Linked Open Services:
Update on Implementations and Approaches
to Service Composition

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Abstract. Linked Open Services are a principled attempt to guide the creation and exposure of online services, in order to enable productive use of, and contribution to, Linked Data. As a technical basis, they communicate RDF directly via HTTP-based interaction, and their contribution to the consumer's knowledge, in terms of Linked Data, is described using SPARQL-based constructs. In this demo we will show some of our latest results in the production of Linked Open Services and the applications in which they can be taken up.

1 Overview

In [2], we present the groundwork of an initiative called Linked Open Services (LOS!). Subsequent work on developing such RDF/SPARQL-driven services at the community site `http://www.linkedopenservices.org` has led to the refinement of a number of defining principles:

1. Describe services as *LOD prosumers* with input and output descriptions as *SPARQL graph patterns*.
2. *Communicate RDF* by *RESTful content negotiation*.
3. Communicate and describe the *knowledge contribution* resulting from service interaction, including *implicit knowledge* relating input, output and service provider.

   Associated with the last principle, there is an optional fourth one:

4. When wrapping non-LOS services, extend the (lifted, if non-RDF) message to make explicit the implicit knowledge it contains, and use Linked Data vocabularies and *SPARQL CONSTRUCT* queries to derive the constructed knowledge.

In our demo we present LOS implementations, applications and first results towards the use of Linked Open Services in processes and service compositions. In Linked Open Services, we see an approach to linked data mash-ups with real world side-effects. It is in the nature of the work, and the call to which we respond, that this will be of 'late breaking nature'. We have already taken forward particularly the challenge of geospatial services; both in the development of novel services according to these principles, and in wrapping existing services from `http://www.geonames.org`.[1]

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[1] `http://www.linkedopenservices.org/services/geo/`

astergdem	children	cities	countryCode	countryInfo	countrySubdivision	earthquakes	extendedFindNearby	findNearby	findNearbyPlaceName	findNearbyPostalCodes	findNearbyStreets	findNearbyStreetsOSM	findNearByWeather	findNearbyWikipedia	findNearestAddress	findNearestIntersection	findNearestIntersectionOSM	get	gtopo30	hierarchy	neighbourhood	neighbours	ocean	postalCodeCountryInfo	postalCodeLookup	postalCodeSearch	rssToGeo	search	siblings	srtm3	timezone	weather	weatherIcao	wikipediaBoundingBox	wikipediaSearch
J	J	J	J	J	J	J	–	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	J	–	J	J	J	J	J	J	J	X
X	X	X	X	X	–	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	–	X	X	X	X	–	–	X	X
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–

Fig. 1. The current services offered over the geonames Linked Data set (J=JSON,X=XML,R=RDF)

2 Geospatial Services

While `geonames.org` is rightly regarded as one of the key components of the Linked Data cloud (cf. `www.linkeddata.org`), for the services that offer functionality over this data the use of semantics is much less encouraging, as shown in Figure 1. In fact, while all but one service are capable of using JSON (marked with a 'J'), rapidly replacing XML ('X') as the de facto language for service communication, only one is currently enabled to directly communicate RDF ('R').

A number of Linked Open Services are therefore dedicated to re-exposing these services in a form where they can communicate RDF. In order to do so we employ a library we have developed, and will demonstrate, named JSON2RDF. The point of this library is not to directly produce usable RDF, but rather to automatically produce some kind of RDF that can then be transformed into a useful form simply using SPARQL CONSTRUCT queries, as per Principle 4.

Table 1. Automatic JSON2RDF Lifting of GeoNames Weather Service

GeoNames output JSON:

```
{"weatherObservations": [
  { "clouds": "few clouds",
    "windDirection": 20,
    "ICAO": "CYOW",
    "lng": 41.7,
    "temperature": "35",
    ...
```

Generic RDF after lifting:

```
[ json2rdf:weatherObservations [
    json2rdf:clouds "few clouds" ;
    json2rdf:windDirection "20"^^xsd:short ;
    json2rdf:ICAO airports:CYOW ;
    json2rdf:lng "41.7"^^xsd:double ;
    json2rdf:temperature "35" ;
    ...
```

Table 1 shows the result of applying JSON2RDF to a GeoNames weather service, while Table 2 sketches the CONSTRUCT query that is subsequently applied. Note that this is not only the opportunity to introduce the use of standard Linked Data vocabularies, but also of provenance information, which is increasingly becoming a 'hot topic' in the Linked Data community; cf. [1] for example.

Table 2. CONSTRUCT Query over GeoNames Weather Service

```
CONSTRUCT { [ met:weatherObservation [
  weather:hasStationID ?icao ;
  ...
  wgs84:long ?longitude ; wgs84:lat ?altitude ; ... ] ] .
}
WHERE { [ json2rdf:weatherObservations _:a ] .
  _:b json2rdf:ICAO ?icao ;
      json2rdf:lng ?longitude ; json2rdf:lat ?latitude ; ...
}
```

In our work with geospatial services we have also capitalised on the cross-fertilisation of Linked Data and RESTful service principles followed in Linked Open Services. Not only is the vocabulary for the airports that are used in weather reporting in geonames services missing, but the chance to view service calls as operations against the concerned resources, rather than as disembodied 'RPC calls', is missing. In response, Linked Open Services have been provided that openly manage spatial resources, such as those in the geonames dataset, and airports have been included so that the 'weatherICAO' service (where ICAO is a code identifying airports) is offered as an HTTP POST operation against a URI version of the ICAO code. The demo will also show how REST frameworks like JAX-RS can be used in developing such services in combination with semantic technologies.

3   Summary

In the demo we demonstrate our latest work on service development in the context of Linked Open Services [2]. The applications and services to be showcased focus foremost on our work with GeoNames data and services, and include demonstrations of our inclusion of provenance data and provision of resource-oriented services. We would also hope to present services related to the telecoms domain and demos supporting also the composition of Linked Open Services in the form of process.

References

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