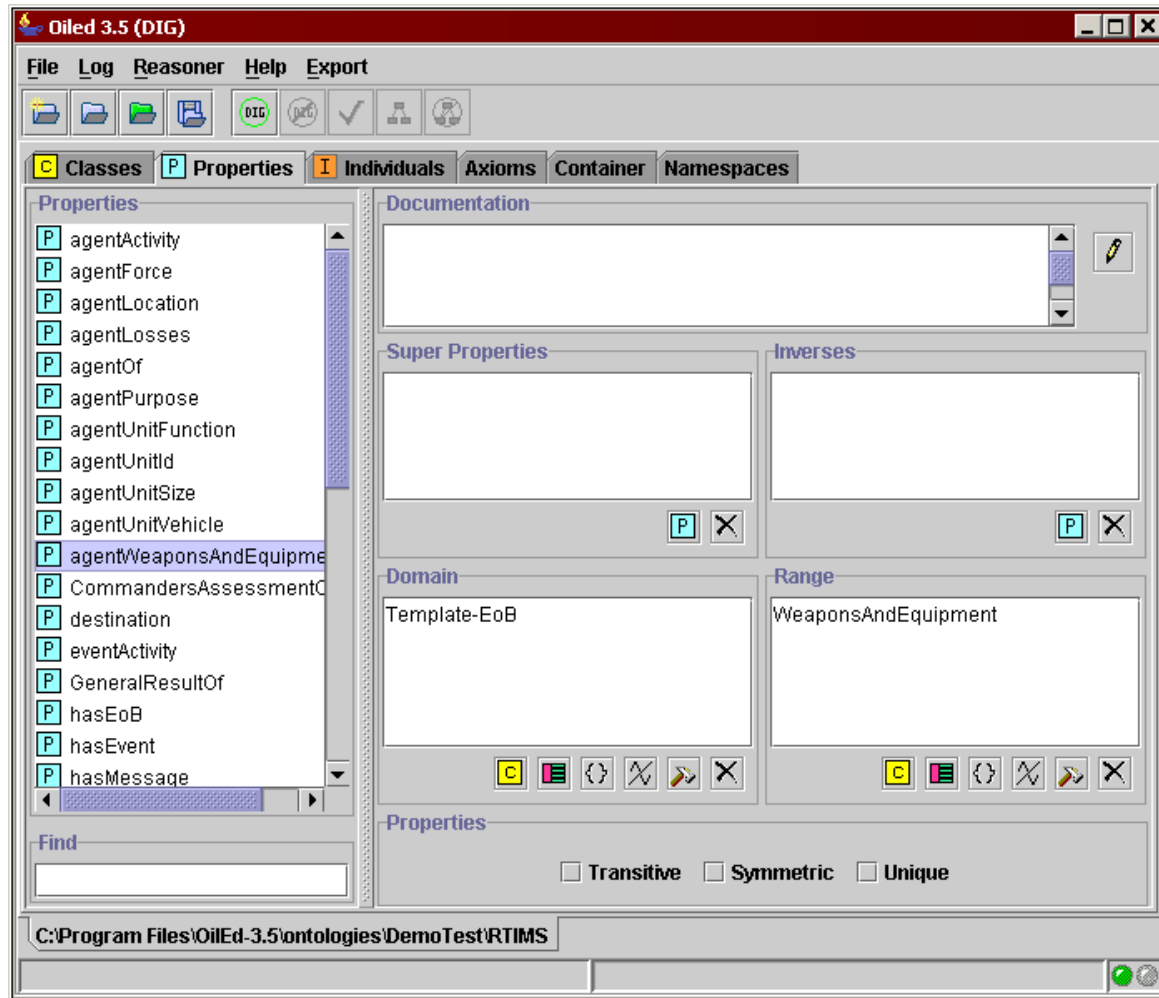
- *Object Unit* (i.e. acted on): ForceType, Location, Losses, Function, Id, Size, Vehicles

- **Move Templates only:** Destination, Direction, ETA

Ontology in OilEd: Classes



Ontology in OilEd: Properties



Metadata in OilEd

Message 1 has two templates:

The screenshot shows the OilEd 3.5 (DIG) interface. The 'Classes' tab is active, and 'ZZ-Msg-001' is selected in the left-hand pane. The main area displays the following information:

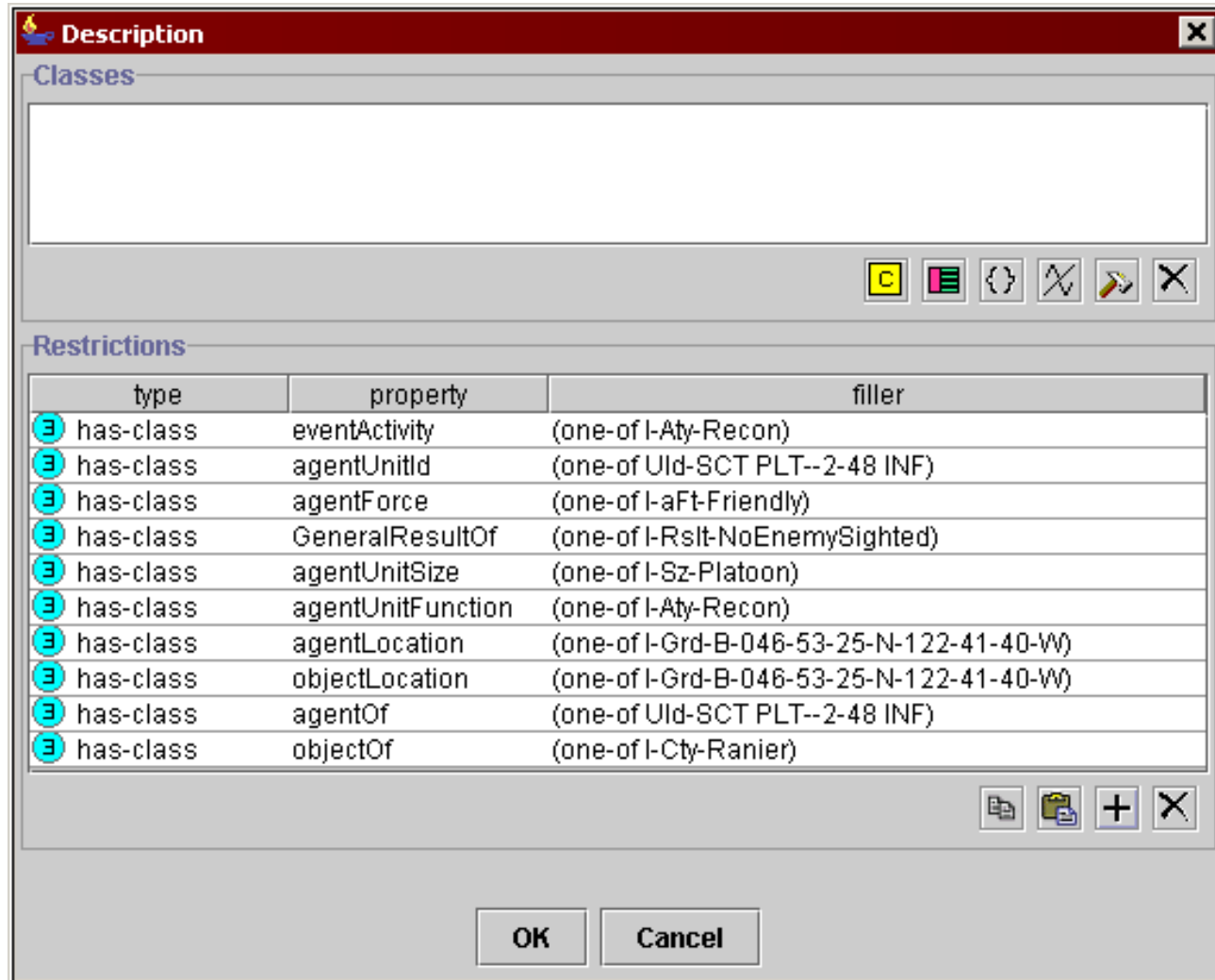
- Name:** ZZ-Msg-001
- Properties:** SubclassOf, SameClassAs
- Documentation:** (Empty text area)
- Classes:** Message-Individual
- Restrictions:**

type	property	filler
has-class	hasEvent	((eventActivity some (one-of I-Aty-Recon)) and [agentUni...
has-class	hasMove	([agentUnitId some (one-of UId-SCT PLT--2-48 INF)] an...

The status bar at the bottom indicates the file path: C:\Program Files\OilEd-3.5\ontologies\DemoTest\RTIMS

Metadata in OilEd

One Event template with several role restrictions:



The screenshot shows a software window titled "Description" with a "Classes" section and a "Restrictions" section. The "Restrictions" section contains a table with three columns: "type", "property", and "filler". Each row in the table is preceded by a blue circle containing the number 3. The "filler" column contains various role restrictions, such as "(one-of I-Aty-Recon)" and "(one-of I-Grd-B-046-53-25-N-122-41-40-W)".

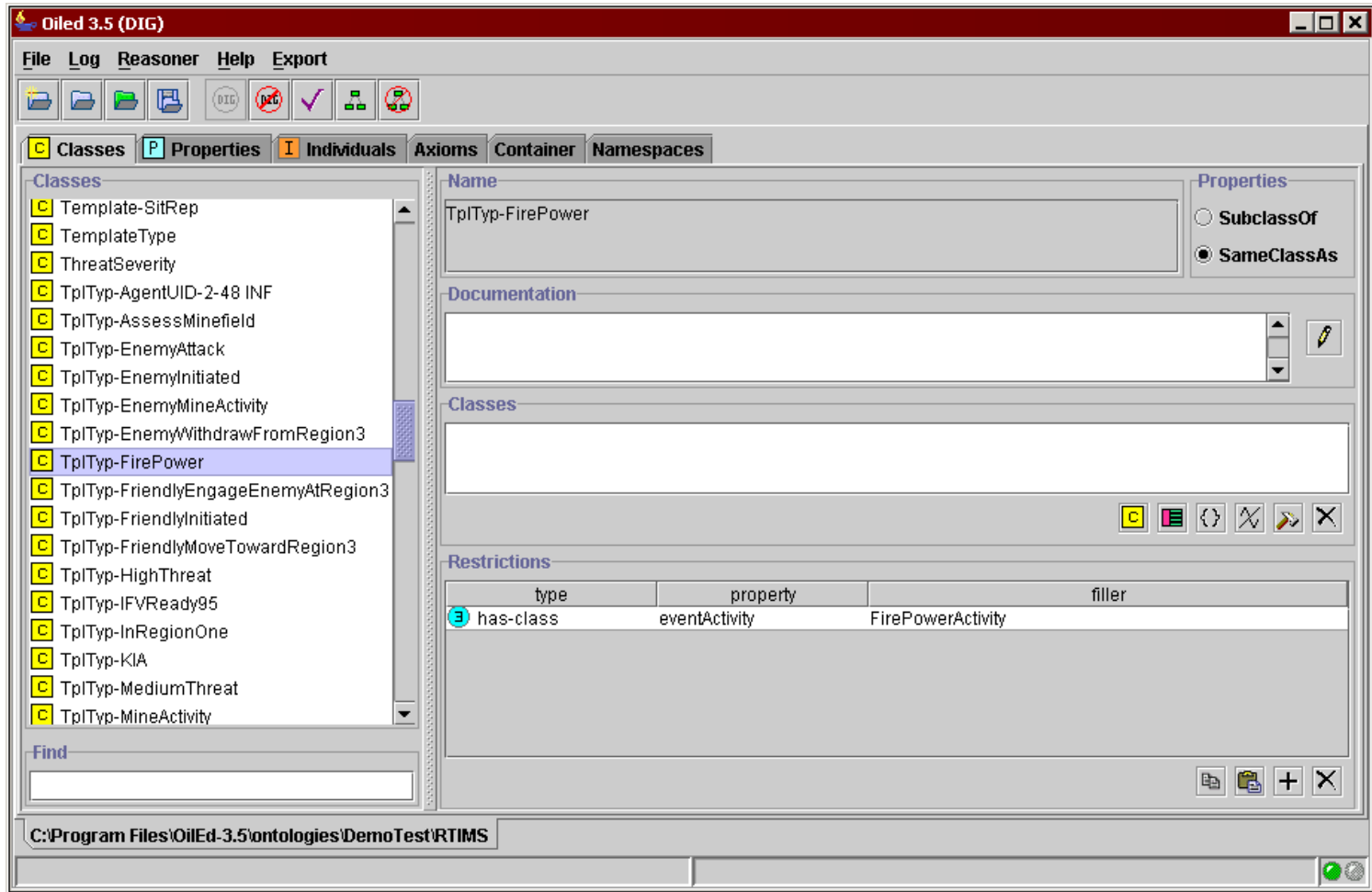
type	property	filler
3 has-class	eventActivity	(one-of I-Aty-Recon)
3 has-class	agentUnitId	(one-of UId-SCT PLT--2-48 INF)
3 has-class	agentForce	(one-of I-aFt-Friendly)
3 has-class	GeneralResultOf	(one-of I-Rslt-NoEnemySighted)
3 has-class	agentUnitSize	(one-of I-Sz-Platoon)
3 has-class	agentUnitFunction	(one-of I-Aty-Recon)
3 has-class	agentLocation	(one-of I-Grd-B-046-53-25-N-122-41-40-W)
3 has-class	objectLocation	(one-of I-Grd-B-046-53-25-N-122-41-40-W)
3 has-class	agentOf	(one-of UId-SCT PLT--2-48 INF)
3 has-class	objectOf	(one-of I-Cty-Ranier)

Metadata Exported to XML

```
<DEFCONCEPT NAME="N0_ZZ-MSG-001"></DEFCONCEPT><IMPLIESC><CONCEPT><PRIMITIVE NAME="N0_ZZ-MSG-001"></PRIMITIVE></CONCEPT><CONCEPT><AND><PRIMITIVE NAME="N0_MESSAGE-INDIVIDUAL"></PRIMITIVE><SOME><PRIMROLE NAME="N0_HASEVENT"></PRIMROLE><AND><SOME><PRIMROLE NAME="N0_EVENTACTIVITY"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-ATY-RECON"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTUNITID"></PRIMROLE><PRIMITIVE NAME="_I_N0_UID-SCTX1PLT--2-48X1INF"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTFORCE"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-AFT-FRIENDLY"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_GENERALRESULTOF"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-RSLT-NOENEMYSIGHTED"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTUNITSIZE"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-SZ-PLATOON"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTUNITFUNCTION"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-FN-RECON"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTLOCATION"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-GRD-B-046-53-25-N-122-41-40-W"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_OBJECTLOCATION"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-GRD-B-046-53-25-N-122-41-40-W"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTOF"></PRIMROLE><PRIMITIVE NAME="_I_N0_UID-SCTX1PLT--2-48X1INF"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_OBJECTOF"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-CITY-RANIER"></PRIMITIVE></SOME></AND></SOME><SOME><PRIMROLE NAME="N0_HASMOVE"></PRIMROLE><AND><SOME><PRIMROLE NAME="N0_AGENTUNITID"></PRIMROLE><PRIMITIVE NAME="_I_N0_UID-SCTX1PLT--2-48X1INF"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTFORCE"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-AFT-FRIENDLY"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTUNITSIZE"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-SZ-PLATOON"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTUNITFUNCTION"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-ATY-RECON"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_MOVEACTIVITYZ"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-MVATY-MOVE"></PRIMITIVE></SOME><AND><SOME><PRIMROLE NAME="N0_AGENTOF"></PRIMROLE><PRIMITIVE NAME="_I_N0_UID-SCTX1PLT--2-48X1INF"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTLOCATION"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-GRD-B-046-53-25-N-122-41-40-W"></PRIMITIVE></SOME></AND><SOME><PRIMROLE NAME="N0_DESTINATION"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-FNK-LEFTFLANK"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_DESTINATION"></PRIMROLE><PRIMITIVE NAME="_I_N0_UID-2-48-INF"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTLOCATION"></PRIMROLE><PRIMITIVE NAME="_I_N0_I-GRD-G-046-54-55-N-122-44-50-W"></PRIMITIVE></SOME><SOME><PRIMROLE NAME="N0_AGENTOF"></PRIMROLE><PRIMITIVE NAME="N0_UNIT"></PRIMITIVE></SOME></AND></SOME></AND></CONCEPT></IMPLIESC>
```

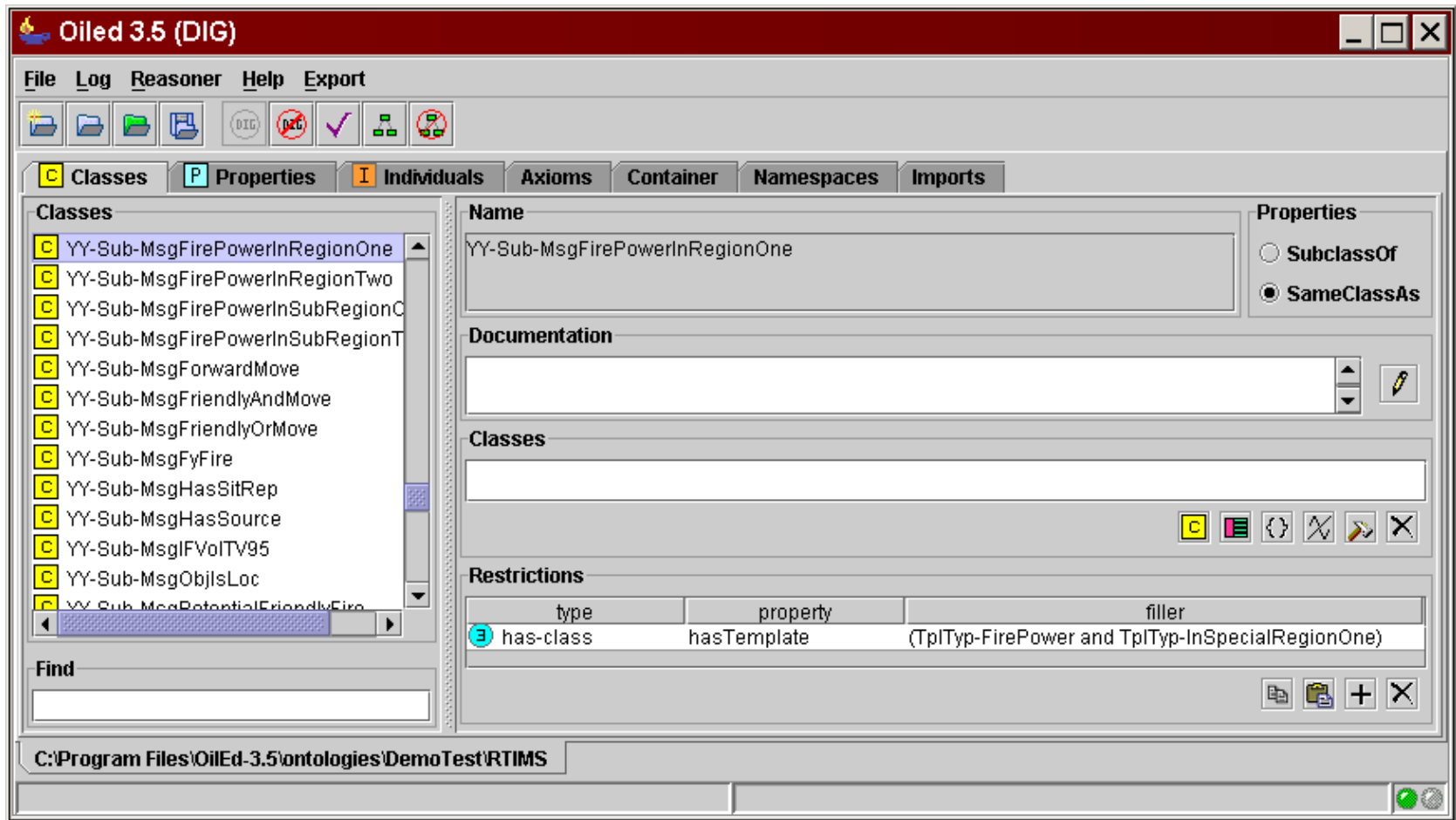
Defining Filters in OilEd

Step 1: define intermediate vocabulary (optional for convenience)



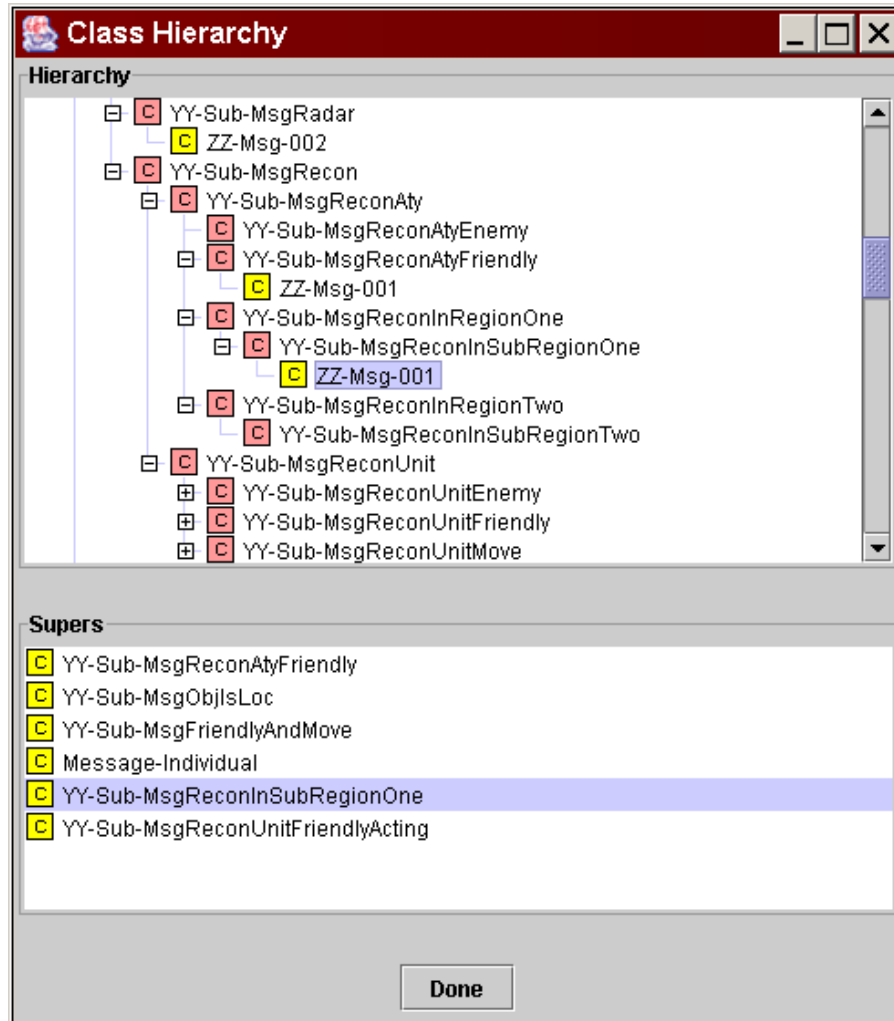
Defining Filters in OilEd

Step 2: define filter using vocabulary

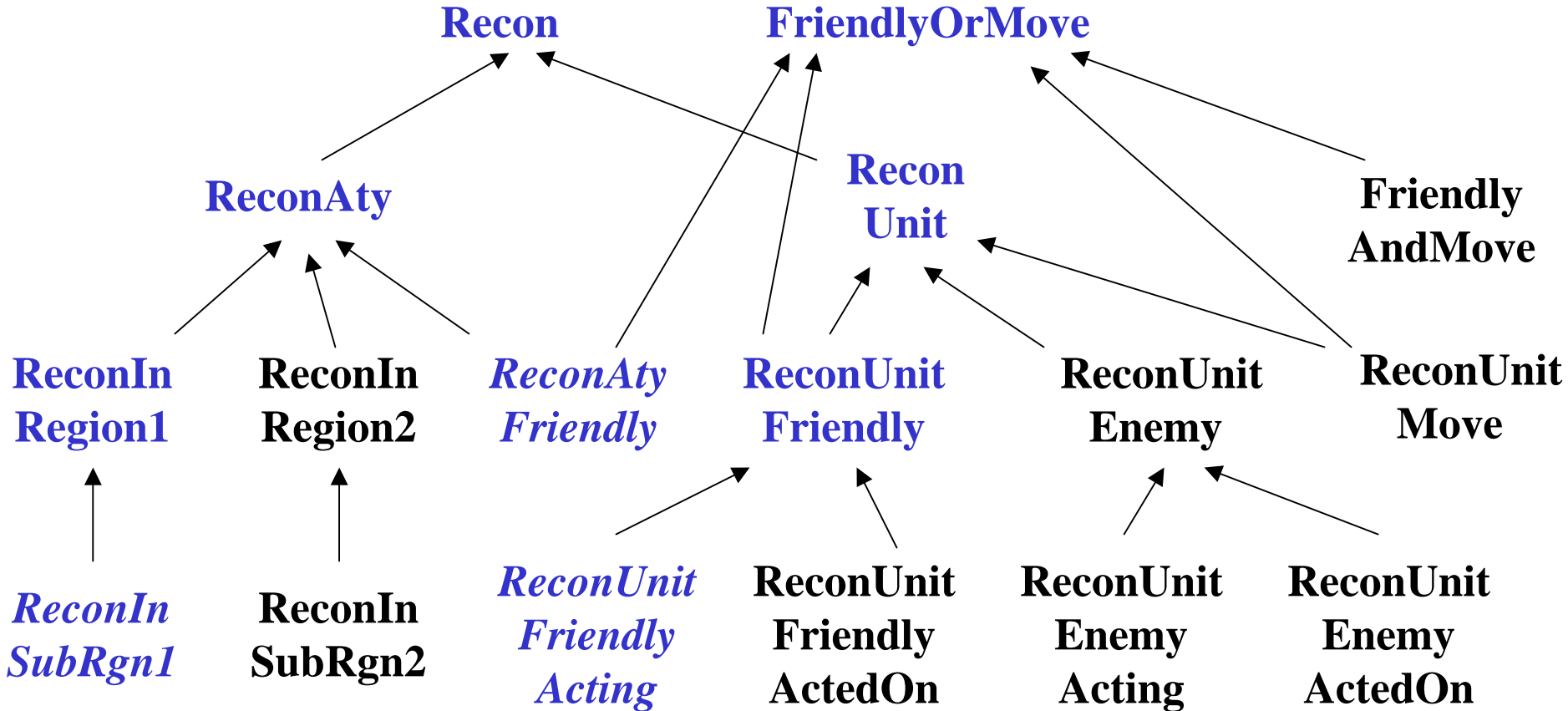


Filter Matching in OilEd

Classify, then Browse Hierarchy

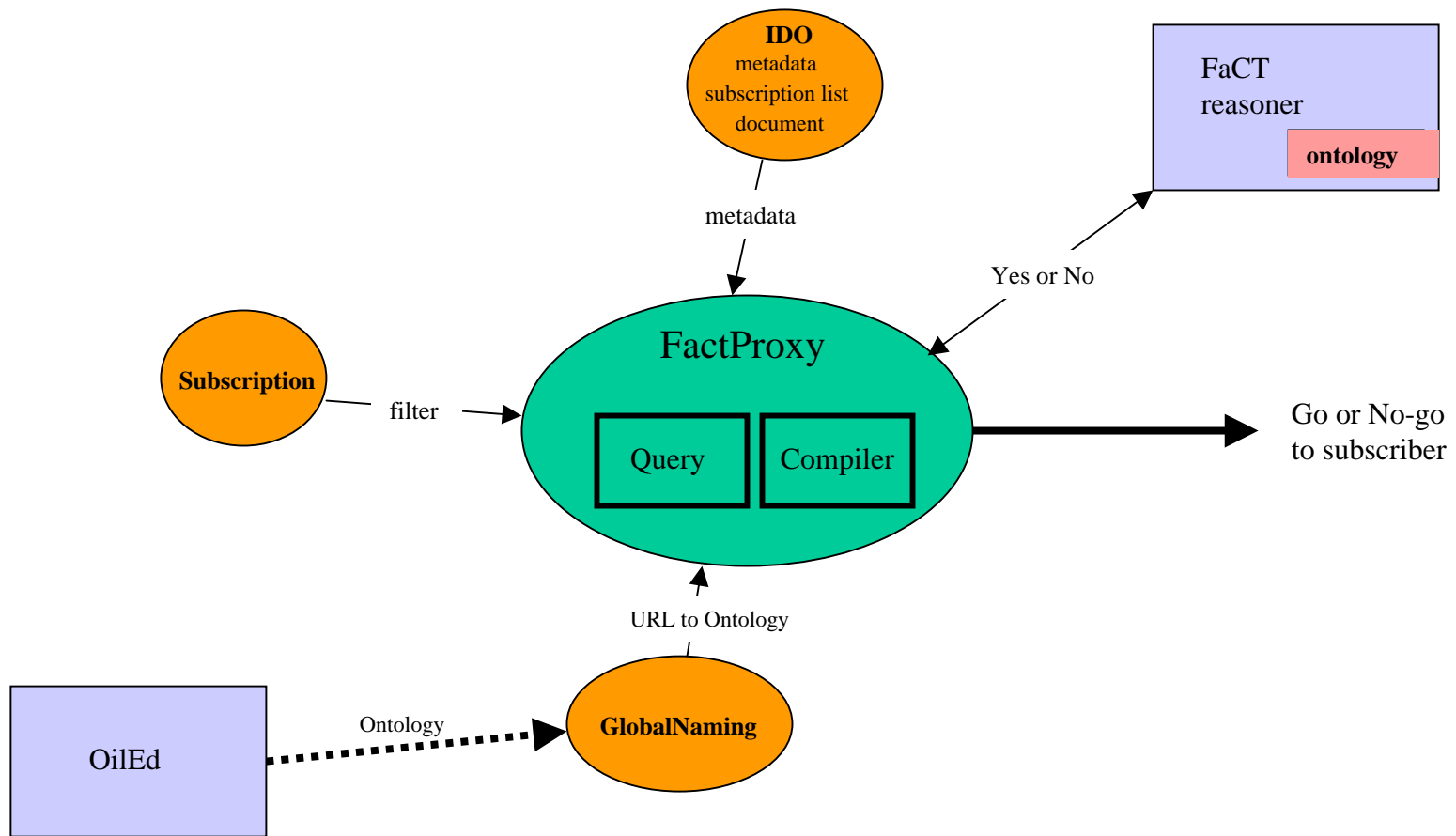


Set of Related Filters



Message 1 matches blue filters.

Integrated into the Infosphere



Issues and Future Work

Practical Issues:

- ***OilEd insufficient*** for end users creating subscriptions;
 - ***DLs very complex***, need to simplify;
 - ***GUI for non experts:*** entering ‘ontology components’;
 - Generic? Or domain specific templates and widgets?
 - ***Ontology Modularity/Management***
 - user extensions, convenient vocabulary usable by others?
 - keep subscriptions separate from ontology (namespaces?)
 - visibility of other users’ sets of subscriptions;
 - allow for classification of all subscriptions
- (But: OilEd is [still?] the only fully functional DL GUI)*
- ***Semantic Plug and Play*** -- “horses for courses”

Issues and Future Work

Theoretical Issues:

- *DL limitation*: **Concrete domains**, sub-regions
- *DL limitation*: Can't have **variables to enforce co-reference**
e.g. tell me if X and Y happen at the same place P.
- Recognizing patterns among **multiple subscriptions / queries**
e.g. Friendly Fire Scenario “*Semantic Bingo*”
- **Persistent Data**: allow for queries of stored sets of IDOs
 - New research at U. of Manchester, Instance Store.
- Does it **scale**?
- **Semantic Metadata**: where does it come from?
- **Semantic integration** of different communities with different models, terminologies, ontologies.

Extras