Rutherford Appleton Laboratory

Semantic Web Best Practices and Deployment

SKOS Core Tutorial
DC-2005 Madrid

Alistair Miles
CCLRC Rutherford Appleton Laboratory

Intro

- SKOS
  - http://www.w3.org/2004/02/skos/
  - Simple Knowledge Organisation System(s)
- SKOS Core
  - http://www.w3.org/2004/02/skos/core/
  - Goal: Simple, flexible, extensible, machine-understandable representation for…
    - Thesauri
    - Classification Schemes
    - Taxonomies
    - Subject Headings
    - Other types of 'controlled vocabulary'…

Overview

- Development and status
- SKOS Features
- Extending SKOS Core

- Other topics:
  - SKOS Core and DCMI metadata terms
  - SKOS Core and OWL
  - HTTP

Development

- SKOS Core is maintained by W3C SWBPD-WG
- Public, consensus-driven, design by open community
- All discussion in public, via
  public-esw-thes@w3.org
- Review proposals for change every 2-3 months
  http://www.w3.org/2004/02/skos/core/proposals
- Publish revised working drafts
  http://www.w3.org/TR/swbp-skos-core-guide
  http://www.w3.org/TR/swbp-skos-core-spec

CCLRC

Status

- Completed second review
- Plan 3rd review November 2005
- Change management policy
  http://www.w3.org/TR/swbp-skos-core-spec/#secChange
- *unstable*, *testing*, *stable*
- Most at *testing*, some at *unstable*
- Feedback on all aspects of work presented here welcome!
  public-esw-thes@w3.org
- Translations most welcome!
  http://www.w3.org/2004/02/skos/core/translations

Basics

- SKOS Core is an application of the *Resource Description Framework*
  - *RDFS Classes* and *RDF Properties*

- ...This tutorial will be demonstrating how to use the classes and properties of the SKOS Core Vocabulary to express the basic structure and content of a concept scheme as an RDF graph

Concept Schemes

- 'Concept scheme' is a blanket term for…
  - Thesauri
  - Classification Schemes
  - Taxonomies
  - Subject Headings
  - Terminologies
  - Other types of controlled vocabularies…
- Defined as…
  - *'A set of concepts, optionally including statements about semantic relationships between those concepts.'*

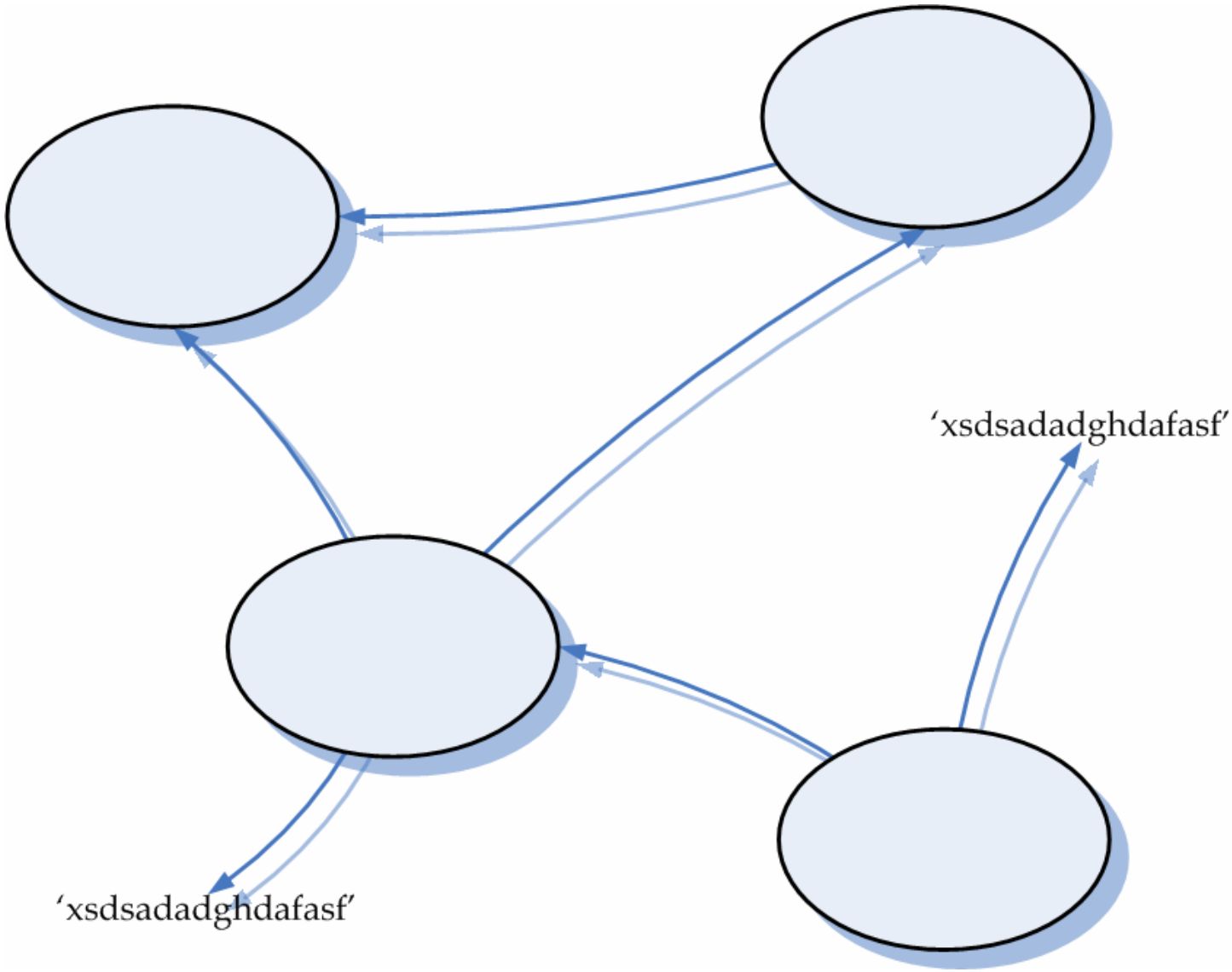
RDF

- Why choose RDF as the basis for a standard?

Most compelling reasons…

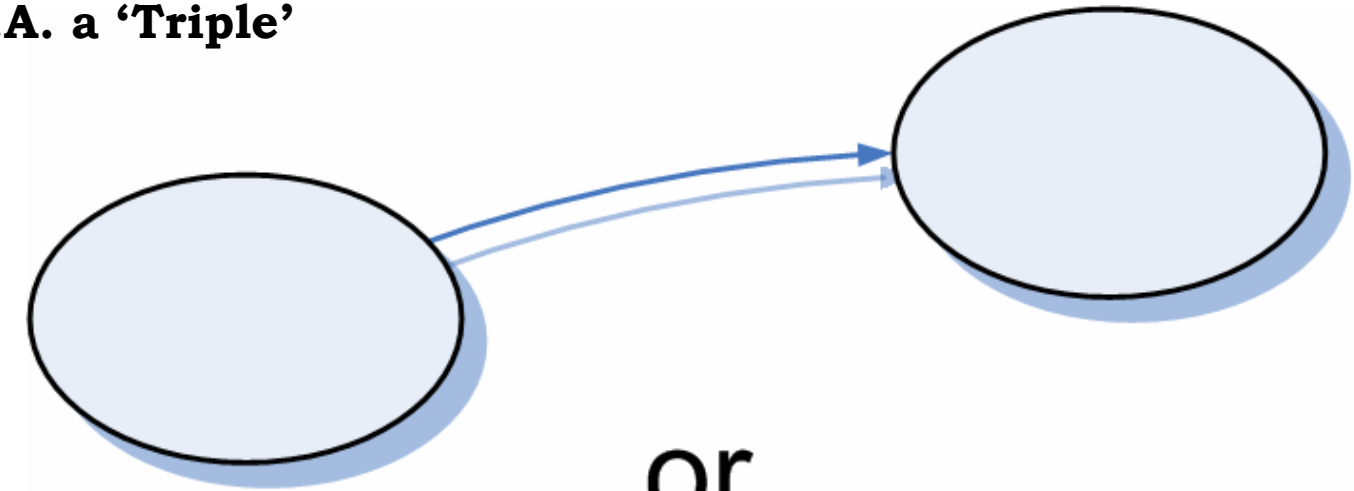
1. Ease of combination with other meta-information standards
   - (KOS data is re-used in a great variety of contexts, in combination with DCMI terms and many others)
2. Flexibility and ease of extension, to cope with variations in structure and style
   - Variations between KOS types (e.g. 'thesaurus' vs. 'classification scheme') and within KOS types (compare e.g. the AAT or GEMET with ISO2788)

Quick RDF: a 'Graph'

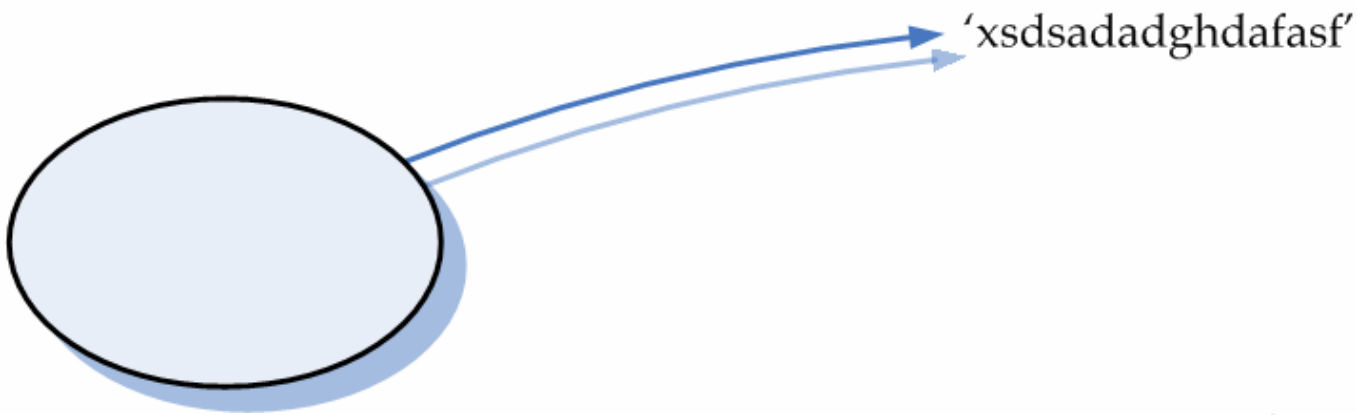


Quick RDF: a ‘Statement’

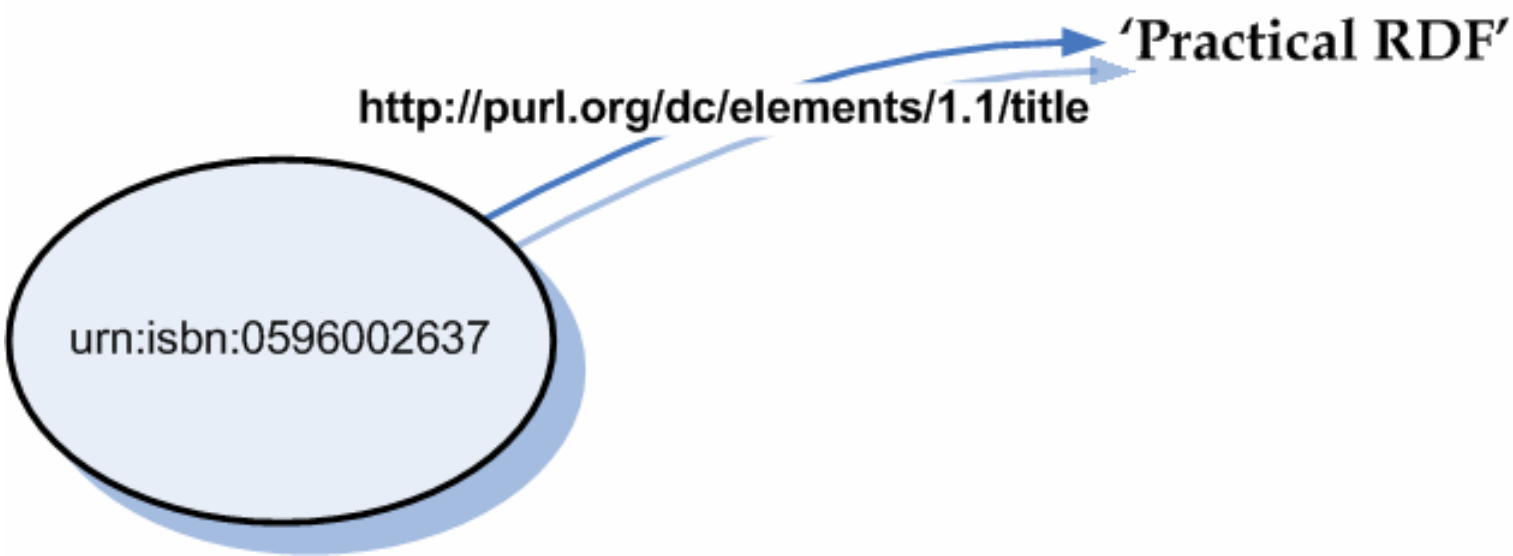
A.K.A. a ‘Triple’



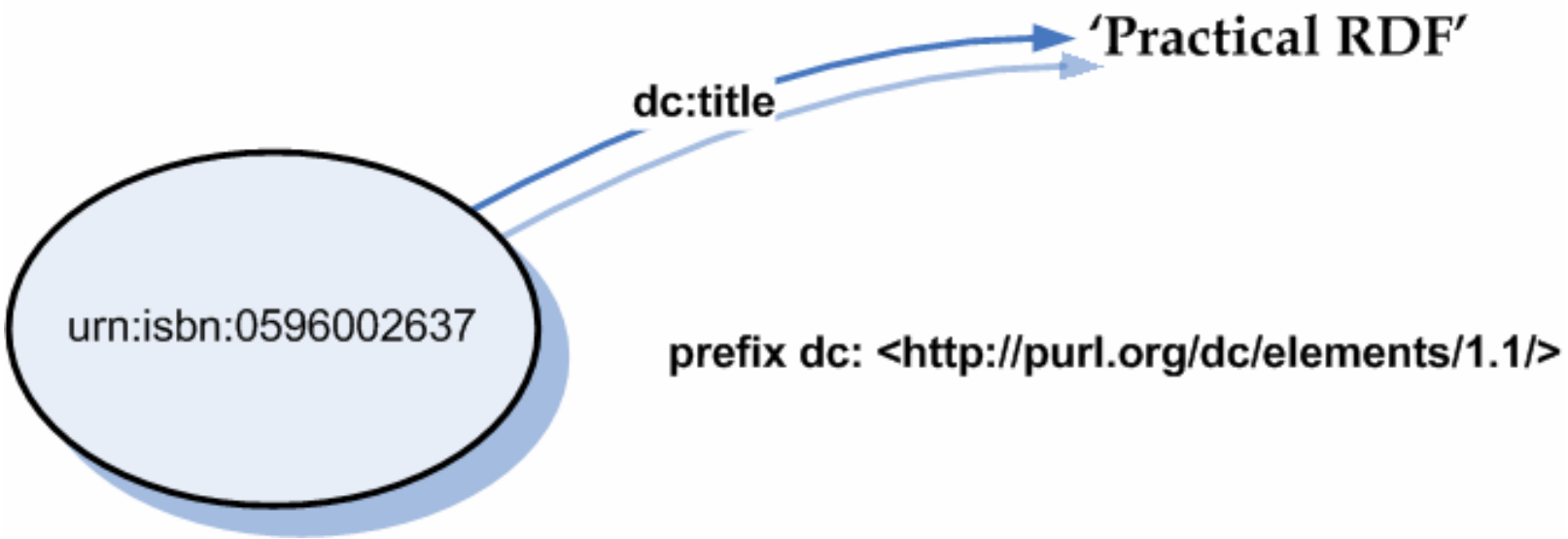
or...



Quick RDF: URIs for Naming

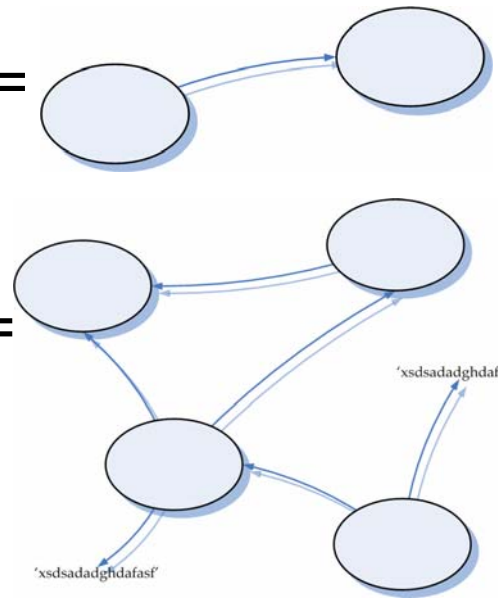


Quick RDF: QNames

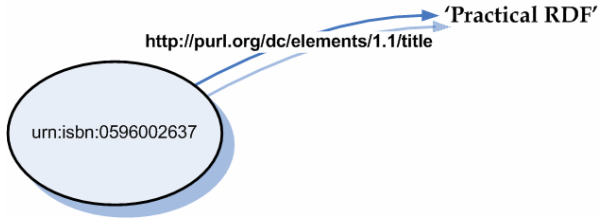


Quick RDF: Lingo

- *Resource* = thing
- *Literal* = string of characters (?lang, ?datatype)
- *Statement* = *Triple* = (s, p, o) =
- *Property* = (…, **p**, …)
- *Graph* = a set of *Statements* =
- *RDF Description* (of some thing) = a set of *Statements* (about that thing)



Quick RDF: Serialisation



N-Triples

```
<urn:isbn:0596002637> <http://purl.org/dc/elements/1.1/> 'Practical RDF'.
```

Turtle

```
@prefix dc: <http://purl.org/dc/elements/1.1> .
<urn:isbn:0596002637> dc:title 'Practical RDF' .
```

RDF/XML

```
<rdf:RDF
  xmlns:rdf='http://www.w3.org/1999/02/22-rdf-syntax-ns# '
  xmlns:dc='http://purl.org/dc/elements/1.1/'>

  <rdf:Description rdf:about='urn:isbn:0596002637'>
    <dc:title>Practical RDF</dc:title>
  </rdf:Description>

</rdf:RDF>
```

XHTML 2.0

```
<head xmlns:dc='http://purl.org/dc/elements/1.1/'>

  <meta about='urn:isbn:0596002637' property='dc:title'>Practical RDF</meta>

</head>
```

http://www.w3.org/2004/02/skos/core/

Aah...

Story So Far (1)...

- Goal
  - To express the content and structure of concept schemes in a machine-understandable way
- Development
  - Open, collaborative, consensus-driven
- Status
  - May evolve within defined change management policy
- Technology
  - Resource Description Framework (RDF)
- RDF
  - Graphs, statements (triples), resources, properties, literals...

Features...

Controlled Vocabulary

Love

> Strong feelings of attraction towards, and affection for, another adult, or great affection for a friend or family member.

Awe

> A feeling of great respect sometimes mixed with fear or surprise.

Joy

> A feeling of bliss and great happiness.

Process

1. Identify
2. Describe
3. Publish

CCLRC

Identify

- Step 1: Identify concepts…

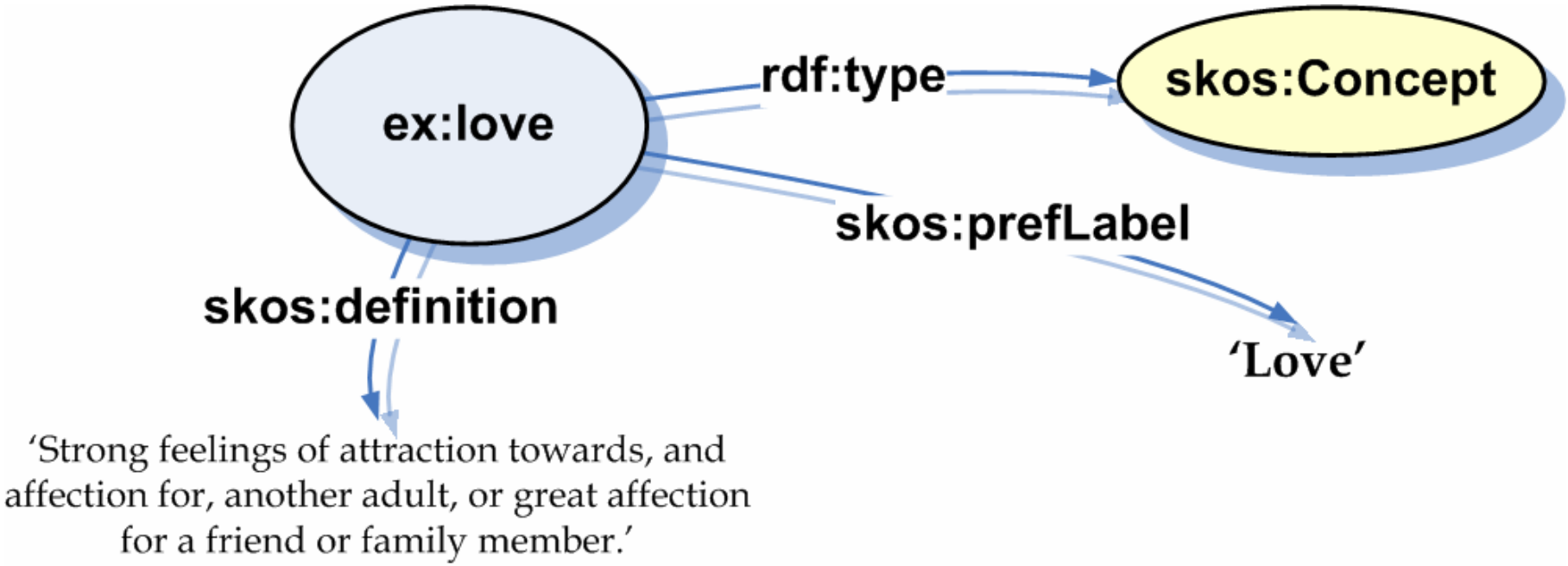
  http://www.example.com/concepts#love
  http://www.example.com/concepts#awe
  http://www.example.com/concepts#joy

- N.B. Could just as well be

  http://foo.bar.org/1234/5678
  urn:
  info:

Describe

- Step 2: Describe…




```
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix ex: <http://www.example.com/concepts#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
```

Publish

- Step 3: Publish…
  - One way is to:
    - Create an RDF/XML serialisation (concepts.rdf)
    - Put this file on an HTTP server (http://www.example.com/concepts)
  - Another way is to:
    - Load statements into a dedicated RDF server (Joseki, Sesame, Kowari …)

Concepts

- N.B. SKOS Core is oriented towards the identification and description of concepts.

Thesaurus (USE/UF)

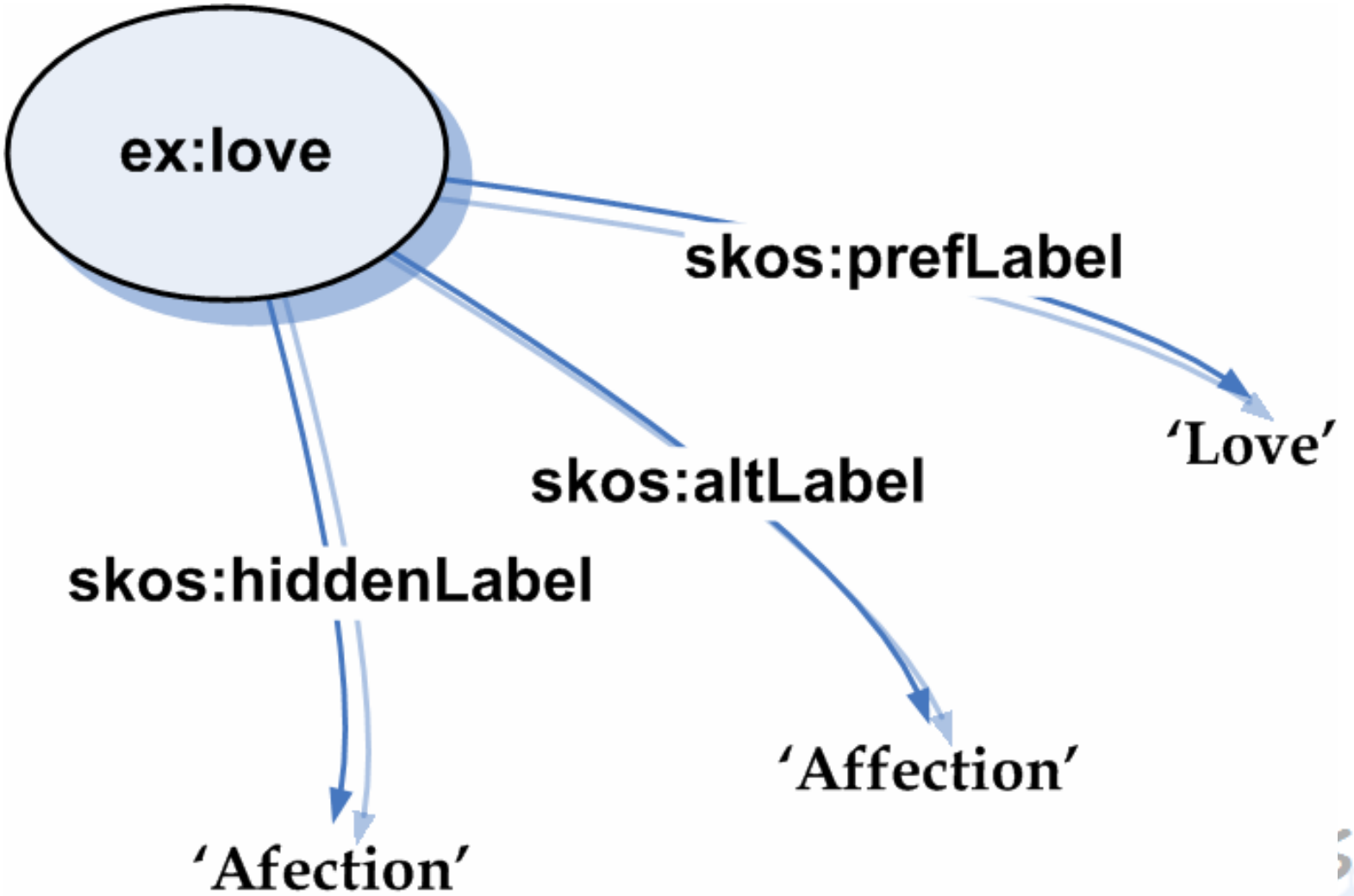
Love

UF Affection

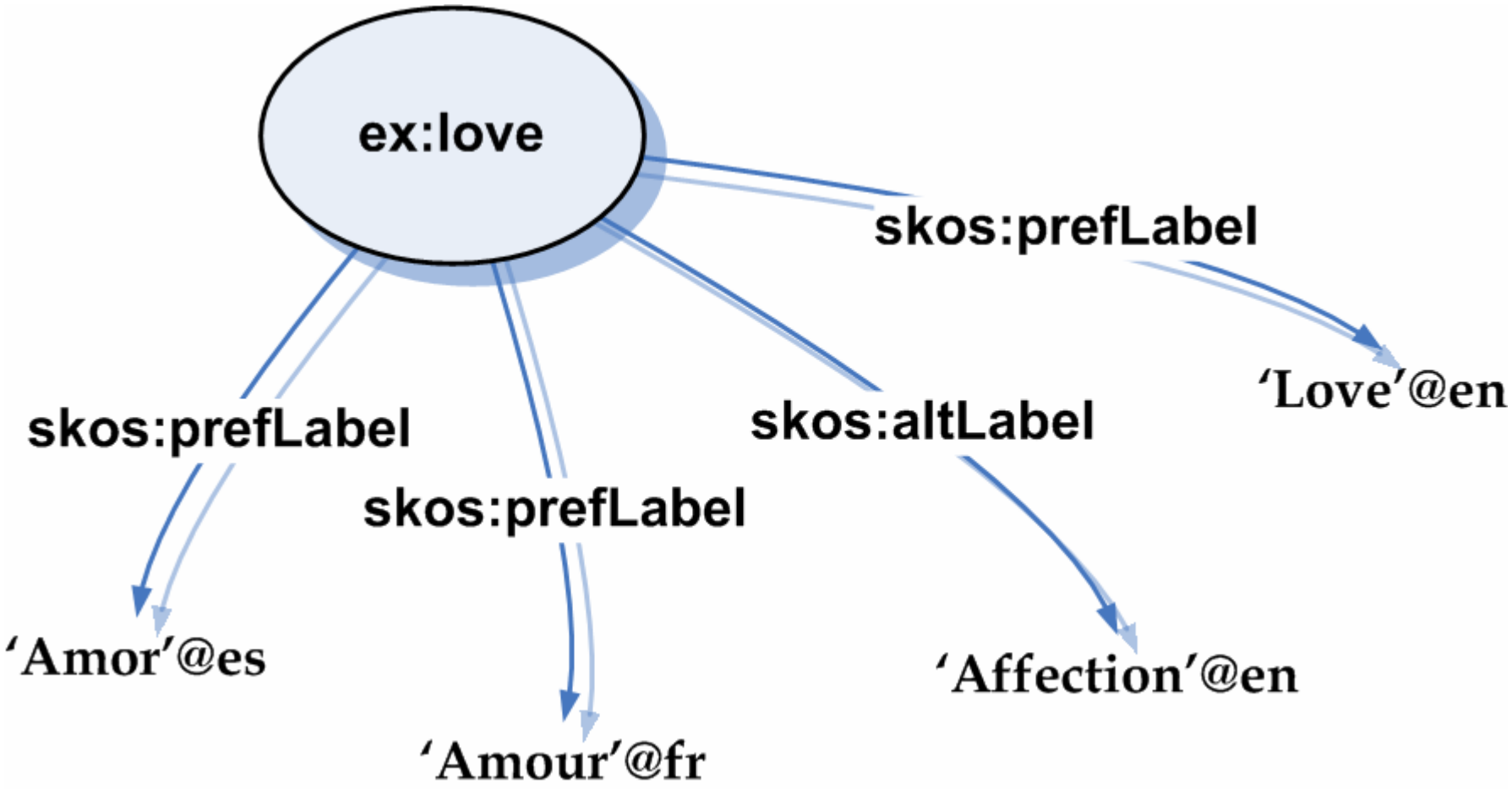
Affection

USE Love

Lexical Labels

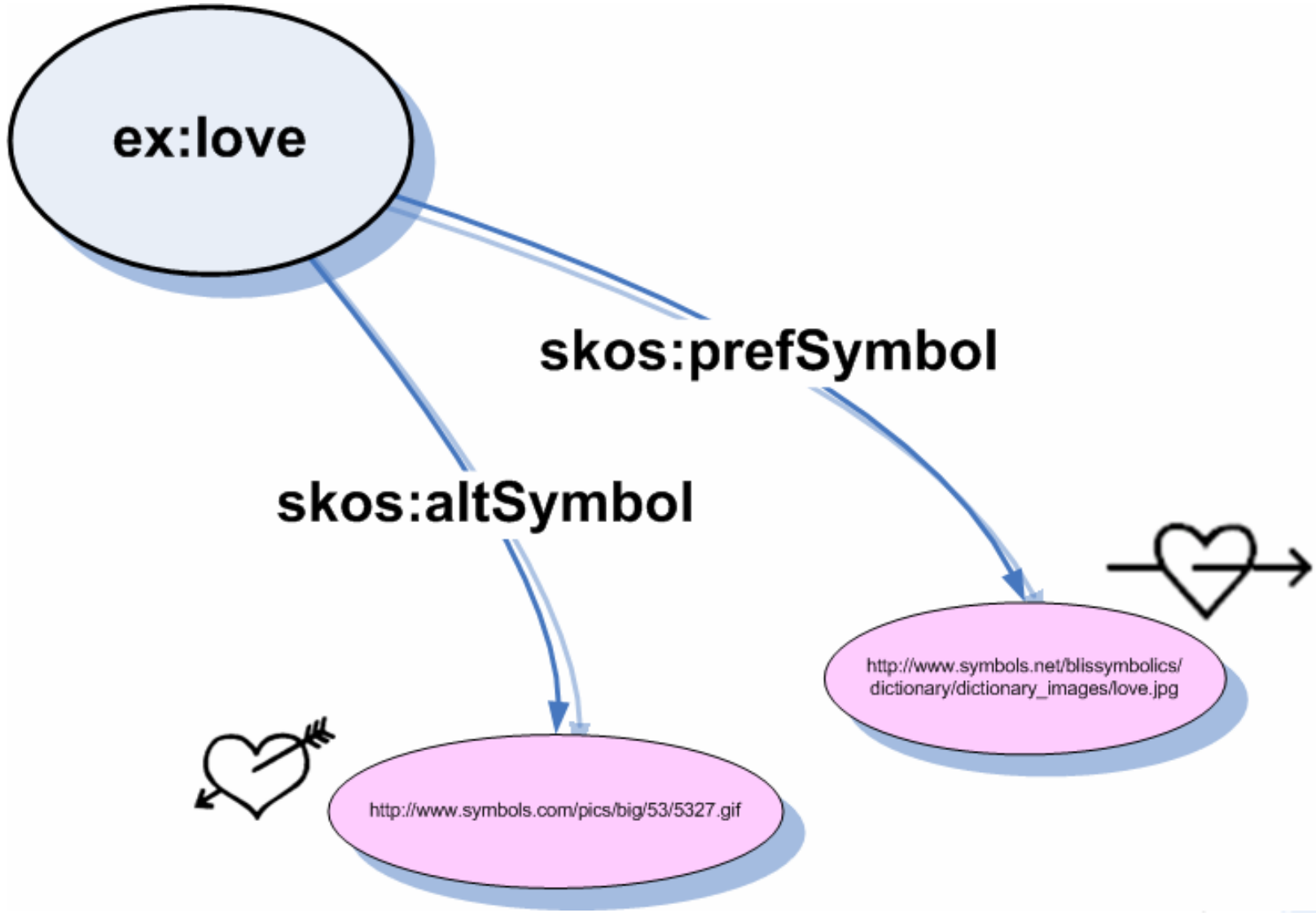


Multilingual Labels



N.B. No more than one **skos:prefLabel** per language

Symbolic Labels



Thesaurus (BT/NT)

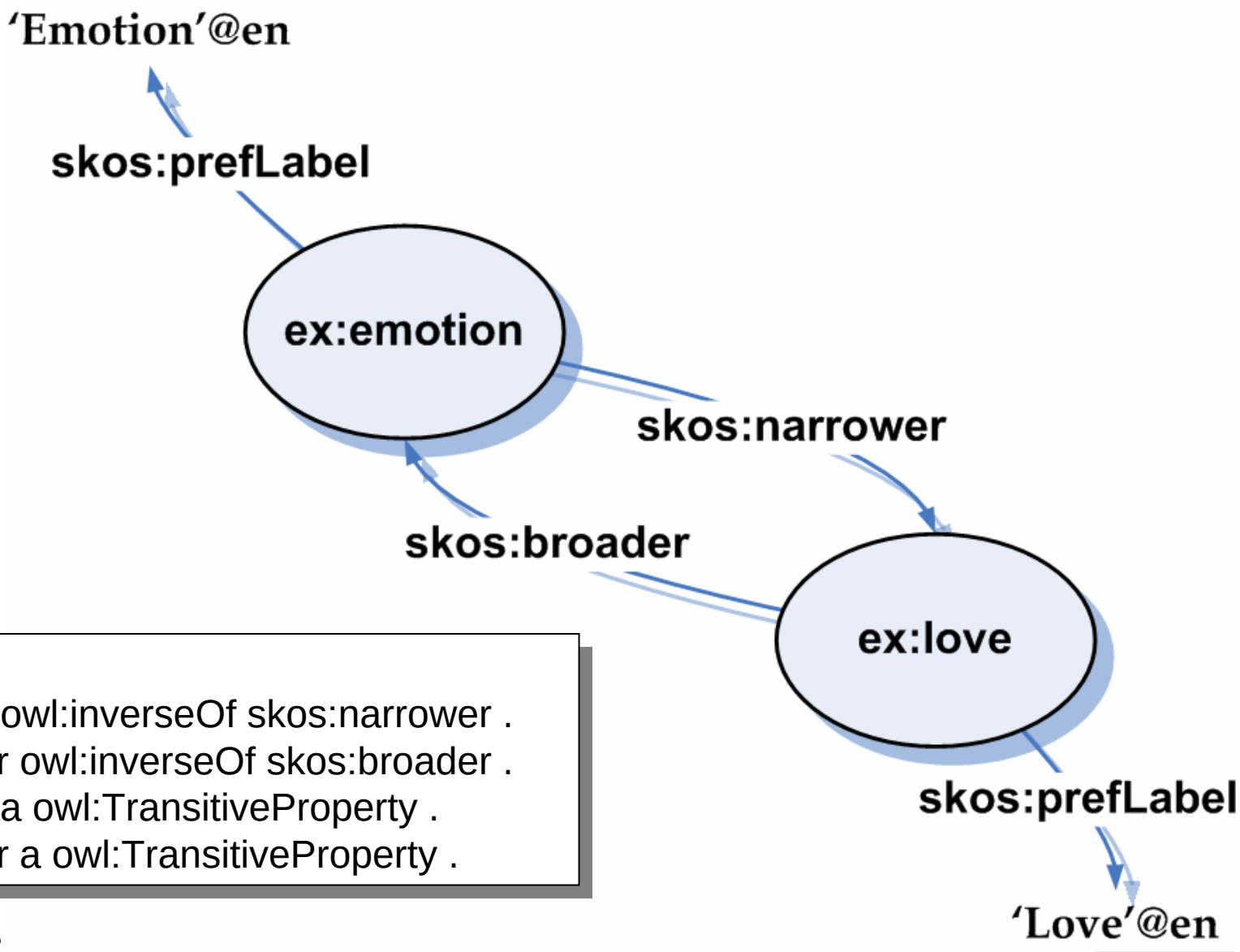
Love

- BT Emotion

Emotion

- NT Love
- NT Awe
- NT Joy

Broader/Narrower



N.B.
skos:broader owl:inverseOf skos:narrower .
skos:narrower owl:inverseOf skos:broader .
skos:broader a owl:TransitiveProperty .
skos:narrower a owl:TransitiveProperty .

Thesaurus (RT)

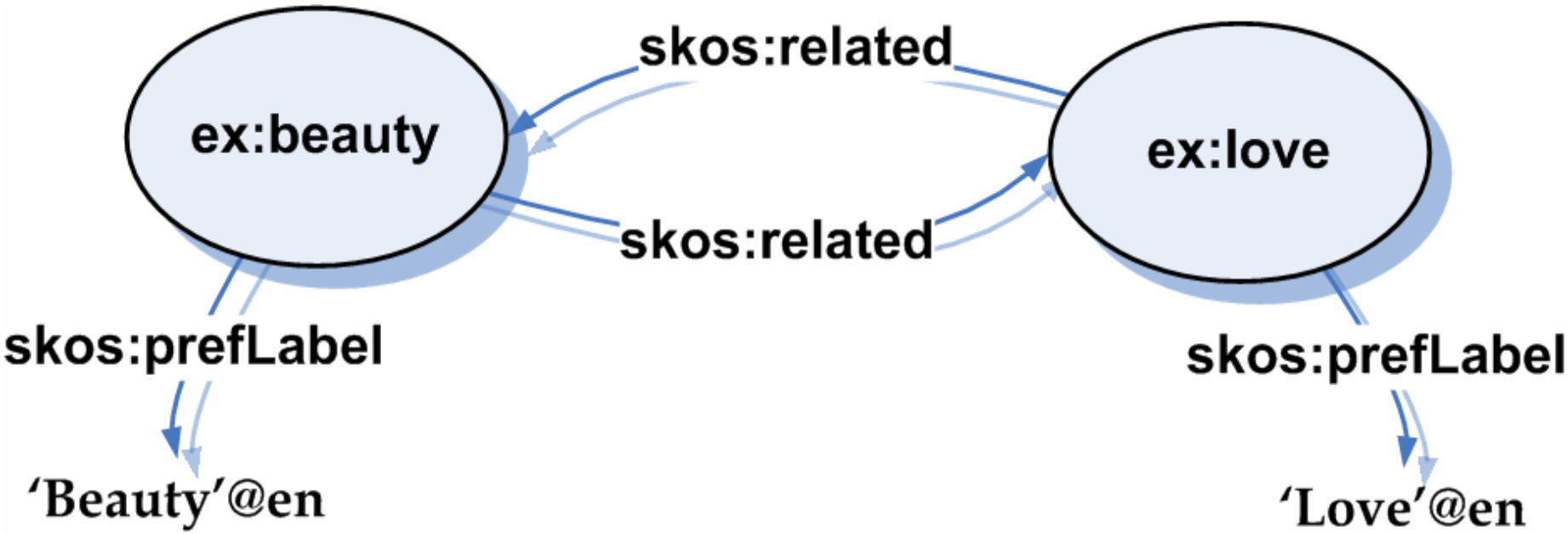
Love

RT Beauty

Beauty

RT Love

Related



N.B.
skos:related a owl:SymmetricProperty .

http://www.w3.org/2004/02/skos/core/

Aah...

Story So Far (2)...

- Basic Structure
  - skos:Concept
- Lexical Labelling
  - skos:prefLabel, skos:altLabel, skos:hiddenLabel
- Symbolic Labelling
  - skos:prefSymbol, skos:altSymbol
- Documentation
  - skos:definition
- Semantic Relations
  - skos:broader, skos:narrower, skos:related

Features...

CCLRC

Documentation Properties

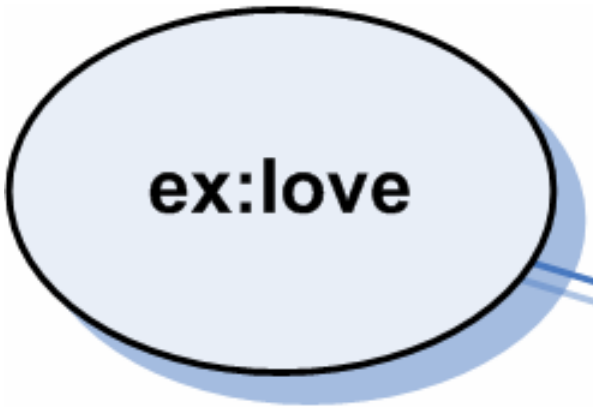
- skos:note
  - e.g. 'Anything goes.'
- skos:definition
  - e.g. 'A long curved fruit with a yellow skin and soft, sweet white flesh inside.'
- skos:example
  - e.g. 'A bunch of bananas.'
- skos:scopeNote
  - e.g. 'Historically members of a sheriff's retinue armed with pikes who escorted judges at assizes.'
- skos:historyNote
  - e.g. 'Deleted 1986. See now Detention, Institutionalization (Persons), or Hospitalization.'
- skos:editorialNote
  - e.g. 'Confer with Mr. X. re deletion.'
- skos:changeNote
  - e.g. 'Promoted "love" to preferred label, demoted "affection" to alternative label, Joe Bloggs, 2005-08-09.'

Documentation as...

Allowed patterns:

1. Documentation as an **RDF Literal**
2. Documentation as a **Related Resource Description**
3. Documentation as a **Document Reference**

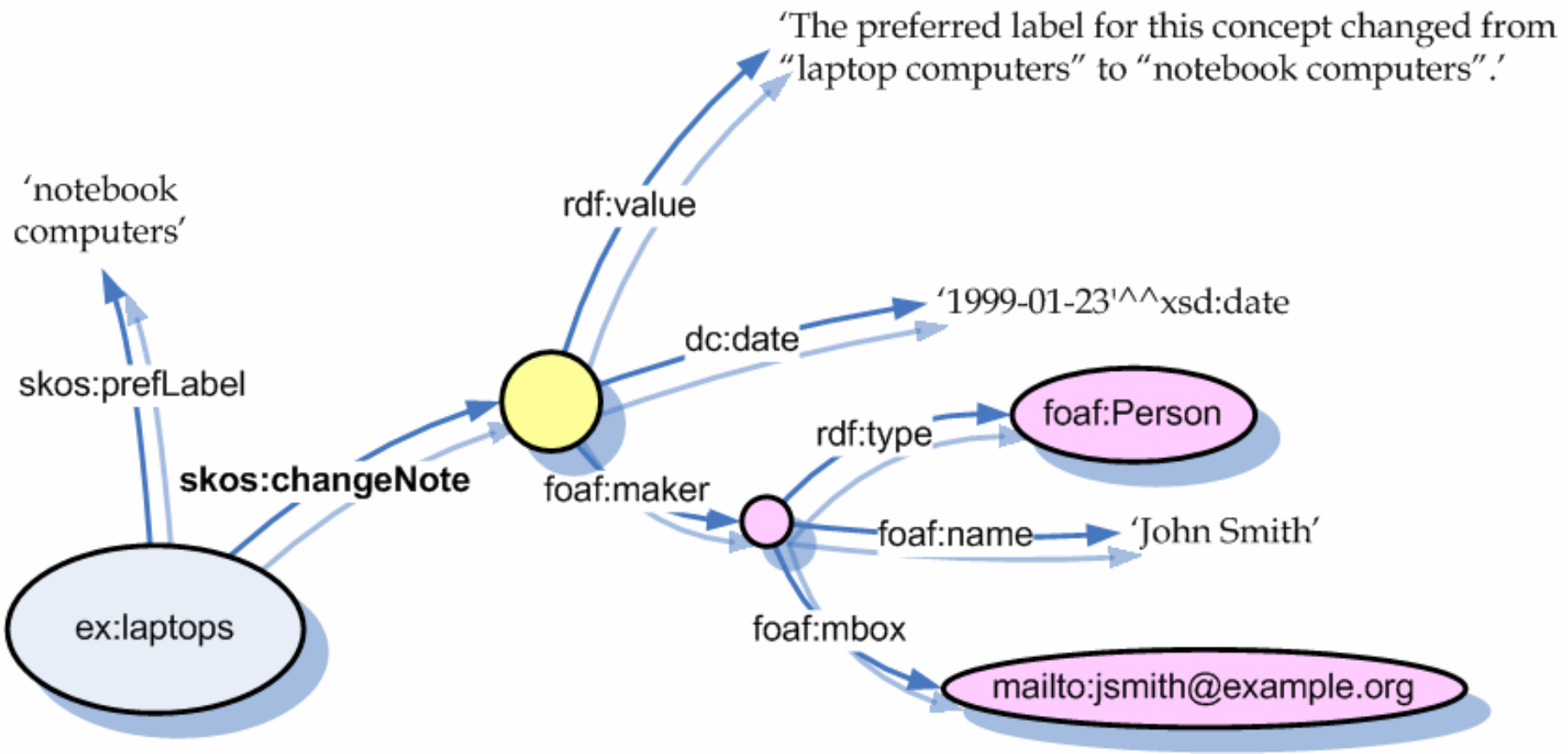
...RDF Literal



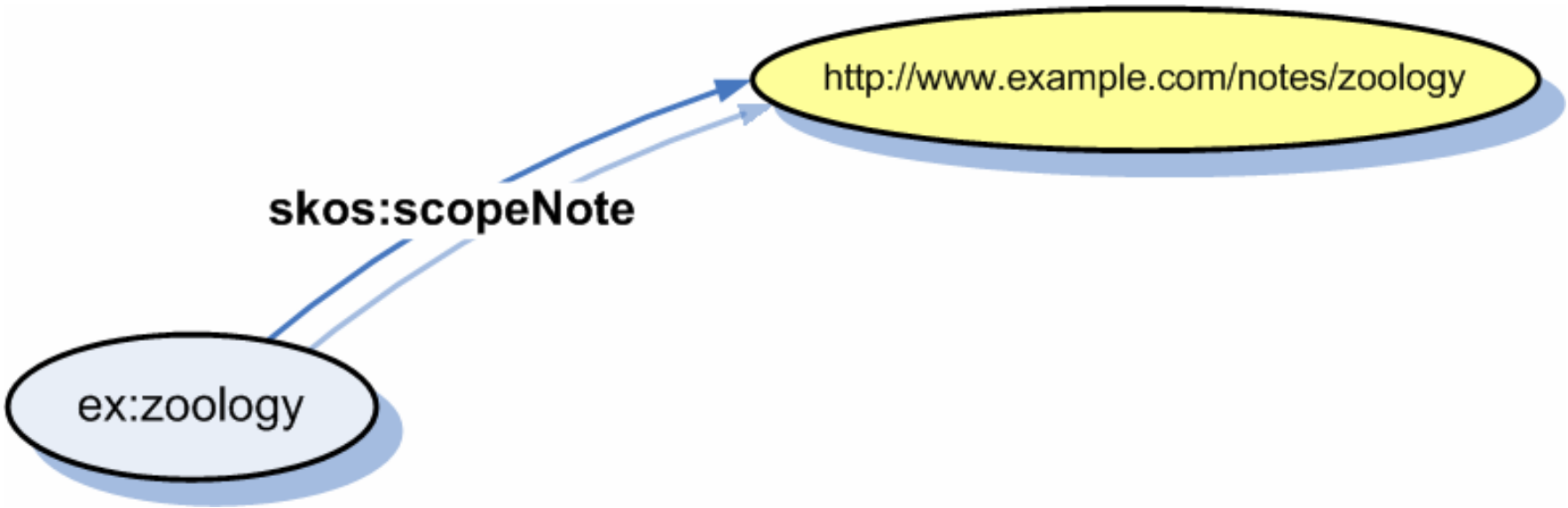
skos:definition

'Strong feelings of attraction towards, and affection for, another adult, or great affection for a friend or family member.'

...Related Resource Description



...Document Reference



Documentation as...

Allowed patterns:

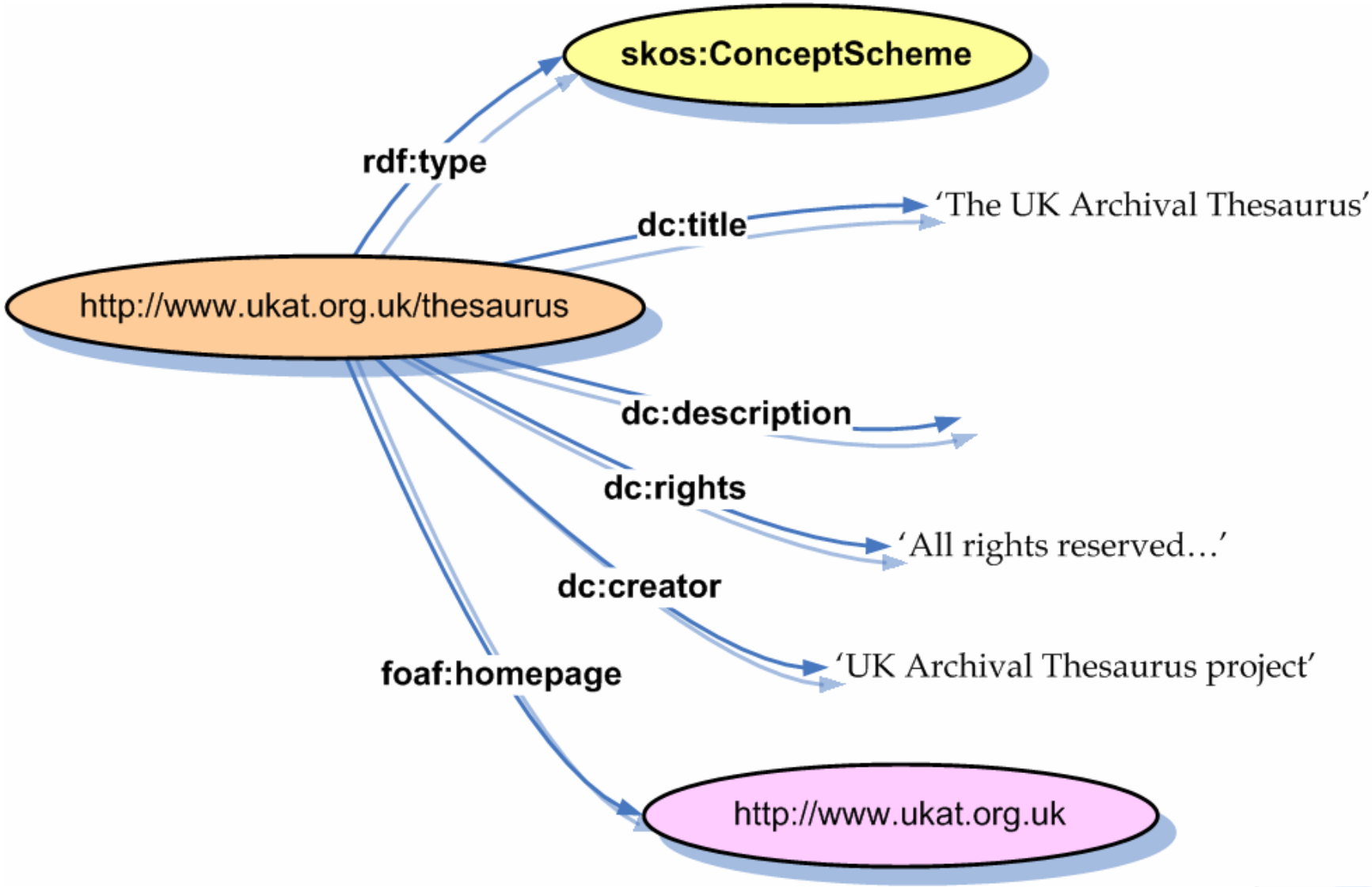
1. Documentation as an **RDF Literal**
2. Documentation as a **Related Resource Description**
3. Documentation as a **Document Reference**

... N.B. this takes SKOS Core outside OWL DL ...

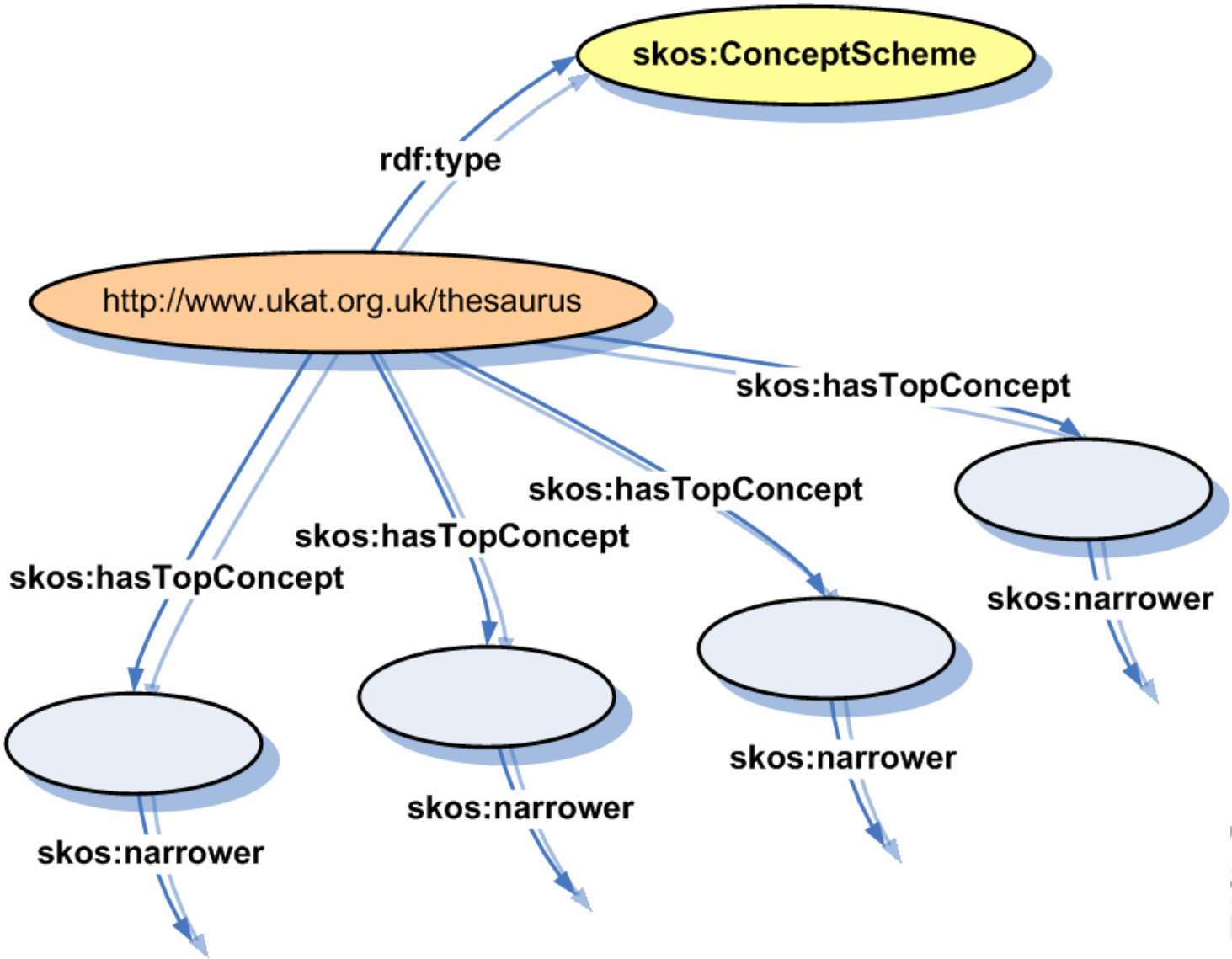
Concept Schemes

- Organise a set of concepts into a **concept scheme**

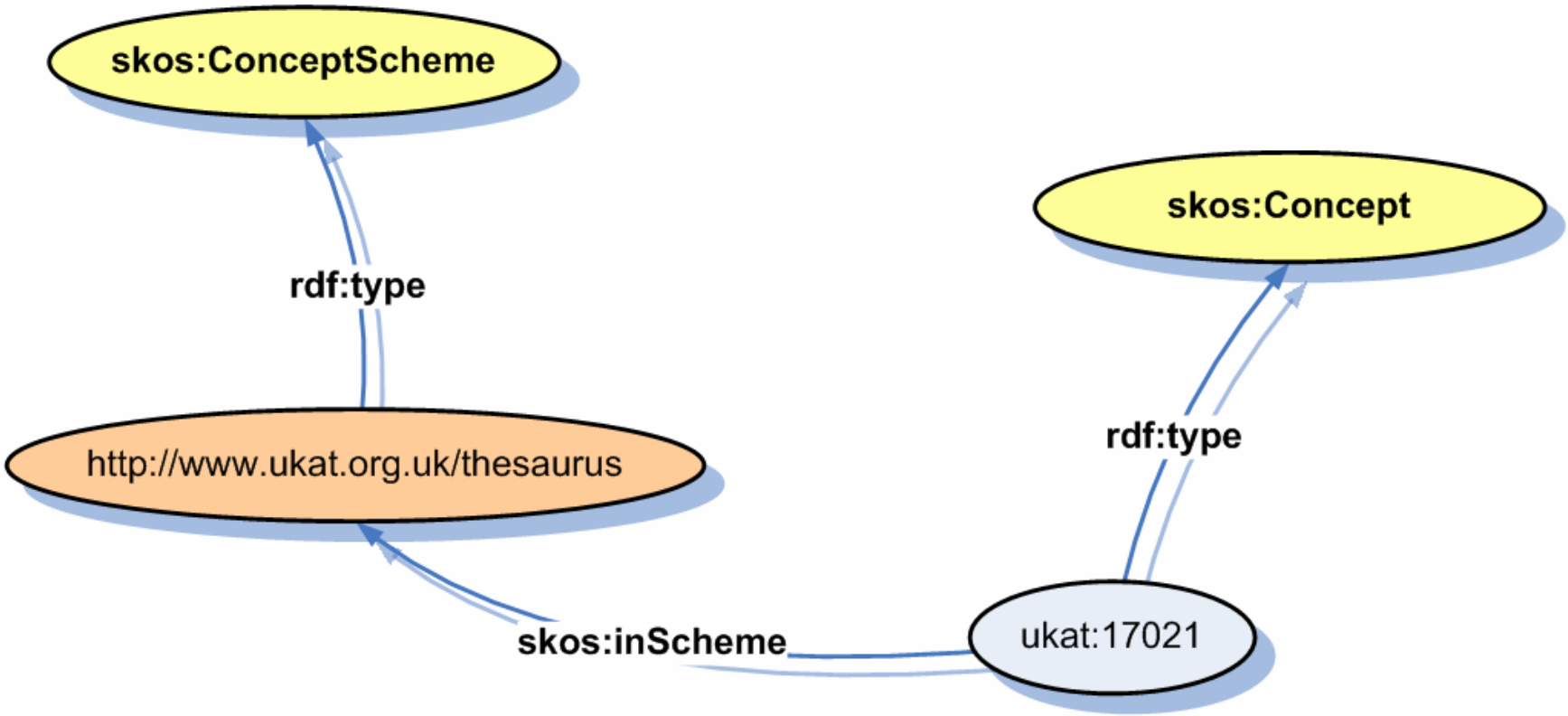
Concept Scheme



Top Concepts



Concepts in Scheme



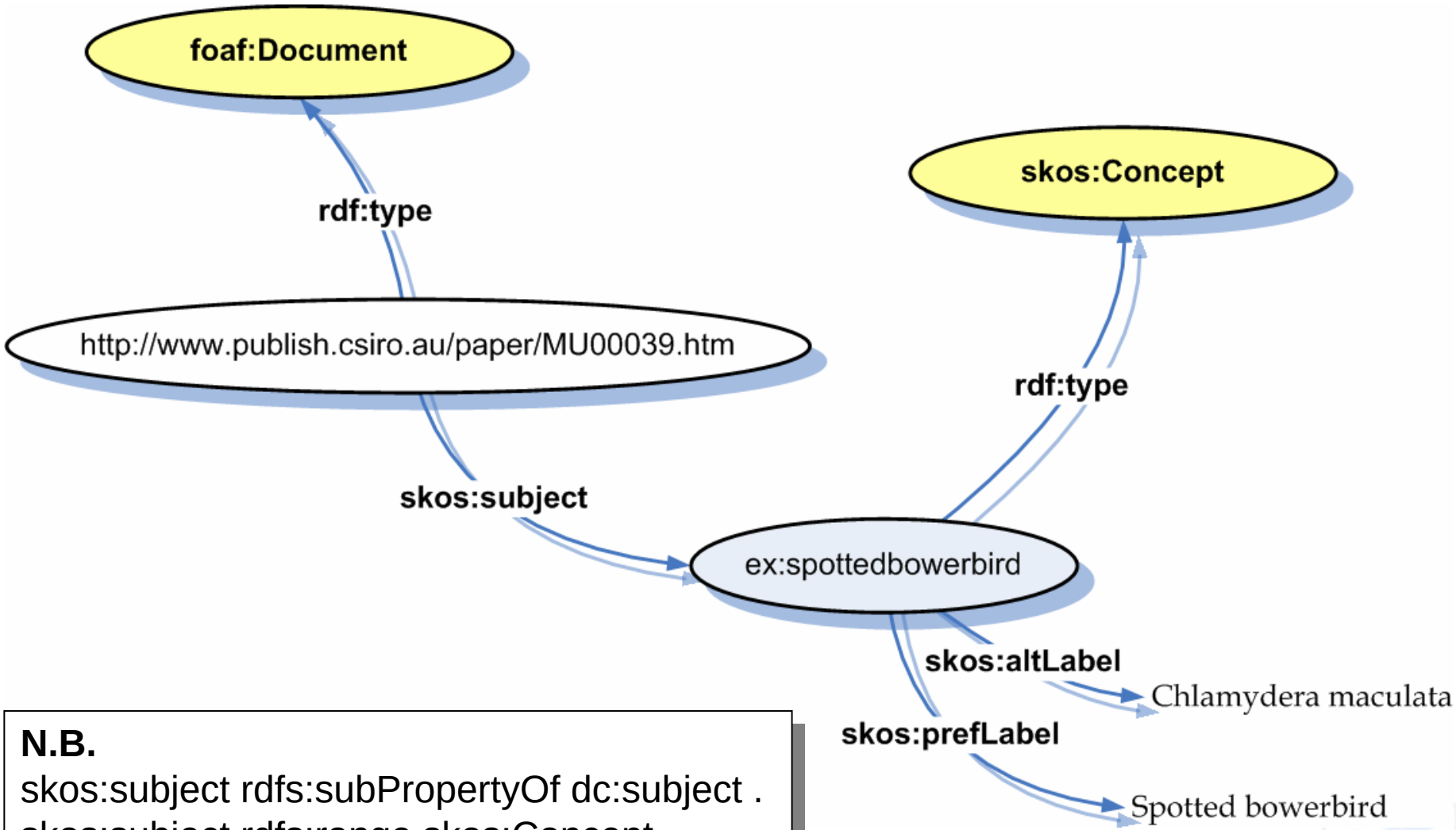

```
@prefix ukat: <http://www.ukat.org.uk/thesaurus/concept/> .
```

Subject Indexing

- Simple functionality based on dc:subject

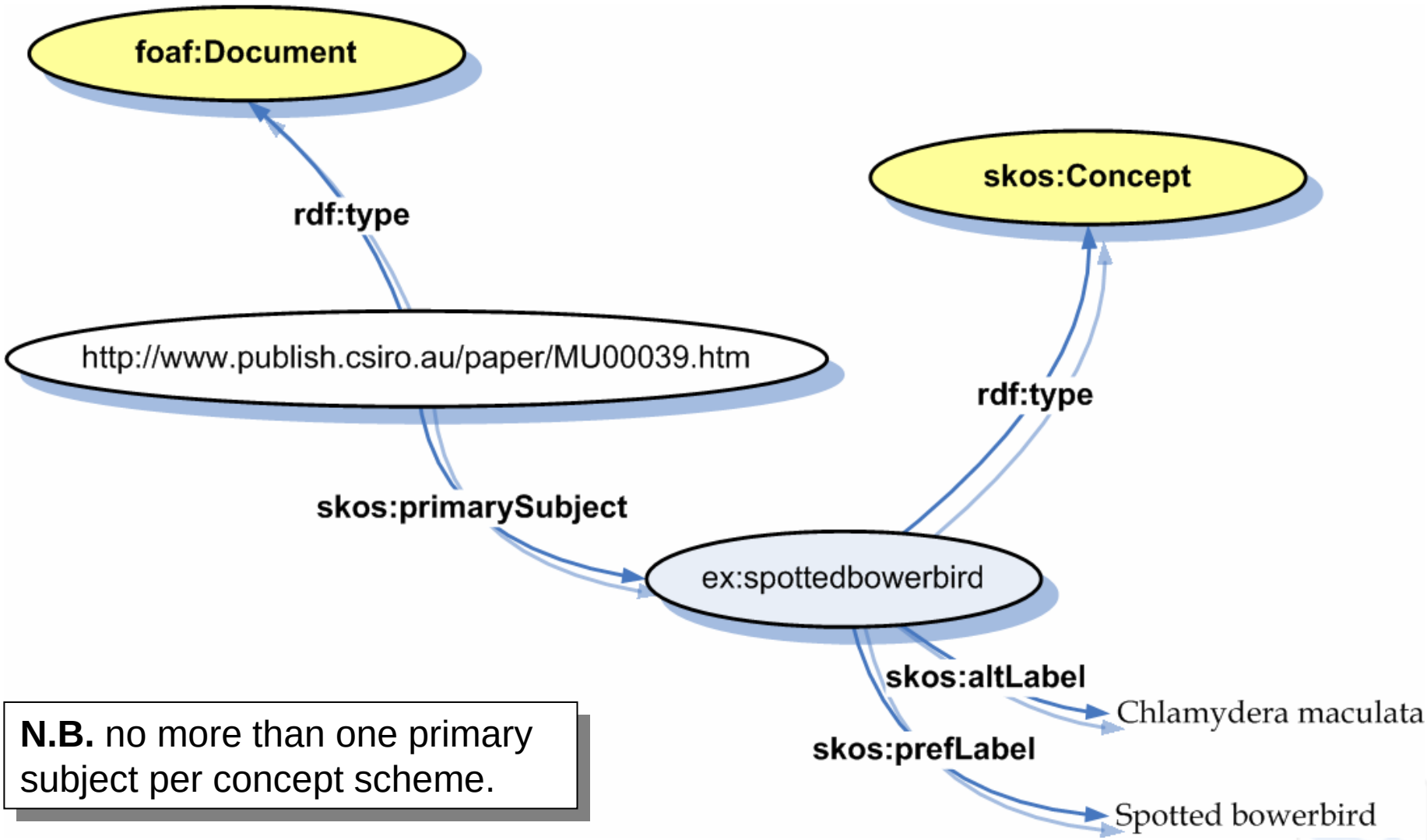
Spotted Bowerbird

Subject



N.B.
skos:subject rdfs:subPropertyOf dc:subject .
skos:subject rdfs:range skos:Concept .

Primary Subject



N.B. no more than one primary subject per concept scheme.

Subject Inverses

- skos:isSubjectOf
  - inverse of skos:subject
- skos:isPrimarySubjectOf
  - inverse of skos:primarySubject

Subject Generality

- Subject generality rule:

```
{
  ?d skos:subject ?x .
  ?x skos:broader ?y .
}
=>
{
  ?d skos:subject ?y .
}
```

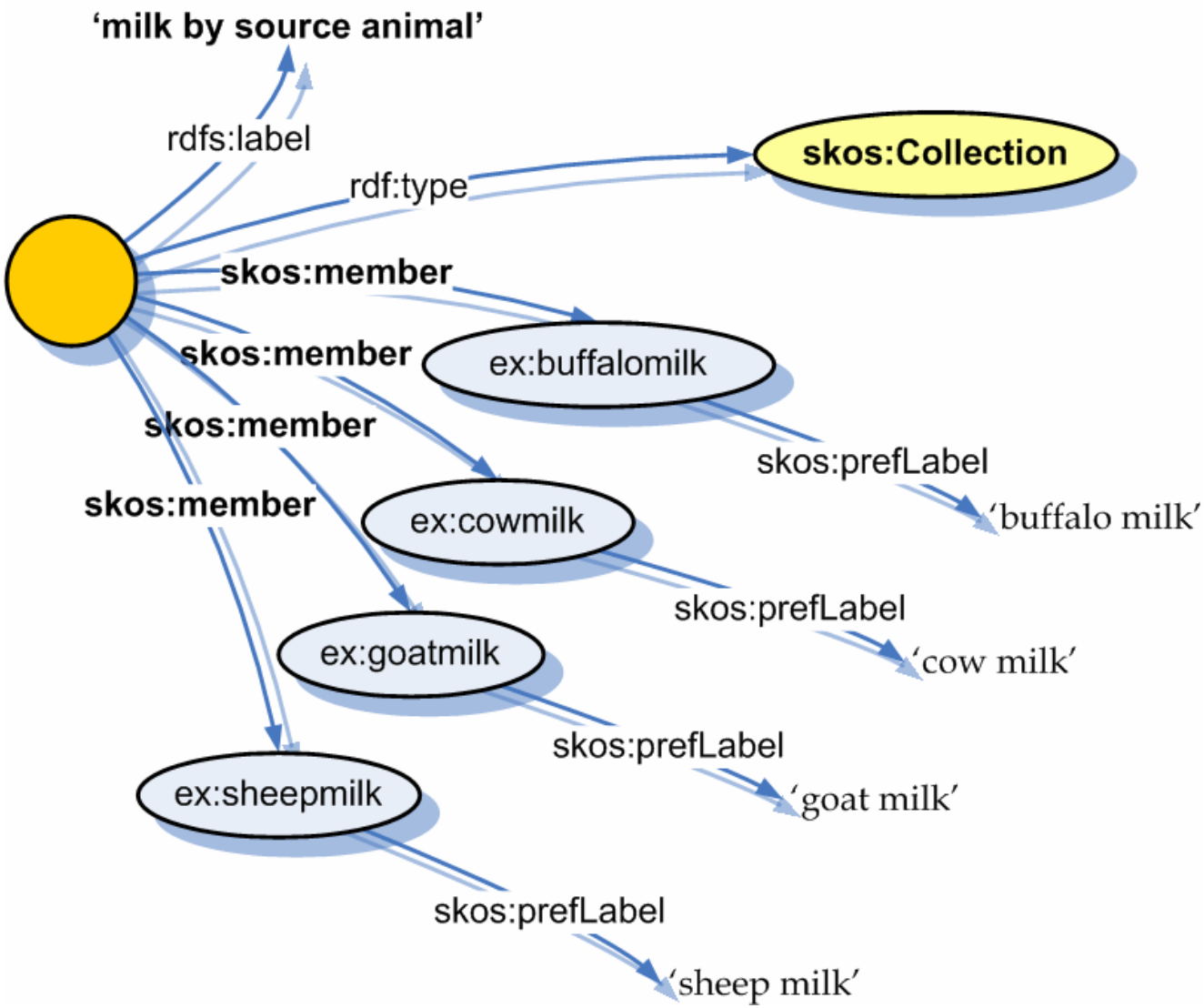
I.e. if a document is about ‘bowerbirds’ and ‘birds’ is broader than ‘bowerbirds’, then the document is about ‘birds’ too.

Use to implement simple query expansion.

Node Labels

<milk by source animal>
- buffalo milk
- cow milk
- goat milk
- sheep milk

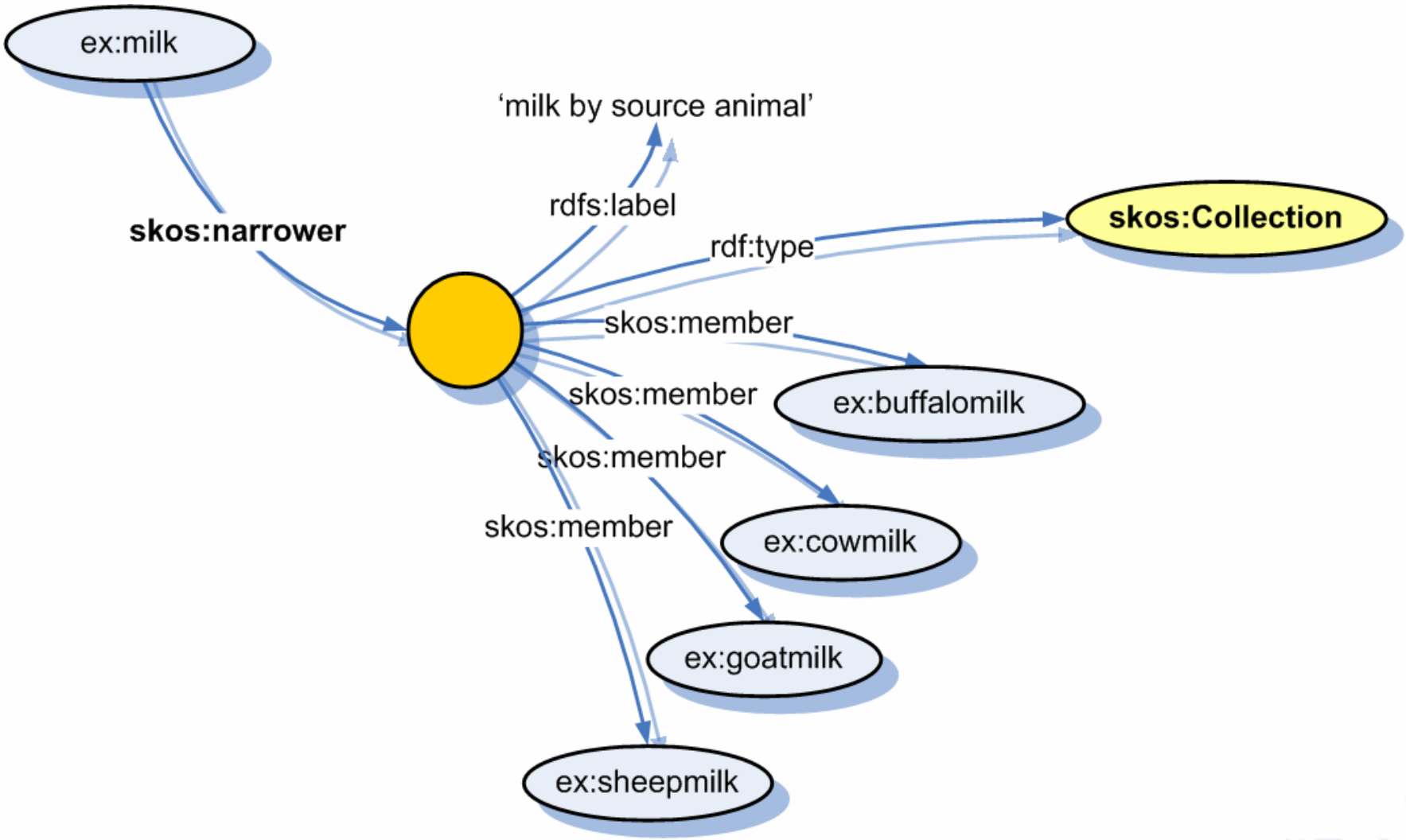
Meaningful Collections



Node Labels in Hierarchy

milk
- <milk by source animal>
  - buffalo milk
  - cow milk
  - goat milk
  - sheep milk

Collectable Properties



Nested Node Labels

chairs
- <chairs by form>
  - armchairs
  - easy chairs
  - <chairs by form: back form>
    - heart-back chairs
    - oval-back chairs

N.B.
A member of a collection may be a concept or another collection.

More on Collections...

- See SKOS Core Guide for...
  - Meaningfully ordered collections
  - Nested ordered/unordered collections
  - Rules for collections
  - Rules for collectable properties

Aah...

Story So Far (3)...

- Documentation Properties
  - skos:note, skos:definition, skos:example, skos:scopeNote, skos:historyNote, skos:editorialNote, skos:changeNote
- Documentation Patterns
  - ...as RDF Literal, as Related Resource Description, as Document Reference
- Concept Schemes
  - skos:ConceptScheme, skos:hasTopConcept, skos:inScheme
- Subject Indexing
  - skos:subject, skos:isSubjectOf, skos:primarySubject, skos:isPrimarySubjectOf
- Node Labels and Guide Terms
  - skos:Collection, skos:OrderedCollection, skos:member, skos:memberList

HTTP Publishing

- You may use any type of HTTP URI as an identifier for a concept …
  - '#' is OK, e.g. http://www.example.com/concepts#love
  - '/' is OK, e.g. http://www.example.com/concepts/love

- (N.B. httpRange-14 is resolved)
  - http://lists.w3.org/Archives/Public/www-tag/2005Jun/0039

HTTP Publishing

- HTTP Behaviour for '#'
  - N.B. you can't actually GET http://www.example.com/concepts#love
  - Current practice in semantic web community: http://www.example.com/concepts should respond to GET with …
    - Response code 200 (success)
    - Content-type: application/rdf+xml
    - A message that describes all concepts in the namespace

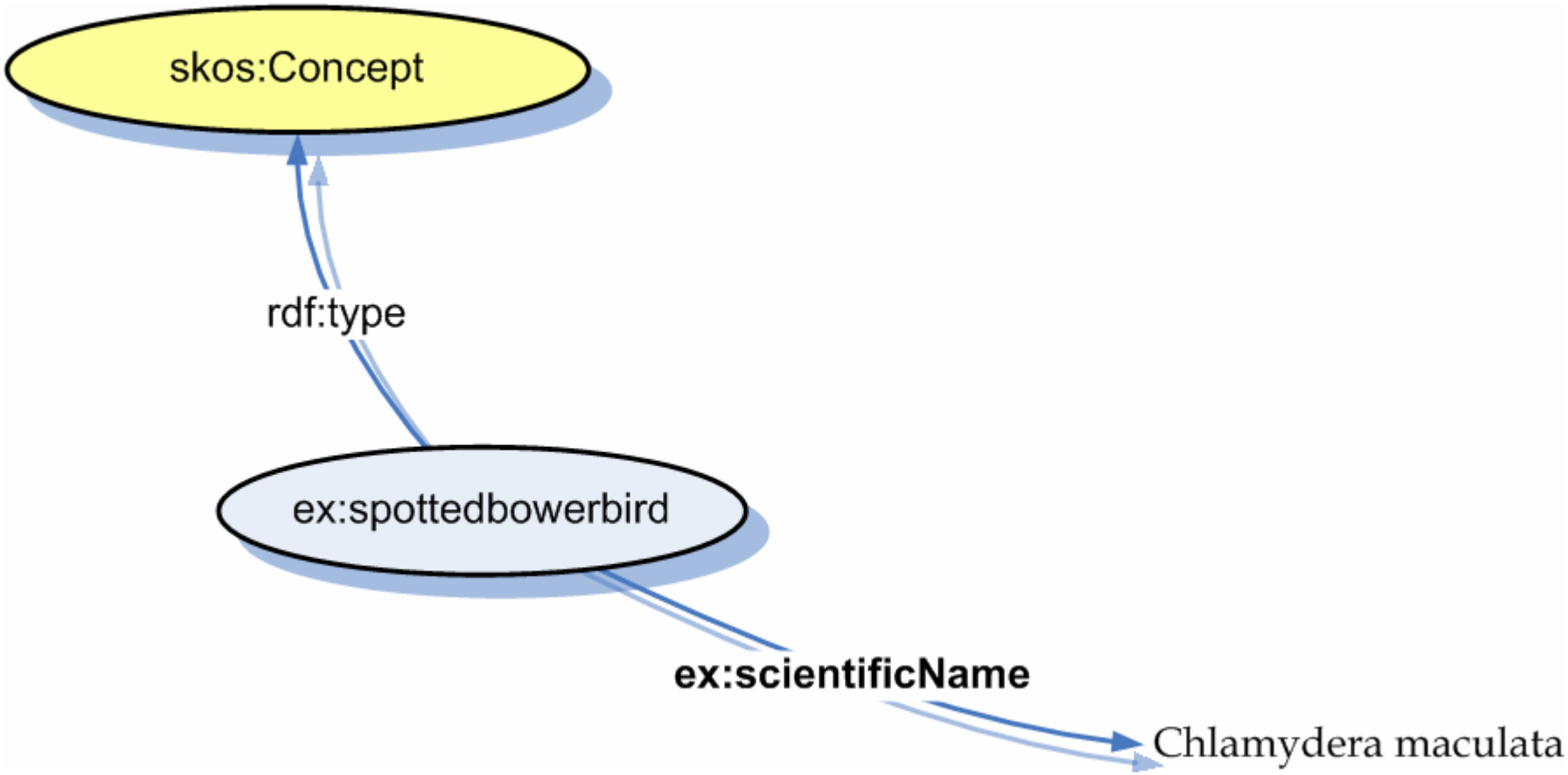
HTTP Publishing

- HTTP Behaviour for '/'
  - http://www.example.com/concepts/love must respond to GET with …
    - Response code 303 (**redirect** see other)
  - What you should be redirected to is an open question …
    - HTML document?
    - RDF document?
    - XHTML 2.0 document with embedded RDF?
    - Content negotiable resource?
  - I suggest …
    - Content negotiable resource, supporting at least application/rdf+xml and preferably also text/html, describing the concept

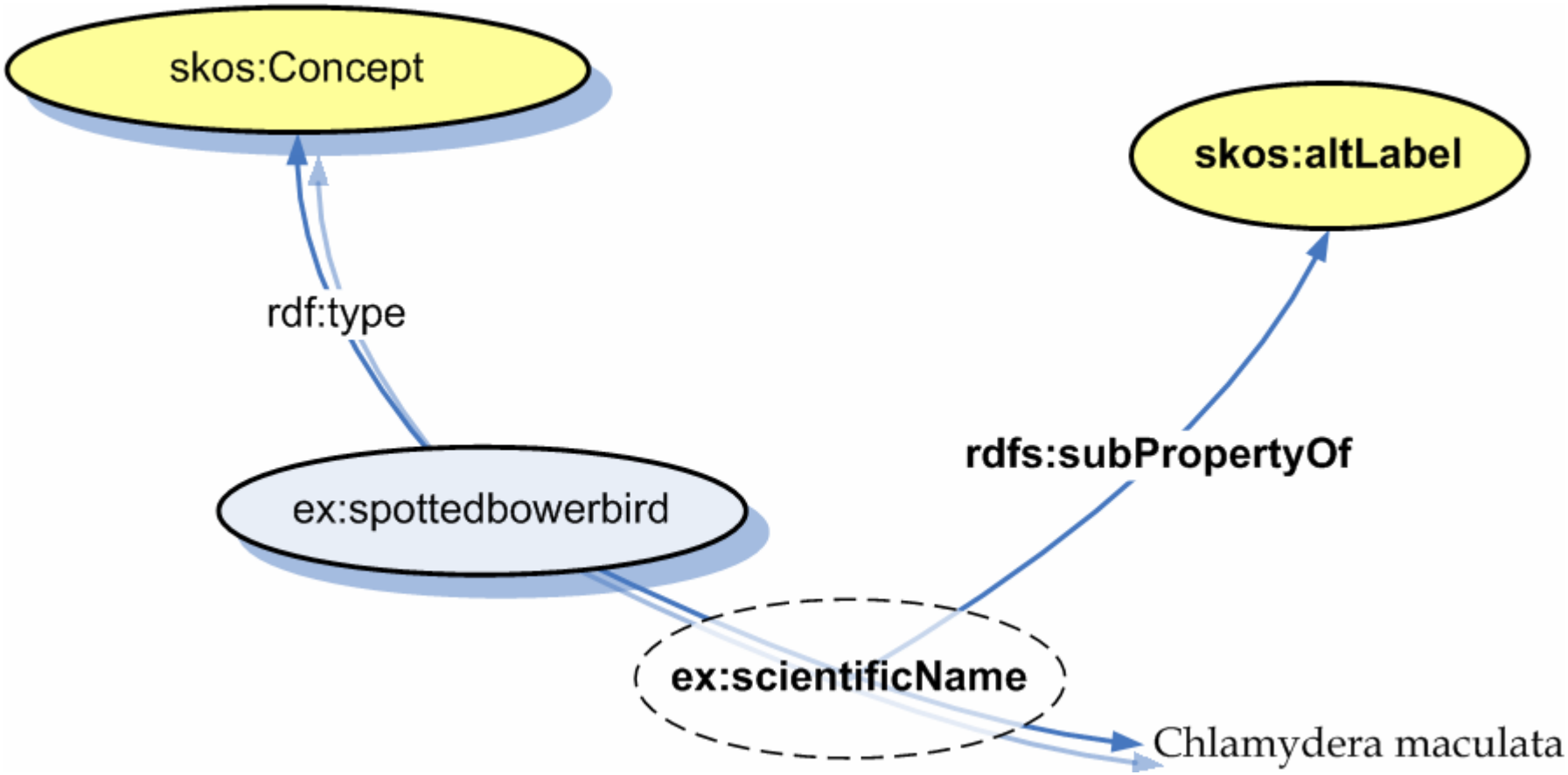
Extensions Intro

- SKOS Core can be **extended** by **refining** the classes and properties of the SKOS Core Vocabulary ...

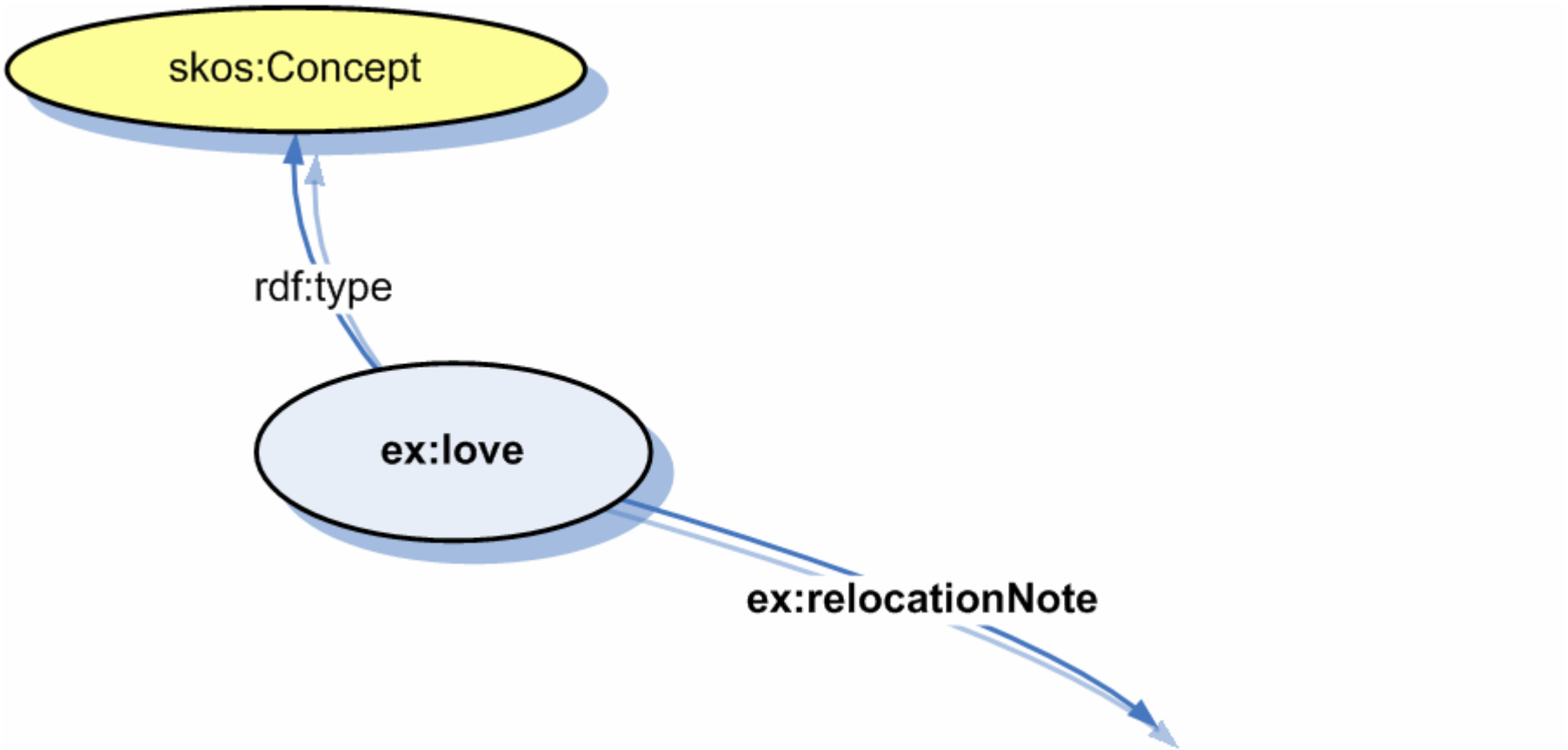
Labelling


skos:Concept
rdf:type
ex:spottedbowerbird
ex:scientificName
Chlamydera maculata

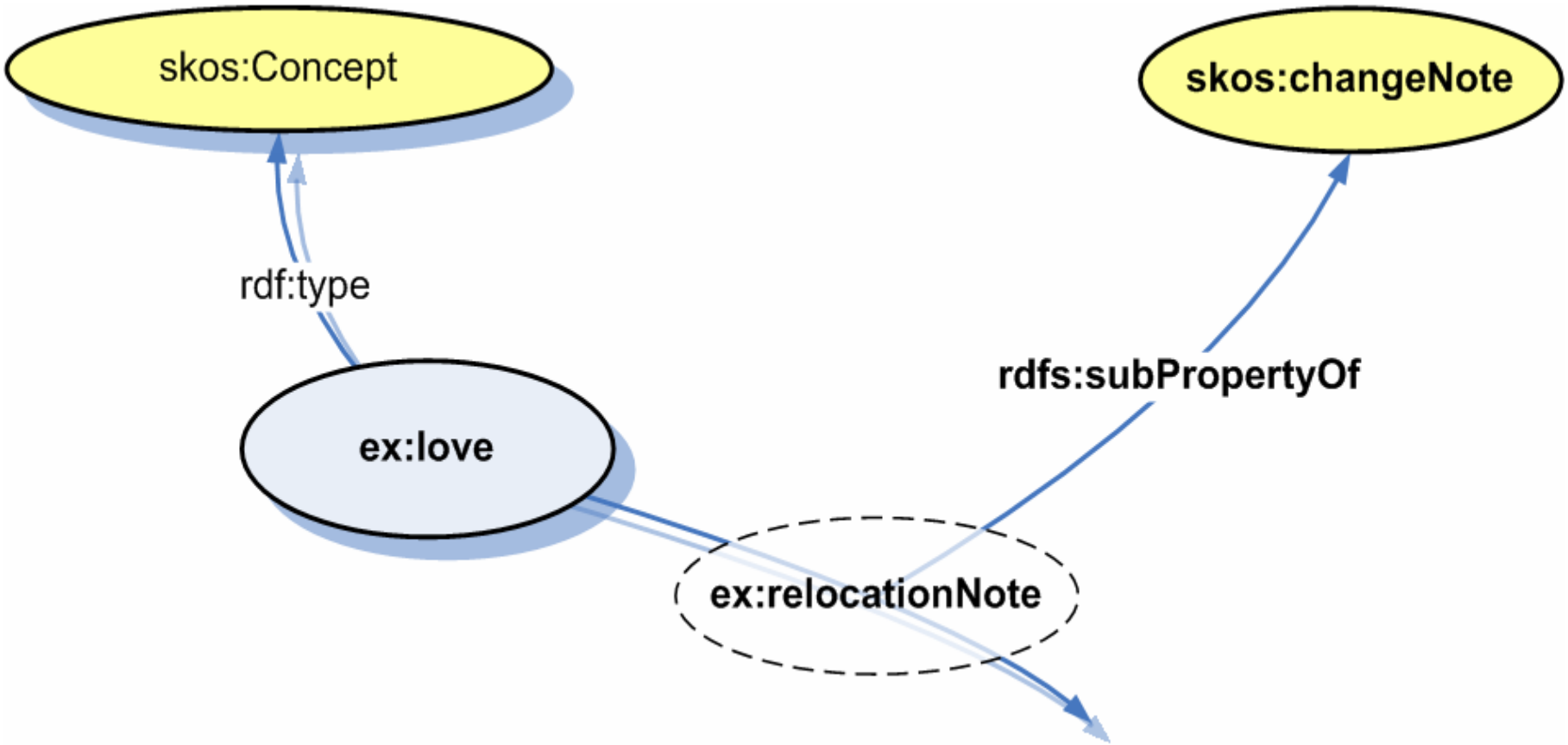
Labelling


skos:Concept
skos:altLabel
rdf:type
rdfs:subPropertyOf
ex:spottedbowerbird
ex:scientificName
Chlamydera maculata

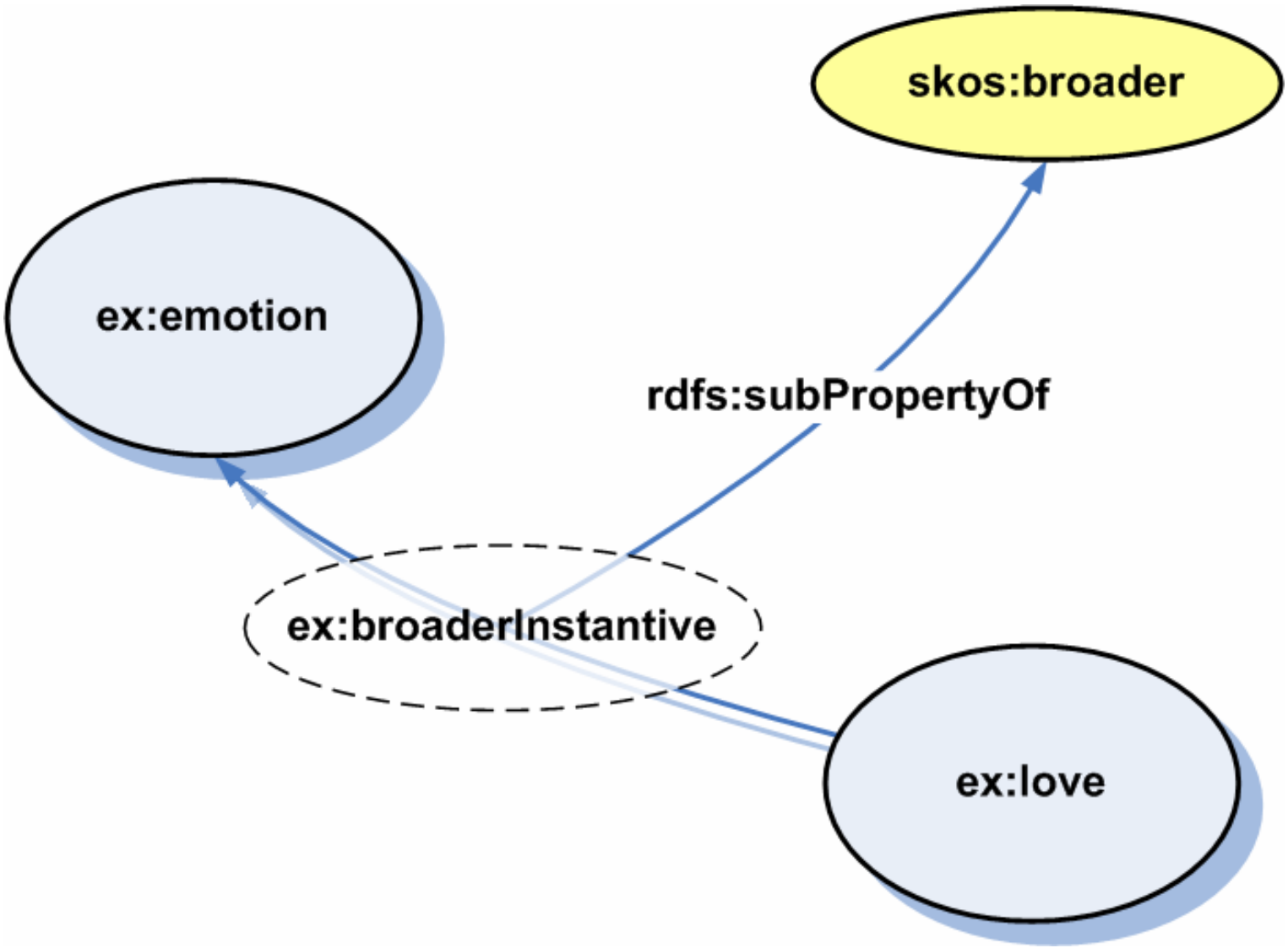
Documentation



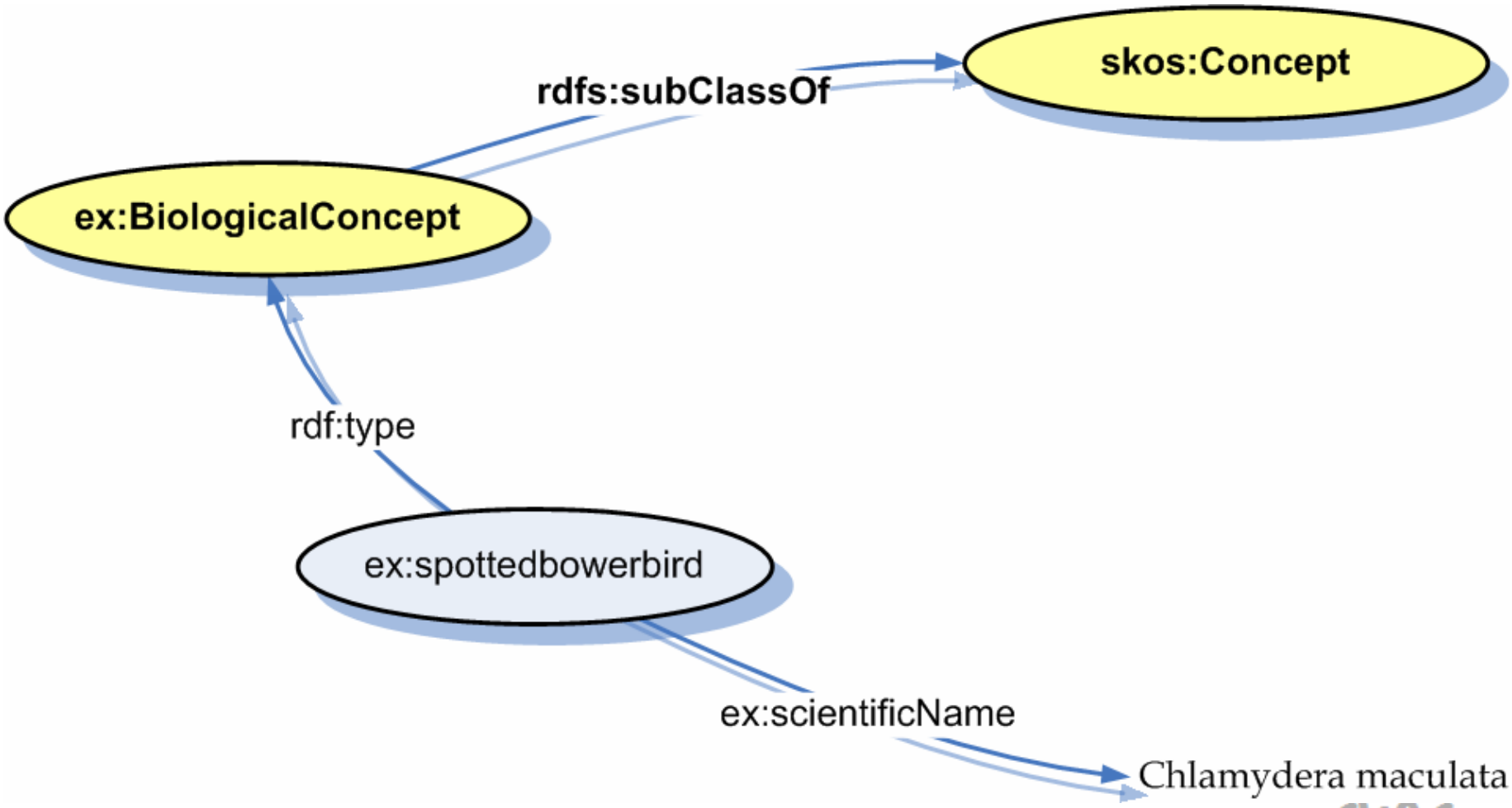
Documentation



Semantic Relations



Classes of Concept



Fundamental Facets

- E.g. AAT …
  - Physical Attributes
  - Styles and Periods
  - Agents
  - Activities
  - Materials
  - Objects

Fundamental Facets

- Model fundamental facets as disjoint classes of concept …

Fundamental Facets

```
# standard namespace prefixes

ex:PhysicalAttributesConcept a rdfs:Class;
  rdfs:subClassOf skos:Concept .

ex:StylesAndPeriodsConcept a rdfs:Class;
  rdfs:subClassOf skos:Concept .

ex:AgentsConcept a rdfs:Class;
 rdfs:subClassOf skos:Concept .

ex:ActivitiesConcept a rdfs:Class;
 rdfs:subClassOf skos:Concept .

ex:MatieralsConcept a rdfs:Class;
 rdfs:subClassOf skos:Concept .

ex:ObjectsConcept a rdfs:Class;
 rdfs:subClassOf skos:Concept .
```

Fundamental Facets

```
# standard namespace prefixes

# Example of using the classes …

ex:300024978 a ex:AgentsConcept;
  skos:prefLabel ‘People’.

# Declare disjointness …

ex:PhysicalAttributesConcept
  owl:disjointWith ex:StylesAndPeriodsConcept;
  owl:disjointWith ex:AgentsConcept;
  owl:disjointWith ex:ActivitiesConcept;
  owl:disjointWith ex:MaterialsConcept;
  owl:disjointWith ex:ObjectsConcept .
```

Weighted Semantic Relations

```
# standard namespace prefixes

# Declare the bits we need …

ex:WeightedRelation a rdfs:Class;
  rdfs:subClassOf rdf:Statement .

ex:weight a rdf:Property;
  rdfs:domain ex:WeightedRelation;
  rdfs:range xsd:integer .

# Now use them …

[] a ex:WeightedRelation;
  rdf:subject ex:love;
  rdf:predicate skos:related;
  rdf:object ex:joy;
  ex:weight '56' .
```

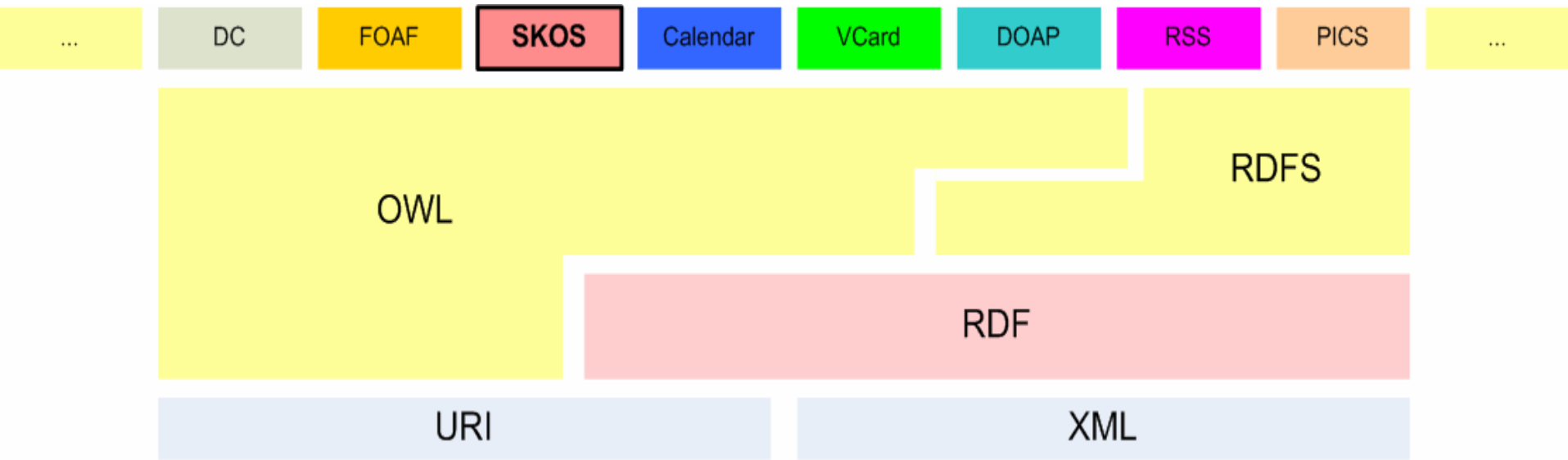
Compound Concepts

- MESH ‘qualified concepts’ e.g. …
  - Calcimycin [standards]
  - Leukemia [complications]

Compound Concepts

```
# Declare some bits …

ex:CompoundConcept a rdfs:Class;
  rdfs:subClassOf skos:Concept .

ex:main a rdf:Property;
  rdfs:domain ex:CompoundConcept;
  rdfs:subPropertyOf skos:broader .

ex:qualifier a rdf:Property;
  rdfs:domain ex:CompoundConcept;
  rdfs:subPropertyOf skos:broader .

# Now use them …

<http://www.example.com/someDocument>
  skos:subject [
    a ex:CompoundConcept;
    ex:main ex:Calcimycin;
    ex:qualifier ex:standards;
  ].
```

Semantic Web



SKOS Core and RDFS/OWL

- Disjoint?
  - Should skos:Concept be disjoint with …
    - rdf:Property ?
    - rdfs:Class ?
    - owl:Class ?
- DL?
  - Should SKOS Core be an OWL DL ontology?
    - Means not allowing flexibility in range of documentation props

Story So Far (4)

- HTTP Publishing
- Extension by Refinement
- SKOS Core and OWL

Summary

- Goals, development, status and nature of SKOS Core
- SKOS Core features
- HTTP, extensions & OWL

Links

SKOS Core Homepage

http://www.w3.org/2004/02/skos/core

SKOS Core Guide

http://www.w3.org/TR/swbp-skos-core-guide

SKOS Core Vocabulary Specification

http://www.w3.org/TR/swbp-skos-core-spec

Mailing list

mailto:public-esw-thes@w3.org

http://lists.w3.org/Archives/Public/public-esw-thes/

This presentation

http://isegserv.itd.rl.ac.uk/cvs-public/skos/press/dc2005/tutorial.ppt

Diagrams used in this presentation (feel free to re-use)

http://isegserv.itd.rl.ac.uk/cvs-public/skos/press/dc2005/img/

Thanks for listening ☺