SKOS: Past, Present Future*
*and a little bit of History, Architecture and Engineering

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The view from the twitterati
• Simple Knowledge Organisation System
• A common data model for sharing and linking knowledge organization systems via the Web.
• Why should you care?
SKOS

- Publication of knowledge organisation systems
- Low cost entry to participation in the Semantic Web/Data Web
- Lightweight integration capabilities
- Mapping support

Simplicity
Standardisation
Extensibility
Bridging the Gap

• *Bridging the Gap*: Bates, Marchionini etc.
• My introduction to Library Sciences and Thesauri
• Facilitating communication and sharing between people with possibly differing viewpoints
• “…Bridge between different communities of practice…”

*SKOS REC*

• A metaphor to (ab)use….
  ▪ “don’t look a gift metaphor in the mouth” (a meta-metaphor?)
Personal History

- Conceptual Hypermedia
- Conceptual models generating link structures for hypermedia
- Use of DAML+OIL/OWL
  - Standardised, published sources, existing infrastructure and tooling
  - But not appropriate navigational structures
- The need for SKOS

http://dx.doi.org/10.1109/MIC.2008.68
What goes around comes around
SKOS the Brave

Bro-Skos

Diwar Wikipedia, an hollouezladur digor

Labour zo d’ober c’hoazh e-raok peurechuïñ ar pennad-mañ. Ma fell deoc’h reñï un tamn skoažell, krogit e-barzh. Mer karfec’h reñï hoch’al ha neutra ken, grit ‘ta e pajenn ar gaozeadenn.

Skos pe Bro-Skos, pe c’hoazh Alba, Alban diwar hec’h anv gouezelek, a zo ur vro geltie e lodenn norzh Breizh-Veur. En tu-mont d’an douar bras ez eus 790 enezenn bennak. Dinedin eo ar gêrbonn, met Glasgow eo ar gêr vraññ. Aberdeen ha Dundee eo an div gêr bouezusañ war-lerc’h, dirak Stirling, Perth, hag Inverness.

Ouzhpenn saozneg e vez komzet gouezeleg, en inizi ar c’hornog drelst-holl, ha skoteg, ur yezh kar d’ar saozneg. Robert Burns, barzh brudetañ Bro-Skos, a skrive e saozneg.
**Thesaurus:** Controlled vocabulary in which concepts are represented by preferred terms, formally organised so that paradigmatic relationships between the concepts are made explicit, and the preferred terms are accompanied by lead-in entries for synonyms or quasi-synonyms.

**Controlled vocabularies:** designed for use in classifying or indexing documents and for searching them.
• SWAD Europe Thesaurus Activity
  • Early work on RDF vocabularies for describing thesaurus data
    – SKOS Core
    – Usage guides
• Implementation work
  – Thesaurus services
Sem Web Best Practices & Deployment

...hands on support for developers of Semantic Web Applications

- SKOS Core Vocabulary Specification
- SKOS Core Guide
- Working Drafts (rather than Rec track documents)
Semantic Web Deployment

In effect, SKOS and RDFa.

- SKOS Reference
- SKOS Primer
- Best Practice Recipes for Publishing RDF Vocabs.

...provide guidance in the form of W3 Technical Reports on issues of practical development and deployment practices in the area of publishing vocabularies...and integrating RDF with HTML documents.
SKOS Use Cases

- Access to image collections.
- Search across (multi-lingual) mapped thesauri.
- Product Lifecycle
- Metadata Registry

- Cultural Heritage, Medicine, Agriculture, TV/Radio

- Not explicitly “Linked Data”
Bridge 77, Macclesfield Canal

William Crosley
Macclesfield Canal Company 1825-1831
SKOS Goals

• to provide a *simple*, machine-understandable, representation framework for Knowledge Organisation Systems (KOS)…

• that has the *flexibility* and *extensibility* to cope with the variation found in KOS idioms…

• that is fully capable of supporting the publication and use of KOS within a *decentralised*, *distributed*, information environment such as the world wide (semantic) web.
SKOS adopts a concept-based (as opposed to term-based) approach.

- Concepts associated with lexical labels.
- Relationships expressed between concepts.
- Possibility of expressing relationships between terms through SKOS-XL.
SKOS Example

animals
  NT cats

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

domestic cats
  USE cats

wildcats

Graphic: Antoine Isaac
Labelling

- Lexical Labels associated with Concepts
  - Preferred: one per language
  - Alternate: variants,
  - Hidden: mis-spellings
- No domains stated, so usage possible on any resource.
- Labels pairwise disjoint.

- Label Extension (SKOS-XL) provides additional support for descriptions of labels and links between them
  - E.g. acronyms, abbreviations
Documentation

- A number of documentation properties
- Not intended to be comprehensive
- *Extension* points
Semantic Relations

- Hierarchical and Associative
- Broader/Narrower
- Loose (i.e. no) semantics
  - A publishing vehicle, not a set of thesaurus construction guidelines
- Domain/Range restrictions on semantic relations
- Broader/narrower not transitive in SKOS
Mapping Relations

- Subproperties of Semantic Relations
- Intended for cross-scheme usage
  - Although no formal enforcement
Support definition of “arrays” with node labels
Node Labels not concepts
Systematic or hierarchical displays can then be created based on Collections
– Application choice as to how to do this.

milk
  <milk by source animal>
    cow milk
    goat milk
    buffalo milk
What’s not there?

- Subject indexing properties
  - Focus on vocabulary publication
- Co-ordination
  - No mechanisms in SKOS that support combinations of terms in *pre-coordination*.
  - *Post-coordination* possible through query
- Support for rich linguistic structures.
- Versioning
Stockport Viaduct

George Watson Buck
1840
Bricks all the way through

• Triples all the Way!
• SKOS is “SW tech” from the ground up
  – URIs for concept identifiers
  – RDF Vocabulary
  – Defined as OWL Ontology
• Use of common infrastructure and off the shelf tooling for delivery, storage and query.
• SPARQL Queries for validation
  – Simple Services for checking labels in vocabs (validation via ASK: IPSV)
  – ZBW Experiences
SKOS and OWL

• SKOS itself is defined as an OWL ontology.
• A particular SKOS vocabulary is an instantiation of that ontology/schema
  – SKOS Concept is a Class, particular concepts are instances of that class
• Allows use of OWL mechanisms to define properties of SKOS (e.g. the querying of the transitive closure of broader).
  – E.g. SKOSEd built on Protege

S. Jupp, S. Bechhofer and R. Stevens *A Flexible API and Editor for SKOS*
ESWC2009 [http://dx.doi.org/10.1007/978-3-642-02121-3_38](http://dx.doi.org/10.1007/978-3-642-02121-3_38)
Containment

- Representation of Semantic Relationships within Schemes
- Can only relate Concepts to the ConceptSchemes in which they occur.
- Named Graphs
Ashness Bridge

Unknown
c. 17th Century
• **International Virtual Observatory Alliance (IVOA)** early adopters of SKOS

• Word lists presented in specifications.
  – Hard coded into applications.
  – SKOS allows explicit representation of that information

• “SKOS to help find data, not describe it – vocabularies rather than ontologies”

[IVOA Vocabularies in the Virtual Observatory](http://www.ivoa.net/Documents/latest/Vocabularies.html)
IVOA Vocabularies

- Multiple Sub-communities

- UCD Universal [Column/Content] Descriptors
  - Observed/Collected from survey of datasets

- IAU “Proper” thesaurus. Proprietary tools/formats
  - Little usage (too big?)

- Keywords lists for papers (Web pages)

- SIMBAD

A. Gray, N. Gray, C. Hall and I Ounis Finding the right term: Retrieving and exploring semantic concepts in astronomical vocabularies Information Processing and Management (2009) http://dx.doi.org/10.1016/j.ipm.2009.09.004
IVOA Scenario

- ADS article archive.
- Journal keywords scraped from papers/PDF metadata.
- Mapping to AVM (used for, e.g. NASA images of the day)
- *Simple* mechanism supporting navigation from papers to images.
- *Mapping* is key here.
  - Communities continue to use their own vocabularies
  - Cross-walking

- SKOS as *glue* in Linked Data
• This is SW 101, but still useful!
• A conservative community – resistant to change, very long term view.
• A techie community, but they don’t like to do it.
  – Vocab construction is not their core business (but useful)
• Timely: SKOS fits the (current) metadata needs of this community.
Europeana

- Access to millions of digital items from multiple collection
- Multiple KOS used
- **SKOSification** of sources: SKOS as a common format supporting integration and mapping/alignment between terminologies.
- Thought-Lab
  - Auto completion
  - Clustering
  - Label Matching
- Linked Data publication

S. Gradmann *Europeana White Paper 1*
Examples: LCSH

- Thesaurus used for bibliographic records
- Not an ontology, but an indexing scheme
- Features/Functions/Labels mapped to SKOS Properties
- Delivery as Linked Data
  - Cool URIs
  - Content Negotiation
- lcsh.info URIS used elsewhere
- Applications consumed the data.

E. Summers, A. Isaac, C. Redding, and D. Krech. **LCSH, SKOS and linked data**
*International Conference on Dublin Core and Metadata Applications 2008* [http://arxiv.org/abs/0805.2855v3]
Scary Bridge

Unknown, Dalat, Vietnam
20th Century
• Taken down by LC (boo!)
• Why?
  – “Confusing”?  
  – Licensing issues? 
  – Scared to step out?
• Convincing organisations of the benefit of opening data.

Dan Chudnov: “It was an important enough success that it was taken down. If it never gained notice, if it weren’t useful, if it didn’t promise something bigger, if it didn’t make sense, if nobody cared, it would still be up. Yknow?”
A happy ending: id.loc.gov

- Now up as http://id.loc.gov/authorities/
  - With redirects from original URIs....
- Exposed using RDFa (as are many SKOS vocabularies)

- Additional vocabs
  - Graphic materials
  - Preservation metadata
RDFa

• Embedding structured data in markup (e.g. HTML Pages).
• Another bridge bringing people into the SW world.
• RDFa a nice fit with SKOS publication.
  – Structured information
  – Chunked
  – Essentially “parallel” human and machine readable aspects to the data
Electronic Service Delivery (ESD)

- Local Authority Service classification
- Integrated Public Service Vocabulary
- Service List
- Local Government Service List
Desiderata:
1. Web-based Presentation
2. Preferred term suggestion
3. Integration with other environments
4. Foster third party reuse
5. Links to other data sets

J. Nuebert: Bringing the "Thesaurus for Economics" on to the Web of Linked Data LDOW2009
• Extension via:
  – Mix in of vocabularies (DC)
  – Subclassing of skos:Concept

  – Subproperties of skos:note
• RDFa presentation of content.

• SPARQL, RDFa, off-the-shelf integration/components
• Standardisation…
ONKI: Finland

- ONKI SKOS Server
- Delivering SKOS Vocabularies as Services
- Widgets for user interaction and concept selection

Jouni Tuominen, Matias Frosterus, Kim Viljanen, and Eero Hyvonen

ONKI SKOS Server for Publishing and Utilizing SKOS Vocabularies and Ontologies as Services

ESWC2009

http://dx.doi.org/10.1007/978-3-642-02121-3_56
Drupal, RDFa and SKOS

- Drupal exposing information using RDFa
- Use of SKOS for representation and exposure of taxonomic information
- SW “by stealth”.
- Another “bridge” bringing users in.

S. Corlosquet, R. Delbru, T. Clark, A. Polleres and S. Decker. **Produce and Consume Linked Data with Drupal!** ISWC2009

http://dx.doi.org/10.1007/978-3-642-04930-9_48
SKOS as a Gateway Drug
Tooling
Union Chain Bridge

Captain Samuel Brown,
Adam Clark, 1820
SKOS and Linked Data

- Linked Data standardised “guidelines” for publishing data
  - URIs for identification
  - Provide useful information when dereferenced
  - Link to other URIs
- SKOS as lightweight semantics for LD
- Facilitating publication of existing KOS/data.

<table>
<thead>
<tr>
<th>SKOS</th>
<th>LD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indexing/Retrieval</td>
<td>Discovery</td>
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<td>Semantic Relations</td>
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</tr>
<tr>
<td>Mapping</td>
<td>Linking and Integration beyond URI matching</td>
</tr>
</tbody>
</table>
sameAs vs mapping

- SKOS mapping properties less “dangerous” than sameAs?
- SKOS mapping properties closer to some interpretations of sameAs?
- What about the domain and range restrictions?

The Mancunian Way

Unknown
Opened 1967
SKOS Namespace

- Original documents used
  - [http://www.w3.org/2004/02/skos/core#](http://www.w3.org/2004/02/skos/core#)
- Proposal was made to change to
  - [http://www.w3.org/2008/05/skos#](http://www.w3.org/2008/05/skos#)
- Final decision (See ISSUES 153 & 175) kept the original namespace
  - Changes to the semantics of broader/narrower. No longer transitive, but transitive super
  - Difficult trade-off. Changing names would negate the benefit of maintaining the namespace.
  - Changes reflected in the machine readable schema, so tooling should, in principle be able to pick this up.
Transitivity of Semantic Relations

- Broader/narrower not transitive in SKOS
  - Addition of broaderTransitive
- Separate assertions from inferences
- Thus can still query across transitive closure of broader.
  - User confusion with transitivity and inheritance.
Previous versions included skos:subject

Issue 77 (cf. 48)

RESOLVED to not include the SKOS indexing properties because 1) it's the role of SKOS to publish vocabularies and not to indicate how they should be used for indexing purposes 2) there appear to be enough support from existing metadata vocabularies to handle links between resources and SKOS concepts

But actually used heavily out there in the wild…
SKOS and OWL

- SKOS as OWL Full Ontology
- Steps outside of the bounds of OWL
  - Property disjointness
  - Annotation subproperties
  - Restrictions on preferred Labels.
  - “Pruned” RDF schema.
- OWL2 can represent some of this
  - But not all…
SKOS and OWL

• SKOS and OWL are intended for different purposes.
  – OWL allows the explicit modelling/description of a domain
  – SKOS provides vocabulary and navigational structure
• Interactions between representations
  – Presenting OWL ontologies as SKOS vocabularies
  – Enriching SKOS vocabularies as OWL ontologies.
  – Use of SKOS as annotation vocabulary
The Forth Rail Bridge

John Fowler & Benjamin Baker
Built by William Arrol & Co. 1883-1890
Are we done yet?

• A Working Group is a constrained exercise
• Chasing Specs
  – OWL/OWL2/RIF/Named Graphs
• Some aspects may be considered out of scope
• Standardisation is necessarily a compromise.
  – Everyone equally unhappy = success!

• A number of issues were *postponed*, due to
  – Lack of time
  – Lack of implementation experience
Postponed Issues

35 RulesAndConformance
- Rules not explicitly mentioned in REC
- No Rule REC at the time

38 CompatibilityWithOWLDDL
- Synchronisation with OWL WG
- OWL DL “pruned” schema

40 ConceptCoordination
- Lack of time and implementation experience.

45 NaryLinksBetweenDescriptorsAndNonDescriptors
- USE X + Y”, ”USE X OR Y”
- Lack of time and implementation experience.

56 ReferenceSemanticRelationshipSpecializations
- broaderGeneric etc.
- Insufficient information on how to embed them in the data model

84 ConstructionOfSystematicDisplaysFromGroupings
- No changes needed to vocabulary
- Implementation is feasible
- Lack of time
131 mappings with a boolean expression (LC)
  – Requires substantial additions to foundations
  – Could be handled via extensions

136 plain literal ranges and internationalisation
  – Constraints not expressed in OWL

137 property disjointness

138 S14 skos:prefLabel

155 SKOS in OWL 2
  – OWL 2

149 Asymmetric associations
  – Possible through extensions

176 Mapping vocabulary constraints
  – Insufficient experience

178 PFWG: Semantic Relations
  – Cf 56.

180 PFWG: skosxl:Label class
  – XL as basis for extensions
Who’s under there?
Simple Knowledge Organisation System

- Is it too simple?
  - Three relations plus some attributes
- Is there enough knowledge?
  - No formal semantics
  - Very little inference capability
  - What’s a concept?
- Is there sufficient organisation?
  - Containment in schemes
Incubator Activity > W3C Library Linked Data Incubator Group

The mission of the Library Linked Data incubator group is to help increase global interoperability of library data on the Web, by bringing together people involved in Semantic Web activities—focusing on Linked Data—in the library community and beyond, building on existing initiatives, and identifying collaboration tracks for the future.

The group will explore how existing building blocks of librarianship, such as metadata models, metadata schemes, standards and protocols for building interoperability and library systems and networked environments, encourage libraries to bring their content, and generally re-orient their approaches to data interoperability towards the Web, also reaching to other communities. It will also envision these communities as a potential major provider of authoritative datasets (personae, topics...) for the Linked Data Web. As these evolutions raise a need for a shared standardization effort within the library community around Semantic Web standards, the group will refine the knowledge of this need, express requirements for standards and guidelines, and propose a way forward for the library community to contribute to further Web standardization actions.

See the charter for more information.

- News
- Deliverables
- Meetings
- Minutes
- About the Library Linked Data XG

W3C Advisory Committee Representatives may join this XG on behalf of their organizations by completing the online form. Non-Members may join W3C or ask the Chair of an Incubator Group to participate as an Invited Expert, subject to W3C's policy for approval of Invited Experts.

Participants are automatically subscribed to the Member and public mailing lists when they join the group. Non-Participants may also subscribe. Please read more about W3C mailing list and archive usage.

News

Deliverables

Meetings

See Wiki

Minutes
Simple Knowledge Organization System (SKOS)

Overview

SKOS is a common data model for sharing and linking knowledge organization systems via the Web.

Many knowledge organization systems, such as thesauri, taxonomies, classification schemes and subject heading systems, share a similar structure, and are used in similar applications. SKOS captures much of this similarity and makes it explicit, to enable data and technology sharing across diverse applications.

The SKOS data model provides a standard, low-cost migration path for porting existing knowledge organization systems to the Semantic Web. SKOS also provides a lightweight, intuitive language for developing and sharing new knowledge organization systems. It may be used on its own, or in combination with formal knowledge representation languages such as the Web Ontology Language (OWL).

Recommended Reading

The official SKOS documents, published in 2009, include a SKOS Primer. The SWD Working Group, that published this Recommendation, is now closed.

A number of textbooks have been published on RDF, RDFS, and on Semantic Web in general. Please, refer to a separate page listing some of those, as maintained by the community. That list also includes references to conference proceedings and article collections that might be of general interest.

Welcome to the SKOS community wiki!

This site is a collaborative space open to the entire SKOS community. It complements the official W3C SKOS web site and the SKOS mailing list.

It is aimed at (slowly!) replacing the old ESW SkosDev wiki, taking into account that SKOS is now an official W3C standard and has evolved since the SkosDev wiki was started.

Your contributions are most welcome!
SKOS

- Publication of simple knowledge sources
- Low cost entry to participation in the Semantic Web/Data Web
- Lightweight integration capabilities
- Mapping support
- Significant takeup and usage

Simplicity
Standardisation
Extensibility
Thanks!

- Manchester Information Management and Bio Health Informatics Groups
- W3C SW Working Group, Guus Schreiber, Tom Baker, Ralph Swick
- Alistair Miles, Antoine Isaac, Norman Gray
Image Sources

- British Library: http://www.flickr.com/photos/stevecadman/486261295/
- Forth Bridge: http://www.flickr.com/photos/sjbradshaw/2261522652/
- Ashness Bridge: http://www.flickr.com/photos/steinsky/2630767772/
- Bridge 77: http://www.flickr.com/photos/sjorford/3222988204
- Spanner: http://www.flickr.com/photos/lwr/468913340/
- Nuts and Bolts: http://www.flickr.com/photos/cmatsuoka/2581876397/
- Hoover Dam: http://www.flickr.com/photos/squeaks2569/3700355684/
- Scary Bridge: http://www.flickr.com/photos/bennbeck/47685371/
- THC: http://www.flickr.com/photos/wonderal/2333550713/
- Others: author
Let’s grab one of these.....
...some of these...
...and do this