

# UCD Library Data Services

## UCD Linked Data API

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### Service Overview

UCD Linked Data Services are intended to provide access to information from the UCD Digital Library as Linked Data.

Linked Data services are planned in two phases:

1. file delivery services. File delivery services enable discovery and download of Linked Data as static or dynamically created RDF serializations. Implementation is planned for the first half of 2013.
2. Interactive query services. Implementation of an interactive query service as a SPARQL endpoint is planned for the second half of 2013.

File delivery services support download of metadata for individual objects from the UCD Digital Library in a range of RDF serialization formats; an RDF dump can also be downloaded in N-Triples format.

Services are managed via a REST endpoint on the host `data.ucd.ie`:

- `http://data.ucd.ie/data/{PID}{.}{formatIdentifier}` or
- `http://data.ucd.ie/data/{PID}{#fragmentIdentifier}`

where

- `PID` identifies an objects in the UCD Digital Library data repository
- `formatIdentifier`, preceded by a full-stop separation character, a value indicating the preferred RDF serialization; and
- `fragmentIdentifier`, preceded by the hash symbol, can be used to identify a concept associated with a URI, such as “title” or “image,” when it is important to clarify the distinction between the description of an entity and the entity to which the description refers.

Further details on the implementation of UCD Library’s Linked Data services follow.

## REST API (February 2013- )

### UCD Digital Library Linked Data File Services API

#### Overview

The UCD Digital Library Linked Data File Services API enables retrieval of information from the UCD Digital Library, as well as related resources comprising UCD Library digital services generally, in RDF serializations. Wherever possible, entities associated with objects in the UCD Digital Library are represented by URI references to vocabularies and, in terms familiar to the bibliographic community, “authorities” for forms of names or for expression of values; the most commonly referenced vocabularies are identified below.

The API’s conception is guided by the Linked Data precepts identified in Tim Berner-Lee’s *Linked Data – Design Issues* (2006),<sup>1</sup> and principles of Linked Data and approaches to deployment of Linked Data services described in Tom Heath and Christian Bizer’s *Linked Data: Evolving the Web into a Global Data Space*.<sup>2</sup>

URIs that refer to Digital Library object descriptions or virtual objects (such as images) are expressed syntactically following these prototypes:

1. `http://data.ucd.ie/data/{PID}{#fragment identifier}`
2. `http://data.ucd.ie/data/{PID}{.}{format identifier}`

As might be inferred from these prototypes, the Linked Data File Services API handles Linked Data content negotiation in a hybrid manner, making use of both hash URIs and HTTP return code 303 redirects. This approach minimizes the number of redirections to which a client application is required to respond via the API and provides a clear syntax for requesting alternative serializations of RDF metadata.<sup>3</sup> (URIs that request digital content, such as images or audio files, refer directly to the UCD Digital Library web API.)

The first prototype handles requests for a descriptive information resource in the UCD Digital Library that is identified by the PID parameter. The PID is a composite value consisting of a namespace identifier, followed by a colon, followed by a numeric identifier; an example would be `ivrla:101`.

The second prototype handles requests for descriptive metadata in any of several supported RDF serializations. The `format` parameter accepts values identifying the preferred format for representation of RDF triples and must be selected from values in the “Format” column of the following table. Data is delivered in most cases with the HTTP `Content-Disposition` header set to “download,” with an identifying filename and filename extension as indicated in the table below; exceptions would be requests for metadata in N3/Notation3 or N-Triples format, which are returned as text, or requests for metadata in HTML format, which incur a redirection to the UCD

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<sup>1</sup> Tim Berner-Lee, *Linked Data - Design Issues*, 2006. <http://www.w3.org/DesignIssues/LinkedData.html>.

<sup>2</sup> Tom Heath and Christian Bizer (2011) *Linked Data: Evolving the Web into a Global Data Space* (1st edition). Synthesis Lectures on the Semantic Web: Theory and Technology, 1:1, 1-136. Morgan & Claypool. See: <http://linkeddatabook.com/book>.

<sup>3</sup> See Heath and Bizer, §2.3.3, <http://linkeddatabook.com/editions/1.0/#htoc14>.

Digital Library web user interface. HTTP Content-Type headers provide Internet media type values as indicated below.

Format	Type	Internet Media Type	Filename extension
rdf	RDF/XML <sup>4</sup>	application/rdf+xml	.rdf
n3	N3/Notation3 <sup>5</sup>	text/rdf+n3	.n3
nt	N-Triples <sup>6</sup>	text/rdf+n3	.nt
nq	N-Quads <sup>7</sup>	text/x-nquads	.nq
ttl	Turtle <sup>8</sup>	application/x-turtle	.ttl
trix	TriX <sup>9</sup>	application/trix	.trix
json	JSON <sup>10</sup>	text/json	.json
xml	XML	text/xml	.xml
html	HTML	text/html	.html

### Vocabularies Referenced

Data is described using vocabularies used ubiquitously with Linked Data generally, and also draws on vocabularies commonly referenced in the bibliographic and cultural heritage communities. In general, choices of vocabularies have been guided by considerations identified in Heath and Bizer, §4.4, namely<sup>11</sup>

- usage and uptake;
- maintenance and governance;
- coverage; and
- expressivity.

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<sup>4</sup> <http://www.w3.org/TR/rdf-syntax-grammar/>

<sup>5</sup> <http://www.w3.org/DesignIssues/Notation3.html>

<sup>6</sup> <http://www.w3.org/TR/rdf-testcases/#ntriples>

<sup>7</sup> <http://sw.deri.org/2008/07/n-quads/>

<sup>8</sup> <http://www.w3.org/TeamSubmission/turtle/>

<sup>9</sup> <http://swdev.nokia.com/trix/>

<sup>10</sup> <http://www.json.org/>

<sup>11</sup> Heath and Bizer, §4.4.4 and 4.4.5.

In addition to OWL<sup>12</sup> and RDFS<sup>13</sup>, the following vocabularies are used:

Namespace	URI
bibo	<a href="http://purl.org/ontology/bibo/">http://purl.org/ontology/bibo/</a>
cc	<a href="http://creativecommons.org/ns#">http://creativecommons.org/ns#</a>
dc	<a href="http://purl.org/dc/elements/1.1/">http://purl.org/dc/elements/1.1/</a>
dcterms	<a href="http://purl.org/dc/terms/">http://purl.org/dc/terms/</a>
foaf	<a href="http://xmlns.com/foaf/0.1/">http://xmlns.com/foaf/0.1/</a>
geo	<a href="http://www.w3.org/2003/01/geo/wgs84_pos#">http://www.w3.org/2003/01/geo/wgs84_pos#</a>
lcgdm	<a href="http://id.loc.gov/vocabulary/graphicMaterials">http://id.loc.gov/vocabulary/graphicMaterials</a>
lcsb	<a href="http://id.loc.gov/authorities/subjects">http://id.loc.gov/authorities/subjects</a>
linked-data	<a href="http://purl.org/linked-data/api/vocab#">http://purl.org/linked-data/api/vocab#</a>
marcrel	<a href="http://id.loc.gov/vocabulary/relators/">http://id.loc.gov/vocabulary/relators/</a>
ore	<a href="http://www.openarchives.org/ore/terms/">http://www.openarchives.org/ore/terms/</a>
viaf	<a href="http://viaf.org/ontology/1.1/#">http://viaf.org/ontology/1.1/#</a>
void	<a href="http://rdfs.org/ns/void#">http://rdfs.org/ns/void#</a>

### Dataset Description and Discovery

UCD Digital Library Linked Data File Services uses the Void RDF schema vocabulary to describe the datasets made available through the service, and adopts associated conventions to enhance discovery of the datasets.<sup>14</sup>

A Void dataset description has been deployed at <http://data.ucd.ie/ld/void.ttl>. Discovery is facilitated using the “Well-Known URI” mechanism described in RFC 5758<sup>15</sup> and Alexander, Cyganiak, et al.<sup>16</sup> This is implemented via Apache `mod_redirect`, with a HTTP 302 redirection from <http://data.ucd.ie/.well-known/void> to <http://data.ucd.ie/ld/void.ttl>:

```
RewriteRule ^/.well-known/void /ld/void.ttl [R=302,L]
```

The void dataset description is also made discoverable via a void backlink.<sup>17</sup> The following RDF triple is included in each individual resource description:

```
<void:inDataset rdf:resource="http://data.ucd.ie/ld/void.ttl#UCDLibraryLOD"/>
```

<sup>12</sup> Deborah L. McGuinness and Frank van Harmelen. OWL Web Ontology Language Overview - W3C Recommendation. <http://www.w3.org/TR/2004/REC-owl-features-20040210/>, 2004.

<sup>13</sup> D. Brickley and R. V. Guha. *RDF Vocabulary Description Language 1.0: RDF Schema* - W3C Recommendation. <http://www.w3.org/TR/rdf-schema/>, 2004.

<sup>14</sup> Keith Alexander, Richard Cyganiak, Michael Hausenblas, Jun Zhao, *Describing Linked Datasets with the Void Vocabulary*. <http://www.w3.org/TR/void/>, 2011.

<sup>15</sup> *Defining Well-Known Uniform Resource Identifiers (URIs)*, M. Nottingham, E. Hammer-Lanav, Internet Engineering Task Force RFC 5758, April 2010. <http://tools.ietf.org/html/rfc5758>.

<sup>16</sup> Alexander, Cyganiak, et al. (2011), §7.2.

<sup>17</sup> Alexander, Cyganiak, et al. (2011), §6.3 and §7.1.

## HTTP Requests and Responses

Client applications may make requests via HTTP GET or POST; POST requests must be accompanied by a Content-Type HTTP header when the request body contains parameters:

Content-Type: application/x-www-form-urlencoded

When requests are made to hash URIs, the HTTP Accept header should indicate preferred formats for metadata returned. Supported Internet media types are listed in the table of supported formats above; for further information see RFC 2616 regarding HTTP Accept headers.<sup>18</sup> For example:

Accept: application/rdf+xml, application/trix;q=0.9, application/json;q=0.8, \*/\*;q=0.5

The following HTTP response codes are returned as circumstances determine:

HTTP/1.1 Response Code	Text
200	OK
302	Found
303	See Other
400	Bad Request
404	Not found
415	Unsupported Media Type [invalid RDF serialization format]
500	Internal Server Error
501	Not Implemented [unsupported RDF serialization format, i.e., TriG]

In addition, requests that yield any of HTTP response codes 400,404,415, or 501 are sent a profile Link header with a reference to documentation for the API:

Link: <http://data.ucd.ie/docs/apiLOD.pdf>; rel="profile"

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<sup>18</sup> <http://www.w3.org/Protocols/rfc2616/rfc2616-sec14.html#sec14.1>.