Sensor Web Enablement (SWE) – CityGML 3.0

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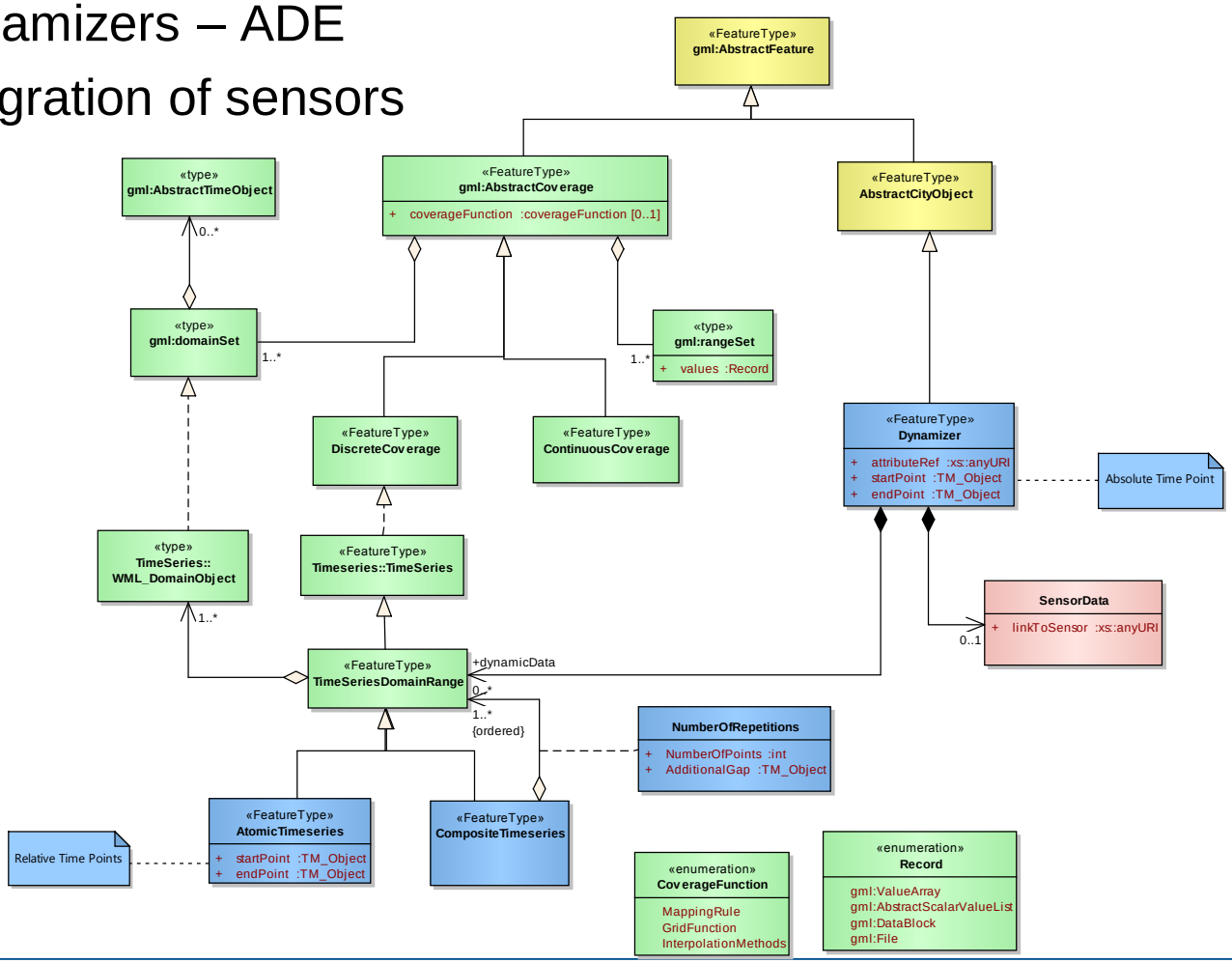
Dynamizers – Conceptual Model

- Ongoing steps
  - Dynamizers – ADE
  - Integration of sensors



Sensors are everywhere

Source : OGC Sensor Web Enablement

Sensor Web Enablement Framework

Heterogeneous sensor network

In-Situ monitors

Airborne


Satellite

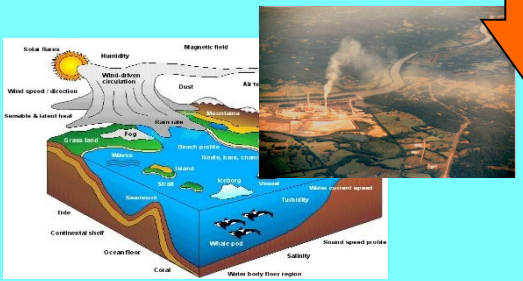


Surveillance


Bio/Chem/Rad Detectors

- sparse
- disparate
- mobile/in-situ
- extensible

Models and Simulations



- nested
- national, regional, urban
- adaptable
- data assimilation

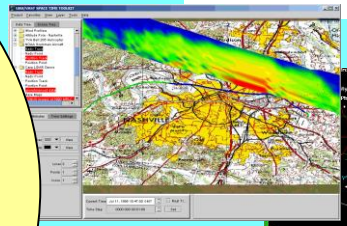
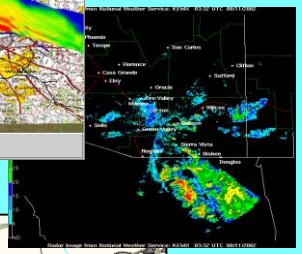
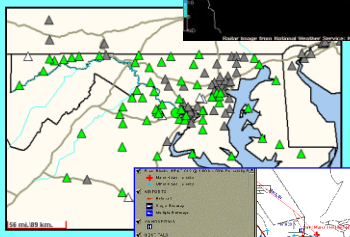
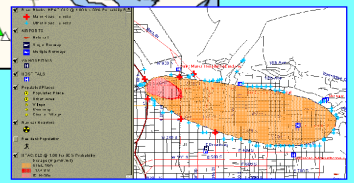
Sensor Web Enablement

- discovery
- access
- tasking
- alert notification

web services and encodings based on Open Standards (OGC, ISO, OASIS, IEEE)

Decision Support Tools



- vendor neutral
- extensive
- flexible
- adaptable

Source : OGC Sensor Web Enablement

Why SWE?

- Enable interoperability not only *within* communities but *between* traditionally disparate communities
  - **different sensor types:** in-situ vs remote sensors, video, models, CBRNE
  - **different disciplines:** science, defense, intelligence, emergency management, utilities, etc.
  - **different sciences:** ocean, atmosphere, land, bio, target recognition, signal processing, etc.
  - **different agencies:** government, commercial, private, Joe Public
- Leverage benefits of open standards
  - competitive tool development
  - more abundant data sources
  - utilize efforts funded by others
- Backed by the Open Geospatial Consortium process
  - 380+ members cooperating in consensus process
  - Interoperability Process testing
  - CITE compliance testing

Basic Vision

- Quickly discover sensors and sensor data (secure or public) that can meet my needs – based on location, observables, quality, ability to task, etc.
- Obtain sensor information in a standard encoding that is understandable by my software and enables assessment and processing without a-priori knowledge
- Readily access sensor observations in a common manner, and in a form specific to my needs
- Task sensors, when possible, to meet my specific needs
- Subscribe to and receive alerts when a sensor measures a particular phenomenon

SWE Standards

- Information Models and Schema
  - **Observations and Measurements (O&M)** – Core models and schema for observations; archived and streaming
  - **Sensor Model Language (SensorML) for In-situ and Remote Sensors** - Core models and schema for observation processes: support for sensor components and systems, geolocation, response models, post measurement processing
  - **SWE Common Data –** common data models used throughout SWE specs
- Interface Models (Web Services)
  - **Sensor Observation Service** - Access Observations for a sensor or sensor constellation, and optionally, the associated sensor and platform data
  - **Sensor Alert/Event Service** – Subscribe to alerts based upon sensor observations
  - **Sensor Planning Service** – Request collection feasibility and task sensor system for desired observations
  - **Web Notification Service** – Manage message dialogue between client and Web service(s) for long duration (asynchronous) processes
  - **Registries for Sensors** – Discover sensors and sensor observations

SensorML Overview

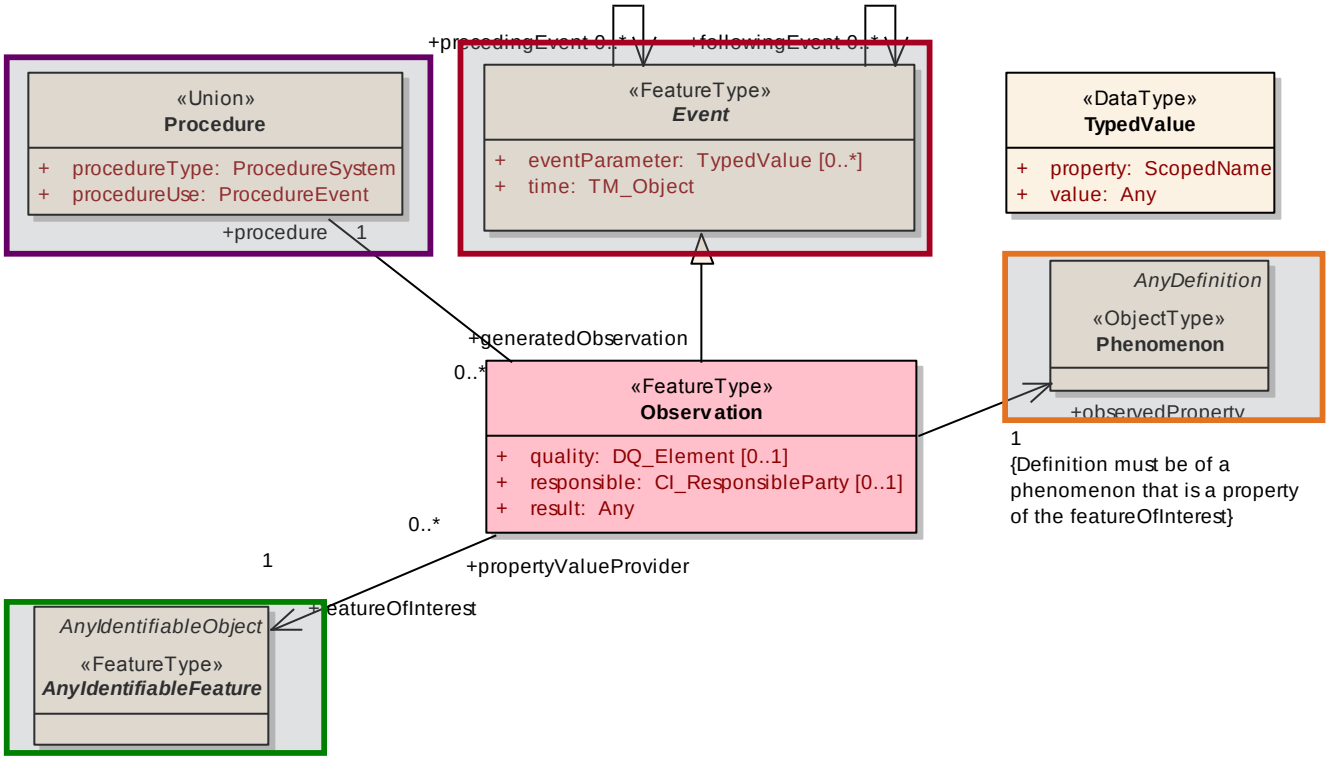
- SensorML is an XML schema for defining the geometric, dynamic, and observational characteristics of a sensor

- The purpose of the sensor description:
  1. provide general sensor information in support of data discovery
  2. support the processing and analysis of the sensor measurements
  3. support the geolocation of the measured data.
  4. provide performance characteristics (e.g. accuracy, threshold, etc.)
  5. archive fundamental properties and assumptions regarding sensor

- SensorML provides functional model for sensor, not detail description of hardware

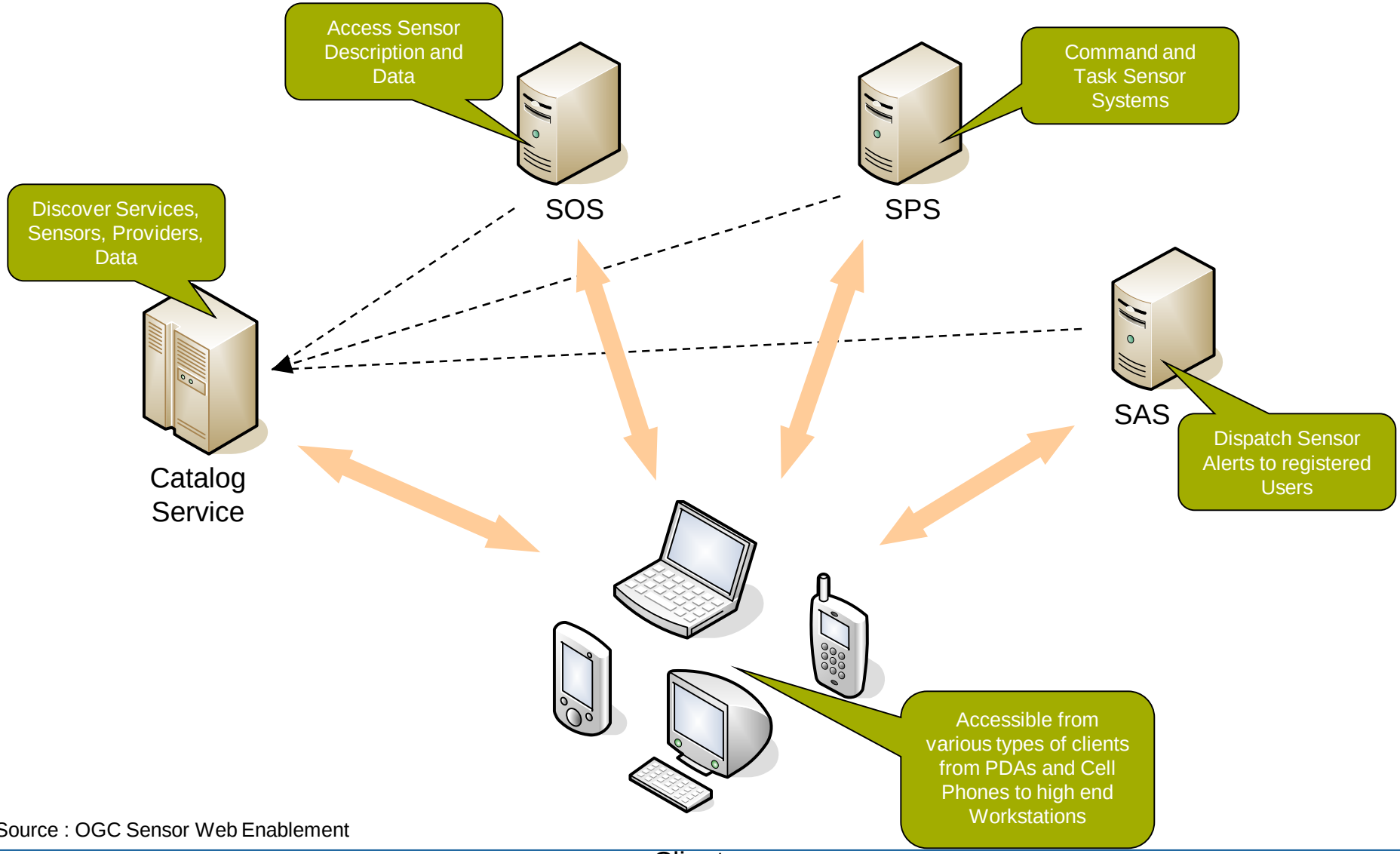
- SensorML separates the sensor from its associated platform(s) and target(s)

Observations & Measurements



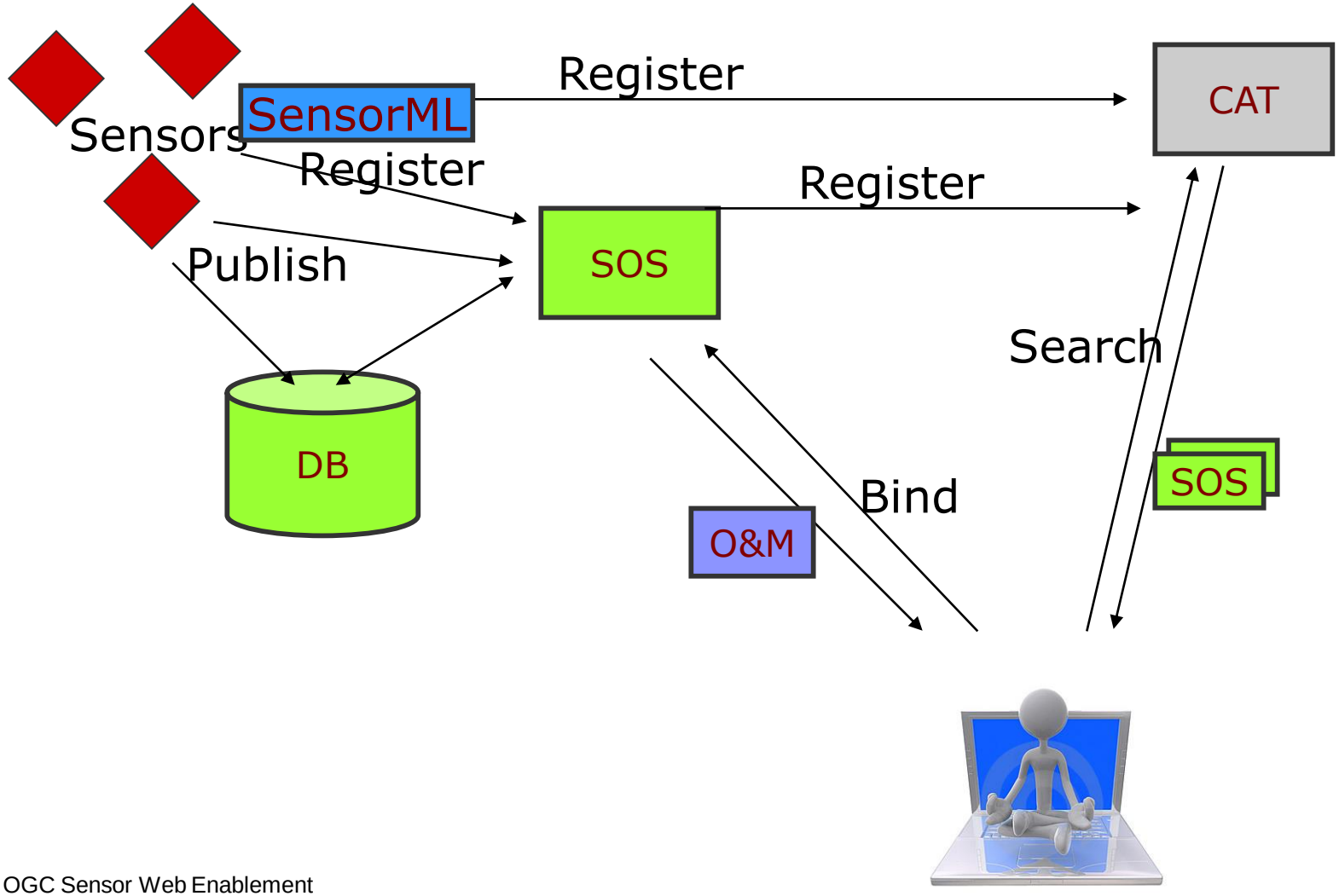
- **An** Observation **is an** Event **whose** result **is an** estimate **of the** value **of some** Property **of the** Feature-of-interest**, obtained using a specified** Procedure
- **The** Feature-of-interest **concept reconciles remote and in-situ observations**

SWE Components – Web Services



Source : OGC Sensor Web Enablement

SWE Services and Encodings Interaction



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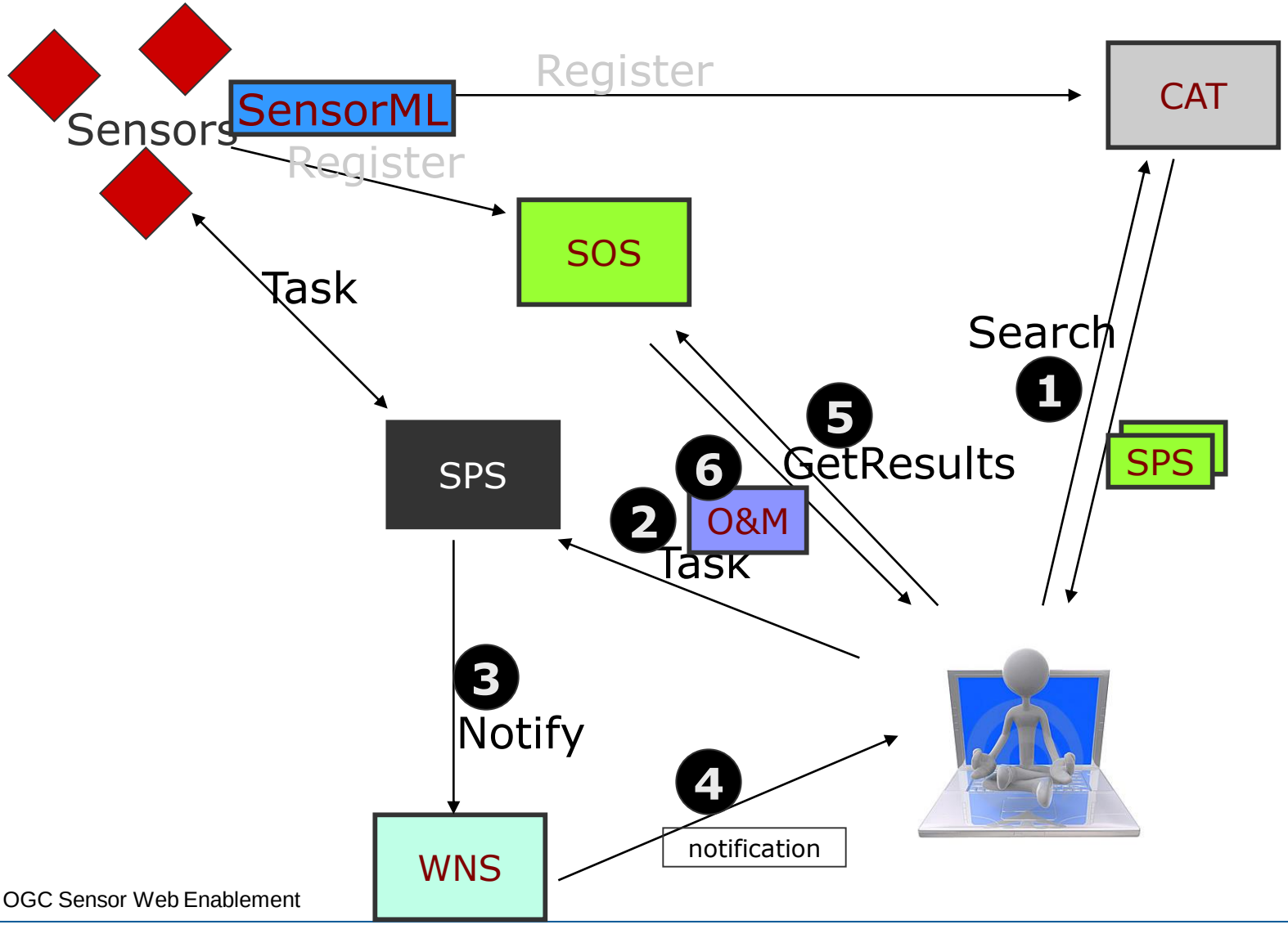

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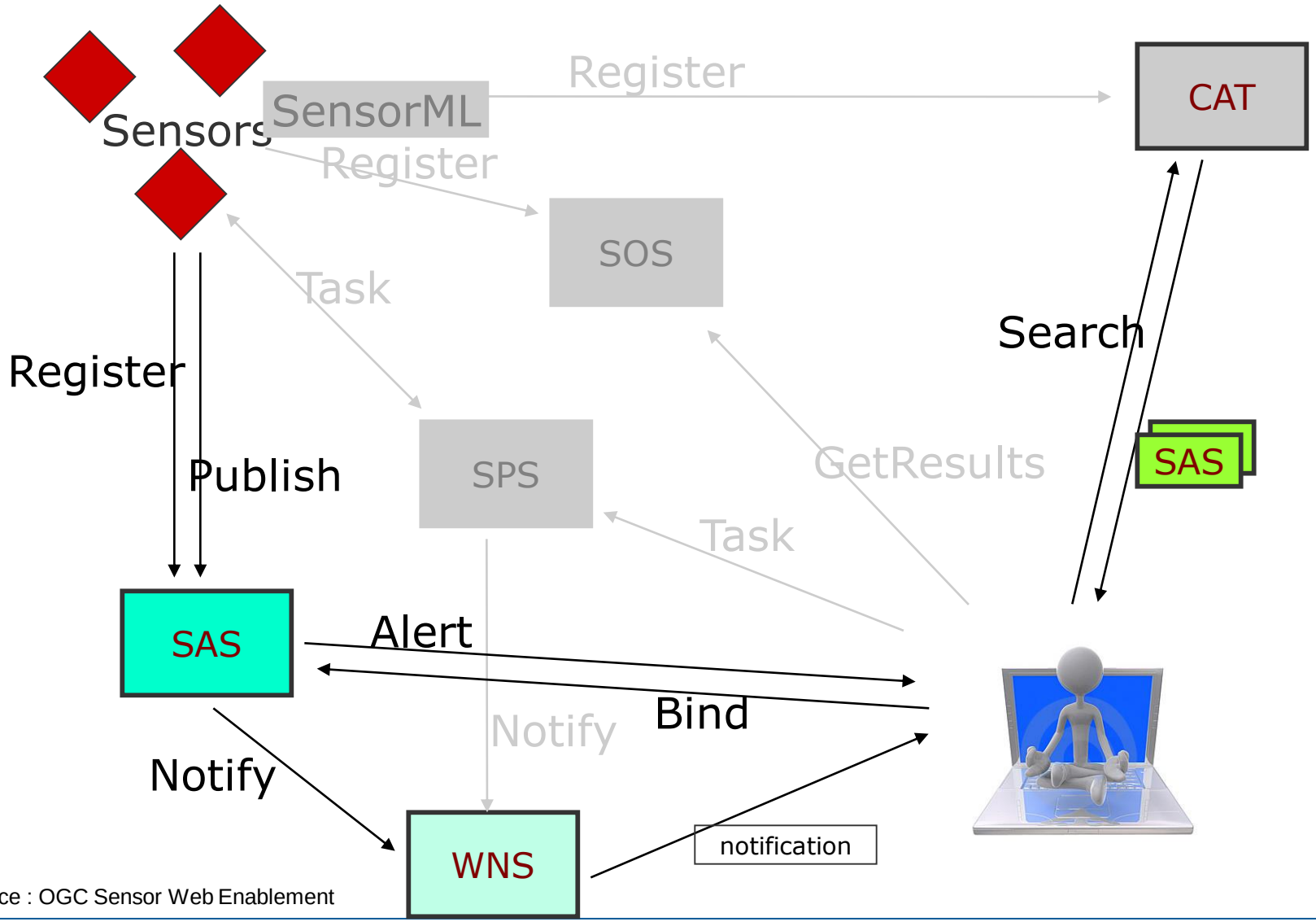
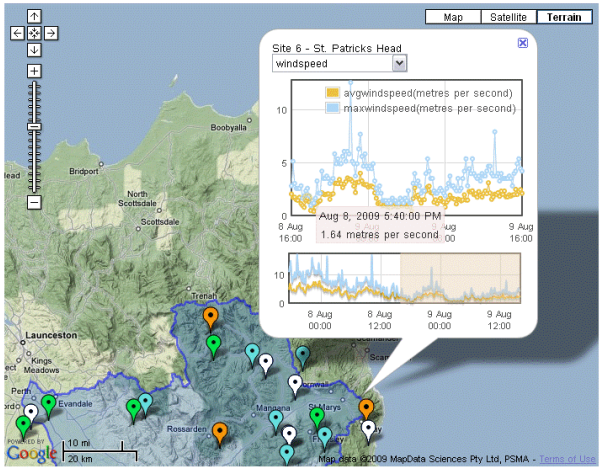
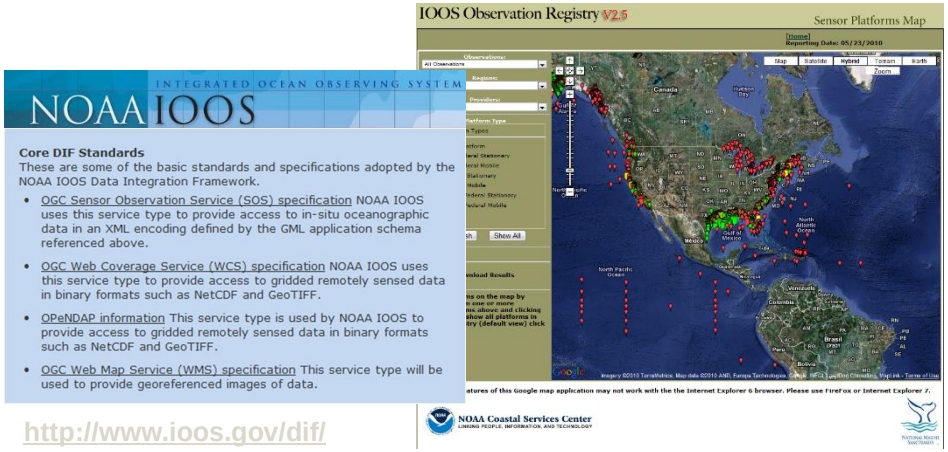


Source : OGC Sensor Web Enablement

SWE Implementations

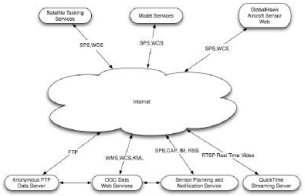
Esk River Hydrologic Sensor Web
CSIRO Tasmania





http://www.ioos.gov/dif/

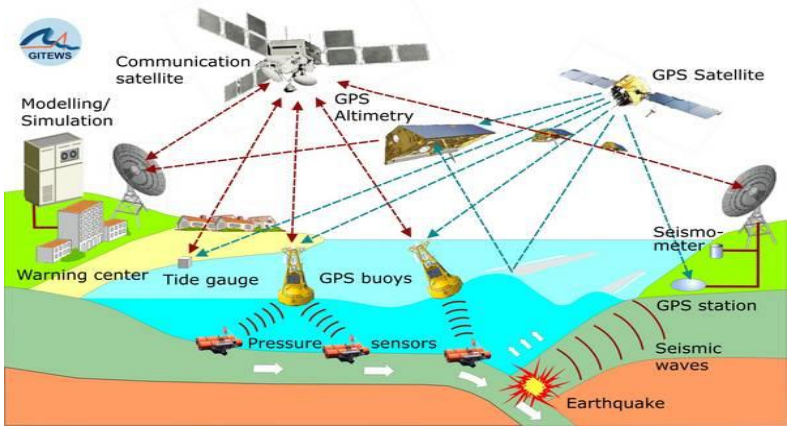
- OTH, Commercial Ku
- C&C and Data
- Multiple web services:
  - WMS, WCS, SPS, WNS
    - Beta WCPS
  - RTSP, RSS
- On board Sensor Web



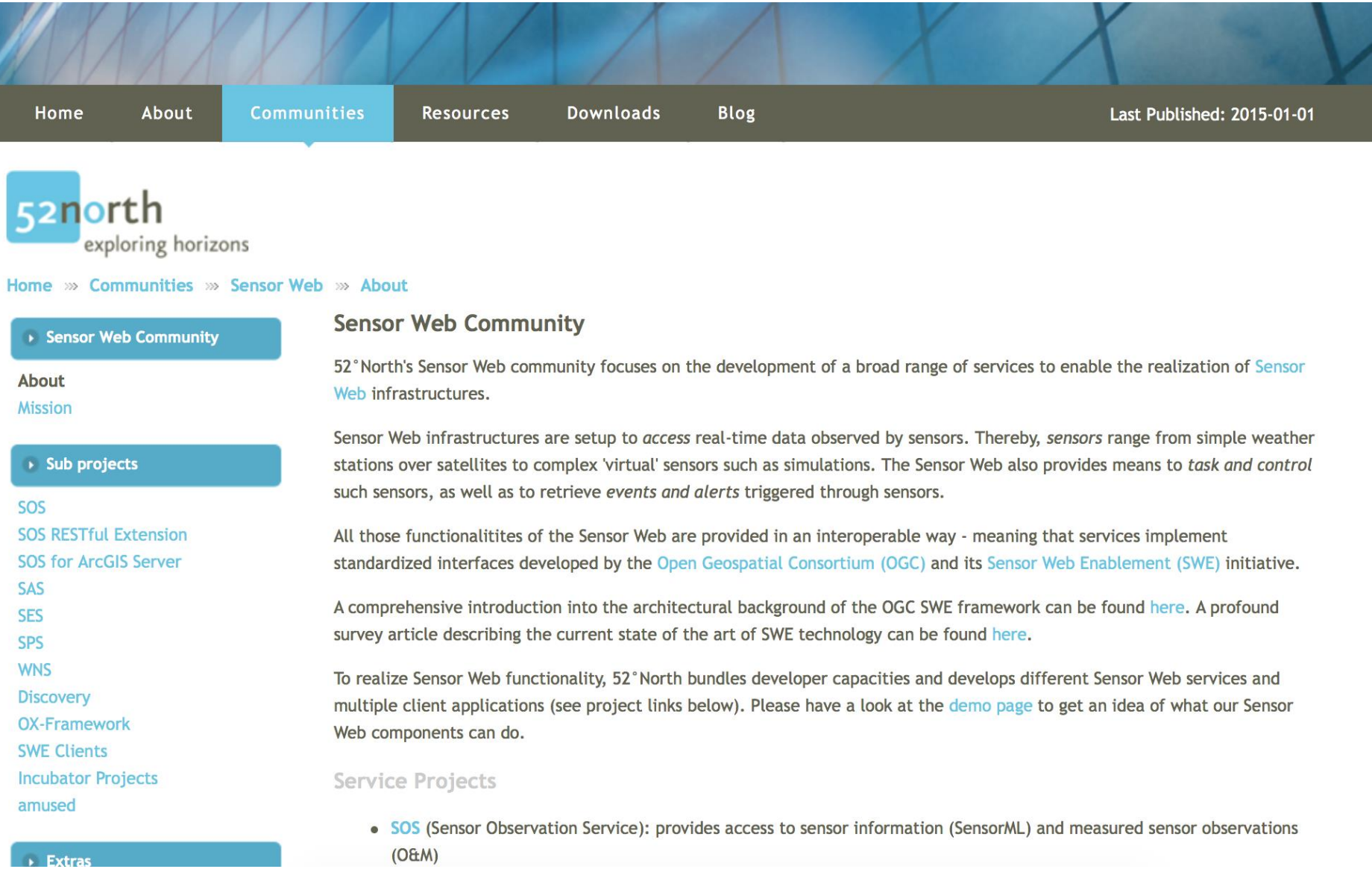
Wildfire Management, NASA

Source: Don Sullivan, NASA

Tsunami Early Warning



Source: www.gitews.org



Source : http://www.52north.org/

SWE Implementations

- Demo
- http://sensorweb.demo.52north.org/sensorwebclient-webapp-stable/

SWE integration with CityGML

- The observation data requested by SOS is encoded in O&M
  - Since O&M is based on GML, it is possible to integrate time-varying observation values with CityGML objects utilizing Dynamizer features.

- Challenges
  - Currently a very few sensor observations are available within SWE framework.
  - There should be more meaningful sensors available within SWE framework, which can be integrated with city models, e.g., Smart Meters

Currently Reviewing – Green Button Initiative

- Initiative by NAESB (North American Energy Standards Board)
  - To make metered data available to consumers
- Interoperable standard
  - Implements NAESB REQ21 – Energy Service Provider Interface (ESPI) energy usage information exchange standard
  - Requires Oauth 2.0 Access
  - Based on HTTP and REST Paradigm
  - Currently, no implementation with SWE framework
- Identified as the preferred implementation option for the meter data exchange protocol to be used in Sunshine project (http://www.sunshineproject.eu/)

Currently Reviewing – Green Button Initiative

- Examples of Green Button data

Source : http://www.greenbuttondata.org/
Source : http://www.geospatialworldforum.org/2014/presentation/GeoEnergy/GWF2014_pg-PDF.pdf

Currently Reviewing – Green Button Initiative

- Examples of Green Button data - UsagePoint

```
<entry>
  <id>urn:uuid:97EAEBAD-1214-4A58-A3D4-A16A6DE718E1</id>
  <published>2012-10-24T00:00:00Z</published>
  <updated>2012-10-24T00:00:00Z</updated>
  <link rel="self"
        href="/espi/1_1/resource/RetailCustomer/9b6c7063/UsagePoint/01"/>
  <link rel="up"
        href="/espi/1_1/resource/RetailCustomer/9b6c7063/UsagePoint"/>
  <link rel="related"
        href="/espi/1_1/resource/RetailCustomer/9b6c7063/UsagePoint/01/MeterReading"/>
  <link rel="related"
        href="/espi/1_1/resource/RetailCustomer/9b6c7063/UsagePoint/01/ElectricPowerUsageSummary"/>
  <link rel="related"
        href="/espi/1_1/resource/UsagePoint/01/LocalTimeParameters/01"/>
  <title>my house</title>
  <content>
    <UsagePoint xmlns="http://naesb.org/espi">
      <ServiceCategory>
        <kind>0</kind>
      </ServiceCategory>
```

Source : http://www.greenbuttondata.org/
Source : http://www.geospatialworldforum.org/2014/presentation/GeoEnergy/GWF2014_pg-PDF.pdf

Currently Reviewing – Green Button Initiative

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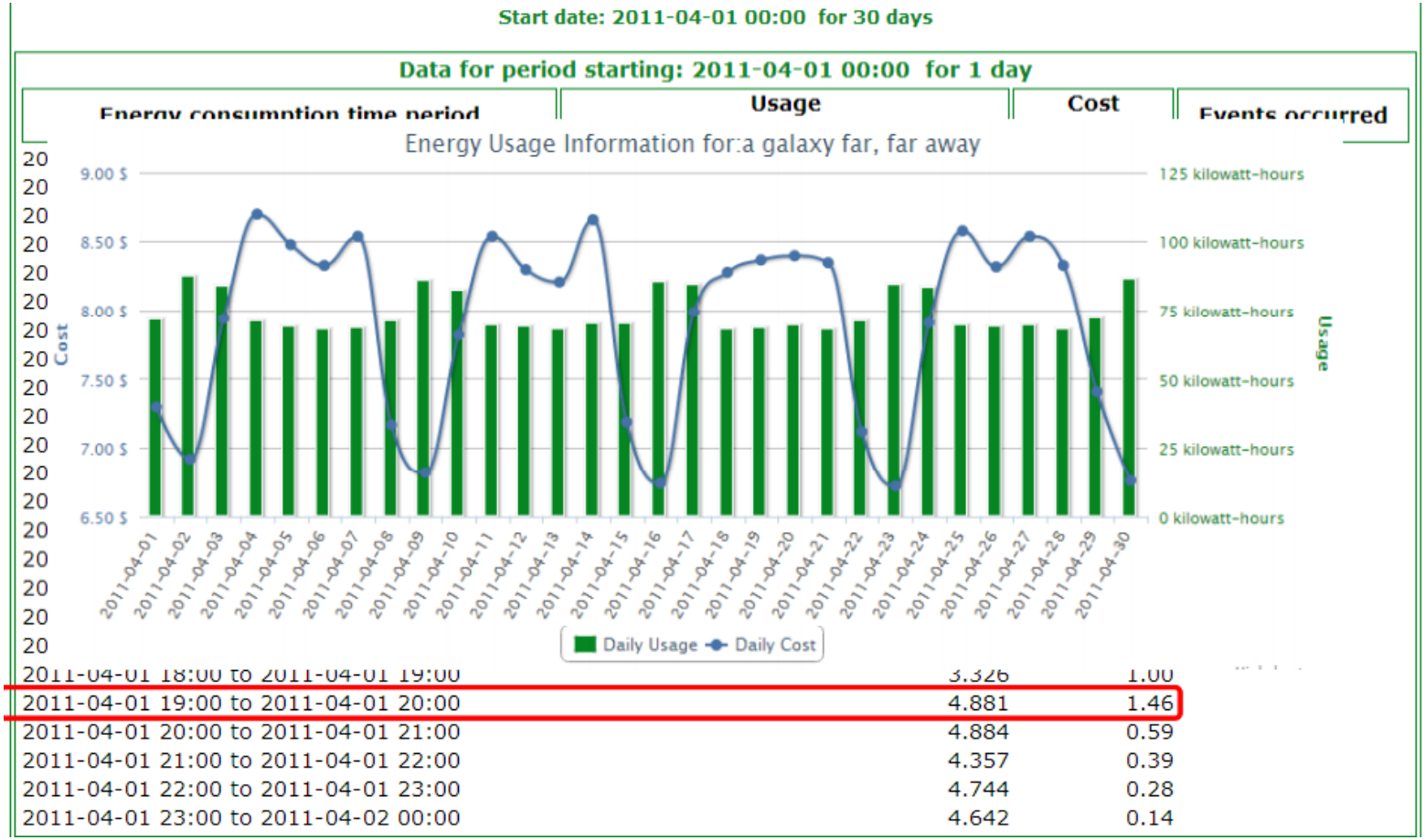
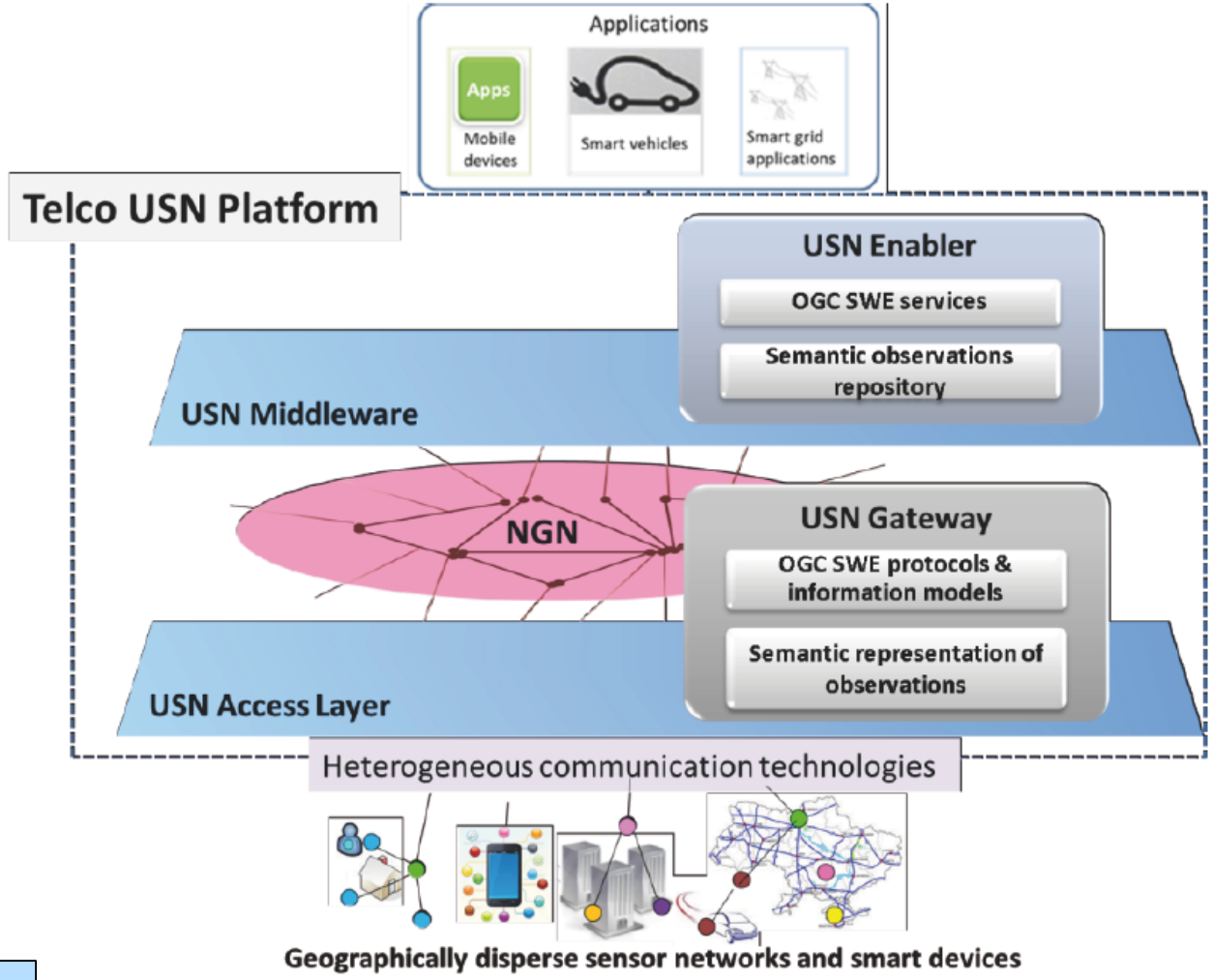


2011-04-01 18:00 to 2011-04-01 19:00	3.326	1.00
2011-04-01 19:00 to 2011-04-01 20:00	4.881	1.46
2011-04-01 20:00 to 2011-04-01 21:00	4.884	0.59
2011-04-01 21:00 to 2011-04-01 22:00	4.357	0.39
2011-04-01 22:00 to 2011-04-01 23:00	4.744	0.28
2011-04-01 23:00 to 2011-04-02 00:00	4.642	0.14

Source : http://www.greenbuttondata.org/
Source : http://www.geospatialworldforum.org/2014/presentation/GeoEnergy/GWF2014_pg-PDF.pdf

Currently Reviewing – Ubiquitious Sensor Networks



USN	Ubiquitious Sensor Network
NGN	Next Generation Network

Source : A Ubiquitous Sensor Network Platform for Integrating Smart Devices into the Semantic Sensor Web

Currently Reviewing – Ubiquitious Sensor Networks

- USN Applications and Services platform, which enables the effective use of a USN in a given application or service.
- USN Middleware, including functionalities for sensor network management and connectivity, event processing, sensor data mining, etc.
- Network infrastructure, mainly based on Next Generation Networks (NGN).
- USN Gateway: a node which interconnects sensor networks with other networks.
- Sensor networks

- Based on this idea, the USN-Platform integrates OGC SWE functionalities into the USN middleware through USN-Enabler

Source : A Ubiquitous Sensor Network Platform for Integrating Smart Devices into the Semantic Sensor Web

Future Work

- OGC SWE integration with Smart Meters
- Working demonstration of integrating sensors within CityGML objects
- Dynamizer ADE and instance examples