Weaving repository contents into the Semantic Web

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Digital Repositories

Repositories are systems to safely store and publish digital objects and their descriptive metadata.

Not in the meaning of software repositories.
Examples:

- Digital archives
- Institutional repositories (preprints, postprints, open access publications, …)
- Digital image libraries
- Research data repositories
- …

Source: The Directory of Open Access Repositories, http://www.opendoar.org, retrieved June 06, 2014.

More than 2500 Open Access repositories worldwide.

Repository contents are particularly suited

The data stored in repositories are particularly suited to be used in the Semantic Web:

- Metadata already exist in a structured form.
- They do not have to be generated or entered manually for publication as Linked Data.
- “Just” convert the data in RDF, add links and publish them respecting the Linked Data Principles.

xxx.lanl.org / ArXiv.org

"Although the WorldWideWeb still represents only a small fraction of the overall usage, this access mode is expected to become dominant in the near future."

Paul Ginsparg 1994

Source: Paul Ginsparg, *First Steps Towards Electronic Research Communication*. In: *Computer in Physics*, Vol. 8, No. 4, 1994, pp. 390-396.

Current data exchange with Repositories

- OAI-PMH (Open Archive Initiative – Protocol for Metadata Harvesting): de facto standard in the context of repositories
- But: limited to that context
- Google retired support for OAI-PMH in 2008 (used before as alternative to the sitemap protocol)
- “Just” an interface, not a format

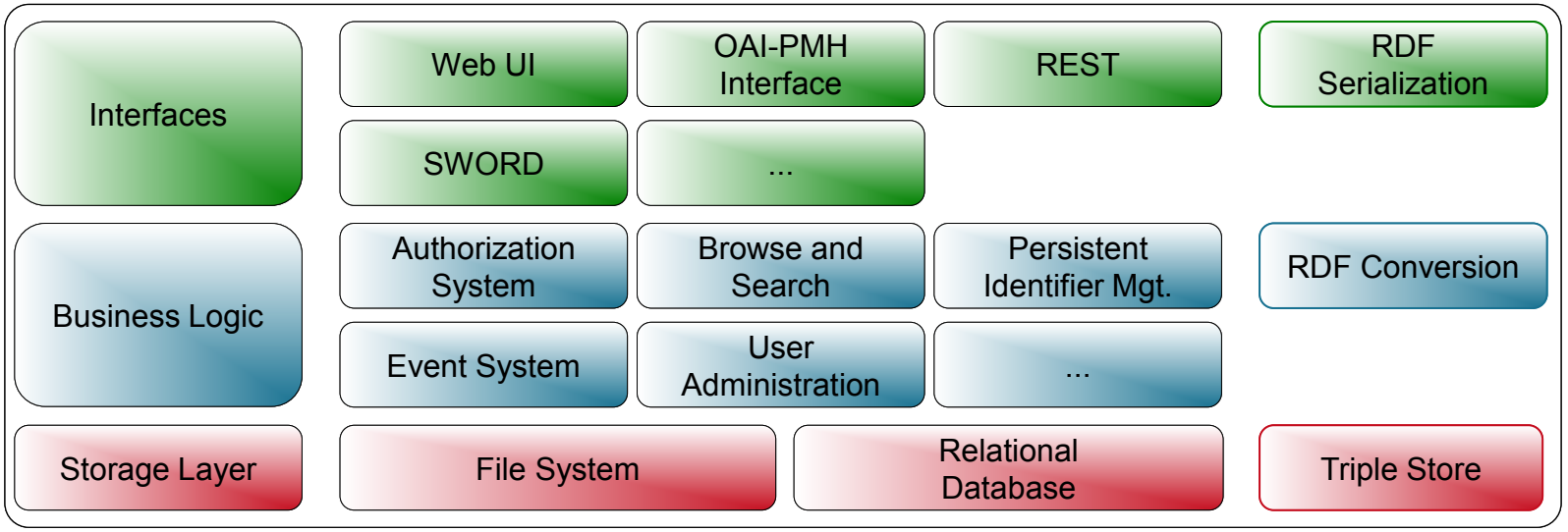
- ➢ Linked Data is a generic, native way of data exchange, not only in the field of repositories
- ➢ Data published following the Linked Data Principles is self-descriptive
- ➢ Linked Data simplifies data exchange with repositories

Characteristics of repositories

- Different repositories may use different metadata schemas.
  - ➢ Conversion must be highly configurable and extendable.
- Metadata may use already existing vocabularies (e.g. Dublin Core, LCSH, …).
  - ➢ Convert metadata values to URIs / links.
- Repository contents change rarely (to be citable and reliable).
  Conversion may be time intensive.
  - ➢ Convert data and store converted data in a cache.
- Repositories generate URIs that shall be used to address their content.
  - ➢ Reuse those URIs, add content negotiation to them.
- Persistent Identifiers (handle, DOI, …) violate the Linked Data Principles.
  - ➢ Use Persistent Identifiers in form of HTTP(S) URIs (http://dx.doi.org/...).

Extending Repositories

- Add a Triple Store.
  - Use it as cache for converted data.
  - Use it to provide a SPARQL endpoint.
- Add methods to convert data into RDF and to add links.
- Add a module to serve data as RDF serializations.
- Add content negotiation.



What do Repositories store?

"Repositories are systems to safely store and publish digital objects and their descriptive metadata."

- Digital objects
  - ➢ One or several files:
    Documents (PDF, Text, …), Tables (CSV, …),
    Images (PNG, Tiff …), Audio (Wave, …),
    Video, File Archives, …

- Descriptive metadata
  - ➢ Structured metadata as key – value:
    dc.title, dc.contributor.author, dc.description,
    dc.date.available, dc.subject.lcsh,
    dc.subject.ddc, …

Full metadata record

DC Field	Value	Language
dc.contributor.author	Lindau, Alexander	-
dc.date.accessioned	2014-02-27T14:19:30Z	-
dc.date.available	2014-02-27T14:19:30Z	-
dc.date.issued	2014-02-27	-
dc.identifier.uri	http://depositonce.tu-berlin.de/handle/11303/157	-
dc.identifier.uri	http://dx.doi.org/10.14279/depositonce-1	-
dc.description	The 'SAQI. Test Manual. v1.0' documents the complete German and English version of the SAQI. It serves as an user-oriented introduction giving valuable hints for practical application, e.g., by referring to the whisPER Matlab toolbox v1.8.0 which features a full implementation of a SAQI test. Additional resources are provided in a zip-container. It includes relevant project-related publications, illustrative audio examples, empirical test data sets, and Matlab functions for convenient later statistical analysis and plotting of SAQI test results. Folder structure in 'SAQI. Test Manual. v1.0. Additional files.zip': /1 references /2 audio files /3 mfiles Further related resources: http://www.ak.tu-berlin.de/saqi http://www.ak.tu-berlin.de/whisper	en_US

➢ We can't convert the files (technical problems, far too much work).

➢ But we can convert the metadata and link to the files!

Convert existing metadata to RDF

- Repository software can be extended to support more or other metadata fields.
- Dublin Core is used often, but there are other metadata schemas as well.

- ➢ Make the conversion highly configurable!
- ➢ Use RDF for the configuration (so all features of RDF can be used in the configuration easily).
- ➢ Use Reification to describe the results.
- ➢ Use Placeholders where necessary, e.g. URIs used by the repository.
- ➢ Use Regular Expressions to generate Literals and/or URIs from a metadata value.
- ➢ Create a vocabulary to write such configurations.

Example: DSpace Metadata RDF Mapping Vocabulary

http://digital-repositories.org/ontologies/dspace-metadata-mapping/

- One Mapping describes how to convert one metadata field in RDF.
- Can detect the metadata field by its name (key) and a regular expression used on its value.
- Creates one or several triples.
- Can use a placeholder for the URI of the object being converted currently.
- Can create Literals or Resources as needed.
- Can specify value types and language tags.
- Can use the language tag DSpace stores for some metadata fields.
- Can reuse the metadata value, of course.
- May use regular expressions to modify metadata values used as Literals or Resource URIs.

Example: DSpace Metadata RDF Mapping Vocabulary

```
@prefix dc: <http://purl.org/dc/elements/1.1/> .
@prefix dm: <http://digital-repositories.org/ontologies/dspace-metadata-mapping/0.2.0#> .
@prefix : <#> .

:title
    dm:metadataName "dc.title" ;
    dm:creates [
        dm:subject dm:DSpaceObjectIRI ;
        dm:predicate dcterms:title ;
        dm:object dm:DSpaceValue ;
    ] ;
.
```

Example: DSpace Metadata RDF Mapping Vocabulary

```
:doi
    dm:metadataName „dc.identifier.doi" ;
    dm:condition „^doi:“ ;
    dm:creates [
        dm:subject dm:DSpaceObjectIRI ;
        dm:predicate dc:identifier;
        dm:object [
            a dm:ResourceGenerator ;
            dm:modifier [
                dm:matcher „^doi:(.*)$“ ;
                dm:replacement „http://dx.doi.org/$1“ ;
            ] ;
        dm:pattern „$DSpaceValue“ ;
        ] ;
    ] ;
.
```

Describing Repositories

- Beside converting metadata it is worth describing the repository itself.
- Who is running the repository? Does it have an OAI-PMH interface? Where can I find a SPARQL endpoint? How is the content structured? …
- A vocabulary to link to the digital objects (files) is needed as well.

- For DSpace, I created the DSpace Repository Ontology:
  http://digital-repositories.org/ontologies/dspace/
- A Digital Repositories Ontology would be great, describing repositories independent from the software used to create them.
  - A mapping between such an ontology and the DSpace Repository Ontology, the EPrints Ontology or any other would be great!
  - If you are interested in creating such an Ontology as well: please contact me.

Things to mention, even if they should be clear

- Reuse existing URIs wherever possible, don't create your own URI if there already exists one.
  - E.g.: For classifications like the Library of Congress Subject Headings URIs already exists.
- Create URIs only for you own entities or if you have enough information.
  - Do not create URIs for authors unless you can distinguish different authors with the same name!
  - Think about whether the author should create his or her own URI or if it is really up to you to create one.
  - But create URIs for the objects in your repository.
- Create links wherever possible.

DSpace 5

- DSpace is the most often used software for Open Access Repositories worldwide
- Release of DSpace version 5.0 planned for December 2014
  (release candidates are out, testathon is running)
- Will contain support for Linked Data (RDF/XML, Turtle, N-Triples, SPARQL)
- Will support content negotiation
- Highly configurable, good default configuration included

- Test it yourself:
  http://demo.dspace.org/data/handle/10673/5/ttl
  http://demo.dspace.org/data/handle/10673/5/ttl?text
  wget -O - --header='Accept: text/turtle' http://demo.dspace.org/jspui/handle/10673/5
  or download and install a release candidate

If you're about to use DSpace 5.0 or above
please consider switching Linked Data Support on.

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Servicezentrum Forschungsdaten und –publikationen
http://www.szf.tu-berlin.de

Repository DepositOnce
http://depositonce.tu-berlin.de

Thesis „Repositorien und das Semantic Web“ (in German)
http://www.pnjb.de/uni/diplomarbeit/