

Toward a Standard Rule Language for Semantic Integration of the DoD Enterprise

A MITRE Sponsored Research Effort

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28 April 2005

Purpose

- **Identify use cases for application of a standard rule language in Department of Defense (DoD)**
- **Present research plan : *Toward a Standard Rule Language for Semantic Enterprise Integration***
- **Discuss early findings of research**
- **Outline the way ahead**

Motivation

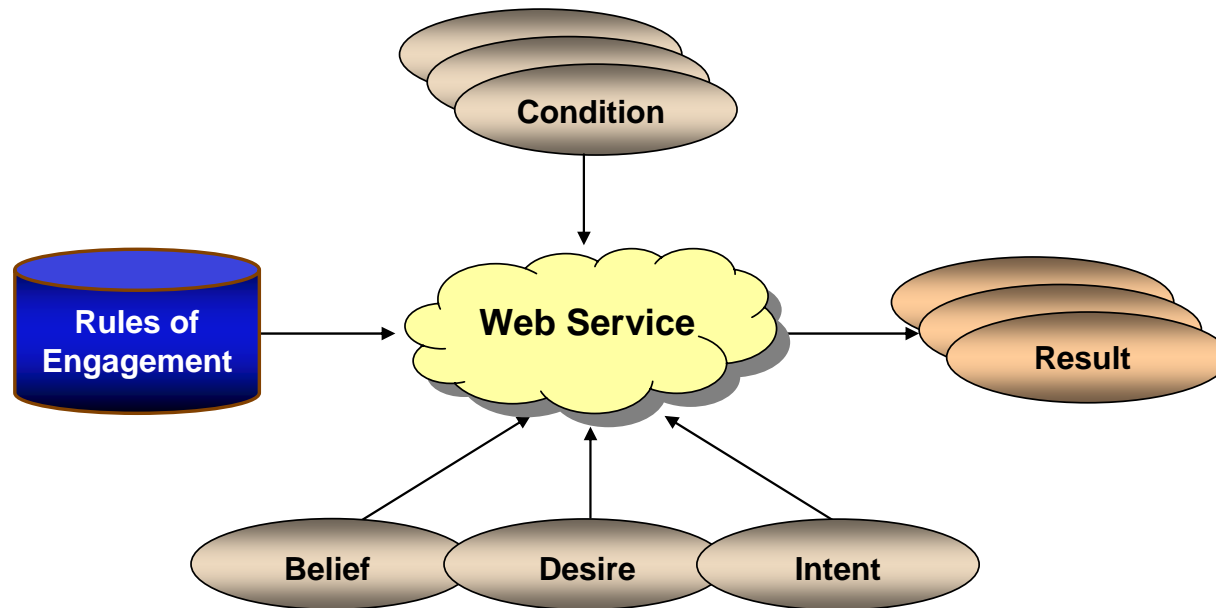
- **To defeat emerging threats, DoD systems must be dynamic and adaptable**
- **Separation of rules from application code supports the ability to dynamically modify system behavior in complex, changing environments**
- **To realize the benefits of rule separation, a Rule Language Standard is required to enable agility and interoperability across the enterprise**

Use Cases

- **Dynamic Service Oriented Architectures**
- **Rapid Enterprise Integration and Reuse**
- **Complex Semantic Integration and Synthesis**
- **Dynamic Information Sharing and Mediation**
- **Machine to Machine Interactions**
- **Computer Vision**

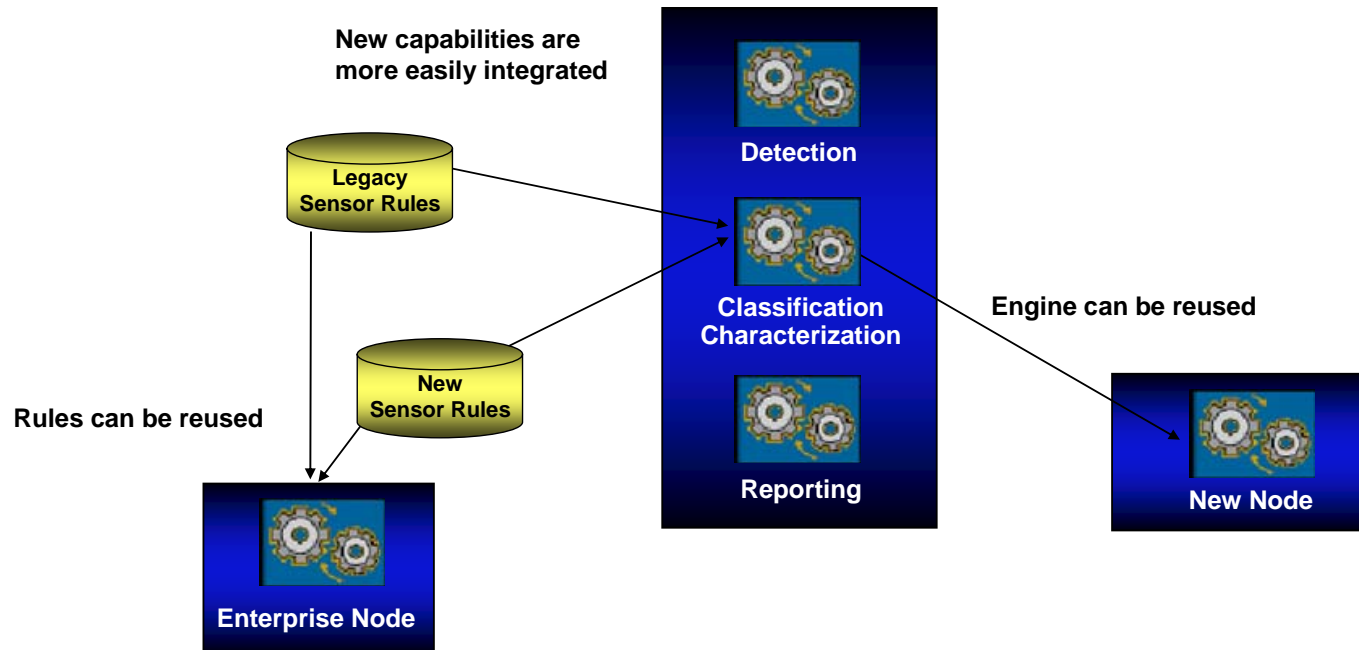
Use Cases, cont.

- Dynamic Service Oriented Architectures



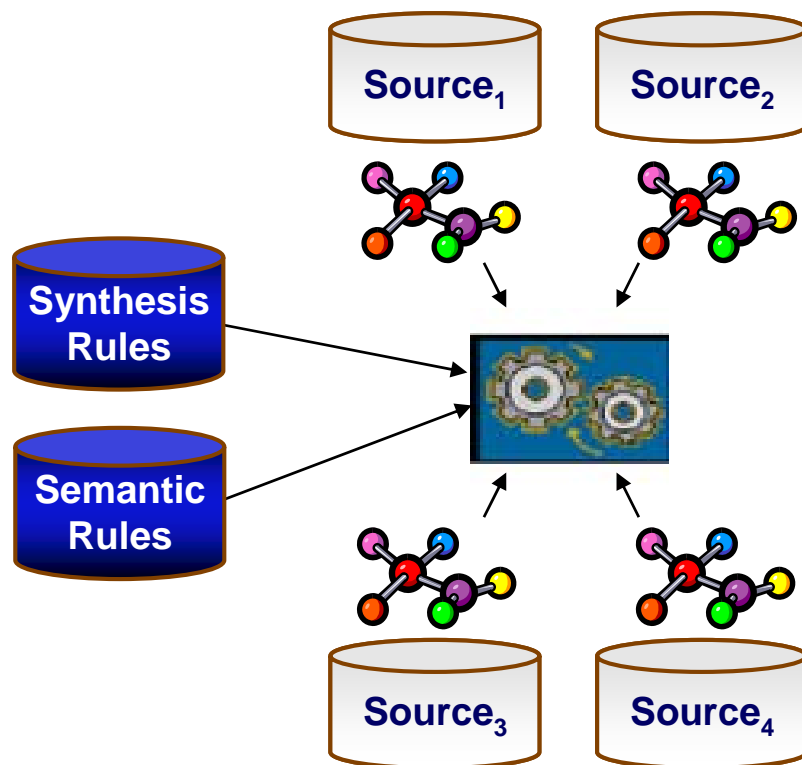
Use Cases, cont.

- **Rapid Enterprise Integration and Reuse**



Use Cases, cont.

- Complex Semantic Integration and Synthesis



Use Cases, concluded

- **Rules for Dynamic Information Sharing and Mediation**
 - Security enforcement: blocking & transformation
 - Syntactic & semantic mediation
 - Discovery
 - Event driven publication
- **Machine to Machine Interactions**
 - Allocation of battlefield capabilities
 - Battlefield event monitoring
 - Event driven, automated communication
- **Computer Vision**

Research Objectives

- **Develop demonstrable recommendations for a standard rule language**
- **Identify DoD specific requirements by applying rules to a real world problem**
- **Build experiments to show how ontology and rule layers should interact and compare approaches**
- **Look ahead to future requirements for the evolving standard**

Early Findings and Thoughts

- **Standard method of expressing uncertainty and provenance is required**
 - Estimation of truth required in ontology & rules
- **Need to distinguish battlespace objects from reports about them**
- **Orchestration issues exist with dynamic classification**
- **Need to persist derived states in time**
- **Closed world vs. open world predicates**
 - How do we control the discovery process?
 - Do we need a hybrid?
- **Translation to executable environment is difficult**
- **Integrated framework of tools, languages & standards must evolve**

The Way Ahead

- **Complete first year research**
- **Explore more complex, dynamic rules and how those affect the rule standard**
- **Examine impact of rule exchange across multiple disparate domains**
- **Investigate self-maintaining ontologies and rule sets**
- **Explore ontological closure and annotation for rule discovery**

Backup Slides

Research Plan: Year 1

- **Build experiment to develop recommendations for standard rule language**

Select mission use case and capture ontology & rules

Build an application with **layered** ontology and rules

Build second application with **integrated** ontology and rules

Compare how each performs and observe issues with interaction and orchestration across layers

Keep all factors constant other than differences in languages used

Interesting Questions

- **What are the advantages of an integrated vs. layered approach for specification of ontology and rules?**

If an integrated language is best, then how should it be structured to express different rule types and different logics? How tightly should they be coupled?

If a layered approach is preferable in which rules and ontologies are separate, then how should these layers interact? Can the rules be separated from the concepts? If so, how?
- **How should inferencing best be orchestrated?**
- **Do the approaches lead to deterministic systems?**
- **Would the use of metadata about the ontologies and rules help in automating the orchestration process?**
- **Are there certain properties of ontologies that will make them more or less tractable with certain execution environments?**
- **Should OWL, RuleML and SWRL be translated to executable environments? Or should integrated SWRL engines be developed and integrated into DoD systems?**