Data Quality on Mars

ISO 80000 and other Standards

Werner Keil

@wernerkeil | @UnitAPI | wkeil@apache.org

APACHE: BIG_DATA EUROPE

CORINTHIA HOTEL
BUDAPEST, HUNGARY
SEPTEMBER 28-30 , 2015

Agenda

- Introduction
- History
- Mishaps
- Standards
- Projects
- Demo
- Q&A

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Who am I?

- Consultant – Coach
- Creative Cosmopolitan
- Open Source Evangelist
- Software Architect
- JCP EC Member
- JSR 363 Co Spec Lead
- Java EE | DevOps Guy …

Twitter @wernerkeil | Email wkeil@apache.org

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3

HISTORY

Before the Metric System

- Hungary adopted the Metric System in 1874, it is compulsory since 1876 (20 years before Corinthia Hotel was built).
- Before that, the old Vienna measurement system was used for most parts and units like
  - 1 mertföld = 8.3536 km
  - 1 joch = 4316 m^2
  - 1 eimer = 54.30 l
  - One fass was equal to 52.545 gallons, but the value of eimer (per fass) varied from 15.03 (in Upper Hungary) to 19.37 (in Lower Hungary).

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Did you know, Zytglogge in Bern…

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Was actually a Unit Converter, too?

Längenmasse für den Marktgebrauch,
hier angebracht
seit der Mitte des 17. Jahrhunderts.

Von oben nach unten:
- Umrechnungsstab Bernerfuss in Schweizerfuss
- Schweizerschuh
- Mutterschuh der Stadt Bern
- Mutterelle der Stadt Bern
- Metermass
- Doppelmetermass

Die Masse sind, mit Ausnahme der Metermasse, Kopien nach Originalen im Bernischen Historischen Museum und wurden von der burgerlichen Gesellschaft

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UNIT CONVERSION
&
STANDARD MISHAPS

What do these disasters have in common?

- Patriot Missile
  The cause was an inaccurate calculation of the time since boot due to a computer arithmetic error.
- Ariane 5 Explosion
  Floating point number which a value was converted from had a value greater than what would be represented by a 16 bit signed integer.
- Christopher Columbus
  He miscalculated the circumference of Earth assuming a medieval Persian geographer he referred to had used Roman miles (4,856 ft.) instead of the 7,091 ft. Arabic mile, which is part of the reason he unexpectedly ended up in the Bahamas on October 12, 1492, and thought he had hit Asia. Whoops.

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What do these disasters have in common?

- An aircraft more than 30,000 pounds overweight is certainly no laughing matter.
  - In 1994, the FAA received an anonymous tip that an American International Airways (now Kalitta Air, a cargo airline) flight had landed **15 tons** heavier than it should have. The FAA investigated and discovered that the problem was in a kilogram-to-pounds conversion (or lack thereof).
- Gimli Glider (another **near disaster**)

  Fuel loading was miscalculated through misunderstanding of the recently adopted Metric System, replacing the Imperial System in Canada

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1983 | Gimli Glider

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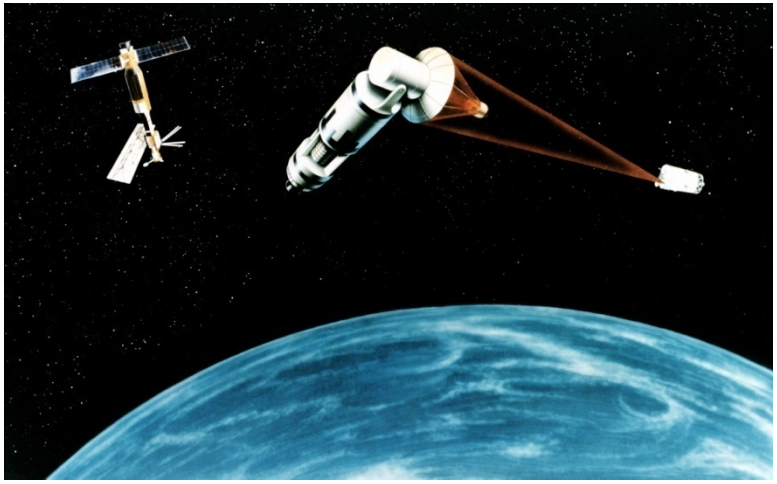
Images: Wayne Glowacki | Wikia „Herr der Ringe“

1983 | NASA „Star Wars“ Initiative

23rd March 1983. Ronald Reagan announces SDI (or “Star Wars”): ground-based and space-based systems to protect the US from attack by strategic nuclear ballistic missiles.



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1985

Mirror on underside of shuttle

Big mountain in Hawaii

SDI Experiment:
The Plan

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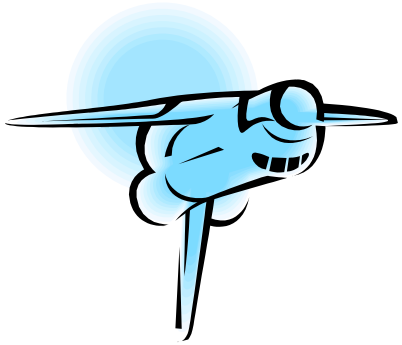
1985



SDI Experiment: What really happened

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1985 | Why it happened?

ACM SIGSOFT SOFTWARE ENGINEERING NOTES vol 10 no 3 Jul 1985 page 10

Attention All Units, Especially Miles and Feet!

Much to the surprise of Mission Control, the space shuttle Discovery flew upside-down over Maui on 19 June 1985 during an attempted test of a Star-Wars-type laser-beam missile defense experiment. The astronauts reported seeing the bright-blue low-power laser beam emanating from the top of Mona Kea, but the experiment failed because the shuttle's reflecting mirror was oriented upward! A statement issued by NASA said that the shuttle was to be repositioned so that the mirror was pointing (downward) at a spot *10,023 feet* above sea level on Mona Kea; that number was supplied to the crew in units of feet, and was correctly fed into the onboard guidance system -- which unfortunately was expecting units in nautical miles, not feet. Thus the mirror wound up being pointed (upward) to a spot *10,023 nautical miles* above sea level. The San Francisco Chronicle article noted that "the laser experiment was designed to see if a low-energy laser could be used to track a high-speed target about 200 miles above the earth. By its failure yesterday, NASA unwittingly proved what the Air Force already knew -- that the laser would work only on a 'cooperative target' -- and is not likely to be useful as a tracking device for enemy missiles." [This statement appeared in the S.F. Chronicle on 20 June, excerpted from the L.A. Times; the NY Times article on that date provided some controversy on the interpretation of the significance of the problem.] The experiment was then repeated successfully on 21 June (using nautical miles). The important point is not whether this experiment proves or disproves the viability of Star Wars, but rather that here is just one more example of an unanticipated problem in a human-computer interface that had not been detected prior to its first attempted actual use.

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1998 | Solar Heliospheric Observatory

- NASA lost equipment worth millions thanks to shoddy conversion practices.
  - SOHO, the Solar Heliospheric Observatory, a joint project between NASA and the ESA (European Space Agency), lost all communications with Earth. After about a week of trying various things, communication was restored and everyone breathed a sigh of relief. Among the problems thought to have caused the sudden blackout?
    - There was an error in the spacecraft's navigation measurements of nearly 100 km, which resulted in a much lower altitude than expected and led to the vehicle's break-up in the atmosphere.
    - *The conversion factor from English to Metric units was erroneously left out of the AMD files.*
    - Interface Specification required that the impulse-bit calculations should be done using Metric Units.

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1999 | Mars Climate Orbiter

CNN.com

sci-tech> space> story page

exploringmars in-depth specials

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Metric mishap caused loss of NASA orbiter

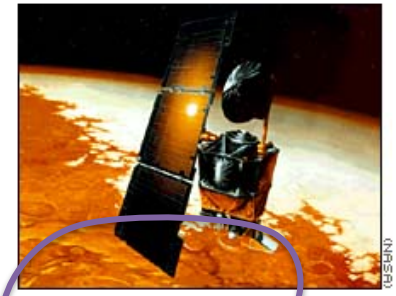
September 30, 1999
Web posted at: 4:21 p.m. EDT (2021 GMT)

In this story:

Metric system used by NASA for many years

Error points to nation's conversion lag

RELATED STORIES, SITES



NASA's Climate Orbiter was lost September 23, 1999

By Robin Lloyd
CNN Interactive Senior Writer

(CNN) -- NASA lost a $125 million Mars orbiter because a Lockheed Martin engineering team used English units of measurement while the agency's team used the more conventional metric system for a key spacecraft operation, according to a review finding released Thursday.

The units mismatch prevented navigation information from transferring between the Mars Climate Orbiter spacecraft team in at Lockheed Martin in Denver and the flight team at NASA's Jet Propulsion Laboratory in Pasadena, California.

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1999 | Mars Climate Orbiter (2)

- Mars Climate Orbiter

  Preliminary findings indicate that one team used US/English units (e.g. inches, feet and pounds) while the other used metric units for a key spacecraft operation.

  – NASA lost a $125 million Mars orbiter because a Lockheed Martin engineering team used English units of measurement while the agency's team used the more conventional metric system for a key spacecraft operation

    - A credible source disclosed, there was **a manual step** with an outsourced person to convert these calculations between the different teams, and NASA budget cuts caused them to fire him and have the wrong, unpatched data transmitted!!!

  – This also underlines the added risk when 3rd party contractors are involved or projects are developed Offshore

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1999 | Overdose

- Gram instead of Grain

  In 1999, the Institute for Safe Medication Practices reported an instance where a patient had received 0.5 grams of Phenobarbital (a sedative) instead of 0.5 grains.

  – When the recommendation was misread. A grain is a unit of measurement equal to about **0.065 grams**… yikes. The Institute emphasized that only the **metric system** should be used for prescribing drugs.

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2015 | Volkswagen defeat device

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Photo: Reuters

2015 | Volkswagen defeat device (2)

- VW's defeat device explained
  - How did VW fool regulators?

    The software switched on when the automobiles were being tested for compliance with EPA standards, turning off during normal driving to allow maximum engine performance.

    The algorithm used information about how the car was being steered, how long the engine ran and atmospheric pressure to "precisely track" the conditions that corresponded to a federal emissions test, according to the EPA.

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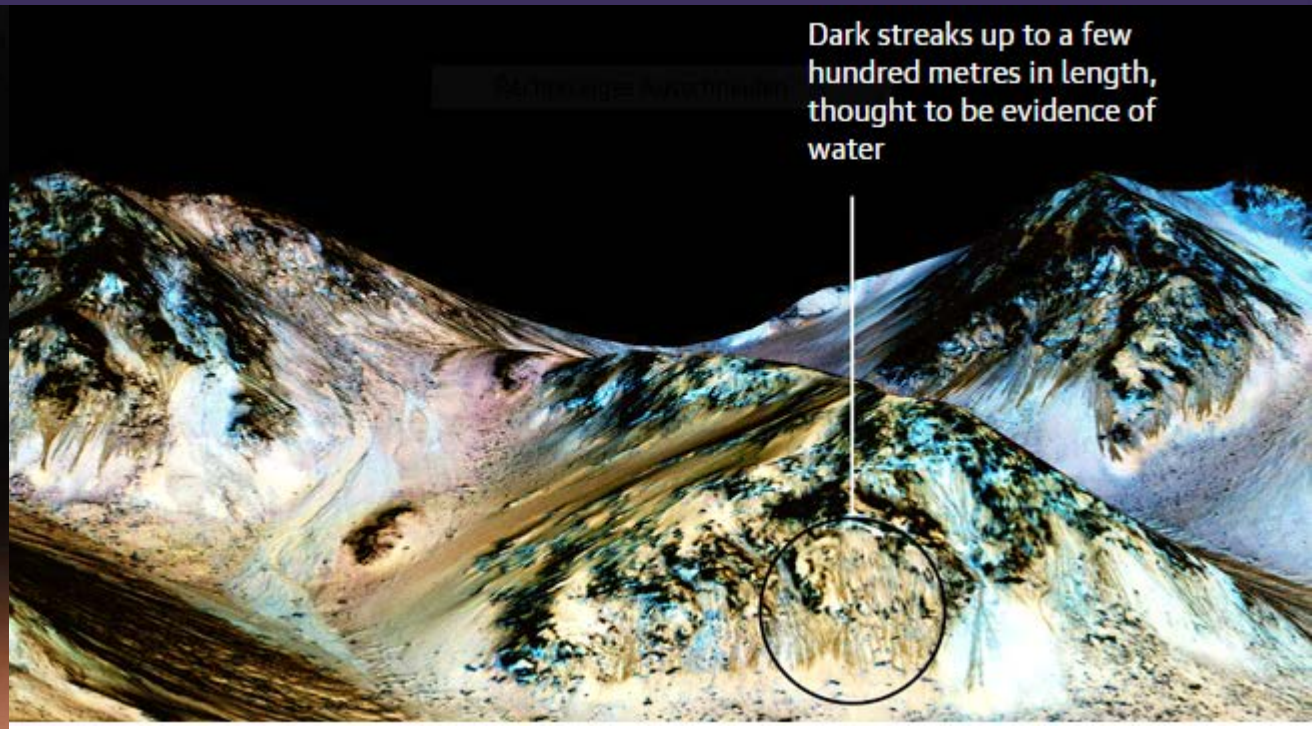
2015 | Mars Reconnaissance Orbiter



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Images: NASA | The Guardian

2015 | Mars Reconnaissance Orbiter (2)

- Mars Reconnaissance Orbiter

  NASA just announced, that images and data by its Mars Reconnaissance Orbiter (MRO) suggest, there is water in liquid form on Mars.

  Which raises at least 2 important questions:

  – Is there Life on Mars?

  – Was the water measured in litres or liquid gallons?

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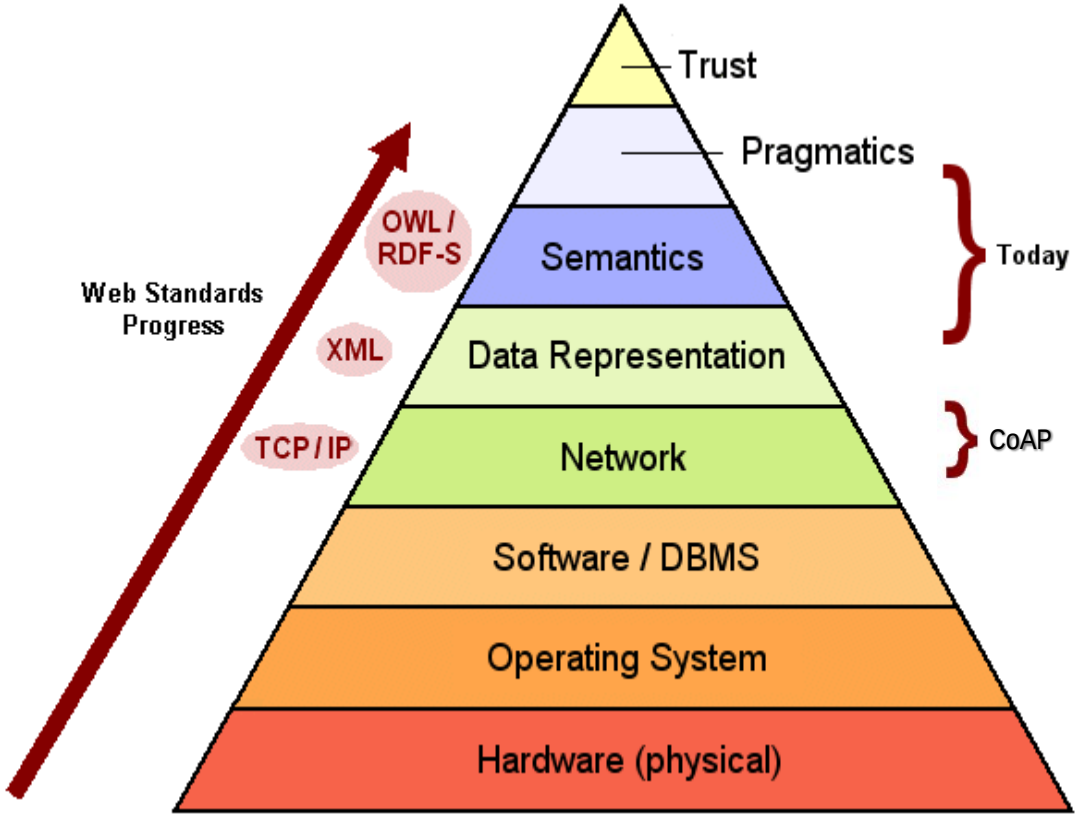
STANDARDS

Data Pyramid



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Data Standards

- SML-S
- O&M-S
- TML-S

W3C Semantic Web

- Resource Description Framework
- RDF Schema
- Web Ontology Language
- Semantic Web Rule Language

- SAWSDL
- SA-REST

Web Services

- Web Services Description Language
- REST

Unicode

OGC Sensor Web Enablement

- SensorML
- O&M
- TransducerML
- GeographyML

Sensor Ontology

Unicode Consortium

- CLDR
- ICU4J

Sensor Ontology

National Institute for Standards and Technology

- Semantic Interoperability Community of Practice
- Sensor Standards Harmonization

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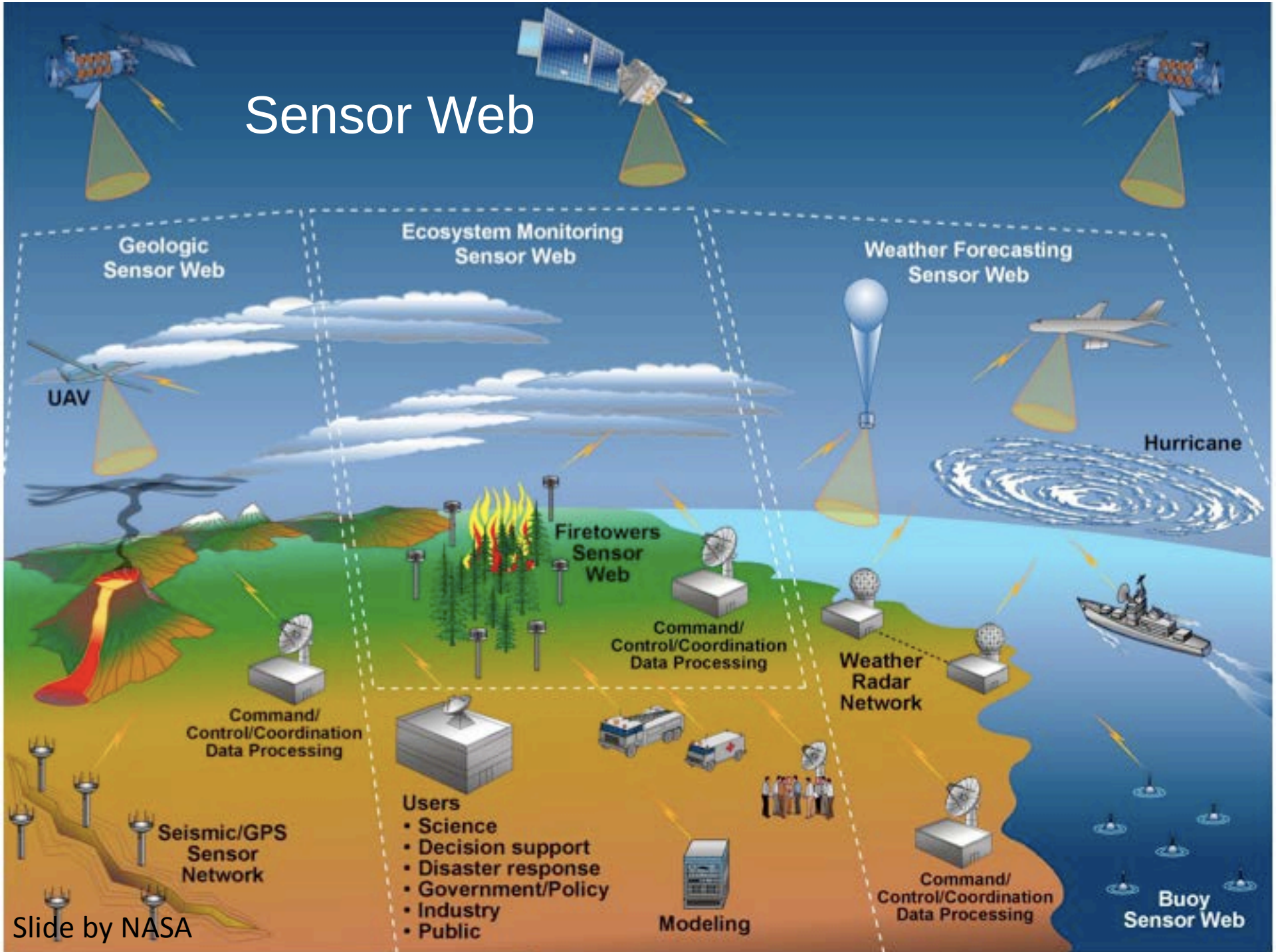
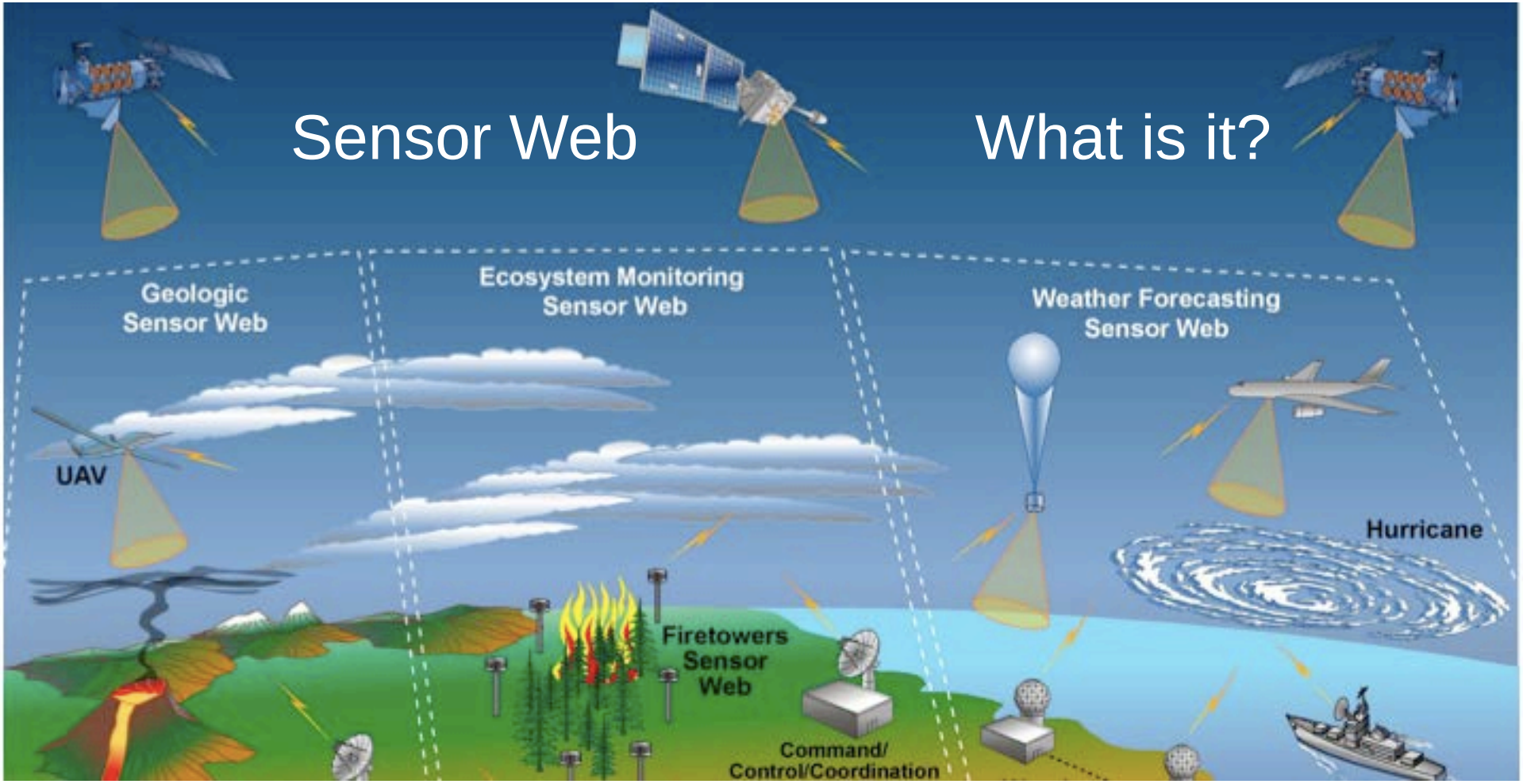

Sensor Web
Geologic Sensor Web
Ecosystem Monitoring Sensor Web
Weather Forecasting Sensor Web
UAV
Hurricane
Firetowers Sensor Web
Command/ Control/Coordination Data Processing
Weather Radar Network
Command/ Control/Coordination Data Processing
Users
• Science
• Decision support
• Disaster response
• Government/Policy
• Industry
• Public
Seismic/GPS Sensor Network
Modeling
Command/ Control/Coordination Data Processing
Buoy Sensor Web
Slide by NASA

Sensor Web What is it?



"A coordinated observation infrastructure composed of a distributed collection of resources that can collectively behave as a single, autonomous, task-able, dynamically adaptive and reconfigurable observing system that provides raw and processed data, along with associated meta-data, via a set of standards-based service-oriented interfaces." (Glenn, 2007)

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Sensor Web | OpenGIS Standards

- SW Enablement working group at OGC have developed a number of standards governing different aspects of Sensor Web

OGC O&M	Observations & Measurements	Approved
SensorML	Sensor Model Language	Approved
TransducerML	Transducer Model Language	Approved
OGC SOS	Sensor Observations Service	Approved
OGC SPS	Sensor Planning Service	Approved
OGC SAS	Sensor Alert Service	In progress
OGC WNS	Web Notification Services	In progress

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SensorML

- Sensor modeling language is the cornerstone of all SW services
- It provides comprehensive description of sensor parameters and capabilities
- It can be used for describing different kind of sensors:
  - Stationary or dynamic
  - Remote or in-situ
  - Physical measurements or simulations

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SensorML | Example

```
.............
<inputs>
 <InputList>
  <input name="ambiantTemperature">
   <swe:Quantity definition=
    "urn:ogc:def:phenomenon:temperature"/>
  </input>
  <input name="atmosphericPressure">
   <swe:Quantity definition=
    "urn:ogc:def:phenomenon:pressure"/>
  </input>
  <input name="windSpeed">
   <swe:Quantity definition=
    "urn:ogc:def:phenomenon:windSpeed"/>
  </input>
</InputList>
</inputs>
.............
```

```
.............
<outputs>
 <OutputList>
  <output name="weatherMeasurements">
   <swe:DataGroup>
    <swe:component name="time">
     <swe:Time
      definition="urn:ogc:def:phenomenon:time“
      uom="urn:ogc:def:unit:iso8601"/>
    </swe:component>
    <swe:component name="temperature">
     <swe:Quantity
definition="urn:ogc:def:phenomenon:temperature
      uom="urn:ogc:def:unit:celsius"/>
    </swe:component>
    <swe:component name="barometricPressure">
     <swe:Quantity

    definition="urn:ogc:def:phenomenon:pressur
    e“
      uom="urn:ogc:def:unit:bar" scale="1e-
    3"/>
    </swe:component>
    <swe:component name="windSpeed">
     <swe:Quantity

    definition="urn:ogc:def:phenomenon:windSpe
    ed“
      uom="urn:ogc:def:unit:meterPerSecond"/>
.............
```


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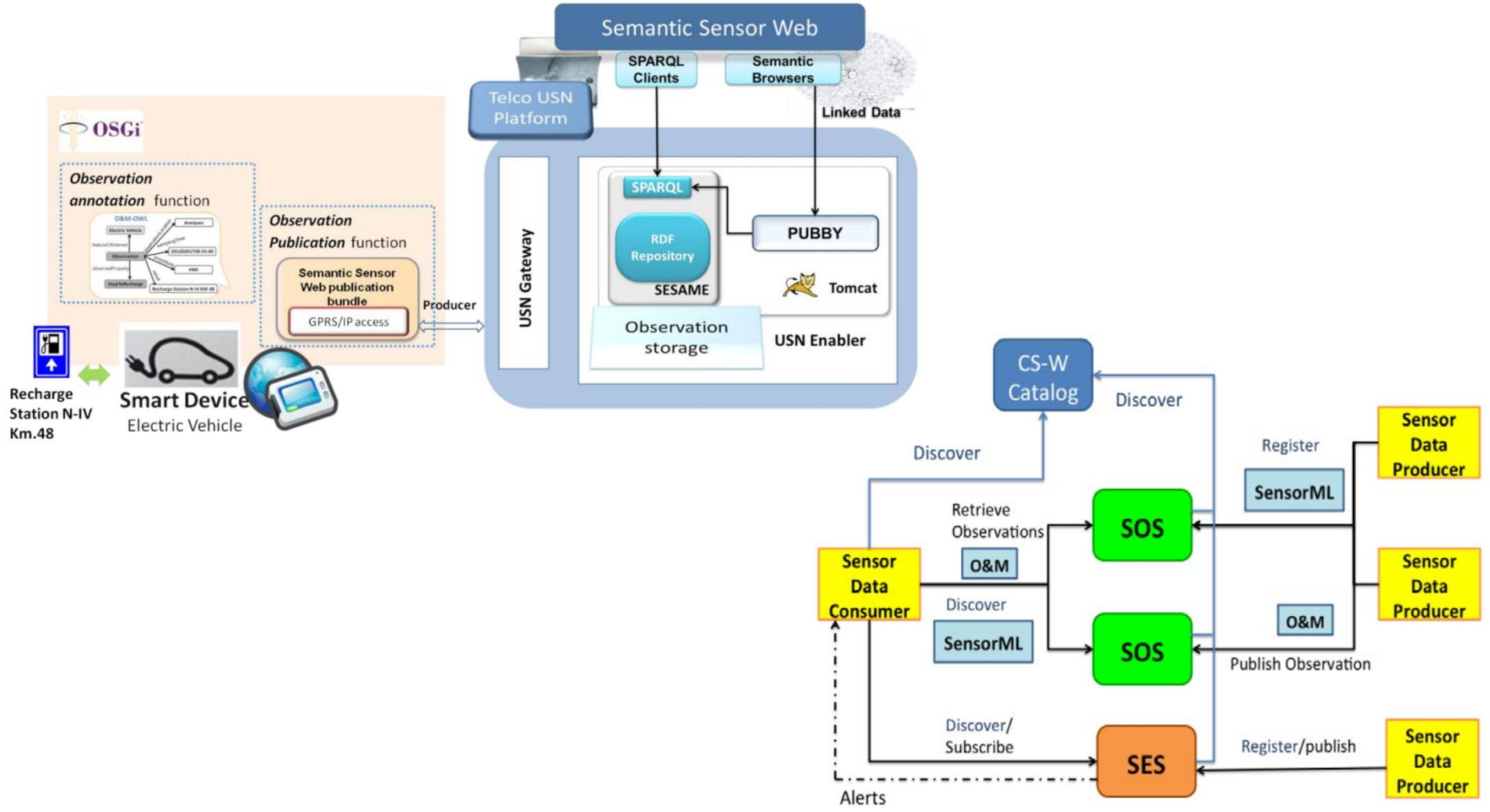
Sensor Web | Smart Grid



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Bilder: Facultad de Informática, Madrid Spain

Sensor Web | Mozambique floods

- The task under study is floods in different parts of the world
- Particular test case was flooding of Mozambique

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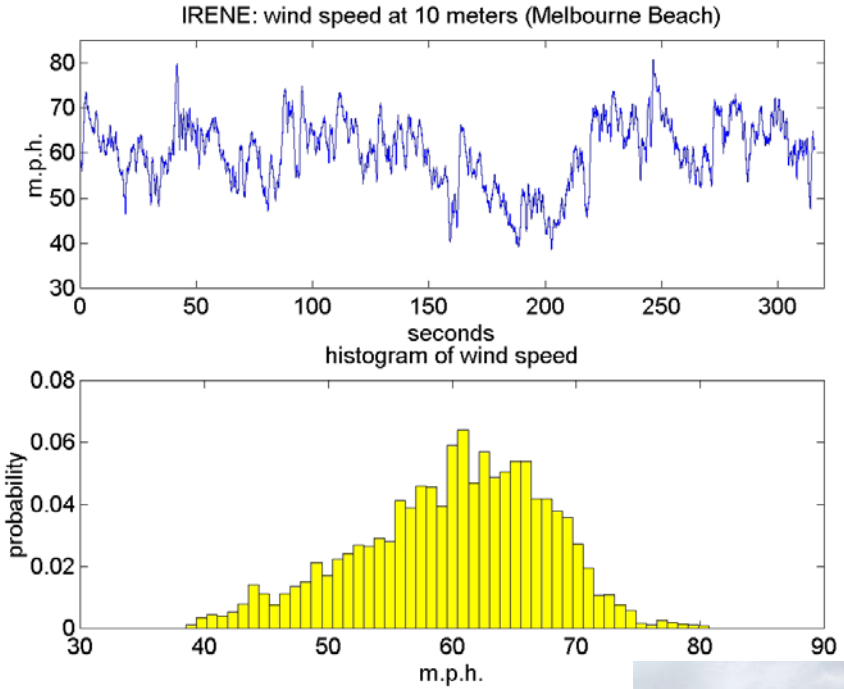
Sensor Web | Hurricane Tower Data

- Time histories of wind speed over the duration of the hurricane
- Statistical analysis reveals information needed for engineering design to resist the wind



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UCUM

Unified Code for Units of Measure

The Unified Code for Units of Measure is inspired by and heavily based on

- ISO 2955-1983
- ANSI X3.50-1986
- HL7's extensions called ISO+

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ISO/IEC 80000

- Quantities and Units
- Successor to ISO 31, IEC 60072
- Definitions, names, letter symbols and their use, relations, and signs / symbols used with them
- ISO TC 12 - Quantities and Units | IEC TC 25
- "style guide" for scientific publications and data quality

International Organization for Standardization

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JSR-275

Users and popular Downstream Projects

- JScience, Eclipse Science
- Groovy/Grails (DSLs e.g. for Healthcare, Unit Conversion,…)
- GeoAPI (OGC standard) and implementations, e.g. uDig
- Orbitz/Ebookers.com
- IEM (Emergency Management, Homeland Security)
- OpenEHR
- Parfait (Monitoring, part of Performance Co-Pilot - PCP)

► Rejected only by JCP EC not Community

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JSR-363

Units of Measurement API (.next)

- Namespace: javax.measure.*
- Only Interfaces and Base Exceptions
  - public interface **Dimension**
  - public interface **Quantity**<Q extends Quantity<Q>>
  - public interface **Unit**<Q extends Quantity<Q>>

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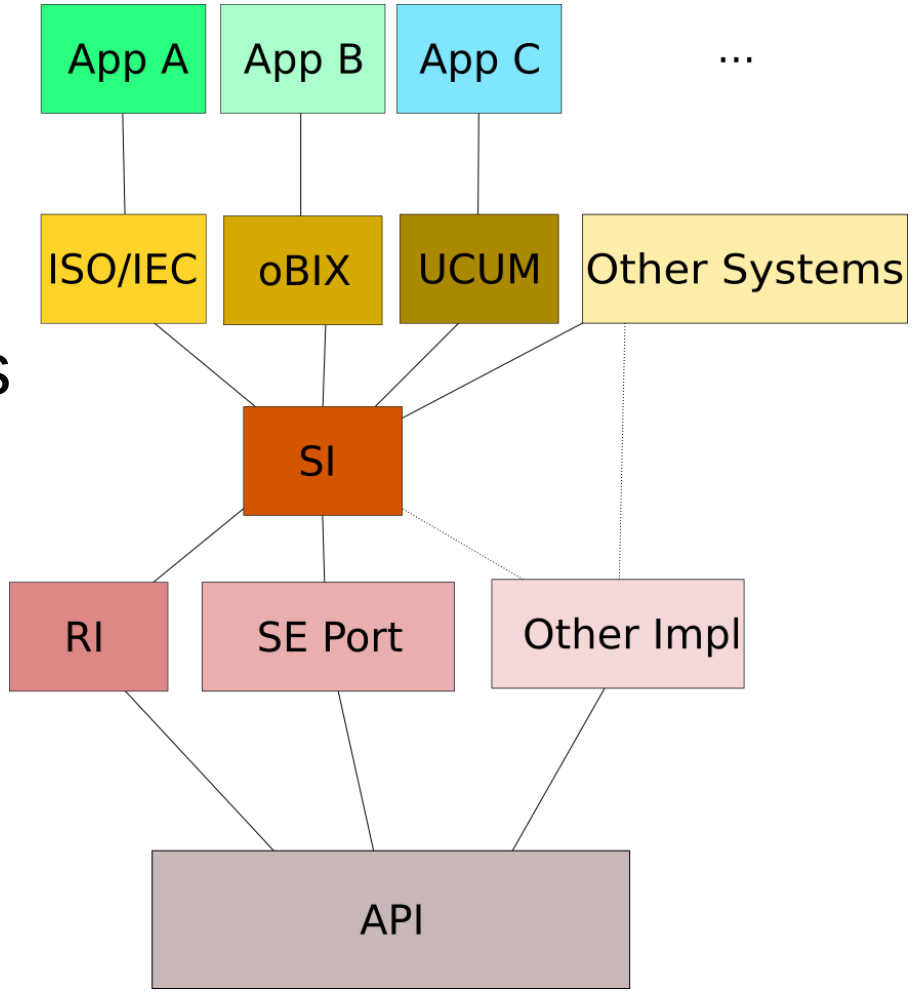
JSR-363 | Systems

Unit Systems

- Currently available
  - Reusable Quantities
  - SI System
  - Common Systems (US, Imperial)
  - ISO 80000
  - UCUM



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JSR-363 | Supporters

Opower

BT

IEM

Samsung

Gemalto M2M

CERN

SFR Group

JUG Chennai

O2

GeoAPI

Thales Group

Austrian Standards

Alcatel Lucent

Fraunhofer Gesellschaft

UCUM

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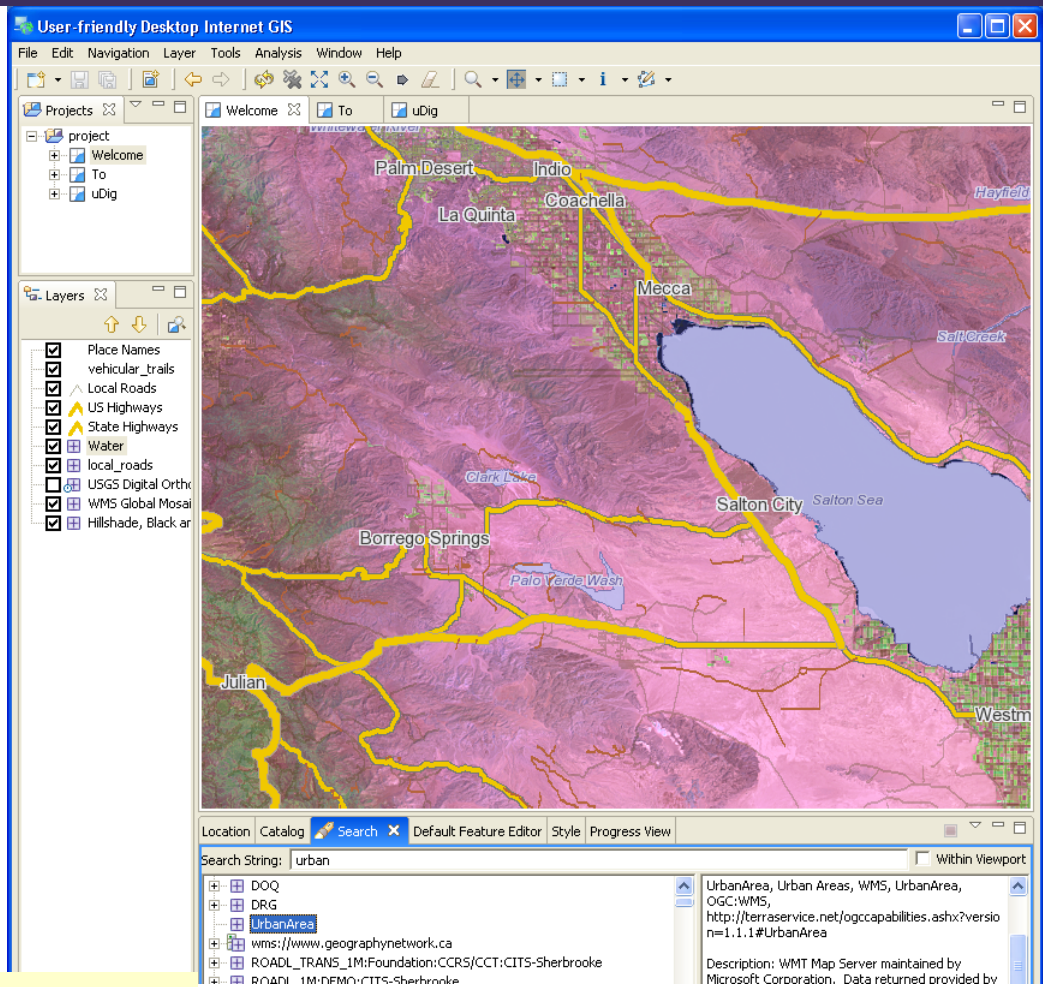
PROJECTS

Eclipse | LocationTech

- uDig is a desktop application framework, built with Eclipse Rich Client (RCP)
  - Internet: supporting standards (WMS, WFS, WCS, KML) …
  - GIS: framework for spatial data analysis
  - Uses GeoAPI / JSR-275



http://locationtech.org/projects/technology.udig

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GeoAPI | Apache SIS

- Apache Spatial Information System (SIS) is a Java library for developing geospatial applications
  - Implements GeoAPI 3.0
  - Using JSR-275

http://sched.co/3ztG

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DEMO

Q & A

Links

JSR-363

https://jcp.org/en/jsr/detail?id=363

Units of Measurement Project

http://unitsofmeasurement.github.io

ISO/TC 12 – Quantities and units

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=46202

Apache SIS

http://sis.apache.org

THANK YOU!