Update on the Linked And Networked DRoneS project:
DEVELOPMENT PHASE

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Overview

1. LANDRS overview and goals
2. LANDRS Ontology
3. LANDRS Toolkit Technology Stack
4. Drone Data Buddy Demonstrator
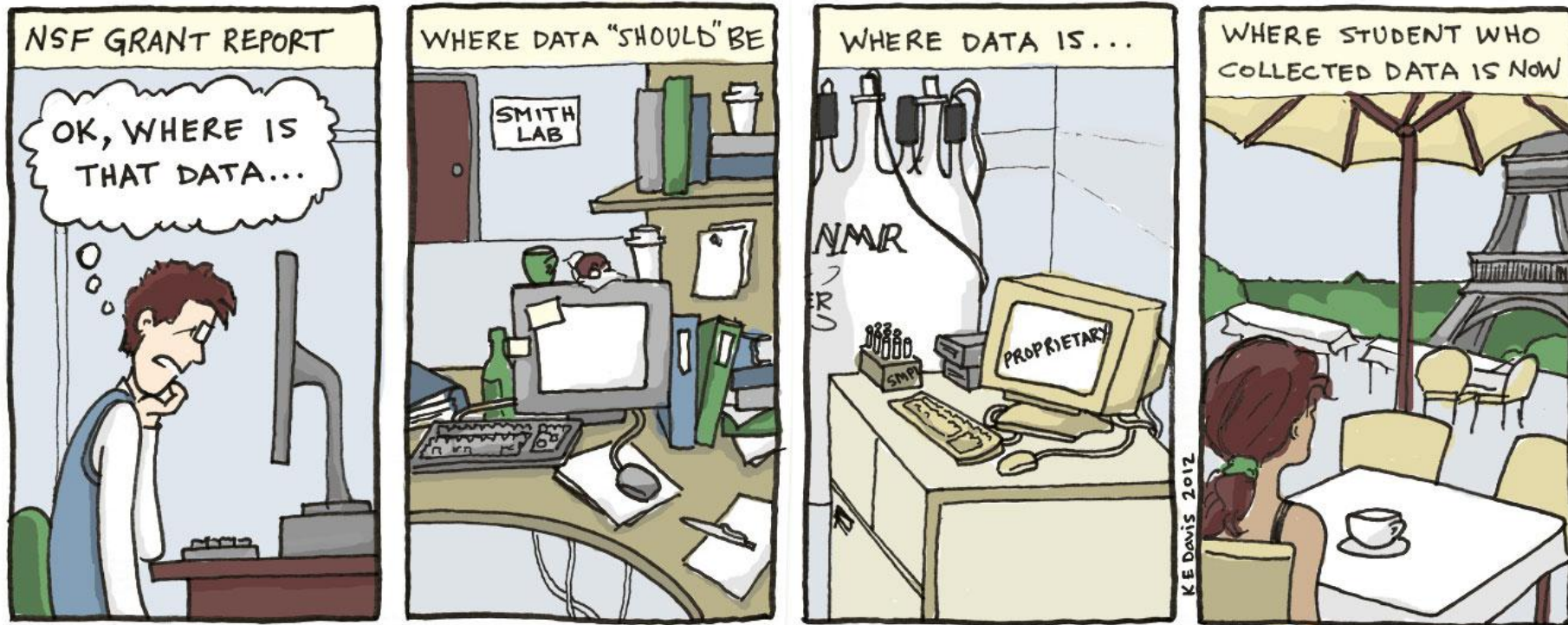5. Planned adopters and extensions

LANDRS: Goals

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.
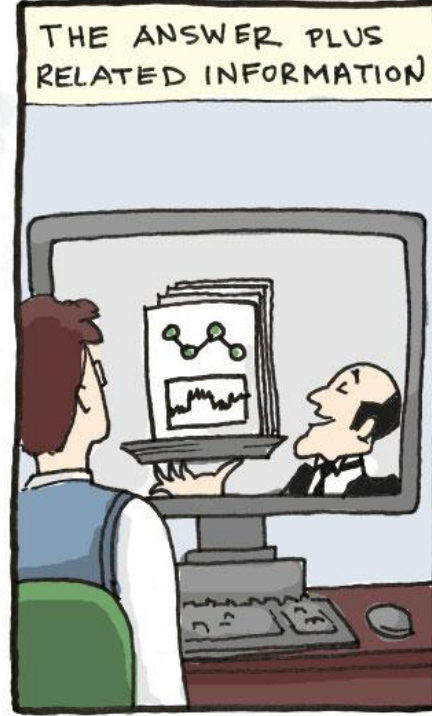
Linked-data
API for
Networked
DRoneS

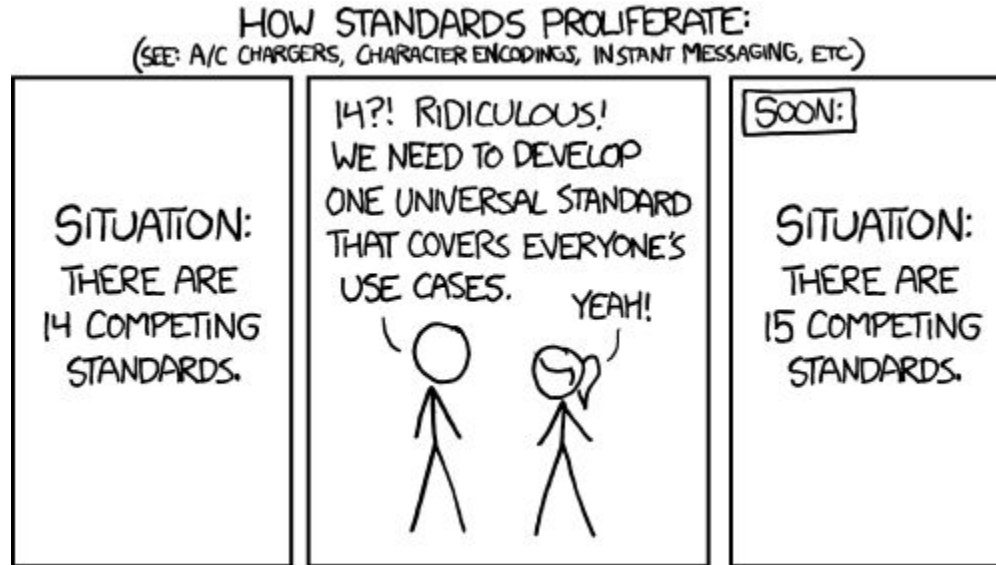[Taking some steps towards enabling FAIR Drone Data]

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Our current world

If we can enable smart agents with smart data

The Issue

https://xkcd.com/927/

Building on Existing Standards

OGC®
Making location count.

Spatial Data on the Web Best Practices

W3C Editor's Draft 18 February 2020

Semantic Sensor Network Ontology

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

OGC® **W3C**
Making location count.

OGC®
Making location count.

Extensions to the OWL-Time Ontology temporal aggregates

W3C Editor's Draft 18 February 2020

Hydra Core Vocabulary

A Vocabulary for Hypermedia-Driven Web APIs

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Building on Existing Standards

Environment Ontology

Keywords: [   ] [Search terms]

Class: atmospheric carbon dioxide

Term IRI: http://purl.obolibrary.org/obo/ENVO_01000451

Definition: Atmospheric carbon dioxide is an environmental material composed of carbon dioxide in its gaseous form present in an atmosphere.

Annotations

- http://www.geneontology.org/formats/oboInOwl#created_by: ORCID:0000-0002-4366-3088
- http://www.w3.org/2000/01/rdf-schema#comment: This could also be considered a part of an environmental material like air.
- in_subset: envoPolar

SWEET Ontologies

chat on slack on channel #sweetontology

Introduction

Official repository for Semantic Web for Earth and Environmental Terminology (SWEET) Ontologies.

ESIP

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5 stars of LD Vocabulary Use

★☆☆☆☆ - There is dereferencable human readable information about the used vocabulary

★★☆☆☆ - The information is available as machine-readable explicit axiomatization of the vocabulary

★★★☆☆ - The vocabulary is linked to other vocabularies

★★★★☆ - Metadata about the vocabulary is available

★★★★★ - The vocabulary is linked to by other vocabularies

LANDRS Ontology Manager

- Forked Open Source Zazuko
  Ontology Manager
  https://zazuko.com/products/ontology-manager/

- LD Community of Developers

- schema.landrs.org
  (live but not yet beta)

Propose Terms for Voting

Thing > Product > Flight Controller Board

Flight Controller Board

Canonical URL: http://schema.landrs.org/schema/FlightControllerBoard

Quick links: Proposals Conversation

Comment on Terms

Description

A flight controller (FC) is a small circuit board of varying complexity. Its function is to direct the RPM of each motor in response to input. A command from the pilot for the multi-rotor to move forward is fed into the flight controller, which determines how to manipulate the motors accordingly.
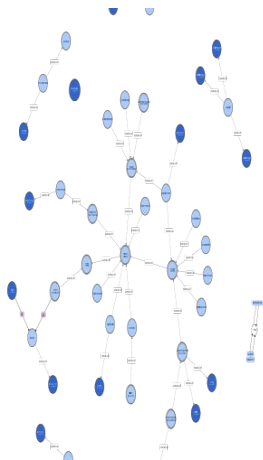
Sub Class Of

http://www.w3.org/2000/01/rdf-schema#subClassOf

– http://schema.landrs.org/schema/Product
– http://www.w3.org/ns/sosa/system

Properties

Property	Expected Type	Description

This resource does not have any properties.

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LANDRS Ontology

https://www.landrs.org/ontology/

Landrs Schema
language **en**

Release 2020-02-01

Revision:
0.0.1
License:
License https://creativecommons.org/publicdomain/zero/1.0/
Visualization:
Visualize with WebVowl
Cite as:
Landrs Schema. Revision: 0.0.1.
Provenance of this page

Abstract

This ontology is developed as part of the Sloan Funded LANDRS project to advance UxV data interoperability

1. Landrs Schema: Overview
back to ToC

This ontology has the following classes and properties.

Classes

Airframe	Automated Robot	Autonomous Robot	Autopilot	Component	event	Event	Flight Control System	Flight Controller Board

Ground Control Station　Mission　Motorized Vehicle　p o component type　Payload　Product　Remotely Piloted Robot　robot　Robot
Robotic Vehicle　Sensor Payload　Surface Vehicle　Thing　Underwater Vehicle　unmanned aerial vehicle
Unmanned Aerial Vehicle Unmanned Aerial Vehicle　Unmanned Aircraft Component　Unmanned Aircraft System Unmanned Aircraft System
Unmanned Vehicle Unmanned Vehicle　Unmotorized Vehicle　UxV Body　Vehicle

Object Properties

component　hasWhole　Winston ODP Component p

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Building LD Applications

Drone Data Buddy example application

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LANDRS SPARQL End Point

Hydra and SHACL

Shapes Constraint Language (SHACL)

W3C Recommendation 20 July 2017

W3C

zazuko / **hydra-box**

| Used by ▾ | 18 | ⊙ Watch ▾ | 7 | ★ Star | 9 | ⑂ Fork | 1 |

| ⟨⟩ Code | ① Issues 26 | ⭲ Pull requests 1 | ⊙ Actions | ▥ Projects 0 | ⊞ Wiki | ⛉ Security | Insights |

Hydra Box - SPARQL to Linked Data APIs for Web developers

| hydra | rdf | linked-data | api | hypermedia-api | hateoas | sparql |

hydra-box

Hydra is a machine readable description for APIs. Hydra Box extends the API description with links to the actual code, which provides the API. Hydra Box will use such an API description to start a server which provides the API and dynamically loads the required code for it.

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Hydra and SHACL

```
Example shapes graph

ex:PersonFormShape
    a sh:NodeShape ;
    sh:property [
        sh:path ex:firstName ;
        sh:name "first name" ;
        sh:description "The person's given name(s)" ;
        sh:order 0 ;
        sh:group ex:NameGroup ;
    ] ;
    sh:property [
        sh:path ex:lastName ;
        sh:name "last name" ;
        sh:description "The person's last name" ;
        sh:order 1 ;
        sh:group ex:NameGroup ;
    ] ;
    sh:property [
```

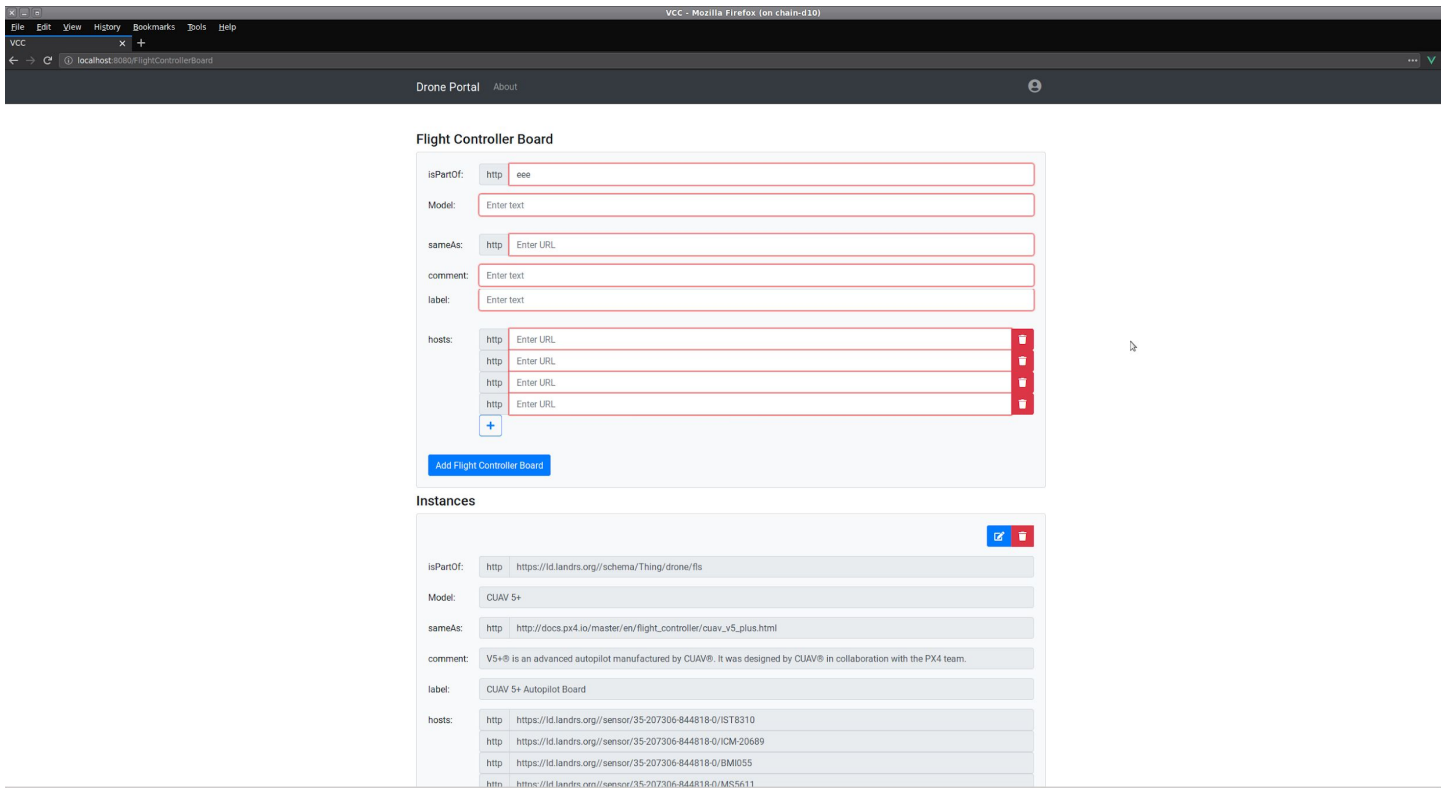**Name**
    first name: John
    last name: Doe

Address
    street address: 123 Silverado Ave
    locality: Cupertino
    zip code: 54321

LANDRS Hydra and SHACL

Incorporating OGC API

OGC API - Features - Part 1: Core

Table 1. Overview of resources, applicable HTTP methods and links to the document sections

Resource	Path	HTTP method	Document reference
Landing page	/	GET	7.2 API landing page
Conformance declaration	/conformance	GET	7.4 Declaration of conformance classes
Feature collections	/collections	GET	7.13 Feature collections
Feature collection	/collections/{collectionId}	GET	7.14 Feature collection
Features	/collections/{collectionId}/items	GET	7.15 Features
Feature	/collections/{collectionId}/items/{featureId}	GET	7.16 Feature

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LANDRS Toolkit: Publication Appliance

- Containerised Microservices
    - Apache Jena Fuseski GeoSPARQL
    - Trifid
    - Hydrabox
    - Server Web Application Client (Forms)
    - Drone Application Client

LANDRS Toolkit: Annotation Appliance

- Containerised Microservices
  - LANDRS Web API
    - Hydrabox
    - RDFjs Filesystem Store
    - Ontologies
  - LANDRS Node Component API
    - Mavlink
    - ROS
    - Dynamic mission routing

rdf-store-fs

npm v1.0.0   build passing   coverage 100%

Filesystem based RDF Store that follows the RDF/JS: Stream interfaces specification.

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Best Practices Exercises

1. USGS
2. LTER
3. RDA

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Planned Extensions

- Image Annotation
    https://www.w3.org/ns/oa

- Jupyter-lab Metadata Service:
  https://github.com/jupyterlab/jupyterlab-metadata-service

- DIDs and Verifiable Credentials
  - https://w3c.github.io/did-core/
  - https://w3c.github.io/vc-data-model/

- 5G

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Get involved

- General info: landrs@nd.edu

- Slack Channel

- Interested in a paid internship?
  - Pitch to us via Google form

- Submit an issue/propose something on Github

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