“Methodology and tools for Multilingual Linguistic Linked Data generation”

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Different methods and guidelines available:

- LOD2
- Datalift
- W3C Linked Data cookbook
- W3C Best Practices for Linked Data
- **Guidelines for Multilingual Linked Data**
- **W3C Best Practices for Multilingual Linked Open Data (BPMLOD) community group** Get Involved!

- We will use a particular use case: "*bilingual dictionaries*" as **running example** (although the proposed methodology is general)
- W3C BPMLOD community group draft report: *"Guidelines for Linguistic Linked Data Generation: Bilingual Dictionaries"*
- Available at: http://bpmlod.github.io/report/bilingual-dictionaries/index.html

Guidelines for ML Linked Data

Main activities:

1. Analysis of data sources
2. Modelling
3. URI/IRI design
4. Generation
5. Publication

Each activity composed of several tasks

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Analysis of data sources

The goal is to:

- Specify and analyse the data sources in order to plan and manage the subsequent activities
- Main aspects to specify are:
  - Format
  - Identifiers structure
  - Access methods: *file, webservice, etc.*
  - Data models: *Standards, terminologies, etc.*
  - Language representation: *how languages are tagged, represented, etc.*
  - License and provenance: *existing license of data sources*

Analysis of data sources EXAMPLE

Documentation of data sources:

- Type of data: *Bilingual dictionary (English and Spanish)*
- Data model: *LMF (Lexical Markup Framework)*
- Format: XML files
- License: GPL 3.0
- Provenance: Apertium EN-ES
- ….

Analysis of data sources EXAMPLE

```
<Lexicon>
   <feat att="language" val="en"/>
   ...
   <LexicalEntry id="bench-n-en">
      <feat att="partOfSpeech" val="n"/>
         <Lemma>
            <feat att="writtenForm" val="bench"/>
         </Lemma>
      <Sense id="bench_banco-n-1"/>
   </LexicalEntry>
    …
```

- Main activities:
  1. Analysis of data sources
  2. Modelling
  3. URI/IRI design
  4. Generation
  5. Publication

Modelling tasks

1. Analysis and selection of domain vocabularies
2. Mapping of data sources and vocabularies
3. Vocabulary for representing licensing and provenance information

Analysis of vocabularies

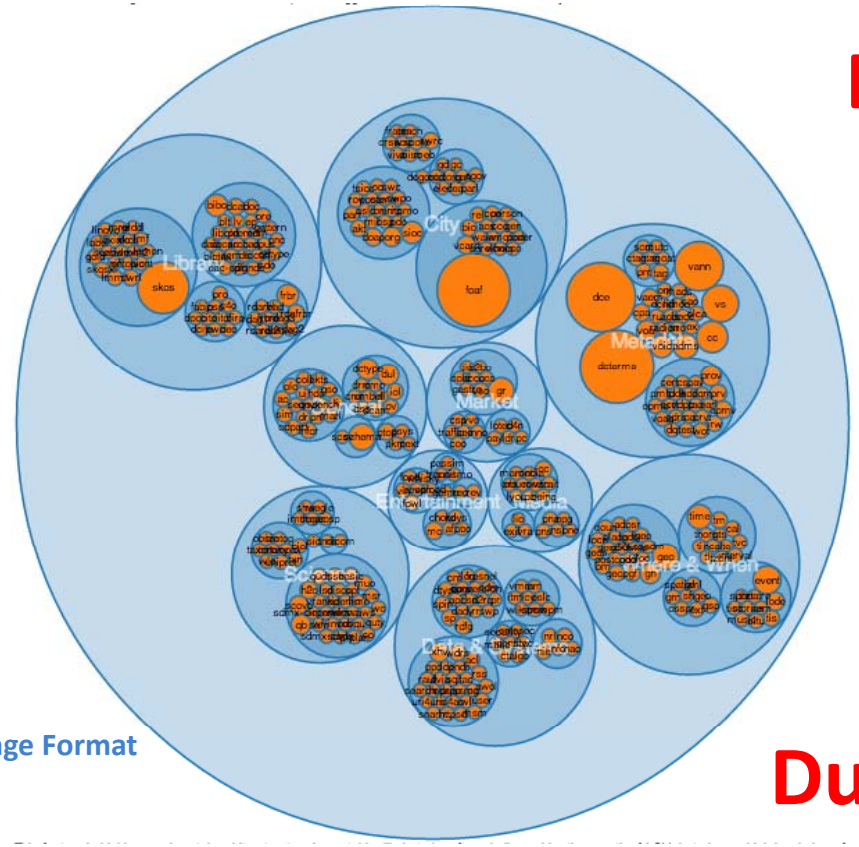
Use **http://lov.okfn.org/**

LexInfo

lemon

NIF

NLP Interchange Format

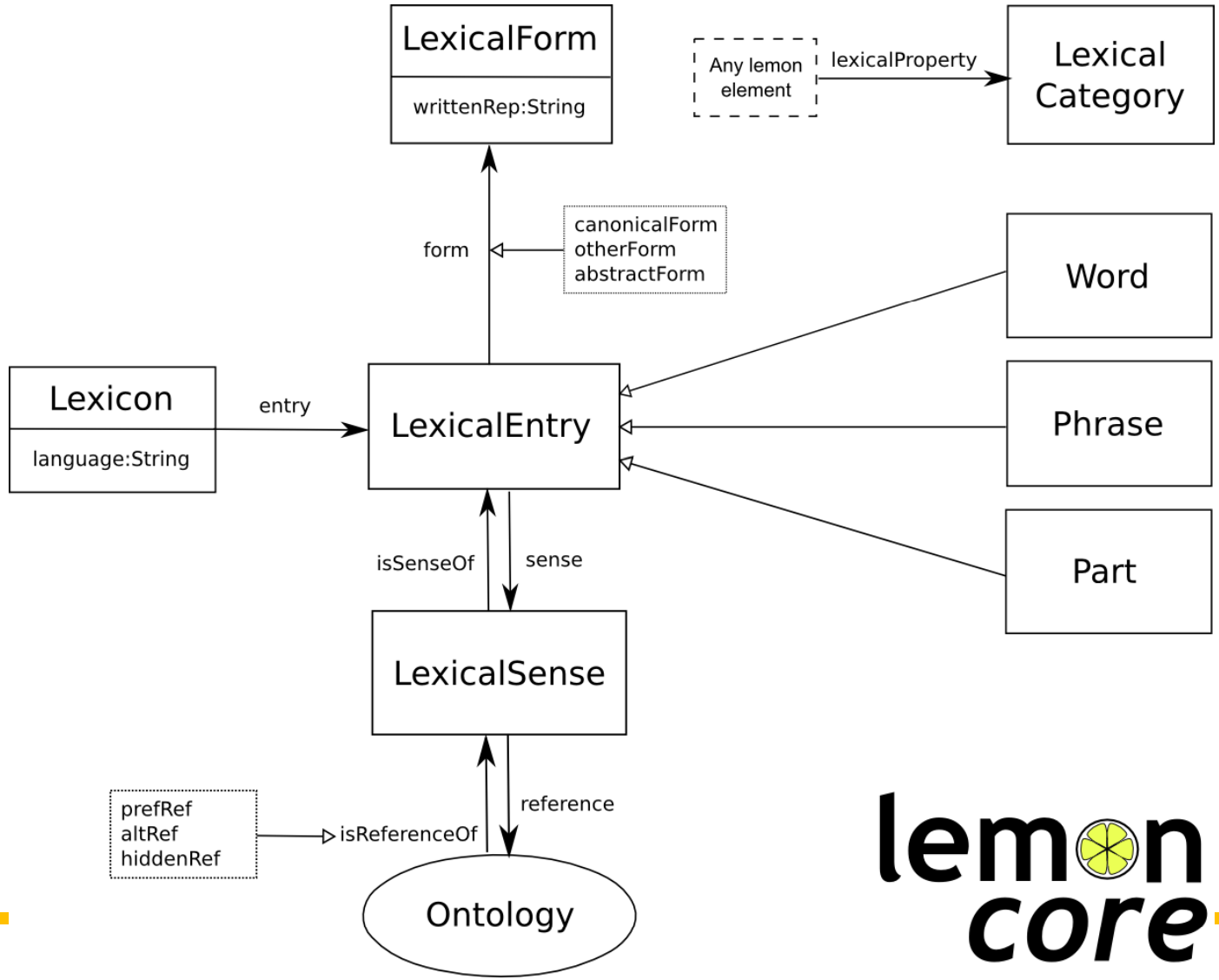


DCAT

PROV-O

Dublin Core

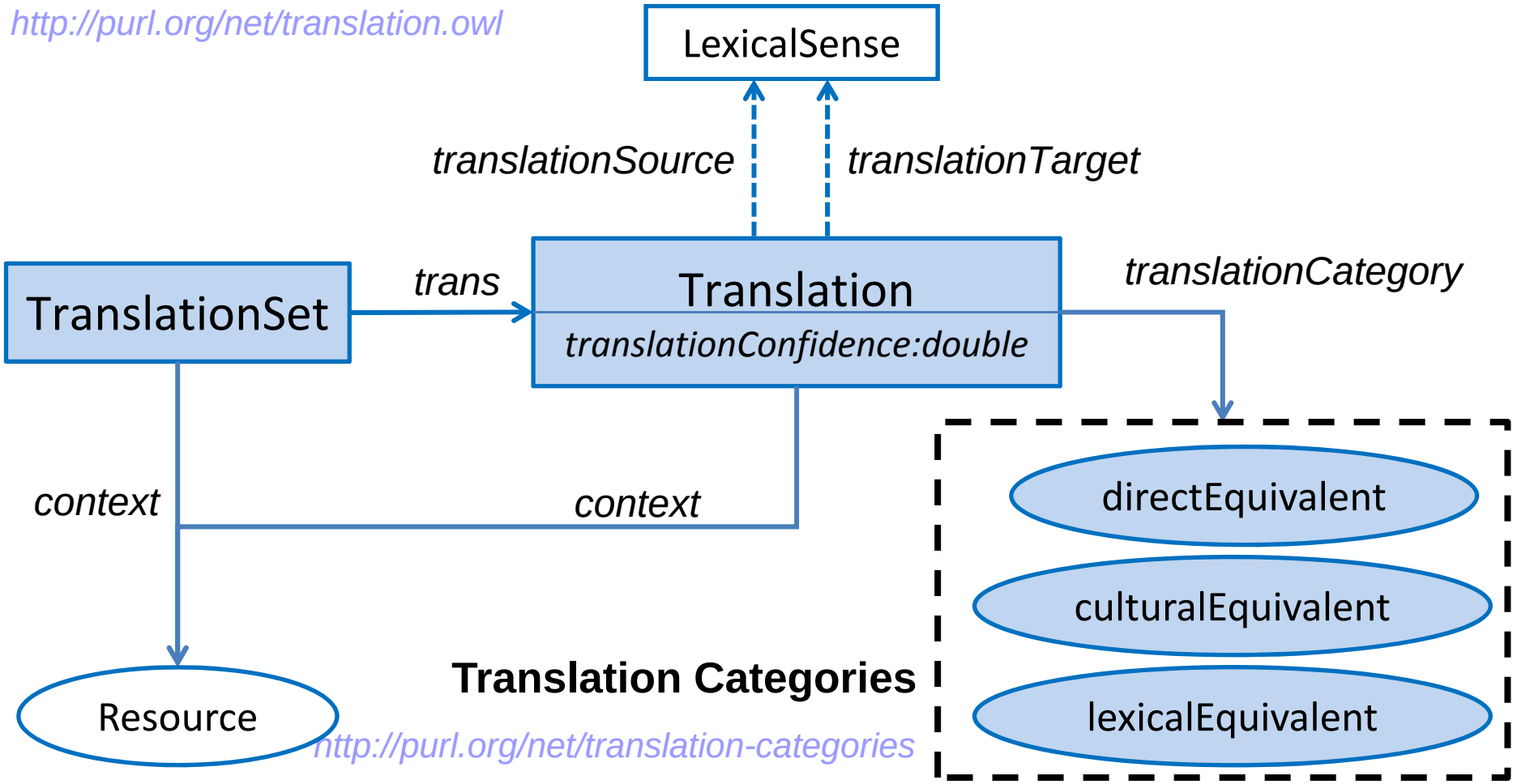
Modelling



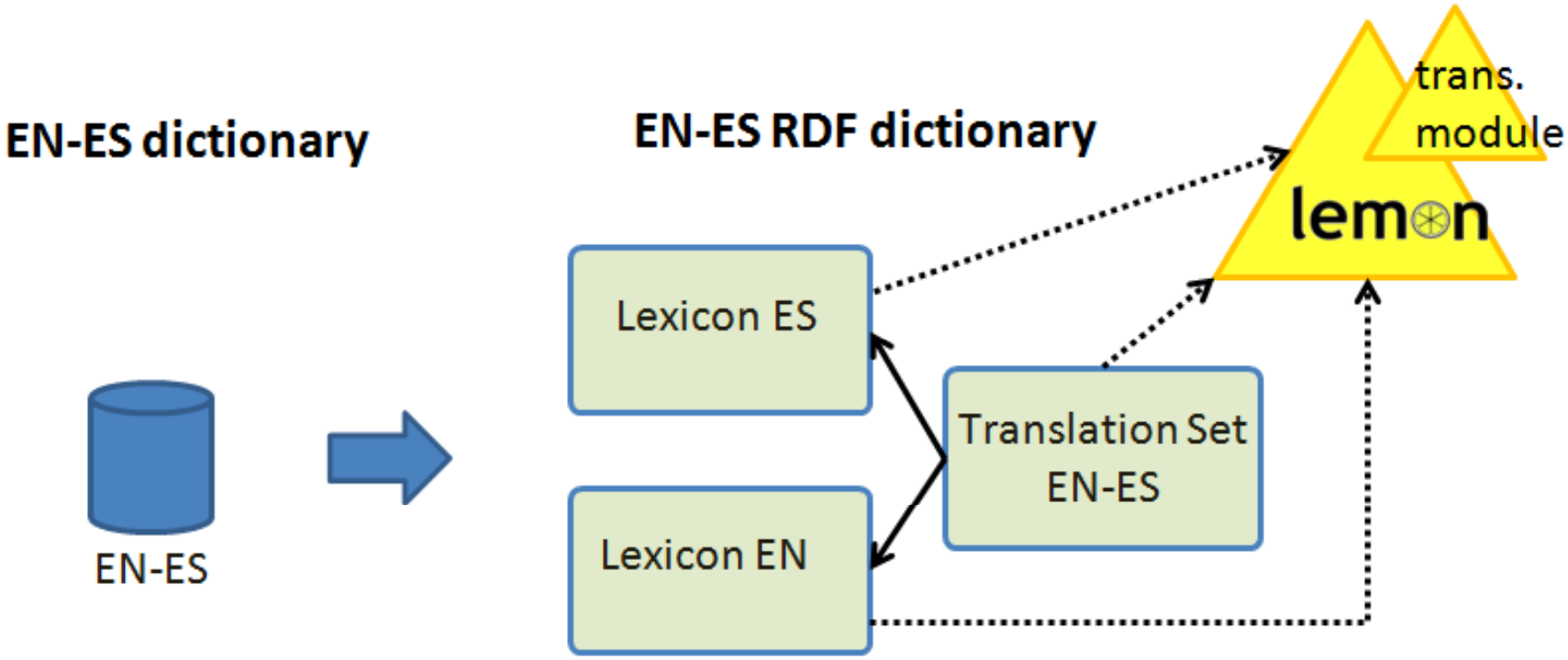
lemon core

Translation Module

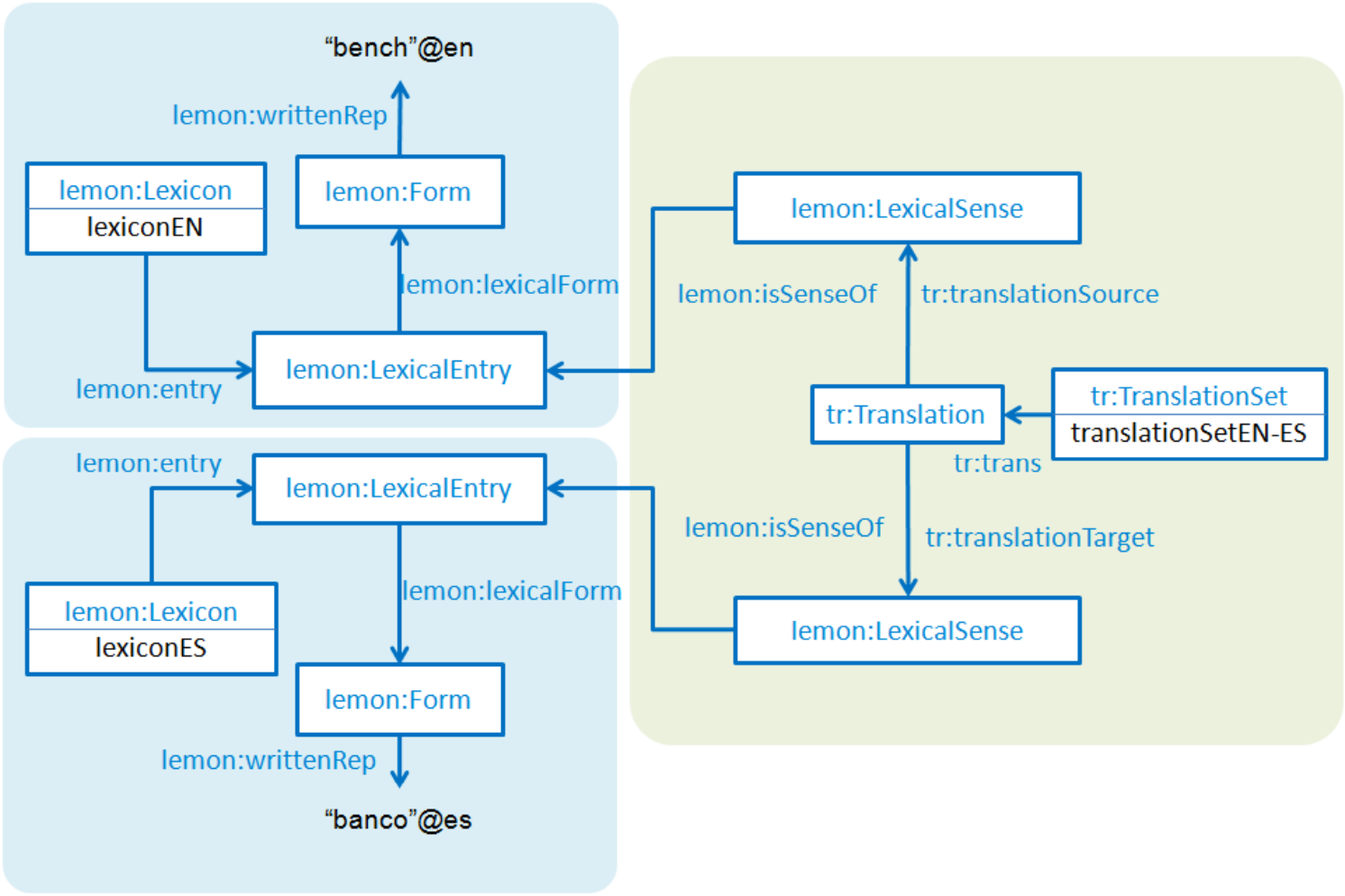
http://purl.org/net/translation.owl



Mapping of data sources



Modelling EXAMPLE



Main activities:

1. Analysis of data sources
2. Modelling
3. URI/IRI design
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The goal is to:

- Define **URI/IRI patterns and namespaces to be used**
- Ensure that LD best practices are followed

URI/IRI design

Some good practises…

1. Define **namespace**(s) (that you own or have control over).
2. Define how to create the **ID of resources** (reuse original data source keys if possible)
3. Define the structure of the **URI space** to organize the resources in different addresses and **avoid collision**.

Useful guidance at:

ISA - Study on persistent URIs Archer et al.,

Linked Data patterns book online → URI patterns

URI/IRI design

Following ISA* recommendations:

`http://{domain}/{type}/{concept}/{reference}`

where:

- `{type}` : a value from the set of type of resources, examples are '`id`' or '`item`' for real world objects; '`doc`' for documents that describe those objects; '`def`' for concepts; '`set`' for datasets

*ISA - Study on persistent URIs, Archer et al.,

URI/IRI design EXAMPLE

http://{domain}/{type}/{concept}/{reference}

{domain}: **http://linguistic.linkeddata.es/**
{type}: **id** (real-world object)
{concept}: **apertium**
{reference}: **resource ID**

```
# Apertium English lexicon:
http://linguistic.linkeddata.es/id/apertium/lexiconEN

# Apertium Spanish lexicon:
http://linguistic.linkeddata.es/id/apertium/lexiconES

# Apertium English-Spanish translation set:
http://linguistic.linkeddata.es/id/apertium/tranSetEN-
ES
```

- Set of main activities:
  1. Analysis of data sources
  2. Modelling
  3. URI/IRI design
  4. Generation
  5. Publication

RDF Generation

1. Selection, extension or development of technologies for RDF generation
2. Mapping of data sources to RDF
3. Transformation of data sources to RDF

RDF Generation EXAMPLE

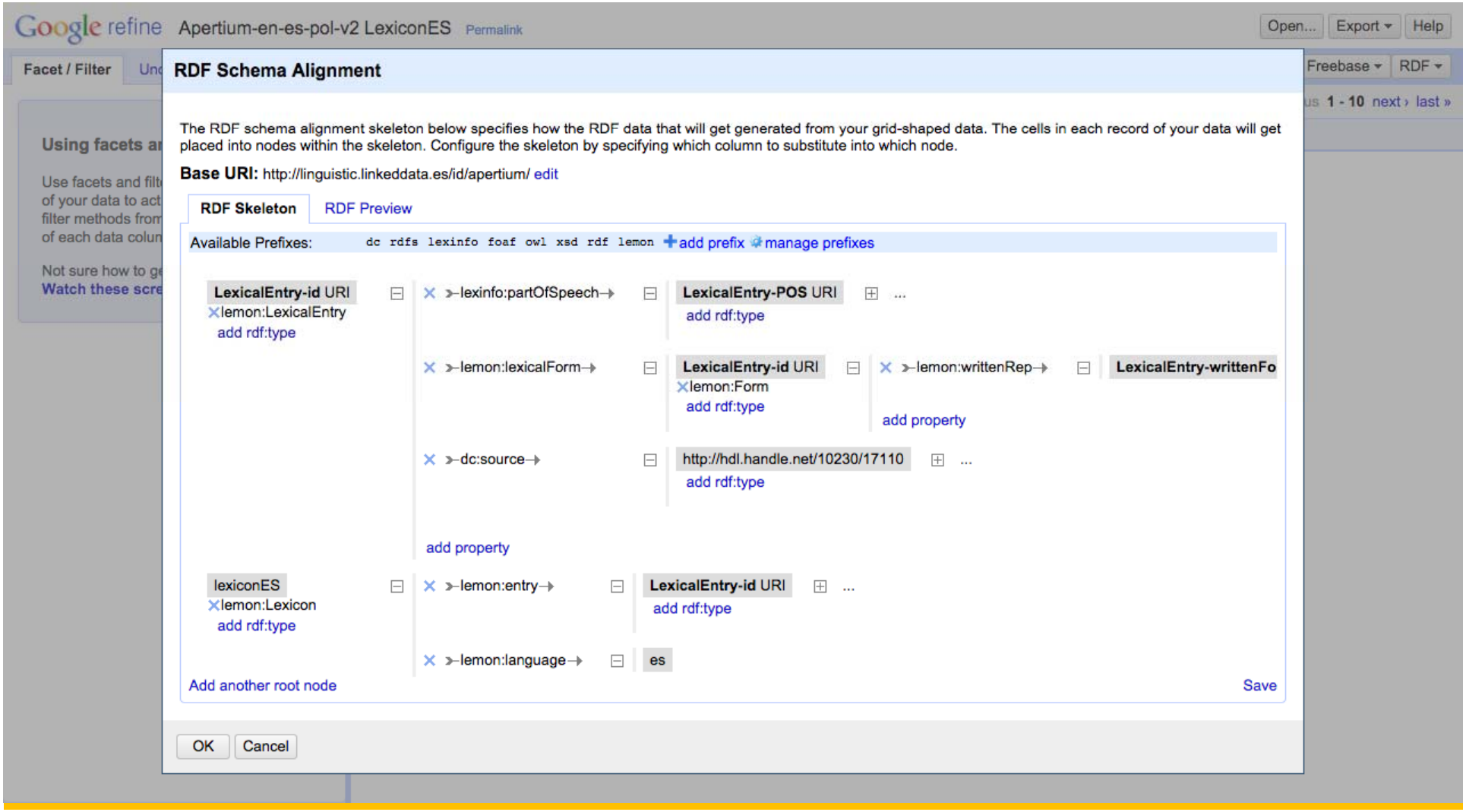
Goal:

```
apertium:lexiconEN a lemon:Lexicon ;
        dc:source
<http://hdl.handle.net/10230/17110> .
...
apertium:lexiconEN lemon:entry
apertium:lexiconEN/bench-n-en .

apertium:lexiconEN/bench-n-en a lemon:LexicalEntry
;
        lemon:lexicalForm apertium:lexiconEN/bench-
n-en-form ;
        lexinfo:partOfSpeech lexinfo:noun .
```

```
apertium:lexiconEN/bench-n-en-form a lemon:Form ;
        lemon:writtenRep "bench"@en .
```

RDF Generation EXAMPLE



Main activities:

1. Analysis of data sources
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Publication

- The goal is to:
  - Make available the RDF dataset following Linked Data best practices
  - Facilitate dataset discovery and consumption

Publication

Vocabulary for licensing and provenance

→ INPUT:

- Documentation of data sources (licensing and provenance)

OUTPUT →

- Selection of standard vocabs

creative commons

ODRL
Open Digital Rights Language

PROV
W3C Provenance Ontology

Publication

1. Add "rights" metadata in the dataset description (e.g., VoID, DCAT)

DCAT W3C
Data catalog vocabulary

2. Use standard predicates to declare "rights" statements (e.g., Dublin Core terms: `dc:rights`, `dct:license`)

Standard license available ?

creative commons

Yes

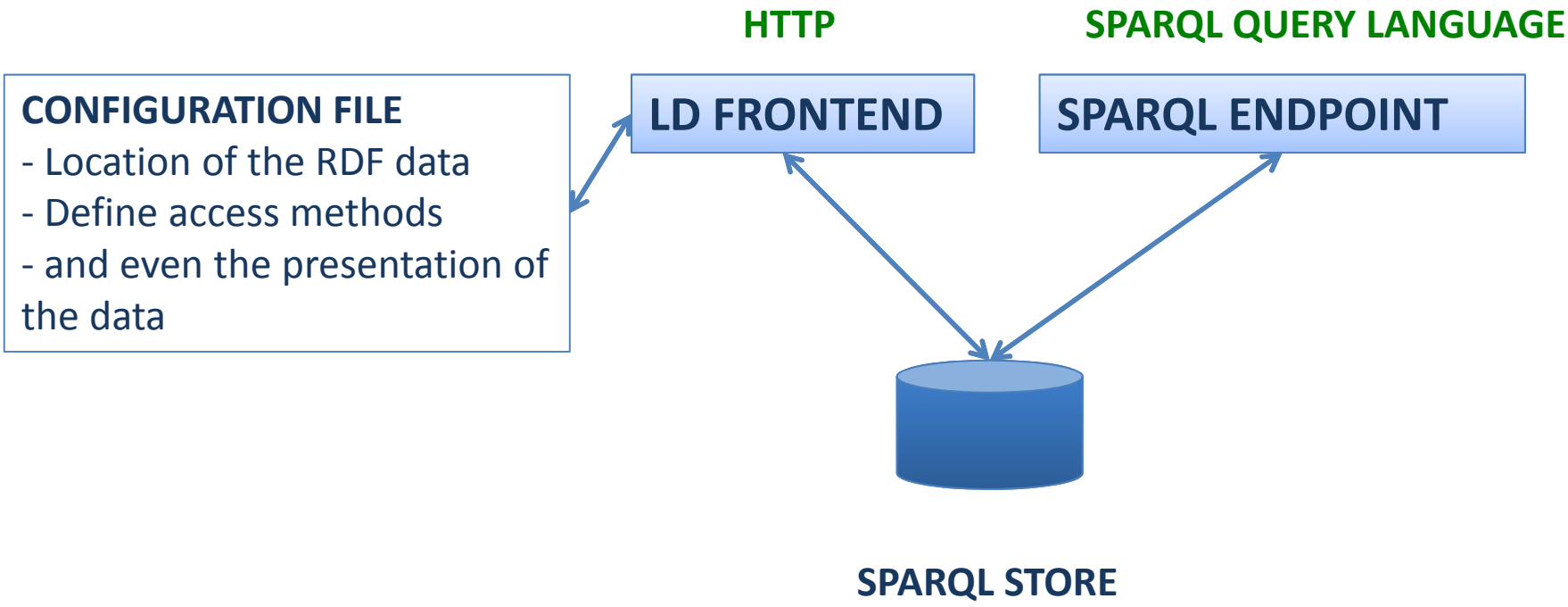
3a. Use **URI** of **standard license** e.g., CC0

No

ODRL
Open Digital Rights Language

3b. Use **rights declaration language**, e.g., ODRL

Dataset and vocabulary publication on the Web



Publication EXAMPLE

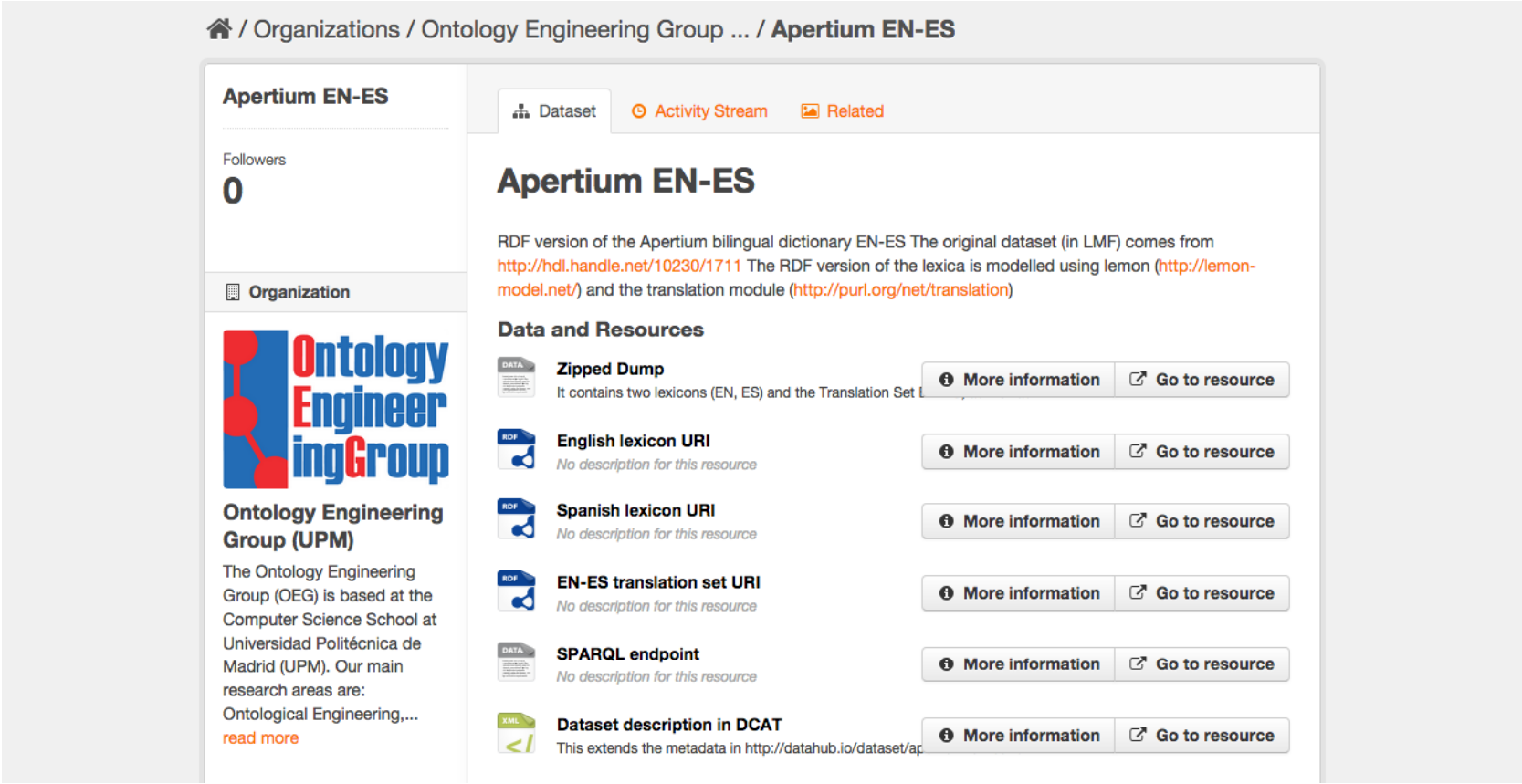
Metadata definition and publication using DCAT

1) Register dataset in datahub.io

2) Extend generated DCAT file and link to datahub.io one

Publication EXAMPLE

http://datahub.io/dataset/apertium-rdf-en-es



Extending DCAT description

```
<dcat:Dataset rdf:about="http://linguistic.linkeddata.es/set/apertium/EN-ES">

   <owl:sameAs rdf:resource="http://datahub.io/dataset/apertium-rdf-en-
es"></owl:sameAs>

   <dct:source rdf:resource="http://hdl.handle.net/10230/17110"></dct:source>

   <dct:license rdf:resource="http://purl.oclc.org/NET/rdflicense/gpl-
3.0"></dct:license>

   <rdfs:seeAlso rdf:resource="http://dbpedia.org/resource/Apertium"></rdfs:seeAlso>

   <rdfs:seeAlso rdf:resource="http://purl.org/ms-lod/UPF-
MetadataRecords.ttl#Apertium-en-es_resource-5v2"></rdfs:seeAlso>

</dcat:Dataset>
```

Publication: SOME TIPS

- Loading the RDF data into a **SPARQL** endpoint **not enough for publishing LD**:
  - Why? We provide a queryable repository, but **URIs are not de-referenceable**
- **We need a mechanism to make our URIs de-referenceable:**
  - Through a common web server (as files)
  - **Linked Data front-ends:**
    - Pubby
    - More sophisticated: LD APIs (Puelia, Elda)

Conclusions

- Documentation of data sources and issues
- Language issues have to be taken into account during the whole process
- Metadata description is key for enabling reusing and discovery
- Vocabulary have to be documented and published following LD BPs