Using URIs to effectively transmit sensor data and metadata

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In situ sensors to measure crucial biogeochemical parameters.
Deployable on many platforms.
Low cost & mass producible.
Using a variety of sensor technologies.

Lab on chip sensor (image courtesy OTE Group, NOC)

Optode sensors mounted on CTD frame ready for deployment (image courtesy E. Fritzsche)

Silicate sensor prototype developed by CNRS (image courtesy CNRS)

Deploying sensors on an observatory system (Hypersub) in Helgoland (image courtesy A. Chennu)

www.senseocean.eu
Question

- How can I gain **quick** access to sensor data that are **fit for purpose**?
Unique URIs

Sensor transmits [data+metadata] to base station

Platform

Satellite

Base station/Data centre

High data transmission costs

Hardware & bandwidth restrictions

Hardware & bandwidth restrictions
Proposed approach

Sensor passes data + UUID through to base station

Platform

Satellite

Base station/Data centre

Data delivery by SOS service, linked data API, SPARQL endpoint

NERC Linked data (RDF, SPARQL) server

SensorML

SSN (OWL)

JSON LD

netCDF
-- Aanderaa 4531 oxygen optode --

URI: http://vocab.nerc.ac.uk/collection/L22/current/TOOL0969/
Identifier(): SDN:L22::TOOL0969
Preferred label (en): Aanderaa 4531 oxygen optode
Alternative label (en): AA optode 4531

Definition (en): A dissolved oxygen sensor which provides analogue and digital output to third party data loggers. Measured oxygen is determined by the quenching of selected substances to act as fluorescence quenchers. The fluorescent indicator is a special dye embedded in a gas permeable foil that is exposed to the surrounding water. A black optical isolation filter isolates sunlight and fluorescent particles in the water. This sensing foil is attached to a window providing a measuring system from inside a watertight titanium housing. The foil is excited by modulated blue light and a light is measured. By linearizing and temperature compensating, with an incorporated temperature sensor, concentration can be determined.

Version Info (): 1
Deprecation(): false
Broader(): http://vocab.nerc.ac.uk/collection/L05/current/351/
This XML file does not appear to have any style information associated with it. The document tree is shown below.

```xml
    <xml:description>TOOLO969_1234</xml:description>
    <xml:identifier codeSpace="uniqueID">
        http://linked-systems.uk/system/instance/TOOLO969_1234/
    </xml:identifier>
    <xml:keywords>
        <xml:KeywordList>
            <xml:keyword>02Sat_2</xml:keyword>
            <xml:keyword>Temp</xml:keyword>
            <xml:keyword>NC_disso2_uncalib_2</xml:keyword>
        </xml:KeywordList>
    </xml:keywords>
    <xml:identification>
        <xml:IdentificationList>
            <xml:Identifier>
                <xml:Term definition="TOOLO969_1234">
                    <xml:Label>UUID</xml:Label>
                    <xml:Value>TOOLO969_1234</xml:Value>
                </xml:Term>
            </xml:Identifier>
            <xml:Identifier>
                <xml:Term definition="http://vocab.nerc.ac.uk/collection/W07/current/IDEN0005/">
                    <xml:Label>Serial Number</xml:Label>
                    <xml:Value>1234</xml:Value>
                </xml:Term>
            </xml:Identifier>
            <xml:Identifier>
                <xml:Term definition="http://vocab.nerc.ac.uk/collection/W07/current/IDEN0006/">
                    <xml:Label>Short Name</xml:Label>
                    <xml:Value>Anderas 4531 optode oxygen</xml:Value>
                </xml:Term>
            </xml:Identifier>
            <xml:Identifier>
                <xml:Term definition="http://vocab.nerc.ac.uk/collection/W07/current/IDEN0002/">
                    <xml:Label>Long Name</xml:Label>
                    <xml:Value>Anderas 4531 optode oxygen</xml:Value>
                </xml:Term>
            </xml:Identifier>
        </xml:IdentificationList>
        <xml:validTime>
            <xml:beginPosition>2016-06-15</xml:beginPosition>
            <xml:endPosition>Indeterminate</xml:endPosition>
        </xml:validTime>
    </xml:identification>
</xml:PhysicalSystem>
```
Implementation
Register Sensor model with metadata in linked systems

New concept in L22 UUID

Publish SensorML/RDF
ERDDAP > Instance Form

This is the Data Provider Form. Need help? Send an email to the administrator of the Platform.

Contact Information

Please enter the register email address

This dataset submission's timestamp is 2016-09-14T1.

Type of Instance: Platform

Please select a type of instance to enter

Platform instances information

This form has been provided to allow you to enter the information required to upload event information. Please go to the linkage system and link your platform. Don't forget to add your unique ID for your platform instance.

Add event Information

Link to sensor

Search database

If you require help please email the system admin at (chogaz at noc dot ac dot uk).

Finished?

NOC Science of the Environment

National Oceanography Centre

noc.ac.uk
ERDDAP > Instance Form

This is the Data Provider Form. 

Contact Information

Please enter the register email address

Type of Instance: Sensor

ERDDAP > sensor Instance ID

ERDDAP > Link Instance Form

This is the Data Provider Form - Instance Linking Section.

Finished?

Click [Submit] to send this information.

ERDDAP > Event Form

This is the Event Form.

Sensor Calibration Information

This form has been provided to allow you to enter the require Event

Finished?

Click [Submit] to send this information.
Register sensor instance
Get UUID
Add event information (calibration, installation etc)
Attach sensor to platform/deployment
Publish SensorML/RDF

This XML file does not appear to have any style information associated with it. The document tree is shown below:

```xml
  xmlns:xsd="http://www.w3.org/2001/XMLSchema#

<s:Sensor rdf:about="http://linkedystems.org/system/instance/TOOL0969_323232/current/"
</s:Sensor>
</rdf:RDF>
```
Send data + UUID ➔ Publish O&M/RDF
Publication & Discovery

http://linkedsystems.uk/52n-sos-webapp/

SOS

http://dev.linkedsystems.uk/sparql

Linked data

http://linkedsystems.uk/system/prototype/
http://linkedsystems.uk/system/instance/

noc.ac.uk
Conclusions

• By using standards (OGC, W3C), we can make data interoperable (quick to access) and enrich it with metadata (fit for purpose)

• Through unique resolvable URIs (UUIDs), data can be linked to metadata dynamically in-situ while saving on the costs of long metadata descriptions

• The transmission of UUIDs also enables the implementation of standards on systems where it is impractical, such as legacy hardware

• Part of the sensor web!
Acknowledgments

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