The Schema Editor of OpenIoT for Semantic Sensor Networks

@jpcik

Prem P. Jayaraman, Jean-Paul Calbimonte and Hoan Nguyen Mau Quoc

RMIT University, LSIR EPFL, Insight – NUI Galway

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OpenIoT FP7

Open Source Cloud solution for the Internet of Things

Established Open-source platform for IoT

https://github.com/OpenIotOrg/openiot

- Integrate **sensors** & things with **cloud** computing
- Configure, deploy and use **IoT services**
- Auditing/assessing **privacy** of IoT apps in the cloud
- **Semantic** annotations of internet-connected objects
- **Energy-efficient** data harvesting
- Publish/subscribe for continuous processing and sensor data filtering
- Mobility of sensors and **QoS** aspects in IoT

Use cases and validation scenarios

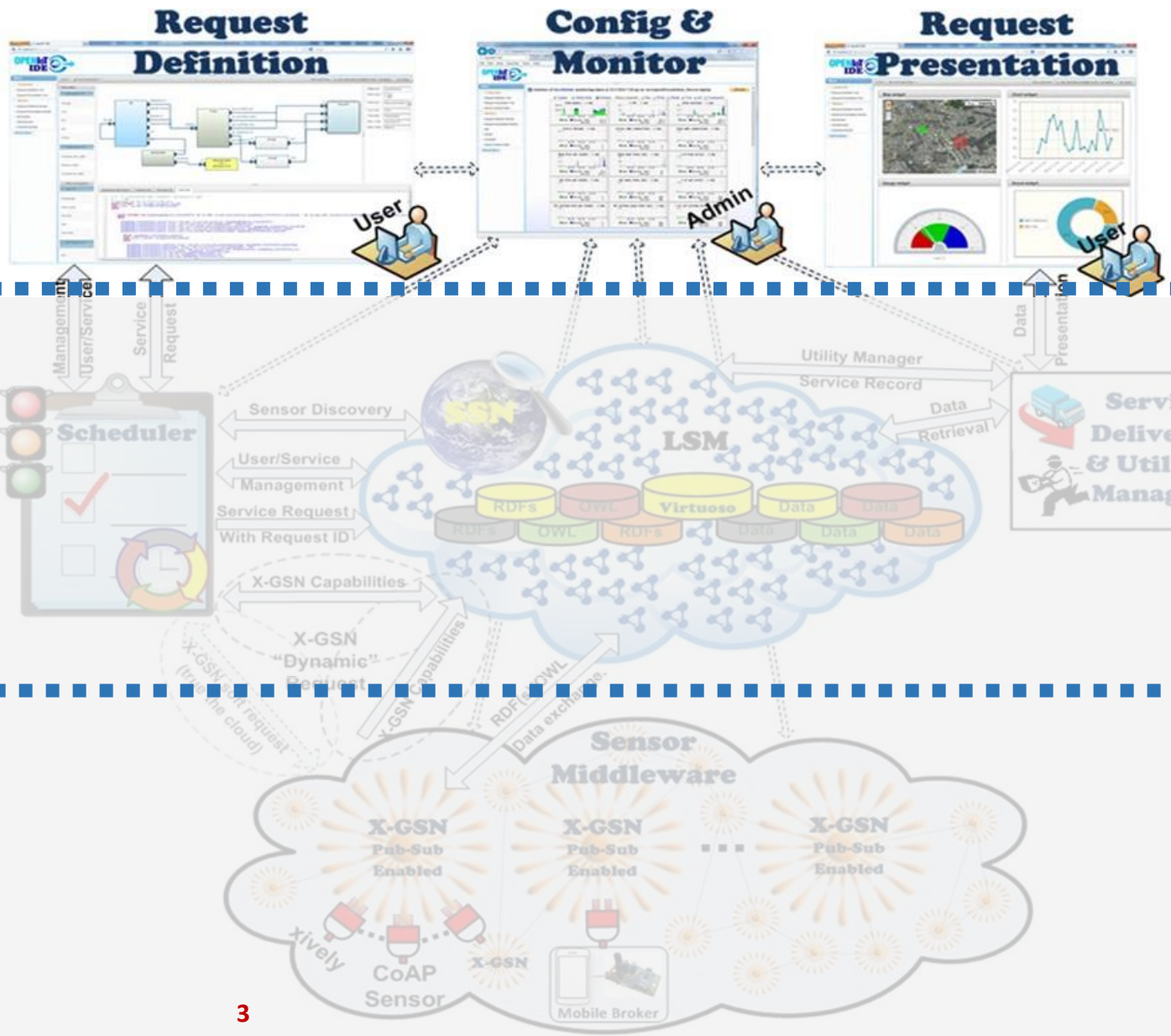
Smart Manufacturing

Campus Guide

Air Monitoring

Agriculture Sensing

The OpenIoT Architecture



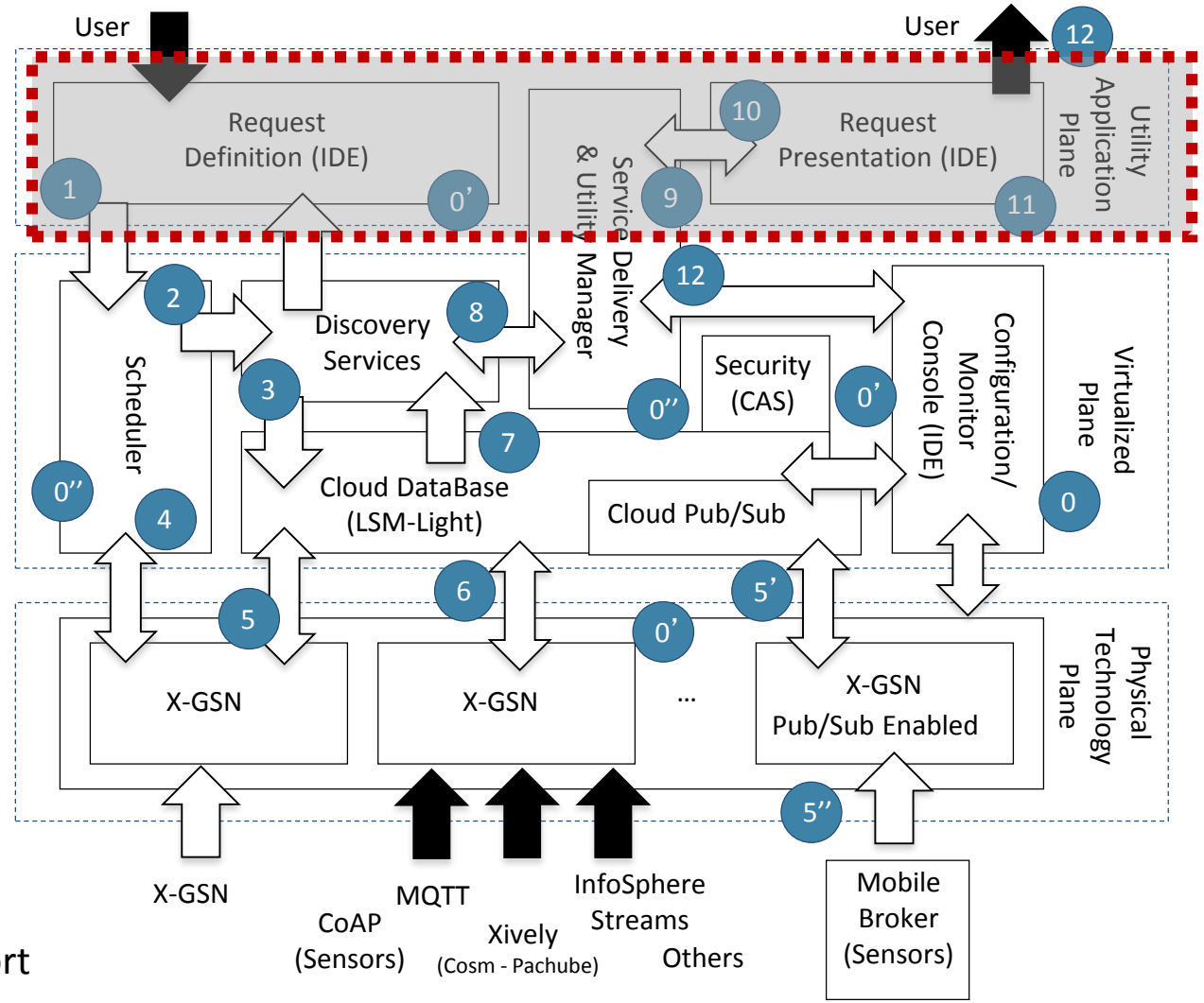
Applications

Semantic data management

Sensor data management

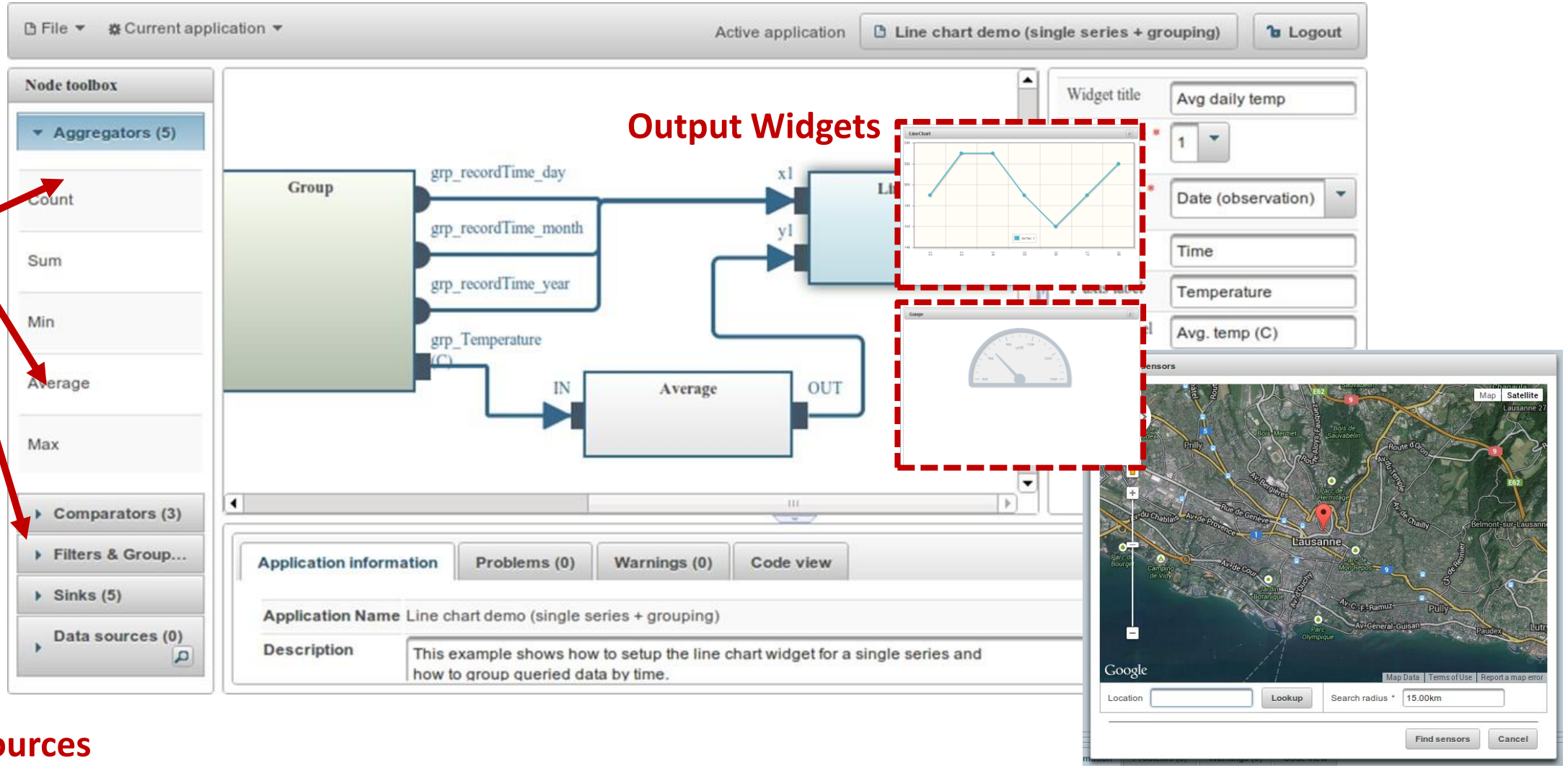
OpenIoT Services and Components

- 0 Setup and Management
- 1 End User Request
- 2 Discovery Services
- 3 Query Content
- 4 Sensor Configuration
- 5 Collect Content / Mobile
- 6 Content Adaptation
- 7 Utility Service Feedback
- 8 Service Delivery
- 9 Service Visualisation
- 10 Get Visualisation
- 11 Data Presentation
- 12 Utility Metrics /Service Report



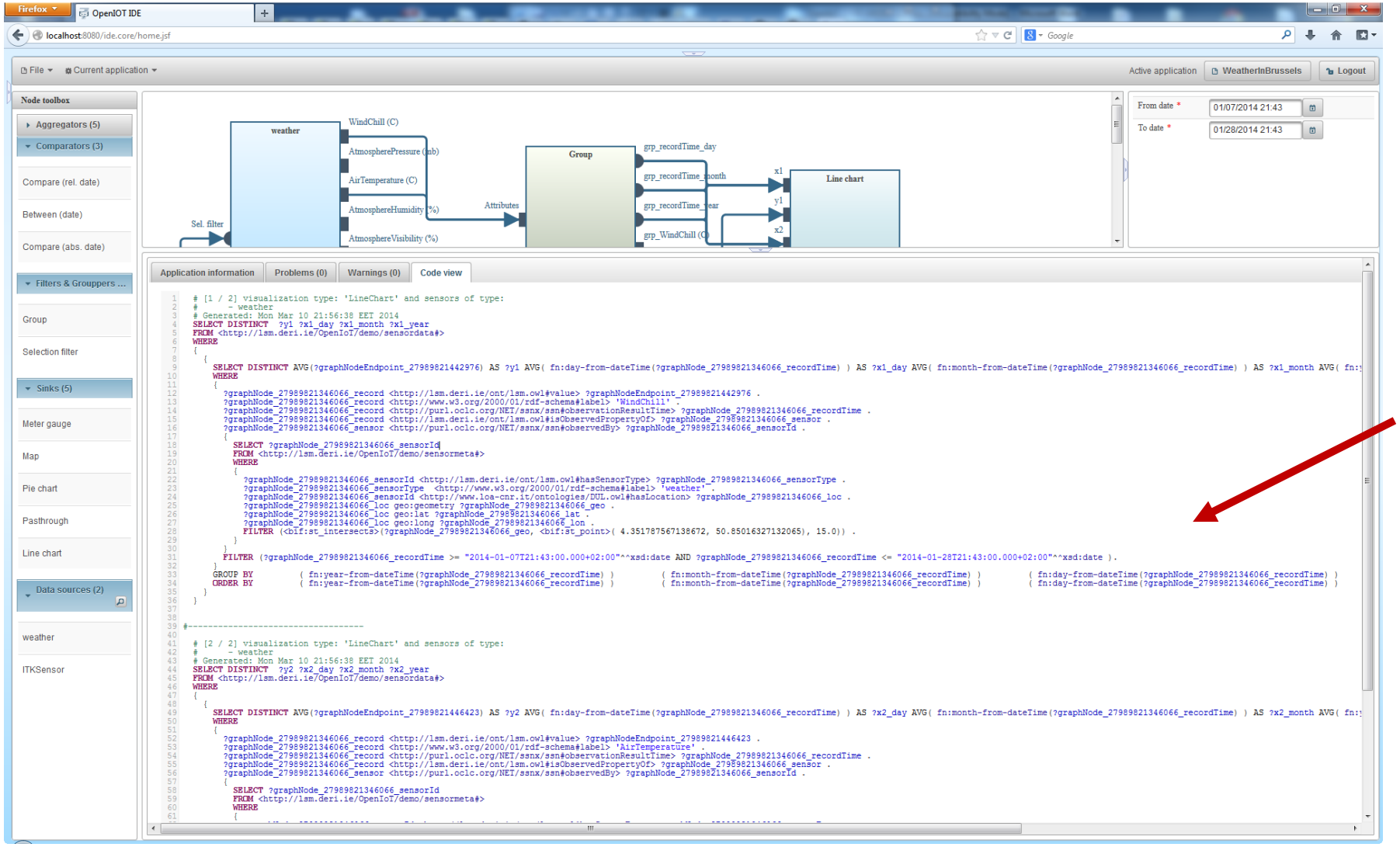
Application Plane

Request Definition & Presentation



Everything nice if your data is also nice

Request Definition & Presentation

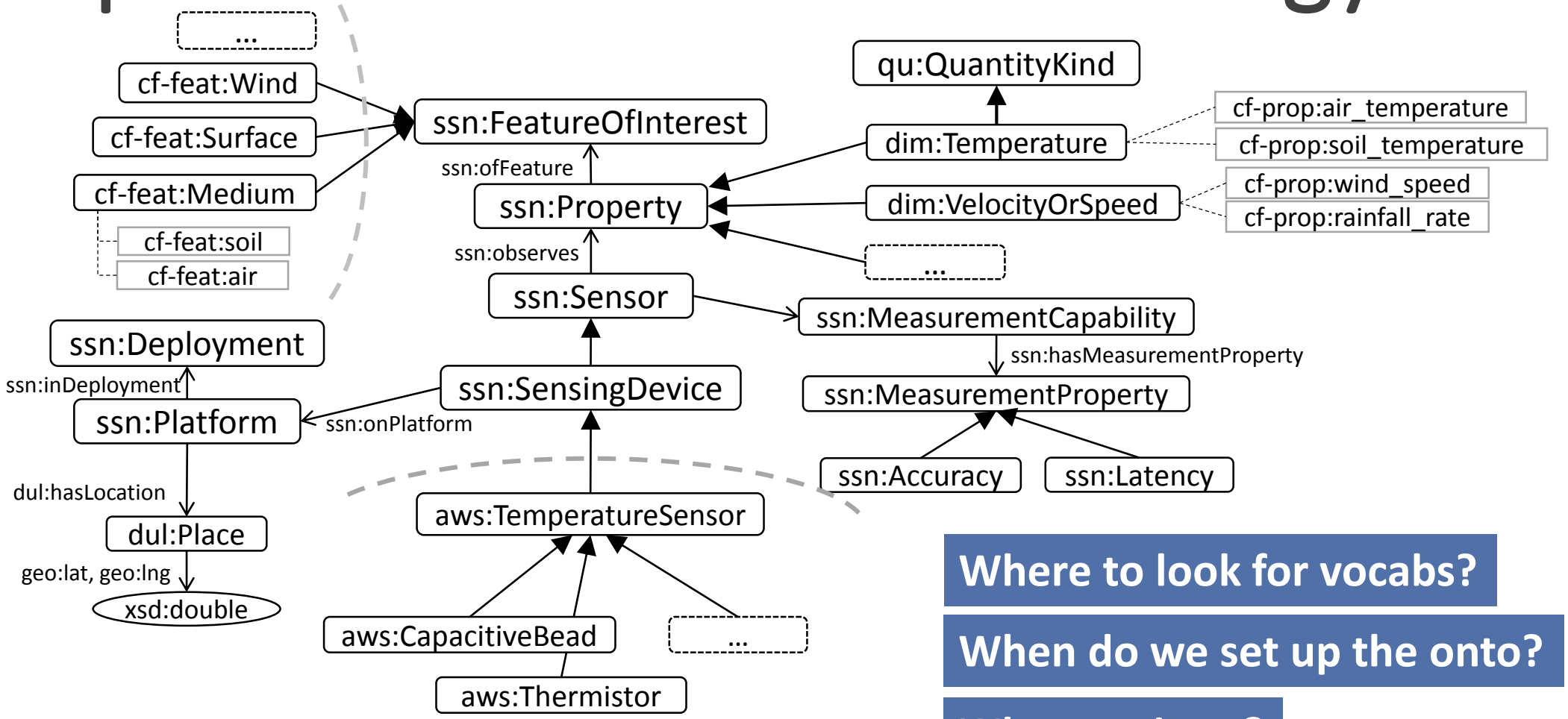



```
# [1 / 2] visualization type: 'LineChart' and sensors of type:
#      - weather
# Generated: Mon Mar 10 21:56:38 EET 2014
SELECT DISTINCT  ?y1 ?x1_day ?x1_month ?x1_year
FROM <http://lsm.deri.ie/OpenIoT/demo/sensordata#>
WHERE
{
  {
    SELECT DISTINCT AVG(?graphNodeEndpoint_27989821442976) AS ?y1 AVG( fn:day-from-dateTime(?graphNode_27989821346066_recordTime) ) AS ?x1_day AVG( fn:month-from-dateTime(?graphNode_27989821346066_recordTime) ) AS ?x1_month AVG( fn:
    WHERE
    {
      ?graphNode_27989821346066_record <http://lsm.deri.ie/ont/lsm.owl#value> ?graphNodeEndpoint_27989821442976 .
      ?graphNode_27989821346066_record <http://www.w3.org/2000/01/rdf-schema#label> 'WindChill' .
      ?graphNode_27989821346066_record <http://purl.oclc.org/NET/ssnx/ssn#observationResultTime> ?graphNode_27989821346066_recordTime .
      ?graphNode_27989821346066_record <http://lsm.deri.ie/ont/lsm.owl#isObservedPropertyOf> ?graphNode_27989821346066_sensor .
      ?graphNode_27989821346066_sensor <http://purl.oclc.org/NET/ssnx/ssn#observedBy> ?graphNode_27989821346066_sensorId .
      {
        SELECT ?graphNode_27989821346066_sensorId
        FROM <http://lsm.deri.ie/OpenIoT/demo/sensormeta#>
        WHERE
        {
          ?graphNode_27989821346066_sensorId <http://lsm.deri.ie/ont/lsm.owl#hasSensorType> ?graphNode_27989821346066_sensorType .
          ?graphNode_27989821346066_sensorType  <http://www.w3.org/2000/01/rdf-schema#label> 'weather'.
          ?graphNode_27989821346066_sensorId <http://www.loa-cnr.it/ontologies/DUL.owl#hasLocation> ?graphNode_27989821346066_loc .
          ?graphNode_27989821346066_loc geo:geometry ?graphNode_27989821346066_geo .
          ?graphNode_27989821346066_loc geo:lat ?graphNode_27989821346066_lat .
          ?graphNode_27989821346066_loc geo:long ?graphNode_27989821346066_lon .
          FILTER (<bif:st_intersects>(?graphNode_27989821346066_geo, <bif:st_point>( 4.351787567138672, 50.85016327132065), 15.0)) .
        }
      }
      FILTER (?graphNode_27989821346066_recordTime >= "2014-01-07T21:43:00.000+02:00"^^xsd:date AND ?graphNode_27989821346066_recordTime <= "2014-01-28T21:43:00.000+02:00"^^xsd:date ).
    }
    GROUP BY        ( fn:year-from-dateTime(?graphNode_27989821346066_recordTime) )        ( fn:month-from-dateTime(?graphNode_27989821346066_recordTime) )        ( fn:day-from-dateTime(?graphNode_27989821346066_recordTime) )
    ORDER BY        ( fn:year-from-dateTime(?graphNode_27989821346066_recordTime) )        ( fn:month-from-dateTime(?graphNode_27989821346066_recordTime) )        ( fn:day-from-dateTime(?graphNode_27989821346066_recordTime) )
  }
}


#-----------------------------------

# [2 / 2] visualization type: 'LineChart' and sensors of type:
#      - weather
# Generated: Mon Mar 10 21:56:38 EET 2014
SELECT DISTINCT  ?y2 ?x2_day ?x2_month ?x2_year
FROM <http://lsm.deri.ie/OpenIoT/demo/sensordata#>
WHERE
{
  {
    SELECT DISTINCT AVG(?graphNodeEndpoint_27989821446423) AS ?y2 AVG( fn:day-from-dateTime(?graphNode_27989821346066_recordTime) ) AS ?x2_day AVG( fn:month-from-dateTime(?graphNode_27989821346066_recordTime) ) AS ?x2_month AVG( fn:
    WHERE
    {
      ?graphNode_27989821346066_record <http://lsm.deri.ie/ont/lsm.owl#value> ?graphNodeEndpoint_27989821446423 .
      ?graphNode_27989821346066_record <http://www.w3.org/2000/01/rdf-schema#label> 'AirTemperature'
      ?graphNode_27989821346066_record <http://purl.oclc.org/NET/ssnx/ssn#observationResultTime> ?graphNode_27989821346066_recordTime .
      ?graphNode_27989821346066_record <http://lsm.deri.ie/ont/lsm.owl#isObservedPropertyOf> ?graphNode_27989821346066_sensor .
      ?graphNode_27989821346066_sensor <http://purl.oclc.org/NET/ssnx/ssn#observedBy> ?graphNode_27989821346066_sensorId .
      {
        SELECT ?graphNode_27989821346066_sensorId
        FROM <http://lsm.deri.ie/OpenIoT/demo/sensormeta#>
        WHERE
        {
```

Generated SPARQL queries

Data at this level is already RDF-ized

OpenIoT and the SSN Ontology



Where to look for vocabs?

When do we set up the onto?

Who sets it up?

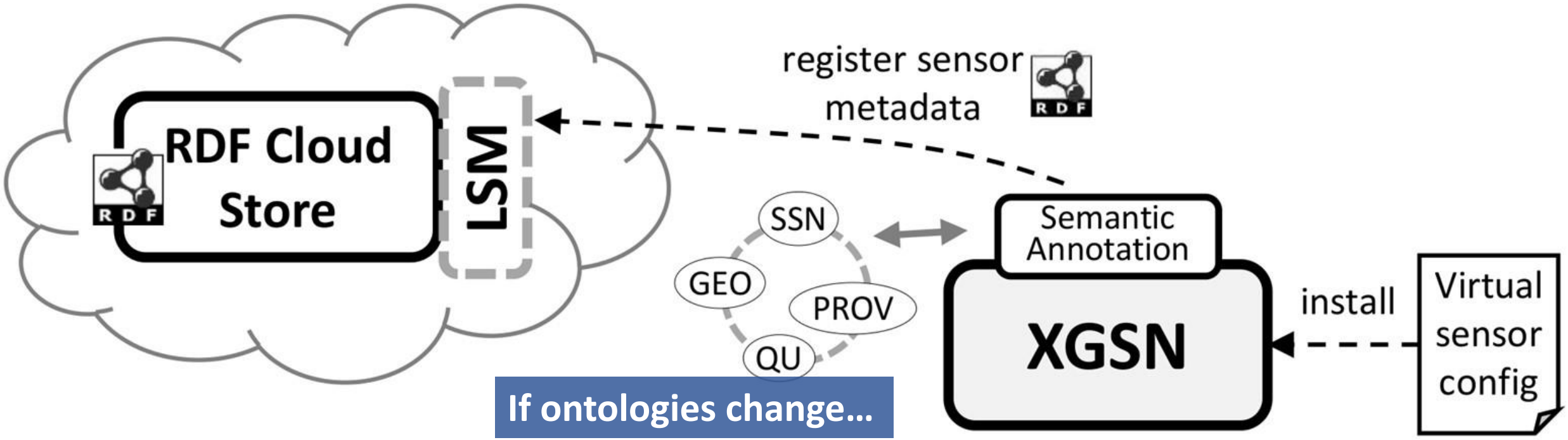
http://lsm.deri.ie/resource/4039002668863045 http://lsm.deri.ie/ont/lsm.owl#unit "Percent"

Generated URIs? **Vocabulary?** **Literals?**

Register metadata

Global Sensor Networks

Do I have control over my sensor metadata?



If ontologies change…

If we add new types of sensors?

Virtual Sensor configuration

```
<virtual-sensor name="room-monitor" >
 <addressing>
  <predicate key="geographical">BC143</predicate>
  <predicate key="usage">
    room monitoring</predicate>
 </addressing>
 <life-cycle pool-size="10" />
 <output-structure>
   <field name="image" type="binary:image/jpeg" />
   <field name="temp"  type="int" />
 </output-structure>
 <storage permanent="true" history-size="10h" />
 <input-streams>
   <input-stream name="cam">
     <stream-source alias="cam"  storage-size="1“
    sampling-rate=“1”>
       <address wrapper=“tinyos2.x">
       <predicate key=“host">tinybox.epfl.ch
       </predicate>
       <predicate key=“port">9001</predicate>
       </address>
       select * from WRAPPER
     </stream-source>
<stream-source alias="temperature1“
     storage-size="1m“ sampling-rate=“1”>
```

```
<address wrapper="remote">
    <predicate key="type">temperature</predicate>
    <predicate key="geographical">BC143-N
     </predicate>
   </address>
   select AVG(temp1) as T1 from WRAPPER
 </stream-source>
 <stream-source alias="temperature2“
        storage-size="1m“>
   <address wrapper="remote">
   <predicate key="type">temperature</predicate>
   <predicate key="geographical“>BC143-S
    </predicate>
   </address>
   select AVG(temp2) as T2  from WRAPPER
 </stream-source>
 <query>
 select cam.picture as image, temperature.T1
 as temp from   cam, temperature1
 where  temperature1.T1 > 30 AND
 temperature1.T1 = temperature2.T2
 </query>
   </input-stream>
 </input-streams>
</virtual-sensor>
```

Some metadata is here

Sensor metadata configuration

Metadata properties

sensorID="http://lsm.deri.ie/resource/1099207032411018"
sensorName=closedsense
source=“Some source"
sourceType=lausanne
sensorType=lausanne
information=Air Quality Sensors from Lausanne station 1
author=opensense
feature="http://lsm.deri.ie/OpenIoT/opensensefeature"
fields="humidity,temperature"
field.temperature.propertyName="http://lsm.deri.ie/OpenIoT/Temperature"
field.temperature.unit=C
field.humidity.propertyName="http://lsm.deri.ie/OpenIoT/Humidity"
field.humidity.unit=Percent
field.co.propertyName="http://lsm.deri.ie/OpenIoT/CO"
field.co.unit=PPM
latitude=46.529838
longitude=6.596818

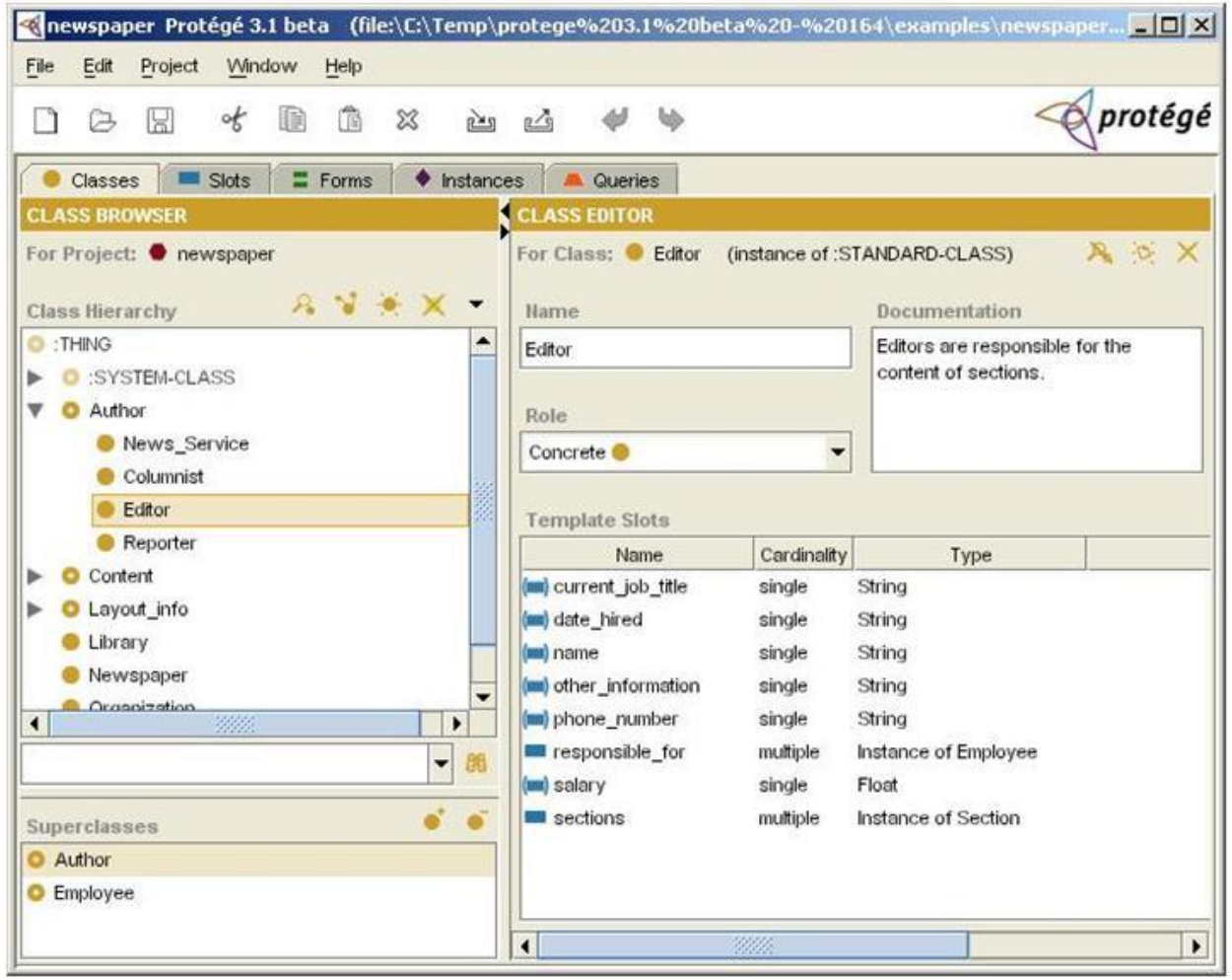
Turtle RDF registration

```
<sensor/5010> rdf:type aws:CapacitiveBead,ssn:Sensor;
        rdfs:label "Sensor 5010";
        ssn:observes aws:air_temperature ;
        phenonet:hasSerialNumber
<sensor/5010/serial/serial2> ;
        ssn:onPlatform <site/narrabri/Pweather> ;
        ssn:ofFeature <site/narrabri/sf/sf_narrabri> ;
        ssn:hasMeasurementProperty
<sensor/5010/accuracy/acc_1> ;
        prov:wasGeneratedBy "AuthorName";
        DUL:hasLocation <place/location1>;
        lsm:hasSensorType <sensorType1>;
        lsm:hasSourceType "SourceType".

<sensorType1> rdfs:label "TypeName".

<sensor/5010/serial/serial2> rdf:type phenonet:SerialNumber;
                phenonet:hasId "5010" .
```

A bit more of semantics

Need tools for this

Editing Ontologies?



- Standard Tools
- Better Suited for ontologists
- Complex for small tasks
- No integration with IoT platofrms
- Generate RDF instances?

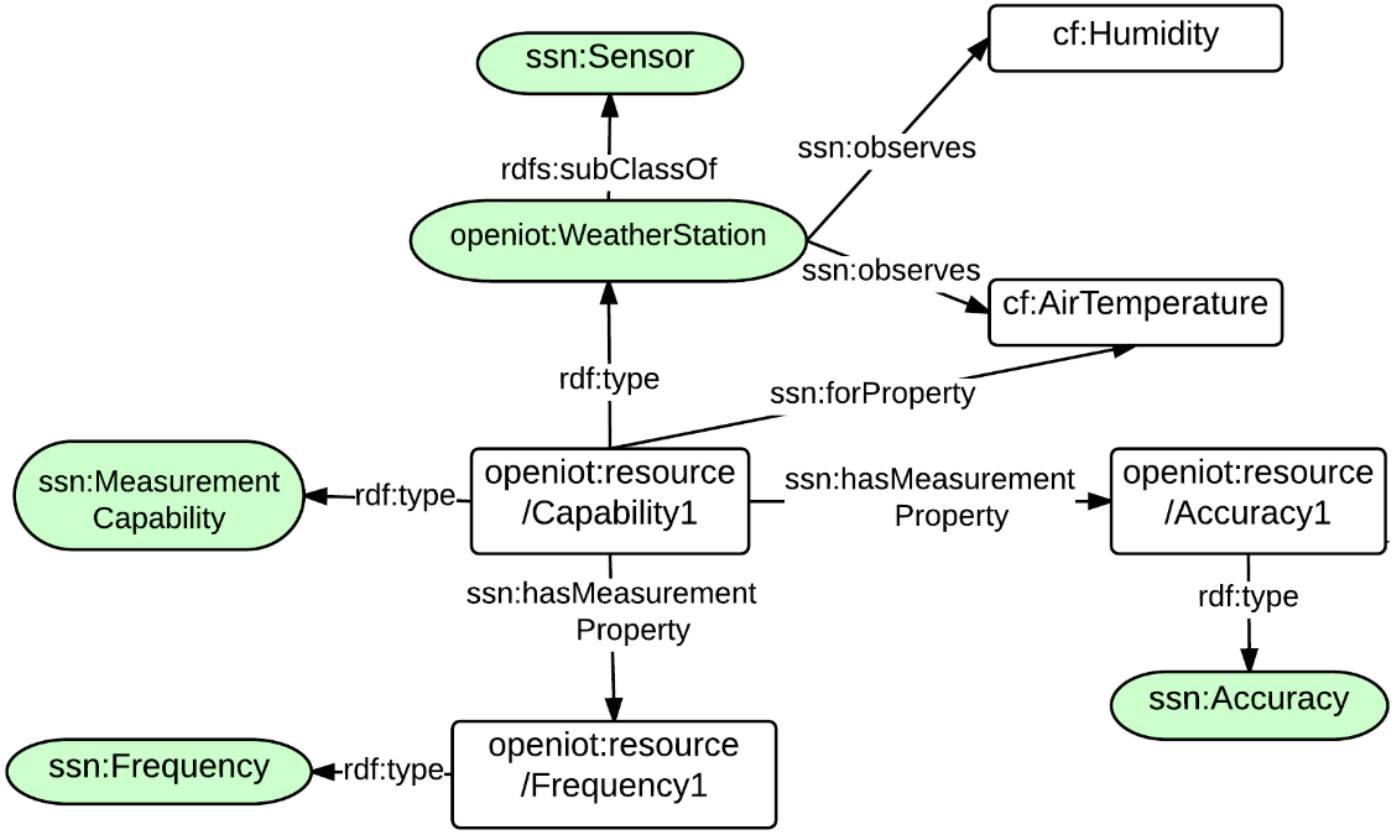
OpenIoT Schema Editor

Existing Sensor Types

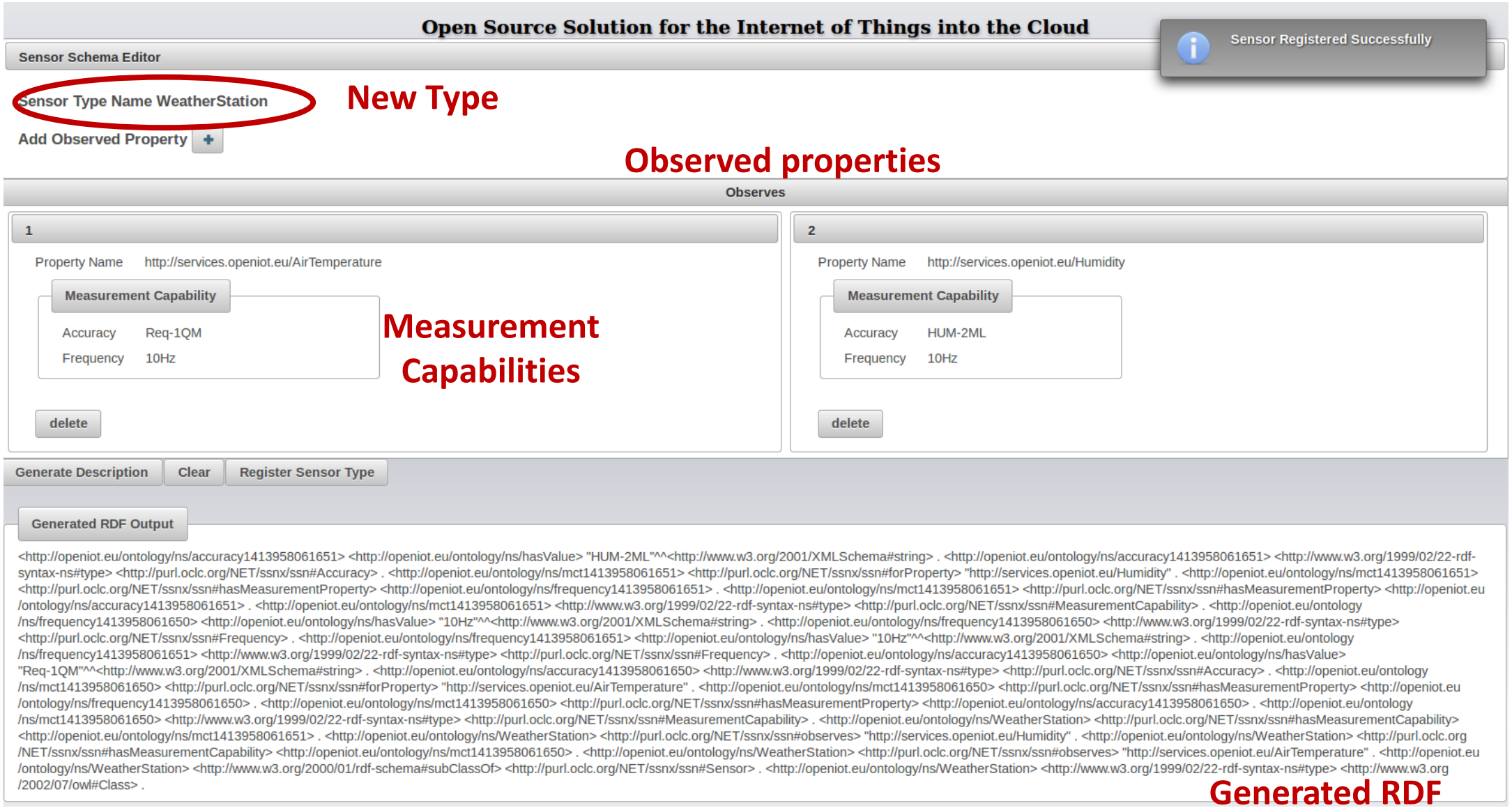
Observed properties

Users exposed to URIs as identifiers

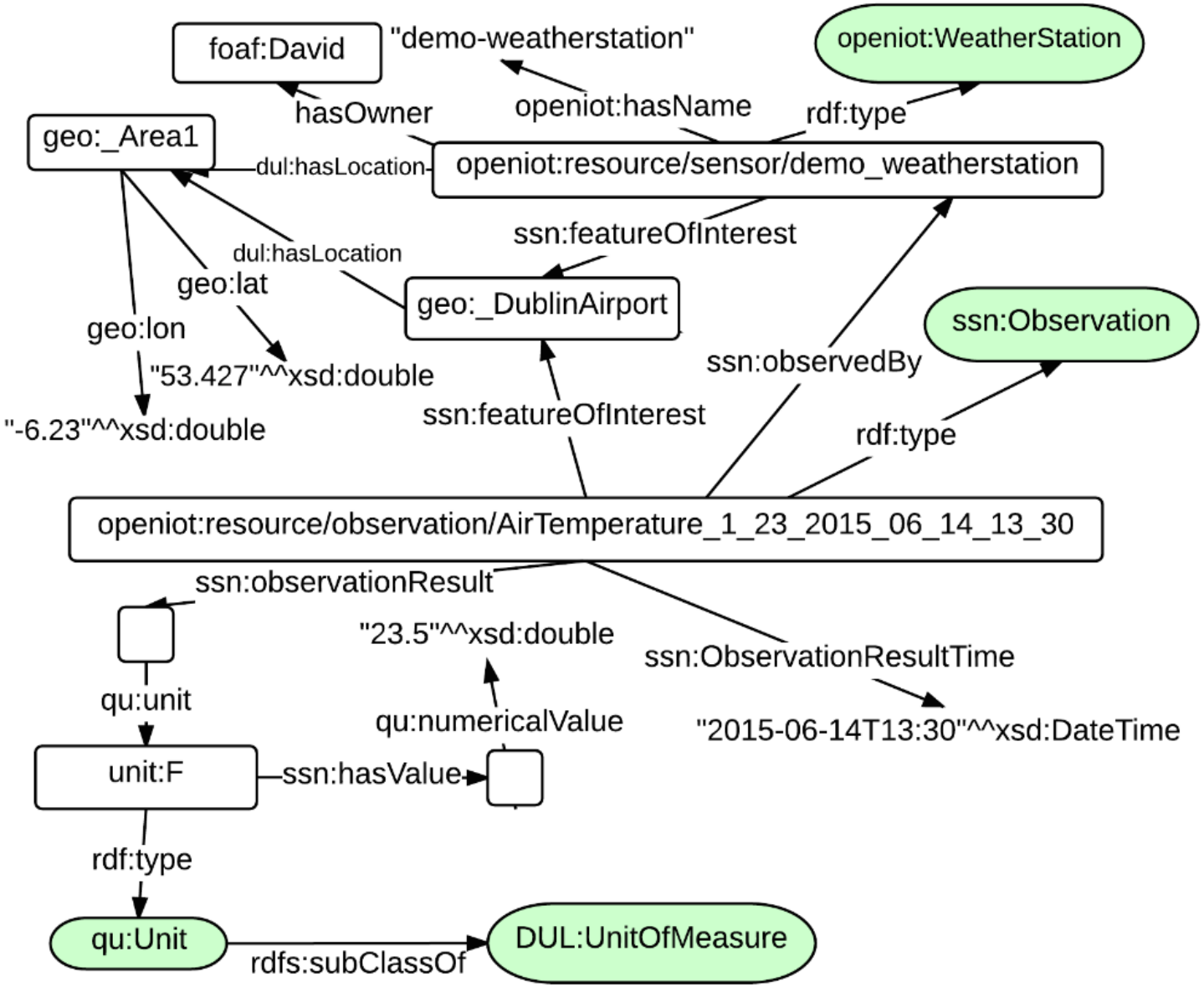
Sensor Types



Schema Editor: Sensor Types



Sensor Instances



Schema Editor: New Instances

Sensor Instance Creator

Sensor Name	WeatherStation_CSIRO
Author/Owner	CSIRO
Description/Information	Weather Station in Canbe
Source URL	http://localhost:22001
Source Type	GSN
Latitude	-35.280268659925426 Show Map
Longitude	149.12370085628936
Feature of Interest	field

Observed Properties

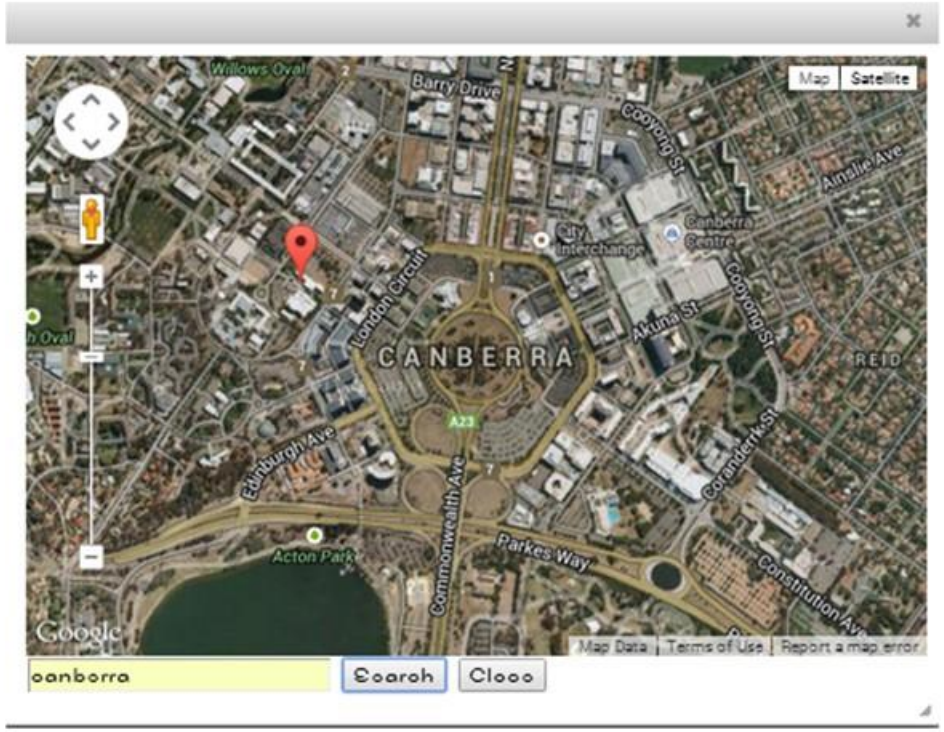
http://services.openiot.eu/AirTemperature

Unit of Measurement	c
XGSN Field Name	temp

http://services.openiot.eu/Humidity

Unit of Measurement	percent
XGSN Field Name	humidity

Register Sensor Instance



OpenIoT Schema Editor

- Based on Standards
- Facilitates Extensions
- Integrated with OpenIoT
- Sensor Types and Instances
- Web User Interface

Schema Editor
based on SSN Ontology

- Extensible Editor?
- URI generation?
- Link to Vocab Libraries?
- Validation of content?
- Beyond OpenIoT-only?

OpenIoT resources

OpenIoT Github
https://github.com/OpenIotOrg/openiot

OpenIoT VDK virtual Machine
https://github.com/OpenIotOrg/openiot/wiki/VDKv2---OpenIoT-Rele

Viedo Demos:
http://www.youtube.com/user/OpenIoT

RMIT UNIVERSITY

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

NUI Galway
OÉ Gaillimh

Muchas gracias!

@jpcik

Jean-Paul Calbimonte

LSIR EPFL

SwissEx

cces

OPENIoT

nano-tera.ch

GSN Global Sensor Networks

FNSNF