

# Ontology Life Cycles and The Web's LOD Cloud

*By Kingsley Idehen*

*Founder & CEO, OpenLink Software*



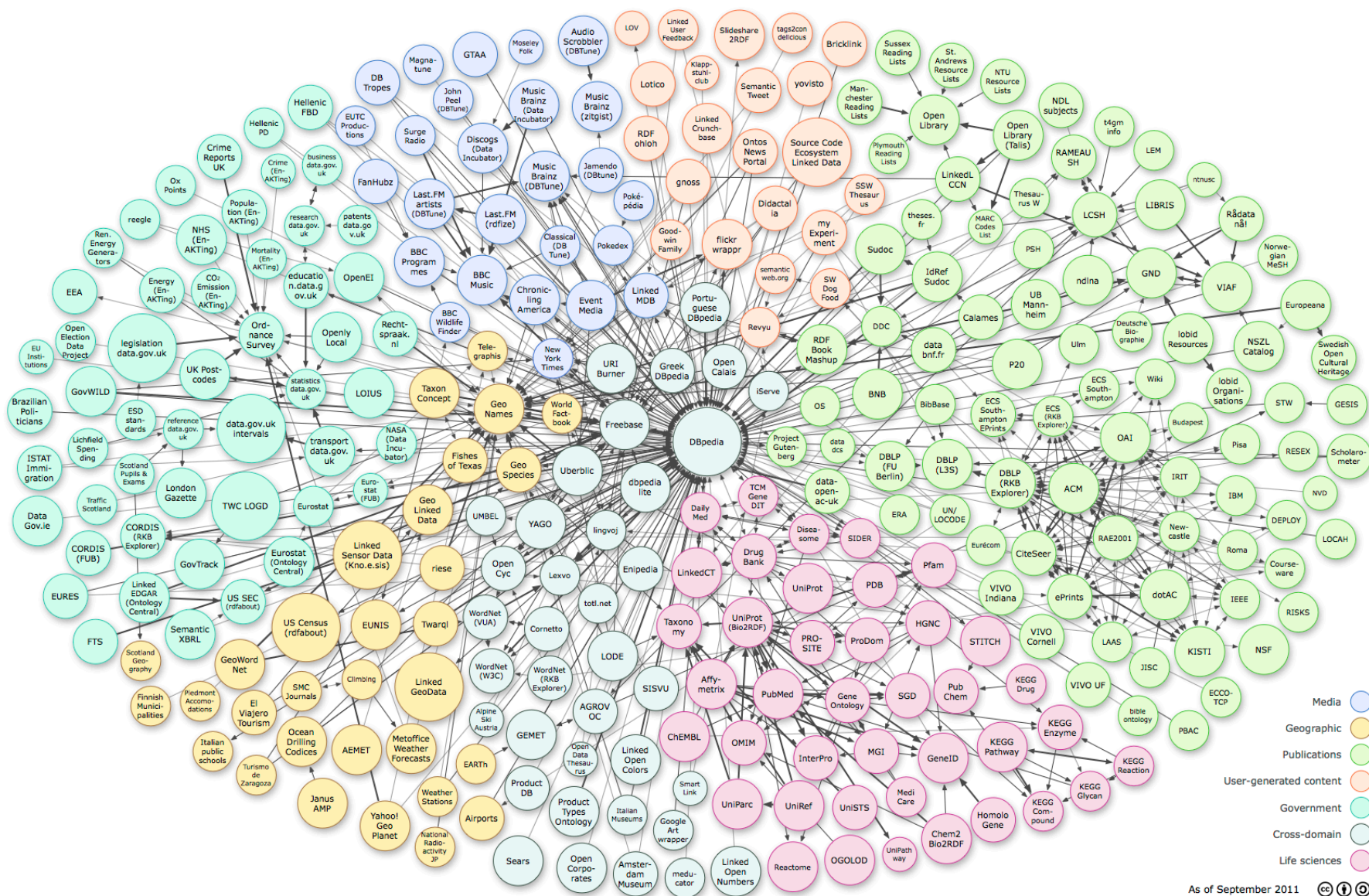
# Life Cycle Challenges

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- Ontology Creation
- Ontology Publication
- Ontology Discovery
- Ontology Use
- Ontology Attribution
- Ontology Problem Discovery
- Ontology Problem Resolution .

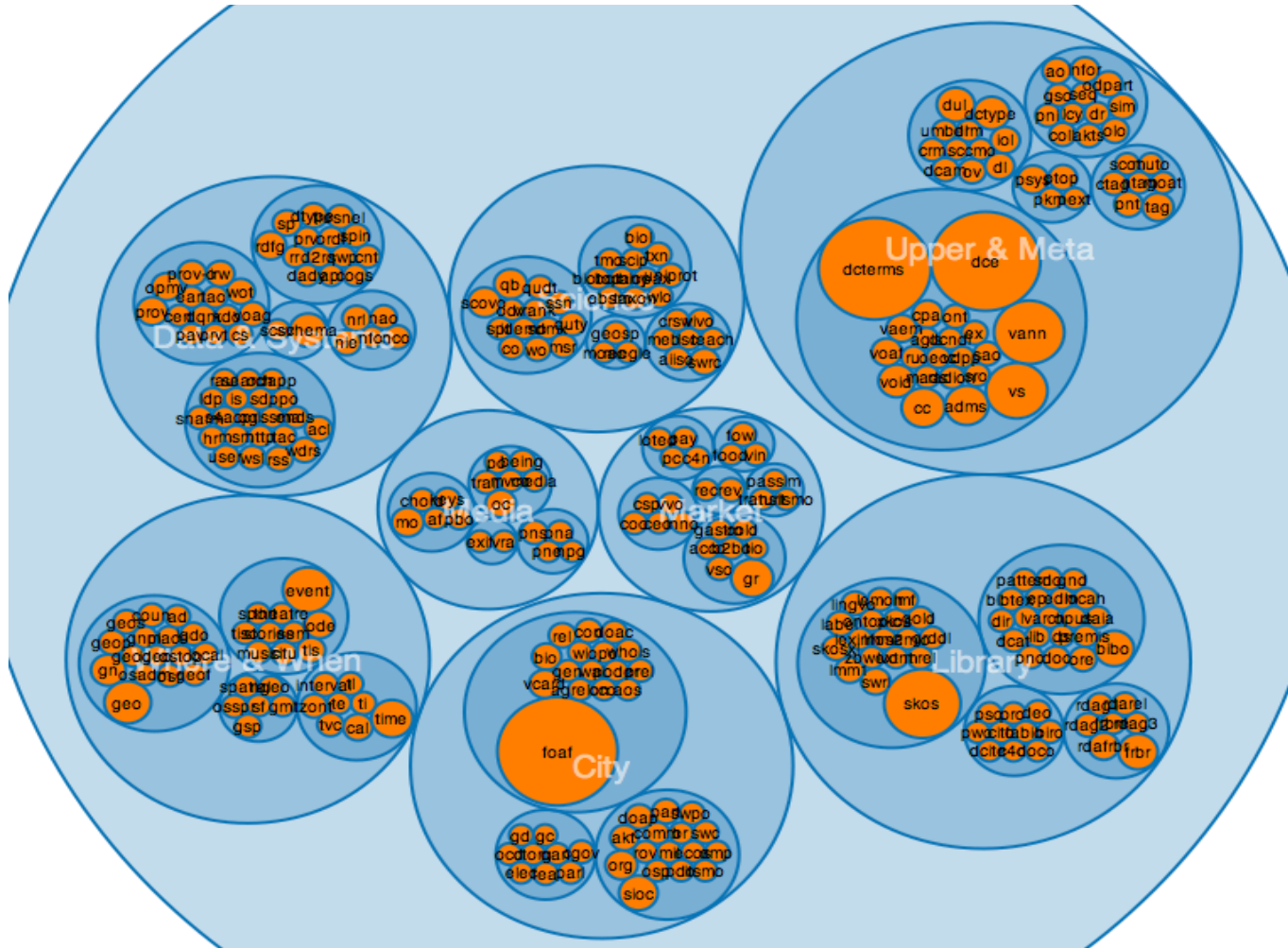


# Linked Open Data (LOD) Cloud





# Linked Open Vocabularies (LOV) Cloud





# Ontology Creation

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- File Creation
- Content Created
- File Saved.



# Ontology Documents Directory

## Index of /DAV/home/kidehen/Public/Linked Data Documents/

Name	Date Modified	Size	Content Type	Owner	Group	Permissions
..						
Offers-Licenses-Products	2012-09-12 18:12:47			kidehen	kidehen	rw-r--rm
.DS_Store	2012-09-19 12:19:26	6 K	application/octet-stream	kidehen	kidehen	rw-r--r
_dbpedia_to_sumo_links.nt	2013-03-21 13:30:59	4 K	application/octet-stream	kidehen	kidehen	rw-r--rm
_fao_to_sumo_mappings.txt	2013-03-21 13:30:53	4 K	text/plain	kidehen	kidehen	rw-r--rm
_sumo_to_fao_mappings.txt	2013-03-21 13:30:56	4 K	text/plain	kidehen	kidehen	rw-r--rm
MyProfile.ttl	2013-01-28 17:56:26	3 K	text/turtle	kidehen	kidehen	rw-r--rm
dbpedia_to_fao_mapping.nt	2012-09-06 15:04:17	28 K	text/plain	kidehen	kidehen	rw-r--r
dbpedia_to_fao_mapping.nt,acl	2012-10-30 10:08:21	924 B	text/turtle	kidehen	kidehen	rw-r--r
dbpedia_to_sumo_links.nt	2013-03-21 13:30:59	16 K	application/octet-stream	kidehen	kidehen	rw-r--rm
fao_to_sumo_mappings.txt	2013-03-21 13:30:38	30 K	text/plain	kidehen	kidehen	rw-r--rm
foaf_addressbook.ttl	2013-01-16 17:37:10	445 B	text/turtle	kidehen	kidehen	rw-r--rm
ldp_to_sioc_mapping2.ttl	2013-01-29 10:17:31	2 K	text/turtle	kidehen	kidehen	rw-r--rm
martin-udogie-podcast-with-ifueko-omogui-okauru	2013-02-01 13:55:11	2 K	text/turtle	kidehen	kidehen	rw-r--rm
operating_systems.ttl	2013-01-04 10:27:04	899 K	text/turtle	kidehen	kidehen	rw-r--rm
opsys.rdf	2013-01-04 10:32:38	3 M	application/rdf+xml	kidehen	kidehen	rw-r--rm
opsys.ttl	2013-01-04 10:22:44	899 K	text/turtle	kidehen	kidehen	rw-r--r
personae.ttl	2013-01-03 12:49:15	1711 B	text/turtle	kidehen	kidehen	rw-r--r
profile.ttl	2013-01-08 17:32:24	2021 B	text/turtle	kidehen	kidehen	rw-r--rm
sumo_to_fao_mappings.txt	2013-03-21 13:30:55	30 K	text/plain	kidehen	kidehen	rw-r--rm
test.ttl	2013-01-09 19:22:41	2 K	text/turtle	kidehen	kidehen	rw-r--rm
vcard_addressbook.ttl	2013-01-16 17:50:11	492 B	text/turtle	kidehen	kidehen	rw-r--rm
vcard_foaf_mapping.ttl	2013-01-16 17:42:26	815 B	text/turtle	kidehen	kidehen	rw-r--rm





# Ontology Publication

- File Published to Web Address
- Ontology Publication Announced

**From:** Diane Hillmann <[metadata.maven@gmail.com](mailto:metadata.maven@gmail.com)>

**Date:** Tue, 12 Mar 2013 15:03:51 -0400

**Message-ID:** <CAEXEg8qd82TrO2t+Kn13nU6BMEWg6efQ3C7L87D6DwBj=t=Tww@mail.gmail.com>

**To:** Kingsley Idehen <[kidehen@openlinksw.com](mailto:kidehen@openlinksw.com)>

**Cc:** [public-vocabs@w3.org](mailto:public-vocabs@w3.org)

Kingsley:

Thanks for your comments. We're in the process of upgrading the Open Metadata Registry, and your suggestions will be considered as we proceed with the upgrade. For the moment, we're applying our limited resources to managing the vocabularies we have, pushing on the upgrade and gathering feedback. So we thank you!

BTW, the remaining LII US Legislative Model properties and classes now appear at: <http://metadataregistry.org/schema/show/id/69.html>. All have the status of 'published', so the URIs should be considered stable.

Diane Hillmann  
Metadata Management Associates





# Ontology Discovery

- Tweets, G+ Posts etc.







# Ontology Discovery

## LOD Cloud Cache Lookup Service

**OPENLINK SOFTWARE**

Displaying List of Distinct Entity Names ordered by Count where:

[Entity1](#) has any Attribute with Value "**Frequency**" [Drop](#).  
[Entity1](#) is a **owl:Class** . [Drop](#)  
[Entity1](#) **rdfs:isDefinedBy** [Entity2](#) . [Drop](#) [Entity2](#)

View query as SPARQL [Facet](#) [permalink](#)

Go to:  Show  | 8 of 8 total

Entity	Count
<a href="#">The Product Types Ontology for Semantic Web-based E-Commerce</a>	<a href="#">Describe</a> 342
<a href="#">OpenVocab</a>	<a href="#">Describe</a> 128
<a href="http://www.ontologyportal.org/SUMO.owl">http://www.ontologyportal.org/SUMO.owl</a>	<a href="#">Describe</a> 11
<a href="#">Ontology for Biomedical Investigation</a>	<a href="#">Describe</a> 6
<a href="#">Dumontier Lab</a>	<a href="#">Describe</a> 6
<a href="#">Dumontier Lab</a>	<a href="#">Describe</a> 6
<a href="#">Dumontier Lab</a>	<a href="#">Describe</a> 6
<a href="#">SCOT Ontology Namespace</a>	<a href="#">Describe</a> 1

Go to:  Show  | 8 of 8 total

Complete result - 8 processed in 451 msec.  
 Resource utilization: 4.271M rrd 1.407M seq 3.842M same seq 335.1K same pg 77.6K same par 0 disk 0 spec disk 30.22MB / 51.27K messages 3.626K fork

Faceted Search & Find service v1.11.19

POWERED BY VIRTUOSO LINKING OPENDATA

OpenLink Virtuoso version 07.00.3202, on Linux (x86\_64-unknown-linux-gnu), Cluster Edition(12 server processes, 756 GB total memory)  
 Data on this page is owned by its respective rights holders.  
 Virtuoso Faceted Browser Copyright © 2009-2012 OpenLink Software

**Entity Relations Navigation**  
 Types  
 Attributes  
 Referencing Attributes  
 Show Matching Values  
 Places

Options  
 Save  
 Featured Queries  
 New Search





# Ontology Discovery

## LOV Cloud Lookup Service

The screenshot shows a Twitter interface with a post from Bill Roberts (@billroberts). The post text is: "#linkeddata people - anyone know any good standard-ish URIs for frequencies - eg 'annually', 'monthly' etc (inverse of year, month)". Below the text are interaction buttons for Reply, Retweet, Favorite, and More. It shows 3 retweets. A reply from Kingsley Uyi Idehen (@kidehen) is visible below, dated 12 Mar, mentioning a link to bit.ly/XoSXDg and using hashtags #LOV, #LinkedData, #LOD, and #SemanticWeb.



# Ontology Discovery

## LOV Cloud Lookup Service



Linked Open Vocabularies (LOV)



developped by Pierre-Yves Vandenbussche

The "LOV Search" Features gives you the possibility to search for an existing element (property, class or vocabulary) in the Linked Open Vocabularies Catalogue. LOV Aggregator endpoint and metrics about the use of vocabularies in the Semantic Web are used to bring you some relevant results.



Frequency

Filter by Domain

- City (0)
- Data & Systems (2)
- Library (6)
- Market (0)
- Media (2)
- Science (2)
- Upper & Meta (2)

Filter by Type

rdfs:Class

Filter by Vocabulary (9)

- http://linguistics-ontolog
- http://purl.org/ontology/
- http://purl.org/spar/fabic

15 results in 9 vocabularies

<a href="http://purl.org/dc/terms/Frequency">http://purl.org/dc/terms/Frequency</a> (rdfs:Class)	score:0.883	>>
rdfs:label <b>Frequency</b> @en		
<a href="http://purl.oclc.org/NET/ssnx/ssn#Frequency">http://purl.oclc.org/NET/ssnx/ssn#Frequency</a> (owl:Class)	score:0.882	>>
rdfs:label <b>Frequency</b>		
<a href="http://qudt.org/schema/qudt#FrequencyUnit">http://qudt.org/schema/qudt#FrequencyUnit</a> (owl:Class)	score:0.672	>>
rdfs:label <b>Frequency</b> Unit		
<a href="http://purl.org/NET/dady#UpdateFrequency">http://purl.org/NET/dady#UpdateFrequency</a> (owl:Class)	score:0.625	>>
rdfs:label update <b>frequency</b>		
<a href="http://voag.linkedmodel.org/voag#ChangeFrequency">http://voag.linkedmodel.org/voag#ChangeFrequency</a> (owl:Class)	score:0.625	>>
rdfs:label Change <b>frequency</b>		
<a href="http://purl.org/linked-data/sdmx#FrequencyRole">http://purl.org/linked-data/sdmx#FrequencyRole</a> (owl:Class)	score:0.588	>>
rdfs:label <b>Frequency</b> property @en		
rdfs:comment ...t plays the role of <b>frequency</b> @en		





# Ontology Use

## DBpedia & LOD Cloud Meshups

OPENLINK SOFTWARE

Facets Description Metadata Settings

**About: Barack Obama** [Sponge](#) [Permalink](#)  
 An Entity of Type : [yago:AmericanCivilRightsLawyers](#), within Data Space : [dbpedia.org](#) associated with source [dataset\(s\)](#)

Type:  Command:

*Barack Hussein Obama II is the 44th and current President of the United States. He is the first African American to hold the office. In January 2005, Obama was sworn in as a U.S. Senator in the state of Illinois. He would hold this office until November 2008, when he resigned following his victory in the 2008 presidential election. Born in Honolulu, Hawaii, Obama is a graduate of Columbia University and Harvard Law School, where he was the president of the Harvard Law Review.*

Attributes	Values
<a href="#">rdf:type</a>	<a href="#">American legal scholars</a> <a href="#">American political writers</a> <a href="#">Presidents of the United Nations Security Council</a> <a href="#">Punahou School alumni</a> <a href="#">People associated with renewable energy</a> <a href="#">»more»</a>
<a href="#">sameAs</a>	<a href="http://cs.dbpedia.org/resource/Barack_Obama">http://cs.dbpedia.org/resource/Barack_Obama</a> <a href="http://el.dbpedia.org/resource/Μπαράκ_Ομπάμα">http://el.dbpedia.org/resource/Μπαράκ_Ομπάμα</a> <a href="http://ko.dbpedia.org/resource/버락_오바마">http://ko.dbpedia.org/resource/버락_오바마</a> <a href="http://pl.dbpedia.org/resource/Barack_Obama">http://pl.dbpedia.org/resource/Barack_Obama</a> <a href="http://es.dbpedia.org/resource/Barack_Obama">http://es.dbpedia.org/resource/Barack_Obama</a> <a href="#">»more»</a>
<a href="#">rdfs:label</a>	Barack Obama <a href="#">»more»</a>
<a href="#">rdfs:comment</a>	Barack Hussein Obama II is the 44th and current President of the United States. He is the first African American to hold the office. In January 2005, Obama was sworn in as a U.S. Senator in the state of Illinois. He would hold this office until November 2008, when he resigned following his victory in the 2008 presidential election. Born in Honolulu, Hawaii, Obama is a graduate of Columbia University and Harvard Law School, where he was the president of the Harvard Law Review. <a href="#">»more»</a>





# Ontology Attribution

## Personal URIs (WebID) for Creators.

**OPENLINK SOFTWARE** Facets Description Metadata Settings

**About: Ultra-simple review vocab** [Sponge](#) [Permalink](#)  
An Entity of Type : owl:Ontology, within Data Space : lod.openlinksw.com associated with source [dataset\(s\)](#)

Type:  Command:

*EXAMPLE USAGE: Super-easy method to say you like the band Coldplay: <#me> like:likes . Or providing a rating (between 0.0 and 5.0): <#me> like:opinion [ a like:Opinion ; like:regarding ; rev:rating 4.5 ] . Here, no rating is provided, but all PositiveOpinions have a rating of more than 3.0 by definition: <#me> like:opinion [ a like:PositiveOpinion ; like:regarding ] . This, however, means you like the Wikipedia article about Coldplay, but doesn't indicate whether or not you like the band: <#me> like:likes . This vocab provides a "like:likes\_topic\_of" term for linking to articles. It's a little ambiguous - the following could mean that I like the Wikipedia article about Coldplay, or that I like the band themselves - or perhaps both! <#me> like:likes\_topic\_of .*

Attributes	Values
<a href="#">type</a>	<a href="#">Ontology</a>
<a href="#">comment</a>	EXAMPLE USAGE: Super-easy method to say you like the band Coldplay: <#me> like:likes <http://dbpedia.org/resource/Coldplay> . Or providing a rating (between 0.0 and 5.0): <#me> like:opinion [ a like:Opinion ; like:regarding <http://dbpedia.org/resource/Coldplay> ; rev:rating 4.5 ] . Here, no rating is provided, but all PositiveOpinions have a rating of more than 3.0 by definition: <#me> like:opinion [ a like:PositiveOpinion ; like:regarding <http://dbpedia.org/resource/Coldplay> ] . This, however, means you like the Wikipedia article about Coldplay, but doesn't indicate whether or not you like the band: <#me> like:likes <http://en.wikipedia.org/wiki/Coldplay> . This vocab provides a "like:likes_topic_of" term for linking to articles. It's a little ambiguous - the following could mean that I like the Wikipedia article about Coldplay, or that I like the band themselves - or perhaps both! <#me> like:likes_topic_of <http://en.wikipedia.org/wiki/Coldplay> .
<a href="#">Maker</a>	<a href="#">Toby Inkster</a>
<a href="#">Date Modified</a>	2010-07-26(xsd:date) 2010-12-01(xsd:date) 2011-01-10(xsd:date)
<a href="#">Date Issued</a>	2009-05-26(xsd:date)
<a href="#">label</a>	Ultra-simple review vocab





# Ontology Problem Discovery

## ■ IFP example with FOAF

### *What is an Inverse Functional relation?*

An Inverse Functional relation enables the determination (inference) of subject equivalence by property value. For instance, let's start with the following urn: scheme URIs that denote me --

- `<urn:person:Kingsley>`
- `<urn:person:kidehen>`

Each of these denotations is associated with an email address, itself denoted by a maito: scheme URI, `<mailto:kidehen@openlinksw.com>`, using the Turtle based statements --

```
<urn:person:Kingsley>  
  <http://xmlns.com/foaf/0.1/mbox>  
    <mailto:kidehen@openlinksw.com>
```

```
<urn:person:kidehen>  
  <http://xmlns.com/foaf/0.1/mbox>  
    <mailto:kidehen@openlinksw.com>
```

I explicitly add the IFP designation --

```
<http://xmlns.com/foaf/0.1/mbox>  
  a  
    <http://www.w3.org/2002/07/owl#InverseFunctionalProperty>
```





# Ontology Problem Resolution

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## ■ Local tweaks

*Update Local FOAF Graph with missing IFP claim*

```
## update starts
INSERT
INTO GRAPH <http://xmlns.com/foaf/0.1/>
{
  <http://xmlns.com/foaf/0.1/mbox>
    a
      owl:InverseFunctionalProperty
}
## update ends
```

# Additional Information

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## ■ OpenLink Software:

- [OpenLink Software](#)
- [OpenLink Virtuoso](#)
- [Universal Data Access Drivers](#)

## ■ Social Media Data spaces

- <http://www.openlinksw.com/blog/~kidehen/> (weblog)
- <https://plus.google.com/112399767740508618350/about> (Google+)
- <https://twitter.com/kidehen> (Twitter)
- Hashtag: #LinkedData (Anywhere) .