The European Commission’s science and knowledge service
Joint Research Centre

INSPIRE in RDF: increasing semantic interoperability for European geospatial data?

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INSPIRE Conference 2017
Background

- INSPIRE aims at improving the exchange of interoperable spatial data between public authorities in Europe,
  - usually under geospatial Standards, as OGC.
- While INSPIRE is being implemented, other technologies are appearing in the geospatial scene as Linked Data
  - Spatial Data on the Web Best Practices,
  - ISA CORE location vocabulary
  - Pioneer experiments with (INSPIRE) geospatial Linked data (Geoknow, PDOK, etc.)
- Since INSPIRE is a long term implementation, it should be flexible enough at least to assess and embrace new technological if those bring benefits.

“As location is often the common factor across multiple datasets, spatial data is an especially useful addition to the Web of data”
**ARe3NA work on Linked Data**

**Phase 1 - Study on "RDF & PIDs for INSPIRE"**
- Identifying recommendations for a common methodology to encode RDF INSPIRE
- Governance issues of Persistent identifiers
- Tools supporting RDF transformation

**Phase 2 - Application**
- Draft guidelines for representing INSPIRE in RDF
- Draft vocabularies
- Two pilots assessing the feasibility and correctness of the former

**GeoDCAT-AP Specification + Sandbox**
The guidelines and vocabulary development

- Produced by Interactive Instruments and PWC
- Goal: keeping the INSPIRE interoperability in the Linked Data world
- Open process by calling to comment on them

- The status of this activity is draft
- A formal review by the EC and Member State representatives (MIG) will be done.
- The guidelines could eventually become an additional encoding for geospatial data exchange in Europe building upon the existing infrastructure
Guidelines for the RDF encoding of spatial data - Why new guidelines?

Regulation 1089/2010

1. Every encoding rule used to encode spatial data shall conform to EN ISO 19118. In particular, it shall specify schema conversion rules for all spatial object types and all attributes and association roles and the output data structure used.
2. Every encoding rule used to encode spatial data shall be made available.

Schemas conversion rules

Converting INSPIRE applications schemas to an OWL ontology

**Topics:** types, properties, associations, constraints

Instance conversion rules

How spatial objects are converted to RDF resources

**Topics:** resource identifiers, encoding geometry, encoding metadata, etc.
Guidelines for the RDF encoding of spatial data

Can only share all the (positive) information a data provider has

http://inspire-eu-rdf.github.io/inspire-rdf-guidelines/
The INSPIRE RDF Vocabularies (schemas)

# This ontology contains classes and properties that have been derived from the INSPIRE "AdministrativeUnits" application schema.

# The following properties have been encoded with global scope (see guidelines for further details):
# - AdministrativeBoundary.country

# During the derivation, the following mappings, alignments, and omissions have been applied:
# - Mappings:
# - Code list and enumeration values are mapped to skos:Concept.
# - The properties 'beginLifespanVersion' and 'endLifespanVersion' are mapped to the global properties defined by the base ontology.
# - Geometry types are mapped to classes from the Simple Feature ontology.
# - Property 'AdministrativeUnit.country' is mapped to the global property 'country' from this ontology.

# - Alignments (through subsumption):
# - Spatial object types are aligned with gsp:Feature.
# - Properties of spatial object types with value type 'GeographicalName' are aligned to property locn:geographicName.
# - Properties with a geometry value type are aligned to locn:geometry and gsp:hasDefaultGeometry.

# - Omissions:
# - Property 'inspireId' is omitted. See the guidelines for further details.
<prefix sfowl: <http://www.opengis.net/ont/sf#> .
<prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
<prefix gsp: <http://www.opengis.net/ont/geospatial#> .

```
<hy-p:ManMadeObject a owl:Class ;
  rdfs:isDefinedBy <http://inspire.ec.europa.eu/featureconcept/ManMadeObject> ;
  rdfs:subClassOf hy:HydroObject , gsp:feature ;
  iso19150-2:isAbstract true ;
  skos:definition "An artificial object which lies inside a body of water and has one of the following" .
```

```
<hy-p:ManMadeObject.levelOfDetail a owl:DatatypeProperty ;
  rdfs:domain hy-p:ManMadeObject ;
  rdfs:range rdf:langString ;
  skos:definition "Resolution, expressed as the inverse of an indicative scale or a ground distance."@en .
```

```
<hy-p:ManMadeObject.condition a owl:ObjectProperty ;
  rdfs:domain SOURCE [DF00] .@en ;
  rdfs:range hy-p:ManMadeObject ;
  rdfs:range skos:Concept ;
  skos:definition "The state of planning, construction, repair, and/or maintenance of the structures" .
```

```
<hy-p:Casting a owl:Class ;
  rdfs:comment "EXAMPLE Aqueduct, bridge, culvert, siphon."@en ;
  rdfs:isDefinedBy <http://inspire.ec.europa.eu/featureconcept/Casting> ;
  rdfs:subClassOf hy-p:ManMadeObject , gsp:Feature ;
  skos:definition "A man-made object allowing the passage of water above or below an obstacle."@en .
```
Example of a converted instance

```xml
<hy-p:geographicalName>
  <gn:GeographicalName xmlns:gn="http://inspire.ec.europa.eu/schemas/gn/4.0">
    <gn:spelling>
      <gn:spellingOfName>
        <gn:text>Barranco de Castellón</gn:text>
      </gn:spellingOfName>
    </gn:spelling>
  </gn:GeographicalName>
</hy-p:geographicalName>
<hy-p:hydroId>
  <hy:HydroIdentifier xmlns:hy="http://inspire.ec.europa.eu/schemas/hy/4.0">
    <hy:classificationScheme>Nacional</hy:classificationScheme>
    <hy:localId>1300</hy:localId>
    <hy:namespace>ES</hy:namespace>
  </hy:HydroIdentifier>
</hy-p:hydroId>
<hy-p:relatedHydroObject/>
<hy-p:beginLifespanVersion>2016-09-23T00:00:00+00:00</hy-p:beginLifespanVersion>
<hy-p:condition xsi:nil="true"/>
<hy-p:geometry>
  <!-- Inlined geometry for HY-P_CROSSING_CRUCE_L1060
  <gml:LineString gml:id="HY-P_CROSSING_CRUCE_L1060">
  </gml:LineString>
  
  <gml:LineString>
    <!-- Inlined geometry for HY-P_CROSSING_CRUCE_L1060

</gml:LineString>
</hy-p:geometry>
<hy-p:inspireId>
  <base:Identifier xmlns:base="http://inspire.ec.europa.eu/schemas/base/4.0">
    <base:localId>CRUCE_L1060001390</base:localId>
    <base:namespace>ES IGN IGR HI</base:namespace>
  </base:Identifier>
</hy-p:inspireId>
</hy-p:CROSSING>

@prefix geo: <http://www.opengis.net/ont/geosparql#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix base: <http://inspire.ec.europa.eu/ont/base#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix hy: <http://inspire.ec.europa.eu/ont/hy#> .


a hy:p:CROSSING ;
  hy:HydroObject.geographicalName "Barranco de Castellón"^^xsd:string ;
  hy:HydroIdentifier.classificationScheme "Nacional"^^xsd:string ;
  hy:HydroIdentifier.localId "1300"^^xsd:int ;
  hy:HydroIdentifier.namespace "ES"^^xsd:string ;
  base:beginLifespanVersion "2016-09-23T00:00:00+00:00"^^xsd:dateTime ;
  hy-p:ManMadeObject.levelOfDetail "5"^^xsd:int ;
```
The JRC has awarded two pilots from a call for tenders that have run from February to mid-2017. Both pilots involved private companies working closely with data providers and data users. They focused on e-government applications.

The goals were to demonstrate the feasibility of sharing INSPIRE data in RDF by applying, testing and improving the guidelines to illustrate how INSPIRE data can be used in e-Government services and processes.

Understand the benefits of this technology.
Pilot 1

Improving the information position of emergency responders with Linked INSPIRE Data
Stakeholders

Dutch Kadaster
Maintains and provides the data about buildings, parcels and addresses

Dutch safety Regions
Cooperation of the public management of villages and towns regarding crisis and disaster management within the region of competence

Netage
Company specializes in applications for emergency response teams. “Smart data for smarter fire fighters”
Business Case

**Combining** different **public** & **private** datasets to generate an **accurate contextual image** for the fire service, both in preparation, prevention & operations

The Fire Service depends on a combination of data from various sources to build a complete “image”:

- Building (size)
- Company register (type of business registered)
- Permit register (type of activities allowed)
- Address & Parcel register

The fire service has **NO authority over any of this data**, it must be harvested from the relevant public bodies.
Process to provide INSPIRE RDF services

**Step 1**  Convert data to RDF both INSPIRE and non-INSPIRE

**Step 2**  Create authoritative identifiers in INSPIRE datasets

**Step 3**  Relate all registrations to their respective identifiers

**Step 4**  Mashup between various INSPIRE themes

**Step 5**  Data from various registration on the current object

**Step 6**  Metadata references to the source of the data
Issues encountered and challenges

- Excess of triples for one city only
- Mix of INSPIRE and non-INSPIRE themes
- An object for them as a “dwelling” could be represented at different levels in different INSPIRE themes; building, facilities, addresses etc.
Benefits perceived

- **Administrative relations** between data sets can prove to be more helpful during incidents than pure spatial relations.
- Simplification of the update and combination of datasets
  - (1) to **keep data at its source** and
  - (2) to relieve the emergency responders of maintaining yet another dataset they do not control (silos).
- **INSPIRE RDF suitable for cross-reference scenarios**
- Support better **business intelligence** and **more advanced analysis**

“**In the national registry of economic activity ("Trading register", Dutch: "Handelsregister"), the location of a service site for elderly and disabled people was registered not on the actual physical location, but on the administrative location.**

“**Punching a pin through the map**” would have failed to get the correct information, while from an administrative point of view the correct relation is registered.”
Serve Hydrographical Data with the Linked Data reusable by interested Public Administrations
Stakeholders & Business Case

**CNIG (Centro Nacional de Información Geográfica)**
- **Promotes** and **markets** the products of the Spanish National Geographic Institute
- **Data Provider:** INSPIRE Hydrography datasets / Publish RDF services

**Andalusia Regional Government Corporate GIS**
- Provision of horizontal tools and services for Andalusian Regional Government
- **Spread INSPIRE RDF guidelines and tools**

**Guadalquivir River Basin Agency**
- Manages the Guadalquivir River Basin
- **Incorporate RDF services in internal business processes**

**Guadaltel**
- Consultancy, SDI and Corporate GIS solutions provider
- Solution developer for RDF spatial data integration
Process to provide INSPIRE RDF services

**Step 1**
Provide existing information from CNIG converting INSPIRE hydrography physical data model to RDF format.

**Step 2**
Identify and harvest National INSPIRE data via public WFS services

**Step 3**
Match hydrography dataset attributes against INSPIRE data model

**Step 4**
Match hydrography dataset attributes against INSPIRE RDF vocabularies

**Step 5**
ETL process translating from INSPIRE hydrography datasets to INSPIRE RDF

**Step 6**
Publish RDF produced data
Issues encountered and challenges

- Technological implementation references for GIS RDF data migration
- INSPIRE RDF guidelines
- Lack of resources and business priorities to incorporate RDF in internal processes
- Make information and knowledge more available
- Enrich use cases to highlight RDF benefits
Benefits perceived

● High added-value solution to link spatial and non-spatial data
● Publish hydrography data in a more extended format and less specific services than OGC in the world wide web.
● Can be indexed in machine to machine searches and so it can be found and used by more parties
● Use of existing tools to locate and process data from RDF
● Cross-sectorial use for published data adding value for: floods, transport planning or agriculture
Additional outcomes of the pilots

Webinar

https://www.youtube.com/watch?v=EVhSa3Rb1EQ

Documentation

Workflows to be included in INSPIRE in practice

Interviews from 5 stakeholders

Detailed Virtuoso migration guidelines
Overall benefits perceived

**Discoverability**
- **Indexable** by search engines
- Supporting **free flow of data**
- **5 stars** Open Data level
- transparency e-Government
- Removing **silos**

**Reuse**
- **New actors** beyond GI
- **New technologies** beyond GI
- **New businesses**

**Linkability**
- Augmented interoperability and integration across sectors and borders (**seamless data**)
- Supports “natively” the **extensibility**
Conclusion

- The benefits look promising, but the biggest challenge is the change of mindset in the institutions (lack of priorities, resources).
- W3C has already recognised the value of spatial Linked Data.
- If INSPIRE finally endorses this new exchange format, it would symbolize a willingness to:
  - adapt to changes by embracing cutting-edge technologies
  - boosting semantic interoperability of geospatial data at an pan European extent
  - Betting for innovation

INSPIRE data models offer a unique opportunity for creating semantically rich and agreed descriptions of geographical features in a consistent way across Europe.
References

ARE3NA Reusing INSPIRE JoinUp space
https://joinup.ec.europa.eu/asset/are3na-reuse/description

*Guidelines for the RDF encoding of spatial data*
http://inspire-eu-rdf.github.io/inspire-rdf-guidelines/

INSPIRE RDF Vocabularies
https://github.com/inspire-eu-rdf/inspire-rdf-vocabularies

ARE3NA study on RDF & PIDs for INSPIRE

Webinar “Understanding the benefits of the provision RDF services on INSPIRE data and how these services support eGovernment services”
- Recording https://www.youtube.com/watch?v=EVhSa3Rb1EQ

Call for tenders (Pilots)

GeoDCAT-AP Sandbox
Keep in touch!

Find us during the conference

Write to us!

Tweet!

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