

# **Secure Geospatial and Sensor Semantic Webs for Crime Analysis and Border Security**

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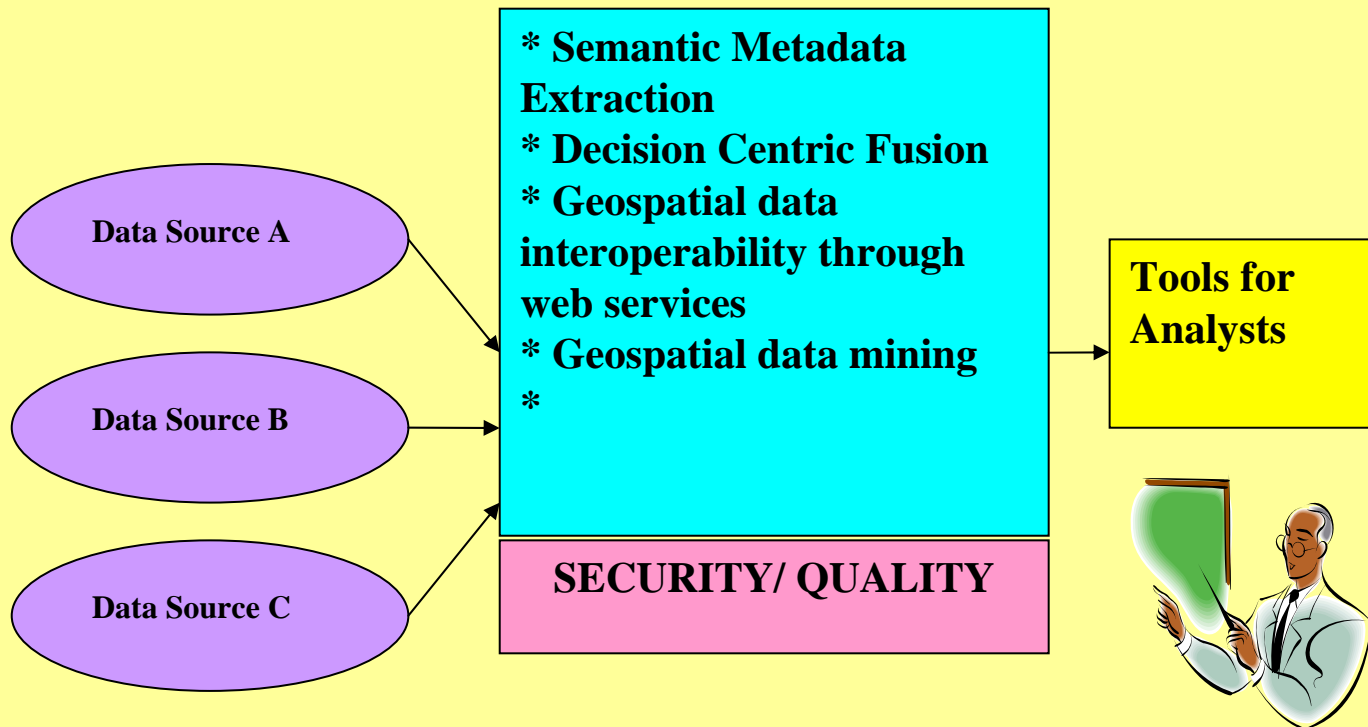
**and**

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**The University of Minnesota**

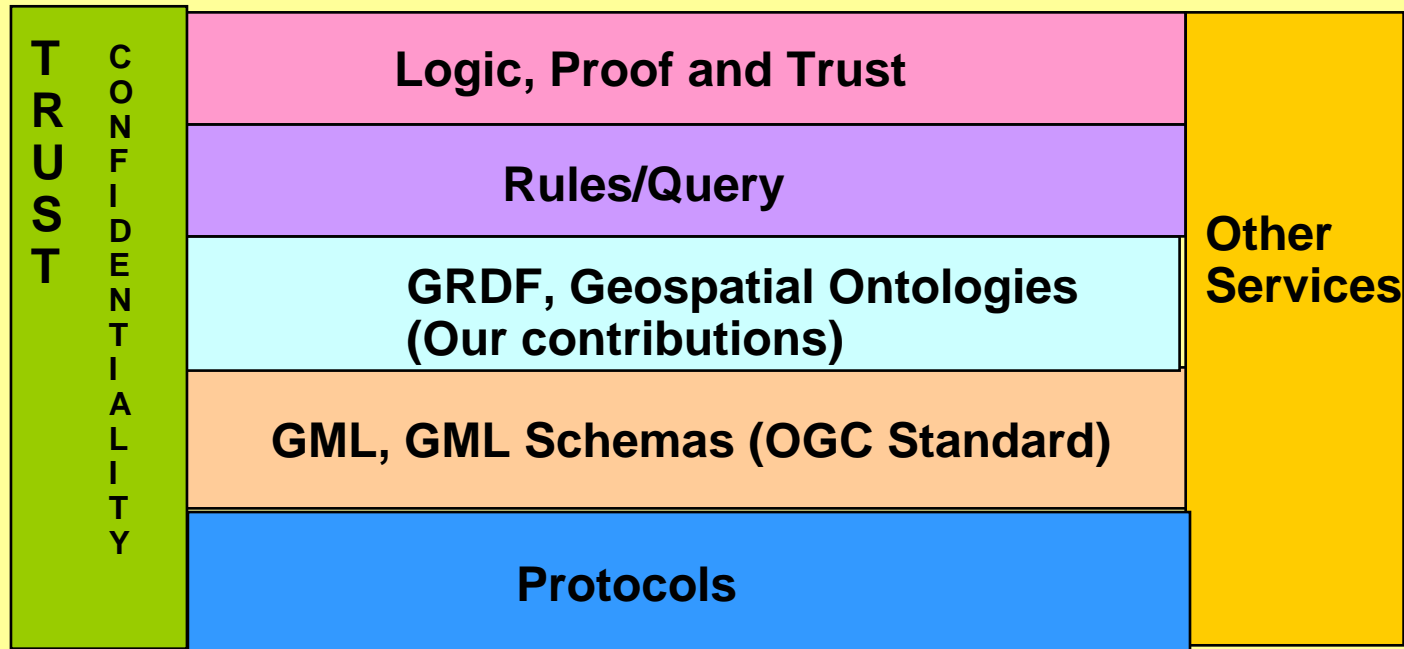
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# Vision for Secure Geospatial Semantic Web



# Technology Stack for Secure Geospatial Semantic Web

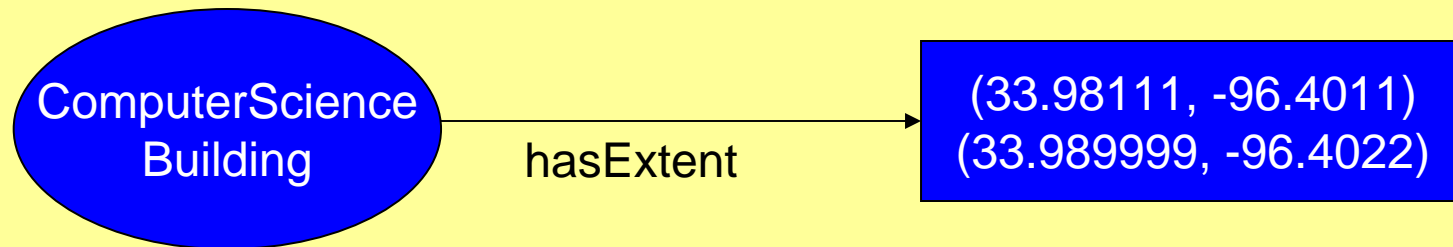
●Adapted from Tim Berners Lee's description of the Semantic Web



# GRDF Geospatial RDF (developed at the University of Texas at Dallas, Ashraful and Thuraisingham)

- **GRDF (Geospatial Resource Description Framework)**

- Adds semantics to data
- Loosely-structured (easy to freely mix with other non-geospatial data)
- Semantically extensible

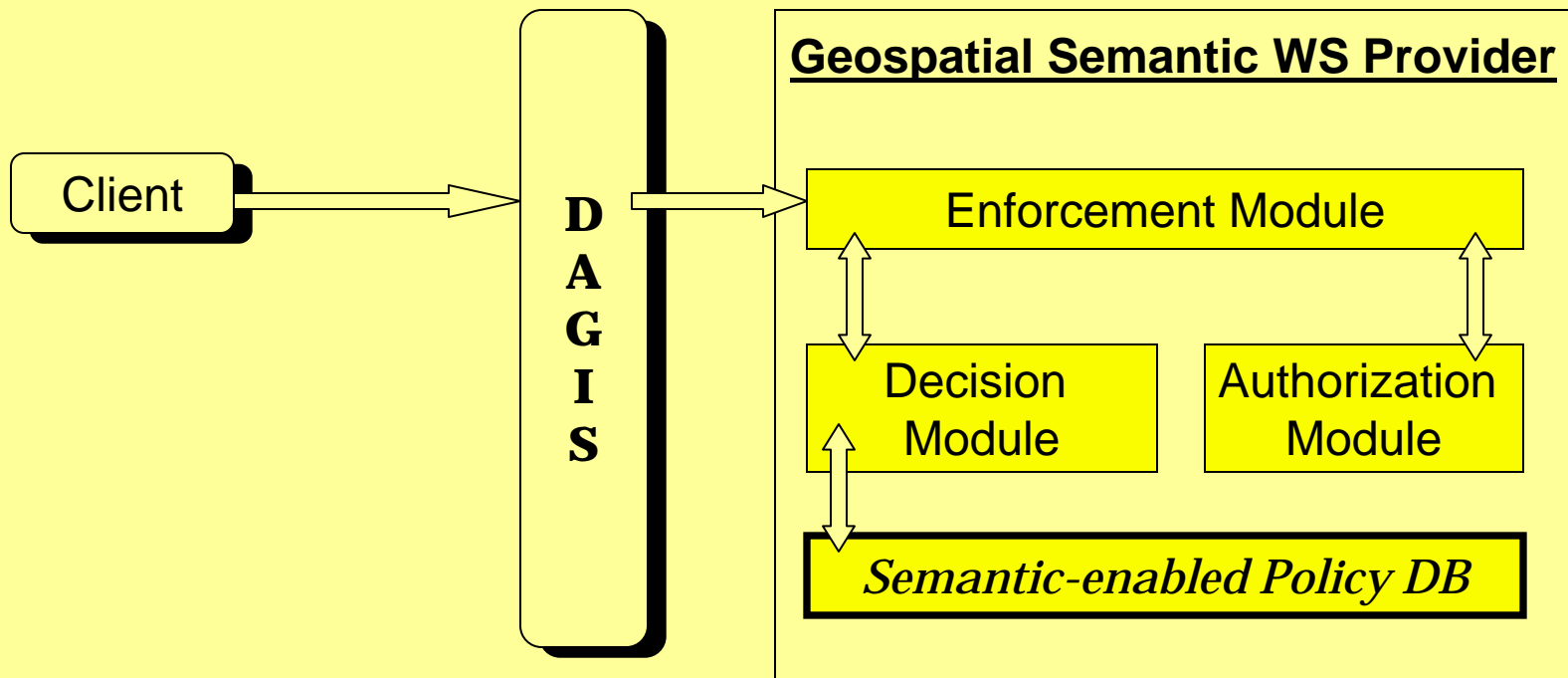


# GRDF Example (Topology Ontology)

```
<owl:Class rdf:ID="Edge"></owl:Class>
<owl:Class rdf:ID="Node"></owl:Class>
<owl:Class rdf:ID="Face">
<rdfs:subClassOf>
  <owl:Restriction>
    <owl:minCardinality
rdf:datatype="http://www.w3.org/2001/XMLSchema#int"
  >1</owl:minCardinality>
    <owl:onProperty>
      <owl:DatatypeProperty rdf:ID="hasEdge"/>
    </owl:onProperty>
  </owl:Restriction>
  ...
</owl:Class>
```

# Security: Semantic Access Control

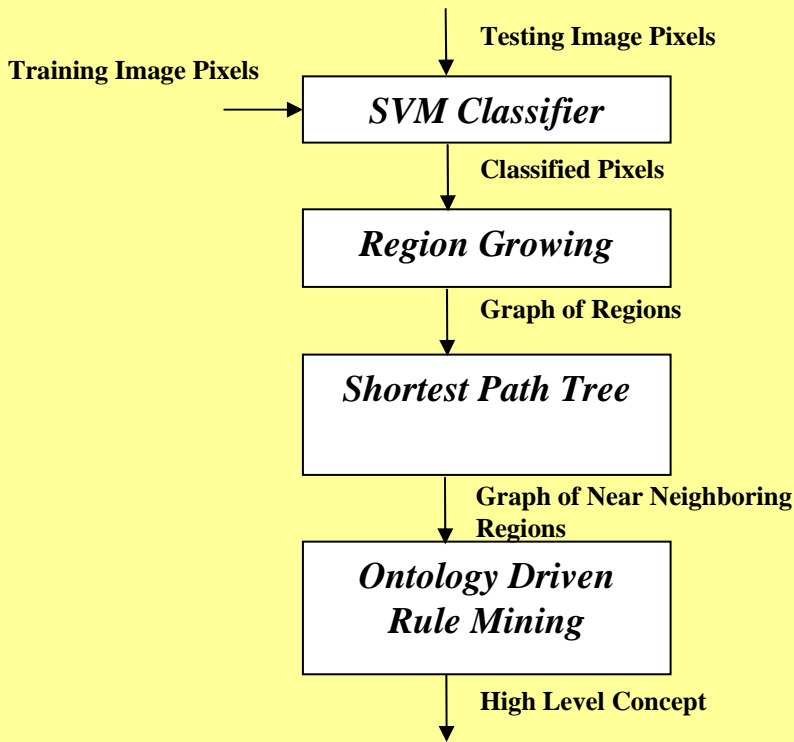
- Architecture



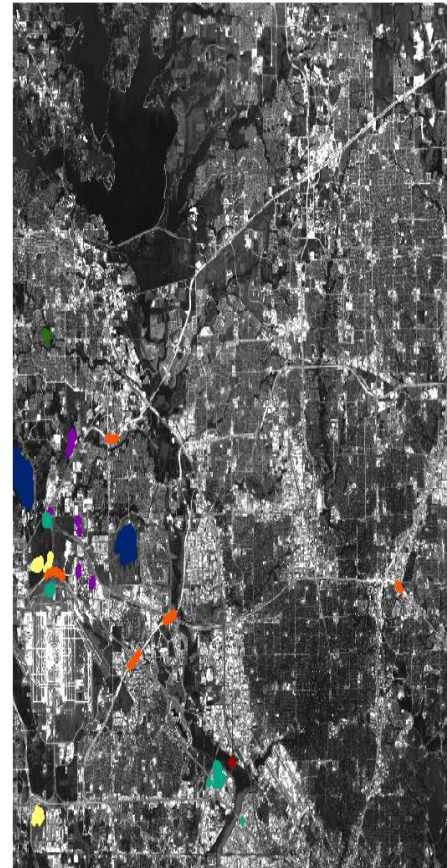
Web Service Client Side

Web Service Provider Side

# Data Mining: Ontology-Driven Classification

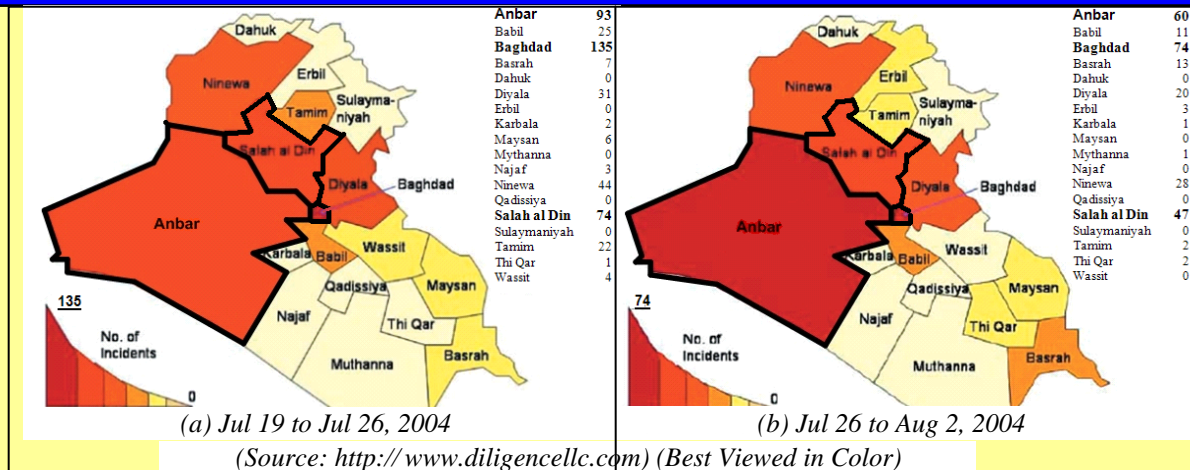


WATER  
BARE LANDS  
GRASS  
FORESTS  
BUILDINGS  
OPEN PLACES  
ROADS



The screenshot shows an ontology software interface with a tree view. The tree is organized into two main sections: **Map** and **Map**. The top **Map** section contains a **City** node with sub-nodes for Water, Bare Lands, Grass, Forests, Buildings, Open Places, and Roads. Below it is a **Deep Forest** node with sub-nodes for Water, Bare Lands, Grass, Forests, and Open Places. The bottom **Map** section contains a **Training Set** node with sub-nodes for Test Set 1 and Test Set 2. Test Set 1 has sub-nodes for Water, Bare Lands, Grass, Forests, Building, Open Places, and Road. Test Set 2 has sub-nodes for Water, Bare Lands, Grass, Forests, Building, Open Places, and Road.

# Geospatial data mining for Crime Analysis



Activity Levels by Jurisdiction (Caution: Use numeric activity count data on right for trend analysis. Color-codes are not directly comparable across Figures a and b )

- Examining theories of time
- Examining current data mining techniques and their limitations (e.g. support vector machine and ontology driven classification)
- Developing novel techniques for spatio temporal data analysis,

The numeric activity count data, shows a diminishing trend for the number of insurgent incidents across multiple provinces from July 19-26, 2004 (Figure a) and July 26-Aug 2, 2004 (Figure 2b). Notice the highlighted entries in numeric activity count data in Figure e.g. Anbar, where the number of insurgent incidents diminished in a matter of weeks.

# Current Research

- **Integrating with sensor/stream data emanating from RFID devices**
  - **Examining Sensor ML and developing Sensor RDF**
- **Working with University of Minnesota on data integration and data mining for spatiotemporal data for crime analysis and border patrol**
- **Security, privacy, misuse detection are all important considerations**
- **Working with OGC for technology transfer to standards**
- **Working with Raytheon to transfer technologies to operational programs**