The Cambridge Conference 2017
Mapping Nations: The Next Decades

Rise of the Machines
The Future of Open Standards

Mark Reichardt
President & CEO
Open Geospatial Consortium

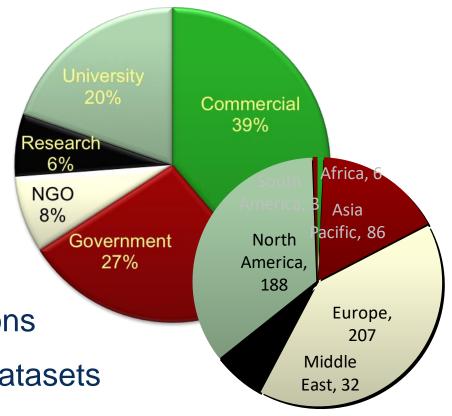# I am here to talk about standards…

The Open Geospatial Consortium

Not-for-profit, international voluntary consensus standards organization; leading open innovation for geospatial data

- Founded in 1994

- 520+ member organizations

- 50 Open Standards

- 99 innovation initiatives

- 268 OGC certified products

- Thousands of implementations

- Enabling access to 100K+ datasets
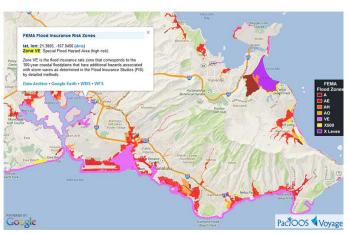

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Example OGC Commercial Members

Thousands of OGC Standards-Based Geospatial Implementations Worldwide

Karnatika, India GeoPortal

New Brunswick Canada Agriculture, Aquaculture And Fisheries

OneGeology Portal

http://oos.soest.hawaii.edu/pacioos/voyager/news/2013/

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OGC's Geospatial Interoperability Standards Framework

- **OGC Web Service Standards**
  - Integrate and share all types of geospatial and remote sensing data

- **OGC Sensor Web Enablement and SensorThings Standards**
  - Discover, task, access and process observations from *fixed & mobile sensors*
  - Access and integration of Internet of Things

- **Support Analysis and Processing**
  - Environmental modeling
  - Urban models
  - Geospatial Big Data / Analytics

- **3D Visualization & Augmented Reality**
  - **Outdoor location, routing**
  - **Indoor location**

- **Social Media / Crowdsourcing**
  - Geo-enabled Social Media

OGC Web Services

Web Feature Server

Web Coverage Server

Web Map Server

OGC Sensor Web Enablement

- All sensors reporting position
- All connected to the Web
- All with metadata registered
- All readable remotely
- Some controllable remotely

Services Viewpoint

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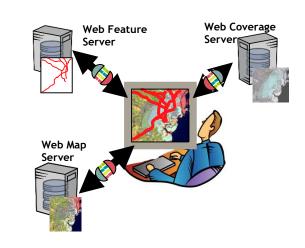
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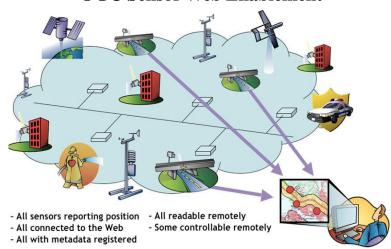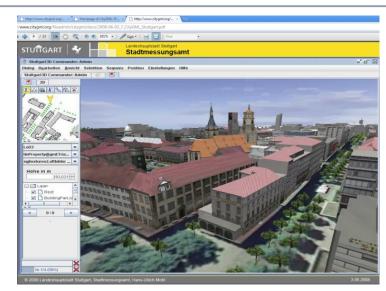 - **Outdoor location, routing**
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  - Geo-enabled Social Media

Source: Thomas Kolbe, Berlin TU
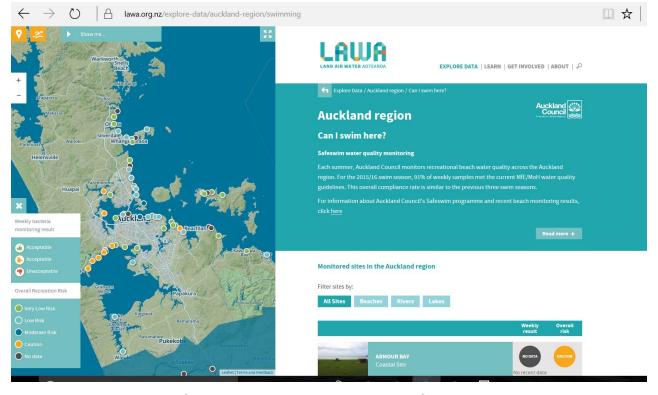

OGC Augmented Reality Markup Language 2.0

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Creating a National Water Observation Network
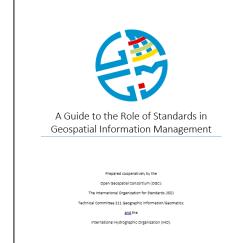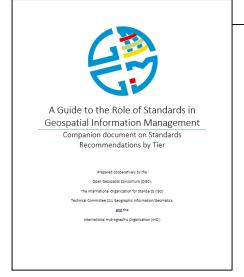
Is it safe to swim here?

- Two OGC standards are unifying hundreds of unique surface water observations maintained by 16 local authorities and national agencies.
  - OGC Sensor Observation Service, WaterML2.0
  - http://www.lawa.org.nz/explore-data/swimming/

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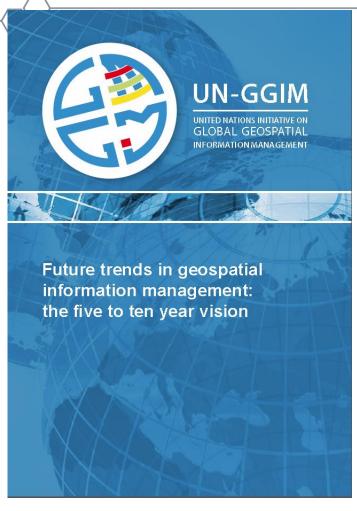# Organizing the Power of Standards for Implementation

- ***A Guide to the Role of Standards in Geospatial Information Management**, issued by the United Nations Group on Geospatial Information Management (UN-GGIM)*

- *Designed to help organizations around the world to better understand what standards to use, when and why*

- *Co-developed by the Open Geospatial Consortium, ISO TC/211 on Geographic Information/Geomatics, and the International Hydrographic Organization.*

- *Will be updated as the standards framework advances to solve interoperability challenges and address new capabilities.*

A Guide to the Role of Standards in
Geospatial Information Management

Prepared cooperatively by the
Open Geospatial Consortium (OGC);
The International Organization for Standards (ISO)
Technical Committee 211 Geographic information/Geomatics;
and the
International Hydrographic Organization (IHO).

A Guide to the Role of Standards in
Geospatial Information Management
Companion document on Standards
Recommendations by Tier

Prepared cooperatively by the
Open Geospatial Consortium (OGC);
The International Organization for Standards (ISO)
Technical Committee 211 Geographic information/Geomatics;
and the
International Hydrographic Organization (IHO).

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A Great Many Opportunities / Challenges Ahead

Future trends in geospatial information management: the five to ten year vision

United Nations Global Geographic Information Management

Future Trends: 5 – 10 Year Vision

- **Key trends**
    - **Cloud computing**
    - **Rapidly evolving sensors / IoT**
    - **Big Data Analytics / Linked data**
    - **Internet of Things**
    - **Change detection, modelling**
    - **Volunteered Geographic Information**
    - **Open Standards**
    - **Legal and Policy**
    - **Data standards and policy**
    - **Coordination and collaboration**
    - **Skills and Training**

http://ggim.un.org/docs/meetings/3rd%20UNCE/UN-GGIM-Future-trends.pdf
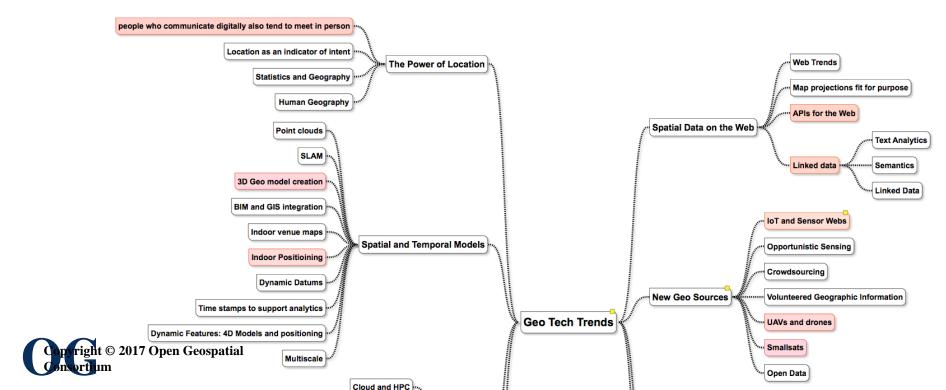
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OGC Strategic Technology Trends

- Themes
  - The power of location
  - Big data
  - Spatial data on the web
  - User platforms and Networks
  - Spatial and temporal models
  - Data science analytics
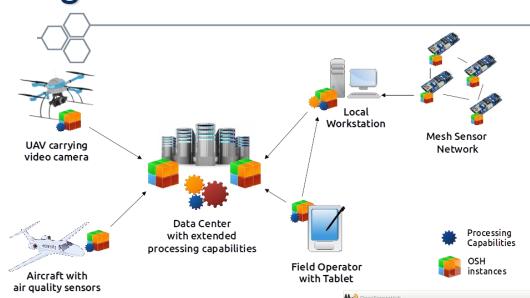 - New Geo sources
  - Software Development

Near Term Priorities

- Power of Location
  - People who communicate digitally tend to meet in person
- Spatial/Temporal Models
  - **3D Geo Model creation**
  - **Indoor positioning**
- Big Data and Data Science
  - **Machine Learning**
  - **Modeling, Simulation and Prediction**
  - **Uncertainty** and Veracity

- Spatial Data on the Web
  - APIs for the Web
  - Linked data
- New Geo Sources
  - **IoT and Sensor Webs**
  - Remote sensing on demand
    - **UAVs and drones**
    - **Smallsats**
- User platforms & Networks
  - Immersive Geo
  - Ambient Services
- Software development
  - Federation, Publish-Subscribe

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Big Geo Data / M2M transactions and workflows

UAV carrying
video camera

Aircraft with
air quality sensors

Data Center
with extended
processing capabilities

Local
Workstation

Mesh Sensor
Network

Field Operator
with Tablet

Processing
Capabilities

OSH
instances
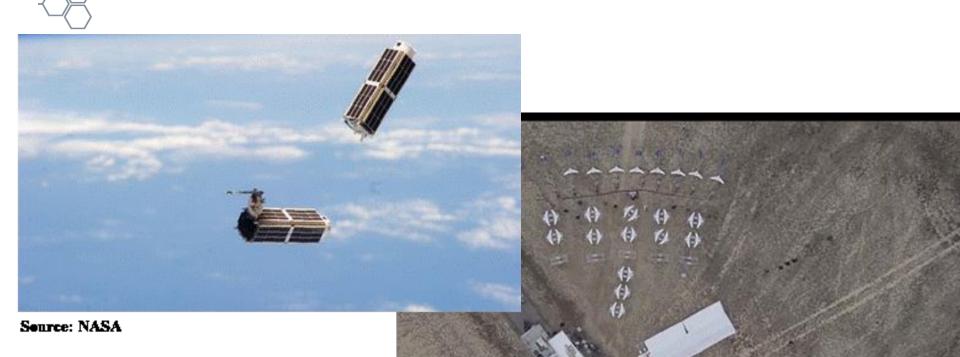
Source: www.opensensorhub.org

Source: www.opensensorhub.org

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Making Sense of All the Sources
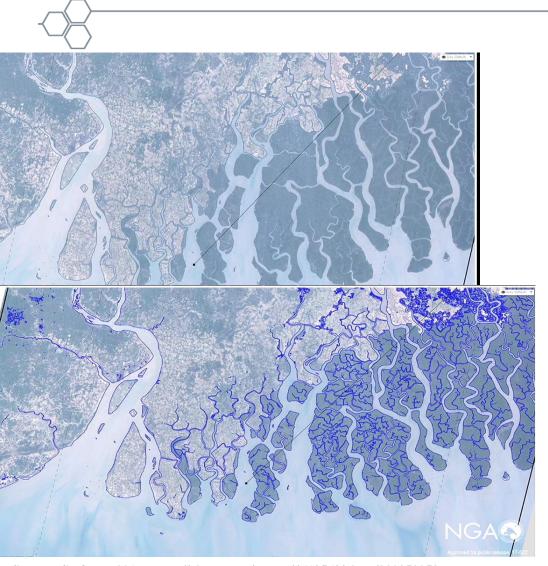# Satellites to Drones to In-Situ Sensors

Source: NASA

Source: Georgia Tech Research Institute

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Progress in Machine Learning, Big Data

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- **River delta system near the India / Bangladesh Border**

- **Auto coastline capture – 300 minutes manually to 6 minutes via BeachFront application**

- **Cartography As A Service**

- **As briefed by NGA Director Robert Cardillo at GEOINT annual conference 5 June 2017**

- **Open Source, https://home.geointservices.io/**

Automated Change Detection

DigitalGlobe
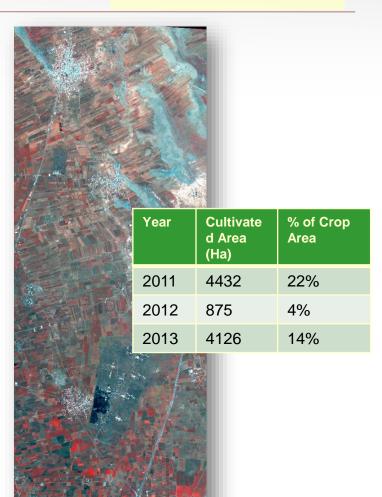
Crop Acreage Estimation

Year	Cultivated Area (Ha)	% of Crop Area
2011	4432	22%
2012	875	4%
2013	4126	14%

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From 2D Maps to 4D Models

SYDNEY, AUSTRALIA
BASED ON SATELLITE IMAGERY

VRICON

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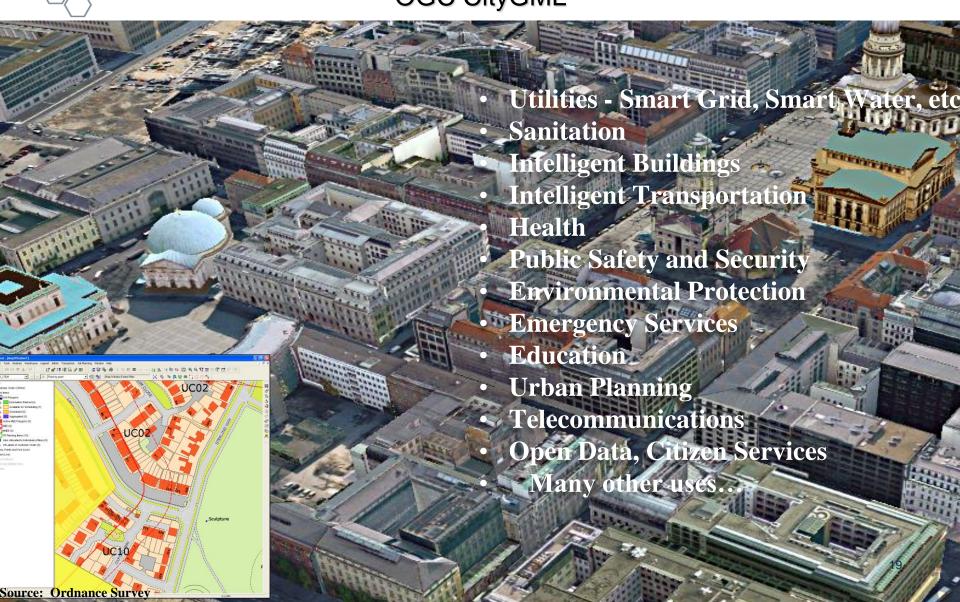
From 2D Maps to 4D Models
In a highly interconnected environment
OGC CityGML

- **Utilities - Smart Grid, Smart Water, etc**
- **Sanitation**
- **Intelligent Buildings**
- **Intelligent Transportation**
- **Health**
- **Public Safety and Security**
- **Environmental Protection**
- **Emergency Services**
- **Education**
- **Urban Planning**
- **Telecommunications**
- **Open Data, Citizen Services**
- **Many other uses…**

Source: Ordnance Survey

From Maps To Models
3D City Model Built with existing NYC open data

OGC CityGML Standard

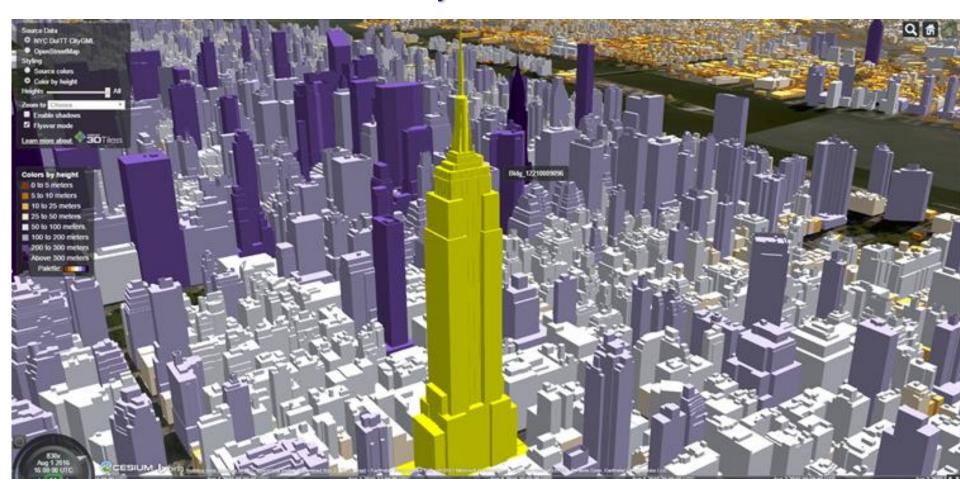**Source:** http://www1.nyc.gov/site/doitt/initiatives/3d-building.page

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A Location Standards Framework for Smart Cities

- "OGC Smart Cities Spatial Information Framework"
  - https://portal.opengeospatial.org/files/?artifact_id=61188

- Influenced by:
  - Survey of Smart City standards activities across the standards community
  - SDO work in geospatial, sensors, IoT, processing, mobile, 3D city model standards
  - Survey of community implementations

- Goals:
  - Advance Best Practices for Location Enabled Smart Cities

Open Geospatial Consortium

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Approval Date: 2014-12-05

Publication Date: 2015-01-21

External identifier of this OGC® document: http://www.opengis.net/doc/WP/smart-cities-sif

Internal reference number of this OGC® document: 14-115

Category: OGC® White Paper

Editor: George Percivall

OGC Smart Cities Spatial Information Framework

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Moving Forward

- Some of the key enabling OGC standards for M2M:
  - Sensor Web Enablement
  - SensorThings
  - Web Processing Service
  - CityGML / IndoorGML

- Growing OGC Member Domain Interest
  - Smart, Safe, Resilient Cities
  - Agriculture
  - Land Administration
  - Transportation
  - Marine / Maritime
  - Health
  - Energy and Utilities
  - Big Data / Geospatial Analytics

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To Address Future Needs

- Innovation
  - Increased emphasis on prototyping ideas with user community and developers
  - Focus on Apps and lightweight standards for developers
  - Taking industry's lead -- defacto industry standards as a driver of SDO work
  - Increased collaboration among SDOs to address the growing complexity
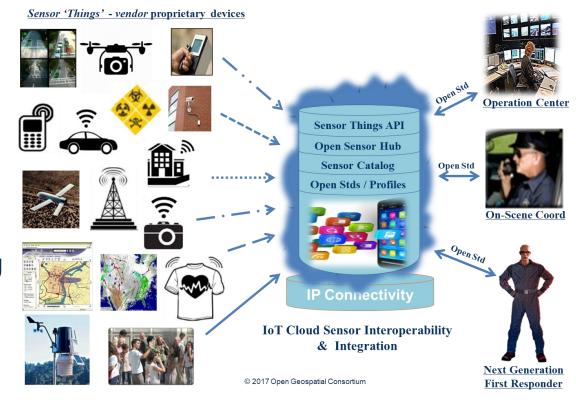 - Addressing the Innovator's Dilemma

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Summary

- Progress is being made to automate the ever widening expanse of location information being generated by people, sensors and processes.

- Standards will continue to be key for rapid integration of new geospatial information and technologies to address the needs of decision makers and to support the expanding role of NMAs

- Standards solutions will increasingly be the product of close collaboration among standards bodies

Enabling IoT for First Responders
To-Be Environment

Sensor 'Things' - vendor **proprietary devices**

Sensor Things API
Open Sensor Hub
Sensor Catalog
Open Stds / Profiles

IP Connectivity

IoT Cloud Sensor Interoperability & Integration

Open Std — **Operation Center**

Open Std — **On-Scene Coord**

Open Std — **Next Generation First Responder**

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Thank You

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Making location count.

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FUTURE CITIES

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