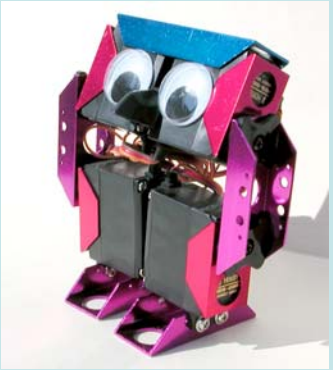
From Atom's to OWL's: The new ecology of the WWW



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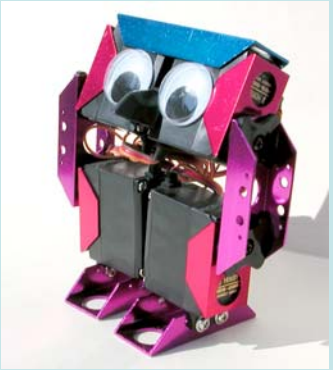
mindswap

maryland information and network dynamics lab semantic web agents project

From Atom*s to OWL§s: The new ecology of the WWW



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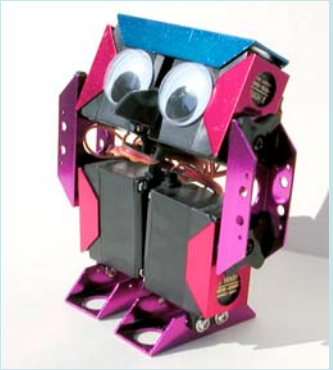
* syntax

§ semantics

Syntax to Semantics

XML 2005 Conference & Exposition
Syntax to Semantics
November 14-18, 2005
Hilton Atlanta, Atlanta, GA



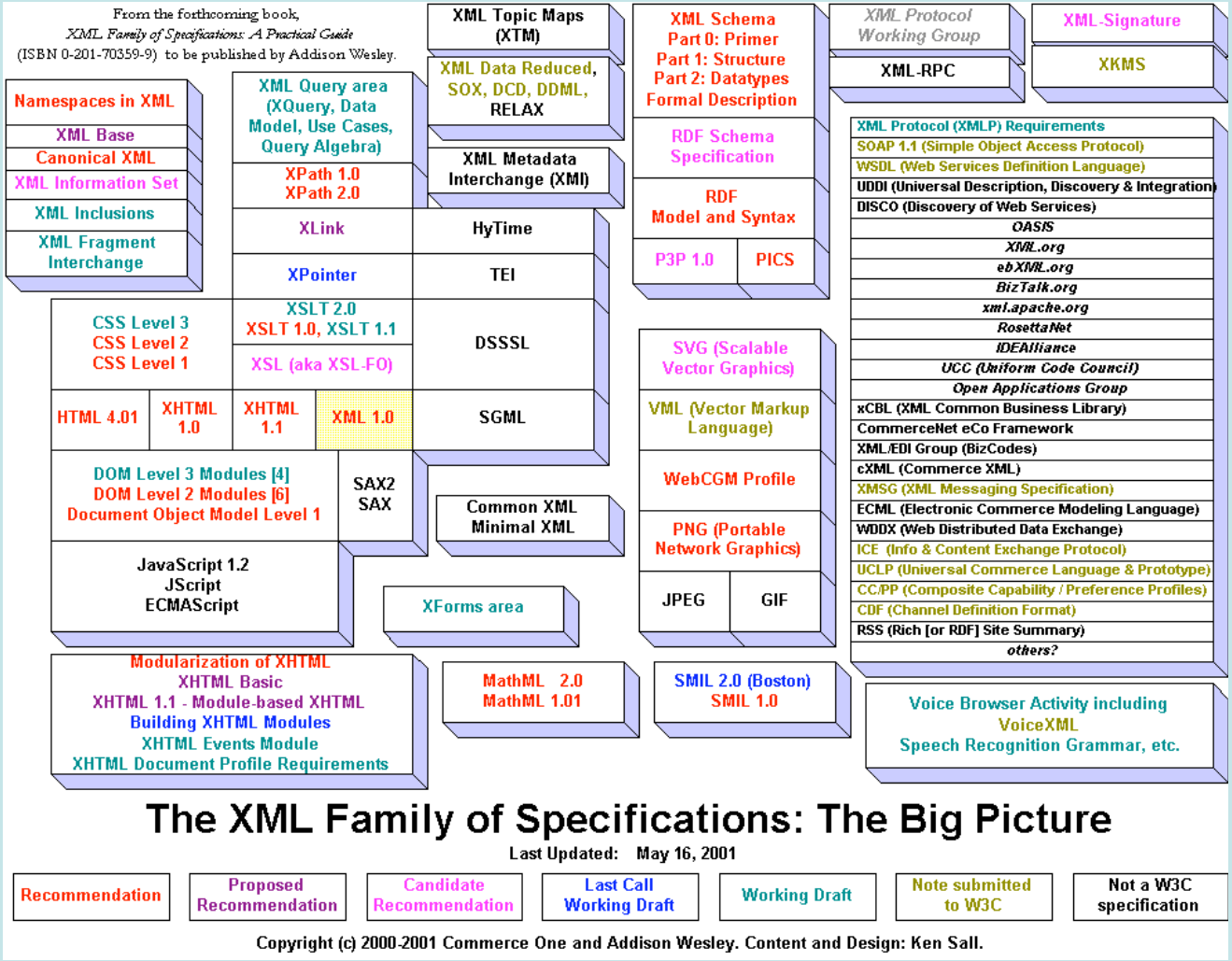
Acknowledgements

- In preparing this talk I have mostly ignored the advice of a great many people including Tim Berners-Lee, Dan Connolly, Wendy Hall, Eric Miller, Brand Nieman, Bijan Parsia, Guus Schreiber, Nigel Shadbolt, and Frank VanHarmelen
- I owe much to my research group
  - Details at http://www.mindswap.org/ (Our Semantic Web Portal)

The Web used to be easy (ca. 1990)

- Documents (HTML)
  - Emacs or vi via some cutting and pasting and it showed in your browser - woohoo!
- And Links (HTTP)
  - Install LibWWW, customize parameters, and you were up and running - woohoo!

But that didn't last long… *(ca 2000)*



Excelsior …

- **Syndication**
  - Atom, JSON, YAML…
- **Microformats**
  - hCard, hCalendar, hReview, XFN, …
- **XML specs**
  - XML 1.1, Xinclude, XML:id, …
- **Semantic Web specs**
  - RDF (XMP), RDFS, OWL, SPARQL, Rules …
- **Web Service languages**
  - WSDL 2.0, WSPL, WS Adressing, CDL, …
  - (and all of the above applied to services
    - UDDI v3, XOXO, XML Protocol, WSDL-RDF, …)

What is this all about?

Text pages	A	Single pages
Music	A-	© and access issues
Images	B+	Lacks precision
Video	C+	Promising start
Personal Info	C	Splintered/ imprecise
Services	C-	Need to play together better
Data	**F**	Not working at a Web scale

Web Search Report Card

Common Goal…

XML: Its primary purpose is to facilitate the sharing of data across different systems, particularly systems connected via the Internet. (Wikipedia)

Sem Web: The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries (W3C SWA)

It's the data, stupid.

Increasingly Common Syntax

- The new ecology is all in XML …

Atom (XML)

```
<?xml version="1.0" encoding="utf-8"?>
<feed version="0.3" xmlns="http://purl.org/atom/ns#">
  <title>dive into mark</title>
  <link rel="alternate" type="text/html"
   href="http://diveintomark.org/"/>
  <modified>2003-12-13T18:30:02Z</modified>
  <author>
    <name>Mark Pilgrim</name>
  </author>
  <entry>
    <title>Atom 0.3 snapshot</title>
    <link rel="alternate" type="text/html"
     href="http://diveintomark.org/2003/12/13/atom03"/>
    <id>tag:diveintomark.org,2003:3.2397</id>
    <issued>2003-12-13T08:29:29-04:00</issued>
    <modified>2003-12-13T18:30:02Z</modified>
  </entry>
</feed>
```

Use XML in syndication

Adobe XMP (RDF-based)

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
      <rdf:Description rdf:about=""
          xmlns:pdf="http://ns.adobe.com/pdf/1.3/">
         <pdf:Producer>Acrobat Distiller 7.0.5 for Macintosh</pdf:Producer>
      </rdf:Description>
      <rdf:Description rdf:about=""
            xmlns:dc="http://purl.org/dc/elements/1.1/">
         <dc:format>application/pdf</dc:format>
         <dc:creator>
            <rdf:Seq>
               <rdf:li>James Hendler</rdf:li>
            </rdf:Seq>
         </dc:creator>
         <dc:title>
            <rdf:Alt>
               <rdf:li xml:lang="x-default">XMLideas.ppt</rdf:li>
            </rdf:Alt>
         </dc:title>
      </rdf:Description>
      <rdf:Description rdf:about=""
            xmlns:xapMM="http://ns.adobe.com/xap/1.0/mm/">
         <xapMM:DocumentID>uuid:93277c40-5534-11da-a3f2-000a95d6b344</xapMM:DocumentID>
         <xapMM:InstanceID>uuid:9327882b-5534-11da-a3f2-000a95d6b344</xapMM:InstanceID>
      </rdf:Description>
   </rdf:RDF>
```

Embed meta-data in PDF, etc.

FOAF (RDF(S))

```
<rdf:RDF
     xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
     xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
     xmlns:foaf="http://xmlns.com/foaf/0.1/">
 <foaf:Person>
   <foaf:name>Jim Hendler</foaf:name>
   <foaf:title>Dr</foaf:title>
   <foaf:firstName>Jim</foaf:firstName>
   <foaf:surname>Hendler</foaf:surname>
   <foaf:mbox_sha1sum>be972c7a602683f7cf3c7a1fd0949c565debe4d3
              </foaf:mbox_sha1sum>
   <foaf:homepage rdf:resource="http://www.cs.umd.edu/~hendler"/>
   <foaf:depiction rdf:resource="http://www.semanticgrid.org/q-iantbljim.jpg"/>
   <foaf:workplaceHomepage rdf:resource="http://owl.mindswap.org"/>
</foaf:Person>
</rdf:RDF>
```

FEA-RMO (OWL)

```
<owl:Ontology rdf:about="file:/C:/Models/eGov/FEA/all.owl">
  <owl:versionInfo>Version 1.0</owl:versionInfo>
  <dc:contributor>Dean Allemang, TopQuadrant</dc:contributor>
  <dc:description>FEA Reference Model Ontology</dc:description>
        <owl:imports rdf:resource="http://purl.org/dc/elements/1.1/"/>
  <dc:source>FEAPMO</dc:source>
  <dc:source>The Performance Reference Model Version 1.0, FEAPMO</dc:source>
  <dc:date>January 2005</dc:date>
  <dc:contributor>Irene Polikoff, TopQuadrant</dc:contributor>
  <dc:contributor>Ralph Hodgson, TopQuadrant</dc:contributor>
</owl:Ontology>

<owl:Class rdf:about="http://www.osera.gov/owl/2004/11/fea/brm#SF_GeneralScienceAndInnovation">
  <owl:disjointWith>
    <owl:Class rdf:about="http://www.osera.gov/owl/2004/11/fea/brm#SF_Heath"/>
  </owl:disjointWith>
  <owl:disjointWith>
    <owl:Class rdf:about="http://www.osera.gov/owl/2004/11/fea/brm#SF_IntelligenceOperations"/>
  </owl:disjointWith>
```

Application specific vocabulary (ontology) definition

So what is the difference?

Documents: XML is a system for defining, validating, and sharing **document formats**. XML uses tags to distinguish document structures, and attributes to encode extra document information. XML will look very familiar to those who know about SGML and HTML. (XML FAQ)

Links: RDF is based on the idea of **identifying things using Web identifiers** (called Uniform Resource Identifiers, or URIs), and describing resources in terms of simple properties and property values. This enables RDF to represent simple statements about resources as a graph of nodes and arcs representing the resources, and their properties and values.(RDF Primer)

Extending the Web

- Bringing new document types, media types, services, and (especially) data to the Web requires BOTH
  - More complex document processing
    - Formats improvement, correctness checking, subdocument components
  - More complex link types
    - Must capture, but not be limited by, structure and models
    - Must have a link "labeling" and ability to "reason" about those links

Compare Xlink

```
<advisor xlink:href="profs/jaysmith7.xml" ...>
  <advisorname xml:lang="en">
    <name>
      <honorific>Dr.</honorific>
      <given>Jay</given>
      <family>Smith</family>
    </name>
  </advisorname>
</advisor>
```

Which provides some info around a link - but no external referent to an entity (i.e. no URI is assigned to this link information)

To RDF

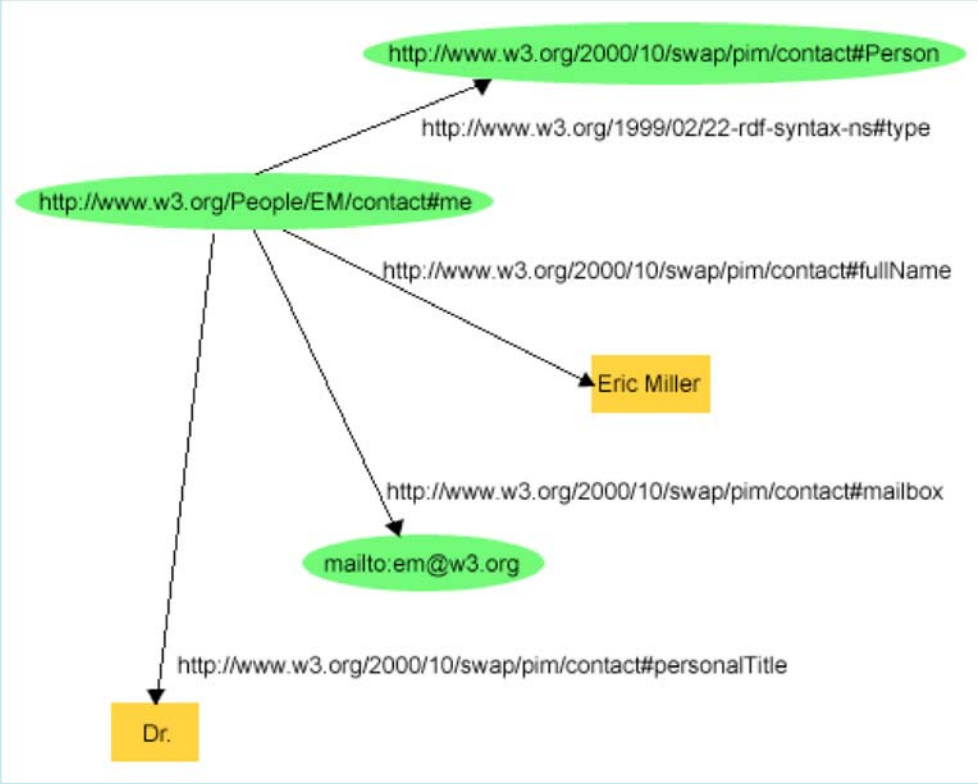
```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:contact="http://www.w3.org/2000/10/swap/pim/contact#">

  <contact:Person rdf:about="http://www.w3.org/People/EM/contact#me">
    <contact:fullName>Eric Miller</contact:fullName>
    <contact:mailbox rdf:resource="mailto:em@w3.org"/>
    <contact:personalTitle>Dr.</contact:personalTitle>
  </contact:Person>

</rdf:RDF>
```

Which assigns specific URIs to the individual fields (i.e. the URI in the rdf:about is a persistent and externally addressable URI) and each "property" (fullname, mailbox, etc.) is defined by a URI)

Or in graph (link!) form

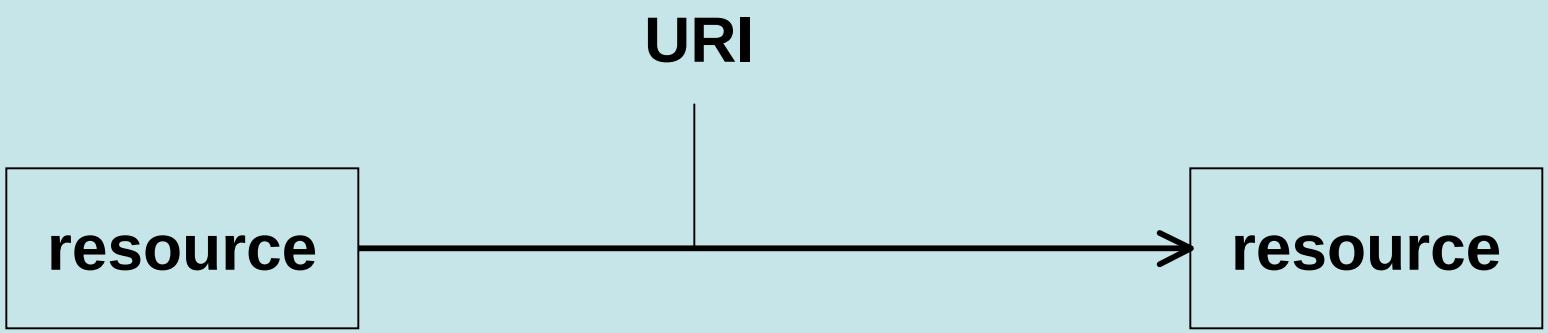


URIs for the relations is important

- common naming

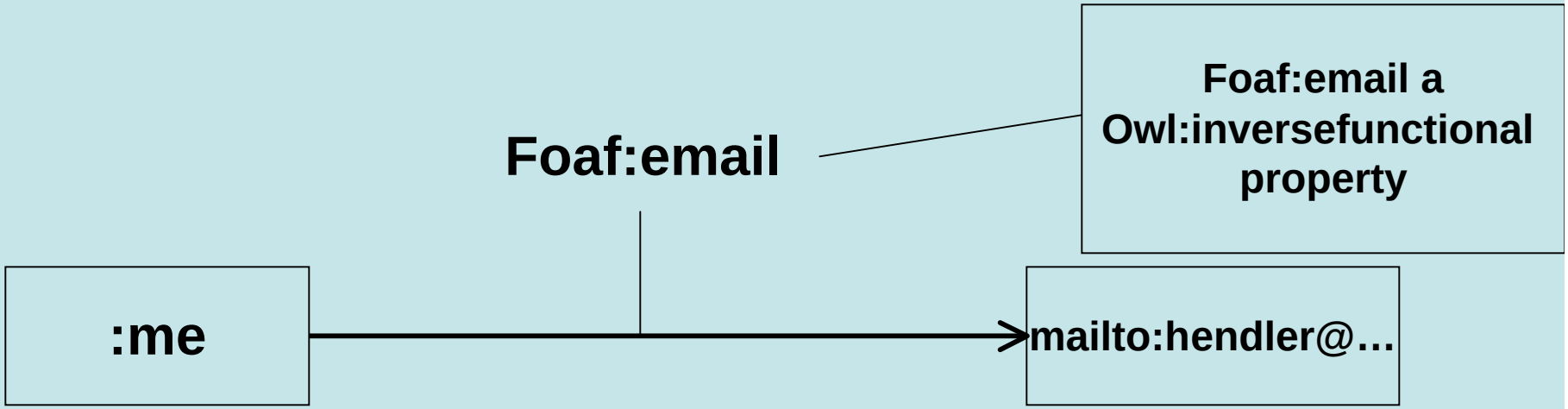
- dereferencing!

Adding the Semantics



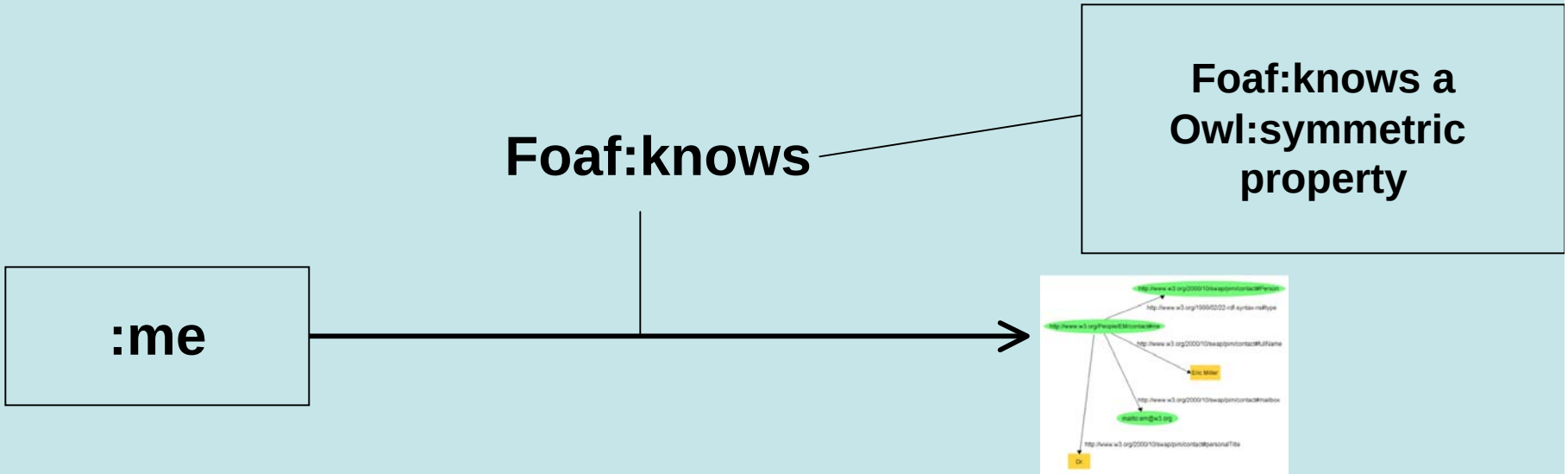
- This is an RDF "Triple" (resources can also be URIs)
- Make the URI dereferencible for a machine-readable description
  - That is, put the ontology at that URI!
  - RDFS and OWL are basically XML dialects for this

Adding the **Semantics**



- Ex: Asserts that email address is a many to one relation (i.e. different people with same email address will be considered equivalent)
  - Can merge multiple FOAF files describing same user from different applications

Adding the Semantics



- RDFS and OWL provide other property restrictions as well
  - Which are properties needed for data modeling, domain vocabularies, etc.
- This is the heart of the Semantic Web
  - Why we talk links, not documents

Real Progress Occuring

- Increasing Semantic Web Uptake
  - Start ups in the space
    - Cerebra, Siderean, SandPiper, Data Grid…
  - Bigger players buying in
    - Adobe, Cisco, HP, IBM, Nokia, Oracle, Sun, Vodaphone… announcements/use in '05
  - Government Projects in and across agencies
    - US, EU, Japan
  - Life Sciences/Pharma an increasingly important market
    - Health Care and Life Sciences Interest Group at W3C
  - Many open source tools available
    - Kowari, RDFLib, Jena, Sesame, Protégé, SWOOP, Onto(xxx)

So…

- XML derives from a focus on the documents
  - Structuring the internals of the nodes of the Web graph (tree structure)
  - Providing structure documents for data description
- RDF/Sem Web derives from a focus on the links between them
  - Labeling the links
  - Adding "restrictions"
  - "Merging" the data from disparate descriptions

Applied to the Web

XML 2005 Conference & Exhibition

XML 2005 Conference & Exposition
Syntax to Semantics
November 14-18, 2005
Hilton Atlanta, Atlanta, GA

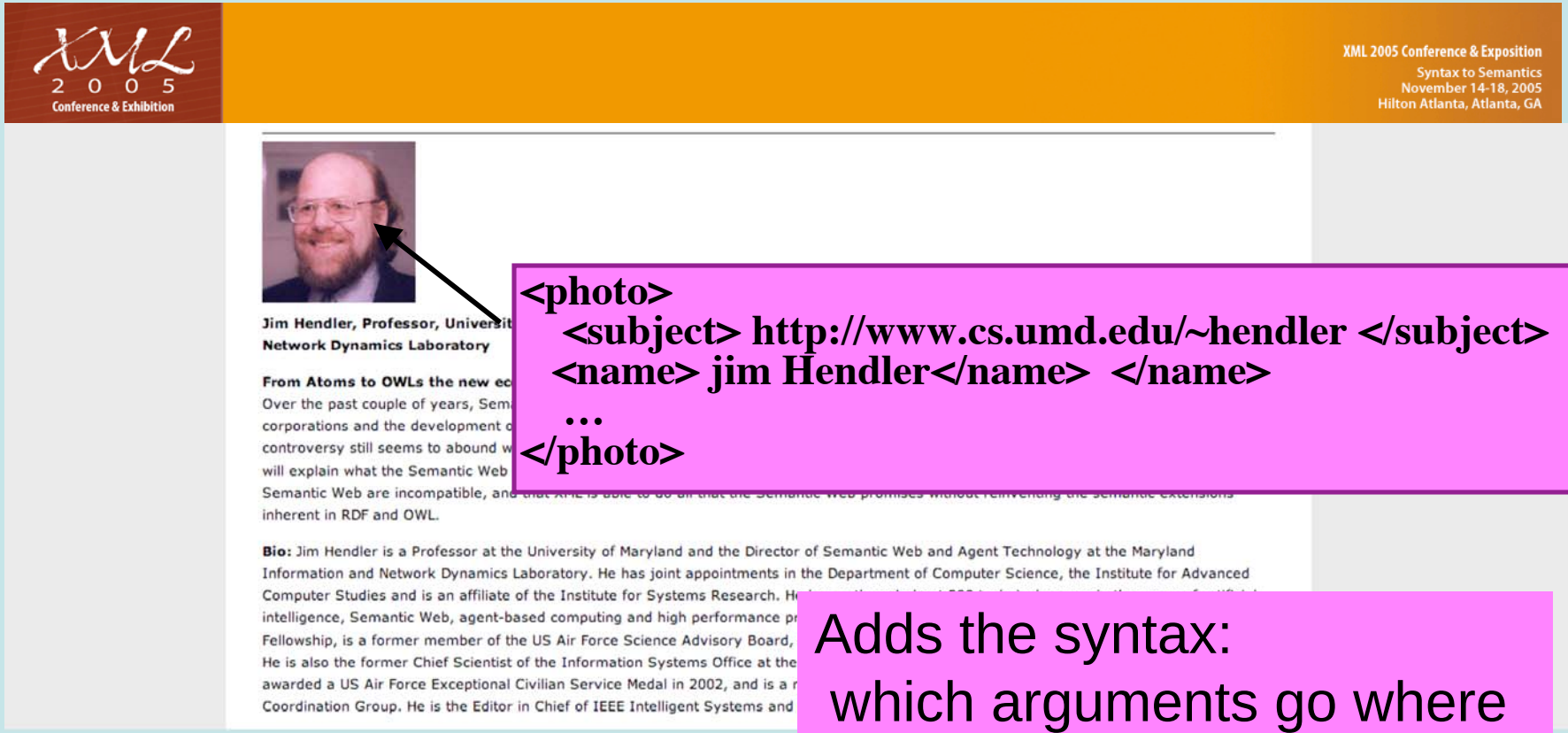
Jim Hendler, Professor, University of Maryland & Director of Semantic Web and Agent Technology, Maryland Information and Network Dynamics Laboratory

From Atoms to OWLs the new ecology of the Semantic Web

Over the past couple of years, Semantic Web deployment has really started rolling. Successes have included adoption of RDF by major corporations and the development of new ontology-based technologies of use for many enterprise and web applications. Despite this, controversy still seems to abound with respect to both the relationship of the Semantic Web to XML, and the use of these technologies. This talk will explain what the Semantic Web is all about and, perhaps more importantly, attempt to dispel two pervasive myths -- that XML and the Semantic Web are incompatible, and that XML is able to do all that the Semantic Web promises without reinventing the semantic extensions inherent in RDF and OWL.

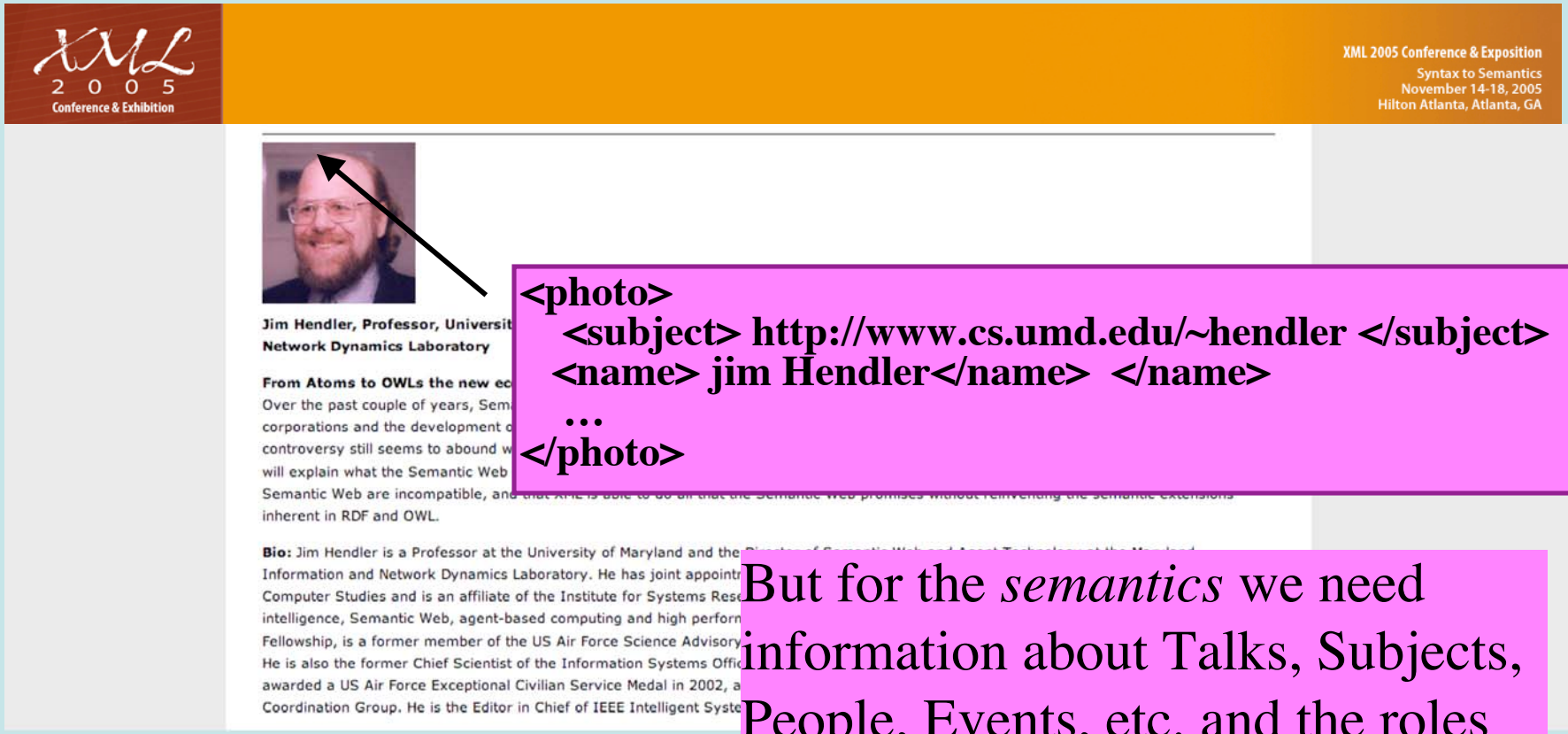
Bio: Jim Hendler is a Professor at the University of Maryland and the Director of Semantic Web and Agent Technology at the Maryland Information and Network Dynamics Laboratory. He has joint appointments in the Department of Computer Science, the Institute for Advanced Computer Studies and is an affiliate of the Institute for Systems Research. He has authored about 200 technical papers in the areas of artificial intelligence, Semantic Web, agent-based computing and high performance processing. Hendler was the recipient of a 1995 Fulbright Foundation Fellowship, is a former member of the US Air Force Science Advisory Board, and is a Fellow of the American Association for Artificial Intelligence. He is also the former Chief Scientist of the Information Systems Office at the US Defense Advanced Research Projects Agency (DARPA), was awarded a US Air Force Exceptional Civilian Service Medal in 2002, and is a member of the World Wide Web Consortium's Semantic Web Coordination Group. He is the Editor in Chief of IEEE Intelligent Systems and is on the Board of Reviewing Editors for Science

XML Markup




```
<photo>
   <subject> http://www.cs.umd.edu/~hendler </subject>
  <name> jim Hendler</name>  </name>
   …
</photo>
```

Adds the syntax:
which arguments go where
how to parse the elements
That define the DOCUMENT

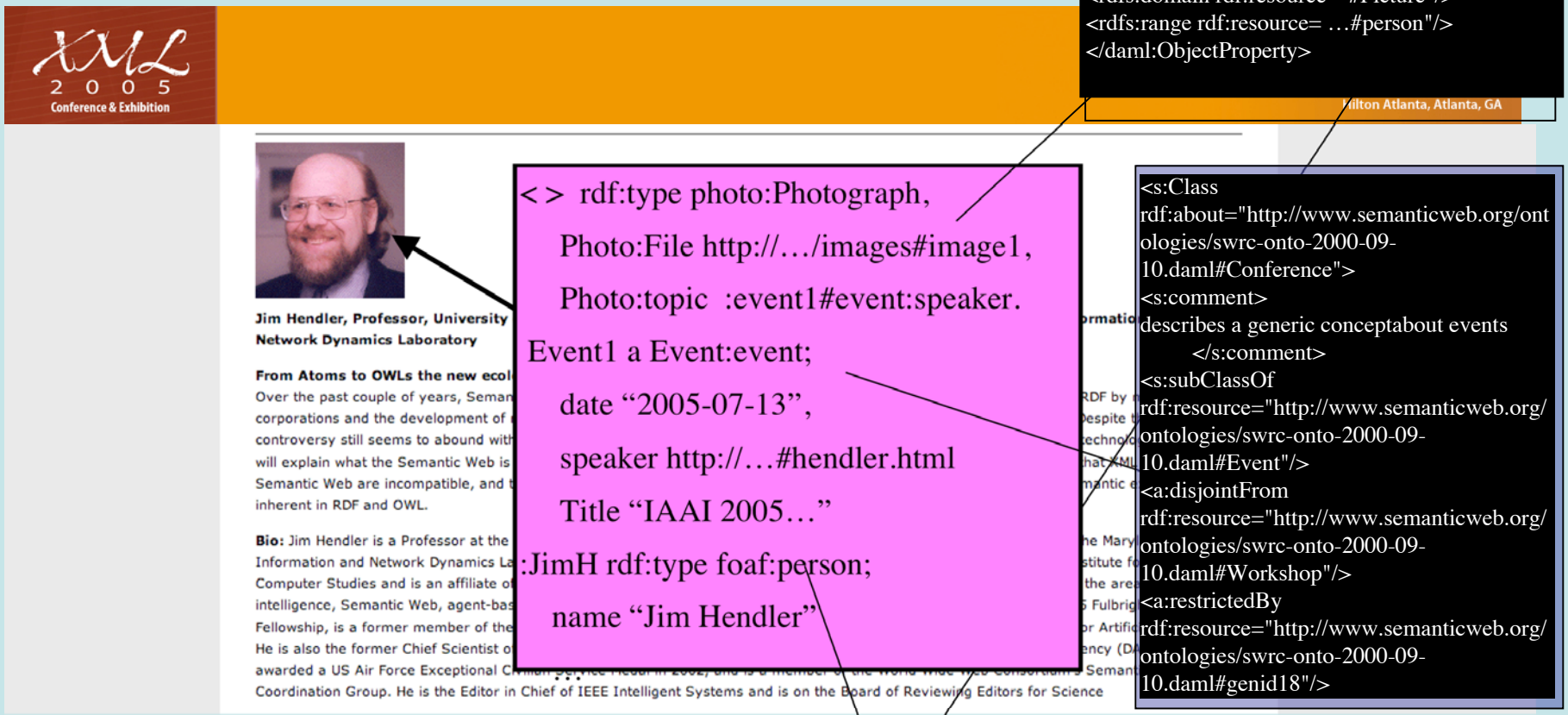



```
<photo>
   <subject> http://www.cs.umd.edu/~hendler </subject>
   <name> jim Hendler</name>  </name>
   …
</photo>
```

But for the *semantics* we need information about Talks, Subjects, People, Events, etc. and the roles this item plays in them

Thus, the *Semantic Web*

```
<daml:ObjectProperty rdf:ID="photograph">
<rdfs:domain rdf:resource="#Picture"/>
<rdfs:range rdf:resource= …#person"/>
</daml:ObjectProperty>
```

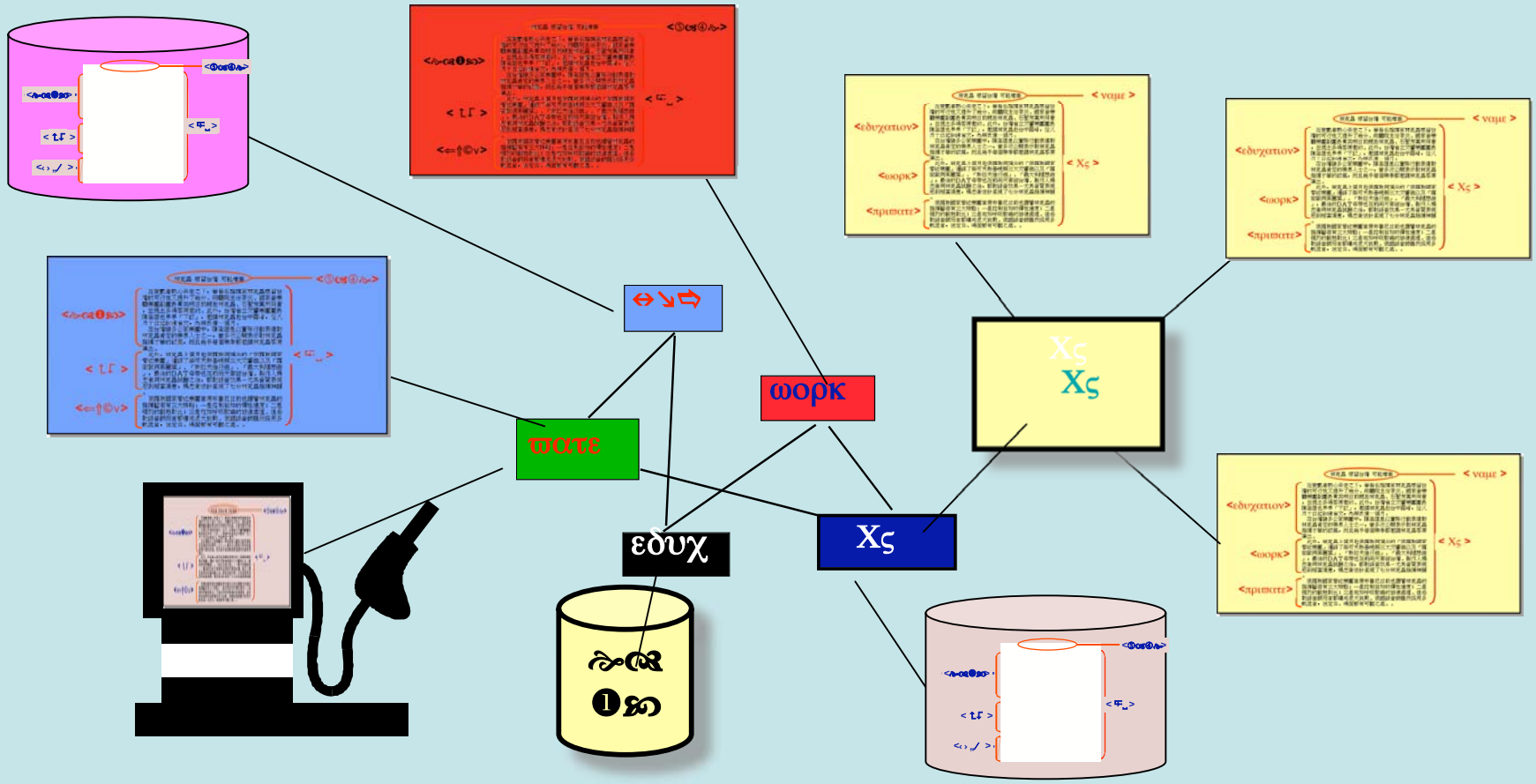



```
<> rdf:type photo:Photograph,
   Photo:File http://…/images#image1,
   Photo:topic  :event1#event:speaker.
Event1 a Event:event;
   date "2005-07-13",
   speaker http://…#hendler.html
   Title "IAAI 2005…"
:JimH rdf:type foaf:person;
   name "Jim Hendler"
```

```
<s:Class
rdf:about="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#Conference">
<s:comment>
describes a generic conceptabout events
    </s:comment>
<s:subClassOf
rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#Event"/>
<a:disjointFrom
rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#Workshop"/>
<a:restrictedBy
rdf:resource="http://www.semanticweb.org/ontologies/swrc-onto-2000-09-10.daml#genid18"/>
```

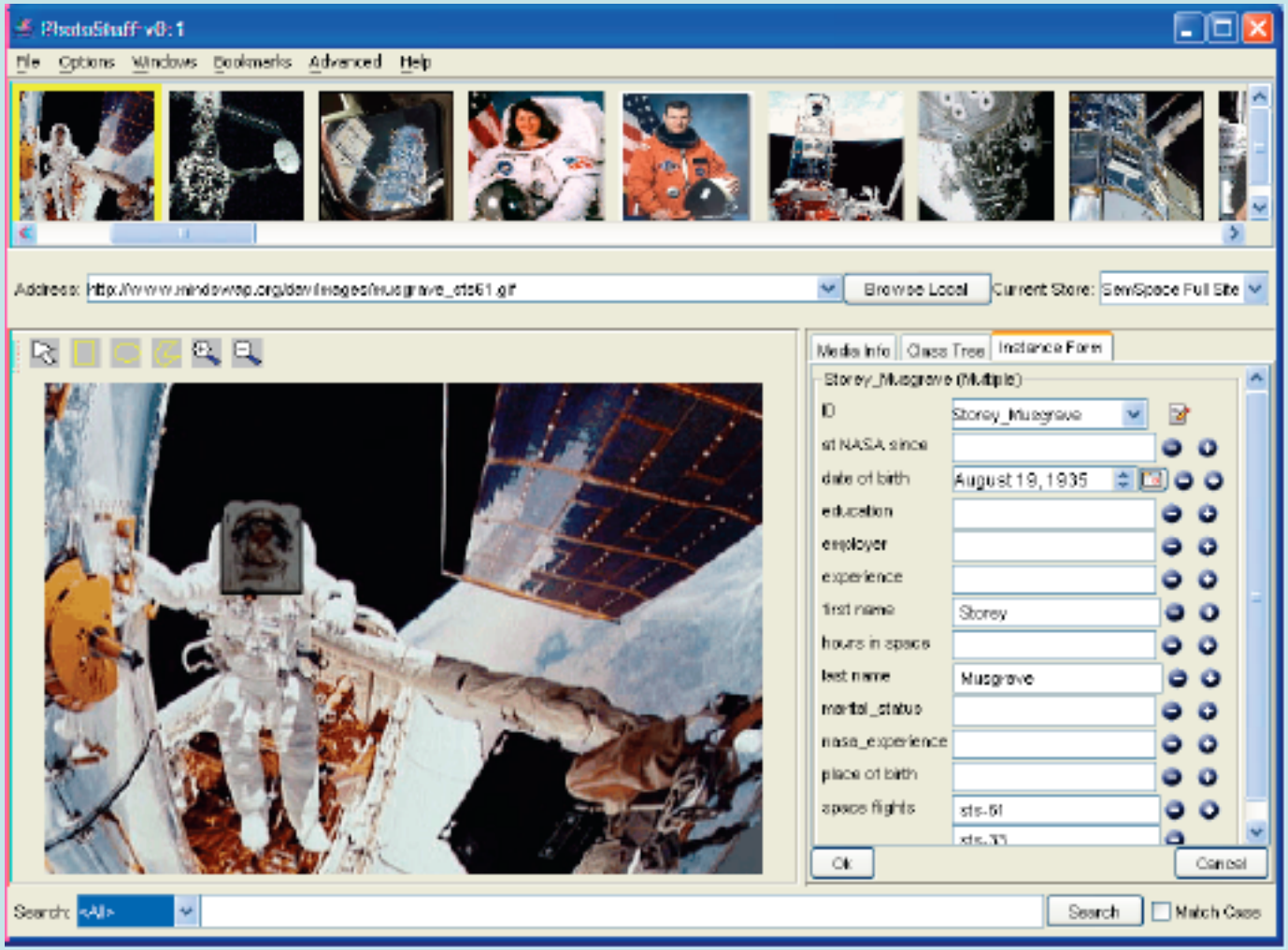
```
<rdf:Description rdf:about="http://www.w3.org/2001/03/earl/0.95#Person">
<rdf:type rdf:resource="http://www.w3.org/2000/01/rdf-schema#Class"/>
<rdfs:subClassOf rdf:resource="http://www.w3.org/2001/03/earl/0.95#Assertor"/>
</rdf:Description>
```

Not just annotation…



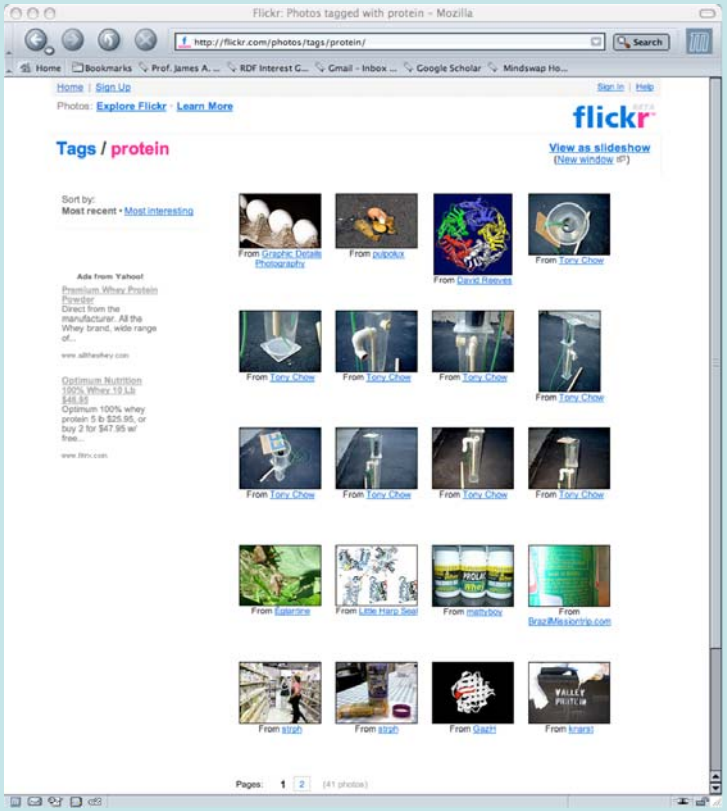
Media formats, Data, Web service descriptions, etc. can be merged via their "semantic relations

Content-based metadata

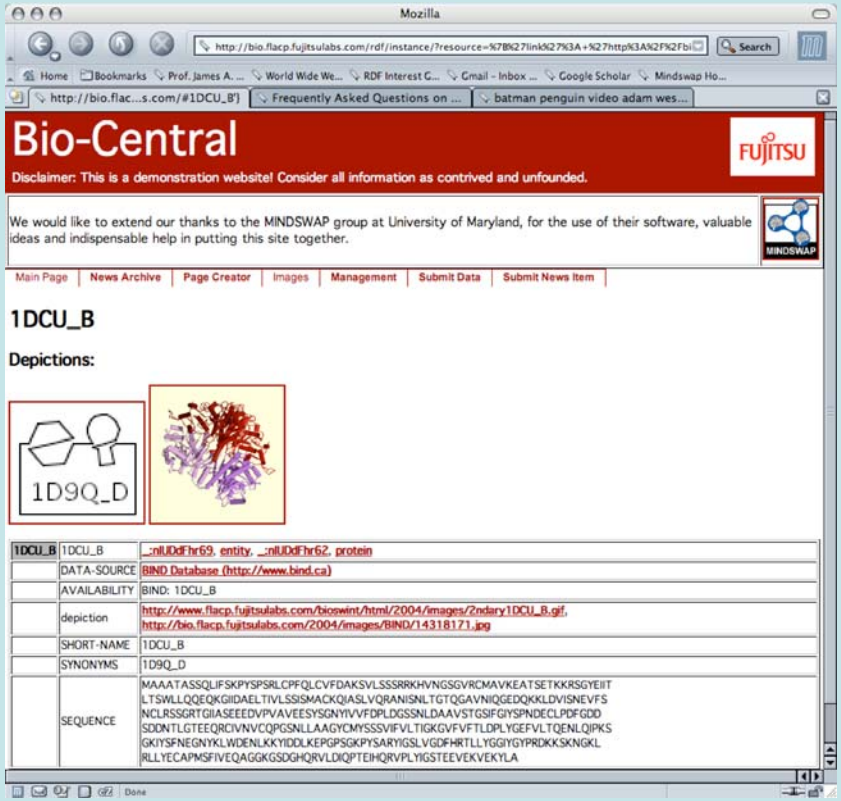


http://www.mindswap.org/2003/PhotoStuff/

"Folksonomy" vs. Ontology



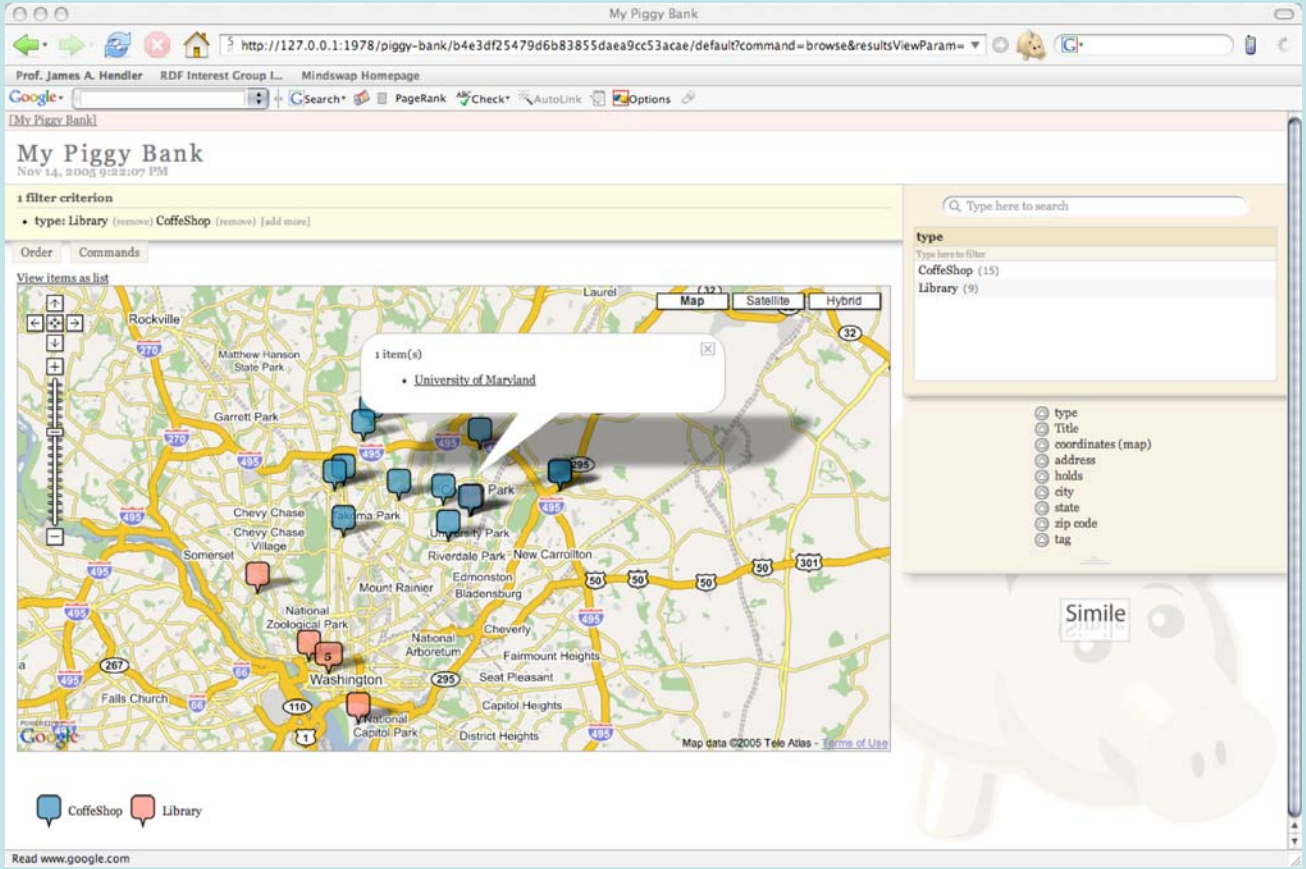
Flickr - protein



Sem Web - protein

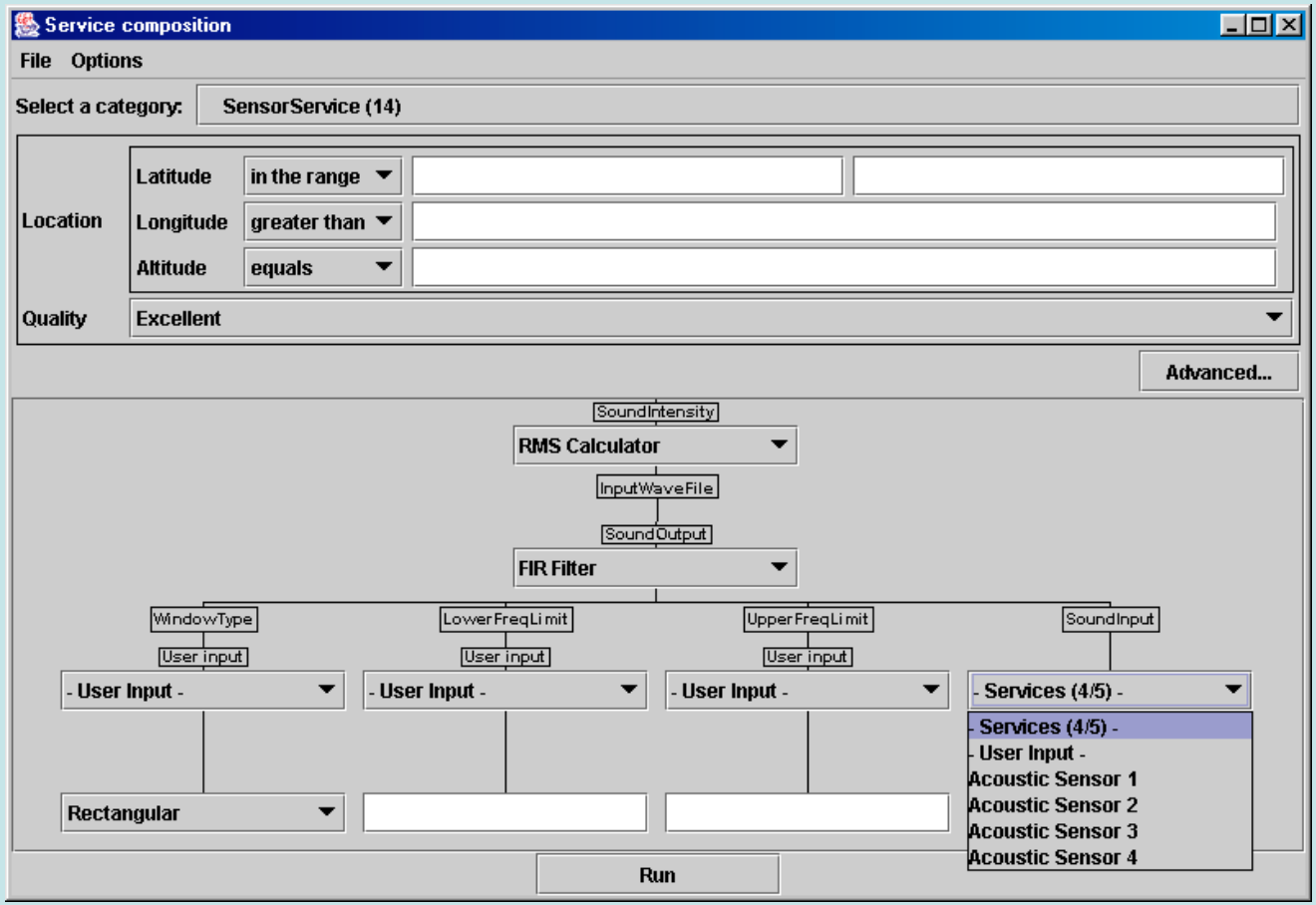
Different levels of precision needed for different users

Merging data



Piggy Bank, MIT Simile project, is a Firefox addition that allows the merging of RDF data on the fly

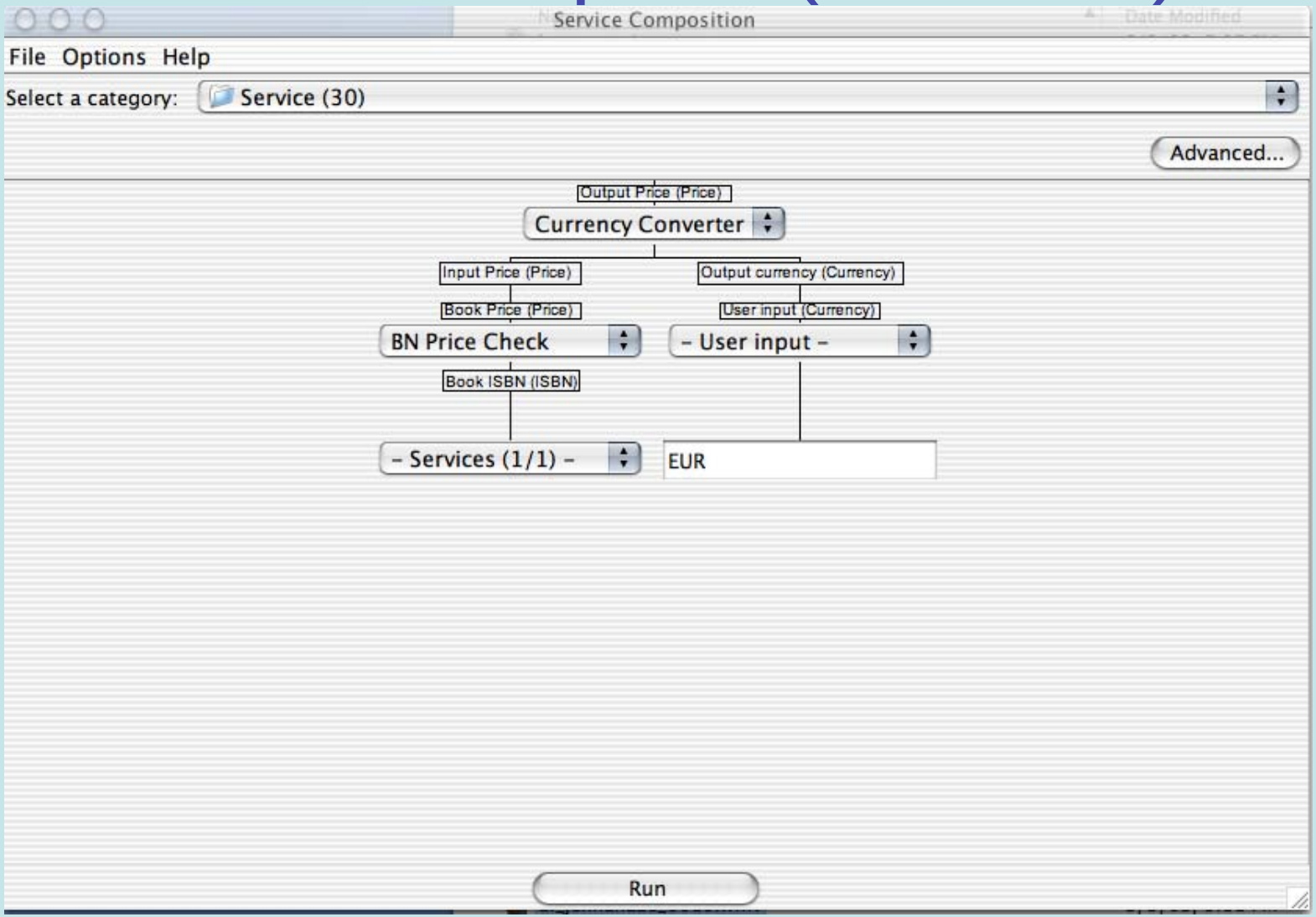
Merging services



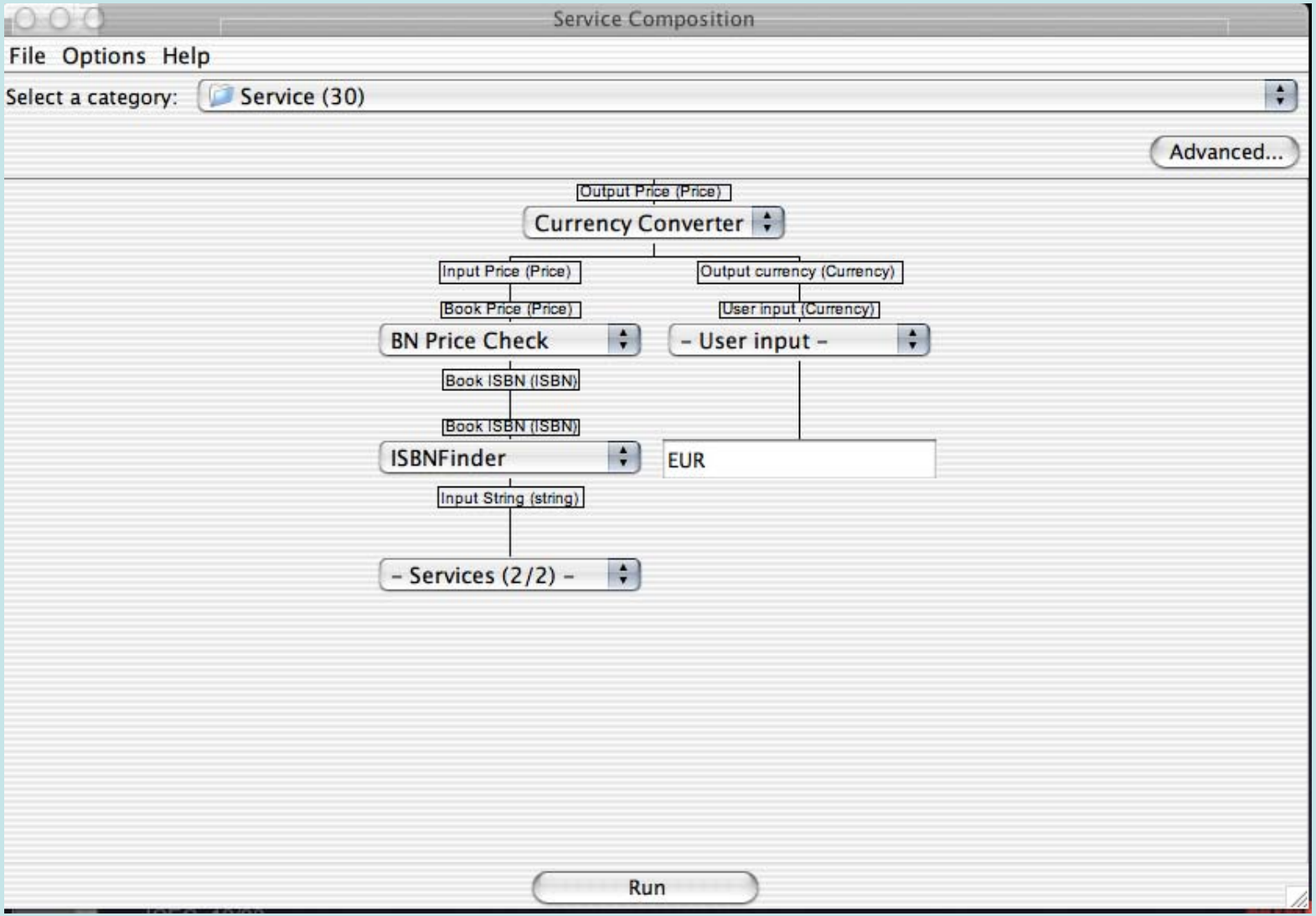
Information management capabilities
Discovery, Filtering, Composition

(Evren Sirin, Bijan Parsia)

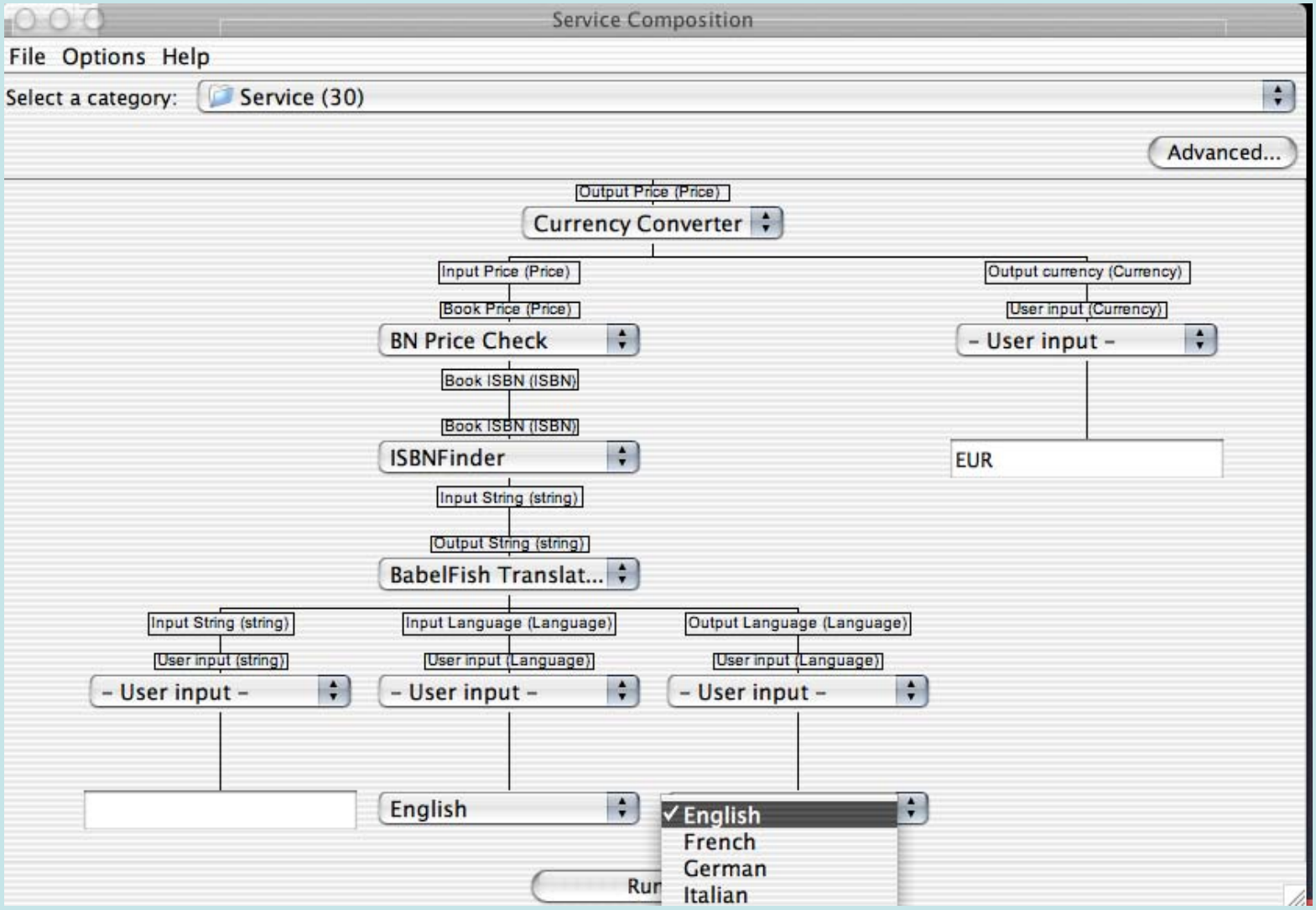
Get a B&N price (In Euros)



Of a particular book



In its German edition?



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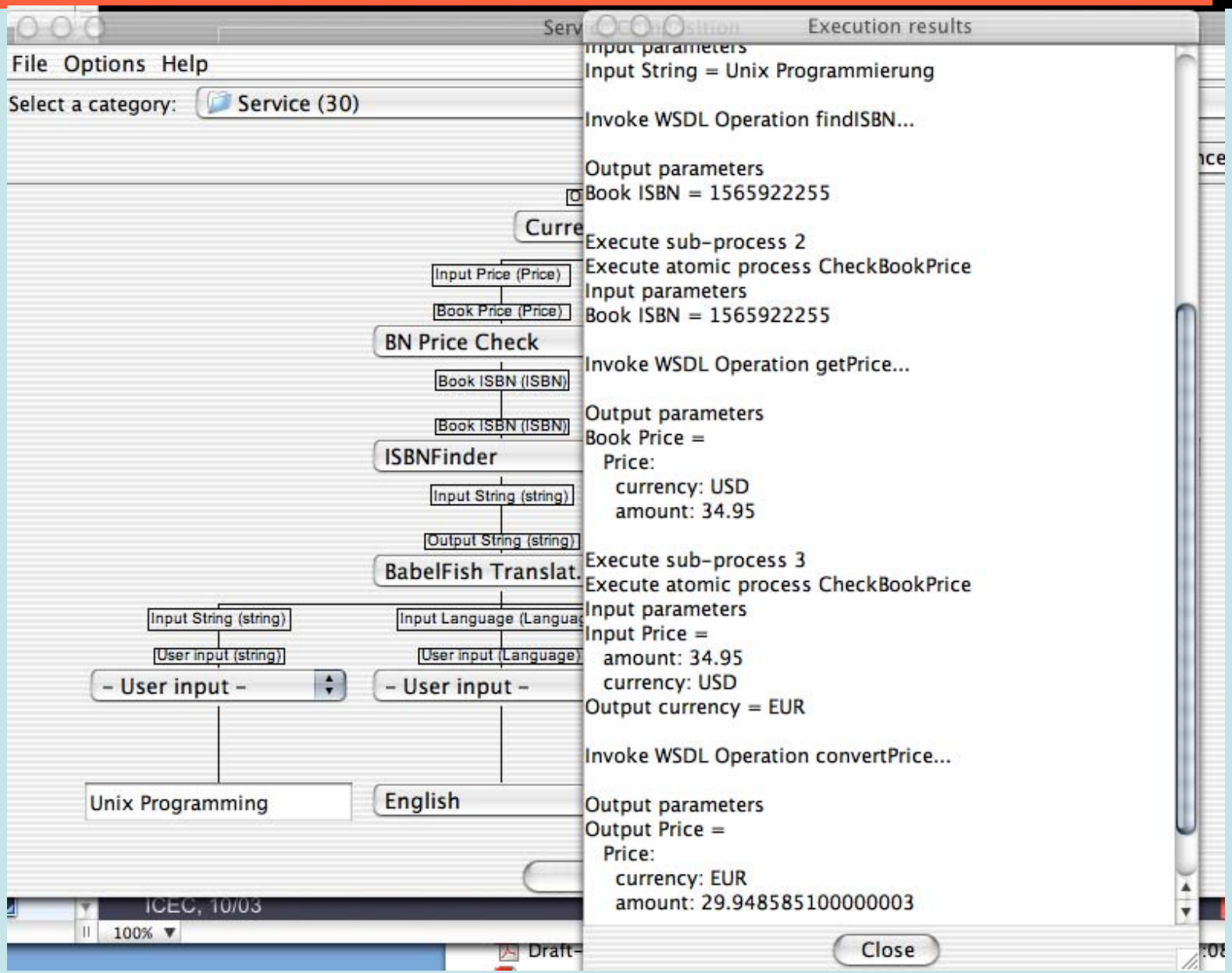
maryland information and network dynamics lab semantic web agents project



Reasoning about access control

URI variable

Alan:

1) If X is AC rep of Y, X can delegate W3C member access rights in Y.
2) *Kari* is AC rep of *Elisa* .

Kari:

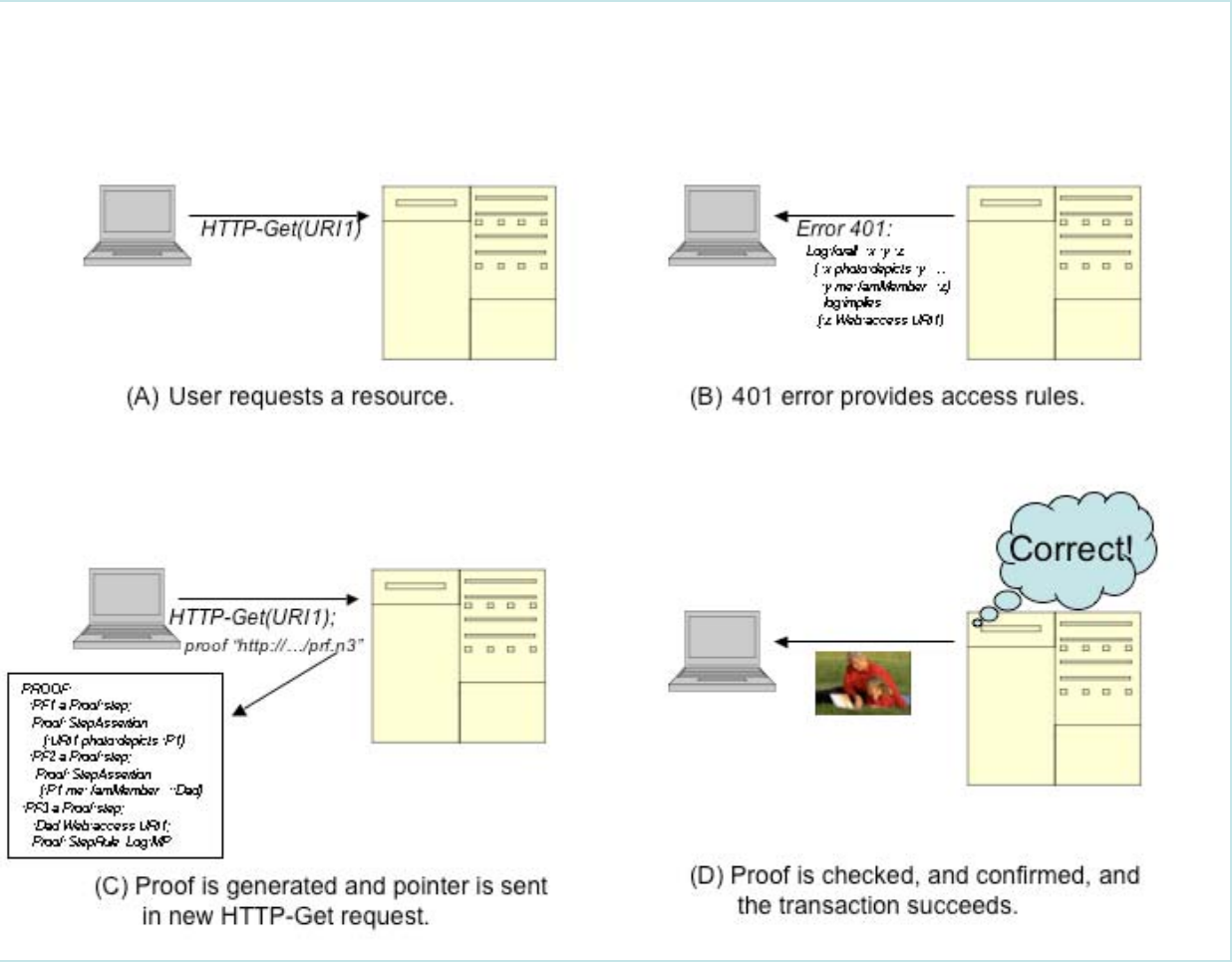
1) If X is employee of *Elisa*, X has W3C member access rights.
2) *Tiina* is employee of *Elisa*.

Tiina: I have W3C member access rights
Proof: Alan 1, Alan 2, Kari 1, Kari 2

W3C MEMBER site

2004 NSF National Priorities ITR to UMCP and MIT (Hendler, Berners-Lee, Weitzner- PIs)

Which gets us back to protocols…



But can't this just be done in XML?

- Yes, it can … and it has
  - RDF/XML is legal XML
  - OWL has an XML Schema and XSLT to move that to the (normative) RDF/XML interchange format
  - SPARQL returns an XML (data) document
  - GRDDL and RDF/A provide XHTML to RDF mapping
- No need to reinvent the wheel, but…

Playing nice together

- Good news: Slash vs. Hash is over
  - The TAG has spoken
    - The armies are burying their dead and returning home as we speak
- And coordination improving
  - Cf. WSDL 2.0 OWL; SPARQL and XQuery, …
- But, Semantic Web ***needs*** some URIs from the XML world
  - Example: OWL cannot use complex XML schema data types
  - Similarly Xlink and Xpath issues

Punch line

- We work towards a common goal
  - Raising the grade for data (and meta-data) on the Web
- XML and RDF/RDFS/OWL can and do coexist very well
  - XML for documents and structure
  - RDF for linking and merging
  - OWL for vocabularies and organization
    - RDF and XML forms
- The Semantic Web is here
  - don't reinvent it