Update on the Linked And Networked DRoneS project: APIs, and Ontologies

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CENTER FOR RESEARCH COMPUTING

Overview

- LANDRS in brief
- Ontology development work
- OpenAPI status update (Lewis McGibbney, NASA JPL)

LANDRS: Goals

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Problem: Complex and painful drone data pipeline costs significant data value

Goal: Allow users to capture the lost value by providing standards based APIs for building drone data wrangling tools.

Linked-data
API for
Networked
DRone**S**

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[Taking some steps towards enabling FAIR Drone Data]

LANDRS: 1st Hackathon

Goal: **Design**

- ESIP Summer meeting
  - July 2019:
  - ~15 people

LANDRS: 1st Hackathon

Outcomes:

- UxS ontology
  - Driven by
    - Prior minimal information framework
    - Drone user engagement
  - View1: Modeling progression
  - View2: Metadata view (CEDARS)
- OpenAPI (covered at end of slide deck)

LANDRS: 2nd Hackathon

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Co-located RDA Plenary 14

- Helesinki Finland 21-22 October
- Hosted at University of Helsinki

Goals:

- Finalise Design
- Kick off of Best Practices working group (would **really** like OGC involvement in that)
- Engage more EU input

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LANDRS: Looking for interns

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- Looking for interns (or PIs?)
  - Paid, Global, Hosted and non-hosted, mentored
- Topics:
  - Ontology development
  - OpenAPI development
  - Onboard API development
  - Demonstrator development
  - Community engagement

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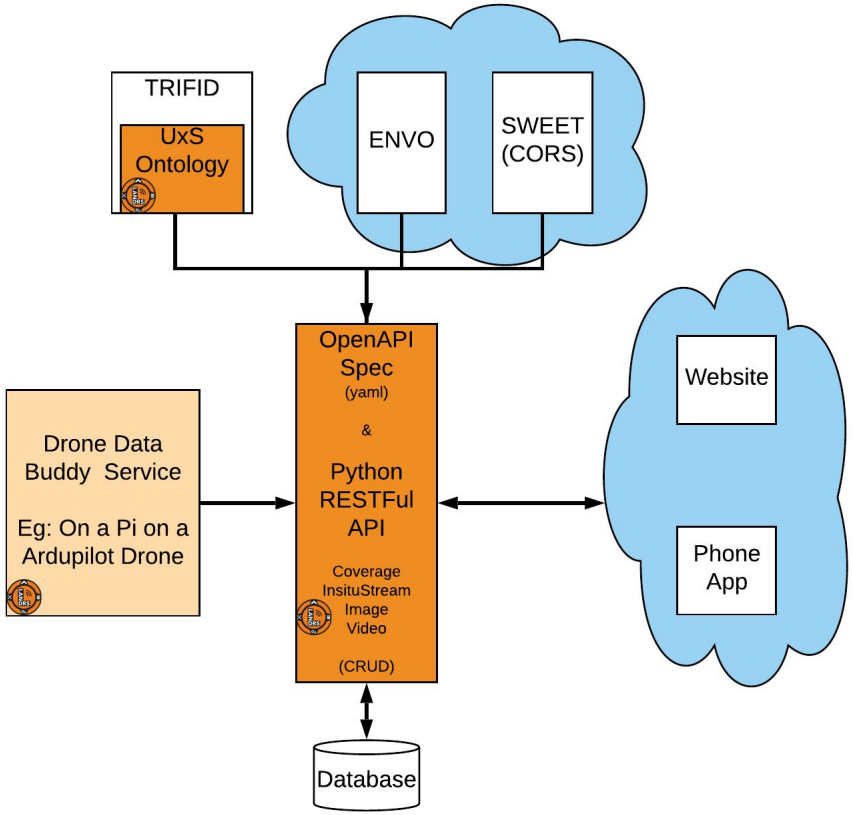
LANDRS: Keeping it grounded

Towards example applications:

- Drone Data Buddy (limited)



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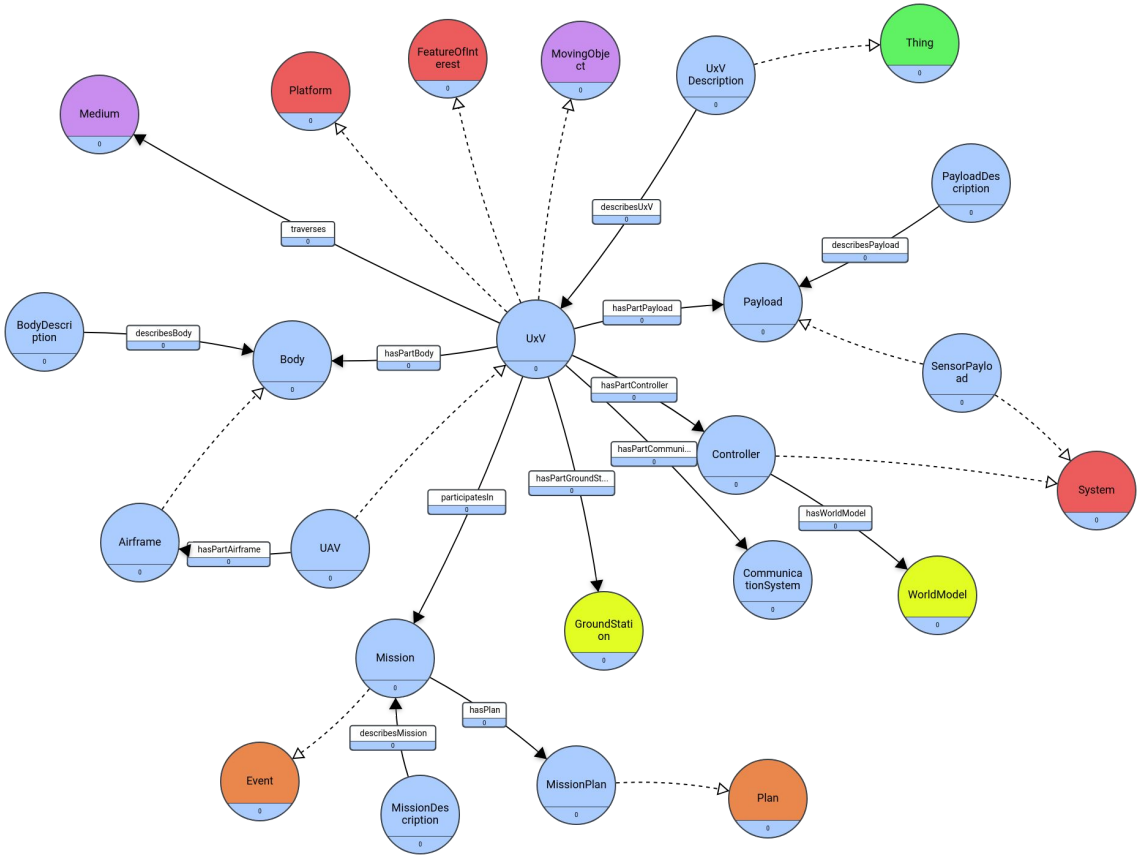
Strawman Conceptual Map



https://github.com/opengeospatial/LANDRS/blob/master/DesignDocs/images/DroneStrawmanConceptualModel.png

SOSA

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Semantic Sensor Network Ontology

OGC® Making location count. W3C

W3C Recommendation 19 October 2017 (Link errors corrected 08 December 2017)

This version:
https://www.w3.org/TR/2017/REC-vocab-ssn-20171019/

Latest published version:
https://www.w3.org/TR/vocab-ssn/

Latest editor's draft:
https://w3c.github.io/sdw/ssn/

Implementation report:
https://w3c.github.io/sdw/ssn-usage/

Previous version:
https://www.w3.org/TR/2017/PR-vocab-ssn-20170907/

Editors:
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Joshua Lieberman, Tumbling Walls

WoT Thing Description

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Web of Things (WoT) Thing Description

W3C Candidate Recommendation 16 May 2019

This version:
https://www.w3.org/TR/2019/CR-wot-thing-description-20190516/

Latest published version:
https://www.w3.org/TR/wot-thing-description/

Latest editor's draft:
https://w3c.github.io/wot-thing-description/

Implementation report:
https://w3c.github.io/wot-thing-description/testing/report.html

Previous version:
https://www.w3.org/TR/2018/WD-wot-thing-description-20181021/

Editors:
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Takuki Kamiya (Fujitsu Laboratories of America, Inc.)
Michael McCool (Intel)
Victor Charpenay (Siemens AG)

Participate:
GitHub w3c/wot-thing-description
File a bug
Commit history
Pull requests

Contributors:
In the GitHub repository

Repository:
We are on GitHub
File a bug

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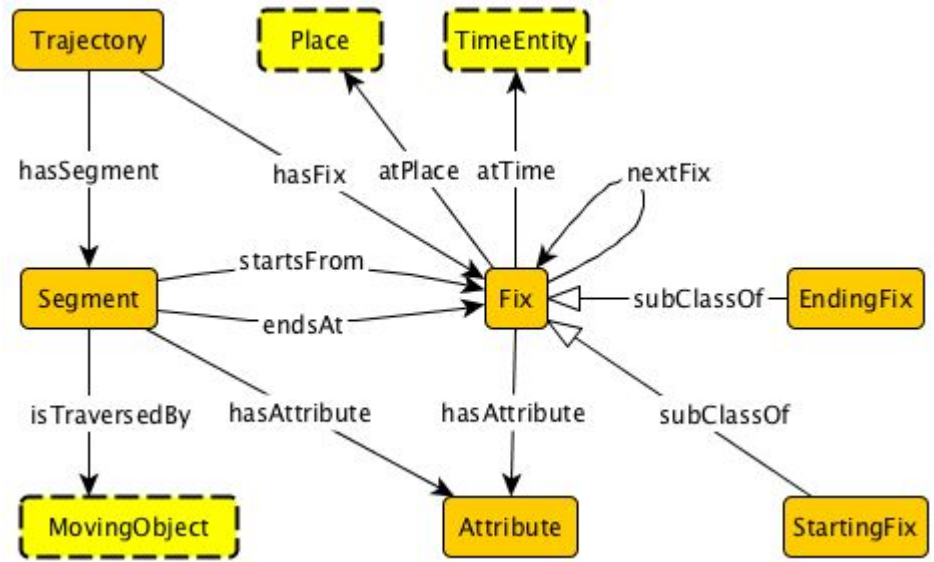
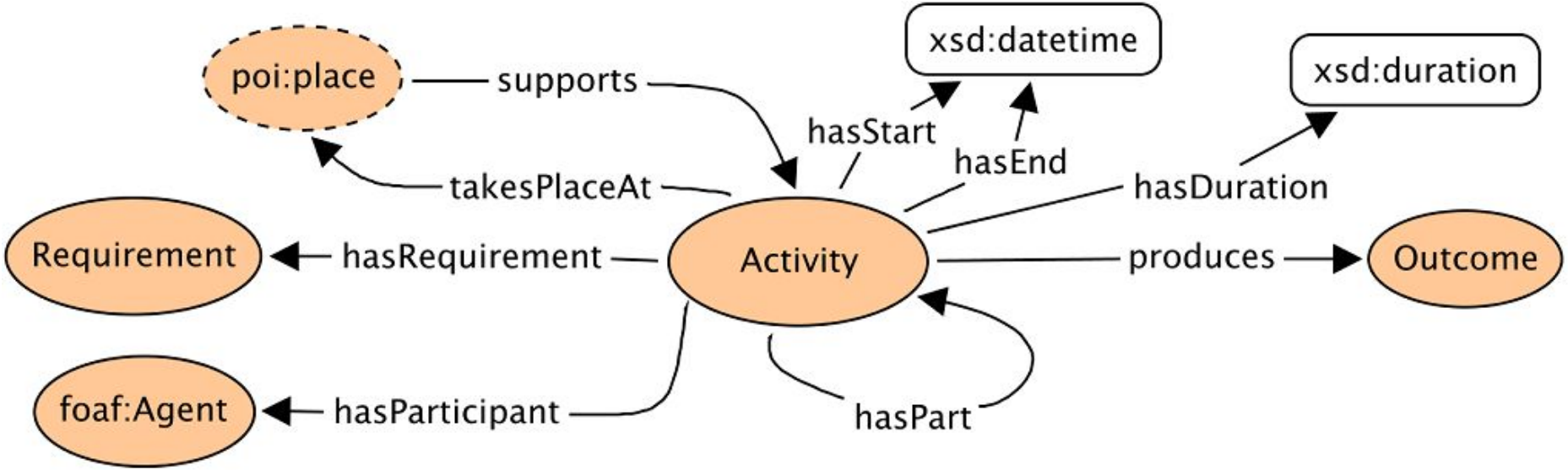
Modular Blocks: Semantic Trajectory



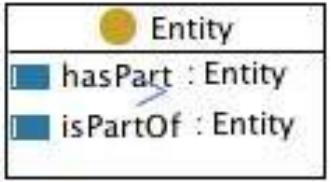
http://ontologydesignpatterns.org/wiki/Submissions:Trajectory

Activity Pattern



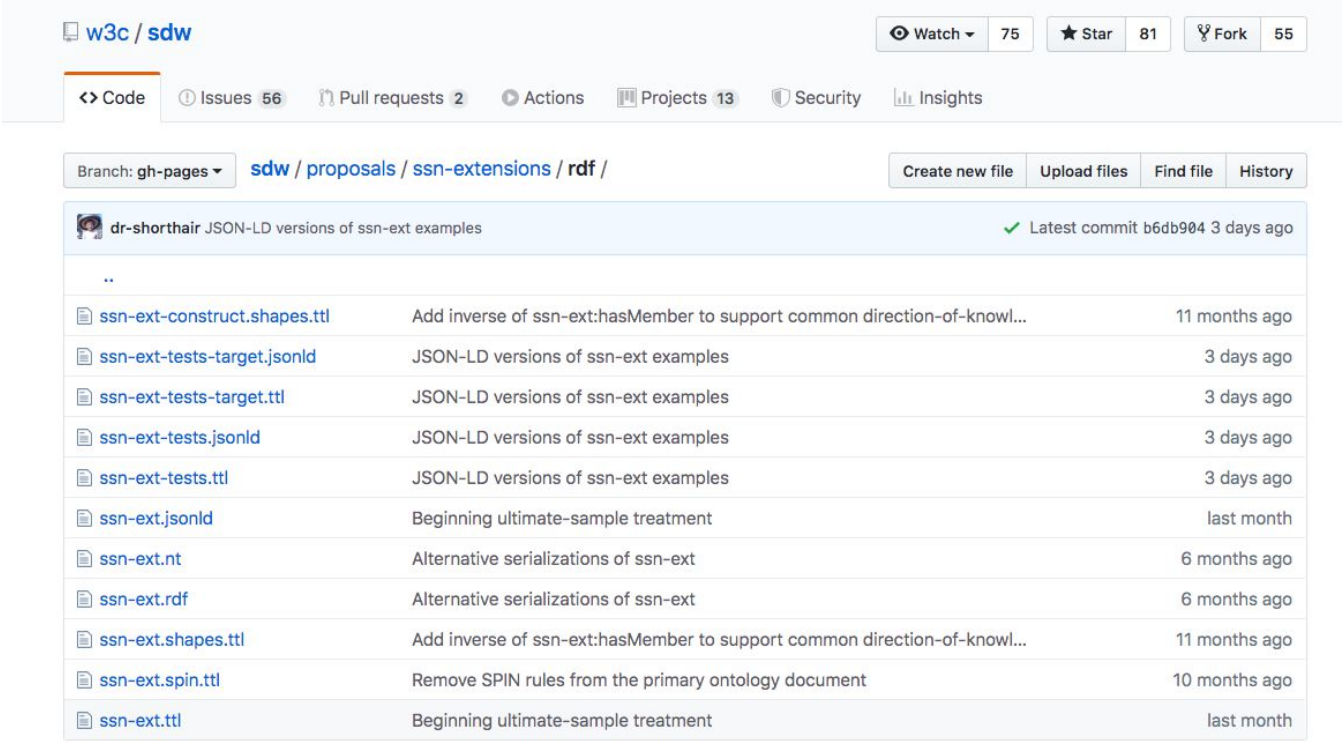
http://ontologydesignpatterns.org/wiki/Submissions:An_Ontology_Design_Pattern_for_Activity_Reasoning

Modular Blocks: PartOf



http://ontologydesignpatterns.org/wiki/Submissions:PartOf

Modular Data View Approach



w3c / sdw

Watch 75 | Star 81 | Fork 55

<> Code | Issues 56 | Pull requests 2 | Actions | Projects 13 | Security | Insights

Branch: gh-pages — sdw / proposals / ssn-extensions / rdf / — Create new file | Upload files | Find file | History

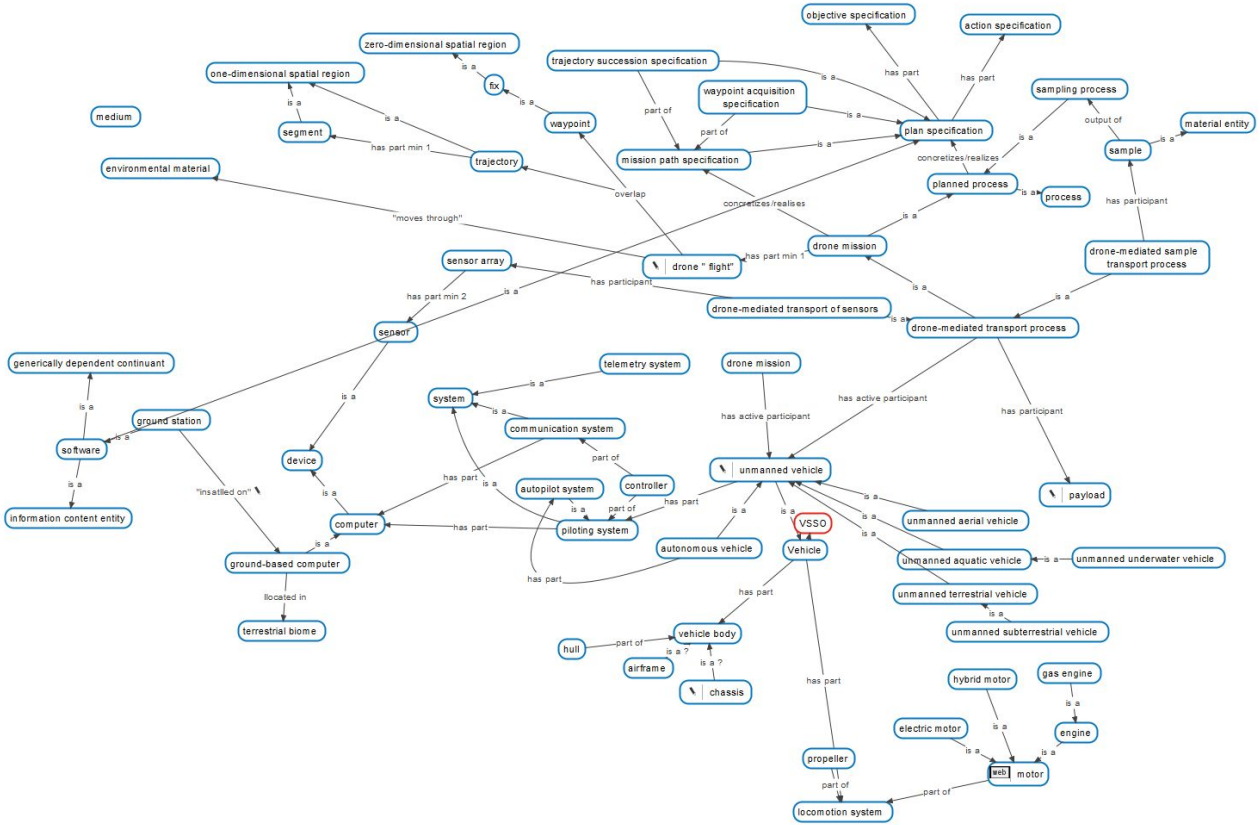
dr-shorthair JSON-LD versions of ssn-ext examples — Latest commit b6db904 3 days ago

..

ssn-ext-construct.shapes.ttl	Add inverse of ssn-ext:hasMember to support common direction-of-knowl...	11 months ago
ssn-ext-tests-target.jsonld	JSON-LD versions of ssn-ext examples	3 days ago
ssn-ext-tests-target.ttl	JSON-LD versions of ssn-ext examples	3 days ago
ssn-ext-tests.jsonld	JSON-LD versions of ssn-ext examples	3 days ago
ssn-ext-tests.ttl	JSON-LD versions of ssn-ext examples	3 days ago
ssn-ext.jsonld	Beginning ultimate-sample treatment	last month
ssn-ext.nt	Alternative serializations of ssn-ext	6 months ago
ssn-ext.rdf	Alternative serializations of ssn-ext	6 months ago
ssn-ext.shapes.ttl	Add inverse of ssn-ext:hasMember to support common direction-of-knowl...	11 months ago
ssn-ext.spin.ttl	Remove SPIN rules from the primary ontology document	10 months ago
ssn-ext.ttl	Beginning ultimate-sample treatment	last month

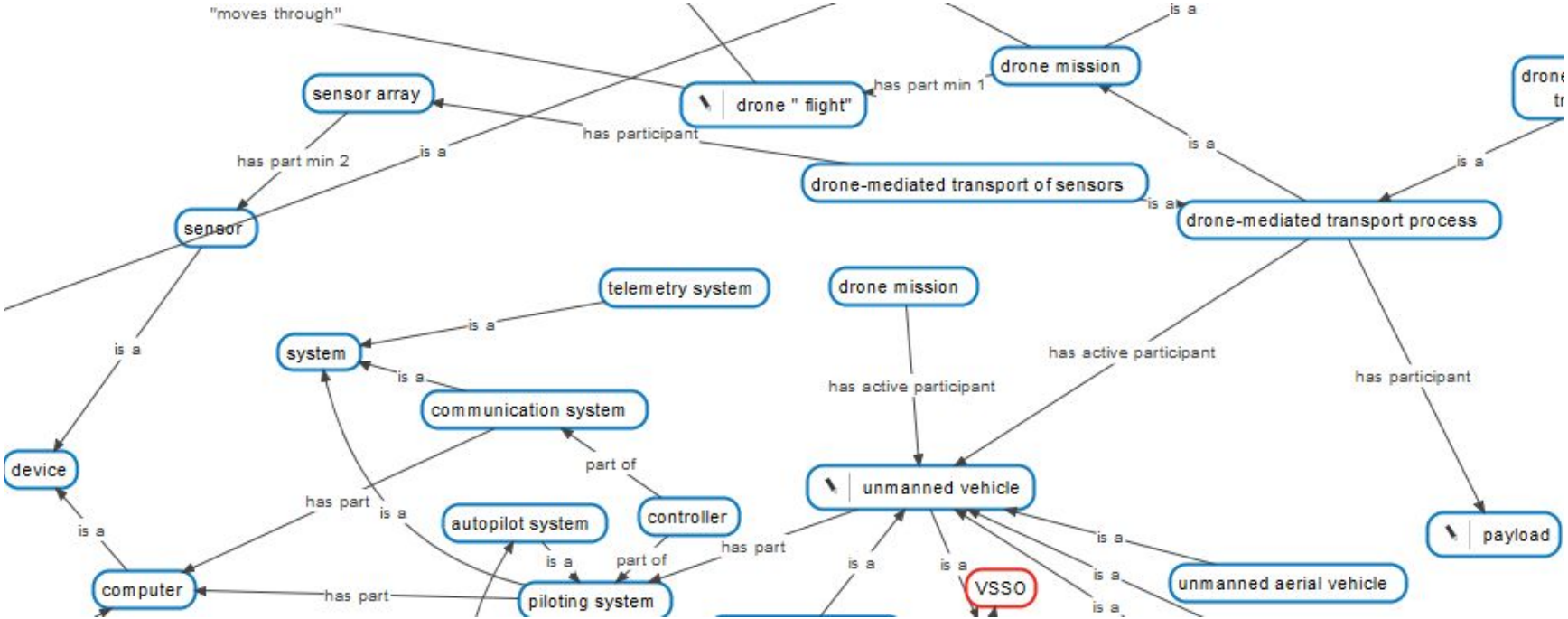
https://w3c.github.io/sdw/proposals/ssn-extensions/

Output: Conceptual Map Knowledge Graph



https://github.com/opengeospatial/LANDRS/blob/master/DesignDocs/DesignHack1/ontology/droneSemanticSketch-copy.png

Sensor Detail of Knowledge Graph



What is the connection between Ontology, Data and API?

An example problem

Derived from the NASA Centurion UAV, this solar cell and fuel cell powered UAV set a world record for flight at 96,863 feet (29,524 m). It was intended to be the prototype for the production Helios aircraft, envisioned as an "atmospheric satellite". The ERAST program was terminated in 2003, and as of 2008 Helios has not entered production. In actuality, it has been reborn in the form of the Global Observer UAS, currently in development under a Joint Concept Technology Demonstration led by USSOCOM. The key technology shift was switching from solar power to liquid hydrogen power.

https://en.wikipedia.org/wiki/Helios_Prototype

The “Linked-Data” Part

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```
#Data of NASA Helios (Q1353965)

PREFIX entity: <http://www.wikidata.org/entity/>
#partial results

SELECT ?propUrl ?propLabel ?valUrl ?valLabel ?picture
WHERE
{
    hint:Query hint:optimizer 'None' .
    {   BIND(entity:Q1353965 AS ?valUrl) .
        BIND("N/A" AS ?propUrl ) .
        BIND("identity"@en AS ?propLabel ) .
    }
    UNION
    {   entity:Q1353965 ?propUrl ?valUrl .
        ?property ?ref ?propUrl .
        ?property rdf:type wikibase:Property .
        ?property rdfs:label ?propLabel
    }

    ?valUrl rdfs:label ?valLabel
    FILTER (LANG(?valLabel) = 'en') .
    OPTIONAL{ ?valUrl wdt:P18 ?picture .}
    FILTER (lang(?propLabel) = 'en' )
}
ORDER BY ?propUrl ?valUrl
LIMIT 200
```

https://w.wiki/875

https://www.wikidata.org/wiki/Q1353965

WIKIDATA

Item | Discussion

NASA Helios (Q1353965)

No description defined — edit

In more languages Configure

Language	Label	Description	Also known as
English	NASA Helios	No description defined	
Spanish	Prototipo Helios	No description defined	
Traditional Chinese	No label defined	No description defined	
Chinese	No label defined	No description defined	

All entered languages

Main page
Community portal
Project chat
Create a new Item
Create a new Lexeme
Recent changes
Random Item
Query Service
Nearby
Help
Donate

Print/export
Create a book
Download as PDF
Printable version

Tools
What links here
Related changes
Special pages
Permanent link
Page information
Concept URI
Cite this page

Statements

instance of
- solar-powered aircraft — edit
  - 0 references — add reference
- light aircraft — edit
  - 0 references — add reference

add value

subclass of
- unmanned aerial vehicle — edit
  - 1 reference

add value

image — edit

Helios in flight.jpg

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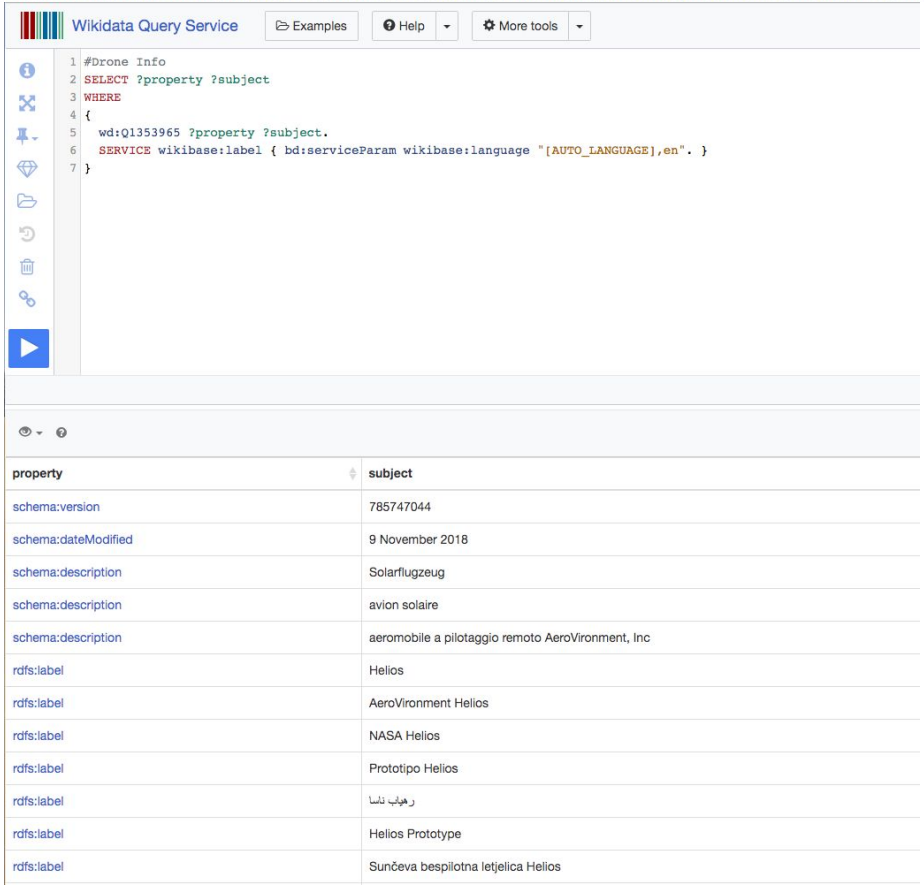
“Follow your nose” Principle

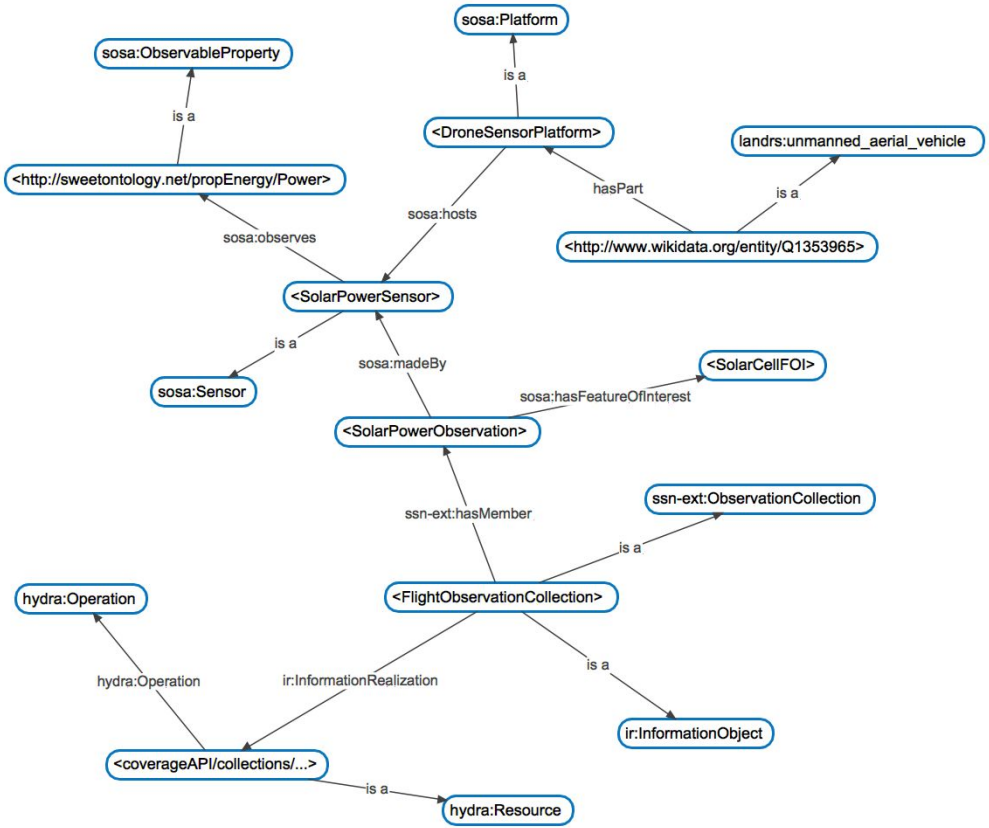
Link to Query:
https://w.wiki/7yz

Note:
https://www.wikidata.org/wiki/Q1353965
is NOT the same THING as
http://www.wikidata.org/entity/Q1353965



property	subject
schema:version	785747044
schema:dateModified	9 November 2018
schema:description	Solarflugzeug
schema:description	avion solaire
schema:description	aeromobile a pilotaggio remoto AeroVironment, Inc
rdfs:label	Helios
rdfs:label	AeroVironment Helios
rdfs:label	NASA Helios
rdfs:label	Prototipo Helios
rdfs:label	رهيلب ناسا
rdfs:label	Helios Prototype
rdfs:label	Sunčeva bespilotna letjelica Helios

Knowledge Graph Fragment



Reuse SWEET Ontology

```
###  http://sweetontology.net/propEnergy/Power
ener:Power rdf:type owl:Class ;
           rdfs:subClassOf quan:ExtensiveProperty ,
                           oper:Ratio ,
                           [ rdf:type owl:Restriction ;
                             owl:onProperty mrela:hasFirstOperand ;
                             owl:allValuesFrom ener:Energy
                           ] ,
                           [ rdf:type owl:Restriction ;
                             owl:onProperty mrela:hasSecondOperand ;
                             owl:allValuesFrom time:Time
                           ] ,
                           [ rdf:type owl:Restriction ;
                             owl:onProperty screla:hasDefaultUnit ;
                             owl:hasValue units:watt
                           ] ;
           rdfs:label "power"@en .
```

Qualified prefixes

```
@prefix : <http://sweetontology.net/propEnergy/> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix xml: <http://www.w3.org/XML/1998/namespace> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix ener: <http://sweetontology.net/propEnergy/> .
@prefix mass: <http://sweetontology.net/propMass/> .
@prefix mult: <http://sweetontology.net/propSpaceMultidimensional/> .
@prefix oper: <http://sweetontology.net/reprMathOperation/> .
@prefix phys: <http://sweetontology.net/procPhysical/> .
@prefix prop: <http://sweetontology.net/prop/> .
@prefix quan: <http://sweetontology.net/propQuantity/> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix rela: <http://sweetontology.net/rela/> .
@prefix time: <http://sweetontology.net/reprTime/> .
@prefix mrela: <http://sweetontology.net/relaMath/> .
@prefix prela: <http://sweetontology.net/relaPhysical/> .
@prefix units: <http://sweetontology.net/reprSciUnits/> .
@prefix screla: <http://sweetontology.net/relaSci/> .
```

Follow your nose again

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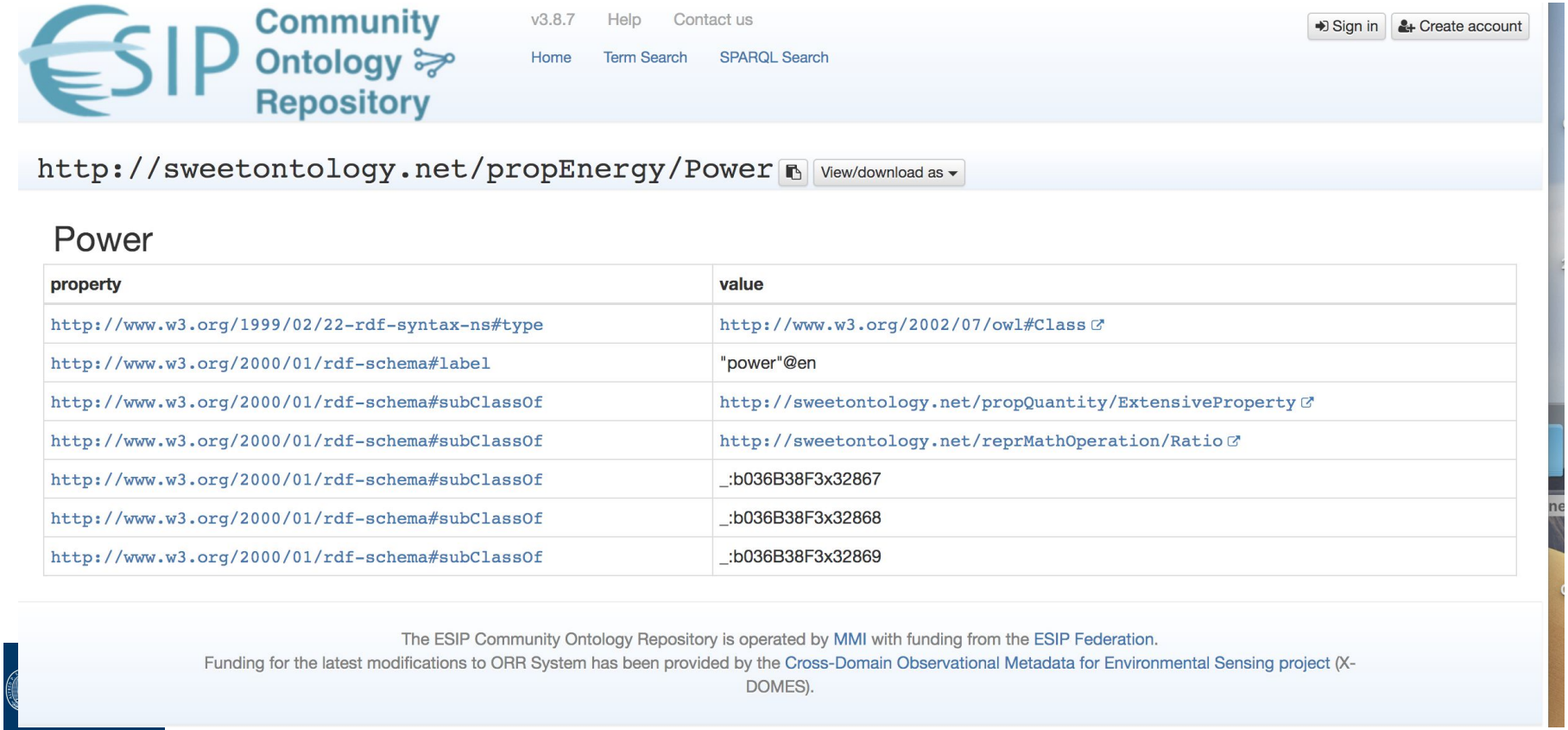
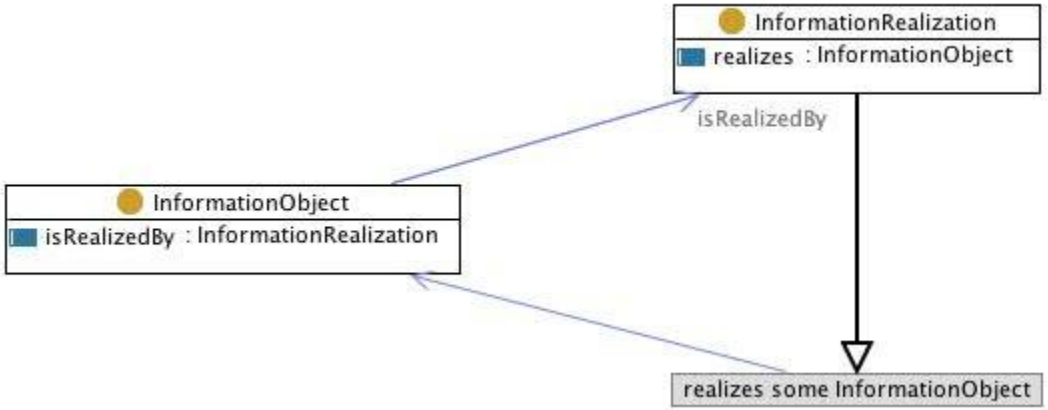


Information Object-Realization



http://www.designpatterns.org/wiki/Submissions:Information_realization

Hydra Core Vocabulary

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Hydra Core Vocabulary

A Vocabulary for Hypermedia-Driven Web APIs

Unofficial Draft 28 May 2019

Latest editor's draft:
http://www.hydra-cg.com/spec/latest/core/

Editor:
Markus Lanthaler (Google)

Author:
Markus Lanthaler (Google)

This document is also available in these non-normative formats: JSON-LD and Turtle

Abstract

Hydra is a lightweight vocabulary to create hypermedia-driven Web APIs. By specifying a number of concepts commonly used in Web APIs it enables the creation of generic API clients.

Status of This Document

This document is draft of a potential specification. It has no official standing of any kind and does not represent the support or consensus of any standards organization.

ISSUE 1

This entire document is a work in progress and several sections are incomplete, missing, or outdated. All open issues and decisions are documented in our issue tracker. If you have questions, please don't hesitate to join the Hydra W3C Community Group and post to the mailing list.

http://www.hydra-cg.com/spec/latest/core/

Linking Convenience APIs to Concepts

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```
# Information Object pattern because observation collection can be repackaged as a dataset release or take other forms.
<:FlightObservationCollection> a sosa-ext:ObservationCollection, ir:InformationObject ;
sosa:madeBySensor <SolarPowerSensor> ;
sosa-ext:hasFeatureOfInterest <http://www.wikidata.org/entity/Q1353965#SolarArray> ;
ir:realizedBy <http://somehost/coverageAPI/collections> .


# Link between SensorThings and SOSA. Use Hydra-core to describe interactions.
# Realization of the Obs Collection since the collection can take different forms. For example a Dataset release, a API endpoint, etc.
# For example hydra-box https://github.com/zazuko/hydra-box/blob/master/examples/spaceprobes.api.jsonld
<http://somehost/coverageAPI/collections> a ir:InformationRealization, st:datastream, hydra:Resource ;
ir:hasInformationObject <FlightObservationCollection> ;
dct:isDescribedBy: http://somehost/api/apiDocumentation ;
hydra:operation [
  a hydra:Operation ;
  hydra:method "GET" ;
  hydra:expects [
    a hydra:RequestSpecification ;
    hydra:content [
      a hydra:rawContent ;
      # Content-negotiation type for api
      hydra:supportedContentType "application/coverage+json"
    ],
    [
      a hydra:rawContent ;
      # Content-negotiation type for api
      hydra:supportedContentType "application/json"
    ]
  ]
] .

http://somehost/api/apiDocumentation a hydra:apiDocumentation .
```

Linked Data JSON Document

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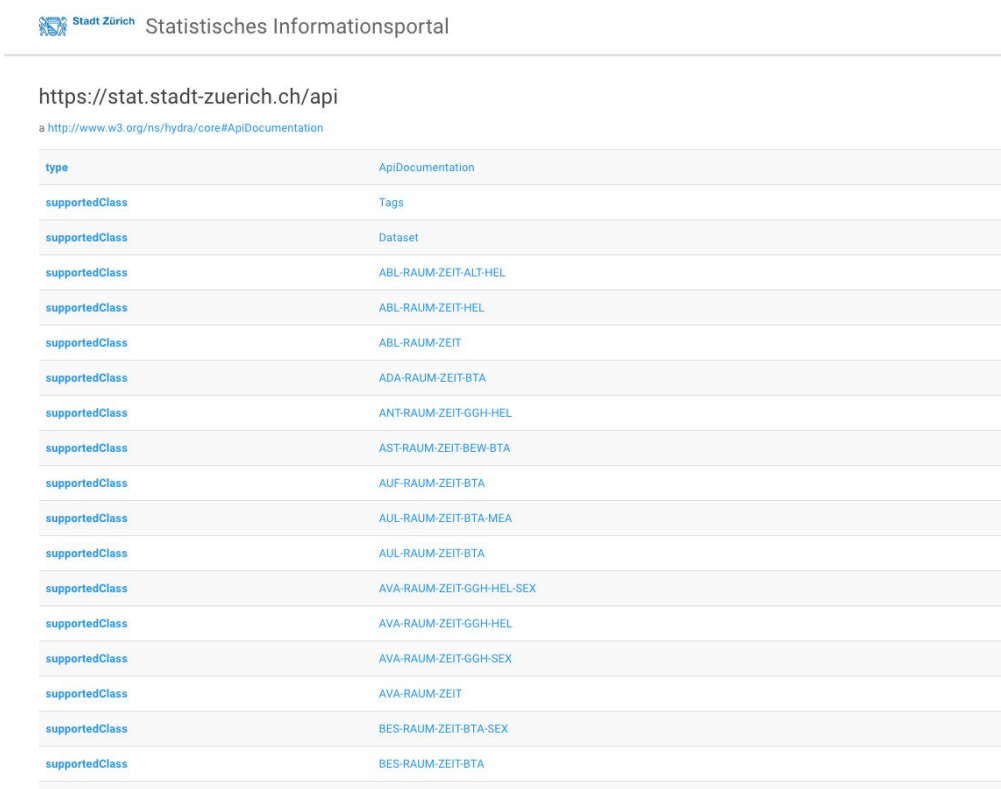
```
"@id" : "http://example.org/O5",
"@type" : "sosa:Observation",
"hasFeatureOfInterest" : "http://www.wikidata.org/entity/Q1353965#SolarArray",
"hasResult" : [
    {"@type": "qudt-1-1:QuantityValue",
    "qudt-1-1:numericValue": {
        "@value": "2.0",
        "@type": "http://www.w3.org/2001/XMLSchema#double"
    },
    "qudt-1-1:unit": "qudt-unit-1-1:W" }
    ],
"madeBySensor" : "http://example.org/SolarPowerSensor",
"observedProperty" : "http://sweetontology.net/propEnergy/Power",
"phenomenonTime" : "_:b11",
"resultTime" : "2018-03-10T15:12:00+10:00",
"usedProcedure" : "http://example.org/p3",
"hasUltimateFeatureOfInterest" : "http://www.wikidata.org/entity/Q1353965"
}, {
"@id" : "http://example.org/FlightObservationCollection_01",
"@type" : "ssn-ext:ObservationCollection",
"hasFeatureOfInterest" : "http://example.org/Sample_2",
"madeBySensor" : "http://example.org/s4",
"observedProperty" : "http://example.org/op2",
"phenomenonTime" : "_:b13",
"usedProcedure" : "http://example.org/p3",
"hasMember" : [ "http://example.org/O5", "http://example.org/O4" ]
}, {
"@id" : "http://example.org/foia",
"@type" : "sosa:FeatureOfInterest"
},{
```

Can be dynamically generated

City of Zurich linked data portal

https://stat.stadt-zuerich.ch/api

https://github.com/StatistikStadtZuerich/stat.stadt-zuerich.ch



CovJSON + OpenAPI

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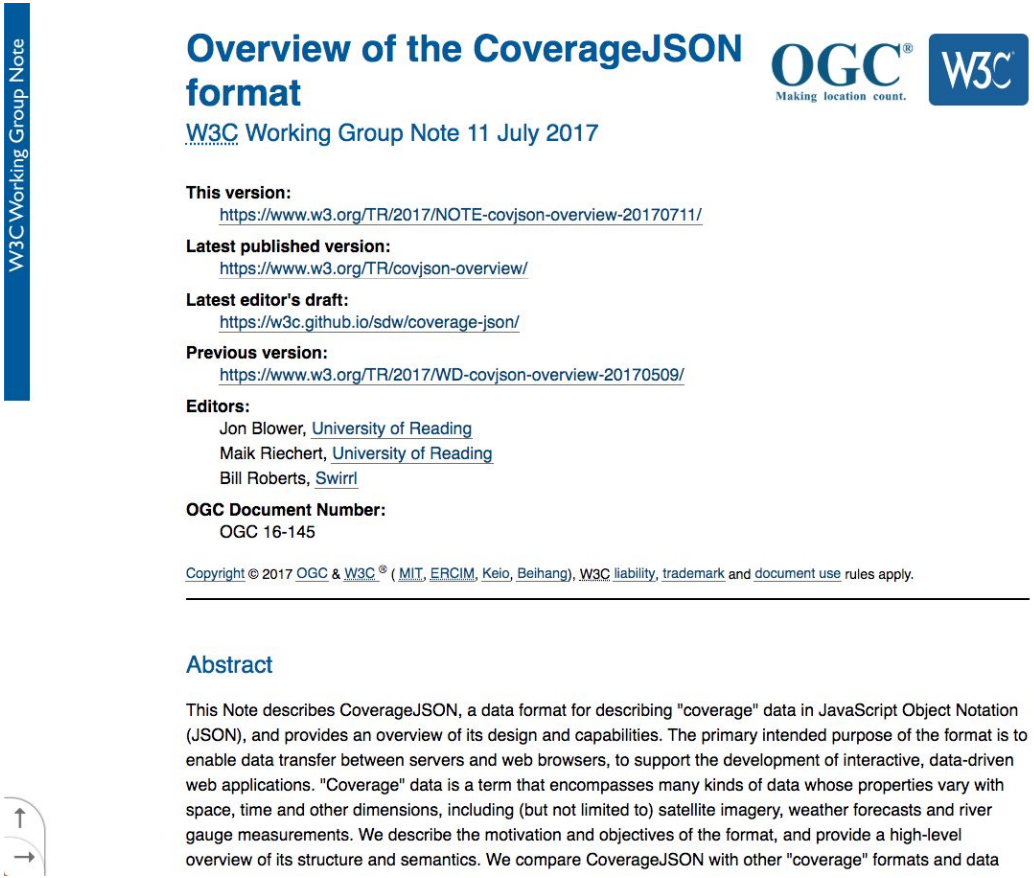

W3C Working Group Note

Overview of the CoverageJSON format

OGC Making location count. W3C

W3C Working Group Note 11 July 2017

This version:
https://www.w3.org/TR/2017/NOTE-covjson-overview-20170711/

Latest published version:
https://www.w3.org/TR/covjson-overview/

Latest editor's draft:
https://w3c.github.io/sdw/coverage-json/

Previous version:
https://www.w3.org/TR/2017/WD-covjson-overview-20170509/

Editors:
Jon Blower, University of Reading
Maik Riechert, University of Reading
Bill Roberts, Swirrl

OGC Document Number:
OGC 16-145

Abstract

This Note describes CoverageJSON, a data format for describing "coverage" data in JavaScript Object Notation (JSON), and provides an overview of its design and capabilities. The primary intended purpose of the format is to enable data transfer between servers and web browsers, to support the development of interactive, data-driven web applications. "Coverage" data is a term that encompasses many kinds of data whose properties vary with space, time and other dimensions, including (but not limited to) satellite imagery, weather forecasts and river gauge measurements. We describe the motivation and objectives of the format, and provide a high-level overview of its structure and semantics. We compare CoverageJSON with other "coverage" formats and data

https://www.w3.org/TR/covjson-overview/

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OpenAPI Status Update

Lewis McGibbney, NASA JPL)

ESIP Design Hack1

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GOAL(S)

OpenAPI Track - Developing an OpenAPI for Drone Data Capture: Starting with the existing OGC Coverages OpenAPI we evaluated whether it met our predefined use case. Future work was tabled to discuss how linked data (SOSA/SSN/SWEET/ENVO) can play a role in linking observation features of interest (the *thing(s)* being sensed), to the platform/sensor/equipment doing the observing (the *thing(s) doing the sensing*).

OUTCOME(S)

Collaborators produced the existing OpenAPI specification which residedes at **https://s.apache.org/t41s3**

The LANDRS OpenAPI

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Capabilities - essential characteristics of the OpenAPI including information about the data
GET /conformance
GET /collections…

Collections - Logical collection grouping to arrange Coverages
PUT /collections/{collectionid}

Coverages - Collection feature that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal domain.
GET /collections/{collectionid}/coverages
GET/PUT /collections/{collectionid}coverages/coverageid
GET /collections/{collectionid}coverages/domainset
GET /collections/{collectionid}coverages/rangetype
GET /collections/{collectionid}coverages/rangeset

Items - Information objects associated with a given {collectionid}
GET /collections/{collectionid}/items
GET/PUT /collections/{collectionid}/items/{itemid}

Example Sensor Application


```
{
  "siteCurrentPowerFlow": {
    "unit": "W",
    "connections": [
      {
        "from": "GRID",
        "to": "Load"
      }
    ],
    "GRID": {
      "status": "Active",
      "currentPower": 3435.7797851562
    },
    "LOAD": {
      "status": "Active",
      "currentPower": 3435.7797851562
    },
    "PV": {
      "status": "Idle",
      "currentPower": 0
    },
    "STORAGE": {
      "status": "Idle",
      "currentPower": 0,
      "chargeLevel": 27,
      "critical": false
    }
  }
}
```


https://en.wikipedia.org/wiki/Helios_Prototype

Future Work

- Serve linked data natively…
  - ‘Site’ metadata
  - Timeseries measurements
  - Site power
  - Current power flow
  - Equipment information
  - Inventory of on-site equipment
  - Solar inverter technical information
  - …
- Utilize the ESIP Community Ontology Repository (COR) for longer-term storage and access to linked data for future LANDRS UxS use cases

Contact Details

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