SKOS
Simple Knowledge Organization System

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Dublin Core tutorial, Sept. 21, 2011

This presenter

- Europeana
- Web & Media Lab, Vrije Universiteit Amsterdam

- W3C Library Linked Data group
- (2006-2009) W3C Semantic Web Deployment group

  SKOS

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This tutorial

- Demo: SKOS data on the web
- SKOS Background
- Simple SKOS features
- More advanced SKOS
- Applications, tools & data

Knowledge Organization Systems?

- Domain-specific KOSs
  - Libraries: LCSH, DDC, UDC
  - Art history: AAT, ULAN
  - Medicine: UMLS, MESH
  - Geography: TGN
  - Food: AGROVOC
- Generic KOSs
  - Lexical vocabularies: WordNet
  - Country codes, languages …

SKOS Demo

Following one's nose to "concepts" as linked data

- American LCSH

  http://id.loc.gov/authorities/sh85145447#concept

- French RAMEAU

  http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb11931913j

- German SWD

  http://d-nb.info/gnd/4064689-0

- Agrovoc

  http://aims.fao.org/aos/agrovoc/c_8309

- STW

  http://zbw.eu/stw/descriptor/14188-0

- Further on to DBPedia

  http://dbpedia.org/resource/Water

Birds

From Library of Congress Subject Headings

Birds

URI
<http://id.loc.gov/authorities/sh85014310#concept>

Type
Topical Term

Alternate Labels
- Aves
- Avian fauna
- Avifauna

Broader Terms
- Amniotes
- Vertebrates

Narrower Terms
- Altricial birds

Sources

- Random House: Aves (A class of vertebrates, comprising the birds)
- The American Heritage dict. of the Engl. lang., via WWW, Aug. 31, 2001 (avifauna: The birds of a specific region or period)
- LC database, Aug. 31, 2001 (avifauna; Aves; avian fauna)

LC Classification

QL671

Created

2003-08-22

Modified

2003-10-06 13:01:40

Similar concepts from other vocabularies

- <http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb11932889r>

Instance Of

- SKOS Concept

Alternate Formats

- RDF/XML
- N-Triples
- JSON

Concept information

URI	http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb11932889r
prefLabel	x-notation: FRBNF119328898 fr: Oiseaux
altLabel	fr: Avifaune
scopeNote	fr: Voir aussi aux ordres, familles, genres, espèces d'Oiseaux
note	fr: Domaine : 590
inScheme	Rameau Rameau - Noms Communs
broader	Amniotes Tétrapodes Vertébrés

related	Ornithologie

Mappings (simple SKOS statements)

Mapping Relation	Concept
closeMatch	http://d-nb.info/gnd/4063673-2
closeMatch	http://id.loc.gov/authorities/sh85014310#concept

Katalog
Einfache Suche
Erweiterte Suche
Browsen (DDC)
Suchverlauf
Meine Auswahl
Hilfe
Datenshop
Mein Konto
Ablieferung von Netzpublikationen
Informationsvermittlung

Über die Deutsche Nationalbibliothek

Gesamter Bestand | Deutsches Musikarchiv | Deutsches Exilarchiv

Suchformular zurücksetzen

Finden

http://d-nb.info/gnd/4063673-2

SWD

Link zu diesem Datensatz	http://d-nb.info/gnd/4063673-2
Schlagwort	Vögel
Erläuterungen	Redaktionelle Bemerkung: Beispiel in RSWK 3. Aufl.
Quelle	M
Typ	Sachschlagwort (Indikator s)
Synonyme	Aves Vogel
DDC-Notation	598
Verwandte Begriffe	Ornithologie

Linked data

```
<skos:Concept rdf:about="http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb11932889r">
  <skos:prefLabel xml:lang="x-notation">FRBNF119328898</skos:prefLabel>
  <skos:prefLabel xml:lang="fr">Oiseaux</skos:prefLabel>
  <skos:altLabel xml:lang="fr">Avifaune</skos:altLabel>
- <skos:scopeNote xml:lang="fr">
    Voir aussi aux ordres, familles, genres, espèces d'Oiseaux
  </skos:scopeNote>
  <skos:note xml:lang="fr">Domaine : 590</skos:note>
  <skos:inScheme rdf:resource="http://stitch.cs.vu.nl/vocabularies/rameau/autorites_matieres"/>
  <skos:inScheme rdf:resource="http://stitch.cs.vu.nl/vocabularies/rameau/noms_communs"/>
  <skos:broader rdf:resource="http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb13743392n
  <skos:broader rdf:resource="http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb12271169q
  <skos:broader rdf:resource="http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb11974791b

<rdf:Description rdf:about="http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb11932889r">
   <skos:closeMatch rdf:resource="http://d-nb.info/gnd/4063673-2"/>
</rdf:Description>
<rdf:Description rdf:about="http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb11932889r">
   <skos:closeMatch rdf:resource="http://id.loc.gov/authorities/sh85014310#concept"/>
</rdf:Description>
```

Linked data

```
df:RDF>
<skos:Concept rdf:about="http://d-nb.info/gnd/4063673-2">
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4360157-1"/>
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4064815-1"/>
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4124425-4"/>
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4129513-4"/>
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4058156-1"/>
   <skos:altLabel xml:lang="de">Aves</skos:altLabel>
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4512696-3"/>
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4231416-1"/>
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4436360-6"/>
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4191119-2"/>
   <skos:altLabel xml:lang="de">Vogel</skos:altLabel>
   <skos:closeMatch rdf:resource="http://stitch.cs.vu.nl/vocabularies/rameau/ark:/12148/cb11932889r"
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4055104-0"/>
   <skos:narrower rdf:resource="http://d-nb.info/gnd/4166667-7"/>
   <dcterms:identifier>(DE-588c)4063673-2</dcterms:identifier>
   <skos:closeMatch rdf:resource="http://id.loc.gov/authorities/sh85014310#concept"/>
```

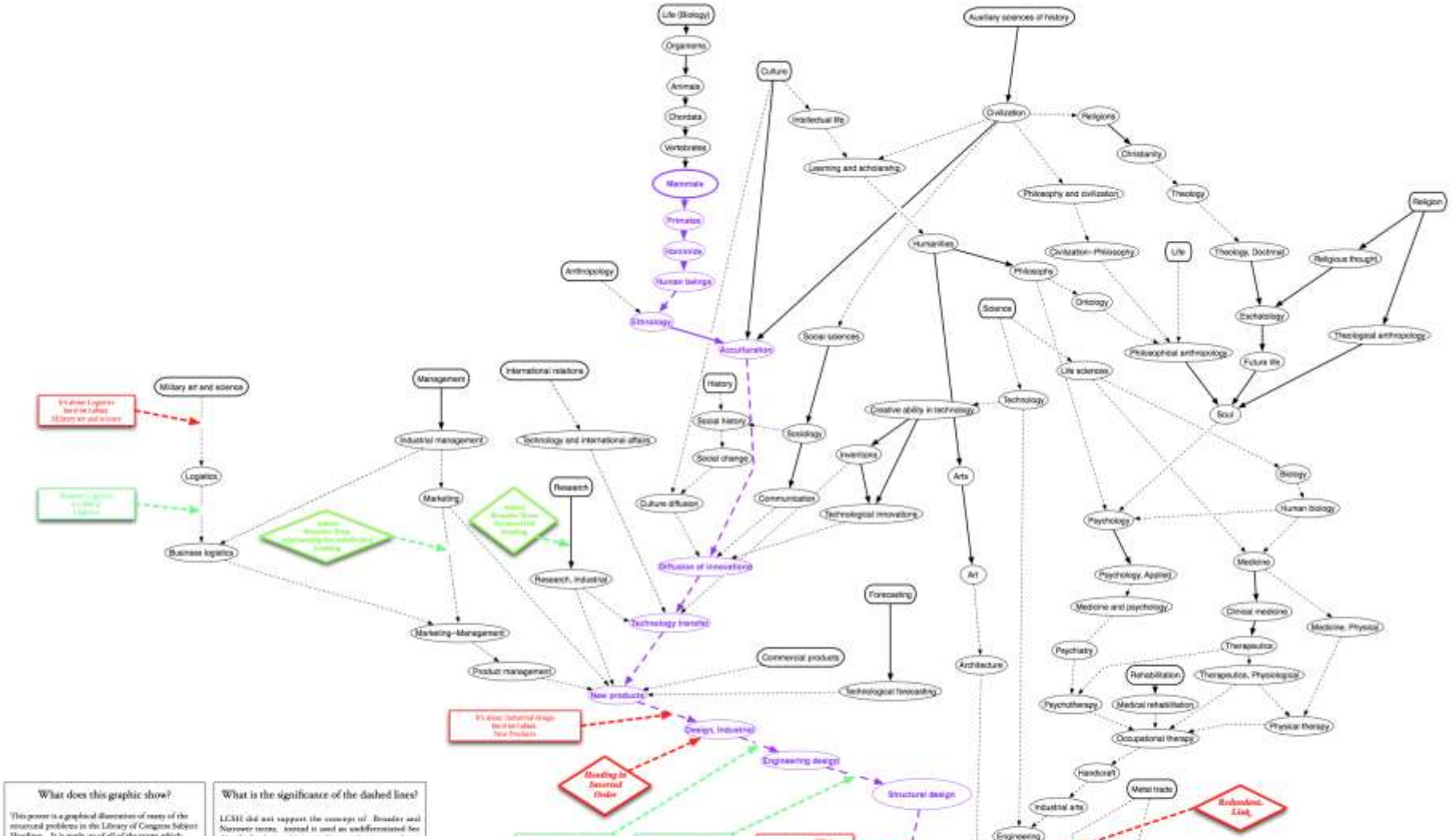
Knowledge Organization Systems for Linked Data?

- (hundreds of) thousands of concepts
- Loose semantics – but still, semantics!

  `Car wheel BroaderTerm Car`
- Proven to be useful for applications

  Search, description

It is useful to enable publishing and re-use of legacy KOSs, in an area which is always craving for *semantics*



LCSH is to Thesaurus as Doorbell is to Mammal: Visualizing Structural Problems in the Library of Congress Subject Headings
Simon Spero,
DC 2008,
http://dcpapers.dublincore.org/ojs/pubs/article/viewArticle/927

This tutorial

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- SKOS Background
- Simple SKOS features
- More advanced SKOS
- Applications, tools & data

W3C Semantic Web Deployment Working Group

Tom Baker, Guus Schreiber, Alistair Miles, Sean Bechhofer, Antoine Isaac, Ralph Swick, Ed Summers, Jon Phipps, Margherita Sini, Diego Berrueta, Clay Redding, and many others…

http://www.w3.org/2006/07/SWD/

Simple Knowledge Organization System

an official W3C recommendation!

Scope: knowledge organization systems (KOS) such as thesauri, classification systems, subject heading lists…

SKOS is for representings KOSs in RDF in a *simple* way

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

- There are many KOS models and formats
- But also common features and application requirements

  Lexical information, semantic links

- SKOS is a model to port KOSs to RDF in a *simple* way
  - Not aimed at fitting everything!
  - Not aimed at replacing existing (non-web) formats!

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

Representing semantics

The formal way: OWL Semantic Web ontology language

Used for ontologies that enable machine reasoning

- Mother is a class
- It is the intersection of the classes Woman and Parent
- Parent is the class of entities of type Person that are related to at least one other resource of type Person using the child property

…

SKOS is not for formal ontologies

- Turning KOSs into ontologies is possible, but KOSs
  - are large
  - have often a focus on terminological information

    Child **UsedFor** Offspring

- Softer semantics can be useful *as such* for many applications!

  Semantic search, annotation…

SKOS is not for formal ontologies

- Rob Styles (Talis): SKOS as a “stepping stone” into Semantic Web and Linked Data
- Allows straightforward conversion and re-use of existing knowledge
- Without some of the benefits granted by
  - Formal axioms (reasoning)
  - Cleaning data (high precision)

W3C standardization process

- Input: draft specification (SKOS 2005)
- Collect use cases & derive requirements
- Create issue list: requirements not handled by the draft spec
- Propose resolutions for issues
- Get consensus on new spec
- Find two independent implementations for each feature in the spec
- *Continuously*: asking for public feedback/comments

  Lot of feedback coming from the SKOS community list public-esw-thes@w3.org

Use Cases and Requirements

- Gathering use cases for SKOS
  - Existing or anticipated applications
  - E.g., "Semantic search service across mapped multilingual thesauri in the agriculture domain"
- From use cases, requirements were elicited
  - E.g., using generalization links between concepts (can be used for hierarchical browsing)

SKOS Use Cases and Requirements

W3C Working Group Note 18 August 2009

This version:
http://www.w3.org/TR/2009/NOTE-skos-ucr-20090818/
Latest version:
http://www.w3.org/TR/skos-ucr
Previous version:
http://www.w3.org/TR/2007/WD-skos-ucr-20070516/
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Basic SKOS

A set of features common to various KOS types and useful for many applications

- Concepts
- Lexical properties
- Semantic relations
- Notes

SKOS Simple Knowledge Organization System Primer

W3C Working Group Note 18 August 2009

This version:
http://www.w3.org/TR/2009/NOTE-skos-primer-20090818/
Latest version:
http://www.w3.org/TR/skos-primer
Previous version:
http://www.w3.org/TR/2009/WD-skos-primer-20090615/
Editors:
Antoine Isaac, Vrije Universiteit Amsterdam
Ed Summers, Library Of Congress

Thesaurus example

Animals

cats
- **UF (*used for*) domestic cats**
- **RT (*related term*) wildcats**
- **BT (*broader term*) animals**
- **SN (*scope note*) used only for domestic cats**

domestic cats
- **USE cats**

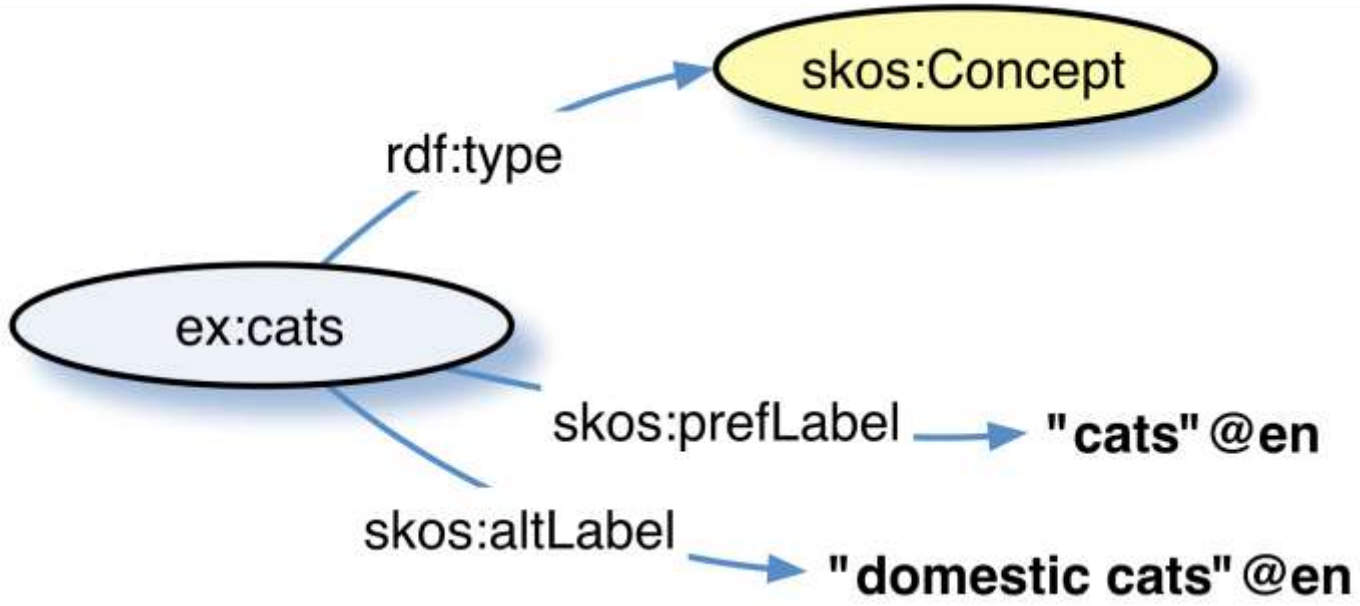
wildcats

ISO 2788 model

Concepts and labels

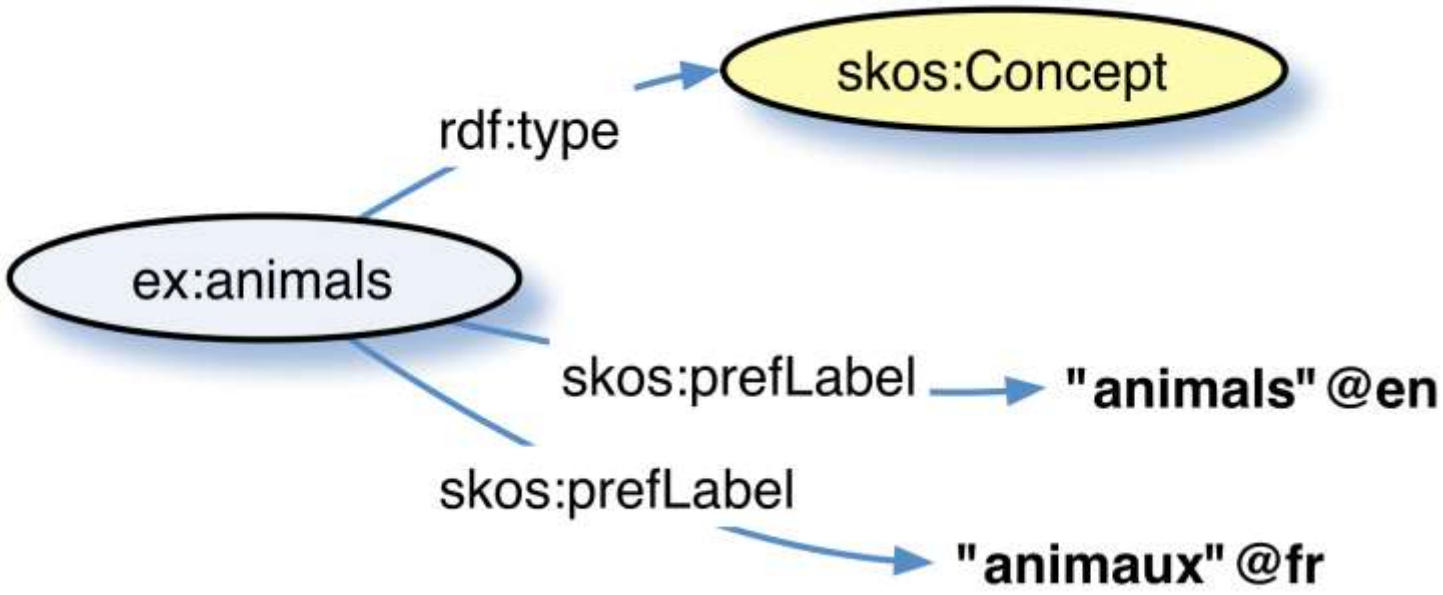
cats

UF (*used for*) domestic cats



skos: = http://www.w3.org/2004/02/skos/core#
rdf: = http://www.w3.org/1999/02/22-rdf-syntax-ns#
ex: = http://example.org/

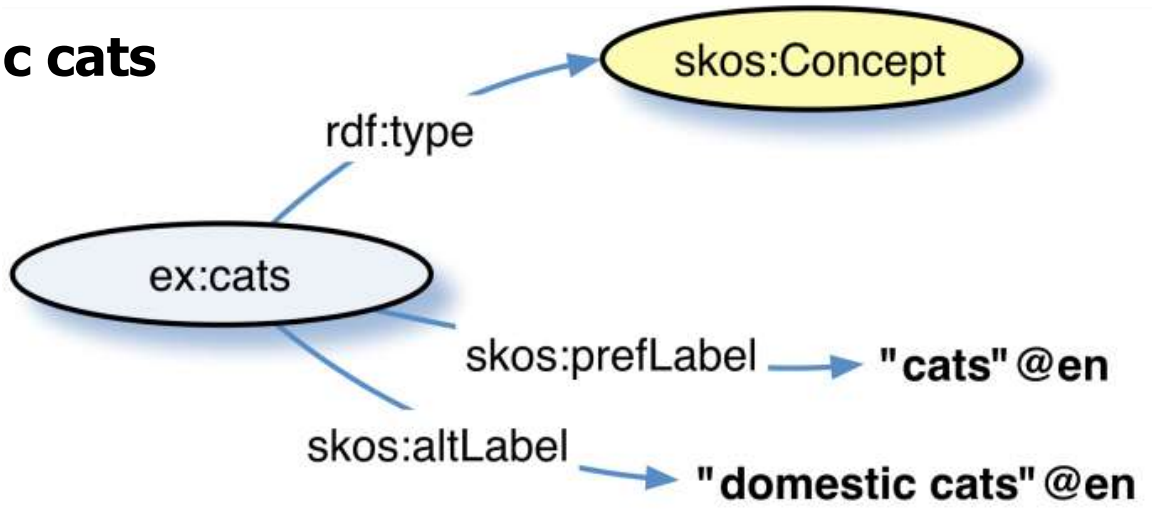
Note: multilingual labels



SKOS is concept-oriented

cats

UF (*used for*) domestic cats



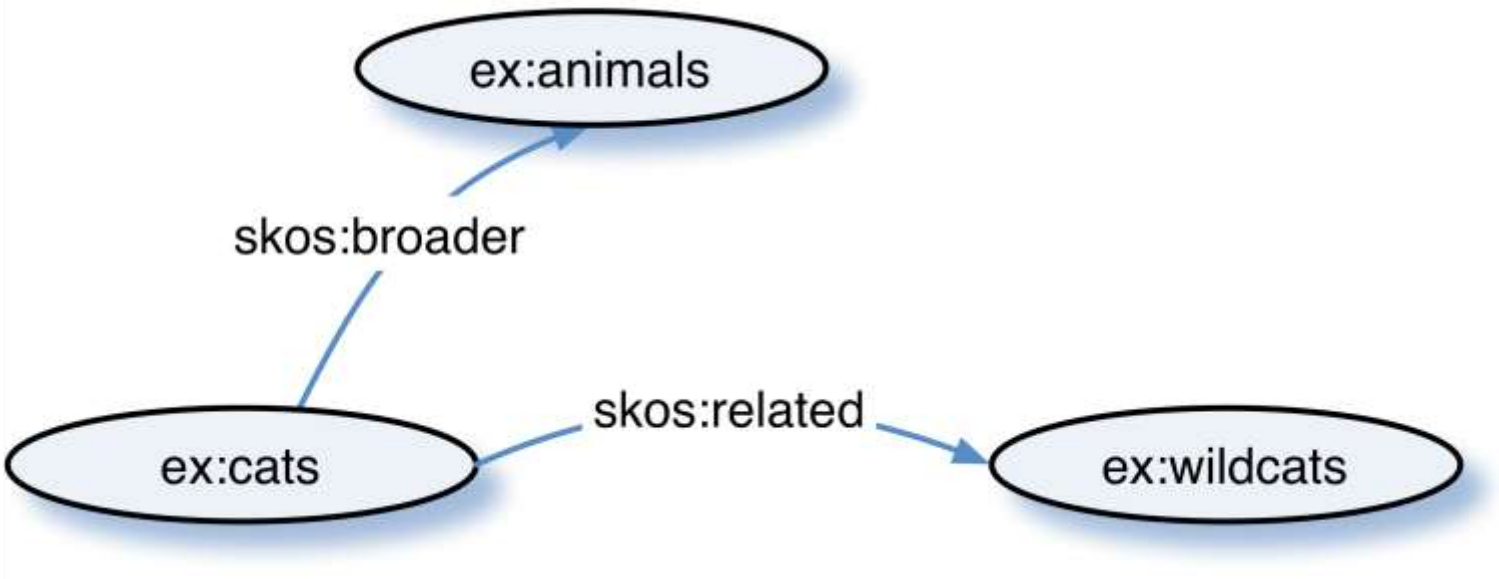
- USE/UF functions, as in ISO2788
- But:
  - Concepts are first-order (RDF) resources
  - Labels are RDF literals (simple string values)
  - Labels are linked via the concept resource

Semantic relations

cats

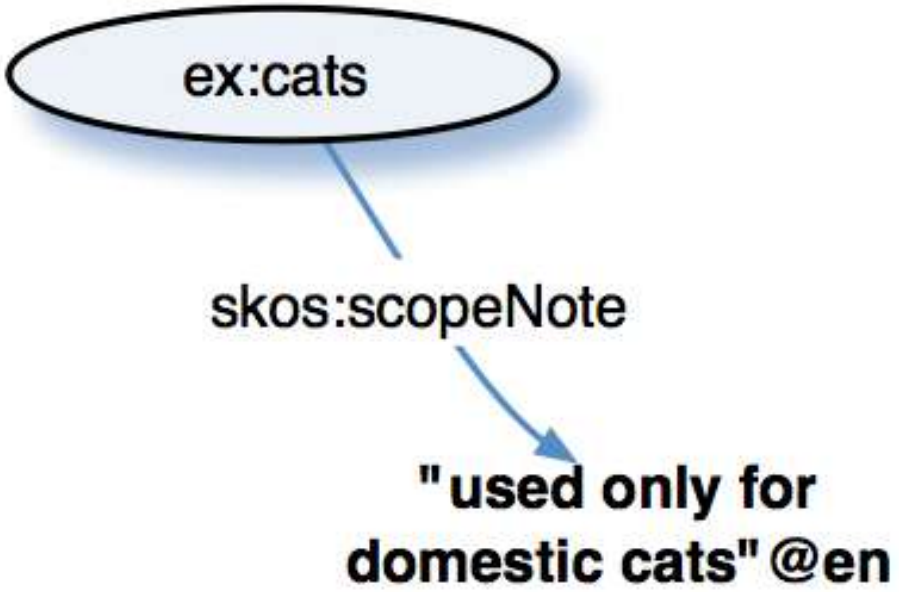
RT (*related term*) wildcats

BT (*broader term*) animals



Documenting concepts

skos:note
|
+-- skos:definition
|
+-- skos:scopeNote
|
+-- skos:example
|
+-- skos:historyNote
|
+-- skos:editorialNote
|
+-- skos:changeNote



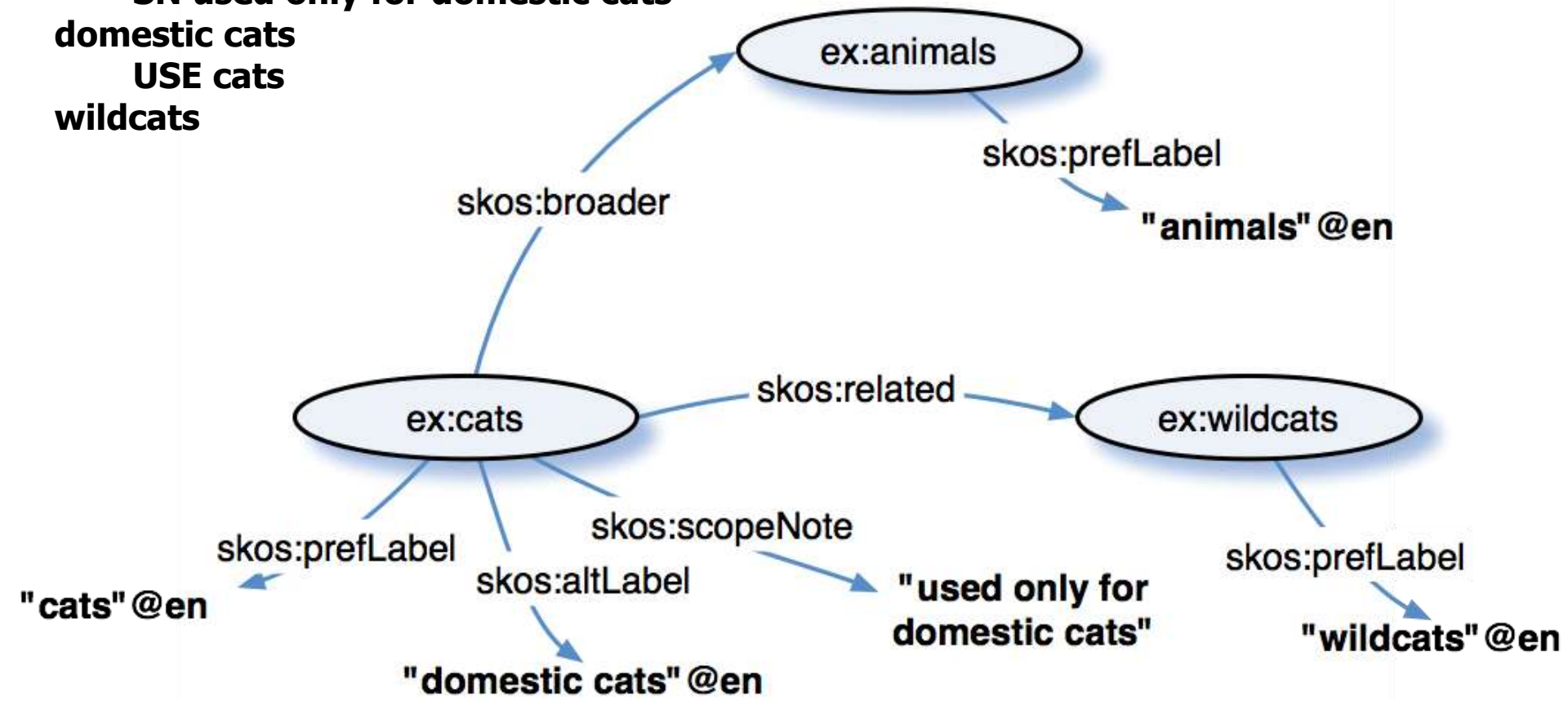
Alistair Miles

A SKOS graph

animals
cats
- **UF domestic cats**
- **RT wildcats**
- **BT animals**
- **SN used only for domestic cats**

domestic cats
- **USE cats**

wildcats



Example: RDF XML serialization

animals
cats
- **UF domestic cats**
- **RT wildcats**
- **BT animals**
- **SN used only for domestic cats**

domestic cats
- **USE cats**

wildcats

```
<rdf:RDF>
<skos:Concept rdf:about="http://example.org/animals">
      <skos:prefLabel xml:lang="en">animals</skos:prefLabel>
</skos:Concept>
<skos:Concept rdf:about="http://example.org/cats">
     <skos:prefLabel xml:lang="en">cats</skos:prefLabel>
     <skos:altLabel xml:lang="en">domestic cats</skos:altLabel>
     <skos:scopeNote>used only for domestic cats</skos:scopeNote>
     <skos:broader rdf:resource="http://example.org/animals"/>
     <skos:related rdf:resource="http://example.org/wildcats"/>
</skos:Concept>
<skos:Concept rdf:about="http://example.org/wildcats">
     <skos:prefLabel xml:lang="en">wildcats</skos:prefLabel>
</skos:Concept>
</rdf:RDF>
```

Converting data to SKOS

MARC Field	Feature/Function	RDF Property	Value of the Property/Comments
010	Control Number	rdf:about	the URI for the skos:Concept instance
150	Topical Term	skos:prefLabel	subfields: a, b, v, x, y, z
151	Geographic Term	skos:prefLabel	subfields: a, b, v, x, y, z
450	See From Tracing (Topical Term)	skos:altLabel	subfields: a, b, v, x, y, z
451	See From Tracing (Geographic Name)	skos:altLabel	subfields: a, b, v, x, y, z
550	See Also From Tracing (Topical Term)	skos:broader	only use this property when subfield w is 'g'; use value to lookup Concept

LCSH, SKOS and Linked Data
Ed Summers, Antoine Isaac, Clay Redding, Dan Krech
DC 2008
http://dcpapers.dublincore.org/ojs/pubs/article/viewArticle/916

Getting that data

It can be tedious:

- Complex data (MARC)
- Data archaeology: mining models from data
- Creating URIs: mostly from local IDs
- Assigning language tags for labels
- Mapping tables don't save you from using your favorite data conversion software

  XSLT, Marc-perl…

But it's never really impossible ☺

Methological references at

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

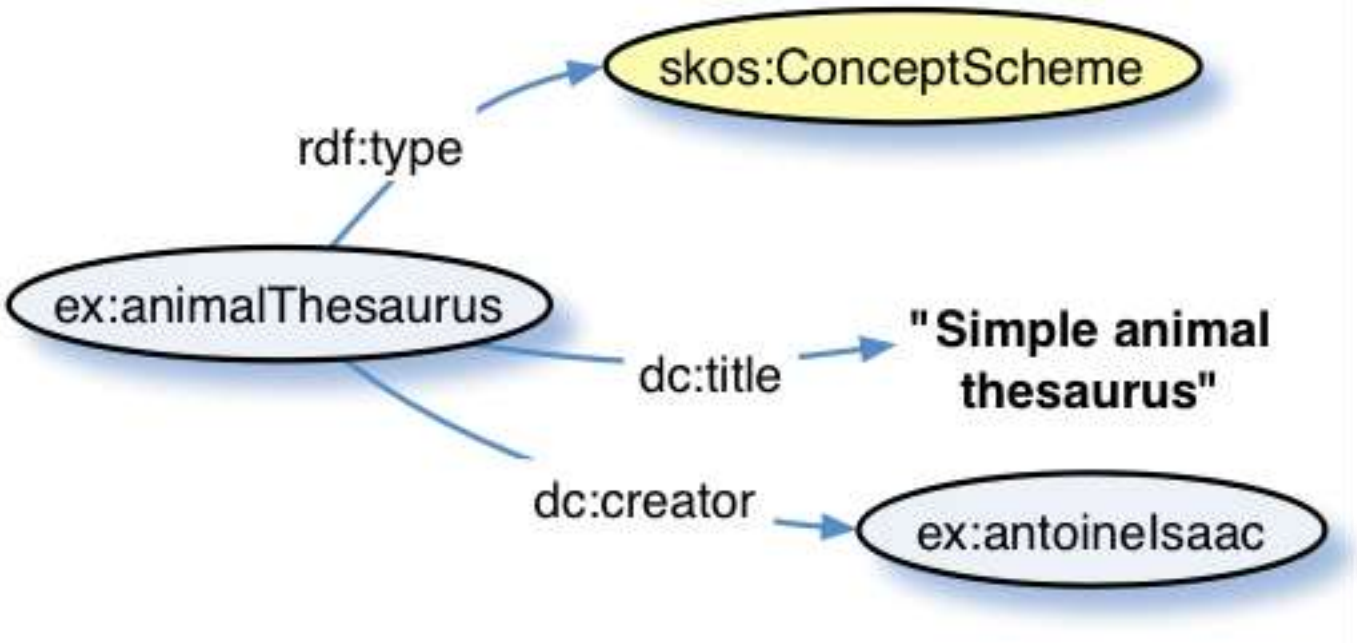
Pete Johnston's posts on conversion to SKOS:

http://efoundations.typepad.com/efoundations/2011/02/term-based-thesauri-and-skos-part-1.html

http://efoundations.typepad.com/efoundations/2011/03/term-based-thesauri-and-skos-part-2-linked-data.html

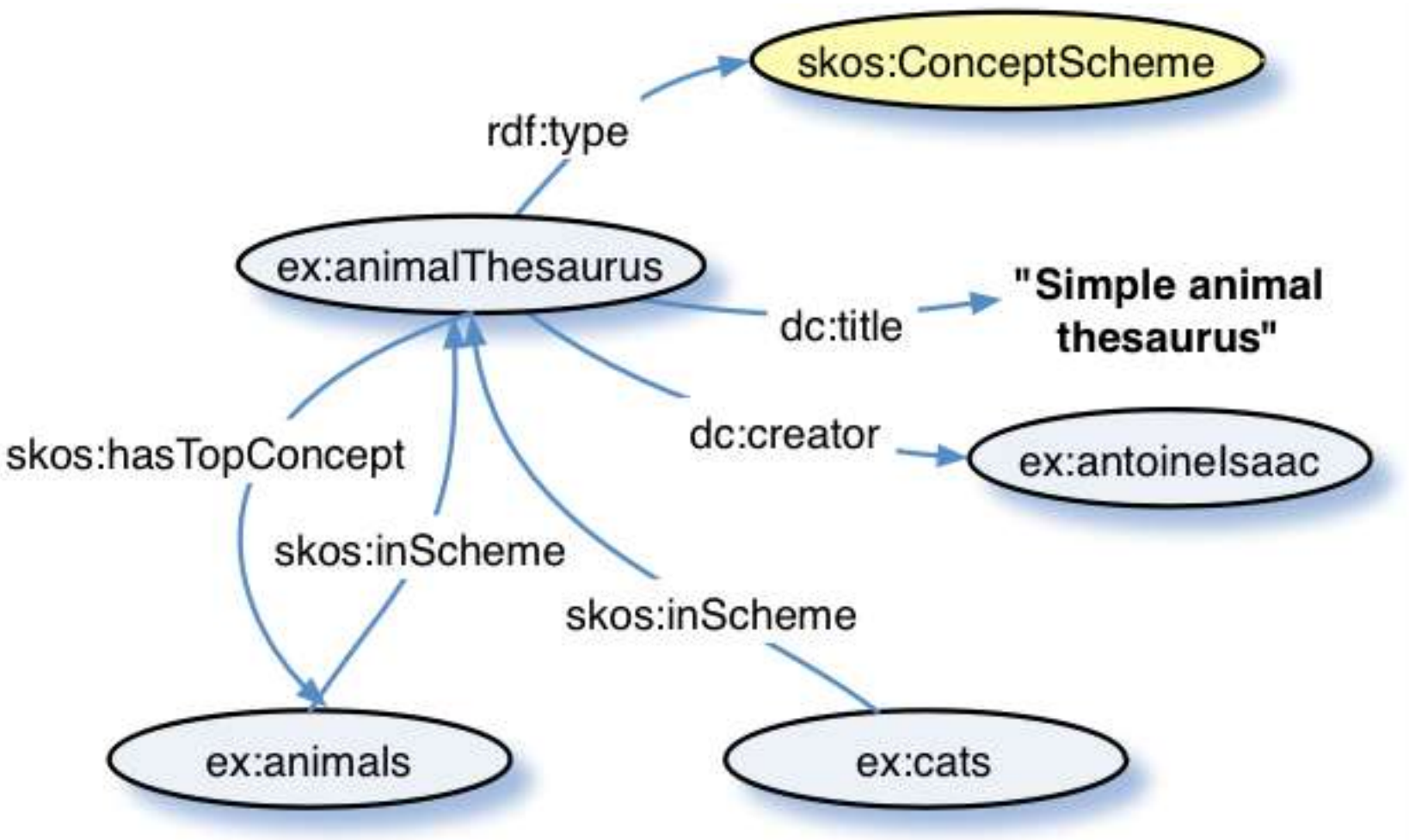
Concept Schemes

Explicit representation of vocabularies



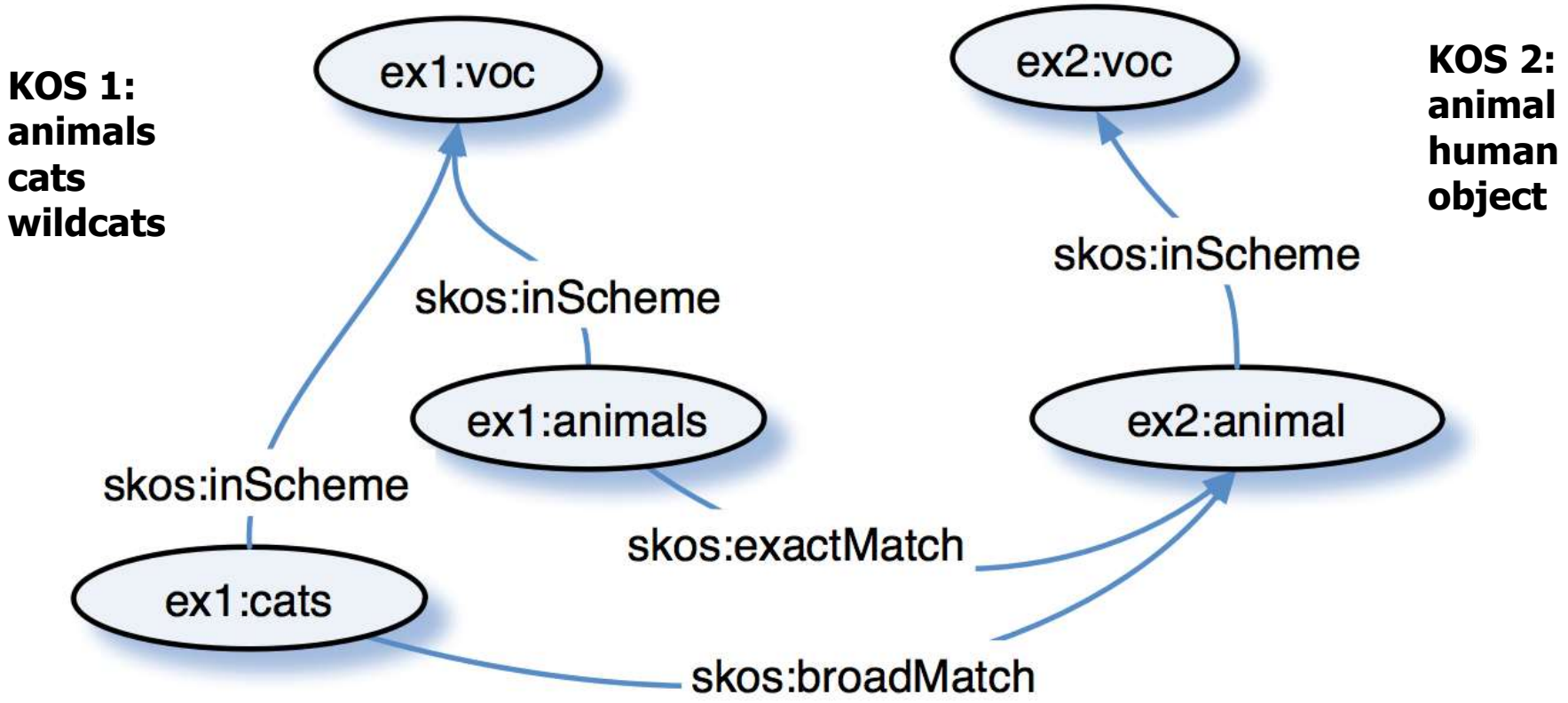
Concept Schemes

Linking concepts to concept schemes

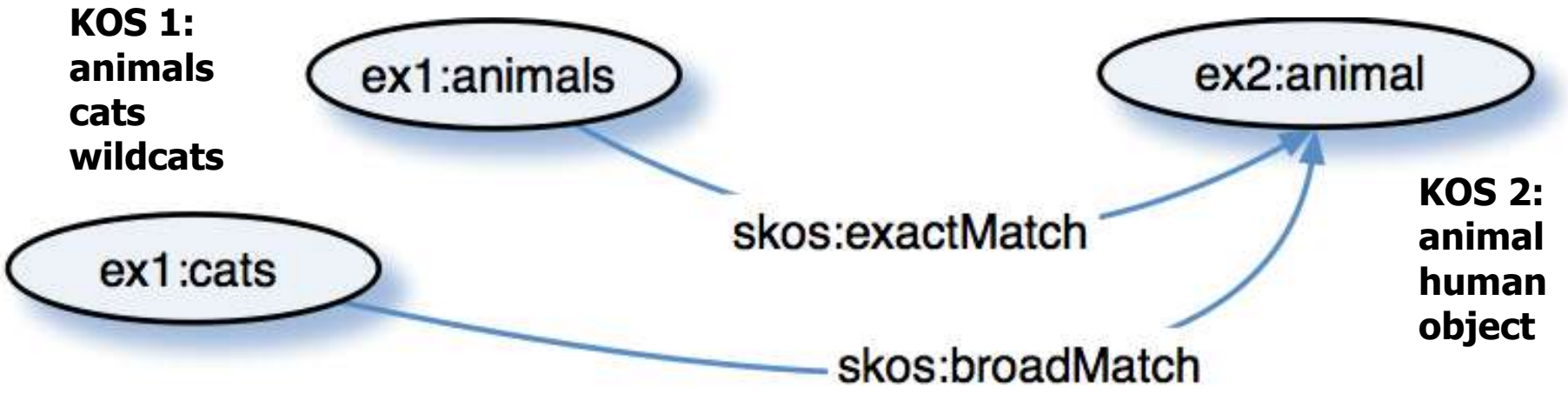


SKOS mappings

SKOS allows bridging across KOSs from different contexts



Networking controlled vocabularies in SKOS



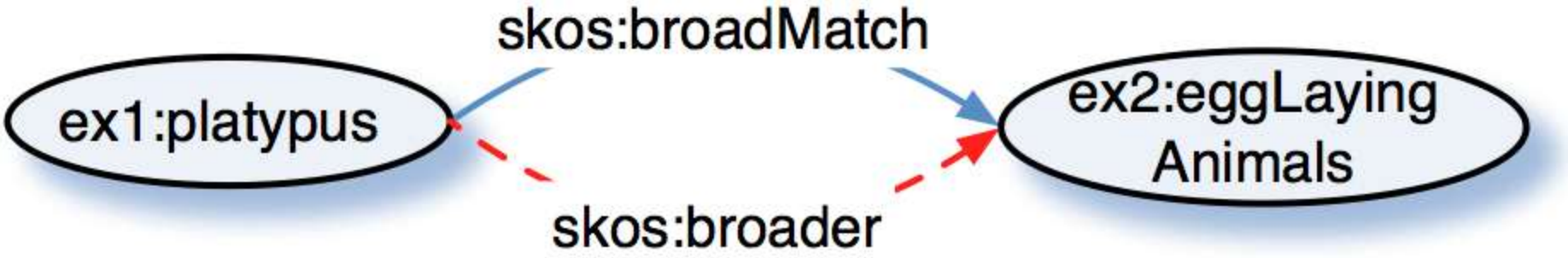
- **`closeMatch`** and **`exactMatch`** for equivalence
  - **`exactMatch`** is stronger and context-independent (transitive)
- **`broadMatch`** and **`narrowMatch`** for hierarchical links
- **`relatedMatch`** for other cases of interest

SKOS mappings

- A common way to represent important info for KOS use cases

  Focusing on types of mapping relationships

- Semantics
  - **`broadMatch`** is a sub-property of **`broader`**
  - Allows to seamlessly use mappings as basic KOS relationships
  - Still keeps the difference at the statement level



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Semantics for SKOS?

- SKOS model enforces basic constraints on SKOS data
- SKOS must cope with existing information, and not infer new knowledge, beyond what KOS publishers intend
- Minimal semantic commitment

  Over-commitment harms interoperability
- SKOS is not a guideline to create KOS

  E.g., SKOS does not say how to create good labels

Semantics for SKOS - labels

- (Hard) A concept has only one prefLabel per language

- (Soft) No two concepts from a same concept scheme should have the same prefLabel in a given language

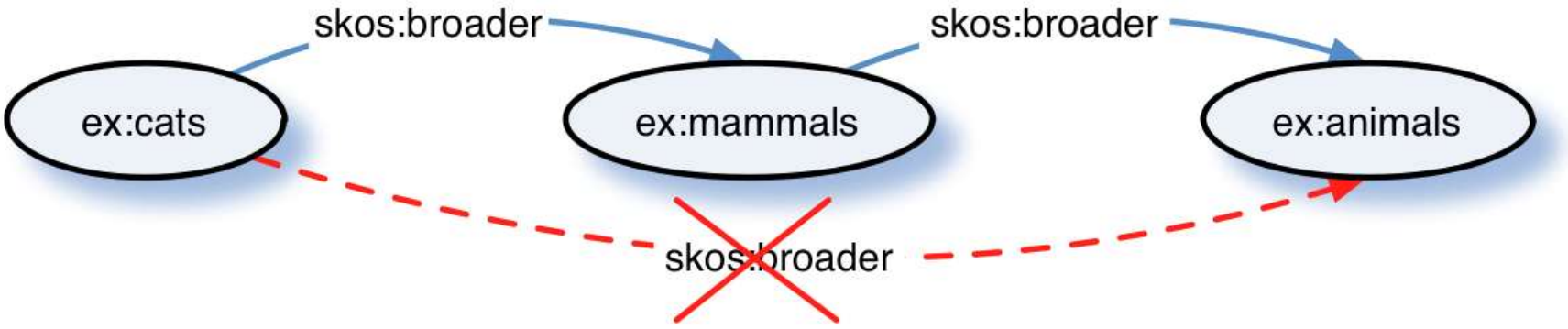
Semantics for SKOS

There are rules to infer new facts

E.g., broader and narrower are inverse of each other

Semantics of skos:broader

Is **`skos:broader`** "transitive"?



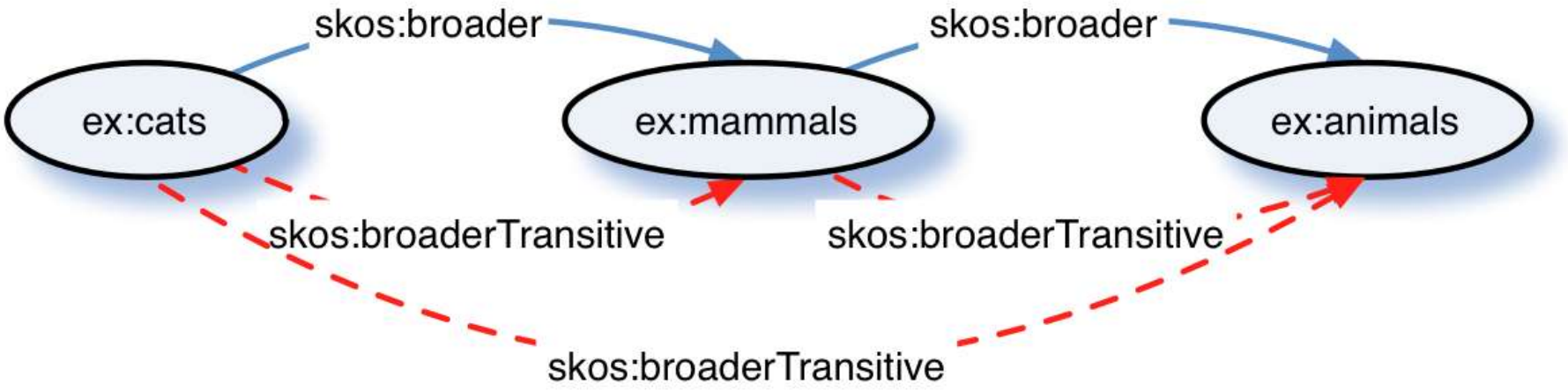
- Infering a new link can be wrong, sometimes!
  Some KOSs are not always hierarchically clean
- **`skos:broader`** is not transitive in general

Semantics of skos:broader

`skos:broader` has a super-property **`skos:broaderTransitive`** with semantics of "has ancestor"

1: every **`broader`** implies a **`broaderTransitive`**

2: **`broaderTransitive`** is transitive!



SKOS semantics

- SKOS is represented as an OWL ontology
- In total 46 axioms
- Axioms may be less rich than expected for OWL fans

See

http://www.w3.org/TR/skos-reference

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

SKOS and OWL -- again

"OWL is a Harley-Davison, SKOS is a mountain bike"
— Tom Baker

- SKOS and OWL are meant for quite different things

- SKOS = Model to represent KOSs in a *simple* way

  Ontology for **concepts** – the elements in (CH) vocabularies

Raising difficult issues: what counts as a "concept"?

- A concept is an artifact
  - used in descriptions, e.g., as subjects
  - used as a cluster for different labels with a similar meaning
  - in semantic relationships with other concepts

- Should a person name authority be represented using a class (foaf:Person) or a skos:Concept? Or both?

E.g., discussion at
http://efoundations.typepad.com/efoundations/2011/09/things-their-conceptualisations-skos-foaffocus-modelling-choices.html

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Relationships between lexical labels

From SKOS Use Cases:

- **Use Case #3 — Semantic search service across mapped multilingual thesauri in the agriculture domain**

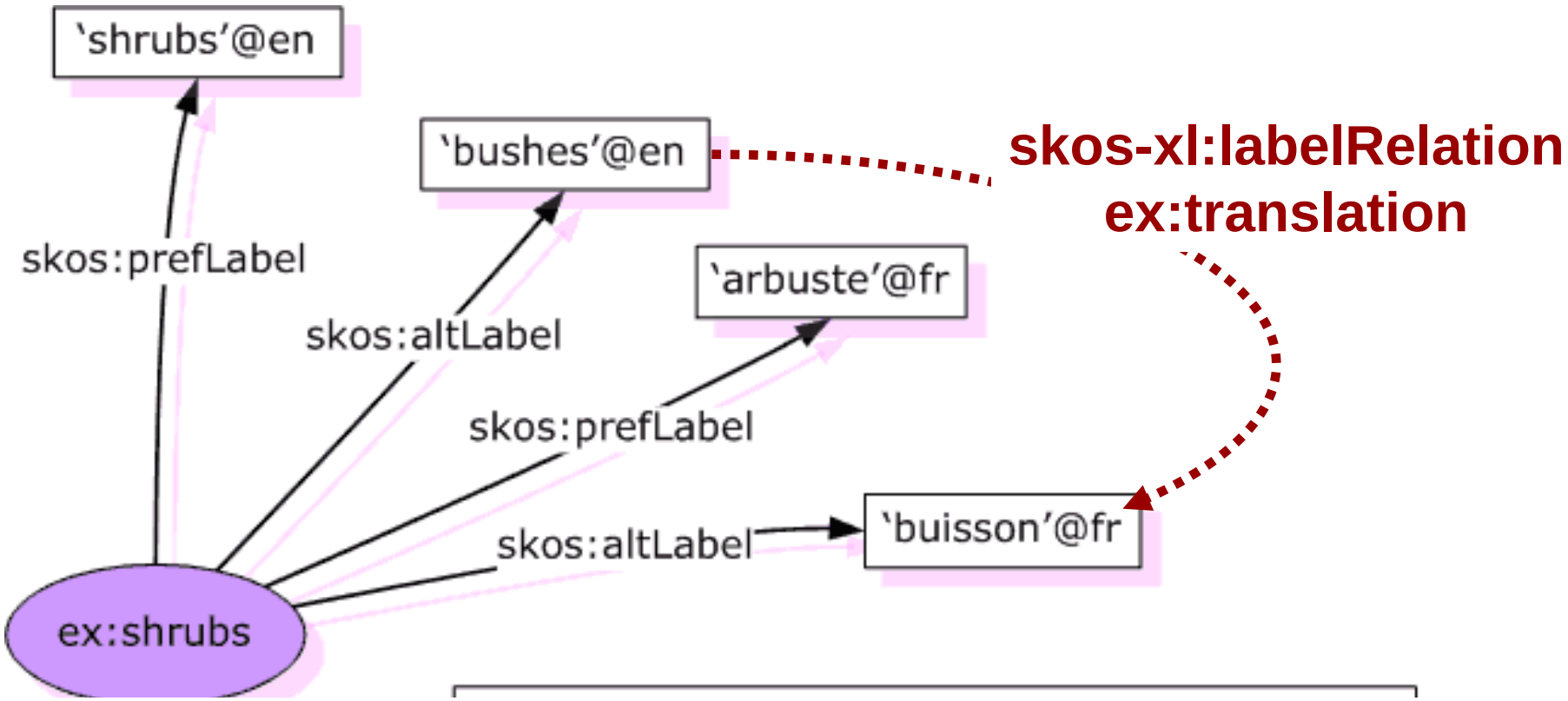
"The AIMS project includes String-to-String relationships"

acronym	Food and Agriculture Organization	FAO
spelling_variant	organisation	organization
translation	vache	cow

"Requires: R-RelationshipsBetweenLabels"

- In basic SKOS, labels are RDF literals and cannot be *subjects* of RDF statements

Relationships between lexical labels



- Done as an extension: SKOS-XL
  - **`skos-xl:Label`**
  - **`skos-xl:labelRelation`**

Other features

- Concept grouping

  skos:Collection, skos:member…

- Notations

  skos:notations

Killed darling example

- Synthesis of new subjects

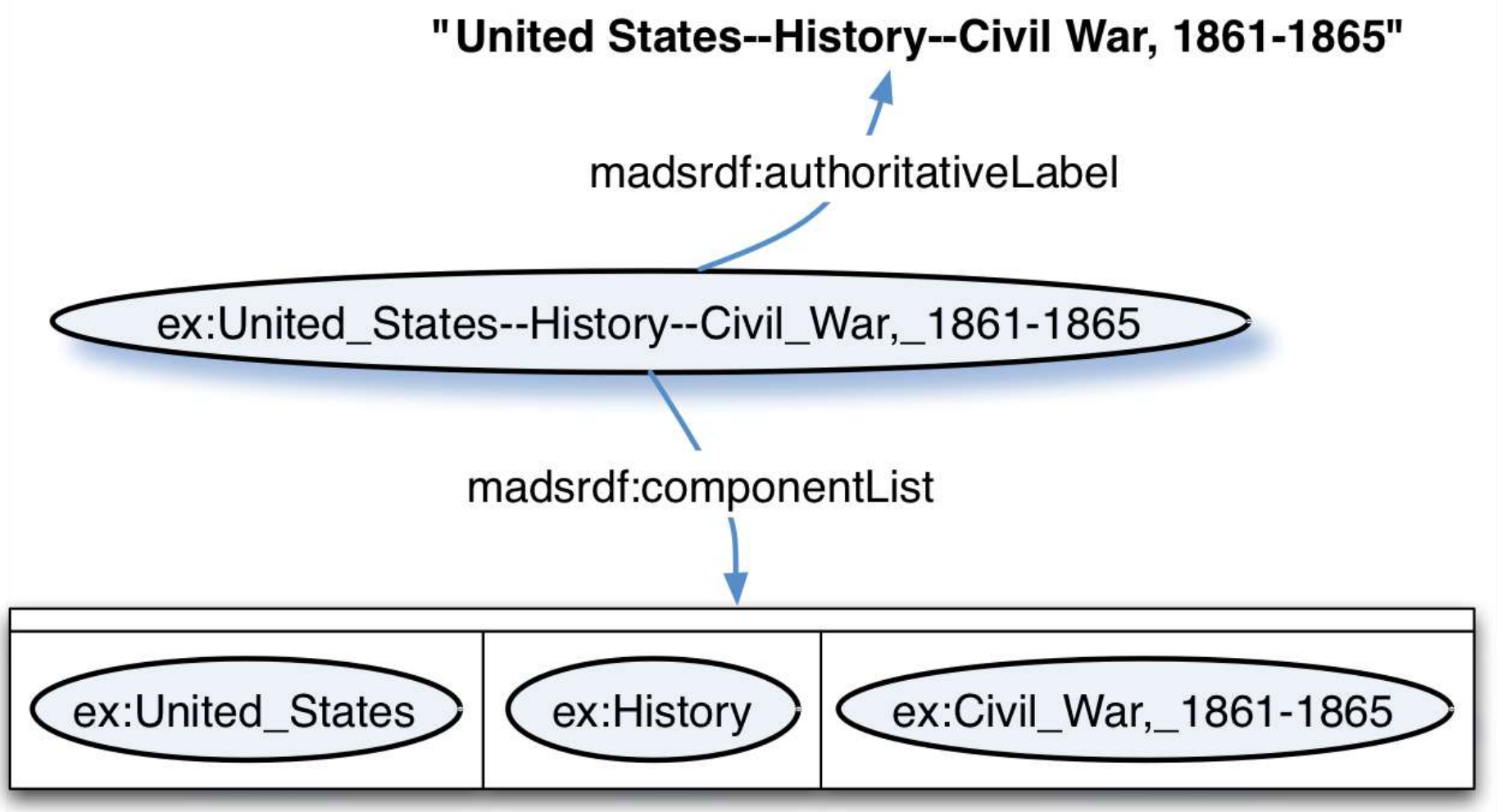
  Using subdivisions: `Brass bands—Sponsorship`

- “Coordination” seems too application- and/or KOS- specific

  At least it did for the SWD Group, compared to other KOS features

- It is also quite complex, not for Simple-KOS

Handled by MADS/RDF



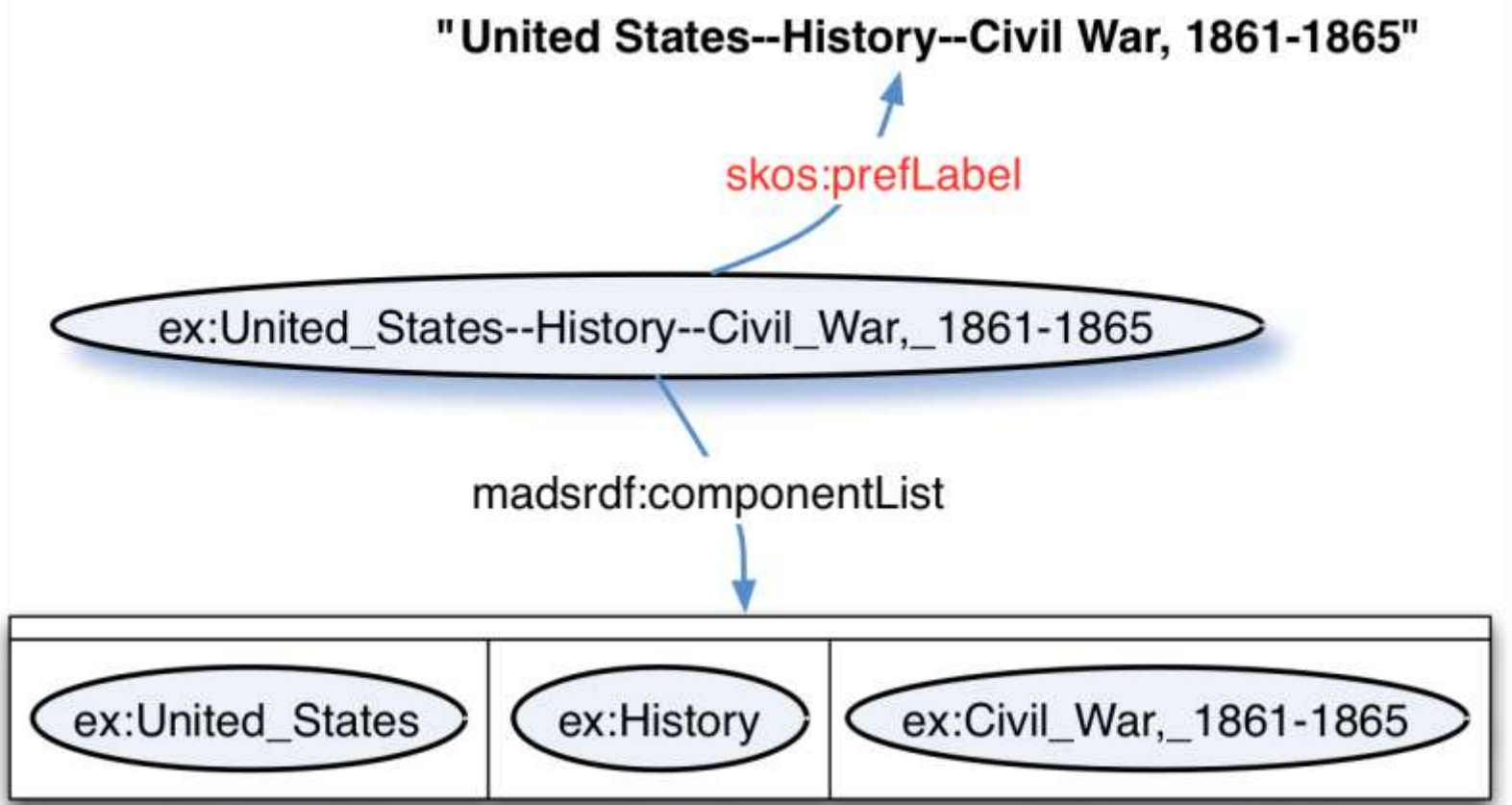
http://www.loc.gov/standards/mads/rdf/, implemented at id.loc.gov

Extending SKOS

- Vocabularies dedicated to specific KOS aspects can be defined as extensions to SKOS

```
madsrdf:authoritativeLabel rdfs:subPropertyOf skos:prefLabel
```

- Ensures compatibility with tools that consume simple SKOS



This tutorial

- Demo: SKOS data on the web
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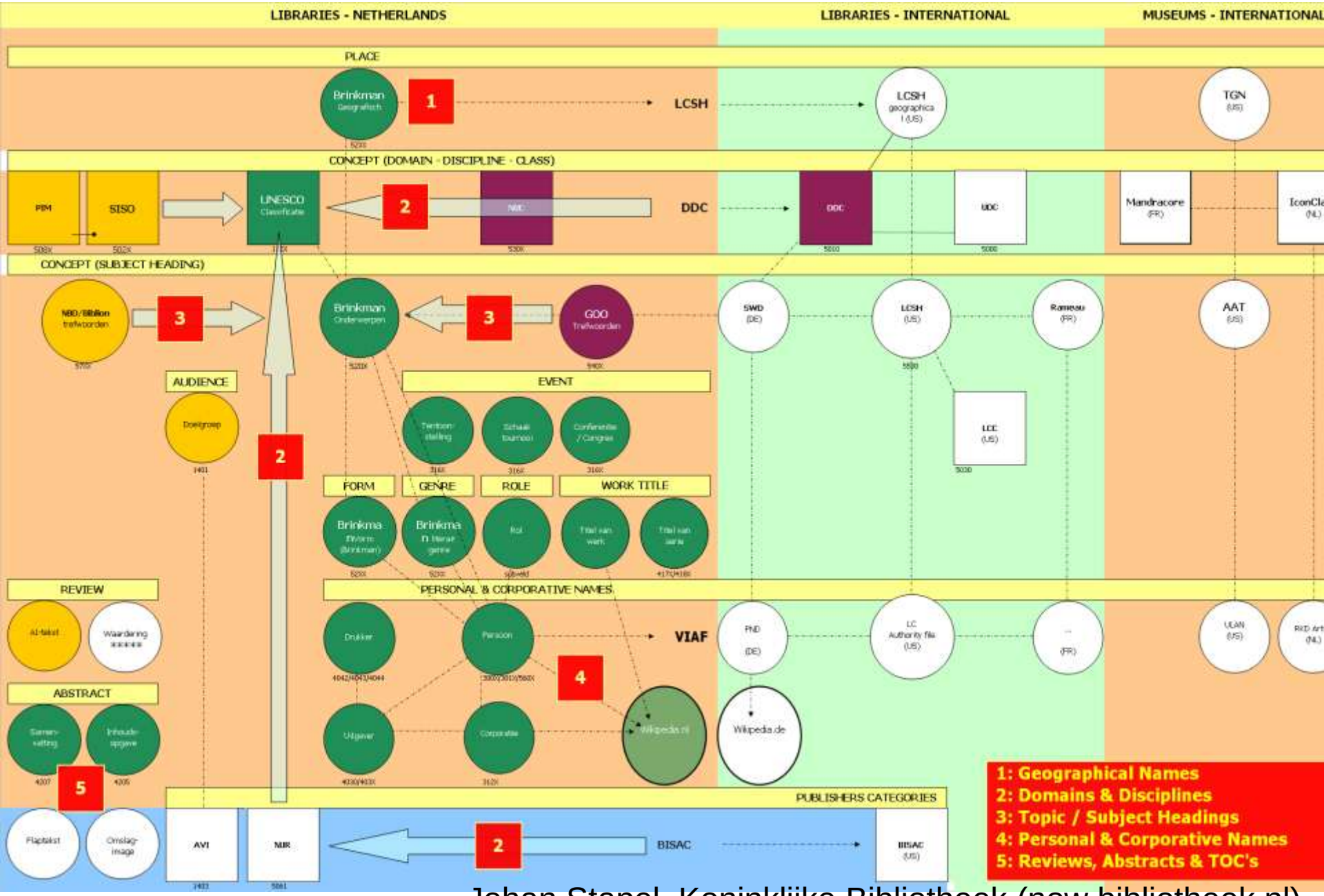
- Simple SKOS features
- More advanced SKOS
- Applications, tools & data

Benefits of SKOS?

Easily fitting KOSs into the Semantic Web & Linked Data vision

- Web-oriented representation
- Re-use & sharing of concepts and their descriptions
- Linking between concepts from different contexts
- Extensibility

A vision for the Dutch National Library



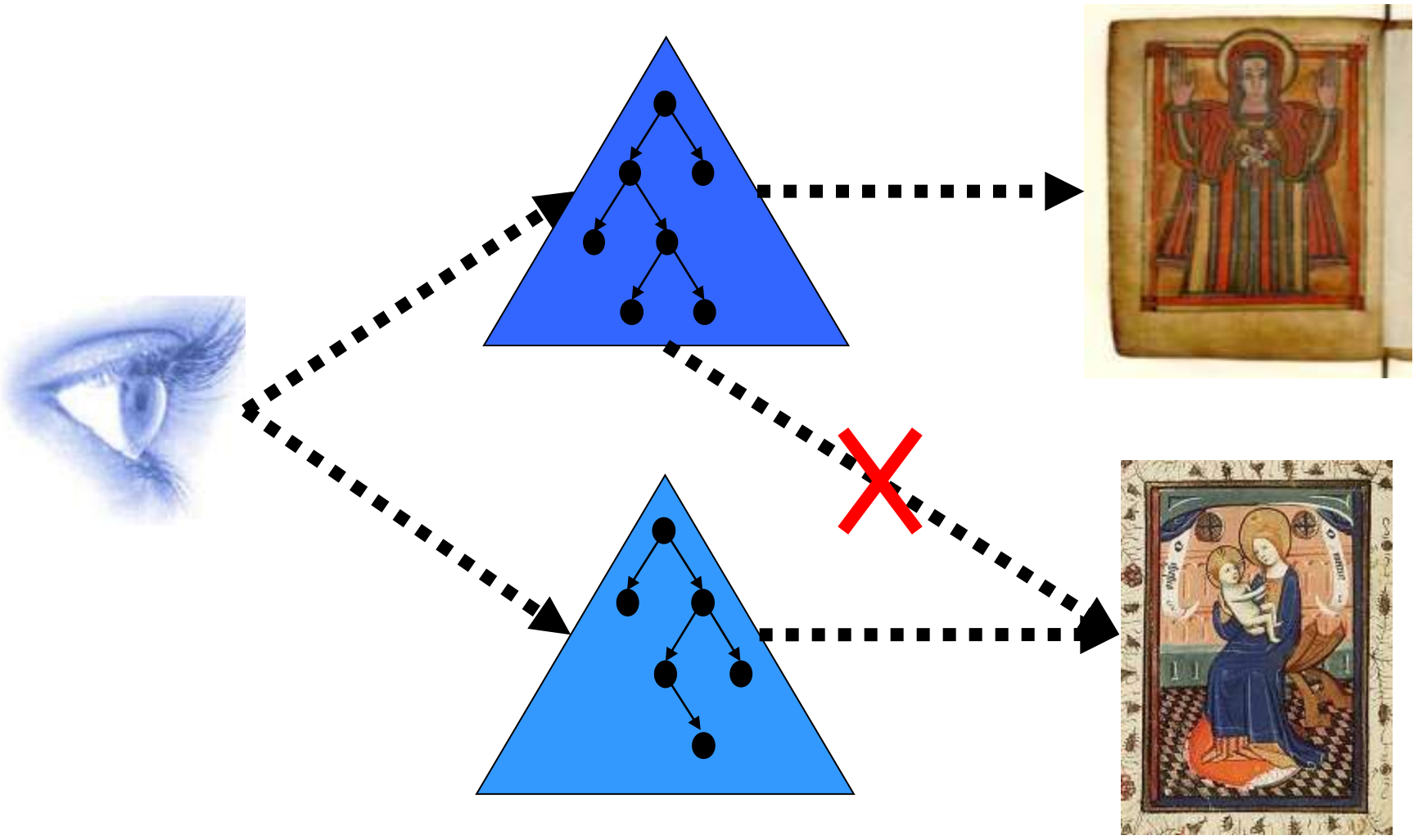
Johan Stapel, Koninklijke Bibliotheek (now bibliotheek.nl)

Unifying access to collections

Experiment from the STITCH project
http://stitch.cs.vu.nl/BNF_KB_demo.html

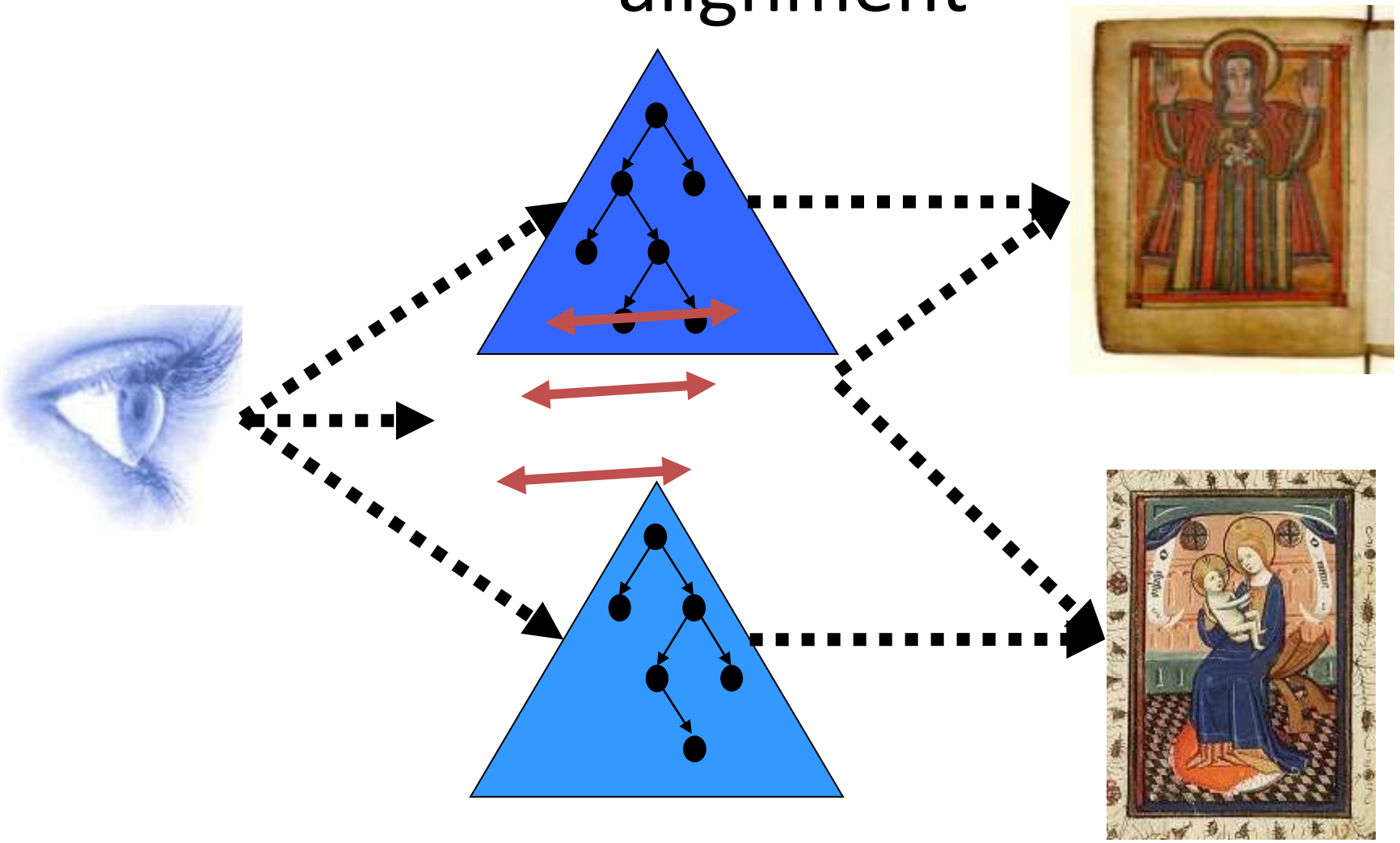
- KB Illuminated Manuscripts
- BnF Mandragore Manuscripts

Semantic reconciliation of collections

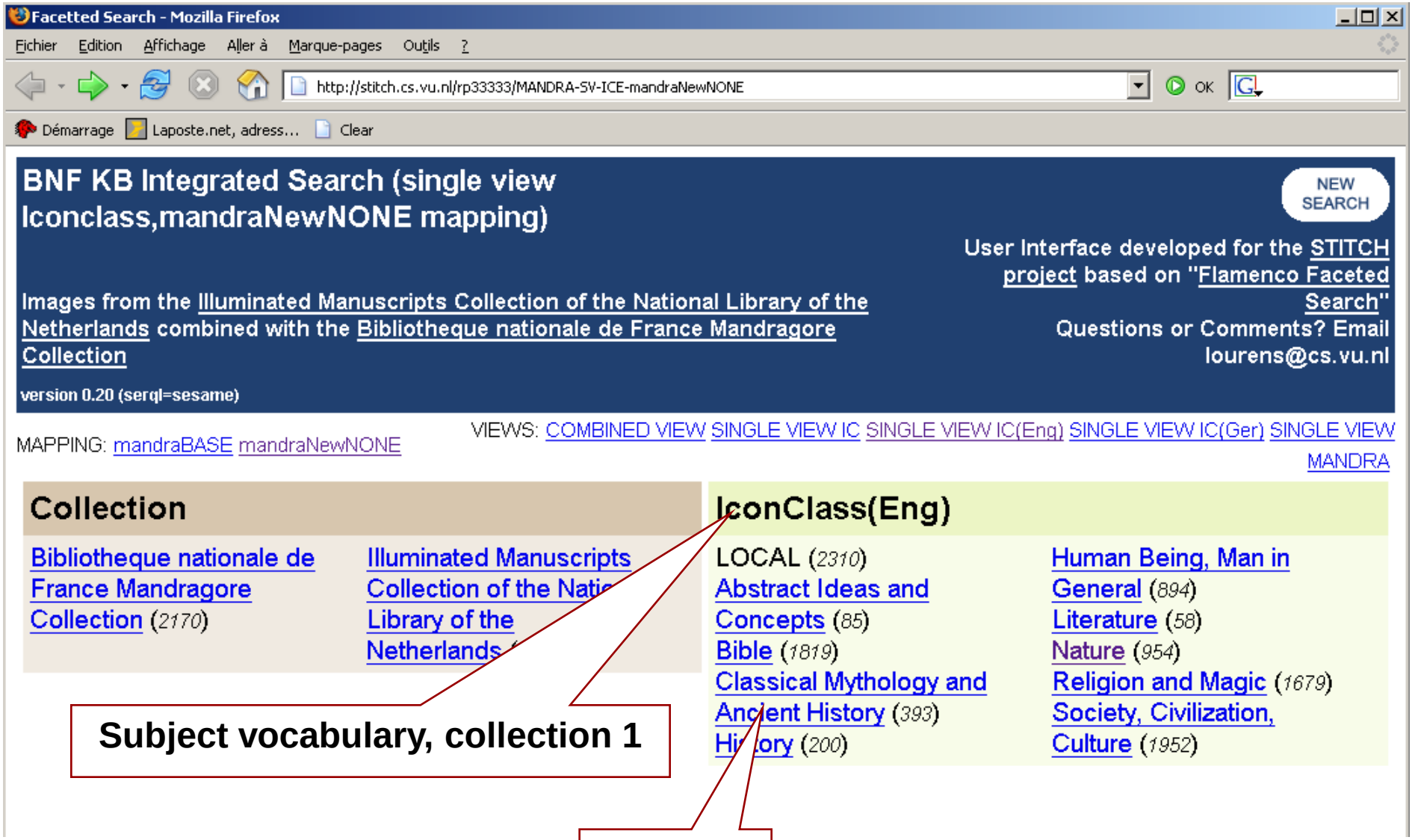


Blue triangles: (collection-)specific vocabularies

Reconciliation through vocabulary alignment

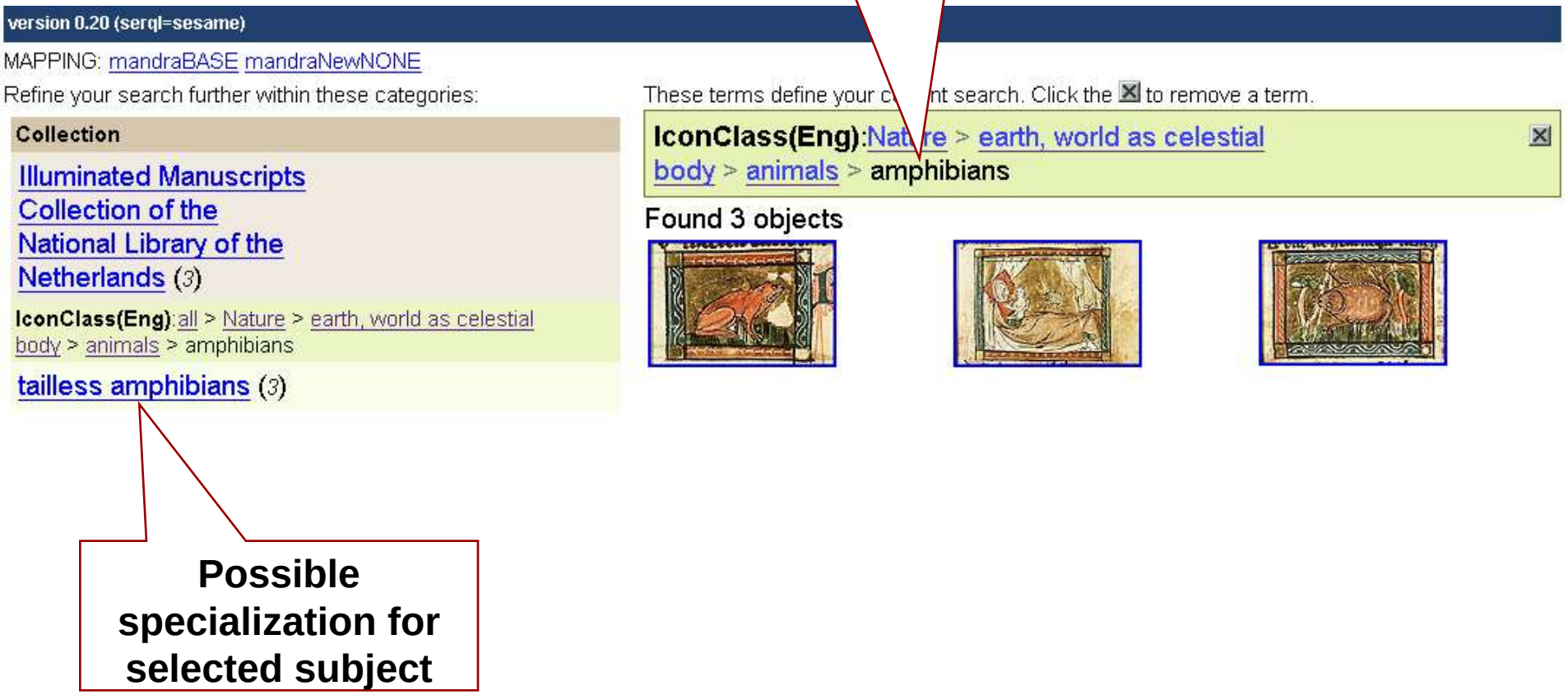


Demo: SKOS, browsing and alignment



Demo: SKOS, browsing and alignment

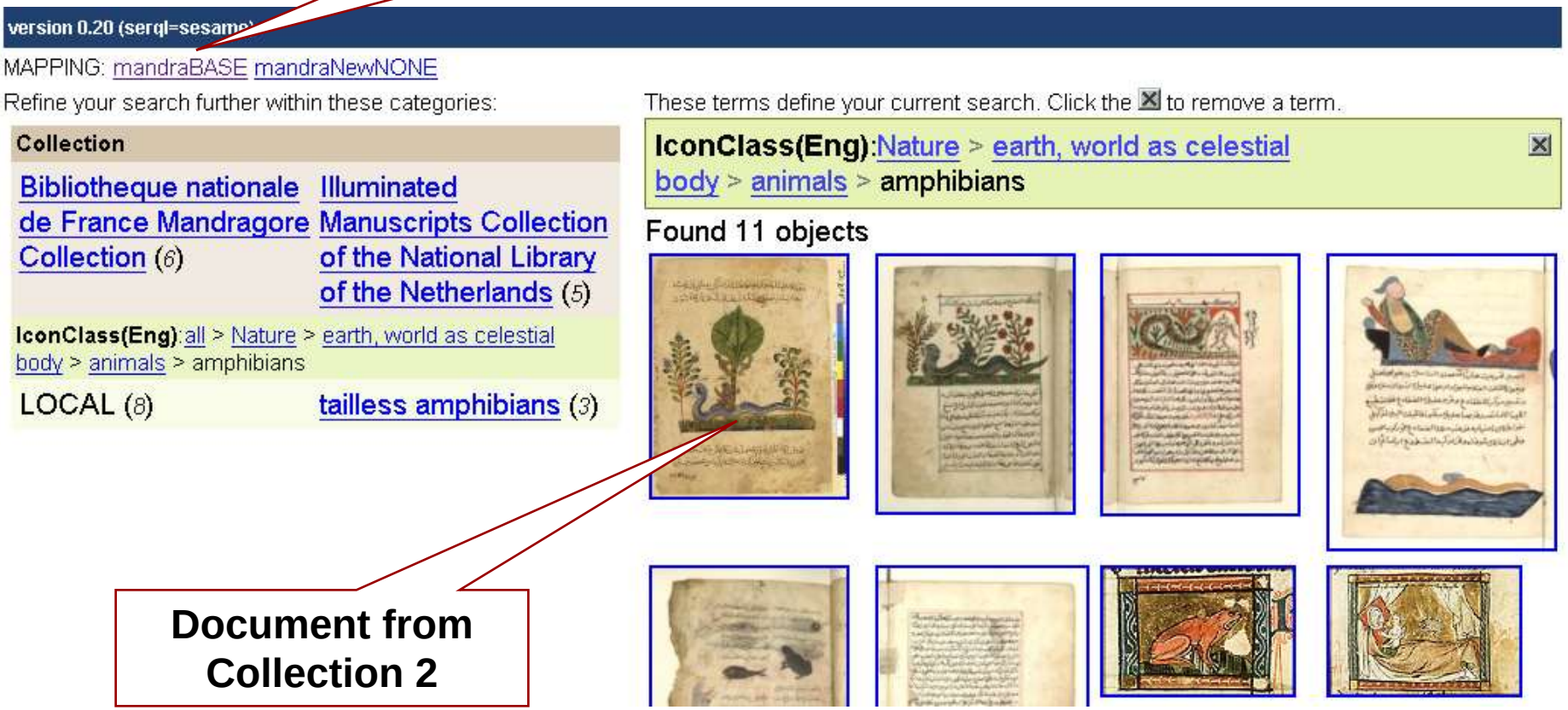
Hierarchical path from root to selected subject



Possible specialization for selected subject

Demo: SKOS, browsing and alignment

Semantic alignment of subjects activated



Document from Collection 2

Demo: SKOS, browsing and alignment

version 0.20 (serql=sesame)

Title:	Fable : le cobra et les grenouilles
Picture:	
Image taille réelle:	http://visualiseur.bnf.fr/Visualiseur?Destination=Mandrag
MANDRAGORE:	plante
MANDRAGORE:	naja
MANDRAGORE:	grenouille
MANDRAGORE:	fable
MANDRAGORE:	arbre
DATE:	13e siècle

Subject from voc2 aligned to voc1:amphibians"

europeana

think culture

Building a search engine on top of metadata is difficult

- Intrinsic quality problems: correctness, coverage

Especially when data is so heterogeneous

- Language issue

http://www.europeana.eu/

Prototype: Europeana Thought Lab

europeana
think culture

This is a research prototype of Europeana's semantic search engine.
Enter a search term, for example: Egypt, Rembrandt, window.

Egypt search

Collections Thesauri


Rijksmuseum
46,038 artworks


RKD
82,781 artworks


Louvre
11,327 artworks

home disclaimer datacloud acknowledgments

http://europeana.eu/portal/thought-lab.html

Noticeable facts

- KOS-independent systems

  A vocabulary can easily replace another in the system

- Use standard SKOS constructs

  `skos:broader`, **`skos:prefLabel`**, **`skos:exactMatch`**

- Computing links is helped by SKOS' straightforward representation of (multilingual) labels

  It is actually a case of monolingual (e.g., French-to-French or Russian-to-Russian) linking!

Semantic Annotation

E-Culture MultimediaN *Rijksmuseum PrentenKabinet Online*

search | browse | local view | annotate

annotate: Veroordeling van Johan van Oldenbarnevelt

Veroordeling van Johan van Oldenbarnevelt

RP-P-OB-77.320

Blad met een voorstelling van de onthoofding van Johan van Oldenbarnevelt op het Binnenhof te 's-Gravenhage op 13 mei 1619. Gezicht op het plein met alle omringende gebouwen en het verzamelde publiek. In de toren linksboven het hof van prins

Who Historical persons

person

What Iconclass (en), WordNet (en), events (nl)

city

Where Name of place or region

geographical place

When Date, year or period

enter date

done | cancel

Michiel Hildebrand

Benefiting from the availability of different vocabularies

E-Culture MultimediaN *Rijksmuseum PrentenKabinet Online*

search | browse | local view | annotate

annotate: Veroordeling van Johan van Oldenbarnevelt

Veroordeling van Johan van Oldenbarnevelt

RP-P-OB-77.320

Blad met een voorstelling van de onthoofding van Johan van Oldenbarnevelt op het Binnenhof te 's-Gravenhage op 13 mei 1619. Gezicht op het plein met alle omringende gebouwen en het verzamelde publiek. In de toren linksboven het hof van prins

Who Historical persons

person

What Iconclass (en), WordNet (en), events (nl)

city

Iconclass view all 178 results

[25I] **city-view, and landscape with man-made constructions**
Nature

[25I1] **city-view in general; 'veduta'**
Nature

[45K4] **capture of city (after the siege)**
Society, Civilization, Culture

WordNet view all 69 results

city (metropolis, urban center)
municipality

city
administrative district

Michiel Hildebrand

Direct access to the context of annotations

Or in a quite different domain…

http://www.nievre-tourisme.com/, with technology from Mondeca.com

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SKOS “Implementations”?

- Report by W3C Semantic Web deployment group
  - Tools to exploit or create SKOS data
  - Vocabularies: KOSs converted to SKOS

Miles, Bechhofer, *SKOS Implementation Report*, May 19th 2009
http://www.w3.org/2006/07/SWD/SKOS/reference/20090315/implementation.htm

SKOS “Implementations”?

Implementations

Construct	UMBEL Service	STW Service	CATCH Service	ScOT Service	PoolParty	SKOSEd	SKOS_WS	Szechenyi Library SKOS Converter	NSDL Metadata Registry	iQvoc
Collection	O	O	O	O	O	X	O	O	O	O
Concept	X	X	X	X	X	X	X	X	O	X
ConceptScheme	O	X	X	O	X	X	X	X	O	X

Vocabularies

Construct	UMBEL	STW Economics	Greek Terms	Decimalised Database of Concepts	CATCH Vocabs	ScOT	National Szechenyi Library Vocabulary	NSDL Vocabs	STAR English Heritage vocabs	LCSH	UMThes	IUPAC Green Book	SISM
Collection	O	O	O	O	O	O	O	O	O	O	O	O	O
Concept	X	X	X	X	X	X	X	O	X	X	X	X	X
ConceptScheme	O	X	X	X	X	O	X	O	X	X	X	X	X
OrderedCollection	O	O	O	O	O	O	O	O	O	O	O	O	O
altLabel	X	X	X	X	X	X	X	X	X	X	X	O	X
broadMatch	O	O	O	O	O	O	O	O	O	O	X	O	O
broader	X	X	X	X	X	X	X	X	X	X	X	O	X
broaderTransitive	X	O	X	O	O	O	O	O	O	O	X	O	O

Tools

SKOSEd, Poolparty, ThManager, iQvoc, ITM, TemaTres, FAO workbench, the Metadata Registry, HIVE, ONKI…

- Editors, browsers, validators, registries
- APIs/Web services
- Annotation tools
- Search engines

But any general semantic web / linked data tool could be relevant

http://www.w3.org/2001/sw/wiki/SKOS

Available data

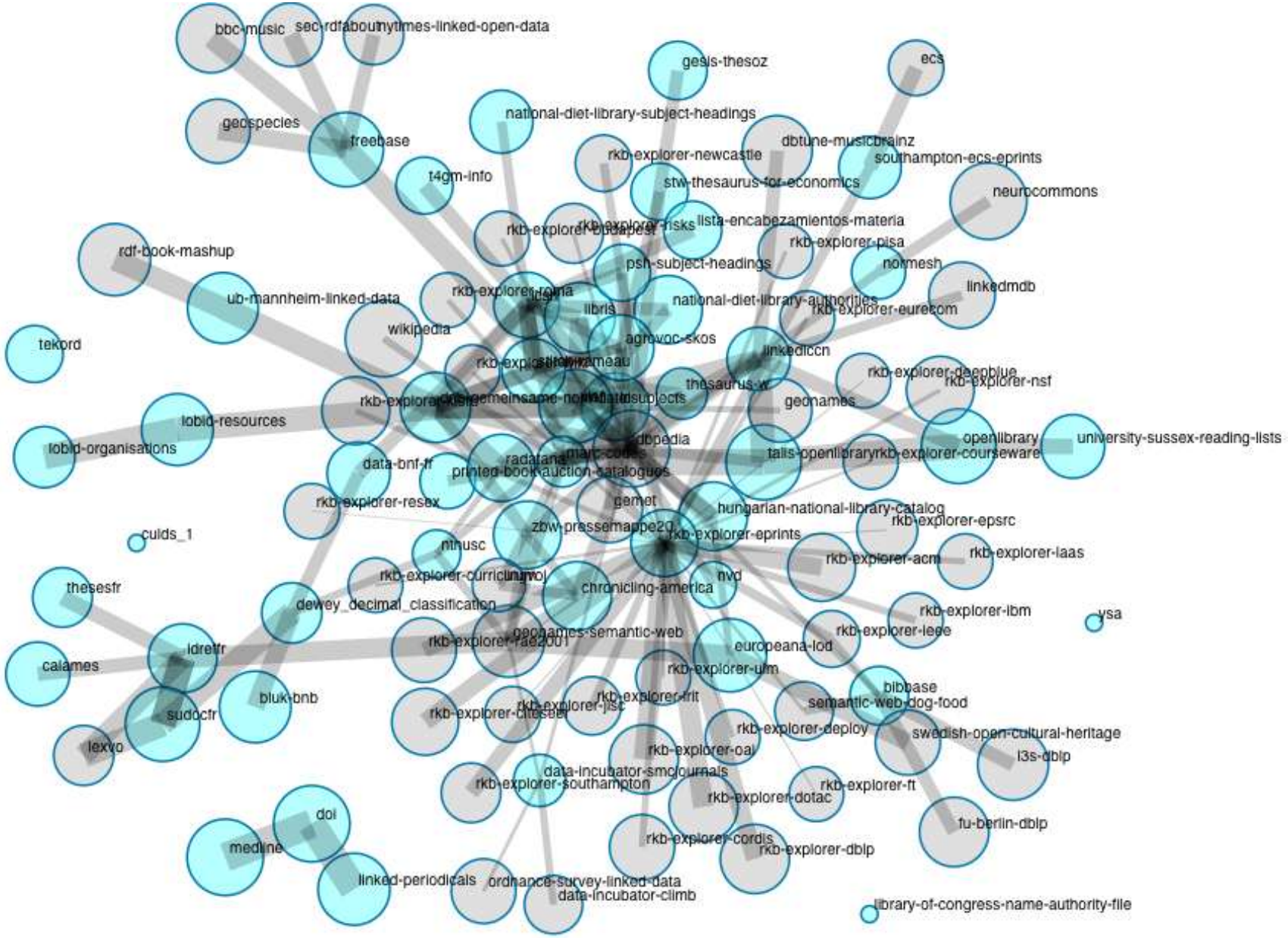
- General SKOS data
  - W3C wiki page http://www.w3.org/2001/sw/wiki/SKOS/Datasets
  - Datasets on the Data Hub: http://ckan.net/dataset?q=format-skos
- Inventory of Library Linked Data resources
  - W3C LLD Incubator Deliverable on available value vocabularies coming very soon!
  - Datasets on the Data Hub: http://ckan.net/group/lld
  - (you can contribute!)

Available data

Specific registry pages

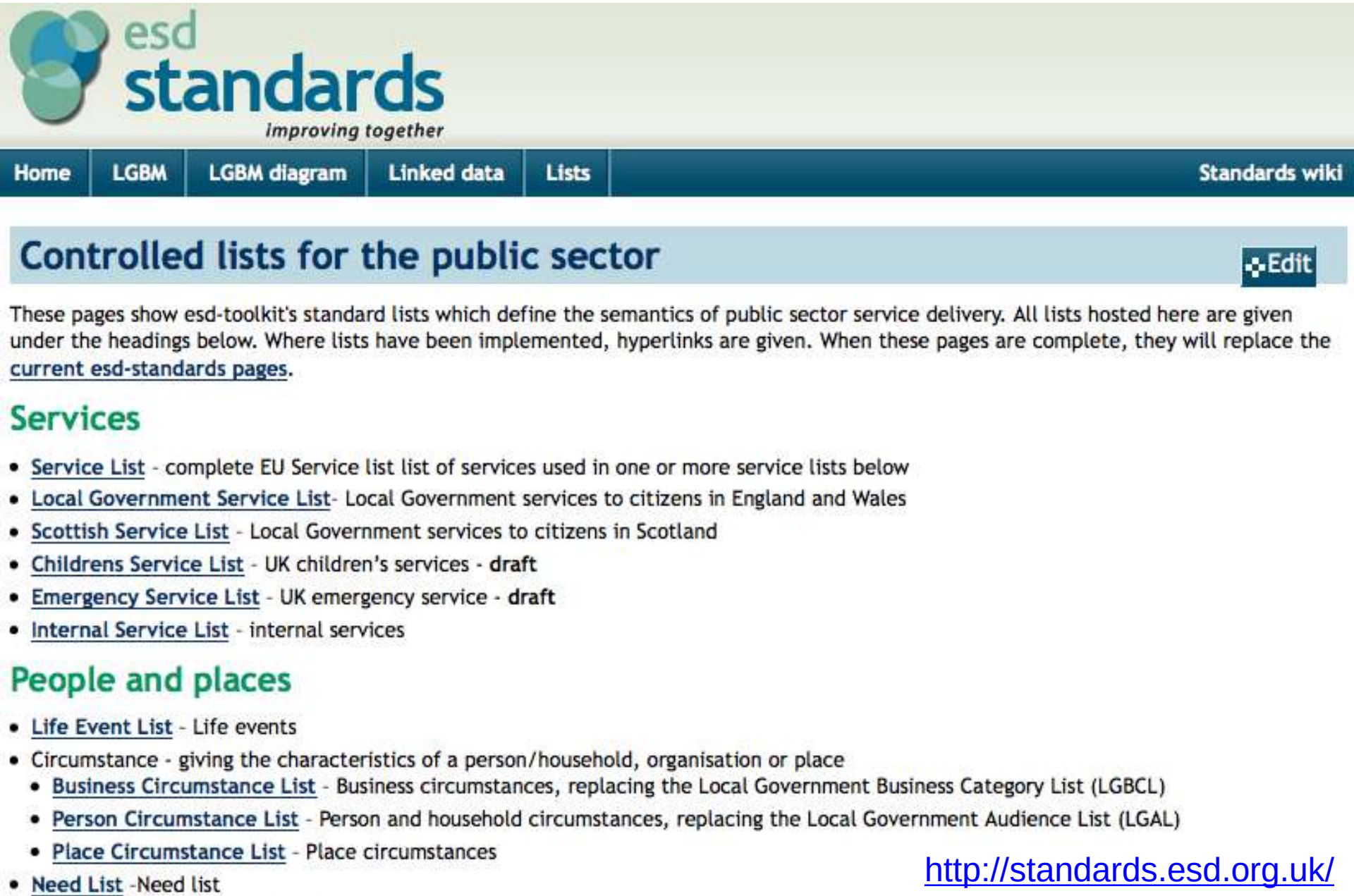
- The Metadata Registry
- ONKI
- HIVE

…



http://semantic.ckan.net/group/?group=http://ckan.net/group/lld

Government data



http://standards.esd.org.uk/

Astronomy research

IVOA Proposed Recommendation

Vocabularies in the Virtual Observatory
Version 1.16

IVOA Proposed Recommendation, 2008 November 4

Editors

Alasdair J G Gray, University of Glasgow, UK
Norman Gray, University of Leicester / University of Glasgow, UK
Frederic V Hessman, University of Göttingen, Germany
Andrea Preite Martinez, INAF, Italy

Authors

Sébastien Derriere, Alasdair J G Gray, Norman Gray, Frederic V Hessman, Tony Linde, Andrea Preite Martinez, Rob Seaman and Br

Abstract

As the astronomical information processed within the *Virtual Observatory* becomes more complex, there is an increasing need for a more fo
quantities, concepts, and processes not confined to things easily placed in a FITS image, or expressed in a catalogue or a table. This docum
format for vocabularies based on the W3C's *Resource Description Framework* (RDF) and *Simple Knowledge Organization System* (SKOS

Some landmark KOS LD implementations

- Many Libraries – not a surprise!
  - Swedish National Library's Libris catalogue and thesaurus http://libris.kb.se/
  - Library of Congress' vocabularies, including LCSH http://id.loc.gov/
  - DNB's Gemeinsame Normdatei (incl. SWD subject headings) http://d-nb.info/gnd/
    Documentation at https://wiki.d-nb.de/display/LDS
  - BnF's RAMEAU subject headings http://stitch.cs.vu.nl/
  - OCLC's DDC classification http://dewey.info/ and VIAF http://viaf.org/
  - STW economy thesaurus http://zbw.eu/stw
  - National Library of Hungary's catalogue and thesauri http://oszkdk.oszk.hu/resource/DRJ/404 (example)
- Other fields
  - Wikipedia categories through Dbpedia http://dbpedia.org/
  - New York Times subject headings http://data.nytimes.com/
  - IVOA astronomy vocabularies http://www.ivoa.net/Documents/latest/Vocabularies.html
  - GEMET environmental thesaurus http://eionet.europa.eu/gemet
  - Agrovoc http://aims.fao.org/
  - Linked Life Data http://linkedlifedata.com/
  - Taxonconcept http://www.taxonconcept.org/
  - UK Public sector vocabularies http://standards.esd.org.uk/ (e.g., http://id.esd.org.uk/lifeEvent/7)

Challenge: Linking!

Manual mapping of large vocabularies is labour-intensive

- MACS project: LCSH, RAMEAU and SWD

  http://macs.cenl.org

- CRISS-CROSS project: SWD and DDC

  http://linux2.fbi.fh-koeln.de/crisscross/

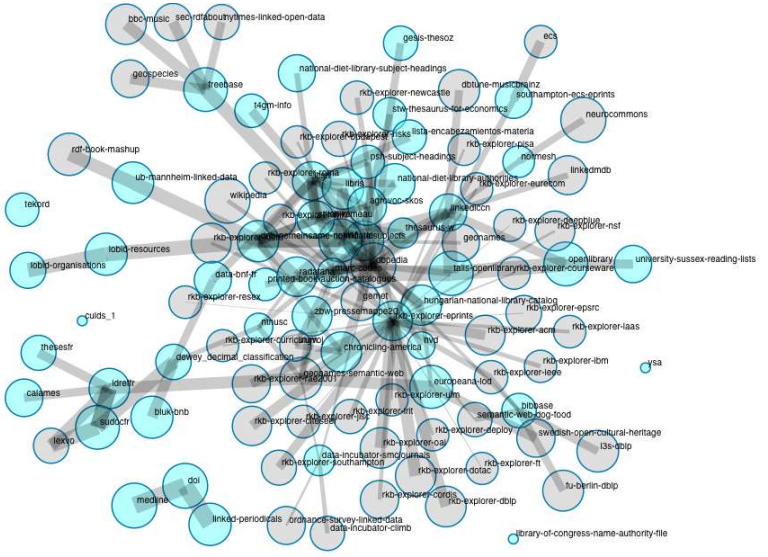
Automatic linking is not perfect but can help

KOS Alignments?

Quite many of them are linked to some other resource

- LCSH, SWD and RAMEAU interlinked through MACS mappings
- GND -> DBpedia, VIAF
- Libris -> LCSH
- Agrovoc -> CAT, NAL, SWD, GEMET
- NYT -> freebase, DBpedia, GeoNames
- dbPedia links are overwhelming

  Hungary, STW, TaxonConcept, GND…



Issue: inter-linking KOS data

- KOSs become valuable when they bring a “semantic layer” over other resources
  - E.g. books and the topics they are about
- Links between concept schemes are still scarce
- Links between objects and KOS are often only implicit in the data

More efforts on semantic annotation with KOS and KOS alignment are needed

Take-home messages: status quo

Publication and linking of linked KOS data is still work in progress,

But we can start building applications that make use of the wealth of data already available

Take-home messages: technical benefits of SKOS

Not just a more sophisticated way to represent data!

- Ease of getting data from external sources
- Ease of publishing data
- Ease of linking across datasets

If we stop here, thanks for your attention!

Any (more) questions?

Acknowledgements

- Material on a couple of slides borrowed from Alistair Miles, Michiel Hildebrand, Johan Stapel and Guus Schreiber
- Participants of the Semantic Web Deployment working group

References

SKOS Reference	http://www.w3.org/TR/skos-reference
SKOS Primer	http://www.w3.org/TR/skos-primer
SKOS homepage	http://www.w3.org/2004/02/skos
SKOS wiki	http://www.w3.org/2001/sw/wiki/SKOS
SKOS mailing list	public-esw-thes@w3.org