DAML Tools for Intelligent Information Annotation, Sharing and Retrieval

UMBC

Johns Hopkins University Applied Physics Lab

MIT Sloan School

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Our Research Agenda

- We have three themes, each lead by one team member and with participation from all
  - Semantic web & agents (UMBC)

    Tim Finin, Anupam Joshi, Yun Peng
  - Semantic web & information retrieval (JHU)

    Jim Mayfield
  - Semantic web & rules (MIT)

    Benjamin Grosof
- Our approach is largely experimental -- building prototypes & tools rather than proving theorems

Theme #1

OWL will enable agents in open, dynamic environments (e.g., agentcities) to share knowledge and manage security, privacy, trust and commitments.

- Working in multiagent systems
- Supporting pervasive systems
- Supporting trust and security in web services

Travel Agent Game in Agentcities

Motivation
- Market dynamics
- Auction theory (TAC)

Features
- Open Market Framework

Technologies
- FIPA (JADE, April Agent Platform)
- Seman
- Web (S
- Interne

Ontologies
http://taga.umbc.edu/ontologies/
- travel.owl - travel concepts
- fipaowl.owl - FIPA content lang.
- auction.owl - auction services
- tagaql.owl - query language

Owl for negotiation

Owl for publishing communicative acts

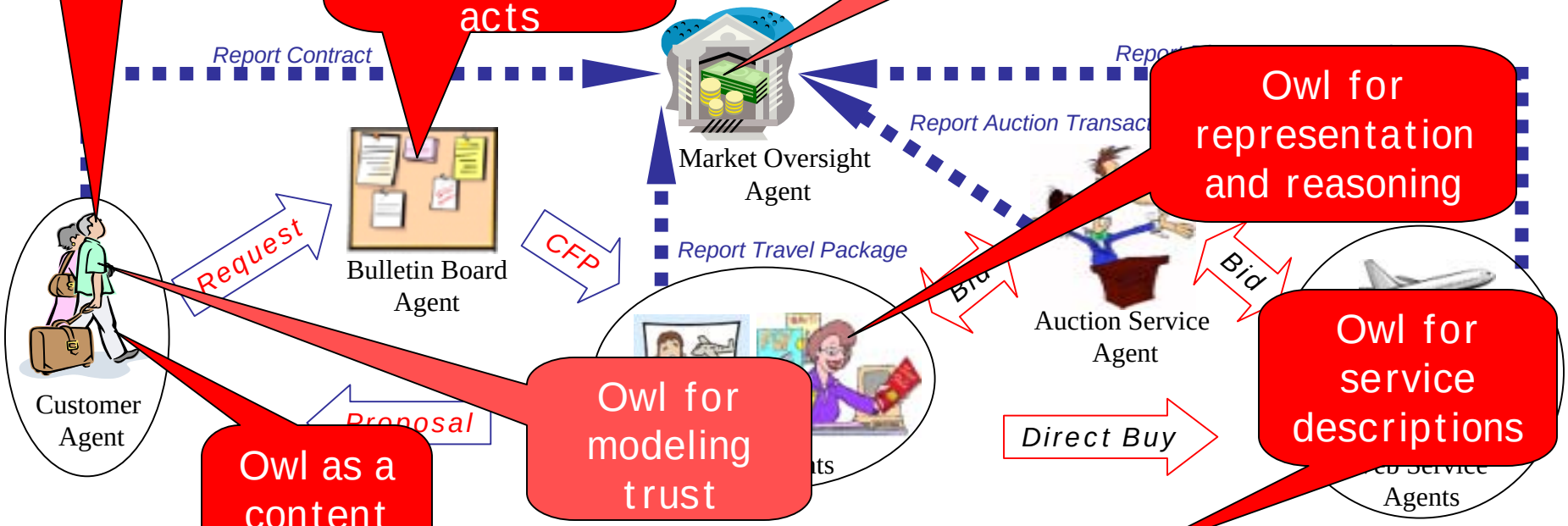
Owl for contract enforcement

Owl for representation and reasoning

Owl for service descriptions

Owl for modeling trust

Owl as a content language

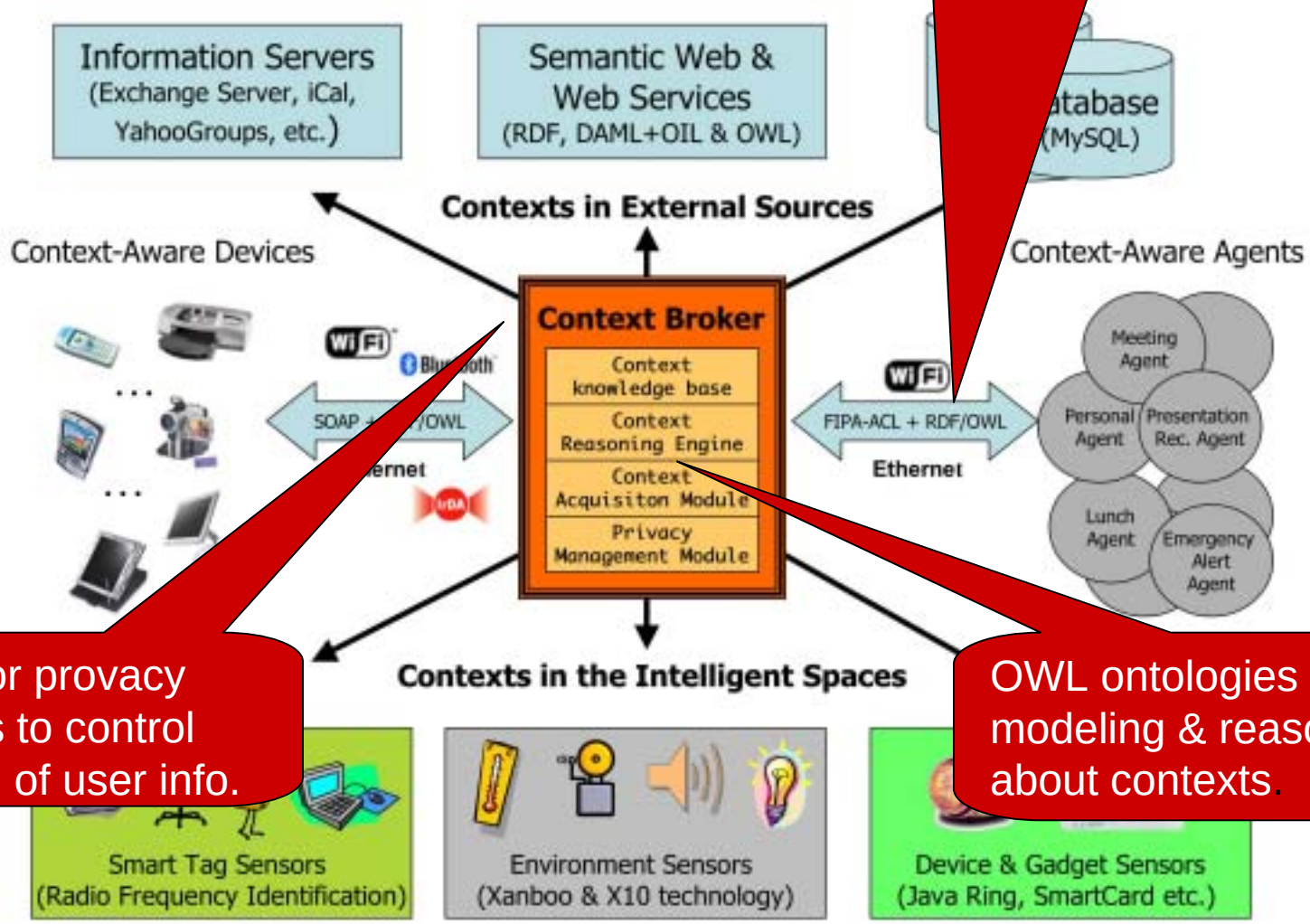


FIPA pl e services, including directory facilitators enhanced to use OWL-S for service discovery

http://taga.sourceforge.net/

OWL in Pervasive

OWL ontologies allow broker, devices, agents & services to share information.



OWL for provacy policies to control sharing of user info.

OWL ontologies for modeling & reasoning about contexts.

http://pervasive.semanticweb.org/

Rei Policy Applications: past, present & future

- Coordinating access in *supply chain management system*
- Authorization policies in a *pervasive computing environment*
- Policies for team formation, collaboration, information flow in *multi-agent systems*
- Security in *semantic web services*
- Privacy and trust on the *Internet*
- Privacy in a *pervasive computing environment*

Theme #2

OWL will be integrated with other knowledge representation paradigms for real world reasoning, e.g. rule based systems and bayesian belief networks

- F-OWL reasoner
- Bayes OWL
- OWL and rules

F-OWL Reasoner

- F-OWL is an OWL reasoner implemented in XSB's Flora-2 system.
- http://fowl.sourceforge.net/
- Features:
  - Supports RDF and OWL-Full
  - Supports RDF/N-Triple query
  - Supports Dynamic Import
  - Provides a Java API
  - Tested with the RDF and OWL test cases, See http://www.w3.org/2003/08/owl-systems/test-results-out.html

Bayes Owl

- Probabilistic extension for uncertainty in ontologies:
  - Extend OWL for probabilistic annotation
  - Translate OWL ontology to Bayesian network (OWL-BN)
  - Probabilistic mappings between individual OWL-BNs

  $\Rightarrow$Treat ontology reasoning as Bayesian inference
- Plan for remainder of 2004
  - Complete translation rules for RDF constructors and formalize translation rules based on OWL semantics
  - Complete construction procedure for conditional probability tables
  - Complete translation algorithm, OWL $\rightarrow$ OWL-BN
  - Preliminary investigation on probabilistic concept mapping between OWL-BNs

MIT rules work

1. How to combine rules with ontologies
2. Uses of rules for services, especially in e-commerce, e.g. for
   - E-contracts
   - Financial reporting and information
   - Trust policies
3. Analysis of business case, value, strategy, and requirements for rules and services

New MIT Research Results

- **Trust Policies in Finance using Rules**

  Application scenarios; analysis of business case, value, strategy, and requirements

- **Representing Process Handbook Ontologies using Rules –** including OO-style default inheritance

  Early prototype; new design improves scaleability; analysis of business case, value, and strategy (e.g., to use Legacy OO process framework knowledge)

- **Refining SweetDeal E-Contracting approach** (rules+ontologies)

  Concepts, paper, presentations

- **SWRL V0.5,V0.6 –** co-authored; co-led Joint Committee rules effort

  Adds horn rules and RuleML syntax to OWL, in tightly integrated fashion. Reports; W3C member submission.

- **RuleML V0.85 –** co-authored; co-led RuleML Initiative

  Adds improved syntax support for OWL, RDF, and object-oriented -- in coordination with development of SWRL

MIT Plan: next 6 months

- Continue the focus areas listed earlier
- New phase effort on tools for rules
  - New prototyping of SweetRules for RuleML/SWRL translation/interoperability, inferencing & authoring/testing
    - Support OWL, XSB, Jess, other systems
  - Pluggable architecture to integrate tools from multiple groups in and out of DAML
  - Open source on SemWebCentral

Theme #3

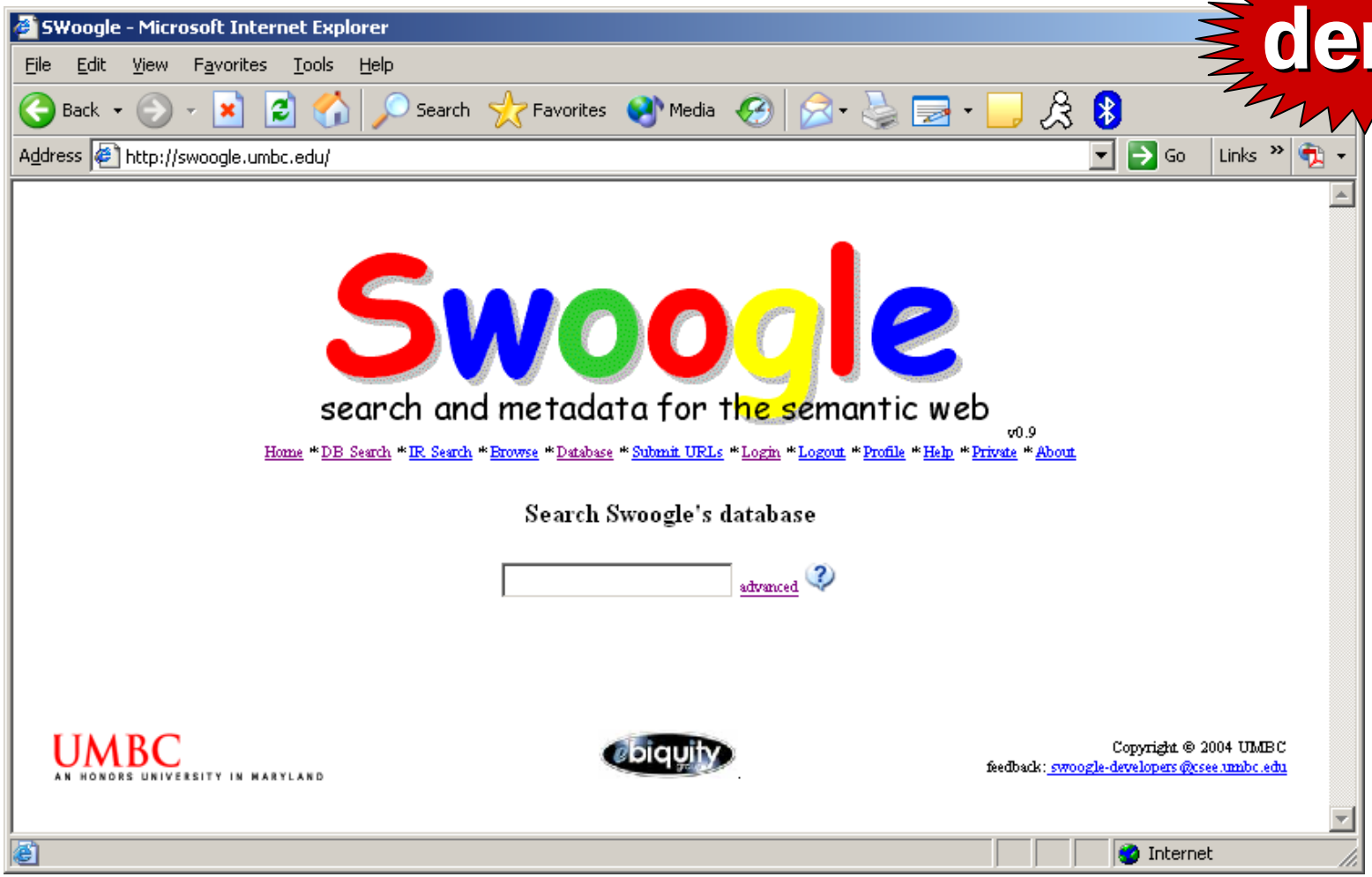
OWL will enable IR systems to work with documents which contain knowledge encoded in semantic markup.

- Swoogle indexing and retrieval system for semantic web documents
- Swangling semantic web documents to prepare them for other conventional IR systems like Google.

Why use IR techniques?

- To retrieve over the structured & unstructured parts of a semantic web document
- To prepare for the appearance of text documents with embedded SW markup
- To harness web infrastructure such as Google
- To take advantage of the unique and useful properties of IR techniques
  - e.g., ranking matches, computing the similarity between two documents, relevance feedback, etc.

http://swoogle.umbc.edu/



Swoogle is a crawler based search an retrieval system for semantic web documents

Harnessing Google

- Google started indexing RDF documents some time in late 2003
- Can we take advantage of this?
- We've developed techniques to get some structured data to be indexed by Google
- And then later retrieved
- Technique: give Google enhanced documents with additional annotations containing *Swangle Terms* ™

Swangle defined

swan·gle

Pronunciation: ‘swa[ng]-g&l
Function: *transitive verb*
Inflected Forms: swan·gled; swan·gling /-g(&-)li[ng]/
Etymology: Postmodern English, from C++ *mangle*,
Date: 20th century

1: to convert an RDF triple into one or more IR indexing terms

2: to process a document or query so that its content bearing markup will be indexed by an IR system

Synonym: see tblify

- swan·gler /-g(&-)l&r/ *noun*

Swangling

- Swangling converts a triple into seven word-like terms
  - One for each non-empty subset of the triple components with missing elements replaced by a *"don't care"* URI
  - Terms generated by a hashing function (e.g., MD5)
- Swangling an RDF document means adding triples for swangle terms.
  - Triples might be explicit ones or added by inference
  - Resulting RDF document can be indexed and retrieved via conventional search engines like Google
- Allows one to search for a semantic web document with a triple that claims *"Osama bin Laden is located at X"*

A Swangled Triple

```
<rdf:RDF
  xmlns:s = "http://swoogle.umbc.edu/ontologies/swangle.owl#"
</rdf>
…
<s:SwangledTriple>
  <s:swangledText>N656WNTZ36KQ5PX6RFUGVKQ63A</s:swangledText>
  <rdfs:comment>Swangled text for
    [http://www.xfront.com/owl/ontologies/camera/#Camera,
     http://www.w3.org/2000/01/rdf-schema#subClassOf,
     http://www.xfront.com/owl/ontologies/camera/#PurchaseableItem]
  </rdfs:comment>
  <s:swangledText>M6IMWPWIH4YQI4IMGZYBGPYKEI</s:swangledText>
  <s:swangledText>HO2H3FOPAEM53AQIZ6YVPFQ2XI</s:swangledText>
  <s:swangledText>2AQEUJOYPMXWKHZTENIJS6PQ6M</s:swangledText>
  <s:swangledText>IIVQRXOAYRH6GGRZDFXKEEB4PY</s:swangledText>
  <s:swangledText>75Q5Z3BYAKRPLZDLFNS5KKMTOY</s:swangledText>
  <s:swangledText>2FQ2YI7SNJ7OMXOXIDEEE2WOZU</s:swangledText>
</s:SwangledTriple>
```

Summary: 2004 Deliverables

- Software tools on semwebcentral.org
  - Swangling tools, F-owl, Rei, SweetDeal, BBN tools, …
- OWL ontologies
  - For FIPA standards
  - For security and trust
  - For swangling
  - SOUPA: Standard Ontologies for Ubiquitous and Pervasive Applications
- Hosted services
  - Swoogle
- Contributions to standards
  - RuleML, SWRL, SWSI, …