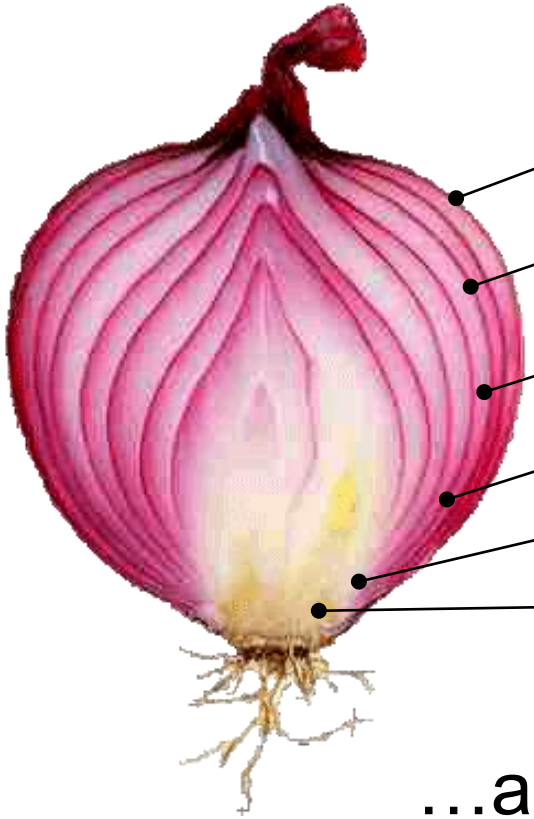
"Enabling Information Sharing through Common Services"

Semantic Technologies – Introduction and Perspectives in FAA

Presented To: AT Information Exchange Conference
Presented By: Mark Kaplun (FAA)
Date: September 1, 2011

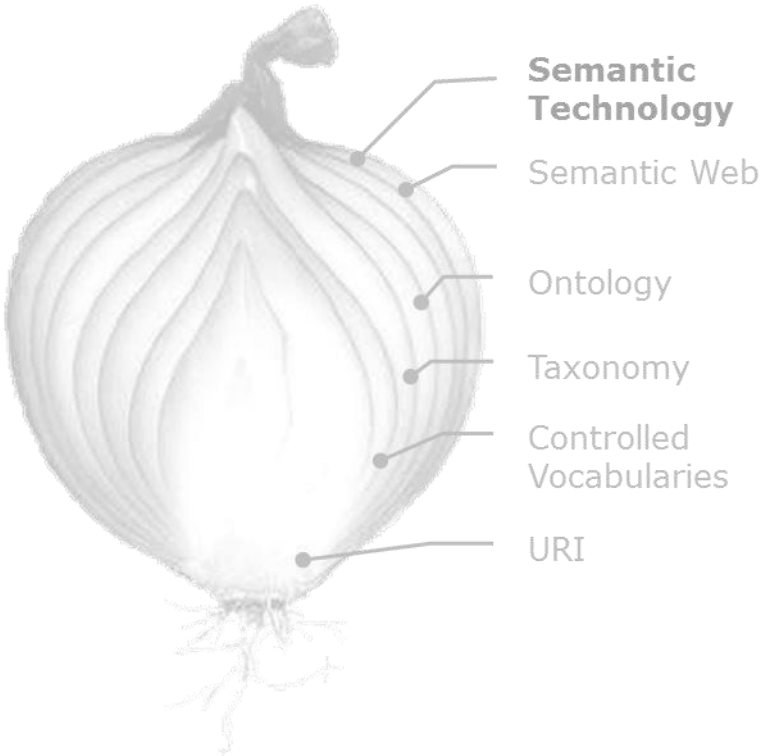
Agenda



- Semantic Technology
- Semantic Web
- Ontology
- Taxonomy
- Controlled Vocabulary
- URI

…and how pieces work together

Semantic Technology



- ***Semantics*** is the study of meaning
- ***Semantic Technology*** utilizes meanings of computational data
- It represents meaning separately from data content and application code, and establishes a ***common format for combining information from various sources of data***

Motivation for Semantic Technology (example)

FBI Knew Terrorists Were Using Flight Schools

Three days after the attack on the Pentagon and the World Trade Center, FBI Director Robert S. Mueller III described reports that several of the hijackers had received flight training in the United States as "news, quite obviously," adding, "If we had understood that to be the case, we would have -- perhaps one could have averted this."

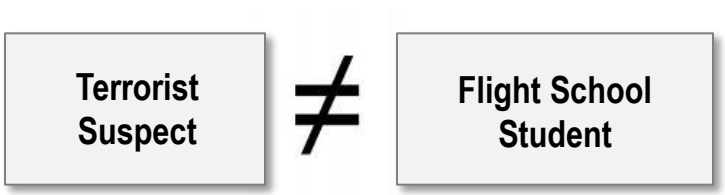
"We were unable to marry any information from investigations or the intelligence community that talked to their use of this expertise in the events that we saw unfold on the 11th," the official said.

Suzanne E. Spaulding, executive director of the National Commission on Terrorism, a congressionally appointed task force, said, "In hindsight, we can see how all these things [flight school connections] might be relevant and important." But, she said, "it is harder on a day-to-day basis. There is no question that technology could help sort information."

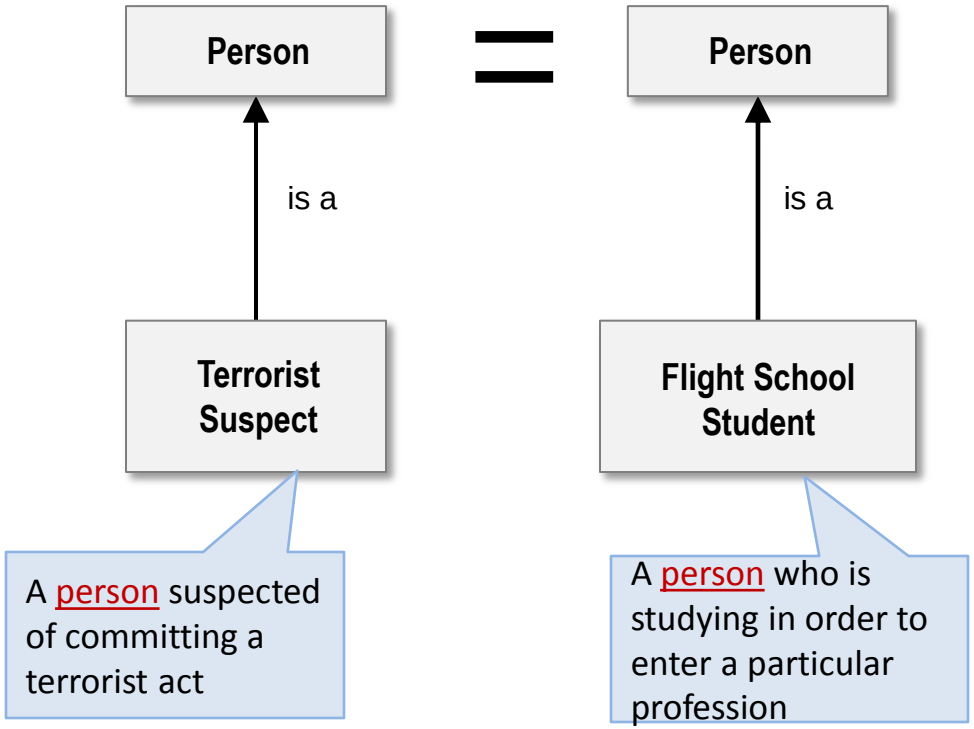
Washington Post: *By Steve Fainaru and James V. Grimaldi* Sunday, September 23, 2001; Page A24

Applying Semantic Technology - example

Non-semantic approach



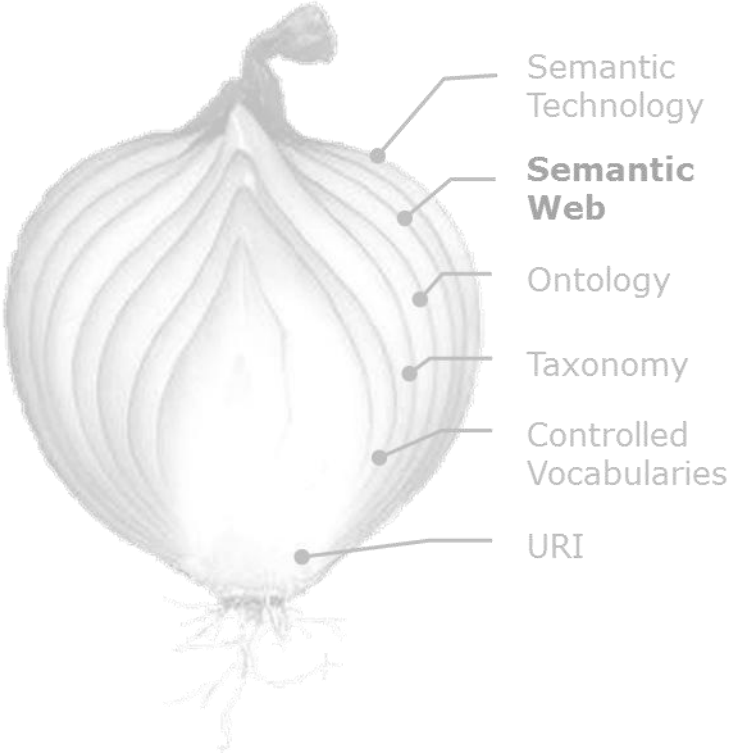
Semantics-based approach



And another reason why we need Semantic Technology

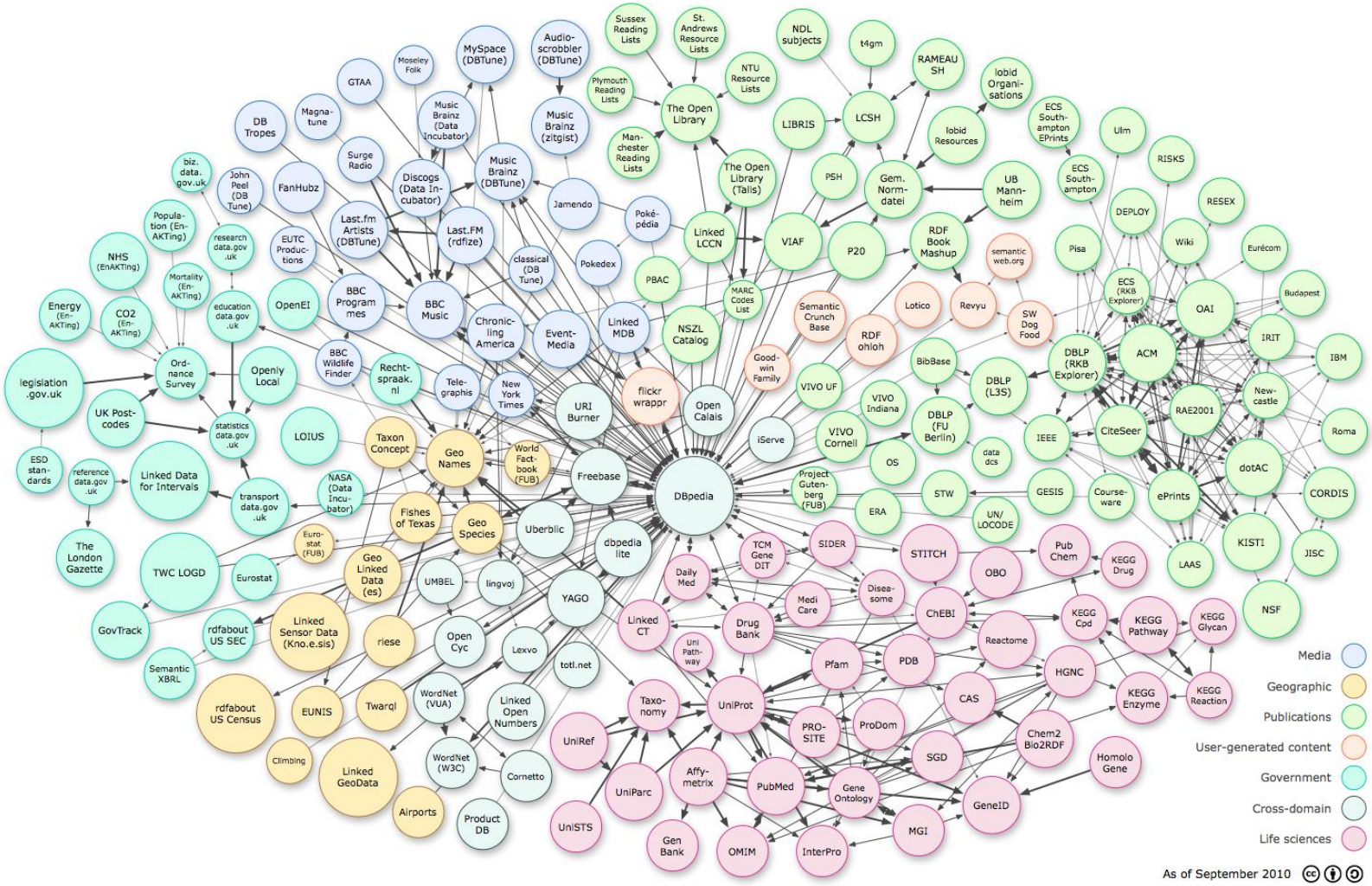
Between 35 and 65% of the $300 billion dollars being spent per year on systems integration is attributable to resolving semantic mismatches between systems.

Semantic Web

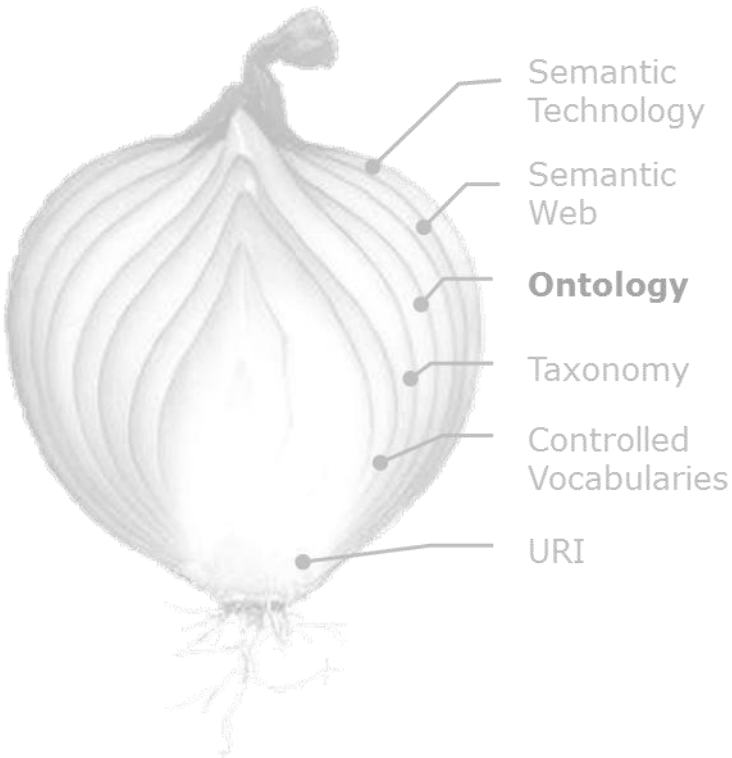


- ***Semantic Web*** is an extension of the current Web that utilizes *semantic technologies* and services
- It allows the integration of online information (usually committed to *ontologies*) which was not previously connected by creators
- It provides a way for machines to derive meaning from information available on the World Wide Web and make some intelligent choices with reduced human intervention

Semantic Web - example



Ontology



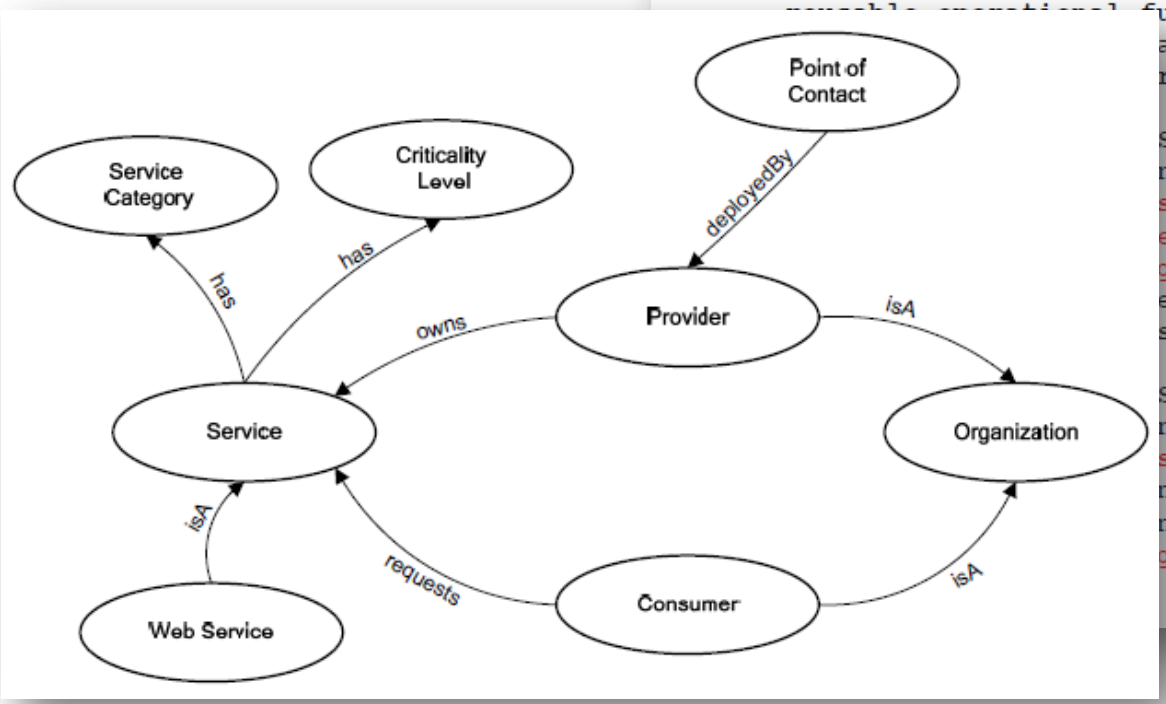
- ***Ontology*** is an *explicit* and *formal* specification of a *shared conceptualization*
  - *Explicit*, because it defines the concepts, properties, relationships, functions, axioms and constrains that compose it
  - *Formal*, because it is machine readable and interpreted
  - *Conceptualization*, because it is an abstract model and a simplified view of existing things it represents
  - *Shared*, because there has previously been a consensus about the information and it is accepted by a group of experts

Ontology - example

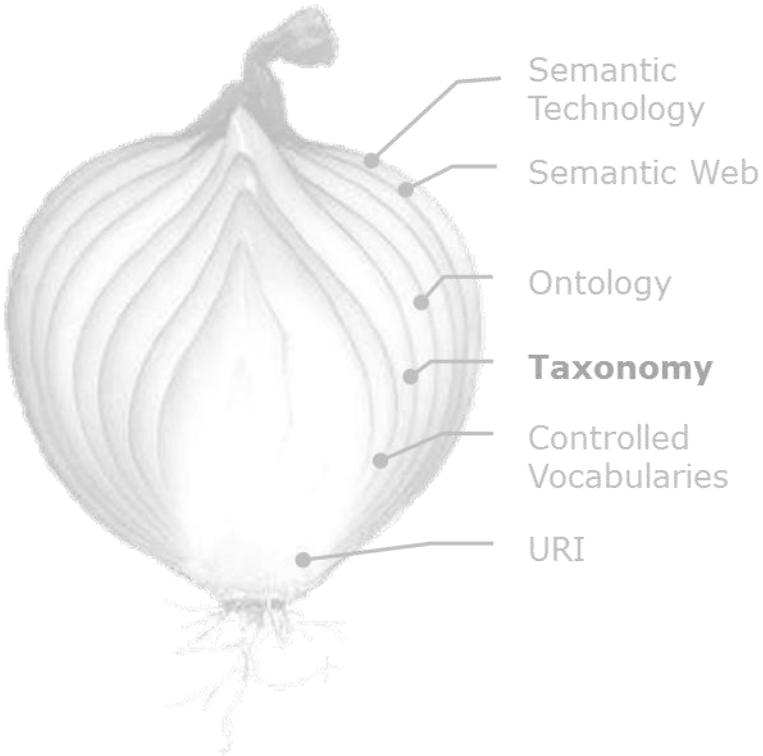
```
<owl:Class rdf:about="#Organization">
     <rdfs:label xml:lang="en">Organization</rdfs:label>
     <owl:disjointWith rdf:resource="#Service"/>
     <dc:description xml:lang="en">A unique framework of authority
      within which a person or persons act, or are designated to act,
      towards some purpose</dc:description>
</owl:Class>
<owl:Class rdf:about="#Service">
     <rdfs:label xml:lang="en">Service</rdfs:label>
     <dc:description xml:lang="en">An implementation-independent
                                  function that may be discovered as
                                  aces, and invoked using open standard
                                  rks</dc:description>

                                  Service Consumer">
                                  n">Service Consumer</rdfs:label>
                                  source="#Organization"/>
                                  esource="#Service Provider"/>
                                  g="en">An organization that seeks to
                                  eed through the use of capabilities
                                  service.</dc:description>

                                  Service Provider">
                                  n">Service Provider</rdfs:label>
                                  source="#Organization"/>
                                  ntest  of the FAA a Service Consumer
                                  n.</rdfs:comment>
                                  g="en">An organization that offers
                                   by means of a service.</dc:description>
```

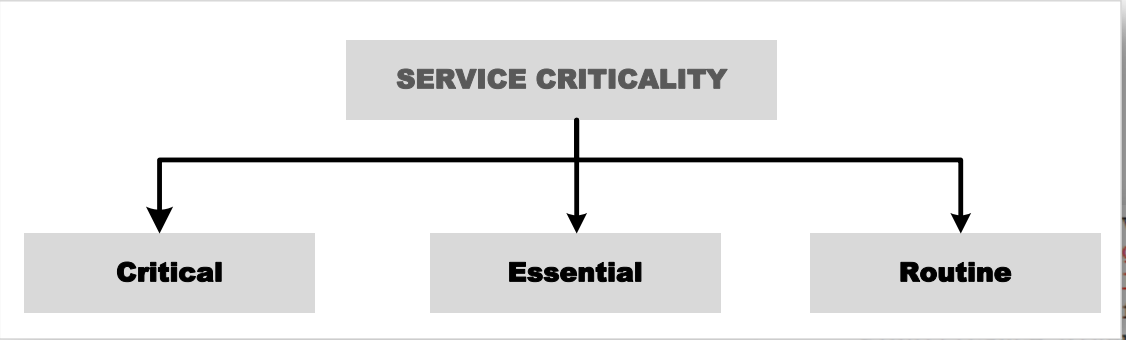


Taxonomy



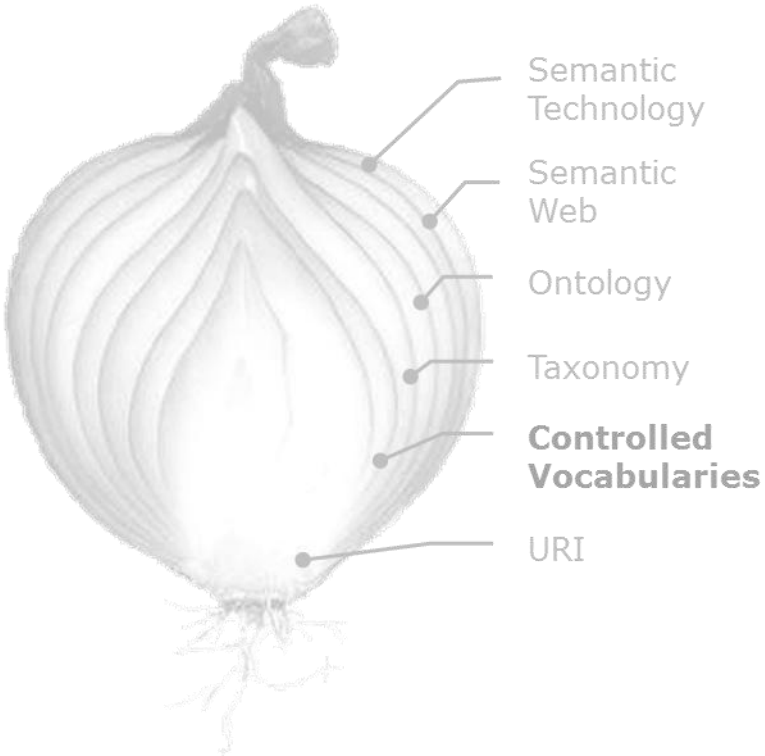
- ***Taxonomy*** is a controlled list of standard terms organized into a hierarchical structure
  - Taxonomy describes relationships among values (parent/child, class/sub-class)
  - Taxonomy supports categorization and classification
  - Taxonomy facilitates the search among collection of entities

Taxonomy - example




```
viceCriticality">
g="en">FAA-STD-066</dc:source>
l:lang="en">This class represents
f a service by expressing the
n to a functional failure of that
service.</dc:description>
</rdfs:Class>
<faa:ServiceCriticality rdf:ID="critical">
    <rdfs:label xml:lang="en">Critical</rdfs:label>
    <rdfs:comment xml:lang="en">Loss of this service would
    significantly raise the risk associated with providing
    safe and efficient operations.</rdfs:comment>
</faa:ServiceCriticality>
<faa:ServiceCriticality rdf:ID="essential">
    <rdfs:label xml:lang="en">Essential</rdfs:label>
    <rdfs:comment xml:lang="en">Loss of this service would
    raise the risk associated with providing safe and efficient
    operations to an unacceptable level.</rdfs:comment>
</faa:ServiceCriticality>
<faa:ServiceCriticality rdf:ID="routine">
    <rdfs:label xml:lang="en">Routine</rdfs:label>
    <rdfs:comment xml:lang="en">Loss of this service
    would have a minor impact on the risk associated
    with providing safe and efficient
    operations.</rdfs:comment>
</faa:ServiceCriticality>
```

Controlled Vocabulary



Controlled Vocabulary is a list of terms that have been enumerated explicitly

- Controlled Vocabulary is controlled by and is available from a controlled vocabulary registration authority
- All terms in a controlled vocabulary must have an unambiguous, non-redundant definition
- Controlled Vocabulary Entries (CVE) are connected through (preferably dereferenceable) URIs on the Web

Controlled Vocabulary - example

Term:
Critical Service

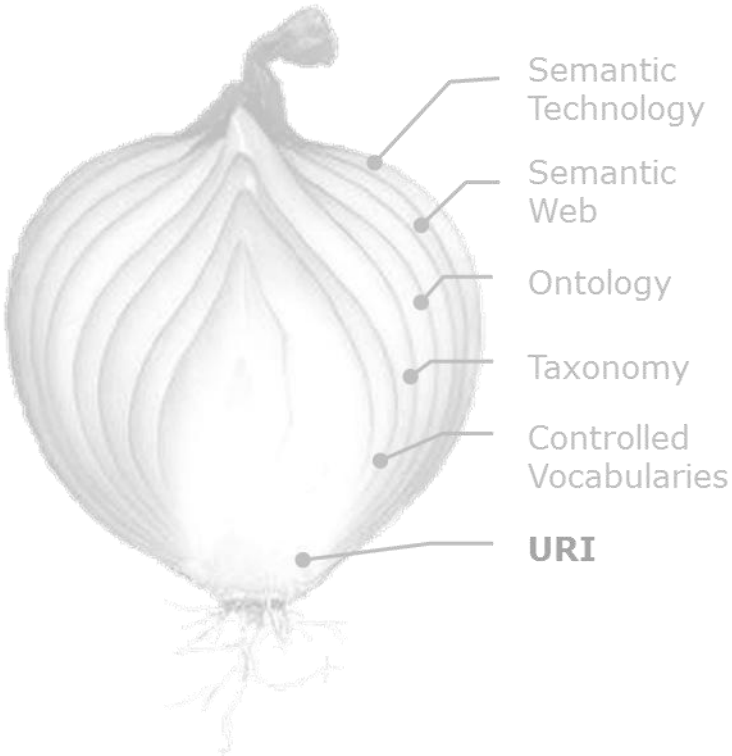
Definitions:
Loss of this service would significantly raise the risk associated with providing safe and efficient operations

Broader terms:
Service Criticality

Related terms:
Essential Service
Routine Service

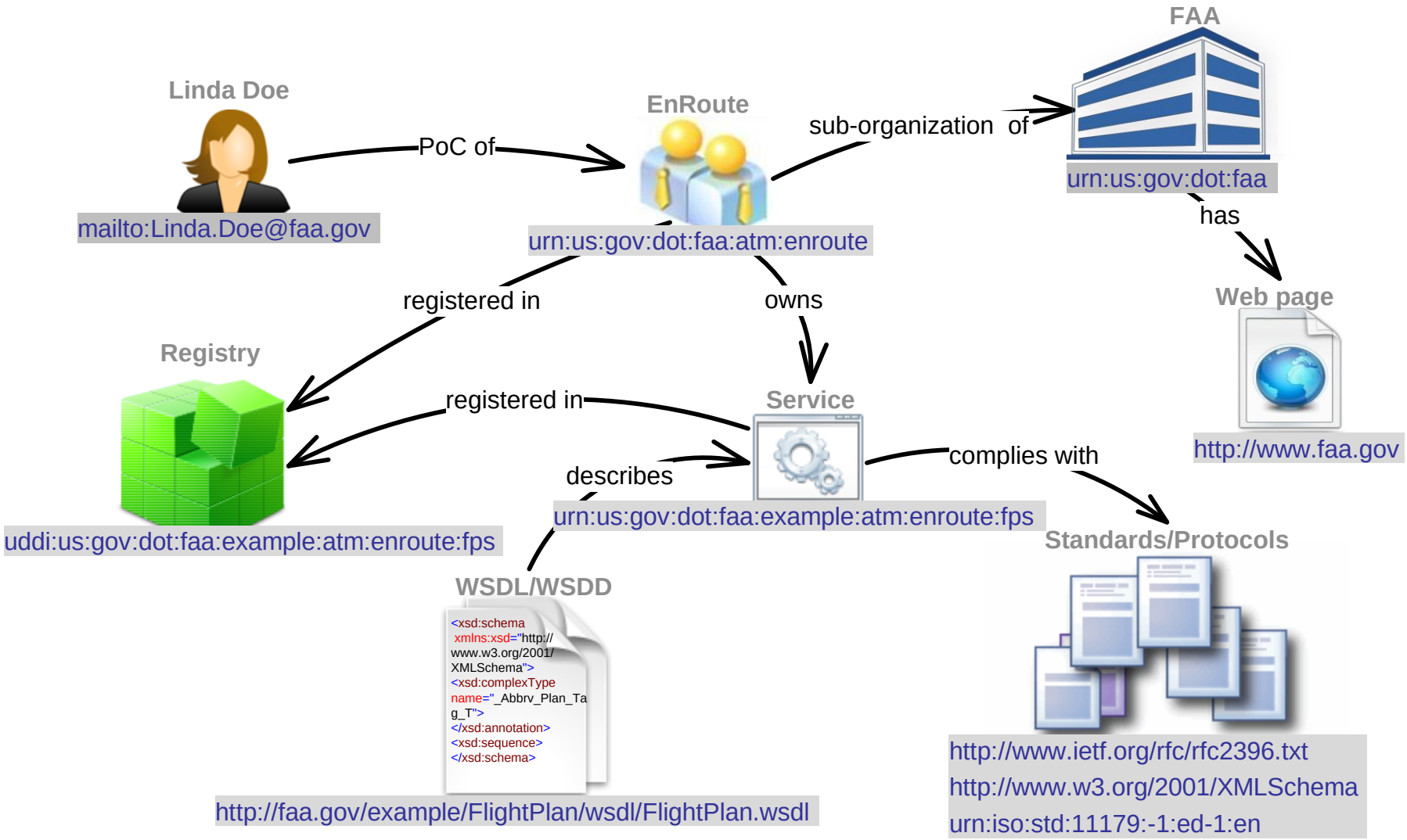
```
df:RDF xmlns:rdf=http://www.w3.org/1999/02/22-rdf-syntax-ns#
       xmlns:rdfs=http://www.w3.org/2000/01/rdf-schema#
       xmlns:skos="http://www.w3.org/2004/02/skos/core#">
skos:Concept rdf:about="urn:us:gov:dot:faa:terms#CriticalService">
 <skos:prefLabel>Critical Service</skos:prefLabel>
 <skos:definition>Loss of this service would significantly raise
   the risk associated with providing safe and efficient
   operations</skos:scopeNote>
 <skos:broader rdf:resource="urn:us:gov:dot:faa:terms#ServiceCriticality"/>
 <skos:related rdf:resource="urn:us:gov:dot:faa:terms#Essential"/>
 <skos:related rdf:resource="urn:us:gov:dot:faa:terms#Routine"/>
 </skos:Concept>
</rdf:RDF>
```

Uniform Resource Identifier (URI)

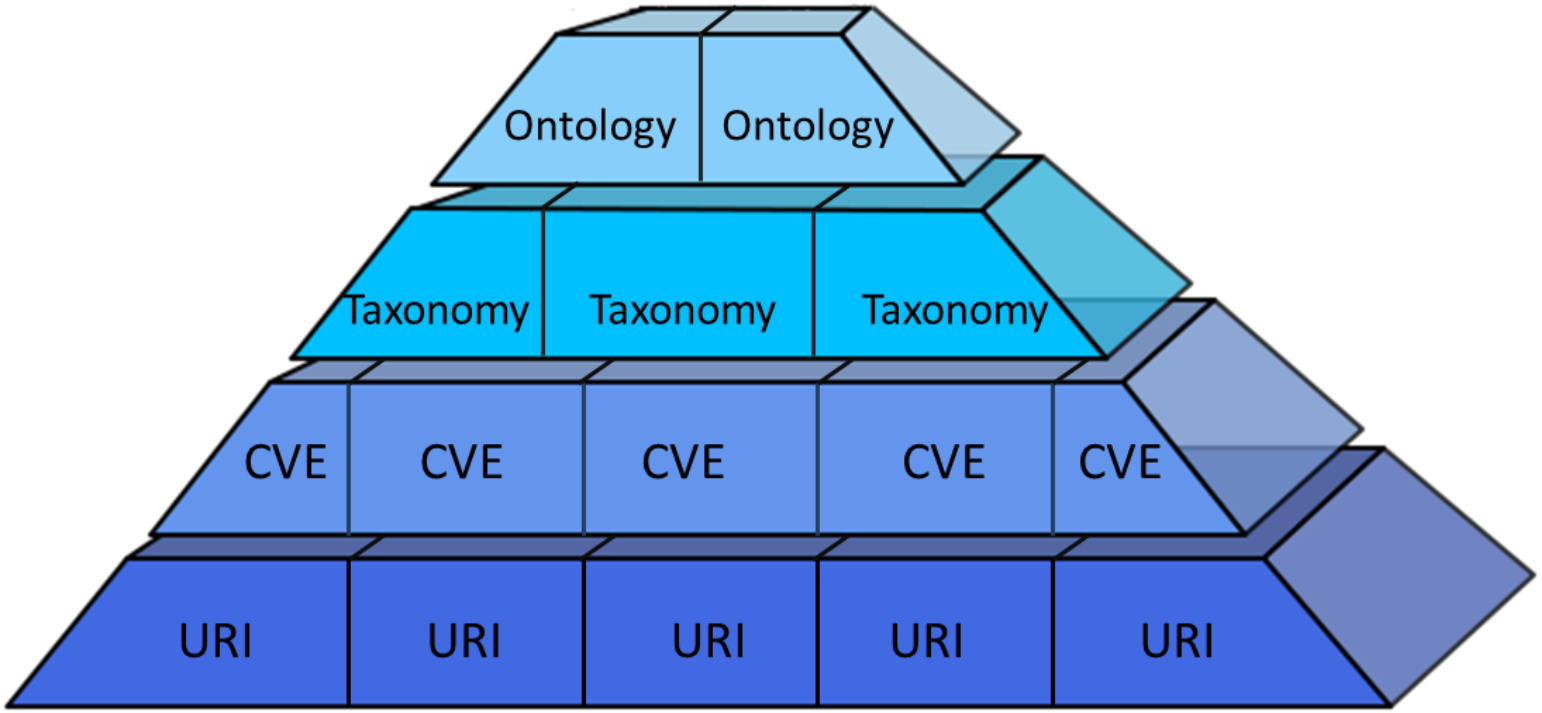


- ***URI*** is a universal system for identification
  - URIs are used to connect all Web documents and other identifiable components
  - URI allows us to identify all kind of objects: concepts, people, places - i.e. anything and everything
  - URI supports interaction between data in context of Semantic Web

URIs - example



How it all may work together



How it all may work together - example

URIs/Namespaces

urn:usa:gov:dot:faa

Controlled Vocabulary

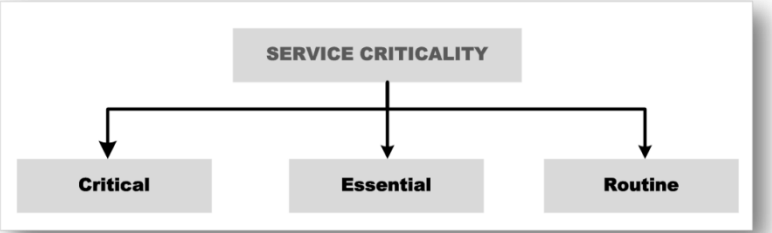
Term:
Critical Service

Definitions:
Loss of this service would significantly raise the risk associated with providing safe and efficient operations

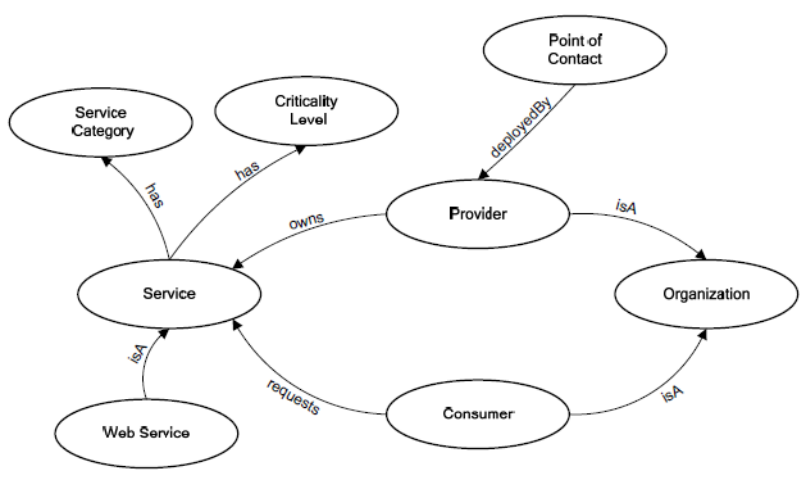
Broader terms:
Service Criticality

Related terms:
Essential
Routine

Taxonomy



Ontology



Questions & Answers

Contact

Air Transportation Information Exchange Conference - (featuring AIXM, WXXM and FIXM)

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<rdf:RDF xmlns:rdf=http://www.w3.org/1999/02/22-rdf-syntax-ns#
         xmlns:foaf="http://xmlns.com/foaf/0.1/">
  <foaf:Person>
    <foaf:name>Mark Kaplun</foaf:name>
    <foaf:mbox rdf:resource="mailto:mark.kaplun@faa.gov"/>
  </foaf:Person>
 </rdf:RDF>
```

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